American Optical Co.

SPENCER

Scientific Instruments



American Optical Company
Scientific Instrument Division
Buffalo 15, N. Y.



Charles A. Spencer, 1813-1881, first American Microscope builder.

American Optical Pioneering

American Optical Company is an institution founded 113 years ago with executive offices and factories in Southbridge, Massachusetts, and manufacturing divisions in Buffalo, N. Y., Brattleboro, Vt., Putnam, Conn., and, in Canada, in Nicollet, Que., and Belleville, Ont. The Company maintains branch laboratories in 281 principal cities. More than 12,000 men and women constitute the AO family.

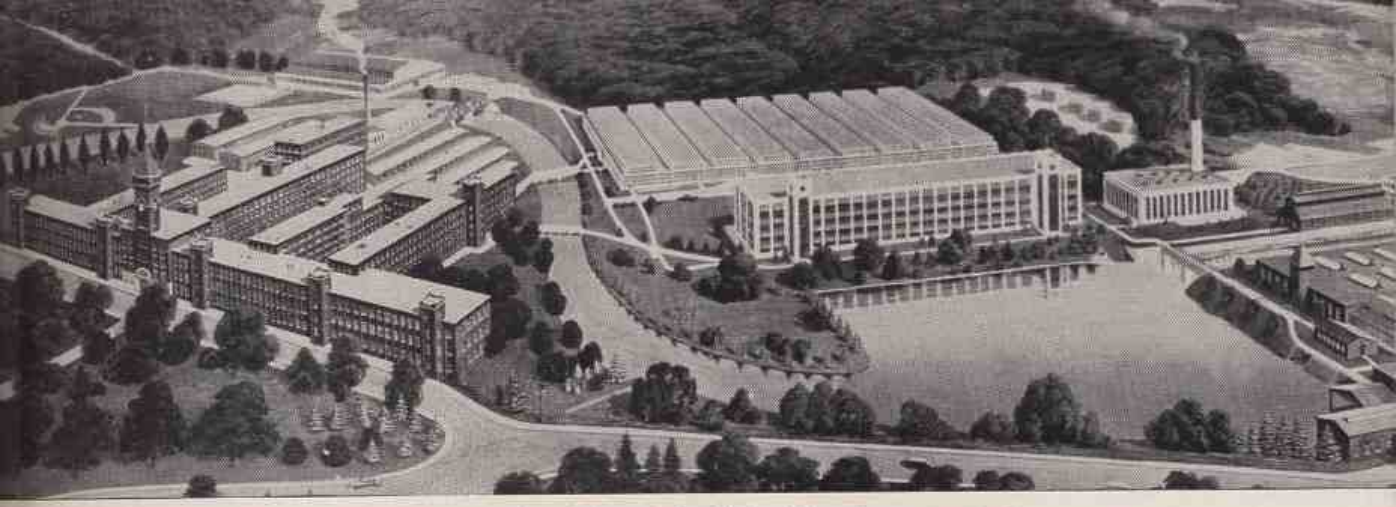
American Optical Company manufactures and distributes technical products used by the professions in providing visual efficiency, aviation and industrial goggles, body protection for industrial workers, and sun glasses.

In 1935, the Spencer Lens Company at Buffalo, N. Y., became the AO Scientific Instrument Division. It manufactures ophthalmic instruments as well as the optical instruments used in medical practice, education, television, research, and industrial control.

During World War II, naval and military fire-control instruments, sighting devices, prism binoculars, and optical parts were produced.

The instruments in this catalog carry the famous name of Spencer, which is today, as it was in the past century, a guarantee of the finest quality available in scientific instruments.

The first American microscope, a medical type, was built in 1846 by Charles A.



American Optical Company, Southbridge, Massachusetts.

Spencer of Canastota, New York, for Dr. C. R. Gilman of the College of Physicians and Surgeons.

After its completion, the microscope was tested by Professor J. W. Bailey of West Point, at that time one of the leading microscopists in America. Bailey was astonished to find that he could reveal details which were beyond the resolution of his expensive European microscope.

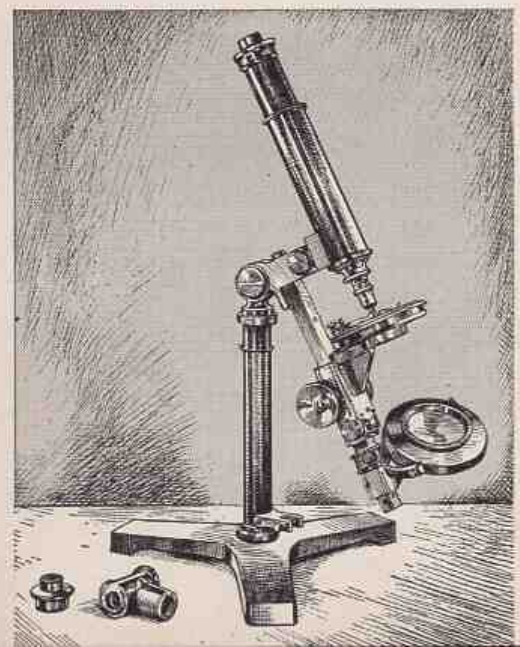
Spencer won world recognition when he produced an objective which was the first to resolve the lines on the sigmoid Navicula, one of the most difficult of test objects. This diatom was later named Navicula spencerii in his honor. In June, 1851, he succeeded in producing what was then considered an impossibility by European microscopists—a 1/12″ objective with an aperture of 178°. Years later, at the International Exposition in Paris in 1878, son Herbert Spencer's objectives, based on his father's formulas, competed with Europe's finest and were awarded the only gold medal presented for excellence in microscope objectives.

That kind of craftsmanship illustrates the perfectionist standards of the Spencers, father and son. Every instrument, with them, was a challenge to something better. These same ideals of workmanship have always been a part of the tradition of American Optical Company. Their personal care in constructing an instrument by hand is matched, in this twentieth century, by advanced engineering and highly precise machine methods.

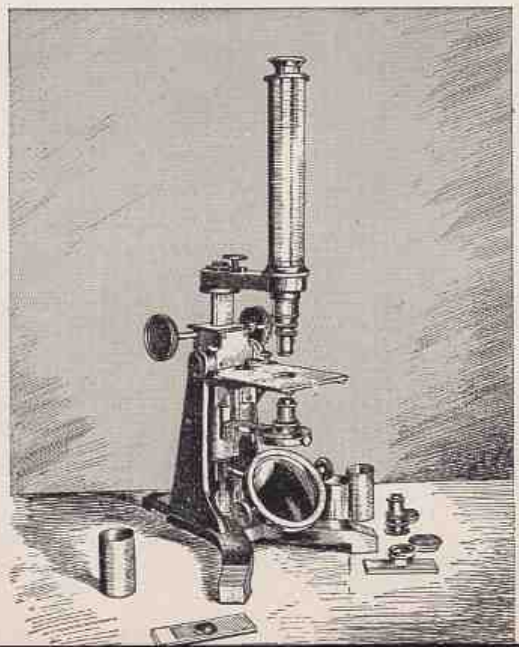
Now, much of the routine work performed by hand by early microscope builders can be handled by machines with almost incredible efficiency and speed, while improvements in design and ingenious inspection methods now in use at American Optical Company assure a constantly advancing standard of quality.

Certainly the Spencer name on a precision instrument will continue to be recognized as the hallmark of quality, and Spencer instruments will continue to satisfy the world's most critical investigators.

Spencer Microscope about 1848.



Trunnion Microscope about 1854.



Complete Modern Facilities for Scientific Instrument Production

Early microscopes were often the work of a single craftsman who ground and polished his own lenses, turned the brass lens mounts and machined the stands. He manufactured and assembled complete instruments. The progress of science, however, increased the demand for optical instruments. Consequently improved production, through specialization, replaced the slow, tedious methods of old.

As a result, our plant has been able to produce more and better microscopes while continually pioneering and experimenting. Facilities which years of experience have shown to be valuable to optical production are found in the modern Buffalo factory. Spacious, well-lighted rooms; special dust free, air-conditioned departments; newly developed machinery—all assure the highest attainable standard of quality.

Research ranks first in the production of scientific instruments. The Research Department, composed of experts in the fields of science, creates new instruments and products, plans improvements, and computes optical systems. Under their supervision is an optical laboratory for producing and testing experimental optical systems.

In the Engineering Department, specialists in instrument design lay out mechanical details of instruments and the tools for their manufacture. The Mechanical Development Department, a complete machine shop, is devoted to production of pilot models of new instruments.

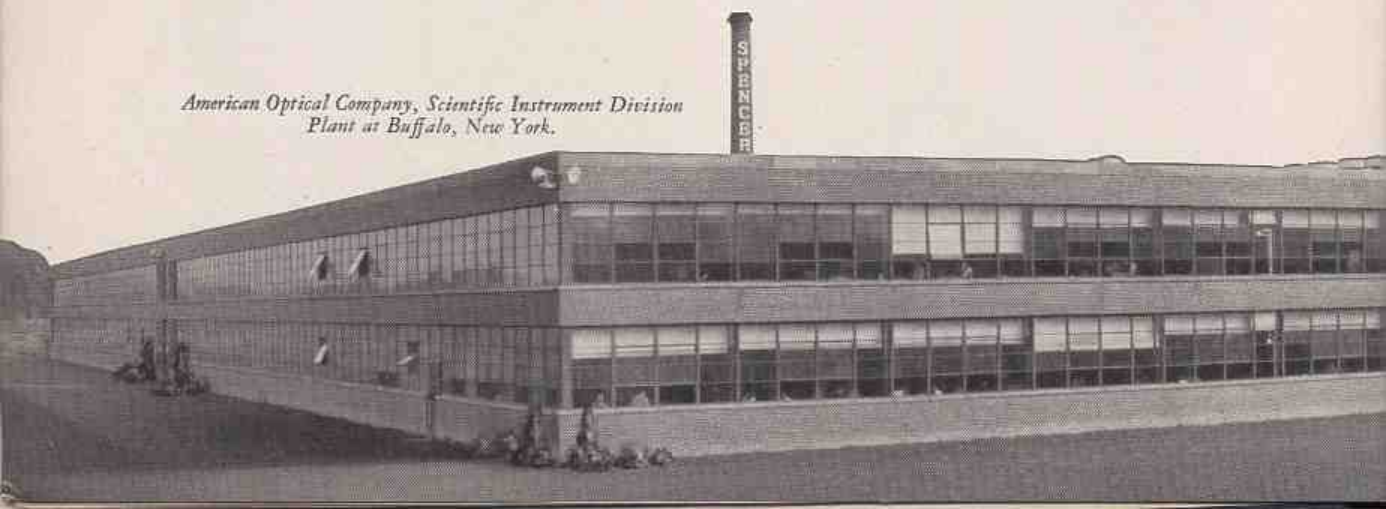
For Producing Fine Optics

The quality of workmanship found in the departments which fashion optical systems, sets the optical industry apart from all others. Here fine optical glass of the many types necessary to correct aberrations, is first molded under intense heat, or sawed to the approximate size. These "blanks" then go through various grinding operations, either by machine or by hand, until they are of proper size, curvature, and surface quality for polishing.

The utmost patience and skill are needed to polish glass elements to the high degree of perfection demanded in a Spencer instrument. During the polishing operations surfaces must be examined for flaws under a magnifier. Finally, they are tested with a master glass for determining precision of surface by Newton's rings. When these rings spread out, forming an even straw color, they represent accuracy to a millionth of an inch—the most critical measurement known to science.

After careful cleaning and rigid inspection, lenses must be centered accurately and mounted permanently into their cells —a mechanical operation which brings physical and optical centers into coincidence.

A complete Mechanical Section produces the stands, stages, lens mounts and innumerable other parts which complement the optics. Row upon row of automatic screw machines, turret lathes, drill presses and every type of boring, milling, grinding and specialized machine necessary to form metal parts is found in this department. Grinding and polishing machines prepare the surfaces of parts for enameling or plating. Then they are sprayed with enamel in cavernous sheet metal booths and transferred to ovens for baking to wear-resist-



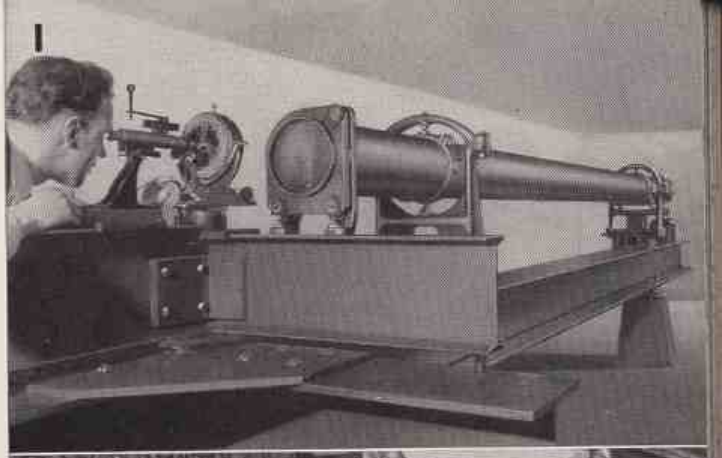
American Optical Company, Scientific Instrument Division Plant at Buffalo, New York.

ing hardness. Some parts receive as many as six coats of enamel, each carefully baked and hand rubbed to satin-like smoothness. In the plating departments, most bright parts are given protective coatings of the metal most suitable for the function to be performed.

For Assembly and Inspection

A survival of old-time craftsmanship is found in the Assembly Department, where there is none of the rush or noise of ordinary assembly line production. Men with complete sets of tools put entire assemblies together and then test their own work. A few of the many operations accomplished in this department requiring exceptional skill and concentration include aligning the complicated system of the prisms in an inclined binocular microscope, adjusting the inclination joint to the exact resistance necessary to hold the microscope in stable equilibrium, accurately fitting the fine adjustment mechanism for smoothest operation.

Further inspection for optical quality, perfection of mechanical parts, and satisfactory performance of the complete instrument under actual working conditions is carried out by experts who are as critical of performance as the scientist who will ultimately use it.











1. *The accuracy of a test lens is checked by the Research Department.*
2. *Small hemisphere lenses are ground to shape by hand.*
3. *Lens surfaces must be accurate to a millionth of an inch.*
4. *Mechanical parts are made by most modern methods.*
5. *Final assembly requires experience and craftsmanship.*

Representatives

Company representatives are stationed throughout the United States. They are available to answer your questions about Spencer scientific instruments. Their optical experience and factory training should be helpful to you. Telephone or write to the nearest office listed below or to the factory at Buffalo 15, N. Y.

Offices of the
AMERICAN OPTICAL COMPANY
SCIENTIFIC INSTRUMENT DIVISION

Atlanta
5 Plaza Way, S. W.
Box 4208
Atlanta 2, Ga.

Boston
110 Tremont St.
Boston 8, Mass.

Buffalo
Box A
Buffalo 15, N. Y.

Chicago
10 S. Wabash Ave.
Silversmith Bldg.
Box 804
Chicago 90, Ill.

Columbus
40 South Third St.
Room 216
Columbus 15, Ohio

Dallas
1709-11 Commerce St.
Box 1929
Dallas 1, Texas

Los Angeles
314 West Sixth Street
Box 2275 Terminal Annex
Los Angeles 14, Calif.

New York
70 West 40th St.
New York 18, N. Y.

Philadelphia
1522 Chestnut St.
Philadelphia 2, Pa.

Pittsburgh
526 Penn Avenue
Box 1108
Pittsburgh 30, Pa.

St. Louis
407 North Eighth St.
Box 1439
St. Louis 1, Mo.

San Francisco
Rosenstock Bldg.
28 Geary St.
San Francisco 8, Calif.

Washington
1317 New York Ave., N. W.
Washington 5, D. C.

Foreign Representatives

For information concerning foreign representatives who supply the scientific instruments described and listed here, please communicate with the Export Sales Department of American Optical Company, Southbridge, Massachusetts.

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Terms and General Information

Placing Order

When ordering, please indicate catalog number and name of equipment. If there should be any doubt about specifications or prices, we will welcome the opportunity to answer your questions.

Orders are subject to final acceptance by the Sales Office at Buffalo, New York, at prices prevailing at the time of shipment.

Prices

All prices, deliveries, and terms of sale listed are subject to change without notice.

When an outfit is ordered without an item regularly included, the price of the excluded item will be allowed, except that no allowance will be made for objective boxes, stage clips, substage glasses, immersion oil, or instrument covers.

Federal, State, City, or other taxes imposed on the sale, lease, or other transfer, use, or consumption of any article listed herein are to be added to the prices quoted.

Packing and Boxing

Except as otherwise noted, prices listed include cost of packing with cartons and boxes for inland shipments.

Terms

Orders, except repairs, will be shipped F.O.B. destination in any of the forty-eight states of the U. S. A. and the District of Columbia with carrier to be chosen by us. Terms are Net 30 Days.

To avoid delay, purchasers who have not had an account with us should accompany their first order with commercial references or remittance.

C.O.D. shipments will be arranged if order is accompanied by funds which will adequately take care of shipping charges both ways.

The customer assumes responsibility for payments of shipping charges on merchandise sent on consignment.

Guarantee

We guarantee all merchandise of our manufacture to be free from defects in either material or workmanship, to a degree consistent with the high standards of quality established and maintained in Spencer instruments.

Claims for Shortage, Exchange, Etc.

We use extreme care in selection, checking, rechecking, and packing to eliminate the possibility of error.

If discrepancies are discovered, claims should be made immediately.

All packing should be examined very carefully to insure that no small items are overlooked.

Claims for damage in transit should be made to the transportation company, as our responsibility ceases with the safe delivery in good condition to the carrier.

Returning Material

Our customers are requested to communicate with us before returning any goods. After arrangements have been made for the return, the material should be plainly tagged with the sender's name and address.

Please indicate the date of invoice and number on which the goods were billed.

Ordering Replacement Parts

In ordering parts of instruments for replacement or repair, give serial number of the instrument as well as the catalog number and full description.

Whenever possible the broken part should be sent to the factory.

Illustrations

Because improvements are being made in our instruments from time to time, the illustrations may not in each case conform in every minor detail to the specific construction of the completed product.

We will welcome opportunities to supply photographic prints or electros of our equipment for use in illustrating publications.

Outstanding Features of
Spencer Microscopes

The quality of a microscope is judged by its optical performance. In the early days, Charles A. Spencer produced, in his small workshop, the finest objectives of his time.

Today, to maintain leadership, a research and development staff continues to devote its efforts to producing the finest in microscope optics. Correspondingly, it is improving the precision of mechanical features in order to obtain the fullest advantages of the optics and, at the same time, afford the user maximum comfort and convenience.

Stand

The stands of all Spencer microscopes are well proportioned and stable. The arm, cast or forged from metals which insure permanent rigidity, like an optical bench, maintains alignment of the optical parts. The curve of the arm provides a large area on the stage for manipulation.

The taper axle inclination joint is designed so that, even after years of use, it will hold the body of the instrument in any position from the vertical to the horizontal. This security with which the instrument is held, together with the smoothness of movement, is due to the fact that the joint consists of a fiber insert bearing against a brass forging.

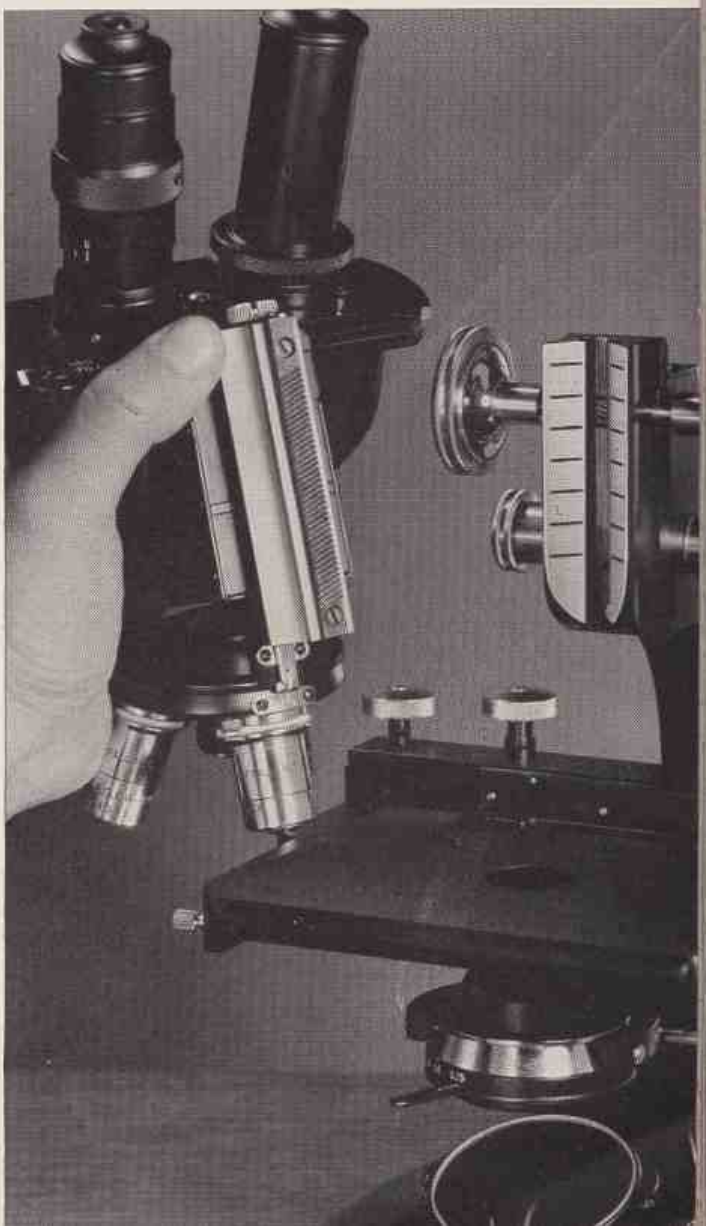
Stability is assured by the well proportioned horseshoe base.

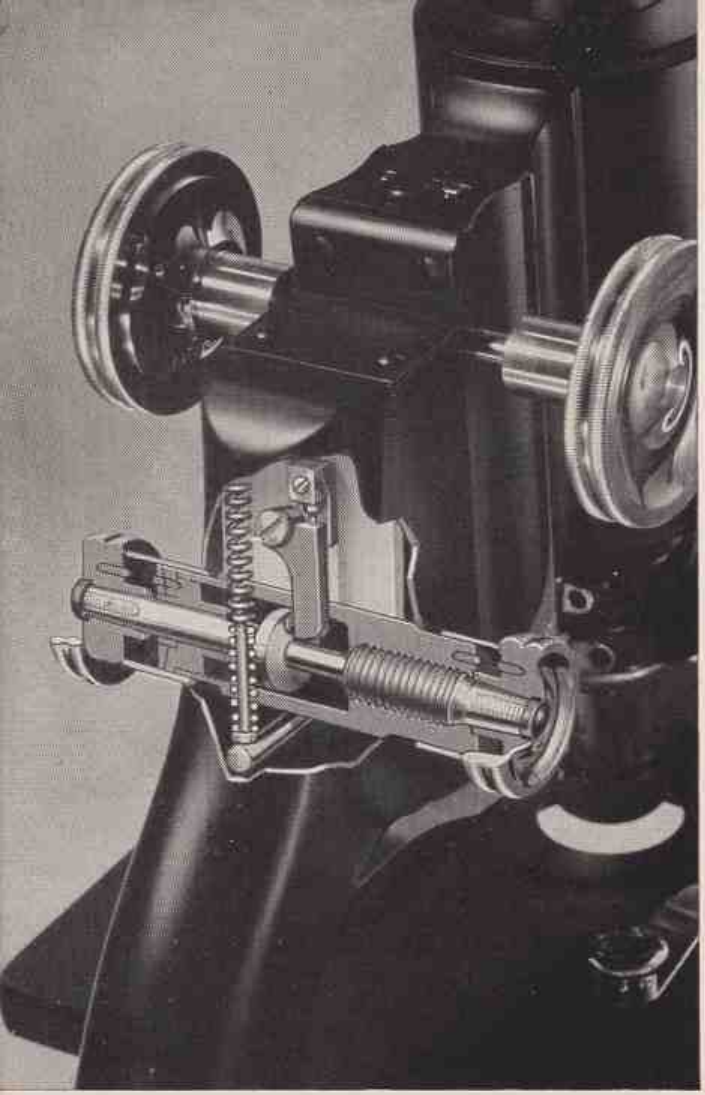
Coarse Focusing Adjustment

The coarse focusing adjustment mechanism used on all Spencer microscopes is engineered to provide smoothness and ease of movement for the life of the instrument. The handlapped slideways of forged brass sliding on extruded brass are milled to provide oil grooves which retain the lubricant and trap dust and abrasive particles.

The rack and pinion are diagonally cut and incorporate an involute tooth design which provides both maximum strength and smooth, precise action.

Smooth operating, hand fitted coarse adjustment bearings with oil grooves.





Precise micrometer screw and nut type fine adjustment

Fine Focusing Adjustment

The fine adjustment is the most important mechanical feature in a microscope stand. The micrometer screw and nut, generally recognized as most suitable for obtaining accurate measurements, was adopted by Spencer more than 20 years ago for fine focusing. Twenty-seven threads, fully engaged at all times, insure precision. Spring tension automatically compensates for wear. Slide bearing metals of different grain structures and lubricant-retaining oil grooves provide smooth operation. Since the action of the fine adjustment is applied only in moving the body tube upward, it automatically ceases to function when the objective contacts the cover glass. Spencer fine adjustments are built and fitted with the precision of a measuring instrument and are responsive and durable.

Dual-Cone Nosepiece

The dual-cone nosepiece has a bearing made of two widely separated opposed cones instead of the usual single cone. The bearing surface, which is thus doubled in area, assures correct alignment of objectives at all times and lengthens the life of the nosepiece by automatically compensating for wear. The nosepiece is provided with two, three or four openings, depending on the number of objectives used.

Stage

The stage is made of solid, durable Bakelite which is resistant to all common reagents and will not warp or fade. It is provided with chromium plated, spring steel clips. The great distance from the optical axis to the curve of the arm provides ample space for large specimens.

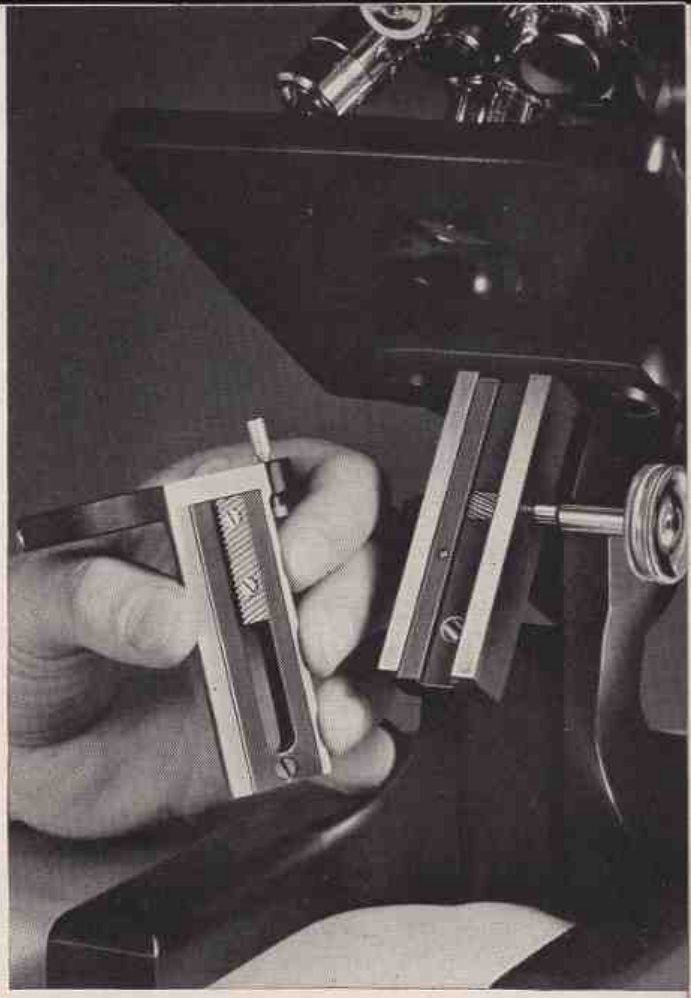


Parfocal position and centering of objectives is maintained by dual-cone construction of nosepiece.

Optics

The excellent optical equipment on Spencer microscopes is the result of constant research and experimentation. Spencer eyepieces, objectives and condensers are designed to work together and when used in proper combination will give the finest results. Eyepieces are truncated cone shape for ease of observation, especially for those wearing glasses. Objectives are marked with the equivalent focus, numerical aperture and initial magnification.

Spencer microscopes are listed with the optical combination shown in the chart below. These selections, developed out of the experience and good practice of past years, may be varied to meet particular requirements. See the complete data in Microscope Accessories section.



Involute tooth design in all rack and pinion movements.

Standard Optical Outfits

APPLICATION	Catalog Designations	Objectives: Achromatic	Eyepieces	Magnification	Condenser
For elementary instruction and laboratory work.	B	16-4	10X Huyghenian	100-440X	No condenser
	D	16-4	6X-10X Huyghenian	60-440X	No condenser
	DA	25-16-4	6X-10X Huyghenian	30-440X	No condenser
For more advanced instruction and average laboratory work.	E	16-4	10X Huyghenian	100-440X	Abbe type condenser, N.A. 0.66, with iris diaphragm
	F	16-4	6X-10X Huyghenian	60-440X	Abbe type condenser N.A. 0.66, with iris diaphragm
	FA	25-16-4	6X-10X Huyghenian	30-440X	Abbe type condenser N.A. 0.66, with iris diaphragm
For medical and advanced laboratory work.	H	16-4 1.8mm. (oil immersion)	6X-10X Huyghenian	60-950X	Abbe N.A. 1.25 condenser with iris diaphragm
	HB	3.5X-16-4 1.8mm. (oil immersion)	6X-10X Huyghenian	21-950X	Abbe N.A. 1.25 condenser with iris diaphragm
	HW	16-4 1.8mm. (oil immersion)	10X Wide Field	100-950X	Abbe N.A. 1.25 condenser with iris diaphragm

Fork-Type Substage

The fork-type substage, an exclusive Spencer feature on advanced laboratory microscopes, assures permanent and precise alignment of the substage condenser with the rest of the optical system. The substage condenser is held firmly in place by means of two spring plungers. This mount also provides an easy interchange of the condenser and the dark field illuminator. All fork-type substages are actuated by diagonal rack and pinion for focusing the condenser.

Finish

All Spencer microscopes are finished in rich, black enamel and chromium trim which enhances not only their beauty, but also their durability. The black parts are baked enamel that is impervious to most laboratory reagents. The plated parts are multiple coated—the final coat being chromium.

Cabinet

The microscopes are regularly supplied in a well made, hard wood cabinet covered with a rich, black leatherette. The cabinet has a lock and key and fittings for extra objectives and eyepieces. Also available for medical microscopes is a leatherette covered carrying case equipped with lock and key, slide box and fittings for additional objectives, haemacytometer and accessories. An interesting booklet containing many useful suggestions for the most effective use of the microscope is furnished with every Spencer microscope.

Fork-type substage holds condenser in positive alignment.



Leatherette covered hardwood cabinet has space for accessories.



Elementary and Routine
Laboratory Microscopes

An increasing number of school science laboratories are providing microscopes for every student, and on the following pages two elementary laboratory microscopes are described for use in schools. The practical experience of many educators guided the Engineering and Research Divisions in designing these instruments. They are manufactured with the same care as medical and research microscopes. A brilliant image is produced by the optical parts, and the easily operated mechanical features.

The No. 66 is a complete instrument, light, simple and easy for students to use. It is available at a minimum cost.

The No. 63 is a heavier model which can be equipped for more advanced laboratory work.

Both microscopes have the advanced Spencer mechanical features and are supplied with the same optical equipment as more expensive instruments. They are simple and sturdy, and will withstand the hard usage of the beginner.

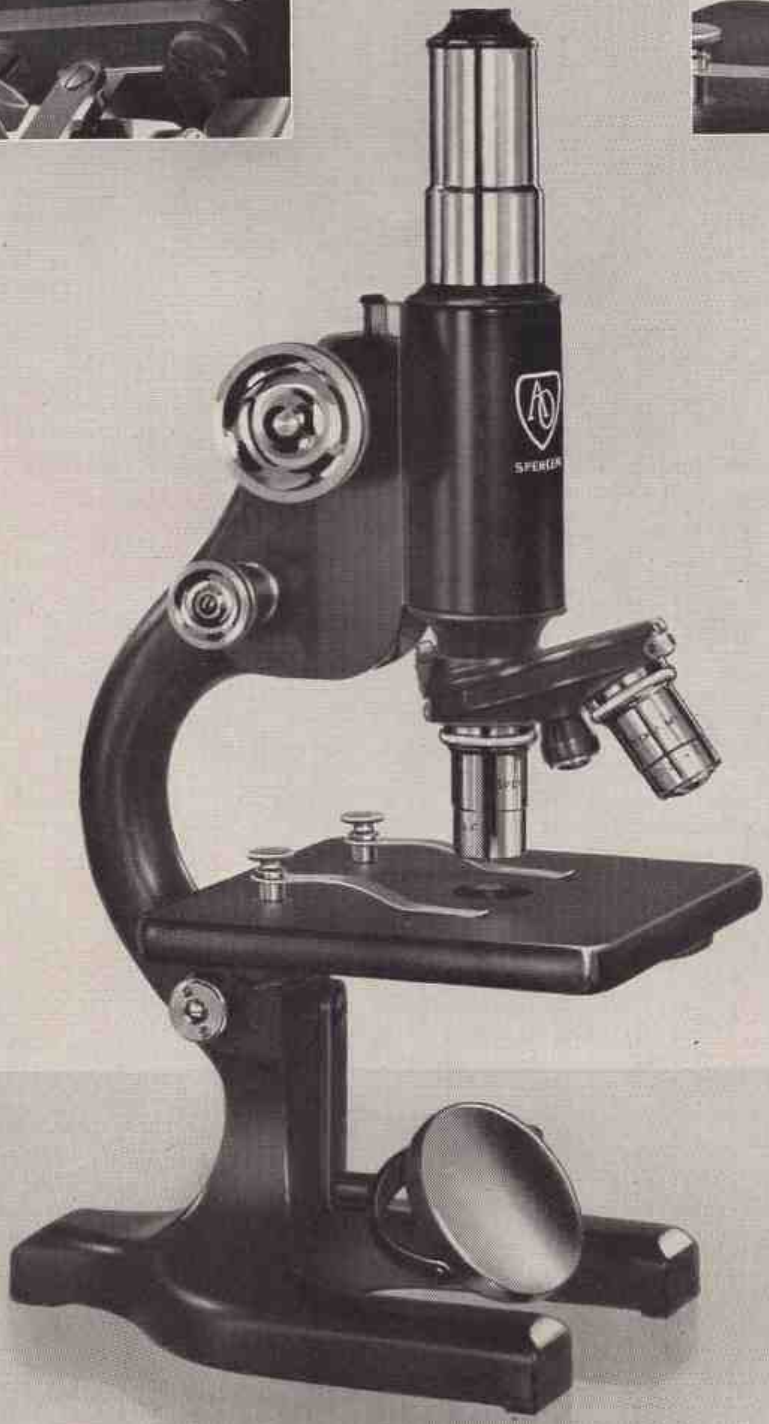
See section on Stereoscopic Microscopes which can be used for elementary work.

They learn best by first hand experience.








SPERER

Spencer Elementary Laboratory Microscope No. 66

The Spencer No. 66 Microscope is particularly suited for use in elementary biology courses. It is a standard sized instrument for laboratory work, moderately priced and equipped with both coarse and fine adjustments.

The eyepieces and objectives are the same as those offered on more expensive instruments and all of the mechanical parts are of high-grade workmanship.

STAND

The stand has a forged brass arm with a standard taper axle inclination joint, and a heavy cast base that insures stability in all positions.

RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop is provided to prevent breaking of the cover glass when focusing with 16mm. objectives.

MICROMETER SCREW TYPE FINE ADJUSTMENT

The ungraduated fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass.

BODY TUBE

The body tube has a length of 160mm., a diameter of 37mm., and accommodates standard diameter eyepieces. It has a standard society thread and accommodates all standard nosepieces, objectives and similar accessories.

Top Left: Revolving Disc Diaphragm.

Top Right: Adapter holds single objective.

Below: Elementary Laboratory Microscope No. 66B.

DUAL-CONE NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective unless otherwise specified.

STAGE

The solid, durable Bakelite stage, 110mm. x 115mm. is resistant to most common reagents and will not warp or fade. It is provided with durable, chromium plated spring steel stage clips.

REVOLVING DISC DIAPHRAGM

The easily operated solid plate diaphragm has five different apertures with a click stop to index each opening. A CONDENSER IS NOT AVAILABLE FOR THIS INSTRUMENT.

MIRROR

The standard diameter concave mirror is mounted in a fork attached to the mirror bar. The fork and the mirror bar are adjustable.

FINISH

The finish is black baked enamel and chromium plating.

CABINET

A leatherette covered hardwood cabinet with a lock and key and plastic boxes for objectives is provided for each microscope. The instrument can also be supplied without cabinet if desired.







Spencer Routine Laboratory Microscope No. 63

The Spencer No. 63 Microscope is a large, sturdy instrument which can be adapted for instruction in more advanced laboratory work.

The eyepieces and objectives are the same as those offered on more expensive instruments, and all of the mechanical parts are of high grade workmanship.

The Abbe type N.A. 0.66 condenser available with the No. 63 is of particular value. This condenser has been developed for use on the microscope when an oil immersion objective is not used. It makes it possible to take advantage of the full numerical aperture of the 4mm. objective and at the same time get full, even illumination of the low power objectives with no adjustment except the iris diaphragm.

STAND

The stand has a forged brass arm with a standard taper axle inclination joint and a heavy cast base that insures stability in all positions.

RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop which is provided prevents breaking of the cover glass when focusing with 16mm. objectives.

MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass. It is graduated in 2.5 micron intervals.

BODY TUBE

The large body tube is 160mm. in length, 45mm. in diameter and accommodates standard diameter eyepieces. It has a standard society screw thread to accept all standard nosepieces, objectives and other accessories.

Top Left: Iris Diaphragm.

Top Right: Abbe type condenser N.A. 0.66 with iris diaphragm.

Below: Routine Laboratory Microscope No. 63H.

DUAL-CONE NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective provided unless otherwise specified.

STAGE

The solid, durable Bakelite stage, 125mm. square, is resistant to all common reagents and will not warp or fade. It is provided with spring steel stage clips that are not easily damaged.

DIAPHRAGM

An iris diaphragm, with corrosion resistant bronze leaves directly beneath the stage opening, provides the illumination control when a condenser is not supplied. This diaphragm can be replaced by an adapter which will hold a substage condenser.

CONDENSER

When work with oil immersion objectives is not contemplated, the N.A. 0.66 condenser with iris diaphragm in a spiral focus sleeve is supplied with optical outfits, including a condenser. When an oil immersion objective is provided, the N.A. 1.25 condenser is supplied.

MIRROR

The standard diameter mirror, which is concave on one side and plane on the other, has a center stop that provides unlimited movement.

FINISH

The finish is black baked enamel and chromium plating.

CABINET

A leatherette covered hardwood cabinet, with a lock and key and plastic boxes for objectives, is provided for each microscope. The instrument can also be supplied without cabinet if desired.

Elementary Laboratory Microscopes

Group "A": Microscopes for elementary instruction and simplest routine work.

Group "B": More flexible Microscopes for elementary work which can be equipped with condenser at a later time for more advanced work.

Group "C": Microscopes for more advanced instruction, including special equipment for Embryology, Histology, Comparative Anatomy, and Entomology.

	Cat. No.	Nose-piece	OPTICS		Range of Magnification	Substage Equipment	Stage
			Achromatic Objectives	Eyepieces Huygenian			
GROUP "A"	66B	Double	16-4mm.	10X	100-440X	Revolving Disc Diaphragm	Plain 110x115mm.
	66D	Double	16-4mm.	6X-10X	60-440X		
	66DA	Triple	25-16-4mm.	6X-10X	30-440X		
GROUP "B"	63B	Double	16-4mm.	10X	100-440X	Iris Diaphragm	Plain 125x125mm.
	63D	Double	16-4mm.	6X-10X	60-440X		
	63DA	Triple	25-16-4mm.	6X-10X	30-440X		
GROUP "C"	63E	Double	16-4mm.	10X	100-440X	Abbe-type condenser, N.A. 0.66*, with graduated iris diaphragm in spiral focus sleeve	Plain 125x125mm.
	63F	Double	16-4mm.	6X-10X	60-440X		
	63FA	Triple	25-16-4mm.	6X-10X	30-440X		
	63H	Triple	16-4mm. 1.8mm. (oil immersion)	6X-10X	60-950X	Same as above, but with N.A. 1.25 condenser	
	63MH	Triple	16-4mm. 1.8mm. (oil immersion)	6X-10X	60-950X	Same as above but with N.A. 1.25 condenser	Mechanical

*If oil immersion objective is to be added later, N.A. 1.25 condenser should be specified at no change in price.

Biological, Medical and Advanced Laboratory Microscopes

Medical and Advanced Laboratory Microscopes have been developed to provide the adaptability, range of magnifications, and convenience needed in medical, public health, industrial and university laboratories. These are the Spencer microscopes that are usually selected by medical students for their college training and subsequent practice. With individualized optical equipments they meet the requirements of all medical colleges.

Years of experience have determined the optical combinations which afford the best possible range of magnification and resolution for different types of observation and study.

For the medical laboratory the usually selected combination consists of three objectives:

16mm. ("low dry") 10X
4mm. ("high dry") 44X and
1.8mm. oil immersion 95X

A condenser of the same numerical aperture (N. A.) as the oil immersion objective (N. A. 1.25) is needed. Two eyepieces, 6X and 10X complete the requirements.

The 16mm. objective is divisible; when the front element is removed the objective becomes a 32mm. system with a larger field of view and an initial magnification of 4X.

The 4mm. objective has a N. A. of 0.66 which provides long working distance for blood counting or tissue examination.

The 1.8mm. oil immersion objective is used for bacteriology, cytology and other work requiring high power.

Magnifications achieved by the various combinations of eyepiece and objective range from 24X to 950X.

In addition to the three objectives, ("H") equipment just described, two and three objective combinations without the oil immersion lens are listed. There are many applications where the higher powers are not necessary.

A low power "finder" or "scanning" lens may be added to the "H" equipment and is recommended where frequent examination of gross specimens is necessary. Such a combination is required by some medical schools. A quadruple nosepiece would then be used. See the chart of optical combinations in the first section.

Two basic groups of instruments are offered:

The No. 33, monocular series are microscopes which provide all the essential features for advanced work. The binocular body cannot be added to these instruments.

The No. 13 microscopes are designed to hold the binocular bodies, either vertical or inclined, and the large diameter monocular bodies. In addition, a simple, positive screw clamps the bodies in place, and an adjustable spring tension is provided to compensate for the difference in weight between the monocular and binocular bodies and to assure positive action of the fine adjustment when the instrument is used in the horizontal position.

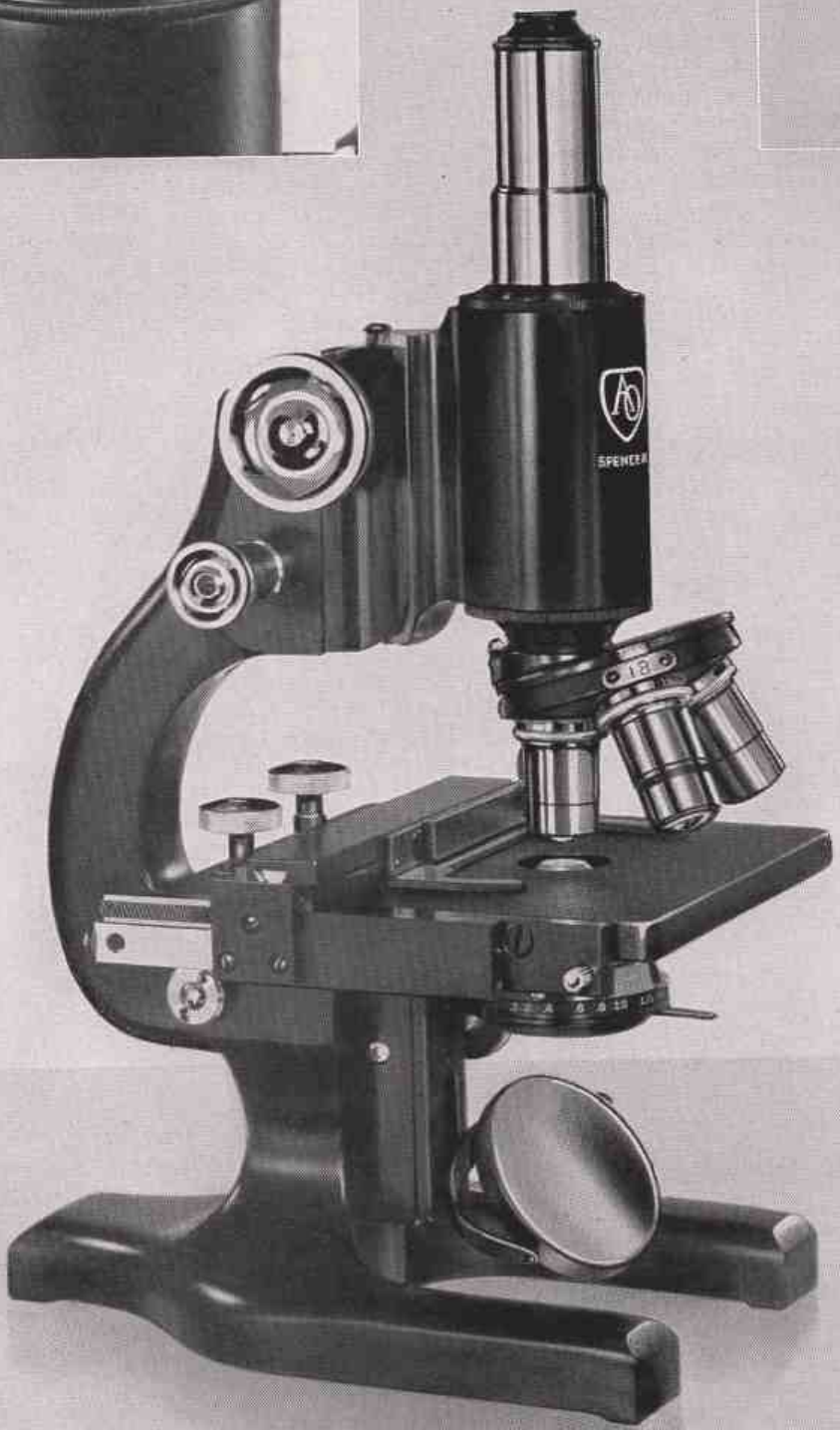
Various Spencer Microscope Accessories may be added to provide different magnifications or to adapt to darkfield or oblique illumination. Reticules and micrometer scales are available for counting or measuring. Teaching accessories such as Demonstration Eyepiece and Camera Lucida may be used.

Spencer Laboratory Microscope No. 33

The Spencer No. 33 Microscope is completely equipped and suitable for most observations with transmitted light. With various accessories, it meets the requirements of all medical schools, and is selected by a high percentage of medical students. It is a standard instrument for advanced biological work. Following are some of the features of construction.


15
16




SPENCER

STAND

The stand has a forged brass arm with a special taper axle inclination joint, and a heavy cast base which insures stability in all positions.

RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop prevents racking down into the cover glass when focusing with 16mm. objectives.

MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment, graduated in 2.5 micron intervals, automatically compensates for wear and ceases to function if the objective contacts the cover glass.

BODY TUBE

The body tube has a length of 160mm., a diameter of 45mm. and accommodates standard diameter eyepieces. It has a standard "Society" screw thread which is common to all objectives and nosepieces of standard microscopes.

DUAL-CONE REVOLVING NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece may have three or four openings, depending upon the number of objectives specified.

STAGE

The solid, durable Bakelite stage, 125mm. square, with a distance of 105mm. from arm to optical axis, is resistant to all common reagents and will not warp or fade. It is provided with chromium plated spring steel clips.

Top Left: Graduated, adjustable draw tube is available.

Top Right: Attachable mechanical stage, with or without graduations may be mounted on a plain stage microscope.

Below: Medical or Advanced Laboratory Microscope No. 33MH.

BUILT-ON MECHANICAL STAGE

When "M" is listed in the catalog number, this stage is included as standard equipment. It provides the range of movement necessary for complete examination of objects on slides as large as 3 X 2 inches. It can be racked off when a plain stage is desired.

RACK AND PINION FORK-TYPE SUBSTAGE

The fork-type mount of this substage provides an easy interchange of substage parts and assures accurate alignment of substage equipment with the rest of the optical system. Focusing of the condenser is accomplished with ease and precision.

CONDENSER

The Abbe type divisible substage condenser has a filter holder and an iris diaphragm with heavy bronze leaves. The condenser can be removed quickly from the fork-type mount for cleaning or replacement by the dark field condenser.

MIRROR

The standard diameter mirror mounted in a fork for tilting to any desired angle, is concave on one side and plane on the other. It may be removed for cleaning or use of substage lamp.

EYEPIECES

For ease in observation, especially for those who wear glasses, the eyepieces are truncated cone shape. Scales and reticles are available for measuring and counting.

OBJECTIVES

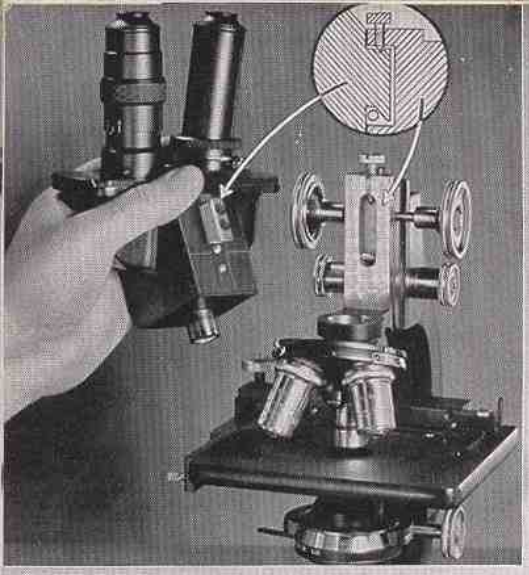
The achromatic objectives are corrected for 160mm. tube length and 0.18 cover glass thickness.

FINISH

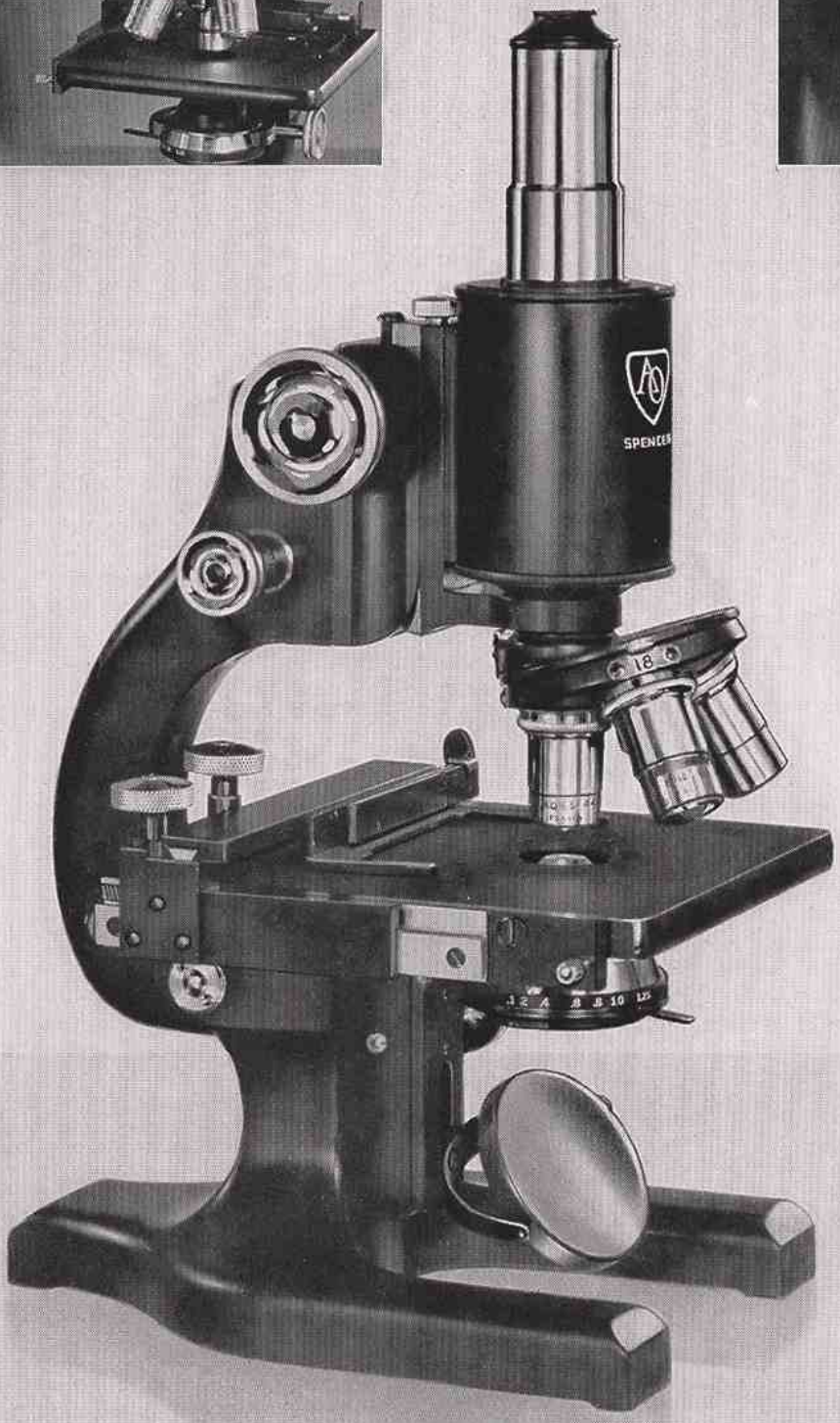
The finish is baked black enamel and chromium plating.

CABINET

The microscope is furnished in a leatherette covered hardwood cabinet which has provision for additional objectives and eyepieces. It is also available in a black leatherette covered carrying case equipped with slide box and fittings for additional objectives, haemacytometer and accessories.




0-2
MICS
160


SPENCER
18

Convertible and Binocular Microscopes No. 13

The Spencer No. 13 Microscope stands contain all of the desirable features of No. 33 and in addition have provision for the interchange of body tubes.

The use of binocular microscopes is preferred in research. Their use is rapidly increasing in the routine work that requires prolonged periods of observation.

No. 13 can be purchased with:

1. The large monocular body with either fixed or graduated draw tube.
2. Vertical Binocular Body
3. Inclined Binocular Body

These bodies are interchangeable.

The growing preference for Spencer Binocular Microscopes can be attributed largely to the unusual ease and comfort afforded by the convergence of the eyepieces. The prism system of Spencer binocular bodies directs the pencils of rays to the eyepieces at an 8° angle—a natural convergence. If the user refers to a text, or reaches for a slide, he will find it unnecessary to re-accommodate to study the field in his microscope. The angle of convergence of his eyes is about the same. There are very few requests for bodies with parallel eyepiece tubes but they can be supplied if desired.

Two types of binocular bodies are available, the vertical and inclined. The latter has the eyepiece tubes tilted 30° from the vertical so that an easy, natural posture can be maintained when using the instrument.

On both types of bodies, interpupillary adjustment can be made by means of a knurled ring at the base of the right eyepiece tube. Graduations permit easy resetting for the individual user. On the left tube is a graduated, knurled collar for adjusting the length of the eyepiece tube to compensate for difference in vision between the eyes.

Top Left: Binocular or monocular bodies are easily interchanged on a No. 13 Microscope.

Top Right: Fine adjustment of No. 13 Microscope is graduated in units of 2.5 microns.

Below: Convertible Microscope No. 13MAH.

STAND

The stand has a forged brass arm with a special taper axle inclination joint, and a heavy cast base that insures stability in all positions.

RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop prevents racking down into the cover glass when focusing with 16mm. objectives.

MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment, graduated in 2.5 micron intervals, automatically compensates for wear and ceases to function when the objective contacts the cover glass.

DUAL-CONE REVOLVING NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece may have three or four openings, depending upon the number of objectives specified.

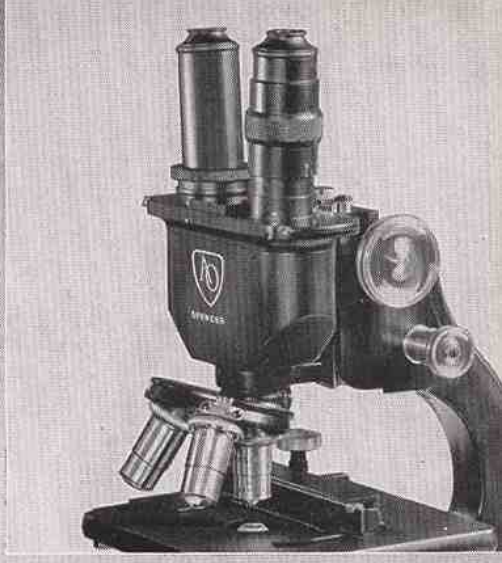
STAGE

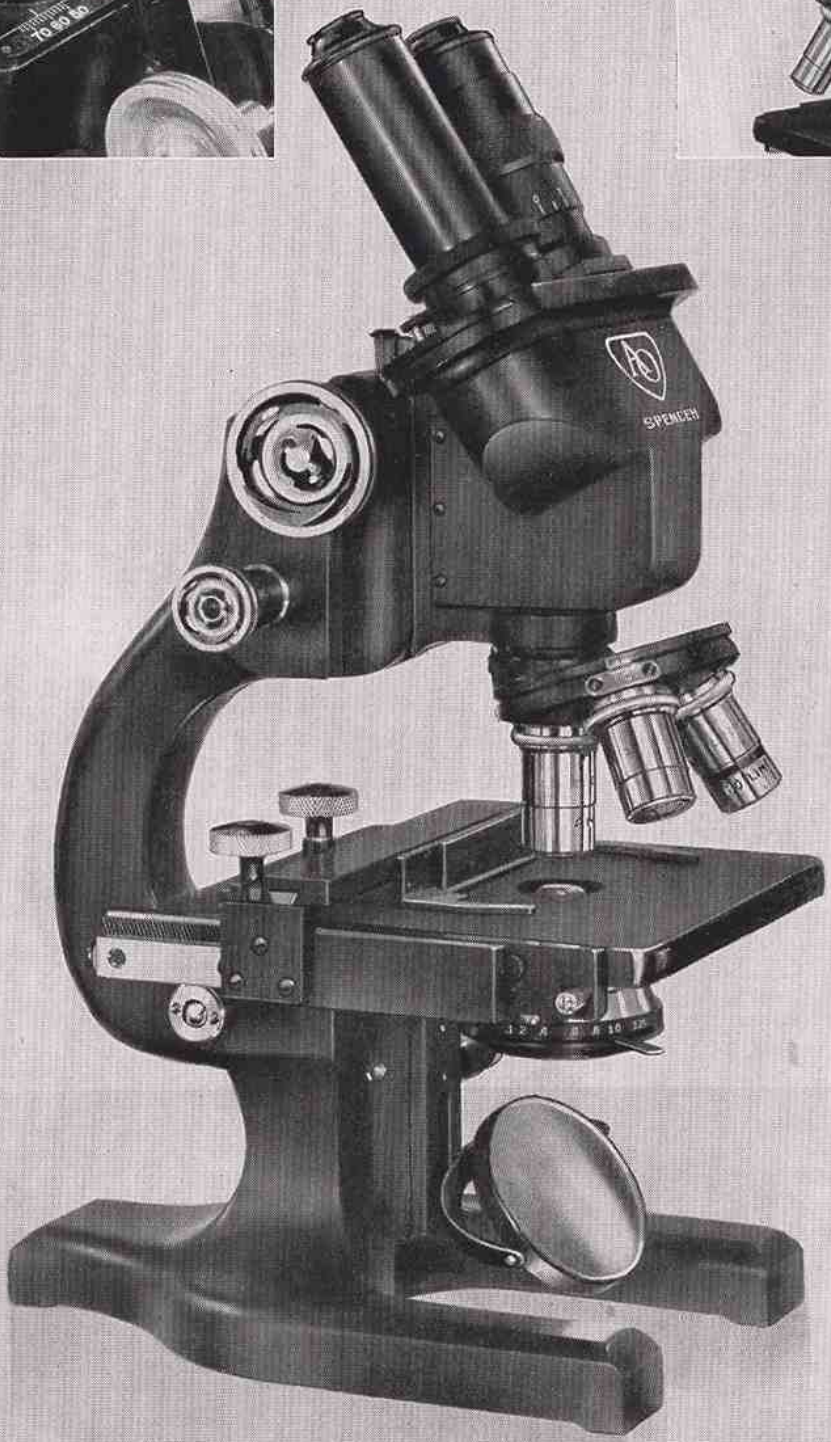
The solid, durable Bakelite stage, 125mm. square, with a distance of 105mm. from arm to optical axis, is resistant to all common reagents and will not warp or fade. It is provided with chromium plated spring steel clips.

BUILT-ON MECHANICAL STAGE

When "M" is listed in the catalog number, this stage is included as standard equipment. It provides the range of movement necessary for complete examination of objects on slides up to 3 X 2 inches in size. It can be racked off when a plain stage is desired.






SPENCER

RACK AND PINION FORK-TYPE SUBSTAGE

The fork-type mount of this substage provides for easy interchange of substage parts and assures accurate alignment of substage equipment with the rest of the optical system. Focusing of the condenser is accomplished with ease and precision.

CONDENSER

The Abbe type divisible substage condenser has a filter holder and iris diaphragm with heavy bronze leaves. The condenser can be removed quickly from the fork-type mount for cleaning or replacement with the dark field condenser.

MIRROR

The standard diameter mirror mounted in a fork for tilting to any desired angle, is concave on one side and plane on the other. It may be removed for cleaning or use of substage lamp.

EYEPIECES

For ease in observation, especially for those who wear glasses, the eyepieces are truncated cone shaped. Scales and reticles are available for measuring and counting.

OBJECTIVES

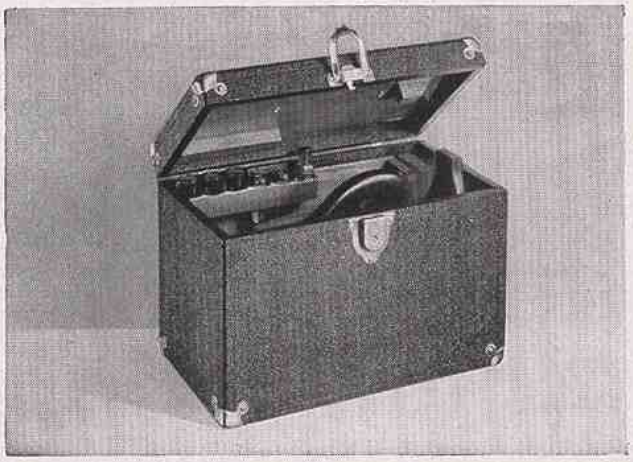
The achromatic objectives are corrected for 160mm. tube length and 0.18 cover glass thickness.

FINISH

The finish is baked black enamel and chromium plating.

CABINET

The microscope is furnished in a leatherette covered hardwood cabinet that has provision for additional objectives and eyepieces. It is also available in a black leatherette covered carrying case equipped with slide box and fittings for additional objectives, haemacytometer and accessories.



Top Left: Eyepiece scale and interpupillary distance scale aid in adjusting a binocular microscope for most comfortable vision.

Top Right: Vertical binocular body is available as shown on Binocular Microscope No. 13MH.

Below: Binocular Microscope No. 13MLH.

Advanced Laboratory and Medical Microscopes

GROUP A: Microscopes equipped for advanced instruction in Biological Sciences.

GROUP B: Standard medical laboratory monocular microscopes. These instruments cannot be converted to binocular type.

GROUP C: Medical laboratory microscopes which will accept the large monocular or the binocular bodies.

	Catalog No.	Nosepiece	OPTICS		Magnification	Stage	Body	Substage
			Achromatic Obj.	Eyepieces				
GROUP "A"	33E	Double	16-4mm.	10X Huy.	100-440X	Plain "S" 125x125mm.	Monocular	Fork-type rack and pinion with Abbe Type Condenser N.A. 0.66 in mount with iris diaphragm.
	33F	Double	16-4mm.	6X-10X Huy.	60-440X	Plain "S" 125x125mm.	Monocular	
	33FA	Triple	25-16-4mm.	6X-10X Huy.	30-440X	Plain "S" 125x125mm.	Monocular	
GROUP "B"	33H	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Plain "S" 125x125mm.	Monocular	Fork-type rack and pinion with Abbe N.A. 1.25 Condenser in mount with iris diaphragm.
	33HB	Quadruple	3.5X-16-4mm. 1.8mm. oil imm.	6X-10X Huy.	21-950X	Plain "S" 125x125mm.	Monocular	
	33MH	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Built-on Mechanical "M"	Monocular	
	33MHB	Quadruple	3.5X-16-4mm. 1.8mm. oil imm.	6X-10X Huy.	21-950X	Built-on Mechanical "M"	Monocular	
GROUP "C"	13AH	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Plain "S" 125x125mm.	Monocular	Fork-type rack and pinion with Abbe N.A. 1.25 Condenser in mount with iris diaphragm.
	13MAH	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Built-on Mechanical "M"	Monocular	
	13H	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Plain "S" 125x125mm.	Vertical Binocular	
	13MH	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Built-on Mechanical "M"		
	13LH	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Plain "S" 125x125mm.	Inclined Binocular	
	13MLH	Triple	16-4mm. 1.8mm. oil imm.	6X-10X Huy.	60-950X	Built-on Mechanical "M"		
	13MLHW	Triple	16-4mm. 1.8mm. oil imm.	10X W. F.	100-950X	Built-on Mechanical "M"		

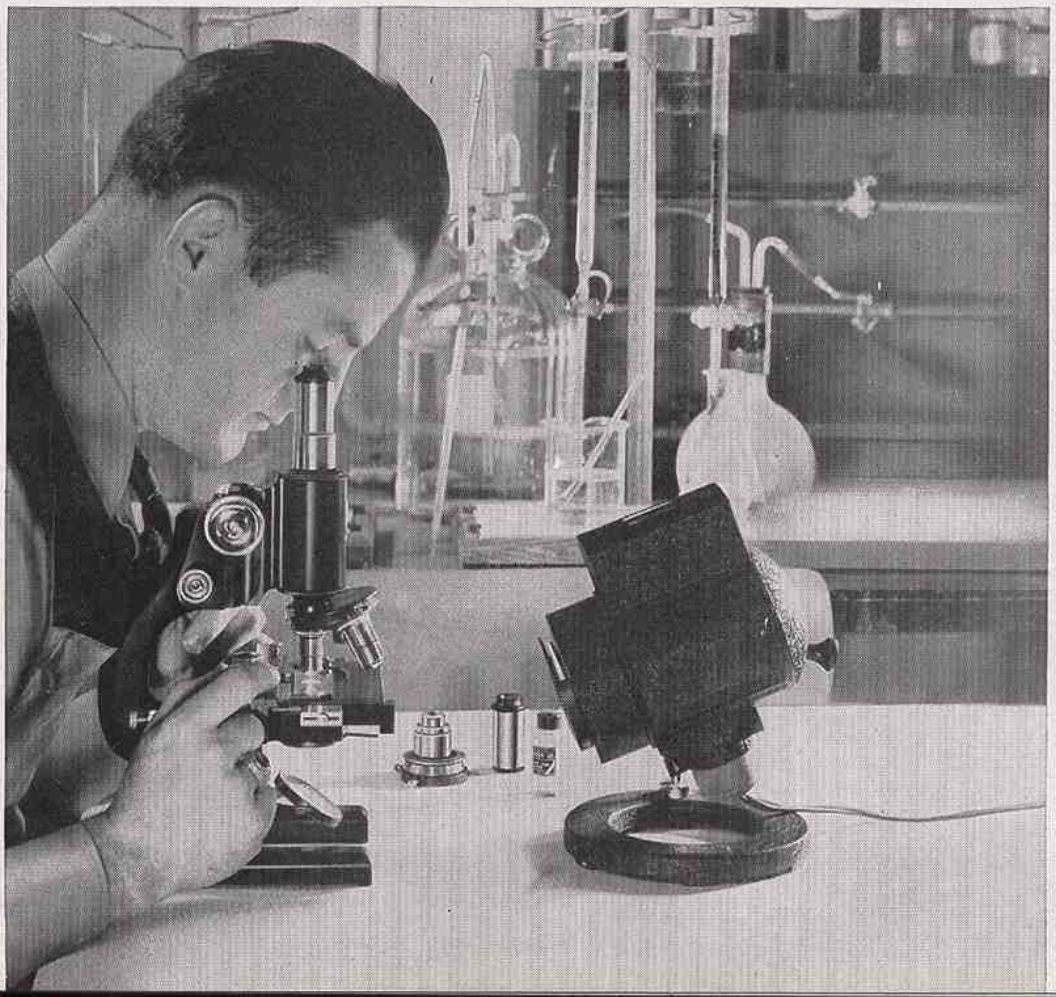
NOTE: The M stage may be added to any microscope listed with plain stage S at additional cost.
The type of eyepiece should be stated—ie. "Huy." or "W.F."

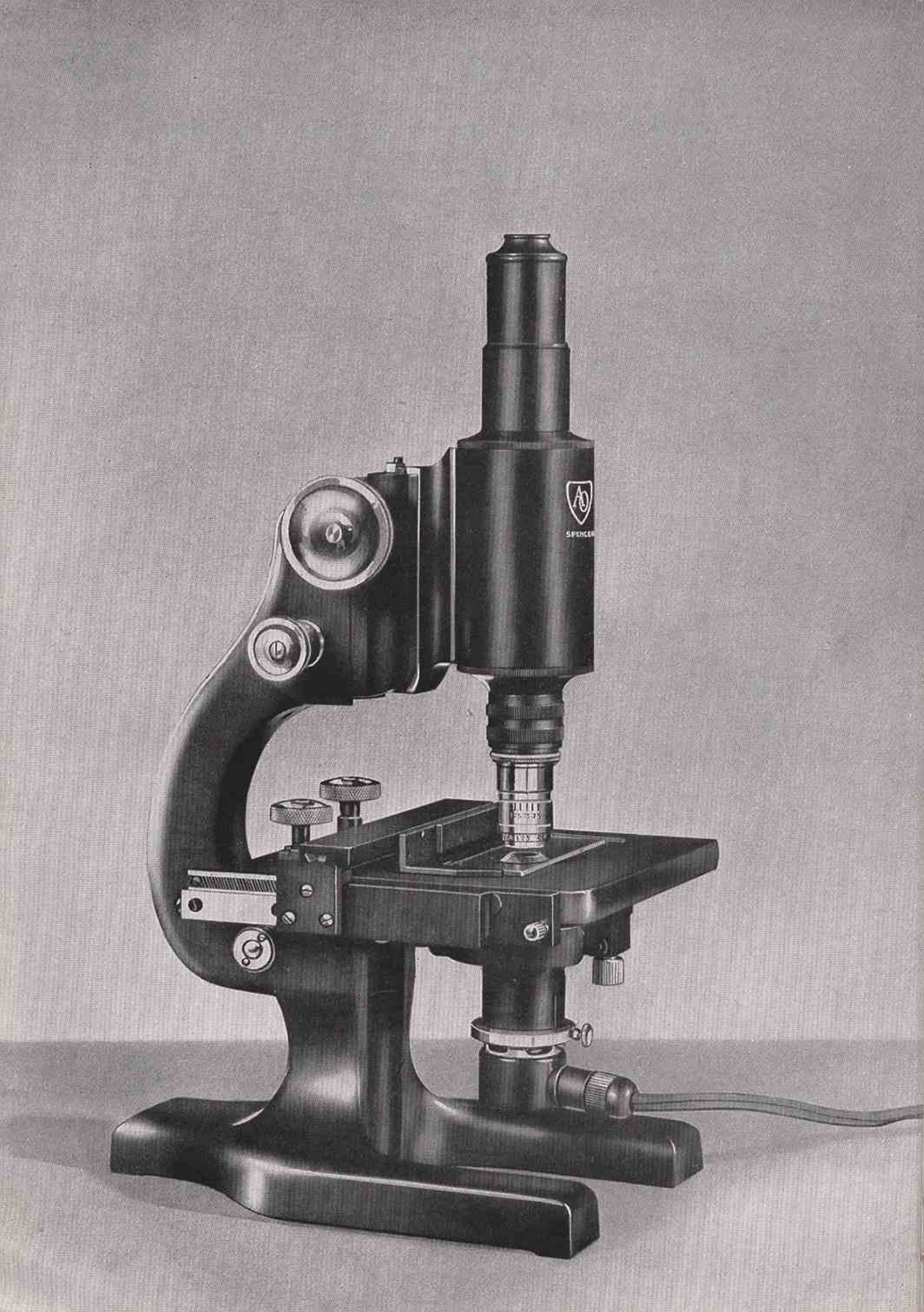
Special Purpose Microscopes

For some types of work a standard Spencer microscope with special optical or mechanical equipment is recommended. In this section only the special features are described. The stand, focusing adjustments, nosepiece, stage, optical quality, finish, and cabinet are identical with those of the advanced laboratory microscopes previously described.

These microscopes are used extensively for specialized medical techniques, analysis of yeast, mold, extraneous matter, and adulterants of one kind or another in the industrial laboratory. They are used for counting and measuring microscopic organisms and characteristics. Standard microscopes can sometimes be utilized for these techniques, but it is possible to increase efficiency and to conserve valuable time by using special instruments. Some of the more popular special purpose and calibrated microscopes are listed and described on the following pages. In each case the advantages of the special microscope are outlined. Some include specific references to approved methods

INSTRUMENT	PRINCIPAL APPLICATION
Dark Field Microscope	Searching for the living Treponema Pallidum.
Pathologist's Microscope	Tissue examination.
Mold Count Microscope	Control of mold in canning.
Bacteria Count Microscope	Bacteria counts in milk.
Water & Sewage Microscope	Plankton counting.
Brewmaster's Microscope	Yeast examination.
Textile Microscope	Identification of fibers; measuring dernier.





The Dark Field Microscope

Special microscopes are offered for routine dark field observations. They have been found useful in public health work for the eradication and control of syphilis. Some micro-organisms are so similar in refractive index and color to the medium in which they live that they cannot be seen in the ordinary bright field, but when the illumination strikes them from the sides, and the background is dark, they become self-luminous and are identified easily. The spirochaete of syphilis is seen with difficulty, except by means of a good dark field illumination.

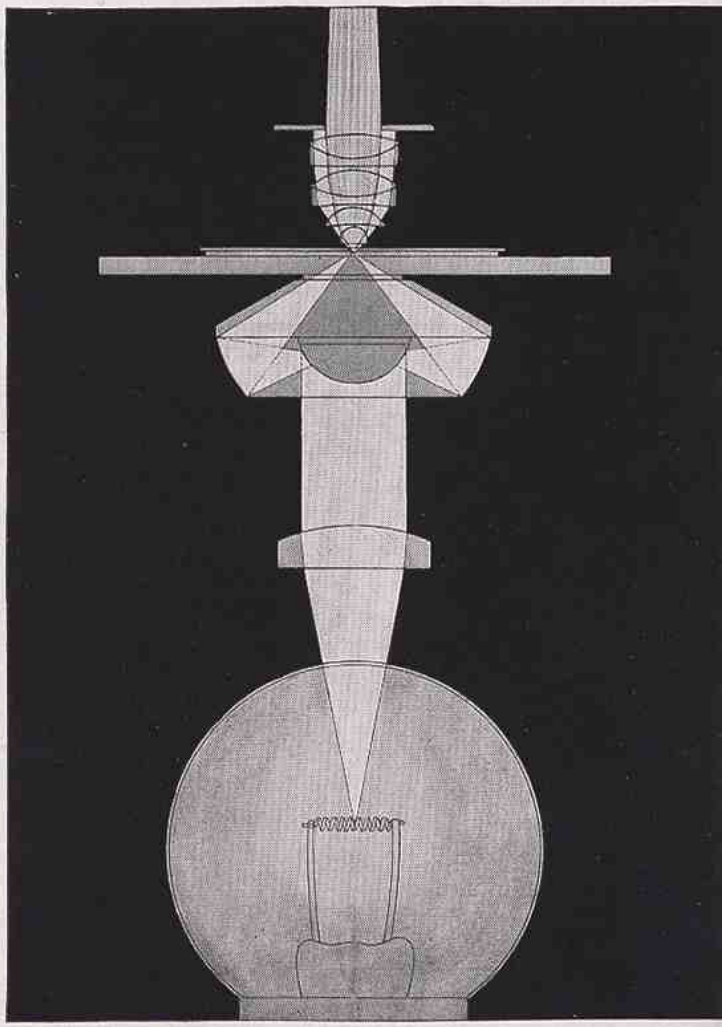
These microscopes are designed to produce excellent dark field illumination without requiring technical skill, since the illuminant, the dark field condenser, and the objective are permanently aligned and the only manipulation necessary is focusing the objective.

As shown on the drawing, the dark field condenser forms a hollow cone of light of such angle as to miss the objective. The specimen, on a slide 1.15 to 1.25mm. in thickness, comes exactly at the apex of the cone and is illuminated brilliantly from all sides. Light from the luminous specimen enters the objective and may be seen.

The substage is hinged at the back end and is held securely at the front by means of a screw with a knurled head. Thus the substage is held in positive alignment with the objective as it is centered at the factory. The hinged construction facilitates cleaning the condenser after it has been used in oil immersion contact with the slide.

The Spencer dark field illuminator (bispheric type) has been found to give excellent results. The light source is built into the same tube that holds the dark field condenser and is positively centered. The bulb is a 6.5 volt, 1.7 ampere, with a built-in condenser.

The achromatic objective is a 1.8mm., N.A. 1.25, having a built-in iris diaphragm. The iris diaphragm provides a means of obtaining the best possible balance between the limited aperture which can be used for dark field work and the maximum resolution. It is mounted on the body tube by means of a single nosepiece adapter.

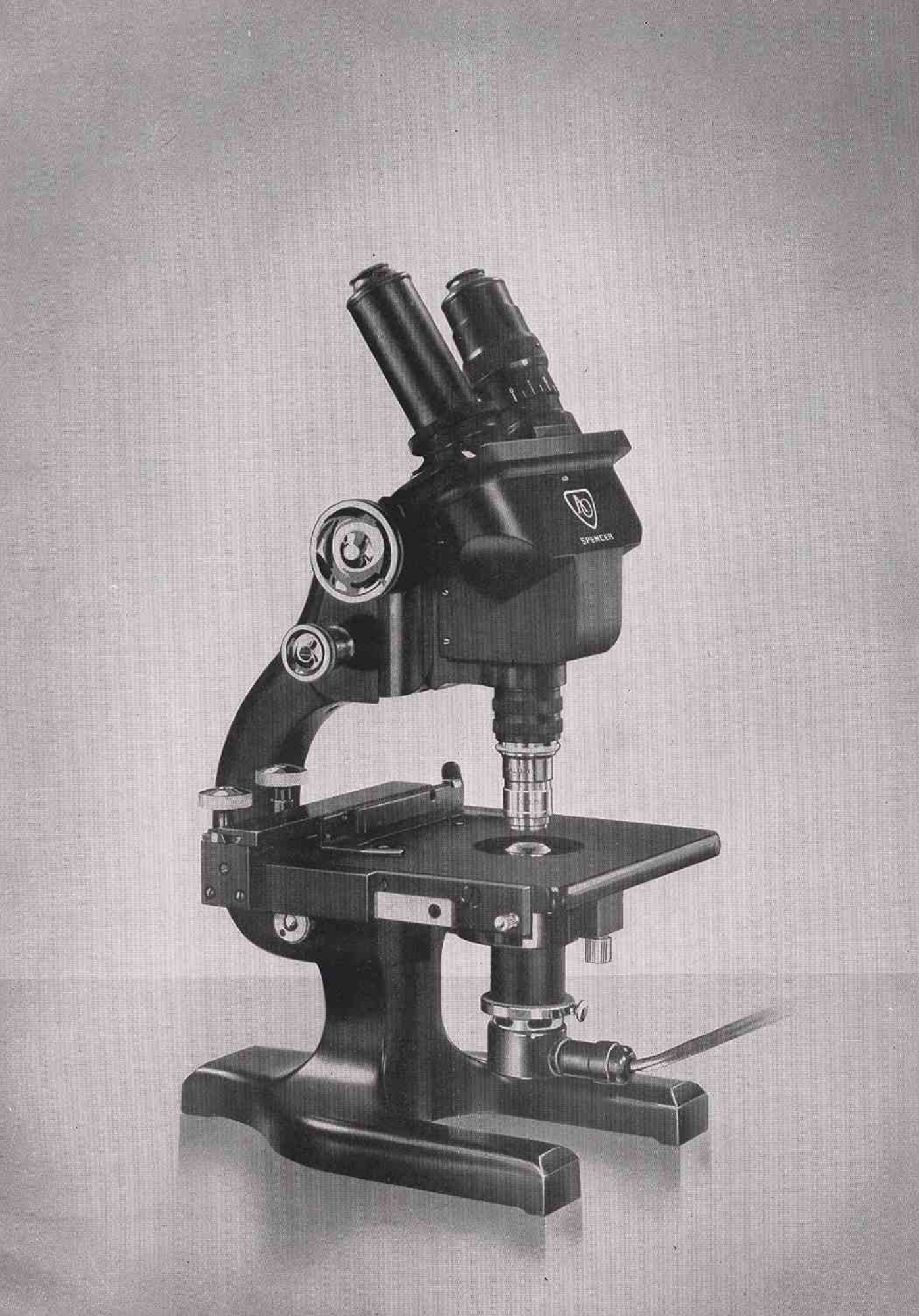


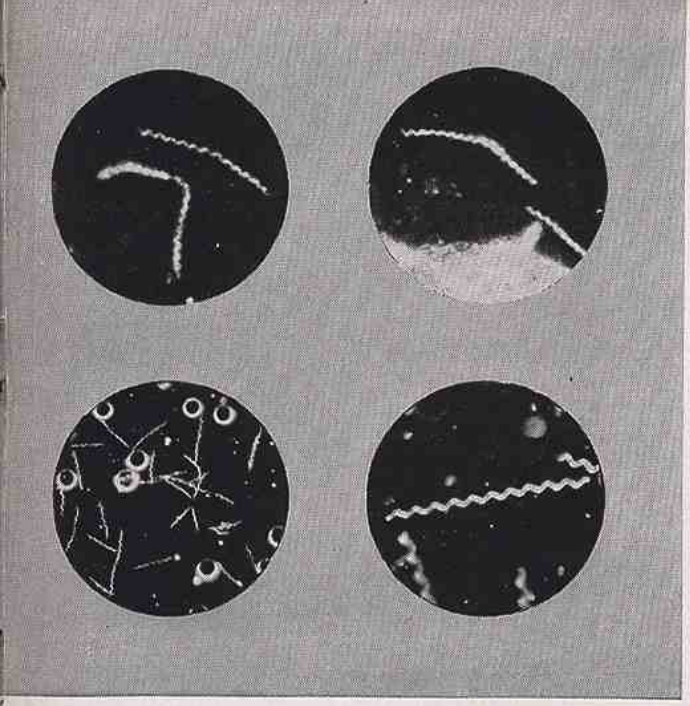
Path of light through the bispheric type dark field condenser.

For those, working continuously with a dark field microscope, the comfort and freedom from eyestrain experienced with the binocular instruments is appreciated. Microscopes having either vertical or inclined binocular bodies are listed.

The following tabulation gives comparative specifications of the Special Dark Field Microscopes which are available.

Left: Spencer Dark Field Microscope No. 32M.


SPENCER



Upper right and left: Spirochaeta pallida; lower left: Spirochaeta obermeyerii; lower right: Spirulina jennerii.

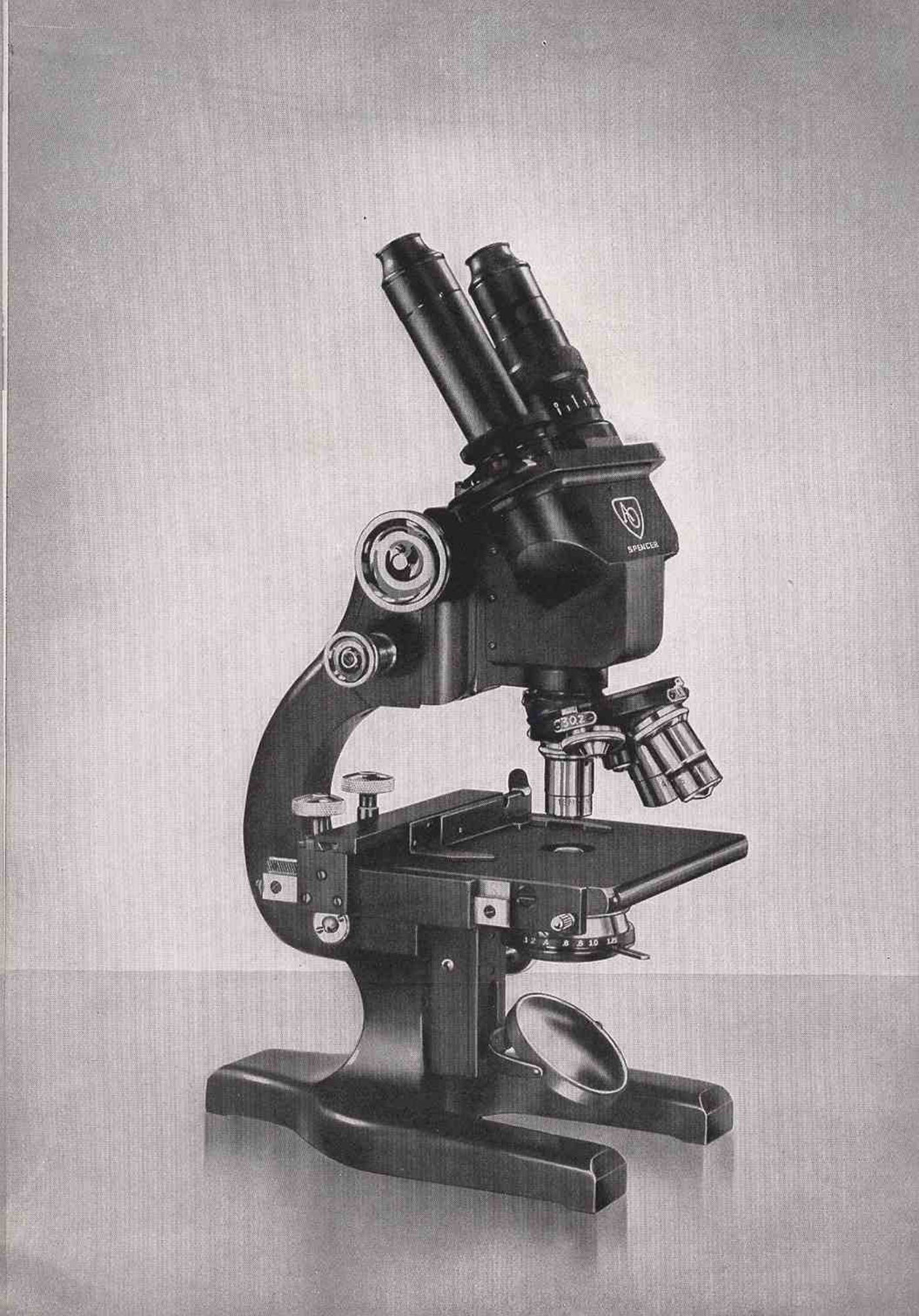


Hinged substage of the Dark Field Microscope.

DARK FIELD MICROSCOPE

Catalog No.	OPTICS		Range of Magnification	Type of Body	Stage	Suggested Accessories (not included in price)	Price
	Achromatic Objective	Eye-pieces					
32	1.8mm. oil immersion with built-in iris diaphragm	10X Huyghenian	950X	Monocular Fixed	Plain Square	Mechanical Stage No. 484 or No. 485	
32M	1.8mm. oil immersion with built-in iris diaphragm	10X Huyghenian	950X	Monocular Fixed	Built-on Mechanical		
12	1.8mm. oil immersion with built-in iris diaphragm	Paired 10X Huyghenian	950X	Vertical Binocular	Plain Square	Mechanical Stage No. 484 or No. 485	
12M	1.8mm. oil immersion with built-in iris diaphragm	Paired 10X Huyghenian	950X	Vertical Binocular	Built-on Mechanical		
12L	1.8mm. oil immersion with built-in iris diaphragm	Paired 10X Huyghenian	950X	Inclined Binocular	Plain Square	Mechanical Stage No. 484 or No. 485	
12LM	1.8mm. oil immersion with built-in iris diaphragm	Paired 10X Huyghenian	950X	Inclined Binocular	Built-on Mechanical		

Left: Spencer Dark Field Microscope No. 12LM.


SPENCER

The Pathologist's Microscope

A Spencer Pathologist's Microscope combines several features of value in obtaining a quick diagnosis—features that have been recommended by some of the foremost authorities in the field of pathology.

In addition to the usual 16mm., 4mm., and 1.8mm. objectives supplied on these microscopes, a low power objective is included. There are two different low power objectives offered. Both provide a wide field, long working distance, and parfocal relationship with the other objectives on the quadruple revolving nosepiece. Either will be very helpful in revealing tissue patterns and in locating desired fields.

Microscope No. 11 carries the 3.5X achromatic objective for the preliminary examination of large specimens. It has a numerical aperture of 0.09 and a working distance of 24mm.

If a slightly higher magnification is desired, Microscope No. 10 provides a 5.1X achromatic objective with N.A. of 0.17 and a working distance of 21mm.

A large flat field is obtained by means of the Wide Field eyepieces. The correction obtained by additional lenses in these eyepieces permits the use of a larger diaphragm and gives a larger field.



A 25mm. objective is included on No. 10.

The Spencer inclined binocular body is designed especially for comfortable posture and vision.

Physiologically it is easy to look into the converging eyepieces and blend the two images in a Spencer microscope. The inclined binocular body is also available with parallel eyepiece tubes and may be specified if desired.

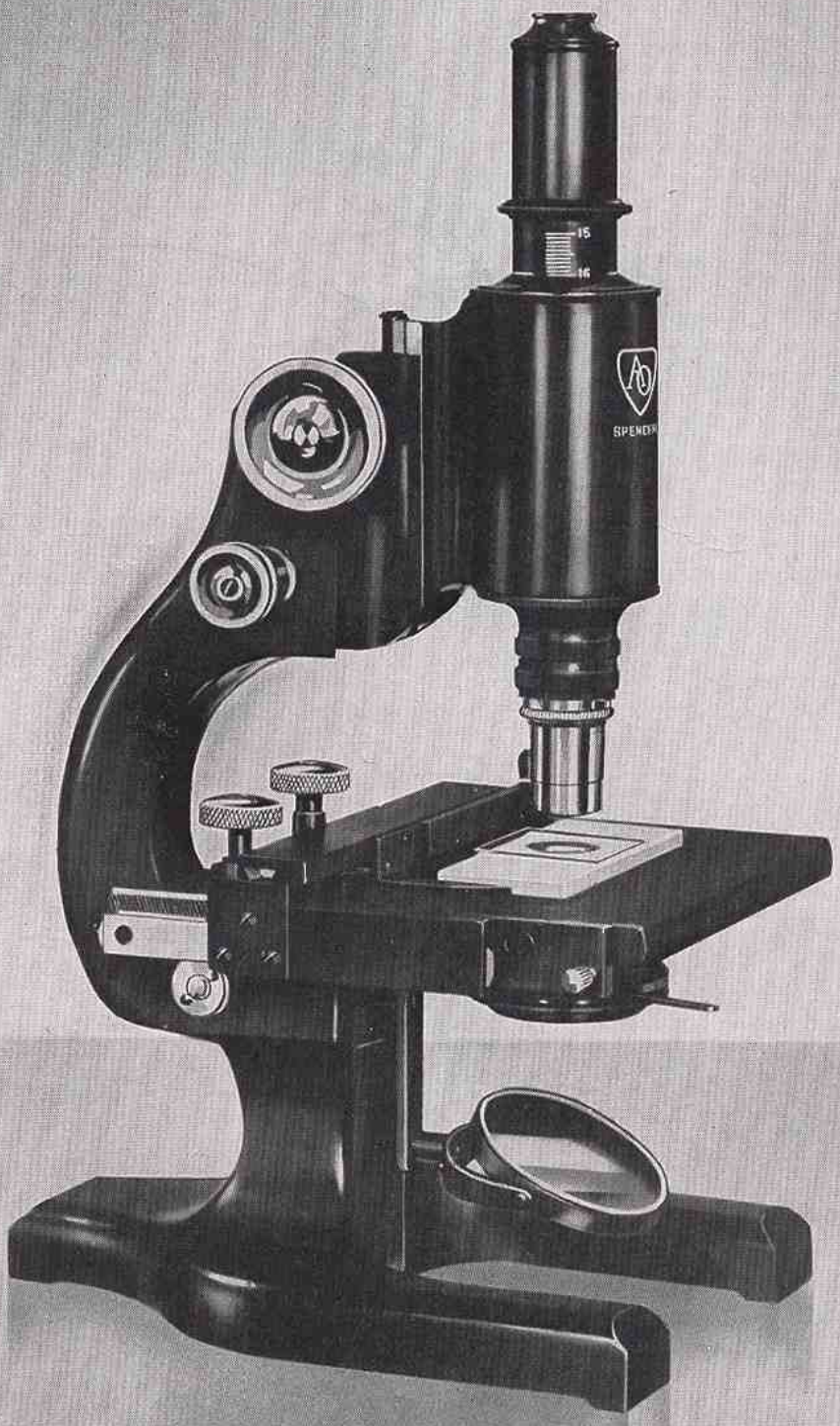
Ease of manipulating a specimen is essential in diagnosis of abnormal tissues. The built-on mechanical stage provides the necessary facility.

An eyepiece micrometer with a focusable eye lens, and stage micrometer, are recommended for making measurements.

PATHOLOGIST'S MICROSCOPE

Catalog No.	Nosepiece	OPTICS		Range of Magnification	Type of Body	Rack and Pinion Substage	Price
		Achromatic Objective	Eyepieces				
11	Quadruple Revolving	30.2, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	35X to 1900X	Vertical Binocular	With N.A. 1.25 condenser with iris	
11L	Quadruple Revolving	30.2, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	35X to 1900X	Inclined Binocular	With N.A. 1.25 condenser with iris	
10	Quadruple Revolving	25, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	51X to 1900X	Vertical Binocular	With N.A. 1.25 condenser with iris	
10L	Quadruple Revolving	25, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	51X to 1900X	Inclined Binocular	With N.A. 1.25 condenser with iris	

Left: Spencer Pathologist's Microscope No. 11L.


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SPENCER

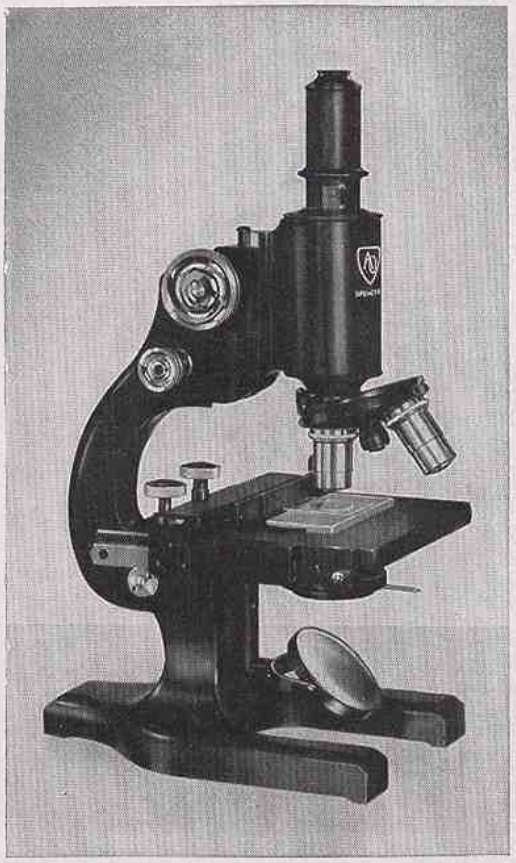
Mold Count Microscope

To maintain a high standard of quality in butter, tomatoes, and a number of other products, it is necessary to make routine mold counts. Below are some of the features of Spencer microscopes especially equipped for this work.

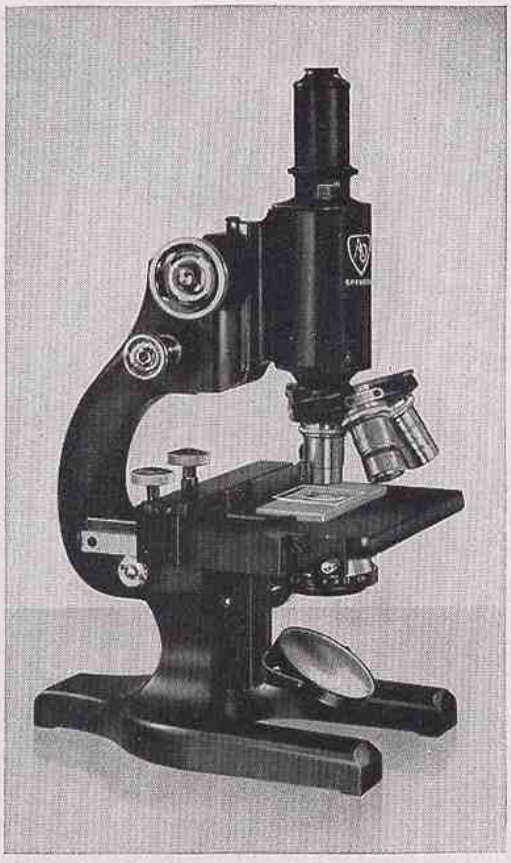
1. Precalibrated to a field diameter of 1.382mm.
2. Condenser to distribute light evenly.
3. Mechanical stage for systematic examination of specimen.
4. No. 417 Howard Mold Count Chamber is included with each microscope.
5. Green filter is available for use below condenser to increase contrast and visual acuity, which thus permits more readings without fatigue.

If the selection of a microscope is for mold count work only, a single 16mm. objective is required. Some laboratories have other uses for the microscope in addition to the mold count technique. Microscopes with an extra 6X eyepiece, a high dry and an oil immersion objective are provided for higher powered work or for a more extensive study of microscopic organisms. The addition of optical equipment to these microscopes in no way impairs their use for mold count work. They are more adaptable models with increased usefulness.

Order Cat. No. 385 Substage Lamp for use with monocular microscopes, or No. 370 for use with binocular instruments.



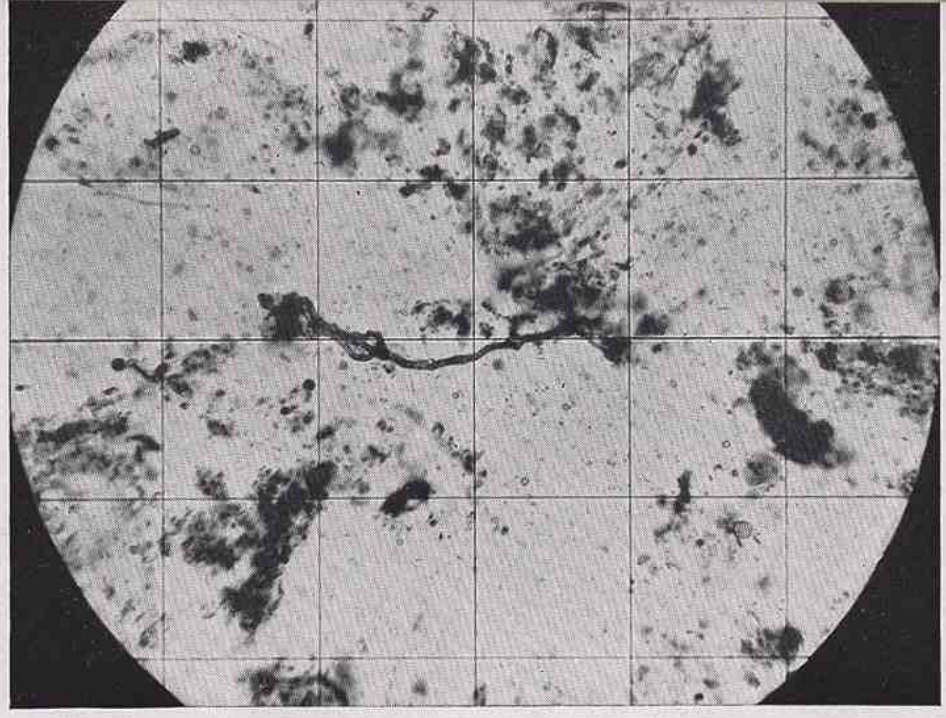
Mold Count Microscope No. 61.



Mold Count Microscope No. 62.

Left: Spencer Mold Count Microscope No. 60.


SPENCER



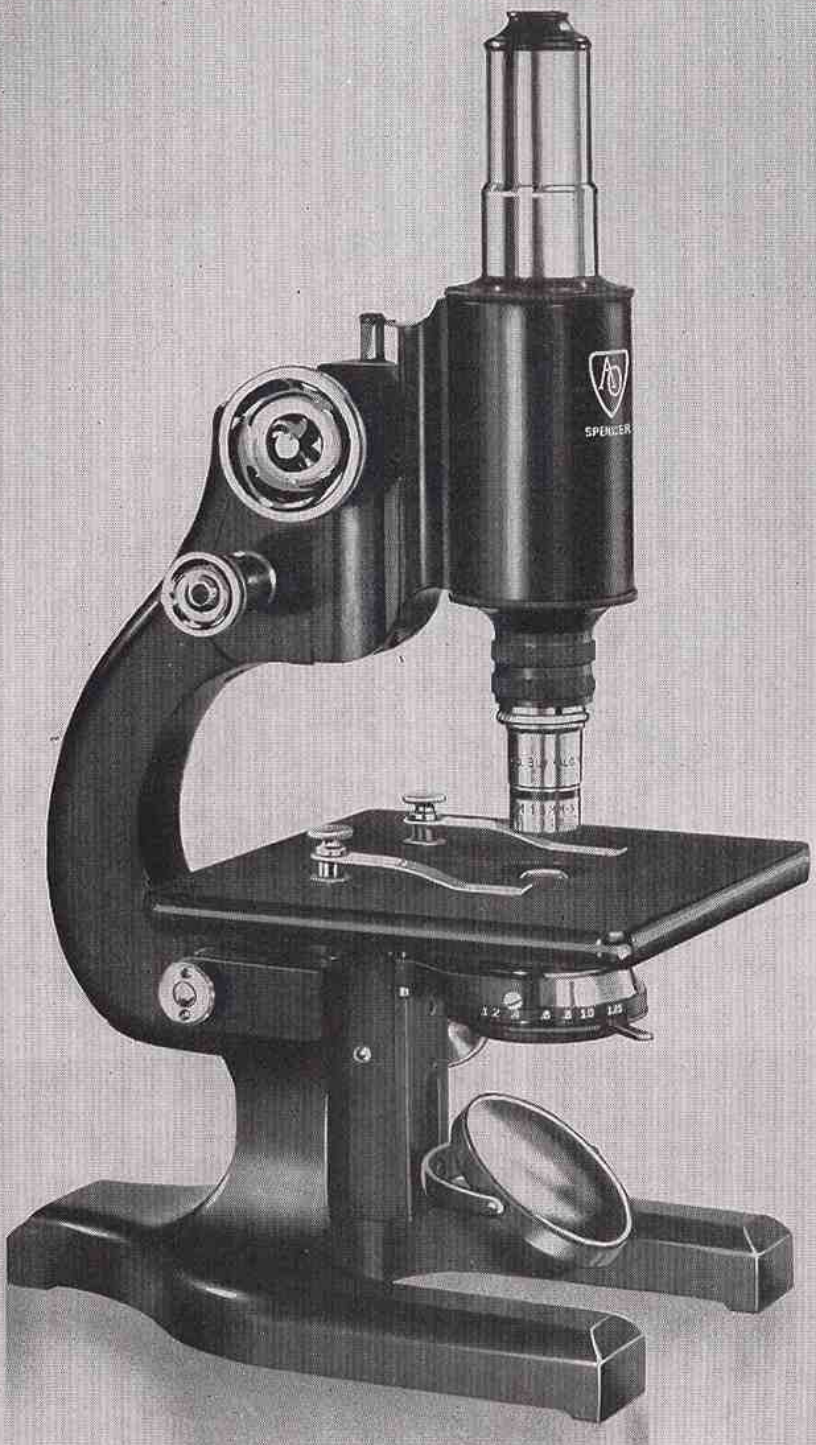
Tomato Mold.

MOLD COUNT MICROSCOPE

Catalog No.	Nose-piece	OPTICS		Range of Magnification	Type of Body	Substage	Price
		Achromatic Objective	Eye-pieces				
60	Single Adapter	16mm.	10X with HowardDisc, Field 1.382mm.	100X	Monocular Graduated Draw Tube	Spiral focus N.A. 0.66 condenser with iris	
61	Double	16 and 8mm.	10X with HowardDisc, Field 1.382mm.	100X 200X	Monocular Graduated Draw Tube	Spiral focus N.A. 0.66 condenser with iris	
62	Triple Revolving	16, 4, 1.8mm. oil immersion	6X 10X with HowardDisc, Field 1.382mm.	60X to 950X	Monocular Graduated Draw Tube	Rack and Pinion N.A. 1.25 condenser with iris	
14	Single Adapter	16mm.	Paired 10X with HowardDisc, Field 1.382mm.	100X	Verticular Binocular Calibrated	Rack and Pinion N.A. 0.66 condenser with iris	
14L	Triple Revolving	16, 4, 1.8mm. oil immersion	Paired 6X, 10X with HowardDisc, Field 1.382mm.	60X to 950X	Inclined Binocular Calibrated	Rack and Pinion N.A. 1.25 condenser with iris	

No. 417—Howard Mold Count Chamber, when ordered separately.....
No. 307—Green Filter for use below substage condenser, if desired.....

Left: Spencer Binocular Mold Count Microscope No. 14L.

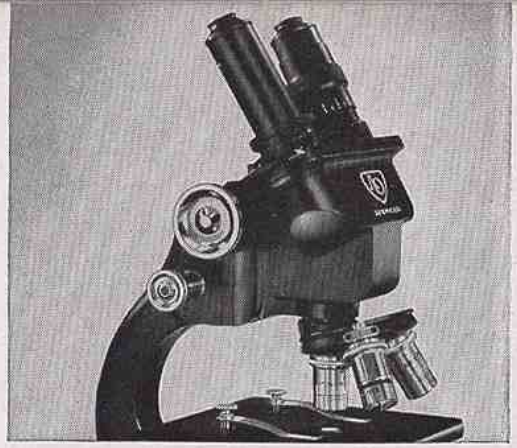

SPENCER

Bacteria Count Microscope

(Breed and Brew Method)

Precalibrated microscopes are advantageous in making bacteria counts in milk because permanent field sizes are assured. Both binocular and monocular instruments can be calibrated at the factory to provide field diameters of 0.206mm. for the 300,000 factor or 0.146mm. for the 600,000 factor. Many bacteriologists find it helpful to have the field divided into quadrants to facilitate counting; therefore a special cross line reticle disc is provided and is included with all standard equipment as listed. A condenser, N.A. 1.25, with iris diaphragm is included on all microscopes. Within the limits of the fields, as specified above, this microscope can be used for other work.

Monocular microscopes are suitable for this type of work, but binocular instruments are preferred where a great number of tests are involved. In order to calibrate binocular microscopes for counting bacteria in milk, the interpupilary distance of the user must be given.



Binocular Bacteria Count Microscope No. 13 LHYZ.

Five instruments are listed: two with the oil immersion objective only; three with the complete "H" optics. In laboratories where other microscopic examinations are to be made involving lower powers, it is advisable to purchase one of the more complete units.

All microscopes are listed with plain square stages. If the large Breed and Brew slide is to be used, a No. 490 Mechanical Stage may be ordered, while for standard sized slides, the built-on Mechanical Stage M may be specified, both at an additional cost.

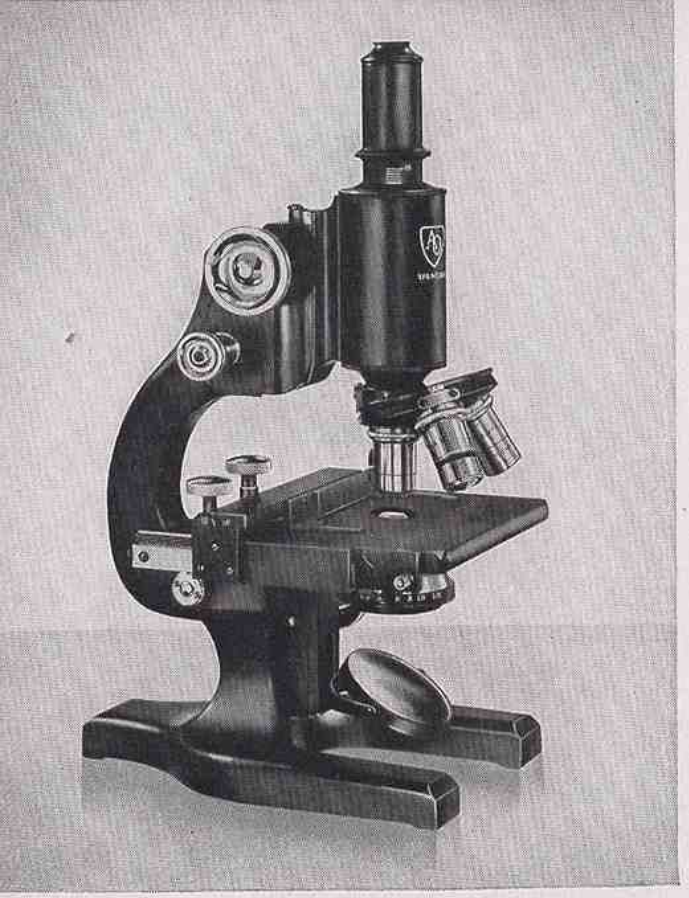
Reference

Standard Methods for the Examination of Dairy Products. Am. Public Health Assoc., N.Y.C., 7th Ed., 1939, 190pp.

BACTERIA COUNT MICROSCOPE

Catalog No.	Nose-piece	OPTICS			Range of Magnification	Type of Body	Price
		Achromatic Objectives	Eye-pieces	Calibration			
33Y	Single	1.8mm. oil immersion	6X with No. 427 Cross Hair Disc	300,000 factor	570X	Monocular with Fixed Eyepiece Tube	
33Z	Single	1.8mm. oil immersion	10X with No. 427 Cross Hair Disc	600,000 factor	950X	Monocular with Fixed Eyepiece Tube	
33HYZ	Triple	16mm., 4mm., 1.8mm. oil immersion	6X and 10X each with No. 427 Cross Hair	300,000 and 600,000 factors	60X to 950X	Monocular with Fixed Eyepiece Tube	
13HYZ	Triple	16mm., 4mm., 1.8mm. oil immersion	Paired 6X and 10X, one of each with Cross Hair	300,000 and 600,000 factors	60X to 950X	Vertical Binocular	
13LHYZ	Triple	16mm., 4mm., 1.8mm. oil immersion	Paired 6X and 10X, one of each with Cross Hair	300,000 and 600,000 factors	60X to 950X	Inclined Binocular	

Left: Spencer Bacteria Count Microscope No. 33Z.



Spencer Water and Sewage Microscope No. 33MHR.

References

Standard Method for the Examination of Water and Sewage. American Public Health Association, N.Y.C., 6th Edition, 1925, 119 pp.

Water and Sewage Microscope

For use in the Water Filtration Plant, a standard microscope with magnifications ranging from 60X to 440X will usually prove satisfactory. If the laboratory has occasion to make bacteriological counts, however, an instrument with an oil immersion lens is necessary.

For plankton count work the Whipple Eyepiece Micrometer Disc No. 416 is supplied in one 10X eyepiece only. For checking calibration of the eyepiece scale, a No. 400 Stage Micrometer is a desirable accessory.

A condenser of N.A. 0.66 provides excellent illumination for the lower powers. When the 1.8mm. oil immersion lens is ordered, the N.A. 1.25 condenser is necessary.

The same instrument is recommended for the Sewage Treatment Plant laboratory.

For manipulation of slides and for counting, the built-on mechanical stage is a great convenience. It can be removed for the examination of Petri dish cultures.

WATER AND SEWAGE MICROSCOPE

Catalog No.	Nose-piece	OPTICS		Range of Magnification	Type of Body	Fork Type Rack and Pinion Substage	Price
		Achromatic Objective	Eye-pieces				
33MFR	Double Revolving	16mm. 4mm.	6X 10X with Whipple Disc	60X to 440X	Monocular Graduated Draw Tube	With N.A.0.66 condenser and iris	
33MHR	Triple Revolving	16, 4, 1.8mm. oil immersion	6X 10X with Whipple Disc	60X to 950X	Monocular Graduated Draw Tube	With N.A. 1.25 condenser and iris	
13MHR	Triple Revolving	16, 4, 1.8mm. oil immersion	Same but paired	60X to 950X	Vertical Binocular	With N.A. 1.25 condenser and iris	
13MLHR	Triple Revolving	16, 4, 1.8mm. oil immersion	Same but paired	60X to 950X	Inclined Binocular	With N.A. 1.25 condenser and iris	

Brewmaster's Microscope

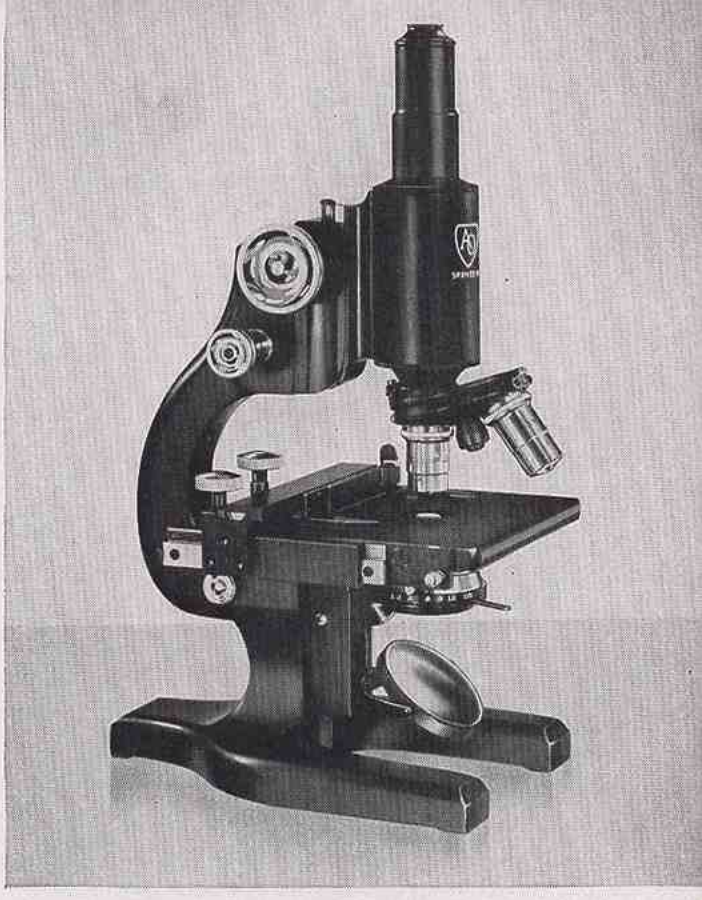
Almost every Brewmaster has accepted the microscope as a requisite in the laboratory. Routine microscopic examination is the only means of assuring continuous and uniform quality production.

A high, dry objective, such as the 3mm., N.A. 0.85 has been selected by a number of men in this field because it provides excellent resolution and a magnification of 600X when used with a 10X eyepiece. The working distance of this objective is relatively short, and thin cover glasses must be employed. Consequently this objective can not be used with a haemacytometer counting chamber.

If a haemacytometer is used for counting yeast, the 4mm. N.A. 0.66, which (with 10X eyepiece) provides magnification of 440X, is preferred. Both are listed in the chart below.

An oil immersion lens is often desirable for the examination of bacteria. The more complete equipment is available in monocular and binocular microscopes.

The built-on mechanical stage, a feature of these microscopes, is a convenience in any laboratory work. It can be removed to facilitate the inspection of the contents of Petri dishes or other large specimens.



Spencer Brewmaster's Microscope No. 33MO.

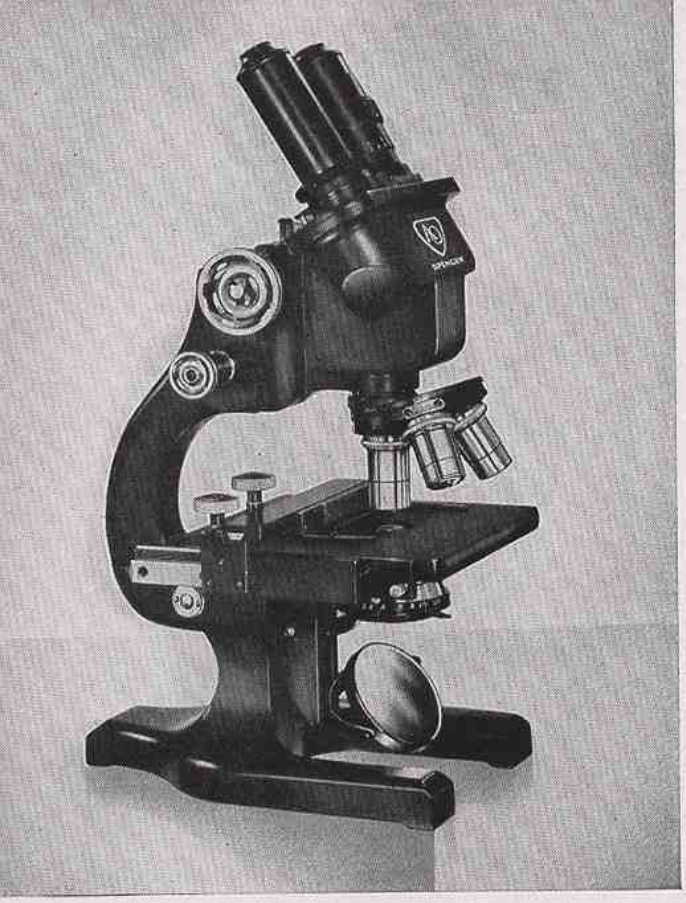
References

Hind, H. L.—Brewing: Science and Practice, 1938-40, New York, 2 vols.

Pozen, M. A.—The Use of the Microscope in the Brewery, Mod. Brew. Age, 1941, 25:77-82; 26:50-60.

BREWMASTERS MICROSCOPE

Catalog No.	Nose-piece	OPTICS		Range of Magnification	Type of Body	Suggested Accessories (not included in price)	Price
		Achromatic Objective	Eye-pieces				
33MO	Double Revolving	16mm. 3mm.	10X	100X 600X	Fixed Monocular	None	
33ME	Double Revolving	16mm. 4mm.	10X	100X 440X	Fixed Monocular	Bright Line Chamber	
33MP	Triple Revolving	16, 3, 1.8mm. oil immersion	6X 10X	60X to 950X	Fixed Monocular	None	
13MP	Triple Revolving	16, 3, 1.8mm. oil immersion	Same but paired	60X to 950X	Vertical Binocular	None	
13MLP	Triple Revolving	16, 3, 1.8mm. oil immersion	Same but paired	60X to 950X	Inclined Binocular	None	



Spencer Textile Microscope No. 13MLT.

References

Plitt, T. M.—Microscopic Methods Used in Identifying Commercial Fibers, Circ. Nat'l. Bu. Stds., C-423, 1939, 26pp.

Preston, J. M.—Modern Textile Microscopy, 1933. London xi *315pp.

Schwartz, E. R.—Textiles and the Microscope, 1934, New York xi *329pp.

Textile Microscope

Higher standards of quality, demand for uniformity, and rigid government requirements have increased the need for scientific instruments in the textile industry. The microscope is used for:

1. Identification of fibers in blends.
2. Determination of quantities of component fibers in blends.
3. Determination of defects.
4. Determination of extent of saponification of acetate in blends.
5. Detection of impurities and foreign matter.
6. Detection of adulteration (for instance; wool or mohair in camel's hair).
7. Counting of filaments in continuous filament rayon yarns.
8. Measuring dernier.
9. Estimating percentage of new and used fibers.

For this work the microscope recommended is equipped with 10X, 20X, and 44X objectives, 6X and 10X eyepieces, a micrometer disc in the eyepiece, a graduated draw tube, a stage micrometer, and N.A. 0.66 substage condenser.

The Spencer No. 385 Substage Lamp is satisfactory for monocular instruments, but the No. 370 Adjustable Laboratory Lamp should be ordered with the binocular.

TEXTILE MICROSCOPE

Catalog No.	OPTICS		Range of Magnification	Type of Body	Substage	Micrometers	Price
	Achromatic Objective	Eyepieces					
33MT	16mm. 8mm. 4mm.	6X 10X	60X to 440X	Monocular Graduated Draw Tube	Rack and Pinion N.A. 0.66 condenser with iris	No. 400 Stage Micrometer No. 405 Eyepiece Disc	
13MT	16mm. 8mm. 4mm.	Same but paired	60X to 440X	Vertical Binocular	Rack and Pinion N.A. 0.66 condenser with iris	No. 400 Stage Micrometer No. 405 Eyepiece Disc	
13MLT	16mm. 8mm. 4mm.	Same but paired	60X to 440X	Inclined Binocular	Rack and Pinion N.A. 0.66 condenser with iris	No. 400 Stage Micrometer No. 405 Eyepiece Disc	

Spencer Research Microscopes

Spencer Research Microscopes have been developed to meet the exacting requirements of the research microscopist, who must spend endless hours searching for minute objects. He necessarily examines specimens thoroughly, usually under the most critical conditions.

They are the culmination of years of experience beginning in the early days of American Microscope Builders with Charles Spencer and Robert Tolles, and of cooperation with leading microscopists whose recommendations have affected the design of these instruments so that they conform to universal requirements.

The optical performance of these instruments is limited only by the wavelength of light. The mechanical adjustments have been refined to give the ultimate in convenience and comfort, and the enduring qualities of Spencer features have been tested by time.

The wide range of optical parts, stages, and substage equipment makes the Spencer Research Microscopes superior. From the lens surfaces, polished to an accuracy of one millionth of an inch, to the flawless satin black and chromium finish, these research instruments exemplify Spencer quality.



Equipment of Research Microscopes

Two Research Microscopes are listed with a number of complete optical equipments suitable for advanced visual work and photomicrography. Several stages and substage equipments are available. Monocular, vertical binocular, or inclined binocular bodies may be specified.

Interchangeability of parts permits a wide range of choice which the advanced worker appreciates. The different parts are described and priced separately so that it is possible to calculate the price of a microscope when a substitution or addition of parts is desired.

Stands

The research stands are designed to achieve rigidity, stability, and graceful symmetry. The inclination joints permit smooth adjustment to any inclined angle, while the well proportioned bases insure stability in all positions. The arms are carefully made to reduce bulk to a minimum and yet preserve proper rigidity.

The black finish is a handsome "velvet" enamel. The bright parts are finished in chromium. All instruments are listed with a triple or quadruple nosepiece, according to the number of objectives specified.

All Spencer Research Microscopes are carefully assembled and inspected before leaving the factory. They are sent out in polished or leatherette covered hardwood cabinets with compartments for accompanying accessories.

Fine Adjustment

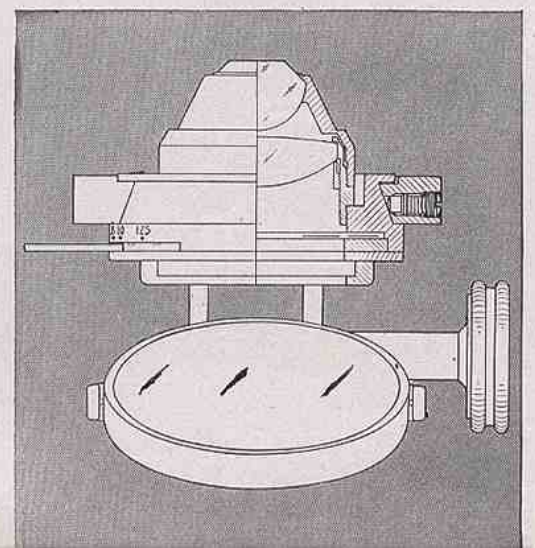
A noteworthy and important feature on Spencer Research Miscroscopes is the low-positioned fine adjustment. The hand rests comfortably on the table while operating the fine adjustment buttons, mechanical stage, or substage.

The fine adjustment is the all-important mechanical element in the microscope stand. In Spencer microscopes the important constituent in this part is a micrometer screw and nut, built and fitted with the precision and accuracy of a measuring instrument. The large bearing surface between thread and nut insures permanency as well as accuracy.

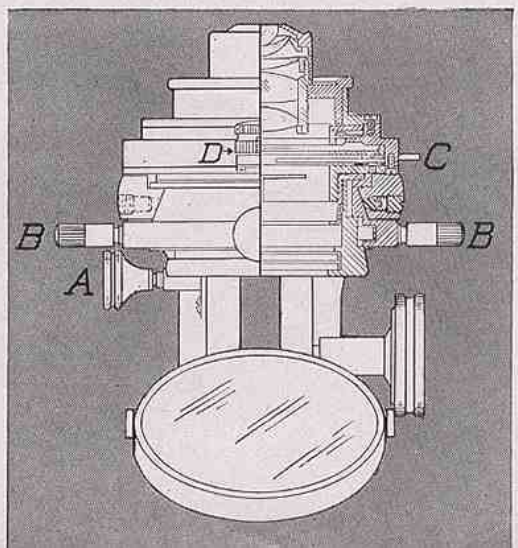
A rigid connection in the arm leads from the micrometer screw at the base of the arm to the fine adjustment bearing at the top. There is a small knurled button on the top of the arm for regulating the tension in the fine adjustment. The metals used in the fine adjustment bearings have been carefully selected to avoid friction, and oil grooves have been incorporated to provide constant lubrication. These parts, together with the heavy bearings and the bell-crank lever, make a fine adjustment providing accuracy, responsiveness, and durability.

The fine adjustment buttons actuate the up-and-down movement of the binocular body or the single body tube, together with the nosepiece. This avoids the objectionable variation in tube length which occurs if only the nosepiece is moved.

Simple Substage with N.A. 1.25 condenser.



Complete Research Substage with achromatic condenser.

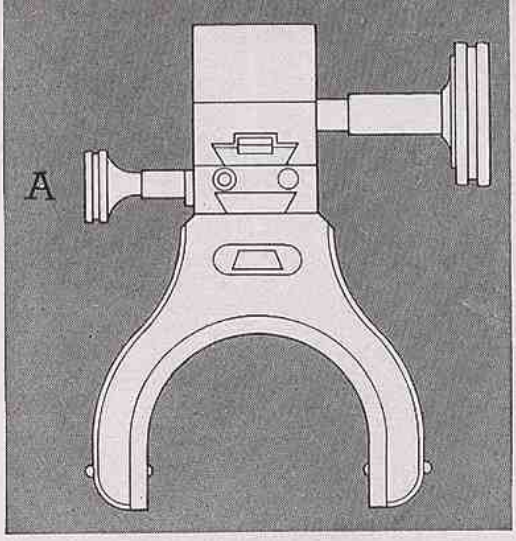


Substages

The Spencer fork-type substages are unique, assuring permanent and proper relationship between the optics and the mechanical parts. Anyone accustomed to the old-style friction ring on a substage appreciates the ease with which the condenser unit may be removed and replaced, and the accuracy to which the unit is held in the optical axis. Two spring plungers snap the unit firmly into place against the back surface of the fork-type support, preventing any slipping. All substages are actuated by diagonal rack and pinion for focusing the condenser.

The **simple** substage supplied on the No. 3 Microscope consists of the focusing means and the fork just described, the fork becoming the support for the condenser mounting and iris diaphragm. The condenser mount No. 324 is graduated to indicate the numerical aperture permitted by the iris diaphragm. A centering mount for the condenser may be substituted at an increase in cost. A centering mount can be provided for all condensers, but the No. 322 **should certainly be specified when the achromatic condenser is selected or supplied.** The Spencer combined oblique light and centering mount can also be supplied for all condensers, and may be obtained at an increased cost to make a complete substage. The No. 333 auxiliary condenser is a useful accessory to slide into the substage slot when low power objectives are used.

The complete **research** substage is supplied on the No. 5 stand. The fork-type support in this substage is focused by the diagonal rack and pinion, **and also by a fine adjustment (A) similar to that used for focusing the objectives.** When high grade condensers, or objectives used as condensers, are used for critical work, this fine adjustment feature is very important. The research substage is completely equipped and consists of the following parts: The condenser mount has the centering mechanism (B), iris diaphragm (C), and oblique lighting feature (D). There are also adapters, by means of which one may use an objective as a condenser; and an auxiliary condenser, which may be slipped into position and used to illuminate the entire field of a low power objective.



Fork-type Rack and Pinion Substage Mounting as used on No. 5; fine adjustment head (A) shown on left.

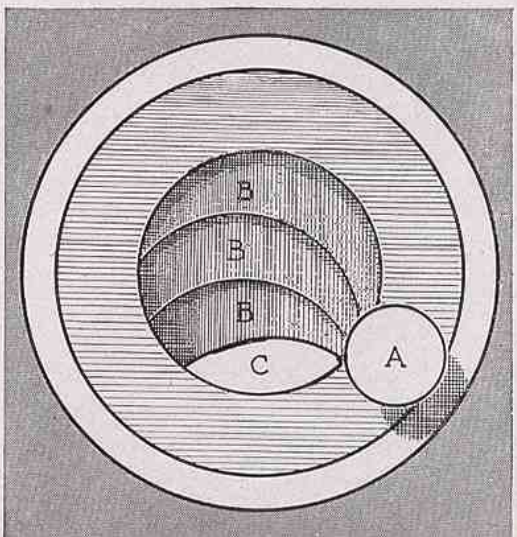
Centering

The centering mechanism of the condenser and iris is substantial. Heavy screws are provided so that the condenser is brought into alignment.

Oblique Light

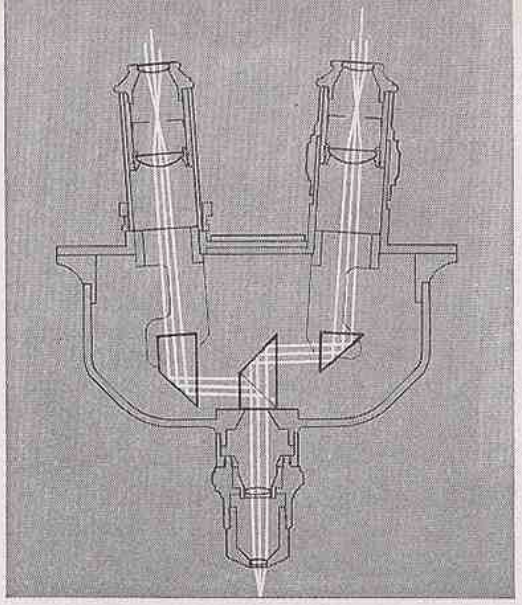
Oblique light is obtained by a new device quite different from the old method of decentering the iris. It is independent of the iris diaphragm and consists of three bronze leaves (B), which rotate on a common axis at one end of each leaf; by turning a button (A), these leaves close the aperture from one side only, leaving an opening (C) for the decentered light to strike the condenser. For the same amount of obliquity, the volume of light is three times that admitted when the iris is decentered. The obliquity can be obtained from the desired azimuth by revolving the ring, to which the leaves are attached, around the optical axis. For simplicity and effectiveness it is without an equal.

Oblique Light Feature.





Vertical Binocular Body.



Path of light through Vertical Binocular Body.

Microscope Bodies

All Spencer Research Microscopes are priced with two bodies: a monocular, with an adjustable draw tube; and a binocular. On all Spencer Research Microscopes any of the bodies, whether binocular or monocular, may be used interchangeably.

Monocular Body

The monocular body, as regularly supplied, is 50mm. in diameter and is provided at the upper end with a removable sleeve, into which is mounted a graduated draw tube for varying the tube length. It is particularly useful for photomicrographic work. The draw tube may be removed to provide a larger diameter when very low power objectives or special photomicrographic objectives (microteleplats) are used, since in these cases the eyepiece is not needed. For critical observations, where the most careful resolution is demanded, the straight tube is preferable since there are no prisms in the light path.

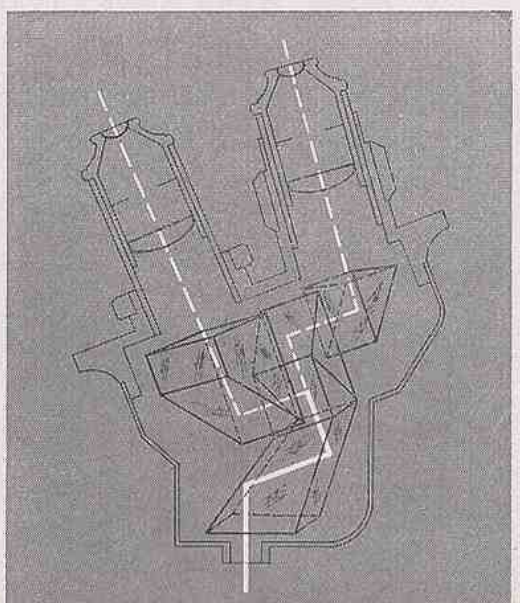
The draw tube of this monocular body has a special mark indicating a tube length of 160mm. To get the best results when working with cover glasses of varying thicknesses and with dry objectives, it is necessary to adjust the tube length.

The graduated draw tubes are fitted in special cloth-lined sleeves and work very smoothly.

Inclined Binocular Body with Converging Eyepiece Tubes.



Path of light through Inclined Binocular Body.



Binocular Bodies

On the Spencer binocular bodies, the eyepiece tubes converge at an included angle of 8°, which is a very comfortable angle of convergence for the eyes. One looks into the two eyepieces in the natural easy way and blends the two images without the slightest difficulty. When picking up a slide and placing it on the stage of the microscope, the eyes converge in the natural manner. The same angle of convergence is maintained when looking into the microscope. Binocular fusion is easy, natural, and comfortable.

Parallel eyepieces can be supplied on the "L" body at no extra charge if specifically requested.

A knurled ring at the base of one of the eyepiece tubes provides for adjustments for various interpupillary distances. A graduated scale indicates the interpupillary separation.

On the other tube is a knurled ring to lengthen or shorten the tube to compensate for differences in the accommodation of the two eyes.



Monocular Body with Graduated Draw Tube.

Standard Binocular Body B

On the standard binocular body B the eyepiece tubes are in a vertical plane.



Inclined Binocular Body with Parallel Eyepiece Tubes.

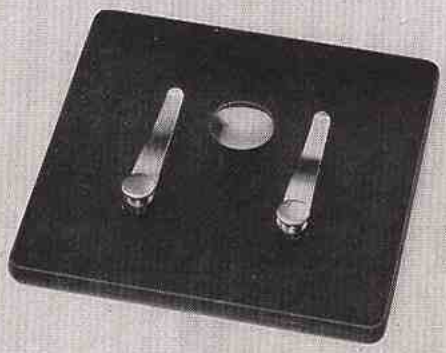
Inclined Binocular Body L

The inclined binocular body L is like the body B described above, except that the eyepiece tubes are inclined from the vertical, 30° toward the operator. The thirty degree inclination was chosen after careful tests were made to determine the most comfortable and convenient angle of inclination.

Cat. No.	Description	Price
91	Single Body Tube	
92	Vertical Binocular Body B	
95	Inclined Binocular Body L with Converging Eyetubes	
98	Inclined Binocular Body L with Parallel Eyetubes	



Graduations indicate interpupillary distance and adjustment for eyepiece accommodation. →



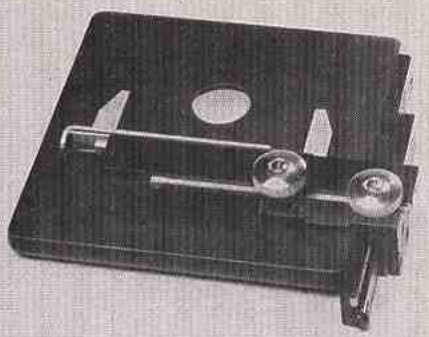
S *Stage*

Stages Applicable to Microscopes Nos. 3 & 5

A large stage is a necessary feature on any microscope. The stage must also be fastened rigidly to the microscope so that there is no movement to change the focus when the hand rests on it. The stage should be made of a material that will not discolor when in contact with the ordinary laboratory reagents. All these conditions are met in Spencer stages.

Plain Square Stage S.

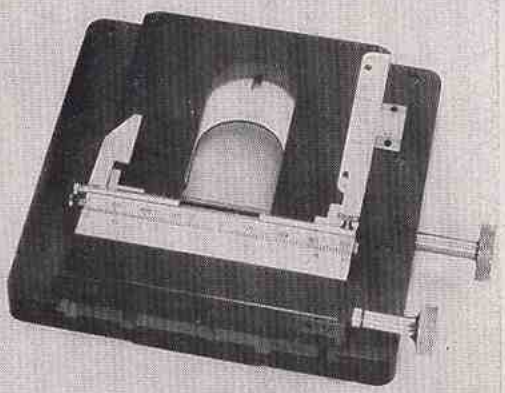
The Plain Square S Stage No. 481 is cast from a hard, rigid, durable Bakelite. It is 125mm. square. Many thousands of Spencer Medical Microscopes, equipped with S or M Stages, are now in daily use.



M *Stage*

Combination Plain and Mechanical Stage M.

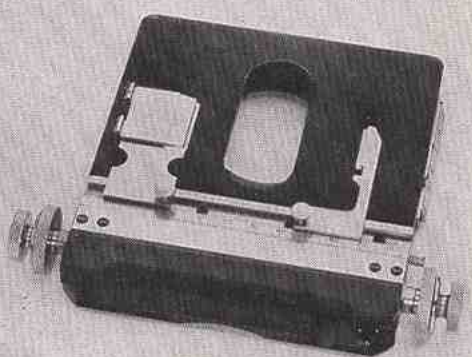
The Rectangular M Stage No. 483, plain stage with a mechanical stage permanently fastened to the edge, has made a very practical, popular, and inexpensive combination. Buttons on vertical axes operate the diagonal rack and pinion movements in both directions. The to-and-fro excursion is 50mm. and the lateral excursion 75mm. When a plain stage is desired, the part above the surface of the stage may be removed by sliding it off its to-and-fro bearings. The slide clip on the right is permanently located, while the one on the left is kept in contact with the slide by spring tension. This is a very sturdy stage, accommodating slides up to 50mm. x 75mm.



P *Stage*

Combination Plain and Mechanical Stage P

The mechanical movements on this Combination Plain and Mechanical P Stage (125mm. square) are operated by buttons on horizontal axes. These are graduated, with verniers for each movement reading to 0.1mm. This 125mm. square stage accommodates slides as large as 50mm. x 75mm. The P Stage No. 1520 is priced with simple slide clips and



R *Stage*

buttons on the right side only in all catalogued equipments. The right hand slide clip is adjustable in a groove to accommodate slides of different lengths. The left slide clip is also adjustable in the same groove and is held against the end of the slide by the tension of a spring. However, this stage can be supplied with operating buttons on both sides and special slide clips at an increased price; with these additions it is classified as No. 1523 in the price lists.

Combination Plain and Mechanical Stage R

The Combination Plain and Mechanical R Stage is 125mm. square. It is listed as No. 493 for use on the No. 5 Microscope and as No. 494 for use on the No. 3. The mechanical movements are motivated by concentric buttons on horizontal axes. The range of movement is 40mm. x 72mm. with graduations and verniers reading to 0.1mm. The stage is listed with operating buttons on both sides, and with the special Spencer slide clips. The slide clips may be removed from the stage and a large flat plate substituted on which Petri dishes and other large objects may be placed. When used in this manner it can be actuated by the mechanical adjustments in both directions.

Circular Revolving Mechanical Stage V

This Circular Revolving Mechanical V Stage No. 1531 is 150mm. in diameter and is made of vulcanized rubber on a bronze foundation. Centering screws are provided to bring the center of revolution coincident with the optical axis of the microscope. It may be locked so that it will not revolve.

The bearing for the to-and-fro movement is in a groove on the surface of the stage. The parts on this groove all remain below the upper surface of the stage; a slide easily passes over them. The buttons operating the two movements are on concentric axes. The to-and-fro movement is 50mm. and the lateral movement is 75mm., with verniers reading to 0.1mm. All the movable parts of the stage are easily removed, and a plate is provided to cover the groove, thus converting it to a plain circular stage. The periphery of the stage is graduated, and, with a vernier, reads to three minutes of arc. Special Spencer slide clips are provided.

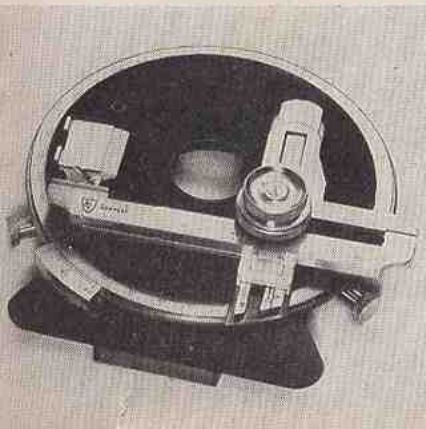
Circular Revolving Mechanical Stage W

The Circular Revolving Mechanical W Stage No. 1532 is 150mm. in diameter. It is provided with centering screws and means for locking it so that it cannot revolve. The buttons for manipulating the stage are on horizontal axes, placed far enough away from other parts to permit easy operation. In other respects, this stage is identical to Stage P, but it is mounted on a circular revolving stage. Buttons are on the right side only and simple slide clips are supplied as standard equipment.

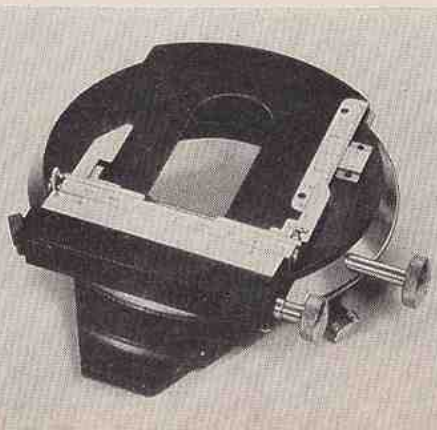
Circular Revolving Mechanical Stage X

The Circular Revolving Mechanical X Stage No. 1540 is similar to Stage W, but is heavier and has additional features that add to its convenience. The operating buttons, on both sides, remain at the same distance from each other and from the optical axes. One becomes accustomed to their fixed position and automatically reaches to the right place for them. The stage has a graduated periphery with a vernier reading to three minutes of arc. When the slide clamps are removed they may be replaced by a large plain stage, which may be used like any plain stage. It may also be actuated by both of the mechanical movements. Special Spencer slide clips are provided.

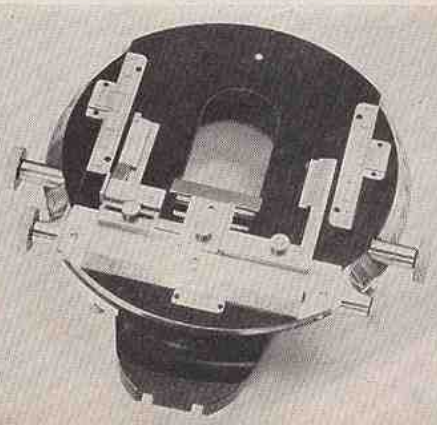
V *Stage*



W *Stage*



X *Stage*





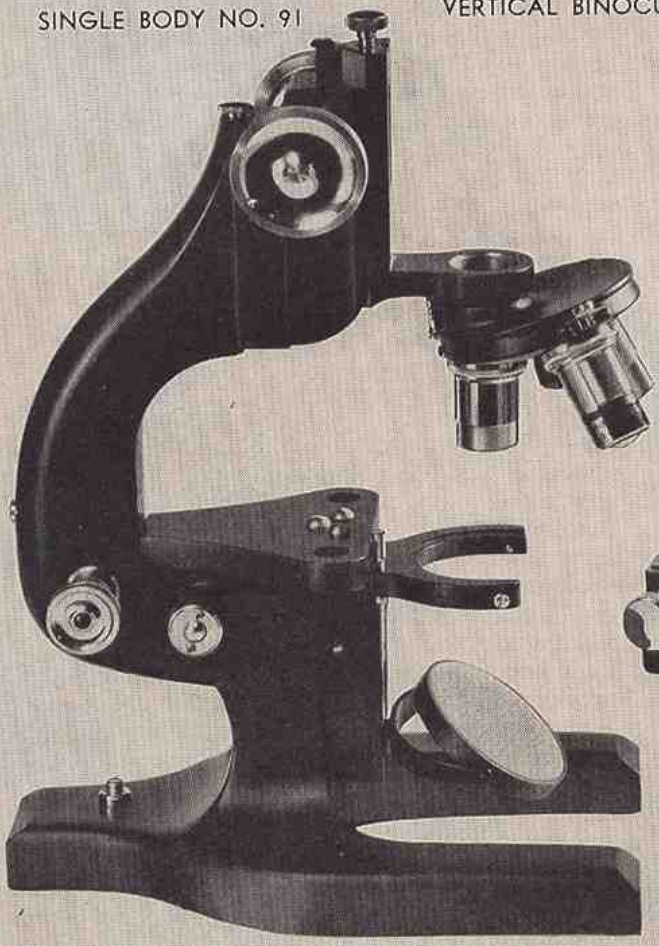
SINGLE BODY NO. 91



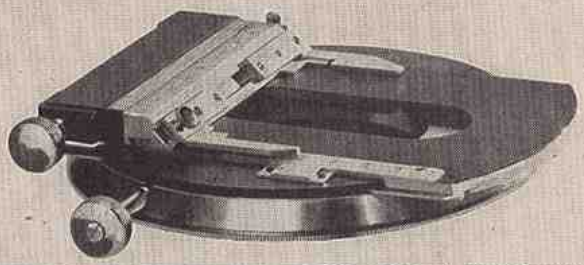
VERTICAL BINOCULAR BODY B



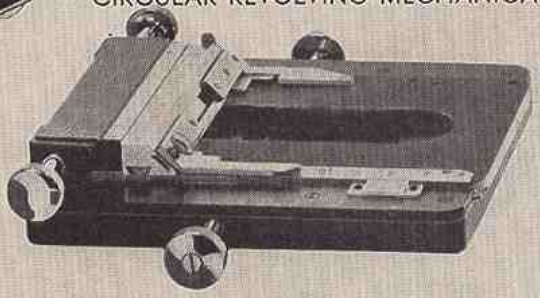
INCLINED BINOCULAR BODY L



RESEARCH MICROSCOPE STAND NO. 3



CIRCULAR REVOLVING MECHANICAL STAGE W



PLAIN AND MECHANICAL STAGE P (Buttons both sides)



SIMPLE SUBSTAGE MOUNTING



COMPLETE SUBSTAGE MOUNTING

Selecting A Research Microscope

Aside from the stands of the Research Microscopes, there are three standard parts, each made in a diversity of forms and offering a broad selection to suit specific needs, or special tastes. We refer to the different styles of body tubes, the large number of stages (plain and combination plain and mechanical), and the choice of different constructions in the substage. The interchangeability of these parts permits a range of choice which the discriminating worker appreciates. The different parts are described and priced separately so that it is possible to calculate the price of a microscope when a substitution or addition of parts is desired.

Each part is designated by its own particular letter and catalog number. The number of each microscope is a combination of the letters of the parts involved; for instance, No. 3LPH Microscope is composed of No. 3 Stand, L Body Tube, P Mechanical Stage, and the H Optical Outfit.

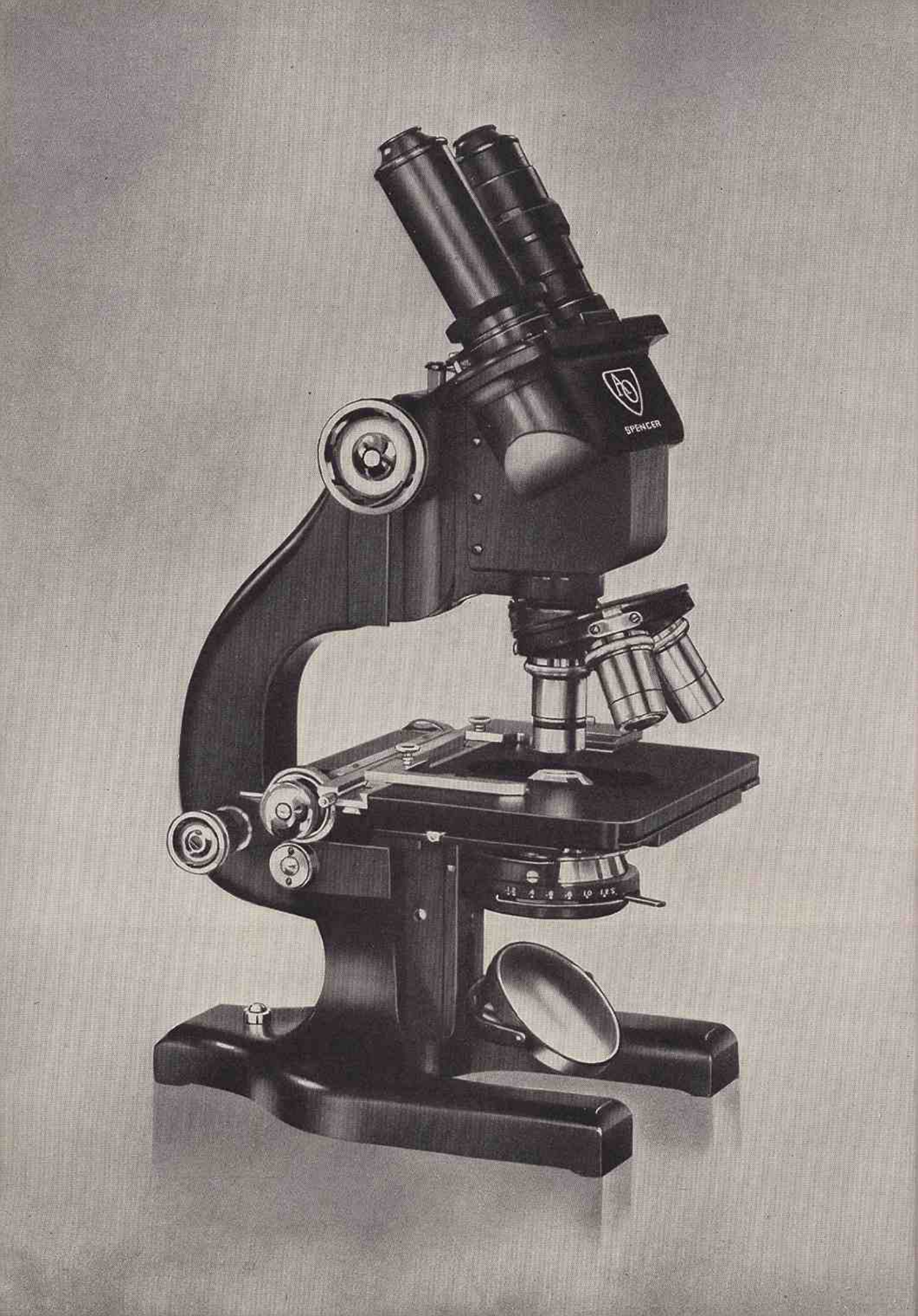
In every instance the outfits include a revolving nosepiece suited to the number of objectives specified.

On microscopes calling for the 4mm. achromatic objective, the N.A. 0.66 objective will be furnished, **but on Microscope No. 5 the N.A. 0.85 objective is supplied.** When specifically requested, the N.A. 0.85 will be furnished on any microscope at the same price. In outfits calling for the 2mm. apochromatic objective, the objective having a numerical aperture of 1.30 will be furnished. If the N.A. 1.40 objective is desired, it may be purchased at the indicated price. An achromatic condenser N.A. 1.30 is standard with all apochromatic equipments on the No. 3 Microscope, and with all equipments on No. 5 Microscope. The Abbe condenser N.A. 1.25 is standard with all achromatic and fluorite equipments on No. 3 Microscope.

The combinations listed above do not represent the complete line of objectives and eyepieces, but are suggested because they are those most often selected for research work. Substitutions and additions may be made to suit the purchaser. By referring to the prices of objectives, eyepieces, condensers, etc., one may arrive at the cost of any optical combination desired.

Optical Outfits

OUTFITS	OBJECTIVES			EYEPIECE POWERS		CONDENSER AND IRIS DIAPHRAGM
	Achromatic	Fluorite	Apochromatic	Huygh enian	Compensating	
H	16-4mm. 1.8mm. oil imm.			6X-10X		Abbe N.A. 1.25
J	16-4mm.	1.8mm. oil imm.		6X-10X		Abbe N.A. 1.25
G Apo.			16-4mm. 2mm. oil imm.		5X-10X	Achromatic
K Apo.			16-8-4mm. 2mm. oil imm.		5X-10X 15X-20X	Achromatic


SPENCER

Spencer No. 3 Research Microscope

The Spencer No. 3 Research Microscope is larger than the Advanced Laboratory and Medical Microscopes, but smaller than the No. 5. It has the low fine adjustment so that the worker's hands remain in close proximity to the other working parts. A rigid connection in the arm leads from the micrometer screw at the base of the arm to the fine adjustment bearing at the top. There is a small knurled button on the top of the arm for regulating the tension in the fine adjustment.

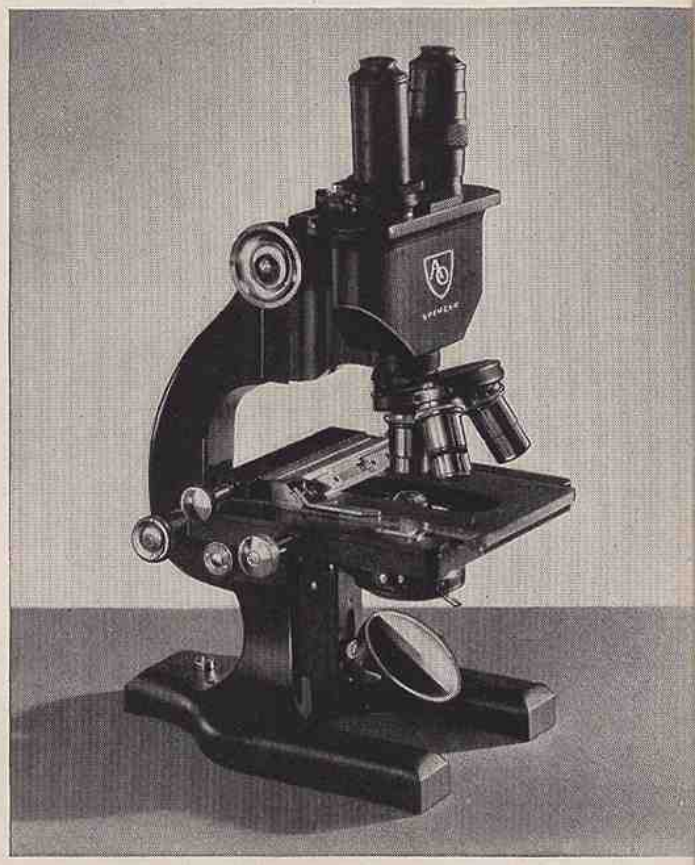
STAND

The stand has a cast brass arm with a standard taper axle inclination joint and a heavy cast iron base that insures stability in all positions.

RACK AND PINION COARSE ADJUSTMENT

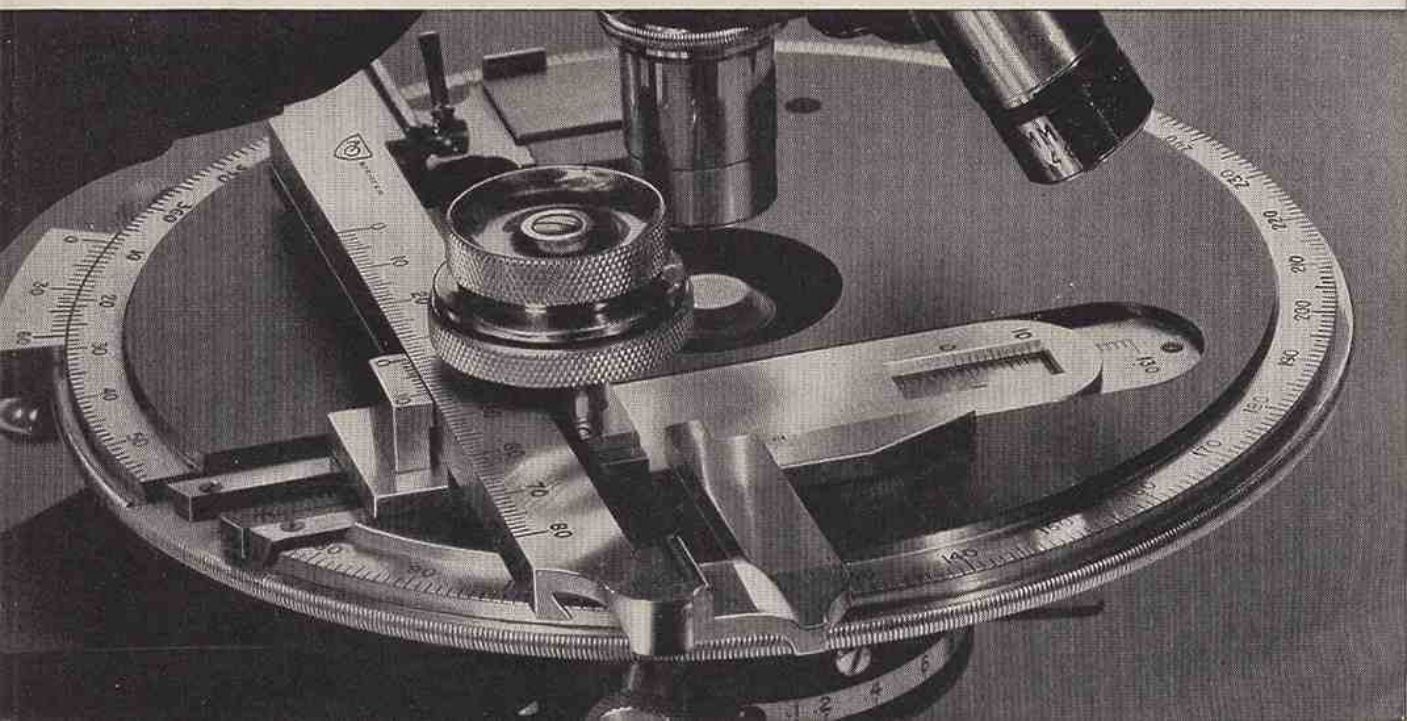
The rack and pinion coarse adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop which is provided prevents breaking the cover glass when focusing with the 16mm. objective.

← *Left: Spencer Research Microscope No. 3LRH.*



Spencer Research Microscope No. 3BPH.

Circular Revolving Mechanical Stage V.



MICROMETER SCREW-TYPE FINE ADJUSTMENT

The fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass. It is graduated in 2.5 micron intervals.

DUAL-CONE NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective provided, unless otherwise specified.

CONDENSER AND SUBSTAGE

An Abbe N.A. 1.25 condenser in the simple substage mount with iris diaphragm, No. 324, is supplied when achromatic and fluorite objectives are specified; but when apochromats are used, the achromatic condenser (N.A. 1.30 or 1.40) is supplied in simple substage mount with iris diaphragm No. 324. **It is recommended that the centerable mount No. 322 be selected in all cases where the achromatic condenser is supplied.** The oblique lighting feature is useful occasionally where difficult resolution is involved. Auxiliary condenser No. 333 is available to slide into the substage when low power objectives are used.

MIRROR

The standard diameter mirror, mounted in a fork for tilting to any desired angle, is concave on one side and plane on the other. It may be removed for cleaning.

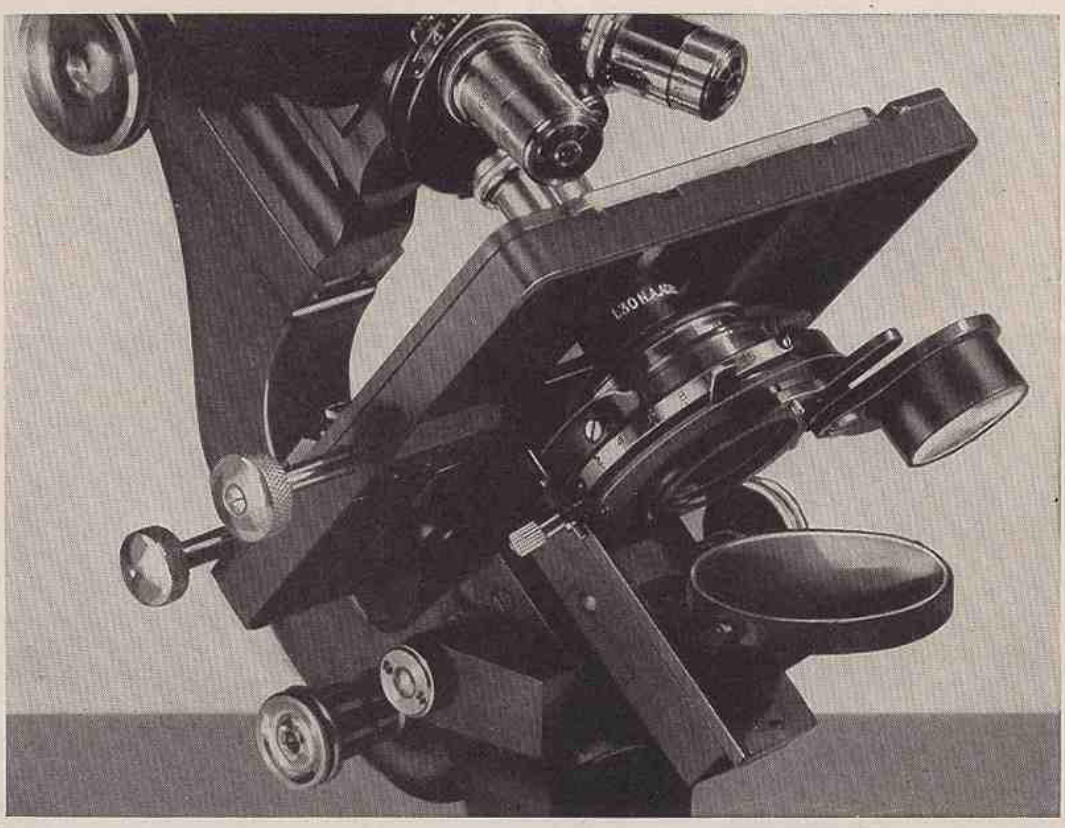
FINISH

The finish is black baked enamel and chromium plating.

CABINET

A leatherette covered hardwood cabinet, with a drawer for accessories, a lock, and plastic boxes for objectives is provided.

Recommended Substage for No. 3 Microscope fitted with achromatic condenser, centerable mount, and auxiliary condenser No. 333.



No. 3 Research Microscope
Suggested Outfits

Cat. No.	Body Tube	Stages	Optical Outfits		
3LSH	L	S		"H" OPTICS	
3LMH	L	M	Objectives	Eyepieces	Condenser
3LPH	L	P	Achromatic	Huyghenian	Abbe
3LRH	L	R	16-4mm.	Paired	N.A. 1.25
3LVH	L	V	1.8mm. N.A. 1.25 oil imm.	6X-10X	
3LWH	L	W			
3LXH	L	X			
3LSG	L	S		"G" OPTICS	
3LMG	L	M	Objectives	Eyepieces	Condenser
3LPG	L	P	Apochromatic	Compensating	Achromatic
3LRG	L	R	16-4mm.	Paired	N.A. 1.30
3LVG	L	V	2mm. N.A. 1.30 oil imm.	5X-10X	
3LWG	L	W			
3LXG	L	X			
3LSK	L	S		"K" OPTICS	
3LMK	L	M	Objectives	Eyepieces	Condenser
3LPK	L	P	Apochromatic	Compensating	Achromatic
3LRK	L	R	16-8-4mm.	Paired 5X-	N.A. 1.30
3LVK	L	V	2mm. N.A. 1.30 oil imm.	10X-15X-20X	
3LWK	L	W			
3LXK	L	X			

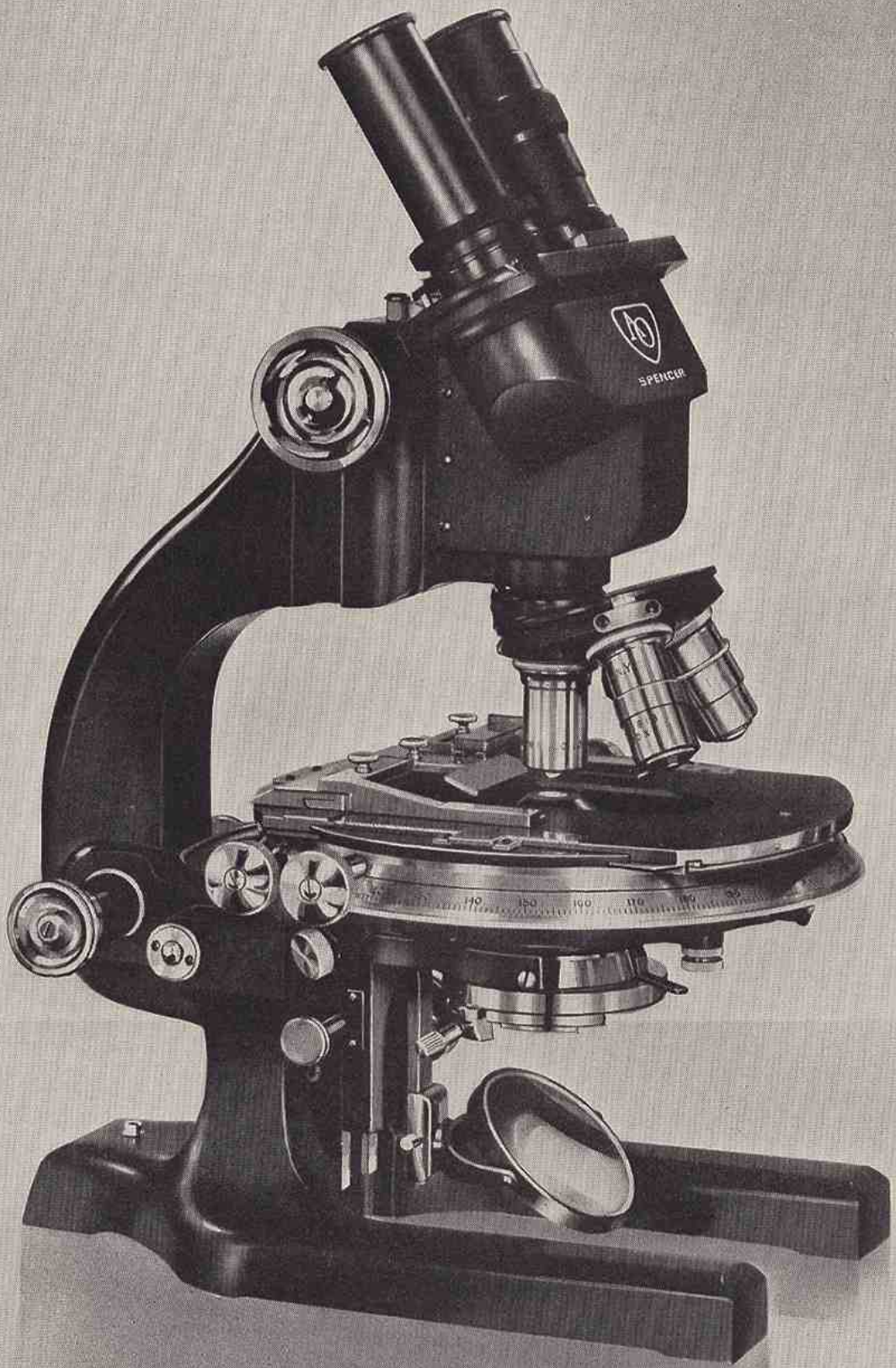
The stages listed above are described on preceding pages.

Prices for above standard catalog outfits will be found in the price supplement to this catalog. Look for the complete catalog number; for example, 3LRK or 3LPH. The prices listed for each No. 3 outfit include: revolving nosepiece to accommodate the number of objectives in the outfit, simple substage, non-centerable condenser mount, iris diaphragm, Abbe condenser with all achromatic and fluorite objective outfits, achromatic N.A. 1.30 condenser with all apochromatic objective outfits, monocular body tube with adjustable draw-tube in addition to binocular body—all complete in a leatherette covered hardwood cabinet with drawer for accessories.

When equipments are selected with achromatic condensers, it is recommended that the centerable mount No. 322 be selected.

If desired, an N.A. 1.40 achromatic condenser may be substituted for the N.A. 1.30 condenser at no change in price.

A vertical binocular body tube may be selected instead of the inclined type at the price indicated in the price supplement. In this case the letter "L" in the catalog number is omitted and the letter "B" substituted; for example, 3BPH.


SPENCER

Spencer No. 5 Research Microscope

The Spencer No. 5 Research Microscope larger and heavier than the No. 3 or Medical and Laboratory Microscopes, is designed for the most critical research work. Both the base and the arm are larger than the No. 3. It has the low fine adjustment so that the worker's hands remain in close proximity to the other working parts. A rigid connection in the arm leads from the micrometer screw at the base of the arm to the fine adjustment bearing at the top. There is a small knurled button on the top of the arm for regulating the tension in the fine adjustment.

In addition to overall size, No. 5 differs from No. 3 in the following respects:

1. A different leverage in the fine adjustment mechanism gives a graduation value of one micron.
2. The substage fork is controlled by a fine adjustment as well as a coarse adjustment.
3. The complete substage has centering screws and an oblique light control.
4. A mounted auxiliary lens, to raise the focal point for hanging drop work or low power objectives, slides into the substage slot.
5. A mount is included for holding an objective in place of the substage condenser for certain types of work.
6. The mirror is mounted on a slide so that its distance below the substage may be controlled.

STAND

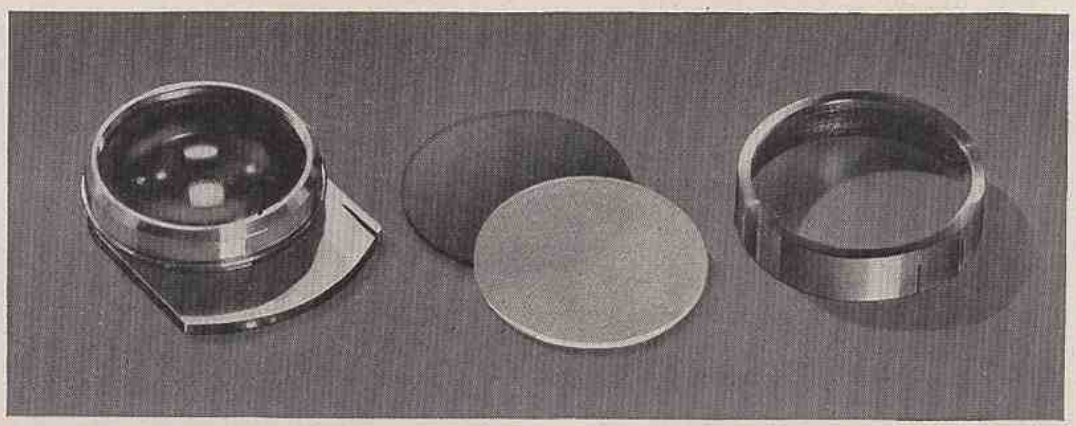
The stand has a cast brass arm with a standard taper axle inclination joint and a heavy cast iron base that insures stability in all positions.

RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop which is provided prevents breaking the cover glass when focusing with the 16mm. objective.

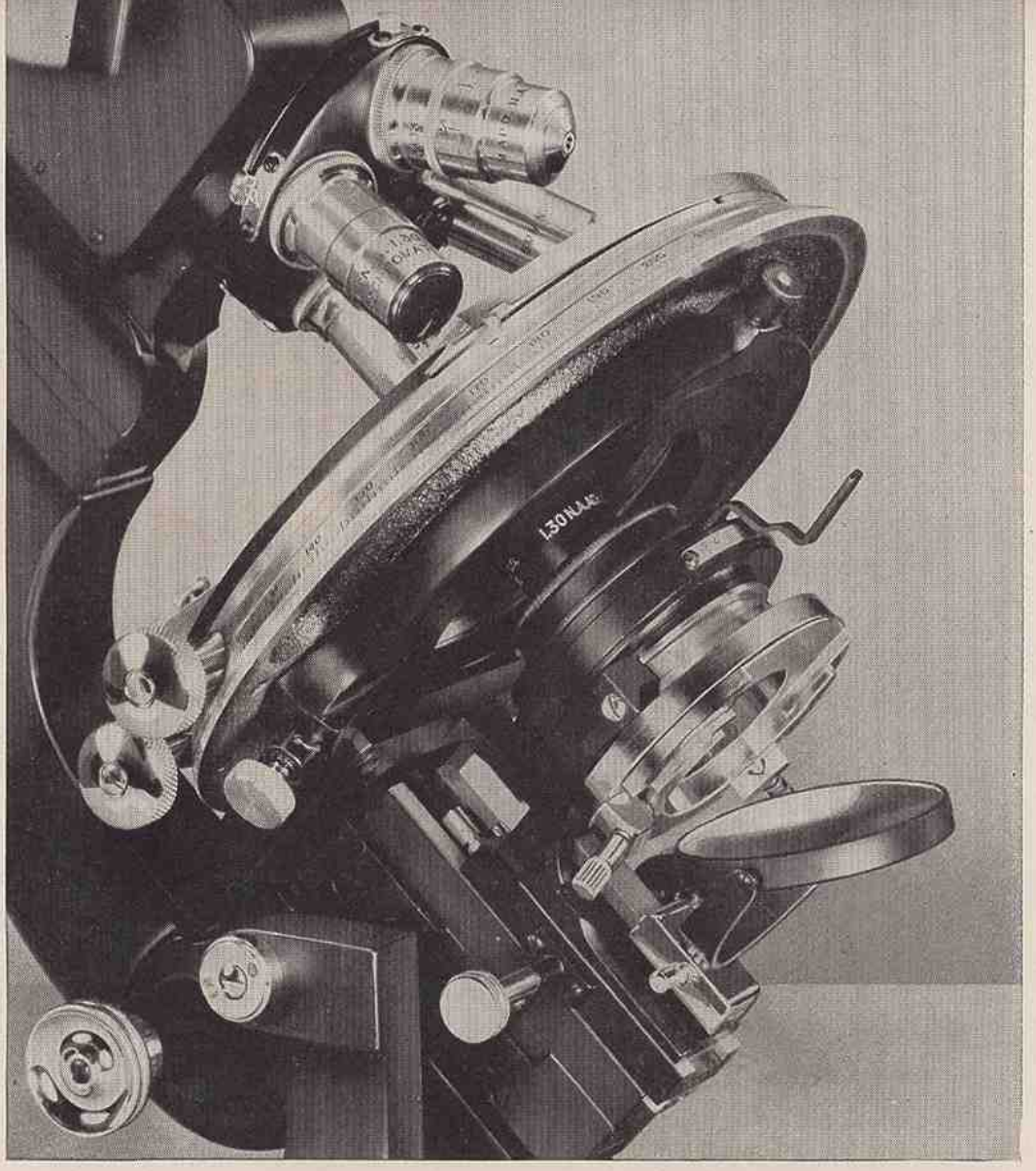
MICROMETER SCREW-TYPE FINE ADJUSTMENT

The fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass. It is graduated in intervals of one micron.



Auxiliary Substage Condenser for No. 5 with blue glass and ground glass.

Left: Spencer Research Microscope No. 5LXK.



Complete Research Substage on Microscope No. 5.

DUAL-CONE NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective provided, unless otherwise specified.

CONDENSER AND SUBSTAGE

An achromatic condenser is supplied with the complete research substage. The numerical aperture will be 1.30 or 1.40 depending on the numerical aperture of the objectives included in the equipment. An auxiliary lens is included to raise the focal point of the condenser in order to illuminate properly the entire field of a low power objective. The centering mechanism of the condenser and iris is substantial, with heavy screws, so that the condenser is easily brought into accurate alignment with the rest of the optical system. The oblique light feature is independent of the iris diaphragm and is useful occasionally where difficult resolution is involved. A fine adjustment for the condenser, operating in the same manner as does the fine adjustment on the arm, is very important for critical work.

MIRROR

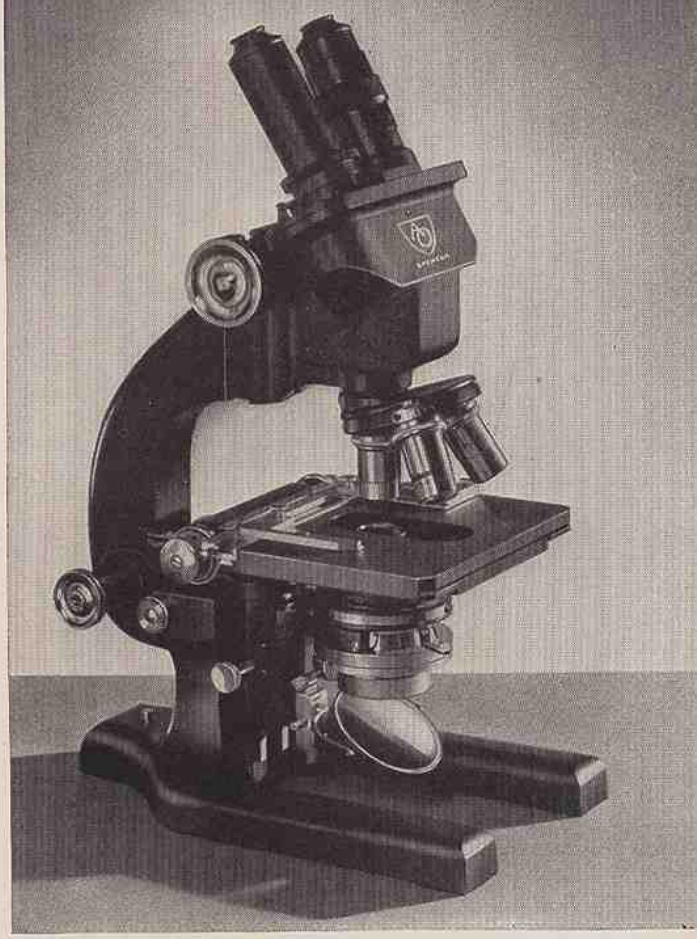
The standard diameter mirror, in a fork for tilting to any desired angle and on a sliding mount, is concave on one side and plane on the other. It may be removed for cleaning.

FINISH

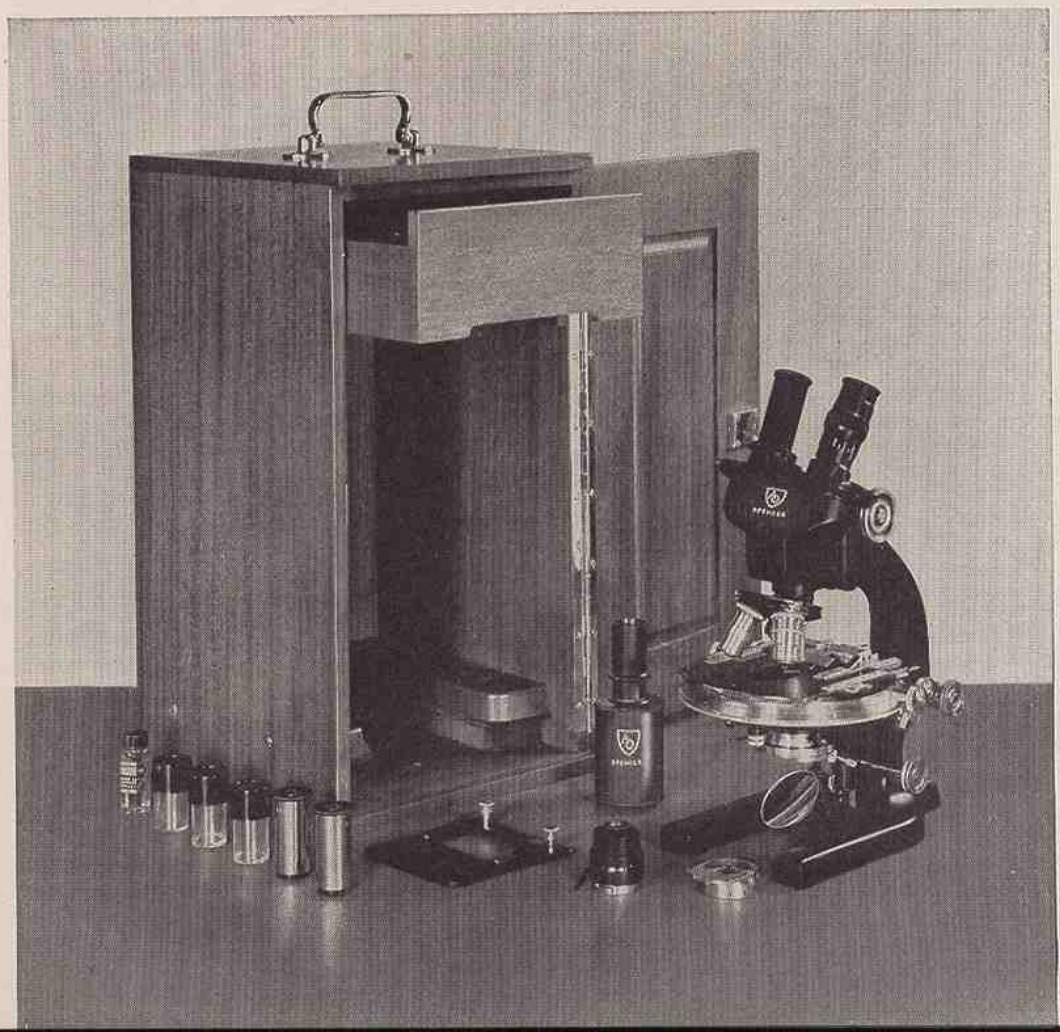
The finish is black baked enamel and chromium plating.

CABINET

A polished hardwood cabinet with a drawer for accessories, a lock, and plastic boxes for objectives is provided.



Spencer Research Microscope No. 5LRH.



Cabinet with drawer for accessories, standard equipment with No. 5 Research Microscope.

No. 5 Research Microscope
Suggested Outfits

Cat. No.	Body Tube	Stages	Optical Outfits		
			"H" OPTICS		
5LPH	L	P	Objectives	Eyepieces	Condenser
5LRH	L	R	Achromatic	Huyghenian	Achromatic
5LVH	L	V	16-4mm.	Paired	N.A. 1.30
5LWH	L	W	1.8mm. N.A. 1.25 oil imm.	6X-10X	
5LXH	L	X			
			"G" OPTICS		
5LPG	L	P	Objectives	Eyepieces	Condenser
5LRG	L	R	Apochromatic	Compensating	Achromatic
5LVG	L	V	16-4mm.	Paired	N.A. 1.30
5LWG	L	W	2mm. N.A. 1.30 oil imm.	5X-10X	
5LXG	L	X			
			"K" OPTICS		
5LPK	L	P	Objectives	Eyepieces	Condenser
5LRK	L	R	Apochromatic	Compensating	Achromatic
5LVK	L	V	16-8-4mm.	Paired 5X-	N.A. 1.30
5LWK	L	W	2mm. N.A. 1.30 oil imm.	10X-15X-20X	
5LXK	L	X			

The stages listed above are described on preceding pages.

Prices for above standard catalog outfits will be found in the price supplement to this catalog. Look for the complete catalog number; for example, 5BRH or 5LXK. The prices listed for each No. 5 outfit include: revolving nosepiece to accommodate the number of objectives in the outfit; complete research substage with fine adjustment, centerable condenser mount, iris diaphragm, oblique light unit, achromatic N.A. 1.30 condenser, auxiliary condenser, ground glass and blue glass filters; monocular body tube with adjustable draw-tube in addition to binocular body—all complete in polished hardwood cabinet with drawer for accessories.

If desired an N.A. 1.40 achromatic condenser may be substituted for the N.A. 1.30 at no change in price.

A vertical binocular body tube may be selected instead of the inclined type at the price indicated in the price supplement. In this case the letter "L" in the catalog number is omitted and the letter "B" substituted; viz., 5BRH.

The 4mm. N.A. 0.85 achromatic objective is supplied on the No. 5 Microscope when "H" optics are selected. The higher numerical aperture is desirable for critical studies under high dry magnification. If, however, it is intended that blood count work will be done, it is essential that a 4mm. N.A. 0.66 objective be specified in order to focus through the cover glass on a haemacytometer.

Microscope Accessories

The outstanding optical performance of modern microscope objectives has been achieved through excellence of optical design, the use of select materials and painstaking workmanship in construction.

Since single lenses with spherical surfaces can provide only an imperfect optical image, it is necessary to overcome the defects or aberrations of single lenses by constructing optical systems which consist of more than one lens. It is the task of the optical designer to discover those combinations of lenses: the radii, thicknesses, separations and glasses of a system which form the most perfect optical image.

The degree of perfection of an optical image is judged by the crispness of the definition in the image, the resolving power of the lens system, which is the power to reveal objects close together as separate objects, and finally, by the contrast by which the details of the object are reproduced.



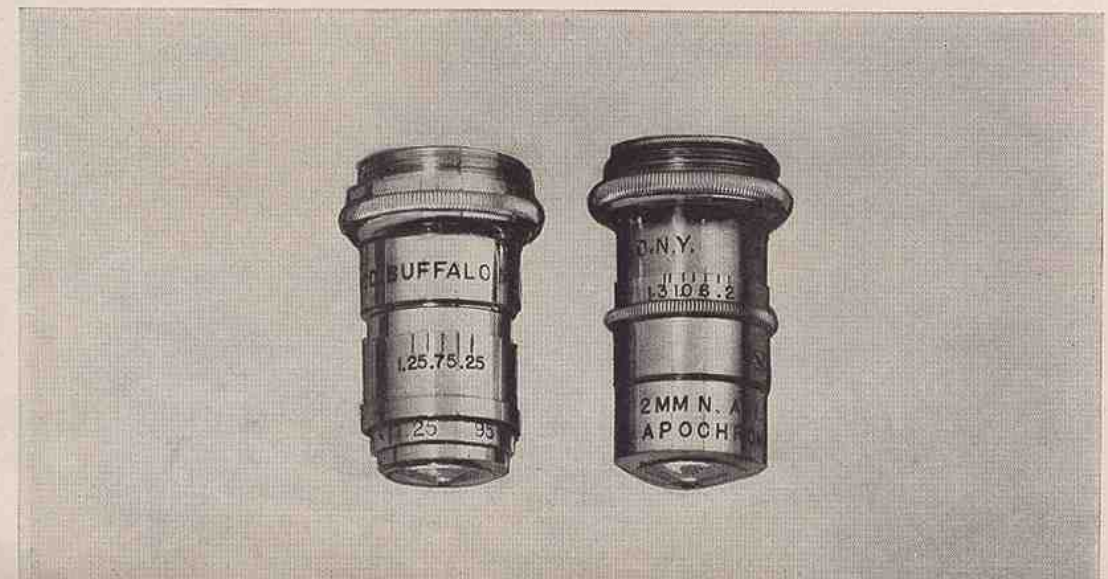
Spencer Optics

The definition of the lens system depends primarily on its image-forming qualities. Its optimum is reached if all the rays from a point on the object are refracted to one and the same point in the image, and if this is true for all other points in the object. Furthermore, this condition should be satisfied for rays of different color, which is called correction for chromatic aberration. By a careful mathematical analysis of the refractive action of lenses on the light rays, it is possible to select lens combinations in which this ideal is very nearly reached. The methods of the optical designer to solve this difficult mathematical problem form a special and extended field in the science of optics, the so-called Geometrical or Ray Optics. Many outstanding physicists and mathematicians from all countries have felt the challenge of the optical design problem and have given consideration to its successful solution. Since the days of the first American microscope builder, Charles Spencer, this organization has kept in close contact with the science of geometrical optics and contributed to its progress. The prime importance of this science for continuous development of superior and efficient methods in optical design has contributed to the improvement of the performance of microscopes.

It is true that the resolving power of the microscope and the contrast within the image depends on the perfection of the definition. Maximum resolving power can only be obtained if the image-focusing action of the lens is flawless. However, even when the definition is perfect we cannot reach an unlimited resolution of objects, since an insurmountable boundary is set by nature through the finite wave length of light. As a consequence of the wave theory of light, one finds that the light energy which is radiated from a point source never can be concentrated again by lenses in one given image point, even if the image-focusing action of the lens is perfect. Instead of a point image, a diffraction disc of finite dimensions is seen whose dimensions cannot be smaller than a certain fraction of the wave length of light. This causes a limit of the resolution which can be shown by the formula $\gamma = \frac{\lambda}{2NA}$ where NA is the numerical aperture of the objective.

This limit is considerably greater if the lens system is not completely corrected and the resolving power is considerably impaired. For a full understanding and

Objectives with Iris Diaphragm:
left, 1.8mm. achromat; right, 2mm. apochromat.



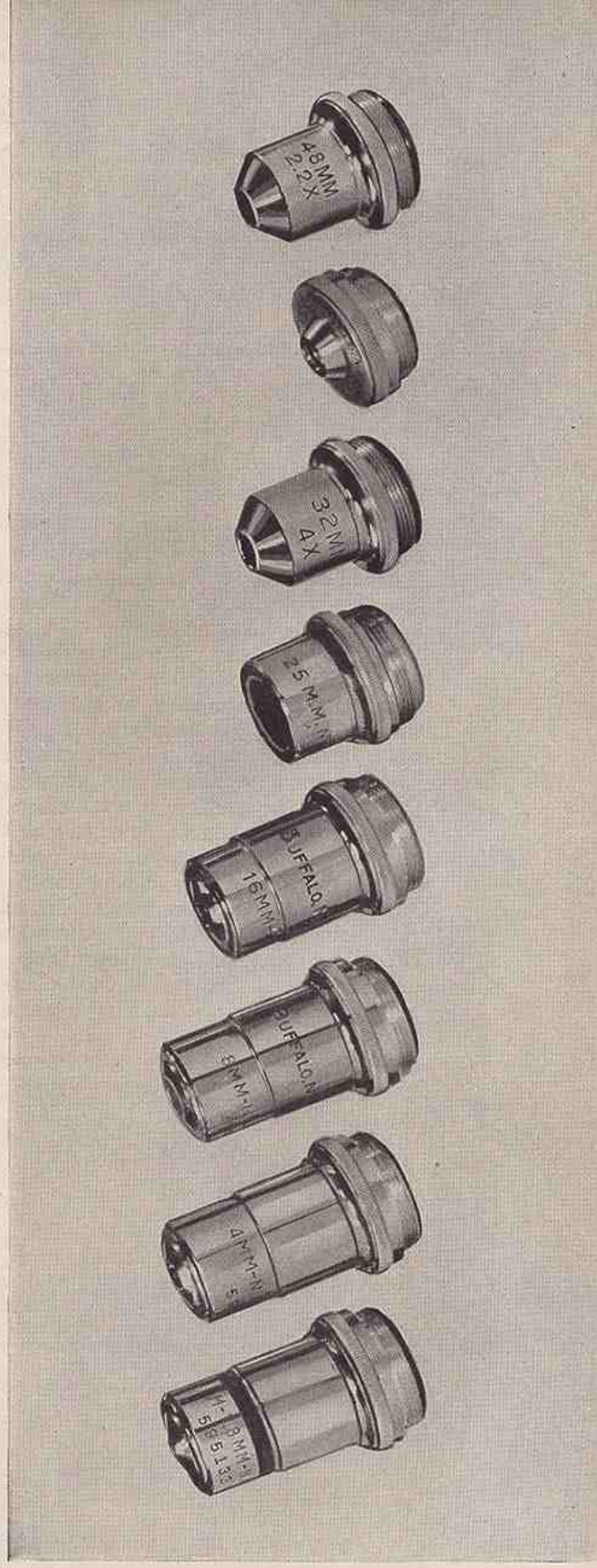
judgment of the perfection of a lens, the designer therefore has to employ, in addition to methods based on geometrical optics, other methods derived from wave optics. This knowledge of wave optics plays an especially important part in the determination of tolerances for which the lens system should be manufactured.

Recent results in the wave optical interpretation of the image have demonstrated the influence which the construction of the lens may have on the contrast of the details in the image. The aim of obtaining images of maximum contrast then represents an additional problem in the improvement of microscopes. Work on this problem has provided us with instruments which have set new standards of performance, and continuing research should lead to even better optical designs in the future.

The materials available for the use of the optical designer have grown in number and quality. Charles A. Spencer made his own optical glass during the middle of the 19th century. He also used natural materials such as fluorite. Optical glass manufacture was developed greatly in Europe during the latter half of the century and was taken up again by Americans during the First World War. We met our needs during this period by establishing an optical glass plant at Hamburg, N. Y.

For many years fine optical glass has been available from several sources in the United States as well as Europe, and the optical designer has had a rapidly growing choice of refractive indices and dispersions. New, unusual glasses have been made from rare oxides and are available to AO lens designers.

Good workmanship interprets careful design and proves the work of the designer. Experimental lenses are made and tested to check every new design, to see that it fulfills its purpose and to determine if it can be produced economically. Good workmanship is revealed in the uniformity of the lenses and mountings. Like lenses are interchangeable optically as well as mechanically. An exhaustive inspection routine guards the quality of Spencer instruments and accessories. The centering, spacing, parcentering and parfocalizing of AO Spencer objectives are examples of good workmanship.



Achromatic Objectives, top to bottom: 48mm., 30.2mm., 32mm., 25mm., 16mm., 8mm., 4mm., 1.8mm.



Apochromatic Objectives, left to right: 16mm., 8mm., 4mm., 3mm. N.A.1.30, 3mm. N.A.1.40, 2mm. N.A.1.40.

Spencer Microscope Objectives

Apochromatic Objectives

Of all types of microscope objectives, the apochromats represent the closest approach to perfect definition. The most common defects in microscope objectives are the failure of light of different wave lengths of the spectrum to focus at the same point (Chromatic aberration) and the failure of light entering different zones of the lens to focus at the same point (Spherical aberration). These defects are overcome to a remarkable degree in apochromats, which are corrected chromatically for three colors of the spectrum, and spherically for two; whereas in the achromatic objectives the corrections are limited to two colors and one respectively. The natural crystal fluorite is used to make some of the lens elements. With glass alone it is not possible to obtain the necessary corrections.

Apochromats are used for the most critical microscopy, both for visual work and for photomicrography. They are especially useful in photomicrography, where color is to be reproduced.

Because of the greater perfection of axial color correction in apochromatic objectives, the oblique color error is of necessity somewhat greater. To compensate for this residual color error, it is necessary to use these objectives in combination with compensating eyepieces. A microscope having an optical system with apochromatic objectives and compensating eyepieces must also have an achromatic condenser to obtain the best possible performance.

Cat. No.	Equiv. Focus mm.	Initial Magnification	Type	Numerical Aperture	Working Distance in mm.
150	16	10	dry	0.30	5.2
152	8	20	dry	0.60	0.75
154*	4	44	dry	0.95	0.20
156*	3	60	dry	0.95	0.16
161	3	60	oil imm.	1.30	0.20
162	3	60	oil imm.	1.40	0.17
158	2	90	oil imm.	1.30	0.10
1299**	2	90	oil imm.	1.30	0.10
159	2	90	oil imm.	1.40	0.05
160	1.5	120	oil imm.	1.30	0.08

*Furnished in collar adjustment mounts.
**With iris diaphragm.



Fluorite Objective

Fluorite Semi-Apochromatic Objectives

The fluorite objectives occupy a position between apochromatic and achromatic objectives in performance and cost. They are

used where the extremely fine correction of apochromats is not required. Their moderate cost is the result of their construction, which is similar to that of the achromatic objectives, with some lenses of fluorite crystal used instead of glass.

Cat. No.	Equiv. Focus mm.	Initial Magnification	Type	Numerical Aperture	Working Distance in mm.
130	1.8	97	oil imm.	1.30	0.10

Achromatic Objectives

Spencer achromatic objectives have been developed to obtain optimum resolving power and definition with simple, economical construction. Their chromatic and spherical corrections are so adjusted that the image is remarkably crisp and free from color.

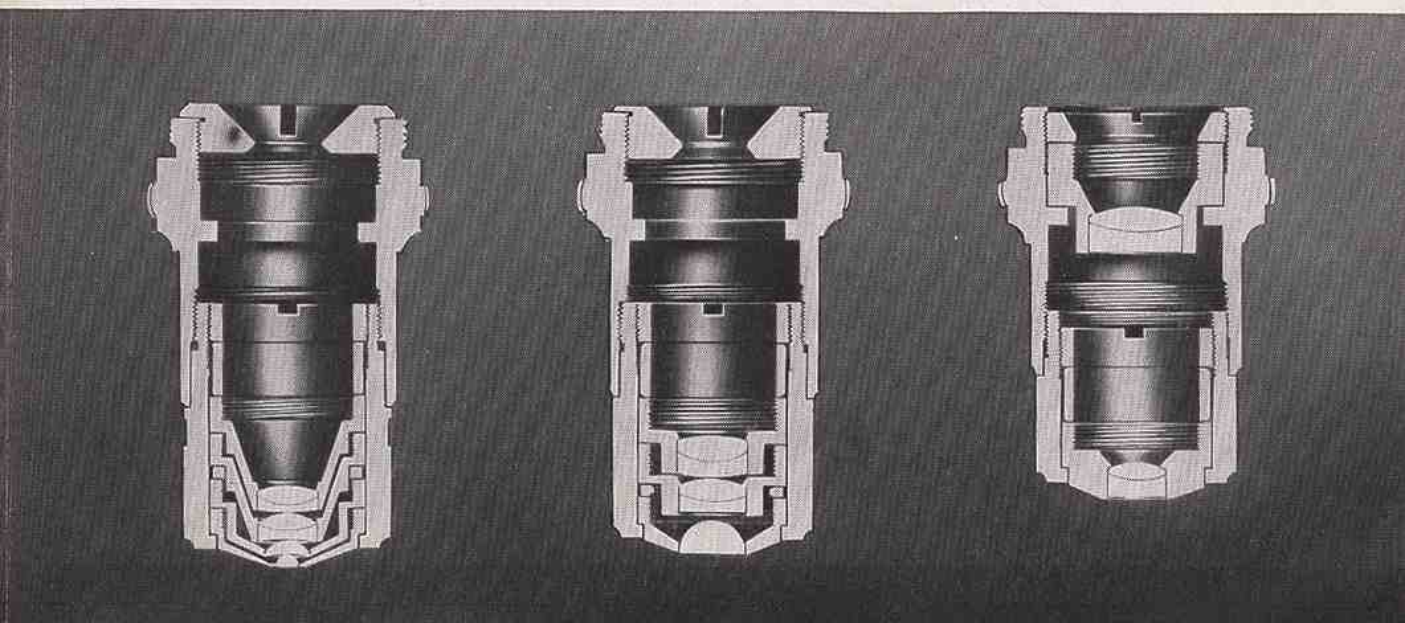
Achromatic objectives are used for most microscopic work, both visual and photographic, in which extremely critical optical performance is not required. The consistently fine performance of Spencer achromatic objectives is universally recognized, and is a result of their excellence of design and construction.

The following listing of objective specifications will help you to select the most suitable optics for your work.

Cat. No.	Equiv. Focus mm.	Initial Magnification	Type	Numerical Aperture	Working Distance in mm.
101	48	2.2	dry	0.08	52.5
102	40	2.8	dry	0.08	35.2
104	32	4.0	dry	0.10	21.0
105	30.2	3.5	dry	0.09	24.1
106	24	3.5	dry	0.08	4.2
107	25	5.1	dry	0.17	21.0
108*	16,32	10,4	dry	0.25,0.10	4.5,21
112	8	20	dry	0.50	1.44
115	4	44	dry	0.66	0.63
118	4	45	dry	0.85	0.20
122	3	60	dry	0.85	0.20
127	1.8	95	oil imm.	1.25	0.13
1292**	1.8	95	oil imm.	1.25	0.13

*Separable objective screw mounting.
**With Iris diaphragm.

Construction of Spencer Objectives, left to right: 1.8mm., 4mm., 16mm.



Spencer Microscope Eyepieces

Huyghenian Eyepieces

Huyghenian Eyepieces are usually supplied for visual work and are standard equipment of High School, Laboratory and Medical Microscopes. They contain two plano-convex lens elements. The focal plane is between these lenses and the diaphragm provides a convenient holder for reticules or scales used when counting or measuring details in the field.

SINGLE			PAIRED		
Cat. No.	Power	Price	Cat. No.	Power	Price
136	5X		1136	5X	
138	6X		1138	6X	
140	8X		1140	8X	
142	10X		1142	10X	
143	16X		1143	16X	
144	12X		1144	12X	

Wide Field Eyepieces

Wide Field Eyepieces for use with compound microscopes provide a large field. They are especially appreciated by pathologists and clinicians for routine examination of blood and bacterial smears. The corrections attained by additional lenses in the eyepieces permit the use of a larger diaphragm in the eyepiece, thus providing a larger field.

SINGLE			PAIRED		
Cat. No.	Power	Price	Cat. No.	Power	Price
135	10X		1135	10X	
137	15X		1137	15X	
139	20X		1139	20X	

Ramsden Eyepieces

Ramsden Eyepieces are particularly well suited optically for the use of scales or reticules for measuring or counting. Paired Ramsden Eyepieces are often included in the Junior Stereoscopic Microscopes. They can be used with achromatic or fluorite objectives.

SINGLE			PAIRED		
Cat. No.	Power	Price	Cat. No.	Power	Price
177	6X		1177	6X	
178	10X		1178	10X	
179	15X		1179	15X	

Compensating Eyepieces

In apochromatic objectives the oblique color error is not corrected to the same degree of perfection as is the axial color. The compensating eyepieces have been designed to compensate for the residual oblique color of apochromatic objectives. Because of their higher degree of correction, compensating eyepieces are frequently used in making photomicrographs with achromatic objectives.

SINGLE			PAIRED		
Cat. No.	Power	Price	Cat. No.	Power	Price
165*	8X		1165*	8X	
166	5X		1166	5X	
167*	10X		1167*	10X	
168	10X		1168	10X	
169	12X		1169	12X	
170	15X		1170	15X	
172	20X		1172	20X	
174	30X		1174	30X	

*High Eye Point

Four types of eyepieces, left to right: Huyghenian, Wide Field, Ramsden, Compensating.



Screw Micrometer Eyepiece

This micrometer eyepiece represents the highest type of precision in construction and guarantees the greatest possible precision of measurement. Instead of the visual cross hairs, a finely-ruled glass scale is used, the center line of which is replaced by a V. This V serves in the usual way as a reference point for the scale. Each interval in the scale is exactly equivalent to one revolution of the screw which moves it; fractions of a revolution of this screw are indicated by a drum graduated into 100 parts. The drum may be rotated on the screw axis to adjust its zero reading to any required position. This system has important advantages, especially in the measurement of large objects. Unlike other micrometers, it does not require the traversing of the index over the entire length of the object, as a fraction of one rotation of the screw is all that is ever necessary.

In measuring the length of an object, the scale is moved until one of the millimeter lines coincides with the margin of the object under examination; and then, by noting the amount of revolution necessary to bring another line into coincidence with the opposite side, the fractional part of the last division can be read to hundredths.



Catalog No. 425 Micrometer Eyepiece.

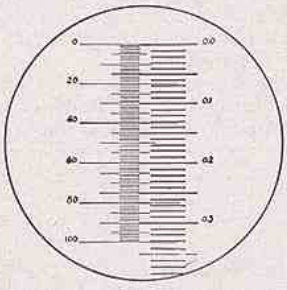
The scale has thirty divisions, with every fifth division indicated by a numbered line of double length.

Cat. No.	Description	Price
425	Micrometer Eyepiece, 10X.....	

Method of Calibrating Micrometer Discs for Eyepieces

All of the scales placed in the eyepieces have arbitrary length, and the apparent length depends on the magnification. Consequently, each scale has to be calibrated for use with each combination of objective and eyepiece. To calibrate, focus on a stage micrometer and move it until one of the graduations corresponds exactly with one of the divisions of the eyepiece micrometer.

The true distance (x) seen on the stage micrometer, which corresponds to the number of divisions (y) of the eyepiece micrometer, is then read, and dividing this true distance by the number of divisions of the eyepiece micrometer, we find the distance each one subtends: ($c = x/y$). The number of divisions covered by the specimen, multiplied by the calibration constant (c) gives the length of the specimen. Once an eyepiece micrometer has been calibrated, it need not be recalibrated when used with the same eyepiece, the same objective and the same tube length. If the tube length of the microscope with adjustable draw tube is changed, these values change proportionally, and this may bring the values of the eyepiece scale to an even value. A slight movement of the draw tube causes little loss of definition, but any change in tube length from the correct value of 160 mm. increases the spherical aberration (and reduces the definition). If small details need not be resolved a certain amount of distinctness in the image may be sacrificed for convenience in calibrating the eyepiece scale.



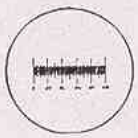
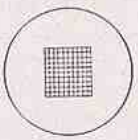
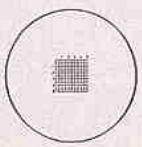
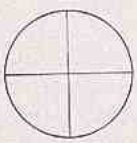
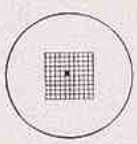
Calibration of Eyepiece Reticule.

Measuring and Counting Accessories

Micrometer discs and reticules are glass discs having finely etched scales. They are placed in the microscope eyepiece for the purpose of measuring or counting objects viewed through the microscope or to limit the field observed.

Spencer discs are supplied in two diameter sizes. The 20.0mm. discs fit old style Huyghenian eyepieces in which the flange of the diaphragm turns up, and also the eyepieces of Spencer Stereoscopic Microscopes. The 21.15 diameter discs fit Spencer Huyghenian eyepieces (as well as B. & L., Leitz, and Zeiss) in which the flange of the diaphragm turns down. The 21.15 diameter discs are also suitable for the Ramsden and Wide Field eyepieces listed for compound microscopes.

The linear value of the graduations on a micrometer disc must be determined for each combination of objective and eyepiece with which it is used. The Catalog No. 400 Stage Micrometer provides an accurate scale for determining these values.

Illustrations	Cat. No.	Name	Diam. in mm.	Ruling	Price
	405	Micrometer Disc	21.15	5mm. scale divided into 50 parts	
	410	Micrometer Disc	21.15	5mm. scale divided into 100 parts	
	1405	Micrometer Disc	20.0	5mm. scale divided into 50 parts	
	1410	Micrometer Disc	20.0	5mm. scale divided into 100 parts	
	1406	Micrometer Disc	20.0	10mm. scale divided into 100 parts	
	1407	Micrometer Disc	20.0	10mm. scale divided into 200 parts	
	1408	Reticule (Net Micrometer)	20.0	10mm. square divided into 100 1mm. squares	
	1409	Reticule (Net Micrometer)	20.0	10mm. square divided into 400 .5mm. squares	
	1421	Reticule (Net Micrometer)	20.0	5mm. square divided into 25 1mm. squares	
	422	Reticule (Net Micrometer)	21.15	5mm. square divided into 100 .5mm. squares	
	427	Cross Hair Disc	21.15		
	1427	Cross Hair Disc	20.0		
	416	Whipple Micrometer Disc	21.15	For use with 10X Huyghenian eyepiece Used with 16mm. objective for counting dust particles, or with higher power objectives for other counts. Each quarter of large 7.0mm. square divided into 25 smaller squares, one of which is subdivided into 25 still smaller ones.	
	472	Spanner Wrench for diaphragms of Nos. 184, 186 and 187 eyepieces.			

Howard Mold Count Equipment

These accessories are especially designed for determination of mold content in food products, although they can be adapted to other uses.

Mold Count Discs are ruled into squares, each of which is equal to 1/6 the diameter of the field. The microscope must be calibrated with disc in place to give field diameter of 1.382mm.

The counting chamber is of standard one-piece construction and is supplied with two cover glasses.

Catalog No.	Description	Price
413	Howard Mold Count Disc, 21.15mm. diameter for use in No. 142 Huyghenian eyepiece, 10X	
1413	Howard Mold Count Disc, 20.0mm. diameter for use in No. 142 Huyghenian eyepiece, 10X	
417	Howard Mold Counting Chamber (used with No. 413)	
418	Cover Glass 1.0mm. thick for Howard Mold Counting Chamber	
419	Cover Glass .6mm. thick for Howard Mold Counting Chamber	

Stage Micrometer

The Spencer Stage Micrometer is a rectangular glass slide with a photographic scale (2mm. long, divided into 200 parts). This accessory is used for calibrating any of the eyepiece micrometer discs and for measuring field size. A simple method of calibrating eyepiece micrometers is described on preceding pages.



Scale of No. 400 Stage Micrometer. Magnification approximately 28X.

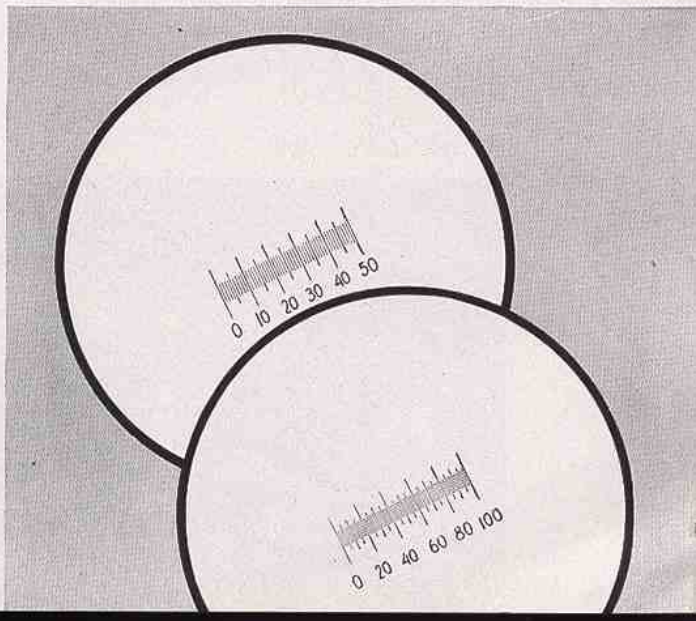
Cat. No.	Description	Price
400	Stage Micrometer with 2mm. scale divided into units of 0.01mm	

Micrometer Eyepieces — Fixed Scale

The eye lens of a micrometer eyepiece is focusable by spiral action so that the micrometer scale can be brought into sharp focus. The micrometer disc is screwed to the focusing sleeve and is so designed that it can be removed quickly and easily for cleaning.

Cat. No.	Description	Price
415	Micrometer eyepiece 6X, 5mm. scale divided into 50 parts	
420	Micrometer eyepiece 10X, 5mm. scale divided into 100 parts	

Scale of Micrometer Eyepiece No. 415; below, Scale of Micrometer Eyepiece No. 420.





Five substage condensers are available. Any one of these may be purchased in any one of the three mounts illustrated below them. Left to right: Abbe N.A.0.66, Abbe N.A.1.25, Wide Angle N.A.1.40, Achromatic N.A.1.30, Achromatic N.A.1.40. The mounts shown, containing iris diaphragms, are for use on Spencer Fork-Type Substages. Left to right: Non-centerable; Centerable; Centerable with Oblique Light Feature.

Spencer Microscope Condensers

Microscope condensers and the mounts that hold them are listed separately. The type of mount to order is determined by the construction of the microscope and by the facilities needed, such as centering and oblique light.

Most Spencer Laboratory and Research Microscopes have the fork-type substage construction and any fork-type mount can be used.

When purchasing a mount for a microscope with a substage ring (either quick screw, rack and pinion, or spiral focusing) the outside diameter of the mount should be specified.

Consult the chart on the opposite page for catalog numbers of mounts for various condensers.

Spencer Microscope Condensers Nos. 306 and 311 are ideal when only the lower medium powered objectives are used. Their numerical aperture of 0.66 provides full illumination for objectives up to the 4mm. and saves the re-focusing that would be necessary if a high aperture condenser were used.

The Spencer Nos. 302 and 304 Abbe-type condensers have a numerical aperture of 1.25. These condensers contain two lens elements and are the ones supplied as standard equipment on medical microscopes. With the top element in place it will illuminate fully the aperture of all objectives from the 1.8mm. oil immersion to the 16mm. low power. The top element can be easily removed, increasing the area of illumination so that the field of long focal length or low power objectives can be illuminated evenly.

The Spencer No. 305 wide angle condenser is a three-lens system. It has a numerical aperture of 1.40 and is an efficient, inexpensive condenser for use with high aperture objectives.

In conformity with the policy of offering the best possible equipment for each individual problem, two achromatic condensers are offered. They are fully aplana-

Left to right: Condensers N.A.1.25, N.A.0.66, and the No. 325 Iris Diaphragm Ring Mount for these condensers.



tic as well as achromatic, and manufactured to the same standard as Spencer objectives. Microscopes using apochromatic objectives and compensating eyepieces must always be illuminated with an achromatic-aplanatic condenser to obtain the full benefit of the highly corrected system.

The Spencer No. 320 achromatic-aplanatic condenser N.A. 1.40 always should be used with an objective having a numerical aperture greater than 1.30.

The Spencer No. 315 N.A. 1.30 achromatic-aplanatic condenser is of the same general design as the N.A. 1.40, but has some features that make its use desirable whenever an objective of N.A. 1.30 or less is used. It will give better performance than the N.A. 1.40 wherever it can be used without sacrificing numerical aperture in the objective.

All Spencer condensers will illuminate the full field of a 16mm. objective without requiring special adjustment of any kind.

No. 333 Auxiliary Condenser is an extra condensing lens for use below the regular condenser. It raises the focal point of the condenser so that the apex of the cone of light is raised about 10mm. above the surface of the stage. This makes an intense illumination at this height for drop culture work, and a larger area at the plane of the stage for use with low power objectives. It is so mounted that it is easily attached and can be swung in or out of the optical system by simple lever action.

Cat. No.	Description	Price
302	Abbe Condenser N.A.1.25 for use in fork-type mounts	
304	Abbe Condenser N.A.1.25 for use in ring-type mounts	
305	Wide Angle Condenser N.A.1.40	
306	Abbe Condenser N.A.0.66 with diaphragm for use in ring-type mounts	
311	Abbe Condenser N.A.0.66 with diaphragm for use in fork-type mounts	
315*	Achromatic and Aplanatic Condenser N.A.1.30	
320*	Achromatic and Aplanatic Condenser N.A.1.40	
333	Auxiliary Condenser	

The above description—and the prices—are for the condensers only. Condenser mounts are listed separately below.

324	Non-centerable condenser mounting with iris diaphragm for fork-type substage
314	Same as above for No. 305 Condenser
325	Non-centerable condenser mounting with iris diaphragm for quick screw substage
326	Centerable mounting with iris diaphragm for fork-type substage. Used with No. 302 and No. 311 Condensers
322	Same as above for No. 315 Condenser
321	Same as above for No. 320 Condenser
327	Centerable mounting with oblique light feature and iris diaphragm for fork-type substage. Used with No. 302 Condenser
317	Same as above for No. 305 Condenser
318	Same as above for No. 320 Condenser
319	Same as above for No. 315 Condenser

*A centerable mounting should always be ordered with an achromatic condenser.

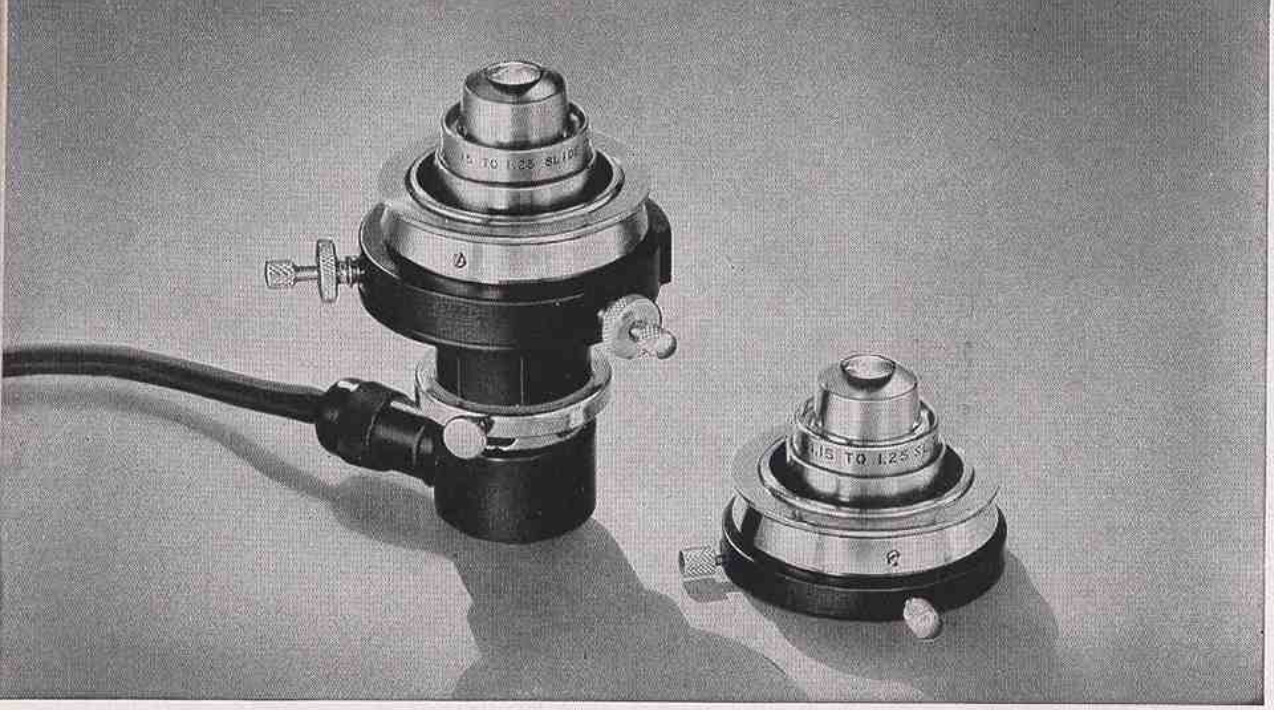
Condenser and Mount Combinations

For Fork Type Substage:

Condenser		Catalog No. of Non-Centerable Mount	Catalog No. of Centerable Mount	Catalog No. of Centerable Mount with Oblique Light
Catalog No.	Description			
311	0.66	324	326	...
302	1.25 Abbe	324	326	327
305	1.40 Wide Angle	324	314	317
315	1.30 Achromatic Aplanatic	324	322	319
320	1.40 Achromatic Aplanatic	324	321	318

For Spencer Ring Type Substage:

Catalog No.	Description of Condenser	Catalog No. of Non-Centerable Mount
306	0.66	325
304	1.25 Abbe	325



Dark Field Illuminators: left, No. 328 with built-in lamp; right, No. 339.

Dark Field Illuminators

The dark field illuminator is now accepted as a standard accessory to the microscope, replacing the substage condenser for certain types of work.

All dark field illuminators listed below are identical optically and vary only in the mechanical mounting to accommodate different types of substage equipment. Adjusting screws are necessary for accurately centering the optical unit and must be an integral part of the illuminator unit proper or the substage equipment in which it is used.

There are two types of illuminators—one using a separate microscope lamp of sufficient intensity, the other having the illuminant which is an electric light (6V-1.7 Amp.) with its condensing lens integral such as in Catalog No. 328. This is the newest, most satisfactory, and most easily adjusted instrument, being designed with two sets of concentric adjusting screws: one for centering the illuminant, the other for the optical unit.

Successful dark field illumination is secured with an objective of 0.85 numerical aperture. This aperture is obtained with either a funnel stop properly placed in objectives of greater N.A. or by using an objective in which is built an iris diaphragm.

Cat. No.	Description	Price
328	Dark Field Illuminator with built-in light source to fit simplified rack and pinion substage. Includes one bulb and objective stop (transformer or resistance extra).....	
329	Same as No. 328 to fit research fork-type substages.....	
330	Same as No. 328 to fit quick screw substages.....	
336	Resistance to adapt No. 334 bulb to 220 volt current, A.C. or D.C.....	
337	Resistance to adapt No. 334 bulb to 110 volt current, A.C. or D.C.....	
391	Transformer to step down 110 volt alternating current to 6.5 volts.....	
395	Variable transformer to step down 110 volt A.C. current 60 cycle to 6.5 volts	
334	Bulb—6.5 V, 1.7 amp. for above.....	MCP
332	Bulb—6.5 V, 1.7 amp., frosted for use with No. 32 Dark Field Microscope..	MCF
339	Dark Field Condenser without centering mount for use with research type substage. Includes aperture stop.....	
342	Same as No. 339 to fit quick screw substages but with centering mount.....	
344	Same as No. 339 to fit simplified rack and pinion fork-type substages but with centering mount.....	

Note: Special funnel stops must be made for objectives other than our own manufacture and for this work a slight additional charge is made. The objectives should be sent to the factory to insure proper fitting.

Spencer Fluorescence Accessories

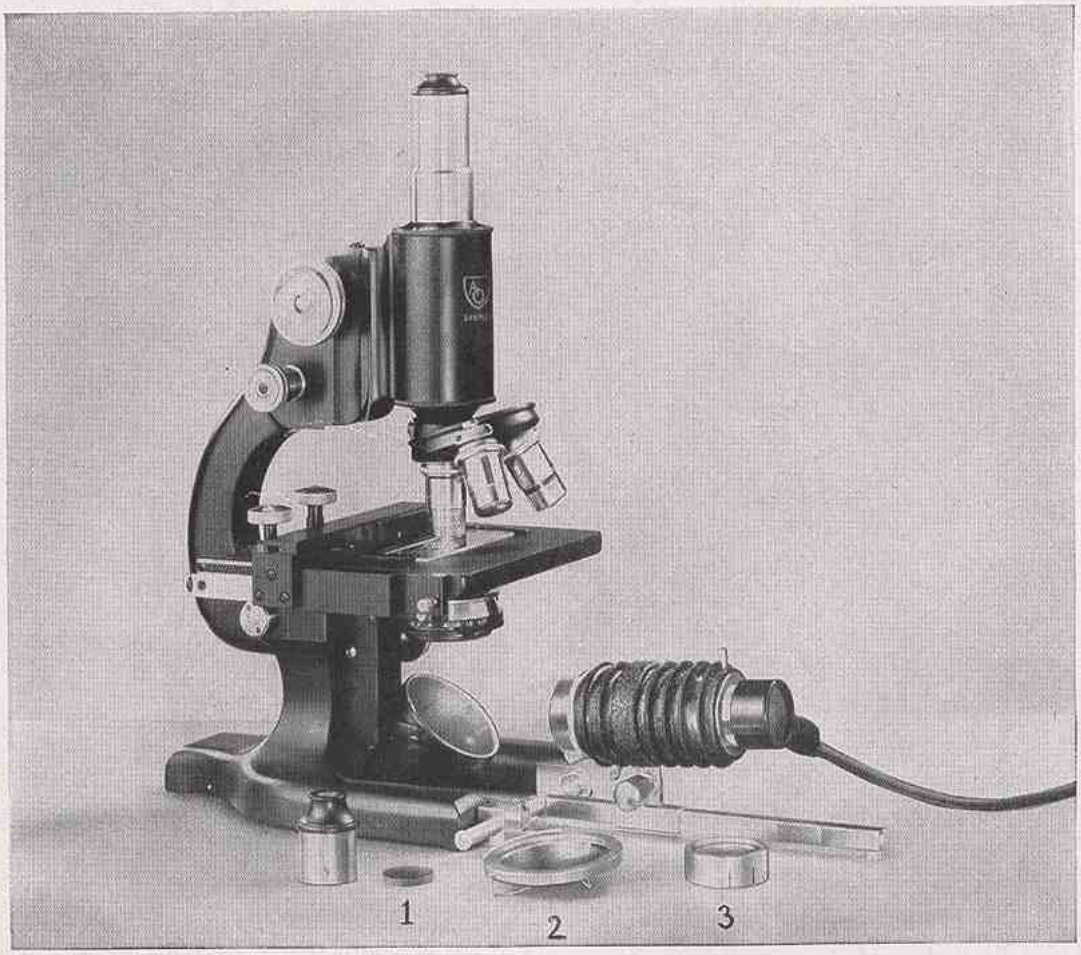
By means of this inexpensive set of accessories any standard monocular microscope can be converted to a simple fluorescence microscope. Acidfast microorganisms including those of tuberculosis and leprosy can then be identified by the fluorescence method*.

Extreme contrast makes the bacteria easily recognizable at the comparatively low magnification of 400 diameters. They can be located with an 8 mm. objective—20X compensating eyepiece combination, and the resulting wide field makes possible a saving of one-fourth to one-third in the time required for searching.

Designed for use with Spencer Nos. 349, 351 or 353 lamps, it consists of a yellow filter to fit in the microscope eyepiece (1), an aluminum mirror to fit over the usual mirror (2), and an ultra-violet filter to fit the lamp (3).

Cat. No.	Description	Price
363	Fluorescence Accessories for No. 353 lamp.....	
353	Universal Microscope Lamp with 6.5 volt, 2.75 ampere, clear bulb with blue glass and transformer.....	

**Bibliography on request.*



Accessories for Fluorescent Microscopy: 1. Yellow Eyepiece Filter 2. Aluminum First Surface Mirror 3. Ultraviolet Filter for Lamp

Spencer Magnifiers

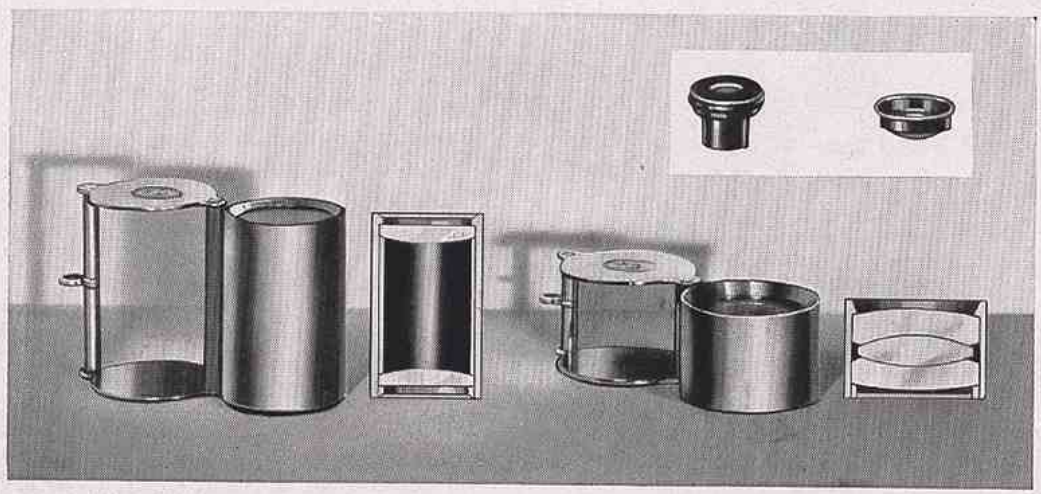
These Magnifiers are computed with the same care and manufactured by the same exact methods as are employed in the construction of other Spencer high-grade optical products. They will be found to be of uniformly excellent quality and to adhere rigidly to the specifications by which they are described.

Two different styles of mountings are offered according to the different purposes for which they are used. The A mounts are black lacquered brass for dissecting microscopes; C mounts, in folding case, are chromium plated.

DOUBLETS are composed of two plano-convex lenses accurately ground and polished and suitably mounted.

TRIPLE APLANATS are corrected, both spherically and chromatically. They are remarkable for their large flat field, freedom from distortion, brilliancy of illumination, and greater working distance.

	Catalog No.	Magnification	Focal Distance		Working Distance mm.	Diameter Real Field in mm.	Mount	Price
			Millimeters	Inches Approx.				
Doublet Magnifiers	202	6X	41.6	1.6	22	22	A-for Dissecting Microscopes	
	204	9X	27.8	1.1	15	16		
	206	12X	20.8	0.8	12	11		
	222	6X	41.6	1.6	22	22	C- Folding Case	
	224	9X	27.8	1.1	15	16		
	226	12X	20.8	0.8	12	11		
Triple Aplanat Magnifiers	256	6X	41.6	1.6	36.8	30	A-for Dissecting Microscopes	
	258	9X	27.8	1.1	24.5	20		
	260	12X	20.8	0.8	18.4	15		
	276	6X	41.6	1.6	36.8	30	C- Folding Case	
	278	9X	27.8	1.1	24.5	20		
	280	12X	20.8	0.8	18.4	15		
	281	15X	16.7	0.7	14.9	12		



Left: Doublet Magnifier in C Mount. Right: Triple Aplanat in C Mount.

Insert left, Doublet in A Mount; right, Triple Aplanat in A Mount.



The Spencer Utility Magnifier No. 623.

Utility Magnifiers

A magnifier is of value in investigating any details or characteristics which are too small for the unaided eye to see clearly. When a magnifier is placed in front (and close) to a human eye, it increases the apparent size of the object under examination, thus increasing the detail visible to the eye.

The Spencer Utility Magnifier is designed to cover the largest uses for such an instrument: dissection, inspection of minerals, textiles, paper, castings, insects, and food products. The horseshoe base holds the lens rigidly at the proper focal distance. The 4.5X lens, having three lens elements, is corrected for chromatic and spherical aberrations. The lens is 36mm. in diameter. It gives an extremely large field.

Cat. No.	Description	Price
623	Spencer Utility Magnifier 4.5X in focusing mount supported by horseshoe base	
624	Spencer Fingerprint Magnifier, same as above, but with base milled to accept coding dispositives	
625	Battley Dispositive	
627	Henry Dispositive	
629	Combined Battley-Henry Dispositive	

Immersion Oil

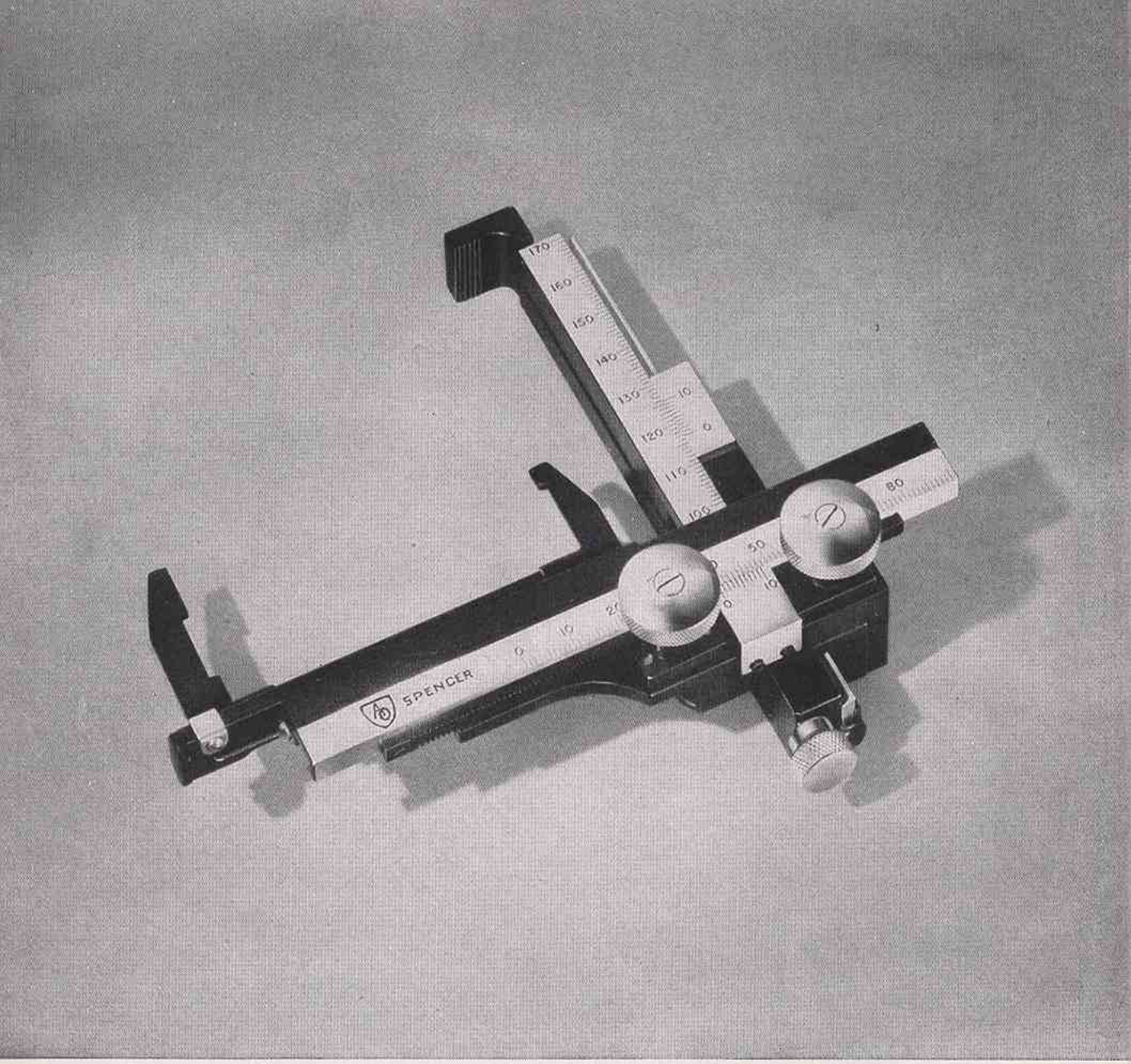
Crown Immersion Oil is a synthetic product developed to meet the exacting requirements of microscopy. Optically it has an n_D of 1.515 and a dispersion about average for cedarwood oil. It is colorless and odorless; will not dry or harden on the objective or cover glass. Because it is more easily applied and removed, it has largely replaced cedarwood oil in many laboratories.

Cedarwood oil is also available for microscopists who may prefer it.

Cat. No.	Description	Price
6140	Crown Immersion Oil, ¼ oz. in applicator bottle	
6142	Crown Immersion Oil, 1 oz. in plain bottle	
6143	Crown Immersion Oil, 4 oz. in plain bottle	
6144	Crown Immersion Oil, 1 pt. in plain bottle	
6130	Cedarwood Immersion Oil, ¼ oz. in applicator bottle	
6132	Cedarwood Immersion Oil, 1 oz. in plain bottle	
6133	Cedarwood Immersion Oil, 4 oz. in plain bottle	
6134	Cedarwood Immersion Oil, 1 pt. in plain bottle	

Crown Immersion Oil.





No. 485 Mechanical Stage.

Spencer Mechanical Stages

Spencer Mechanical Stages, for square stage microscopes, are designed to facilitate the complete exploration of a slide. Four of the stages are graduated so that the positions of selected fields in the specimen may be recorded and located again. The verniers on stages Nos. 489 and 490 are adjustable. The adjustable verniers are desirable if the mechanical stage is to be used on more than one microscope; they provide for correcting the readings of the graduations so that areas observed and recorded on one microscope can be relocated on a different microscope.

All of the mechanical stages are designed to fit plain square stages with sides 105mm. or larger. They may be fastened in place quickly or removed as easily, leaving the microscope stage free of incumbrances. They are built sturdily, with smooth and positive rack and pinion movements in both directions. Smoothness is attained through special bearing construction—chromium against brass. Any portion of a specimen can be placed in precisely the position it is wanted. The extreme edge of the slide can be brought in focus without any part of the mechanical stage striking the objective. All mechanical stages are finished in durable black and chromium. They are supplied in leatherette cases.

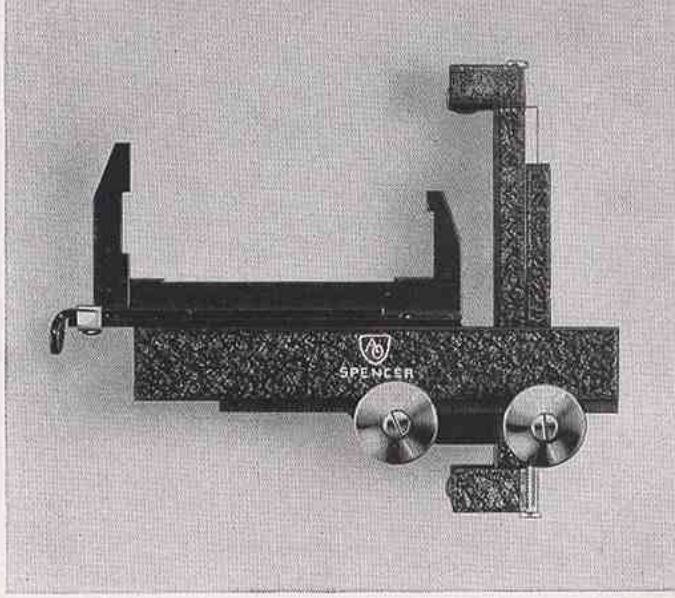
No. 484 Mechanical Stage has a to-and-fro movement of 50mm. and a lateral movement of 75mm. It accommodates slides 25 x 75mm. and 50 x 75mm., but is not graduated. It may be used on any Spencer square stage microscope.

No. 485 Mechanical Stage is heavier than No. 484 and has graduations and fixed verniers reading to 1/10mm.

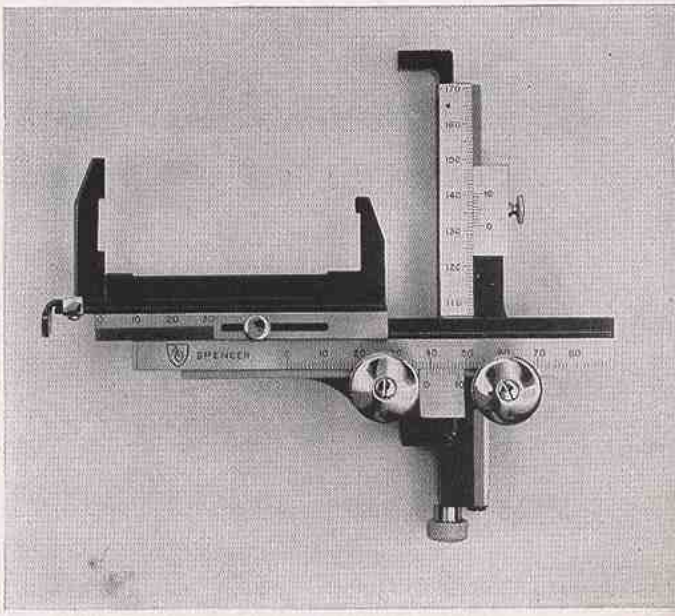
No. 489 Mechanical Stage is the same as No. 485 but has adjustments to change the vernier readings, so that readings locating definite points in a specimen, observed on one microscope, are made available on any other to which the stage is attached.

No. 490 Mechanical Stage is like 489 but has a longer lateral rack and special slide clamp designed to accommodate either the 25 x 75mm. or 50 x 114mm. slides such as used in milk and in dairy laboratory work.

Cat. No.	Description	Price
484	Plain Mechanical Stage to take 25 x 75 or 50 x 75mm. slides	
485	Graduated Mechanical Stage to take 25 x 75 or 50 x 75mm. slides	
489	Same as above but with provision to adjust verniers	
490	Graduated Mechanical Stage to take up to 50 x 114mm. slides	
	If case is not desired with above stages, deduct	

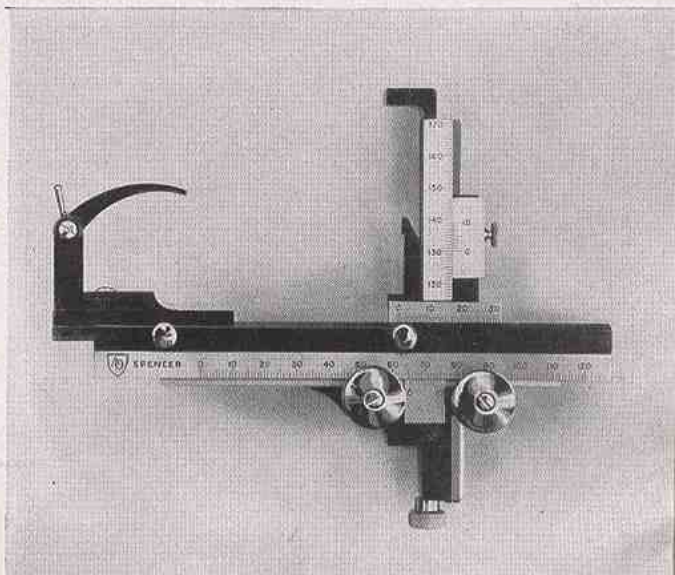


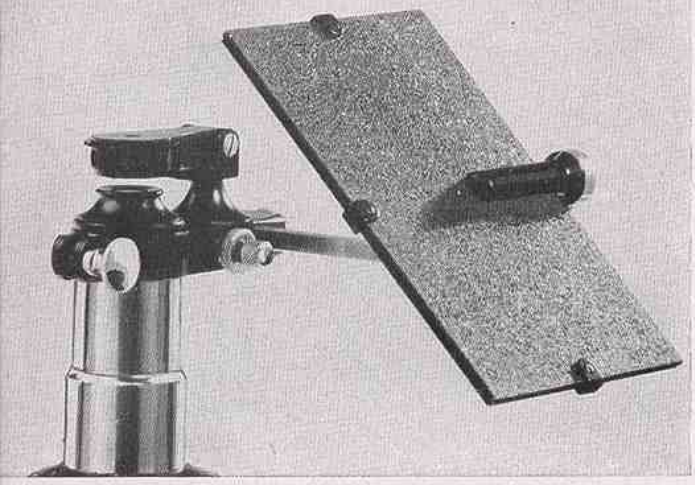
No. 484 Mechanical Stage.



No. 489 Mechanical Stage.

No. 490 Mechanical Stage.





The Spencer Camera Lucida No. 500.

Spencer Camera Lucida

These instruments, of the Abbe-type, are now offered for both the regular laboratory microscopes (monobjective) and the stereoscopic microscope, the chief difference being in the mirrors—the large fields of the latter necessitating larger mirrors.

The entire field of the microscopes may be viewed from above the prism, and the light can be so regulated as to show both the object and the drawing pencil with the same intensity.

In No. 500 two concentric adjusting screws are provided for correctly centering the instrument over the eyepiece.

The entire prism box is hinged to swing on a horizontal axis and is easily thrown out of position for changing eyepieces or for careful examination of the object without the interposition of the prism.

The mirror is supported on an adjustable bar graduated to indicate the distance of the mirror from the microscope. Graduations are also provided to indicate the angle of inclination of the mirror.

In No. 500 the relative intensity of illumination of the object and drawing pencil is regulated by two carefully graded series of neutral tint filters, one between the prism and the eyepiece, and the other between the prism and the mirror.

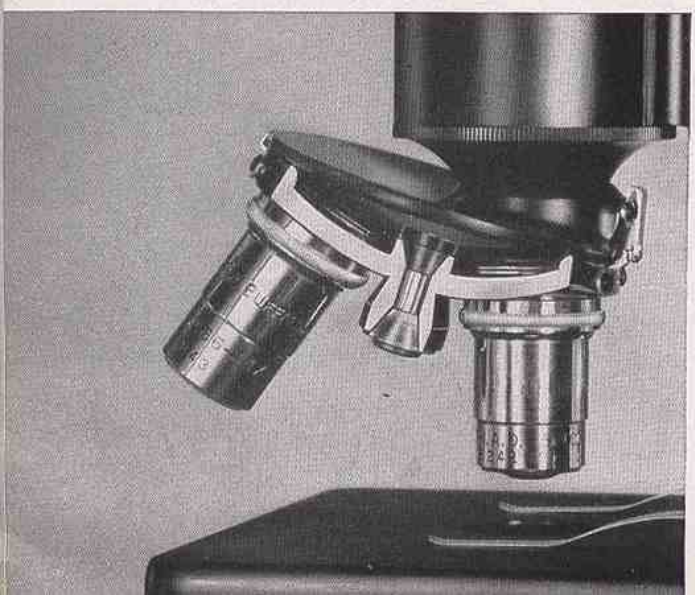
No. 505 differs from No. 500 in the omission of the neutral tint filters between the prism and the eyepiece, and also the centering screws from the prism box.

Cat. No.	Description	Price
500	Camera Lucida in case.....	
505	Camera Lucida in case.....	
501	Camera Lucida similar to No. 500 but for Stereoscopic Microscopes.....	

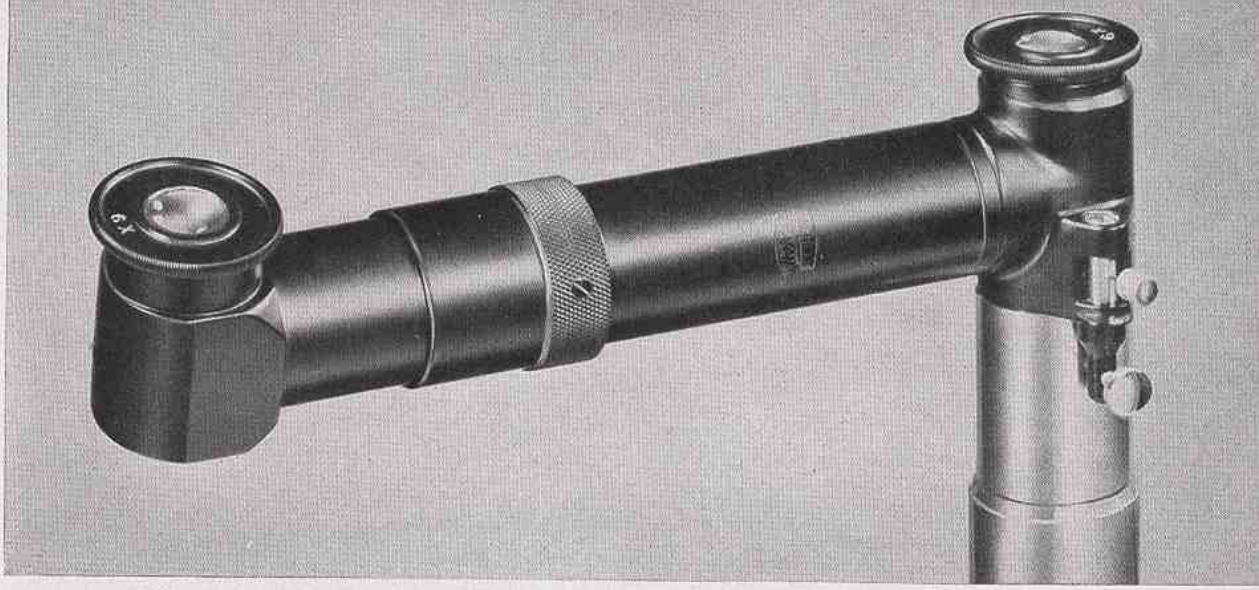
Dual-Cone Revolving Nosepiece

The accuracy of the centering of the objectives on the nosepiece depends upon the precision with which the part holding the objective revolves. In the Spencer Dual-Cone Revolving Nosepiece the bearing shaft is double the usual length and has two conical bearings that are drawn together with a screw to maintain positive alignment. A spring insures a definite stop centering each objective.

Details of the Dual-Cone Revolving Nosepiece.



Cat. No.	Description	Price
441	Single Objective Adapter.....	
450	Double Nosepiece.....	
455	Triple Nosepiece.....	
460	Quadruple Nosepiece.....	



The Spencer Demonstration Eyepiece No. 432.

Demonstration Eyepiece

Demonstration eyepieces can be used on any laboratory microscope, allowing two persons to view the same field at the same time. They are of inestimable value both for quizzes and study. A conveniently located pointer easily moved to any part of the field is visible at the same time in both eyepieces.

The side tube extends out horizontally and the eyepiece revolves about the axis of the extension tube, so that the user of the extension can incline his eyepiece at any angle to the vertical that is convenient. The auxiliary eyepiece is focusable independently of the one at the microscope tube by a knurled ring in the extension tube.

Cat. No.	Description	Price
432	Demonstration Eyepiece with 6X Eyepieces	
434	Demonstration Eyepiece with 8X Eyepieces	

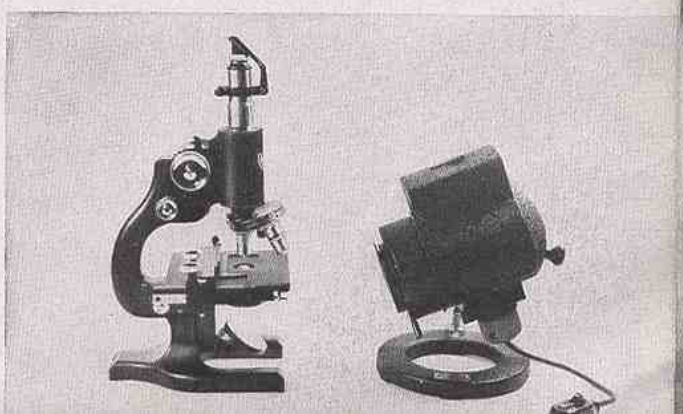
Microprojection Prism

Some instructors hesitate to pass out to students their more valuable slides or specimens requiring experience for proper illumination. Such subjects can be exhibited by using a prism over the eyepiece and projecting the image onto a ground glass or opaque screen.

Any microscope, preferably one having a substage condenser, can be transformed into a simple microprojector. The brightness of the image, of course, depends upon the intensity of the light source, as well as upon the magnification, projection distance, room lighting conditions, etc. A low power objective, small screen and short projection distance will give best results.

Cat. No.	Description	Price
346	Prism, 45° type, hinged to clamp which fits standard diameter eyepiece	

No. 346 Projection Prism.




SPENCER

Darkfield Quebec Colony Counter

The new, improved Darkfield Quebec Colony Counter reveals colonies of bacteria clearly against a dark background. The illumination is uniform; bright enough to show the smaller colonies and to assist in distinguishing colonies from other structures, yet free from glare. Counting is facilitated while fatigue is reduced.

Magnification

The 4½″ lens has the standard 1.5X magnification specified by the American Public Health Association and is mounted on a sliding rod for focusing to suit any operator. It is so positioned that errors from parallax are avoided. A second lens may be attached above the first when greater magnification is desired. When not in use the lens mount may be pushed down and out of the way.

Illumination

Illumination is brighter than from the previous model. Since the instrument remains cool, ventilation is not required and the illuminant is in a closed case. Bulbs can be replaced readily.

Design

The front surface is inclined at an angle found comfortable for most technicians. An auxiliary tilting base is available when greater or less slope is desirable.

Guide Plates

A Wolffhuegel guide plate is supplied with the instrument. Stewart and Jeffers guide plates are also available if desired.



Centering Screws

Centering screws are provided so that the Petri dish may be centered when circularly ruled plates are used.

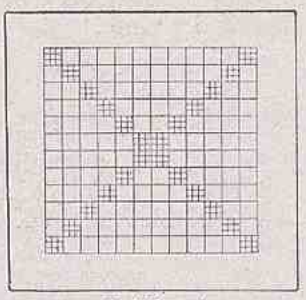
Case and Finish

The case is built of sheet metal:

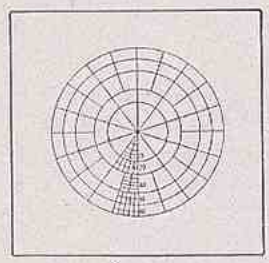
$10\frac{1}{16}$" long
$10\frac{11}{16}$" wide
$10\frac{1}{4}$" high

The instrument is styled to conform with the modern laboratory and finished in a rich maroon.

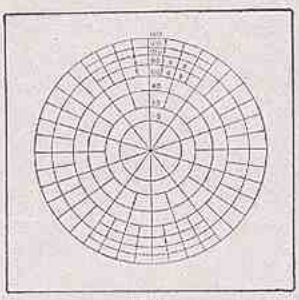
Cat. No.	Description	Price
3330	Spencer Darkfield Quebec Colony Counter with Wolffhuegel plate and 40 watt, 120 volt bulb.....	
3329	Same as No. 3330 but with 50 watt, 230 volt bulb.....	
3331	Auxiliary Lens.....	
3332	Wolffhuegel Counting Plate.....	
3333	Stewart Counting Plate.....	
3334	Jeffers Counting Plate.....	
3335	Extra Bulb, 40 watt, 120 volt..MCP	
3336	Auxiliary Tilting Base.....	
3337	Extra Bulb, 50 watt, 230 volt MCP..	



Wolffhuegel



Stewart



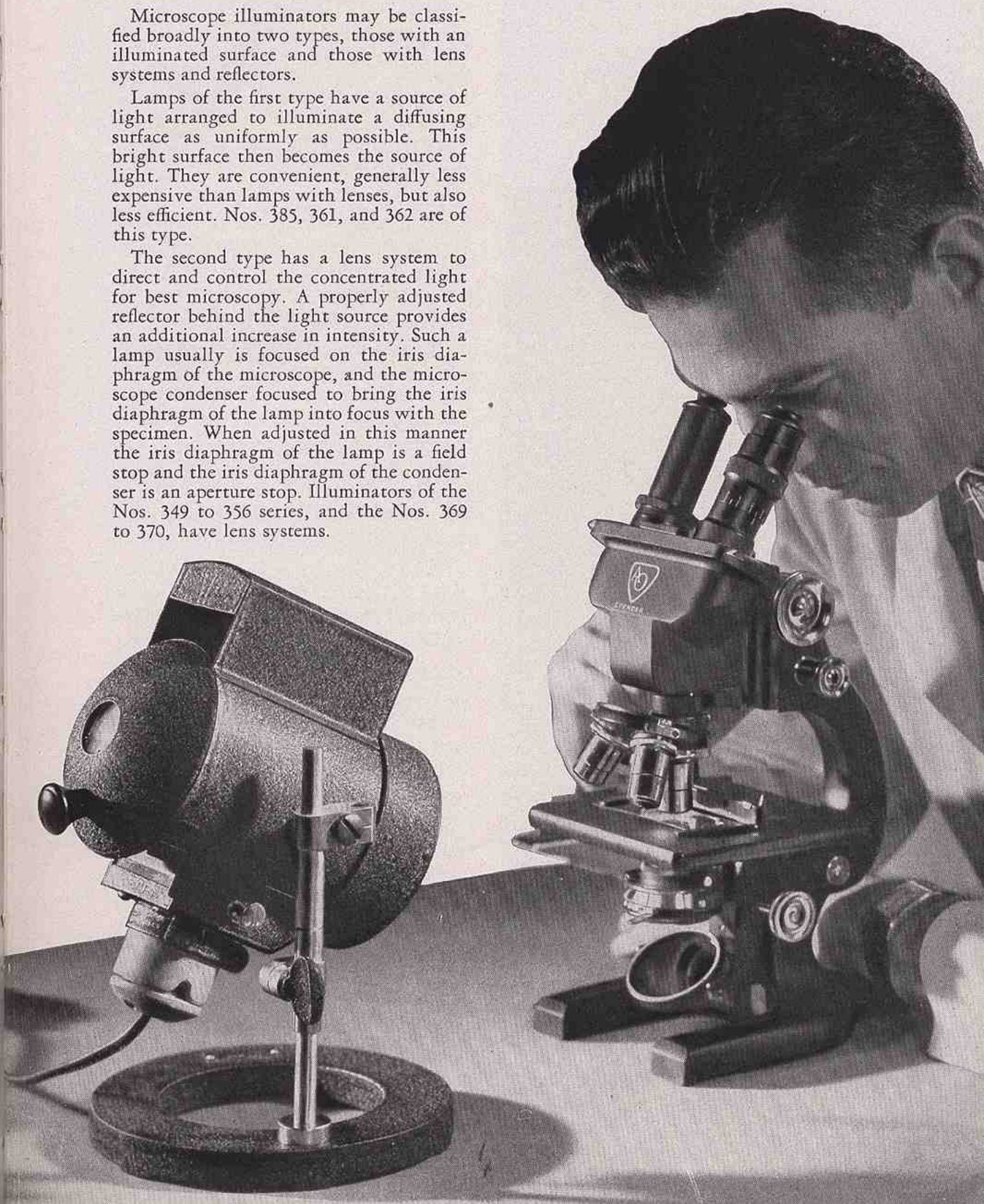
Jeffers

Microscope Illuminators

Microscope illuminators may be classified broadly into two types, those with an illuminated surface and those with lens systems and reflectors.

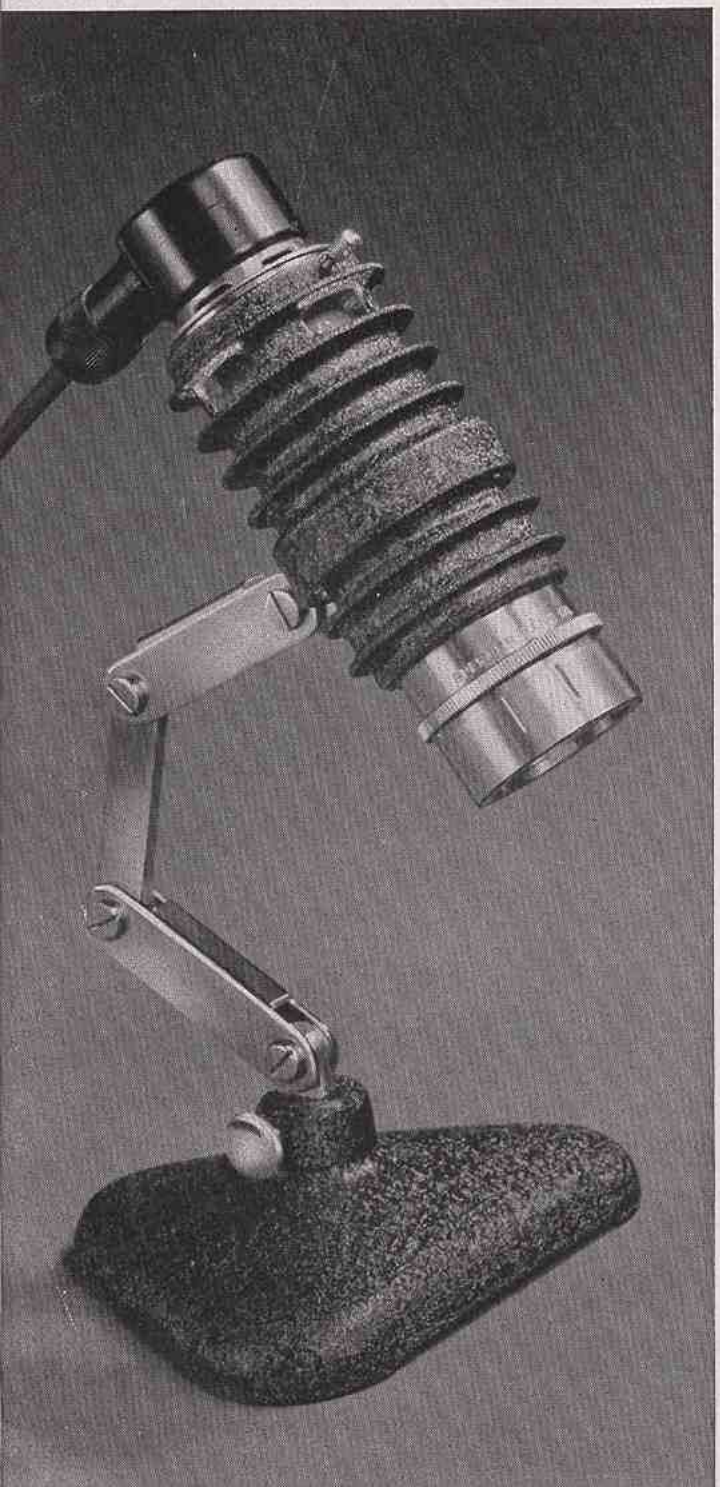
Lamps of the first type have a source of light arranged to illuminate a diffusing surface as uniformly as possible. This bright surface then becomes the source of light. They are convenient, generally less expensive than lamps with lenses, but also less efficient. Nos. 385, 361, and 362 are of this type.

The second type has a lens system to direct and control the concentrated light for best microscopy. A properly adjusted reflector behind the light source provides an additional increase in intensity. Such a lamp usually is focused on the iris diaphragm of the microscope, and the microscope condenser focused to bring the iris diaphragm of the lamp into focus with the specimen. When adjusted in this manner the iris diaphragm of the lamp is a field stop and the iris diaphragm of the condenser is an aperture stop. Illuminators of the Nos. 349 to 356 series, and the Nos. 369 to 370, have lens systems.



Universal Microscope Lamp

The Spencer Universal Microscope Lamp fills a long felt need for a small illuminator, designed to give all types of illumination generally used in microscopy, as well as providing a compact, adaptable light source for general laboratory work.



It serves as an intense source of light and yet is cool enough to handle and adjust. The lamp house is constructed of aluminum and, in addition to being well-ventilated, is provided with fins to increase the surface area and dissipate heat. Modern and attractive in appearance, it is universal in application and low in price.

The triple lens condensing system is in a spiral focusing mount and provides support for the filter holder or iris diaphragm. Cobalt, heat-absorbing glass, neutral density or color filters for photomicrographic work may be inserted in the filter holder.

The same size filter is used in the substage of the Spencer microscopes as is used in the lamp. An iris diaphragm, available for use on the lamp, slips over the front lens mount in place of the filter holder and will hold any of the filters in position. The lamp is a brilliant source which may be focused from a sharp image of the filament to an evenly illuminated spot of light.

The 6.5 volt, 2.75 ampere, bayonet base, single filament type bulb may be easily changed. The voltage is controlled by a variable transformer.

No. 353 Lamp is mounted in a three-link jackknife support and cast iron triangular base. It may be removed from the base for mounting on the Spencer Stereoscopic Microscopes.

Spencer Universal Microscope Lamp No. 351 is supplied with an optical bench for attachment to mon-objective microscopes. It is supplied without the base and links, but for the user who may wish these accessories also, No. 349 is listed.

No. 356 Lamp is mounted on a rod six inches long to be used on any ring stand for illuminating scales, dials, and gages, and to provide "spot" illumination where required in laboratory use.

Universal Microscope Lamp No. 353.

Variety of Uses

1. Microscope illuminant, Köhler illuminator for microscopy.

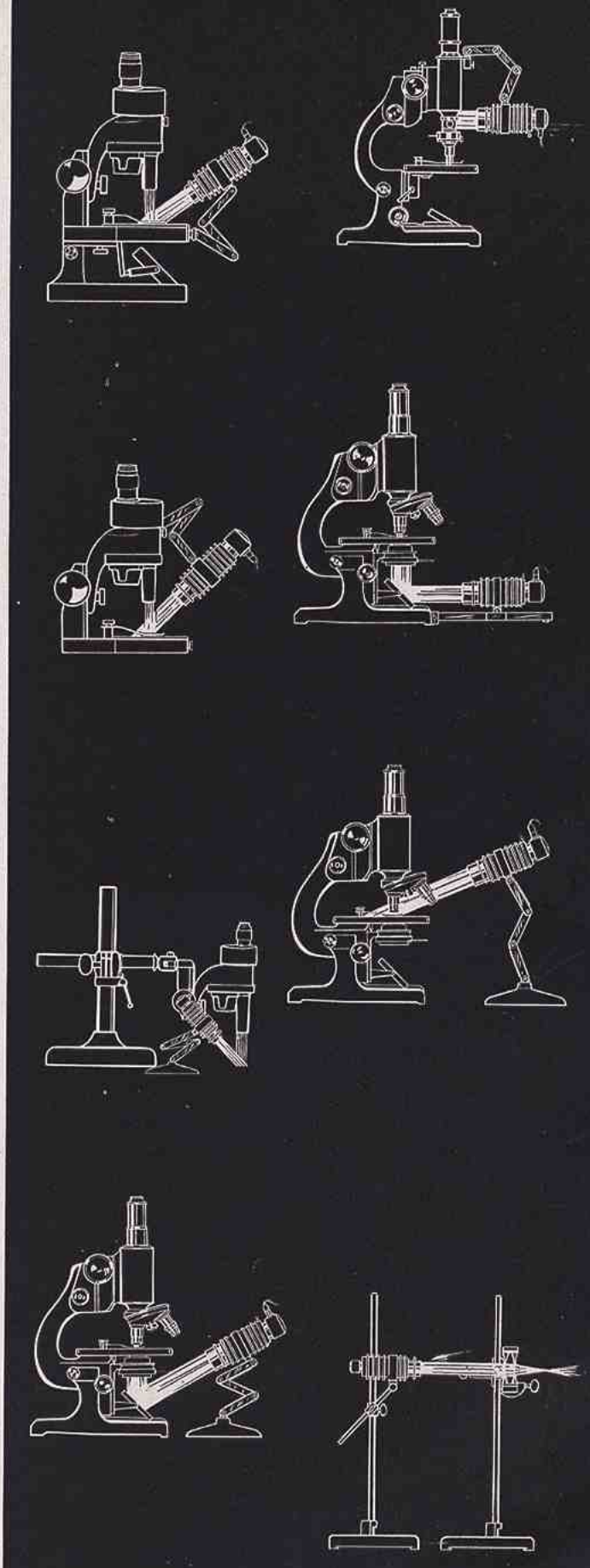
2. Low power inspection or dissection, providing a brilliant, even spot of light. Size of area illuminated may be controlled to match field of microscope.

3. Experiments in physics classes for demonstrating the principals of optics.

4. General "spot" illumination in all laboratories.

5. Photography.

Cat. No.	Description	Price
349	Universal Microscope Lamp, including three-link jackknife standard and base, optical bench attachment, and adapter rod, and with 6.5 volt, 2.75 ampere, clear glass bulb, blue glass, and transformer.....	
353	Universal Microscope Lamp, with three-link jackknife standard and base, and with 6.5 volt, 2.75 ampere, clear glass bulb, blue glass, and transformer.....	
351	Universal Microscope Lamp, with optical bench for attachment to compound microscope, with 6.5 volt, 2.75 ampere, clear glass bulb, blue glass, and transformer.....	
356	Universal Microscope Lamp, with adapter rod, 6.5 volt, 2.75 ampere, clear glass bulb, blue glass, and transformer. For use with any ring stand.	
354	Iris Diaphragm for above.....	
360	Clear Bulb, 6.5 volt, 2.75 ampere .....MCP	
307	Filter, green glass, for above.....	
309	Filter, yellow glass, for above.....	
310	Set of three Neutral Density Filters for No. 353 Lamp, providing 5%, 25%, and 50% transmissions.....	
308	Filter, heat-absorbing glass, for above.	
399	Ground Glass Disc for above.....	
395	Variable Transformer, 110-120 volts to 6.5 volts.....	
477	Adapter for attaching No. 353 Lamp to body tube of Junior Stereoscopic Microscope and old style No. 55 low power microscope series.....	
478	Bracket for attaching No. 353 Lamp to the stage of Spencer Stereoscopic Microscopes Nos. 25, 26, and 28....	



Adjustable Laboratory Lamp

Adjustable Lamps Nos. 369 and 370 meet a wide range of laboratory uses. They may be used for all general microscope illumination, for dark field work, and for photomicrography.

Effective illumination is furnished by the combination of 100 watt bulb, silvered reflector, and effective system of condensing lenses. The size of the illuminated field is controlled by means of an iris diaphragm with graduations. The lamp is focused by adjustment of the slide unit containing the bulb and reflector.

The lamp is easily adjustable on its support, both as to angle and height. The large, heavy base and upright holds the lamp house rigidly in adjustment.

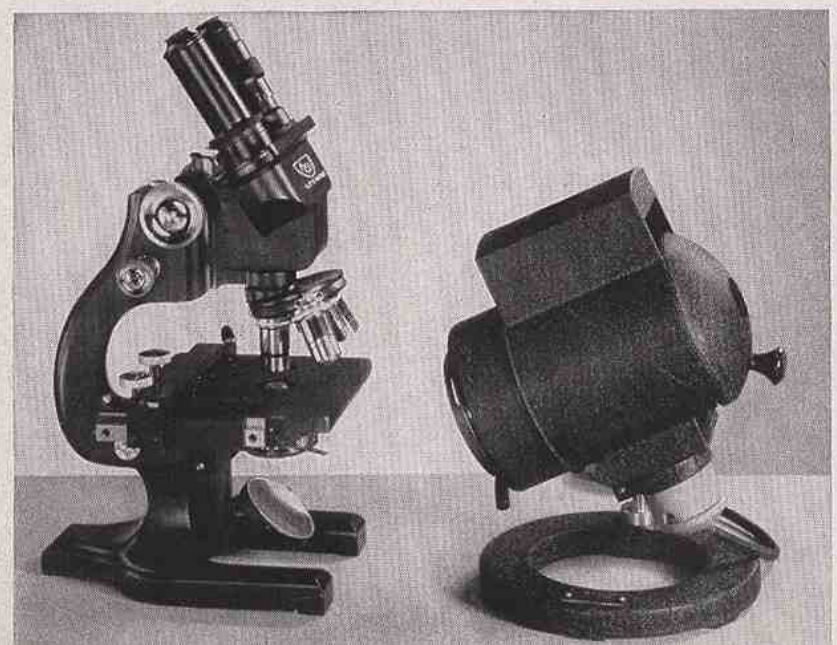
Heat is dissipated by the ventilated lamp house. A non-heat-conducting button at the back of the lamp house makes it easy for the operator to change the angle of the light while working.

The finish is a combination of crinkled black enamel and chromium plating. A five-foot cord, having a switch between lamp and plug, is supplied. Regular equipment includes blue and ground glasses or Corning Daylite Glass, as ordered.

Dimensions

Diameter of base, 6⅜ inches. Length of lamp, 7 inches. Diameter of lamp, 4¼ inches. Diameter of aperture, 2½ inches.

Cat. No.	Description	Price
370A	Lamp, complete as described, with 100 watt, 120 volt, medium screw base bulb, and with one blue and one ground glass	
370B	Lamp, complete as described, with one Corning Daylite Glass	
369A	Same as 370A, but without iris diaphragm	
369B	Same as 370B, but without iris diaphragm	
588	Ground glass, 2⅝ inches diameter to fit Nos. 369 and 370 Lamps	
589	Blue Glass Filter 2⅝ inches diameter.	
590	Daylite Glass Filter 2⅝ inches diameter	
554	Filter and Water Cell Holder to fit Nos. 369 and 370 Lamps	
553	Water Cell	
743	Neutral Density Filter, ⅛ x 3 inches, transmission 50%	
744	Neutral Density Filter, ⅛ x 3 inches, transmission 25%	
745	Neutral Density Filter, ⅛ x 3 inches, transmission 5%	
371	100 watt, 120 volt, Medium Screw Base Bulb	MCP
374	125 watt, 230 volt, Medium Screw Base Bulb	MCP



Substage Lamps

The compactness and adaptability of this Bakelite Substage Lamp makes it particularly useful where a simple, portable lamp is required. It provides ample illumination for most work and does not produce excessive heat.

The lamp is designed for use either in an upright position directly in front of the microscope mirror, or, by removing the mirror, in a horizontal position under the microscope condenser.

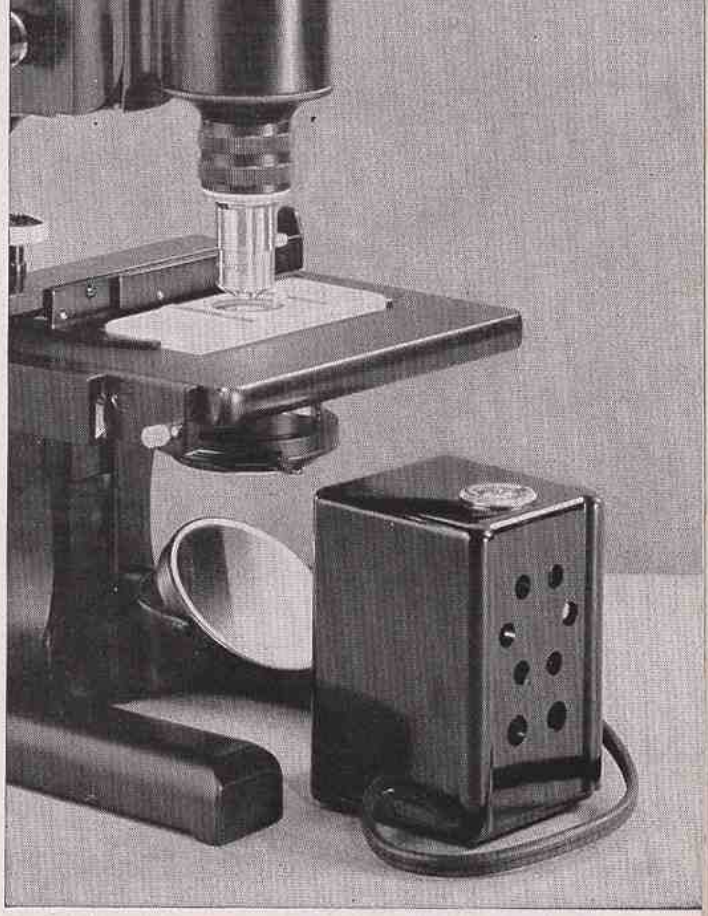
Constructed of tough Bakelite composition, it is capable of withstanding the continuous hard usage and minor accidents which occur in a laboratory. The smooth, satin black finish is permanent and easily cleaned.

For changing bulbs, the lamp is readily separable into two sections. The 10 watt bulb furnished has a minimum replacement cost and may be connected with any 110-120 volt current. Regular equipment includes five feet of cord and either ground blue filter or Corning Daylite Glass filter, as ordered. A 15 watt bulb is also available and is recommended when the lamp is intended for use with a binocular microscope.

Dimensions

Height, over all, 3¼ inches. Body 2½ inches square. Diameter of aperture 1 7/16 inches.

Cat. No.	Description	Price
385A	Bakelite Substage Lamp with 10 watt, 110 volt bulb, and blue glass.	
385B	Bakelite Substage Lamp with 10 watt, 110 volt bulb, and Corning Daylight Glass.....	
385C	Bakelite Substage Lamp with 10 watt, 110 volt bulb, and ground glass.	
386	10 watt, 110 volt, Candelabra Base Bulb.....MCP	
388	15 watt, 115 volt, Candelabra Base Bulb.....MCP	



Substage Lamp No. 385 used in front of stage.

Substage Lamp No. 385 used below stage.



Chalet Type Microscope Lamp

No. 361 Microscope Lamp is small and inexpensive, giving sufficient illumination for use with binocular microscopes when objectives of high magnifying power are used.

It is equipped with a 60 watt, 120 volt bulb. This bulb is standard and can be purchased at any electrical supply store.

The lamp is so well-ventilated that it can be handled comfortably at any time. The visor over the light opening is so arranged that, when the lamp is ten or twelve inches from the microscope, the eyes at the eyepiece are shaded.

A blue glass, ground on one side, is inserted in the aperture. A toggle switch is conveniently located near the base. Five feet of cord with plug are included.

Dimensions

Height, over all, 7 inches. Body, 4 inches square. Aperture, 2¾ x 3½ inches.

Cat. No.	Description	Price
361	Microscope Lamp with 60 watt, 120 volt, frosted, Type D, medium screw base bulb; one blue glass ground on one side.....	
362	Same as above, but with plain ground glass in place of blue ground glass...	
364	60 watt, 120 volt, frosted, type D, Medium Screw Base Bulb.....MCP	

Chalet Type Microscope Lamp No. 361.



Spencer Hematological Equipment

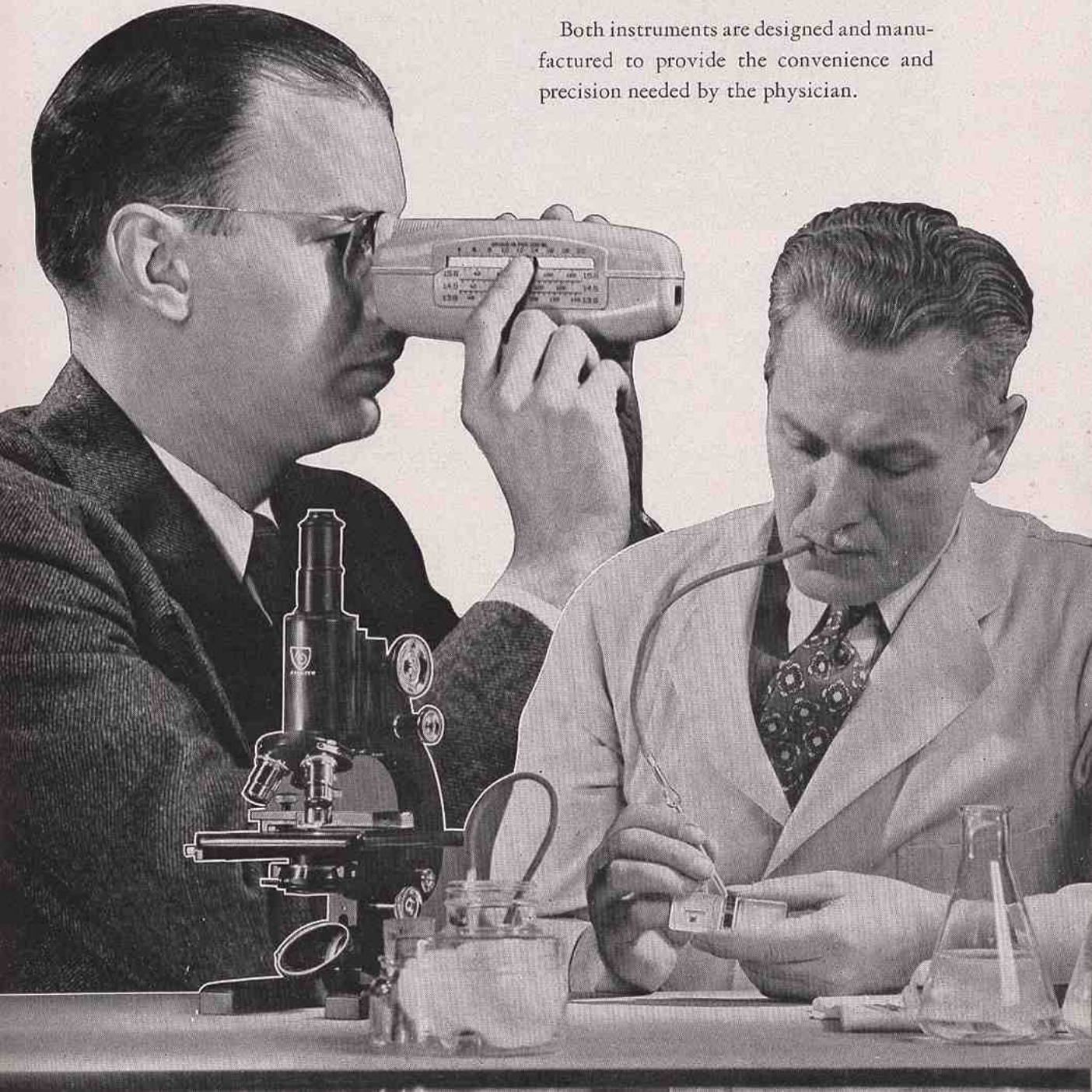
Hb-Meter
and
"Bright-Line" Haemacytometer

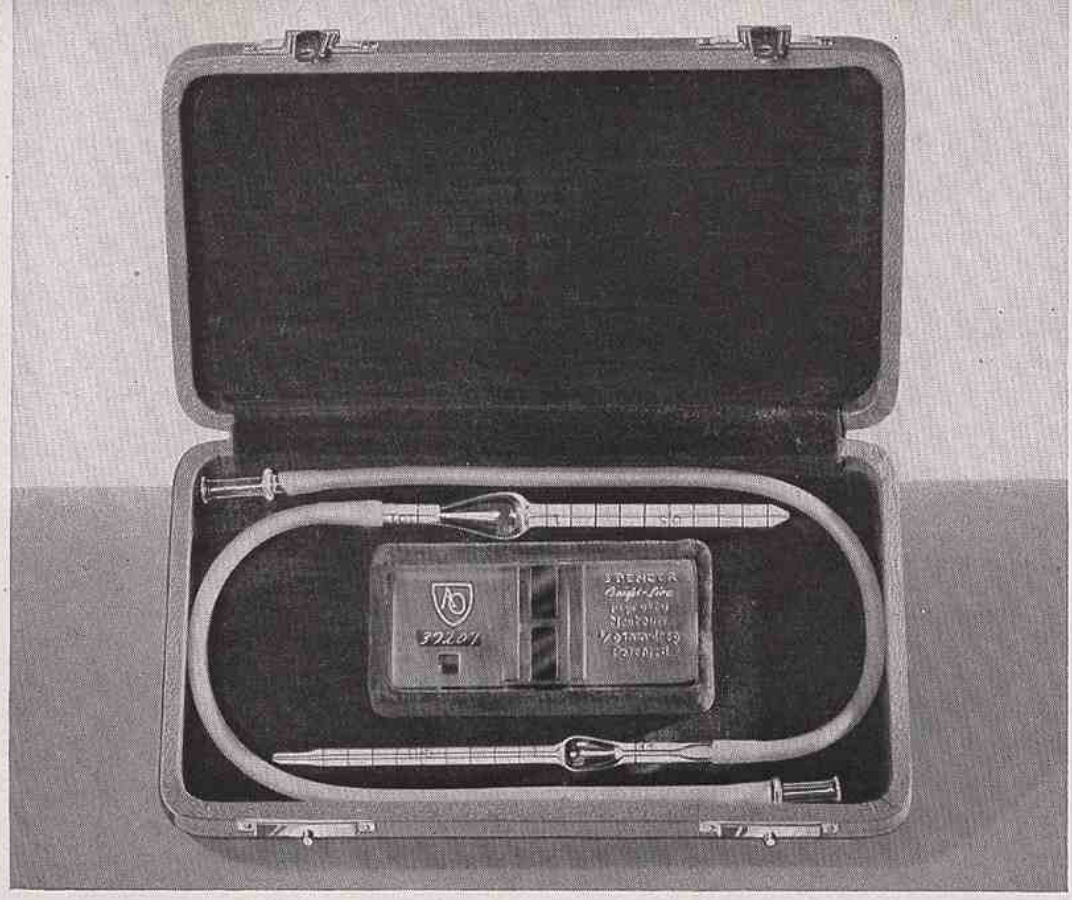
Two instruments are available for the examination and analysis of blood:

Spencer Bright-Line Haemacytometer for counting red or white blood corpuscles.

Spencer Hb-Meter for determining the concentration of hemoglobin in blood.

Both instruments are designed and manufactured to provide the convenience and precision needed by the physician.





Haemacytometer No. 1483

Spencer "Bright-Line" Haemacytometer

The Spencer "Bright-Line" Haemacytometer is an instrument of many applications: for yeast counts; for dust counts; for counts in spinal, salivary, or other body fluids. However, its chief use is for making red and white blood cell counts. For this work it has become a standard in most hospitals and clinical laboratories, an indispensable aid to many thousands of physicians and students.

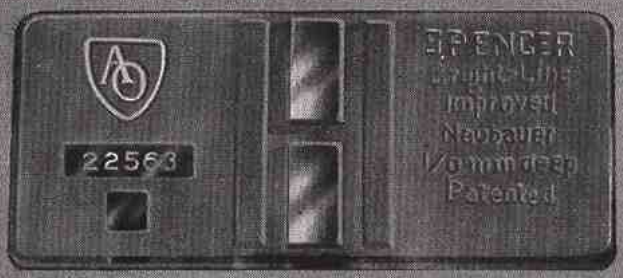
The unique and most noticeable feature of the "Bright-Line" Counting Chamber is the sharp contrast of the bright lines against the darker metalized background.

In manufacturing the "Bright-Line" Chamber, metal is deposited on the glass counting areas in a very thin semitransparent layer, and the lines are ruled through the metal. This metal coating is then fused into the glass.

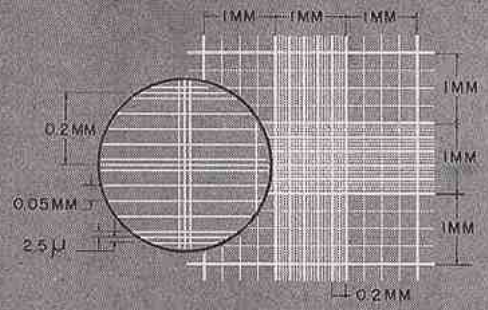
Superior Visibility Through Contrast

Greater accuracy and more comfort result from the use of this Haemacytometer, with less fatigue and eyestrain, because the visibility is superior to that of other chambers. Under the microscope the lines appear white against the semitransparent darker background, with the corpuscles thrown into bold relief. The visibility of the lines depends mainly on this contrast. The triple dividing lines show clearly which cells lie within the counting areas.

It is unnecessary to secure such an exact adjustment of the illumination as is required with lines ruled in glass. There is no glare to fog vision. The blood corpuscles or other particles in the field stand out



The "Bright-Line" Counting Chamber



Ruling for "Bright-Line" Counting Chamber

clearly. It is not necessary to stop down the condenser as it is with other chambers, since the lines can be seen at any opening of the condenser diaphragm.

Green light is not necessary with this chamber, but if the user prefers light of this color, a green filter is available and may be used. (Catalog No. 307).

Better Distribution of Corpuscles

Because of the differences in the surface tension characteristics of the metalized surface on the "Bright-Line" Counting Chamber and the glass surface of the cover, the corpuscles are distributed evenly and the chamber is more easily filled. Even distribution of corpuscles is a recognized necessity for accurate counts. This fortunate characteristic of the Spencer Counting Chamber is a real aid in counting and increases its value.

Precise Construction

The "Bright-Line" Counting Chamber is a single piece of glass with an H-shaped trough forming two counting areas. It has raised supports to hold the cover glass the proper 0.1mm. distance above these areas and a concave indentation on the back. Great care is taken to grind the supports and polish the counting plateaus and cover glasses to correct size. The two cover glasses supplied with each chamber have plane polished surfaces to insure good contact with the cover glass supports.

The slight concavity on the underside, directly under the rulings, has been introduced so that scratches which would impair efficiency will not appear in this area of the lower surface of the chamber. This increases the useful life of the chamber.

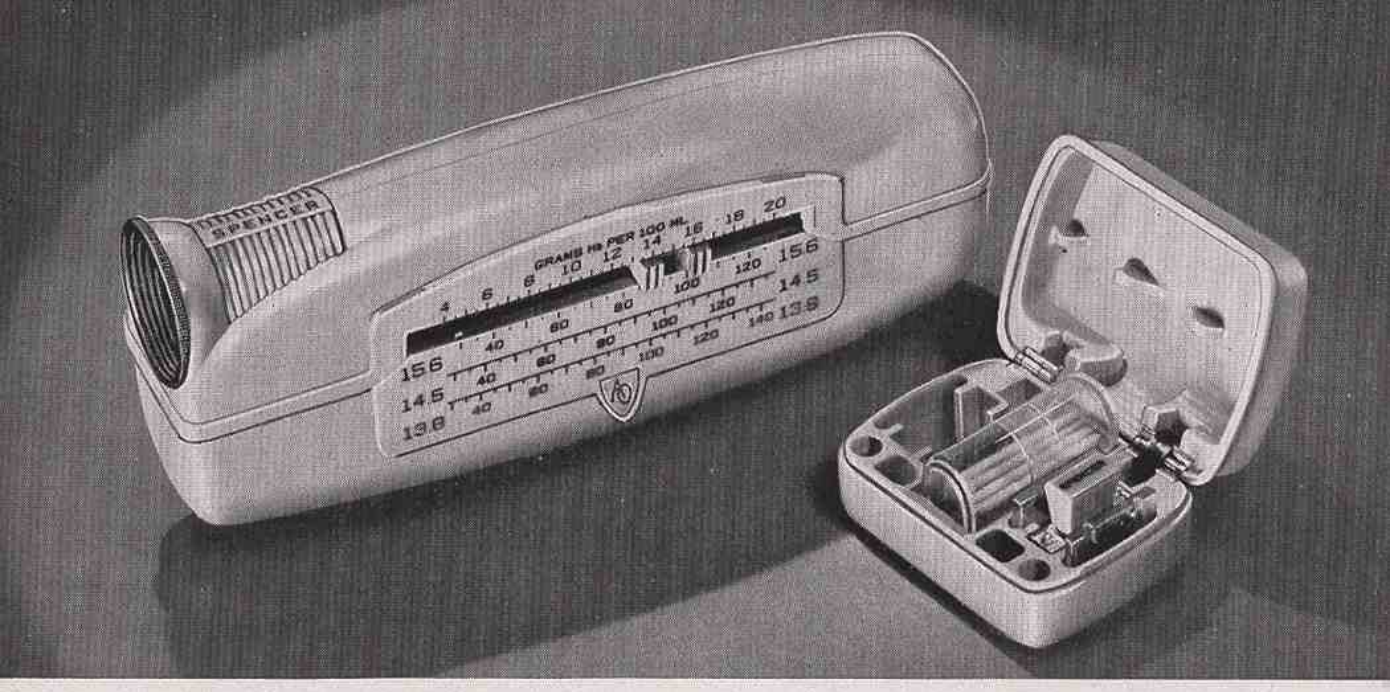
Every counting chamber is tested by exacting scientific methods. The National Bureau of Standards certification is available at a small additional charge.

The leatherette cases are plush-lined and provide space for the counting chamber, cover glasses, and pipettes. There is sufficient space in all Spencer microscope cabinets or carrying cases for a Haemacytometer.

The Spencer "Bright-Line" Haemacytometer is better—it must be seen under a microscope in an actual test to realize fully its advantages.

Standard Outfit Haemacytometer Listing

Cat. No.	Description	Price
1452	Certified Red Pipette	
1454	Certified White Pipette	
1456	Red Pipette	
1458	White Pipette	
1461	Cover Glass 0.4 mm	
1462	Certified Cover Glass 0.4 mm	
1463	Cover Glass 0.6 mm	
1482	Haemacytometer: chamber with Double Improved Neubauer Ruling, two 0.4 mm. cover glasses, one red and one white blood pipette, complete in cardboard case	
1483	Same as 1482 but with leatherette case	
1486	Same as 1482 but with chamber, cover glasses and pipettes certified	
1487	Same as 1483, but with chamber, cover glasses and pipettes certified	
1490	"Bright-Line" Counting Chamber, Double Improved Neubauer Ruling, without cover glasses	
1492	"Bright-Line" Counting Chamber, Double Improved Neubauer Ruling, with two 0.4 mm. cover glasses	
1494	Same as 1492, but with chamber and cover glasses certified	
1503	Cardboard Case for Haemacytometer	
1504	Leatherette Case for Haemacytometer	
307	Filter, green glass, to fit microscope substage	



The Spencer Hb-Meter No. 1000

Spencer Hb-Meter

For measuring the hemoglobin concentration of blood at the bedside or in the physician's office, the American Optical Company has designed a small hemoglobinometer in which a permanent glass wedge is used as a standard to make accurate colorimetric comparisons. No dilutions nor volumetric measurements are required. Less than three minutes is needed to make this simple determination with laboratory accuracy.

Wedge for Comparison

A definite thickness of hemolyzed blood is compared with a glass wedge having similar absorption characteristics throughout the wavelengths of light passed by the built-in eyepiece filter. The maximum absorption of hemoglobin occurs for visual light in the green band of the spectrum, and it is in this range that the comparison of hemolyzed blood and the glass wedge is made. Fortunately maximum visual sensitivity also occurs in the green range of the visible spectrum.

Precise Glass Chamber

The double chamber, similar to the haemacytometer, has an H-shaped moat which separates the two fields and spacing shoulders. A cover glass of equal thickness is held against the chamber by means of a metal clip. Two chamber plates may be used in place of a plate and cover in order to provide a double depth blood layer to increase the precision of measurement at low hemoglobin levels.

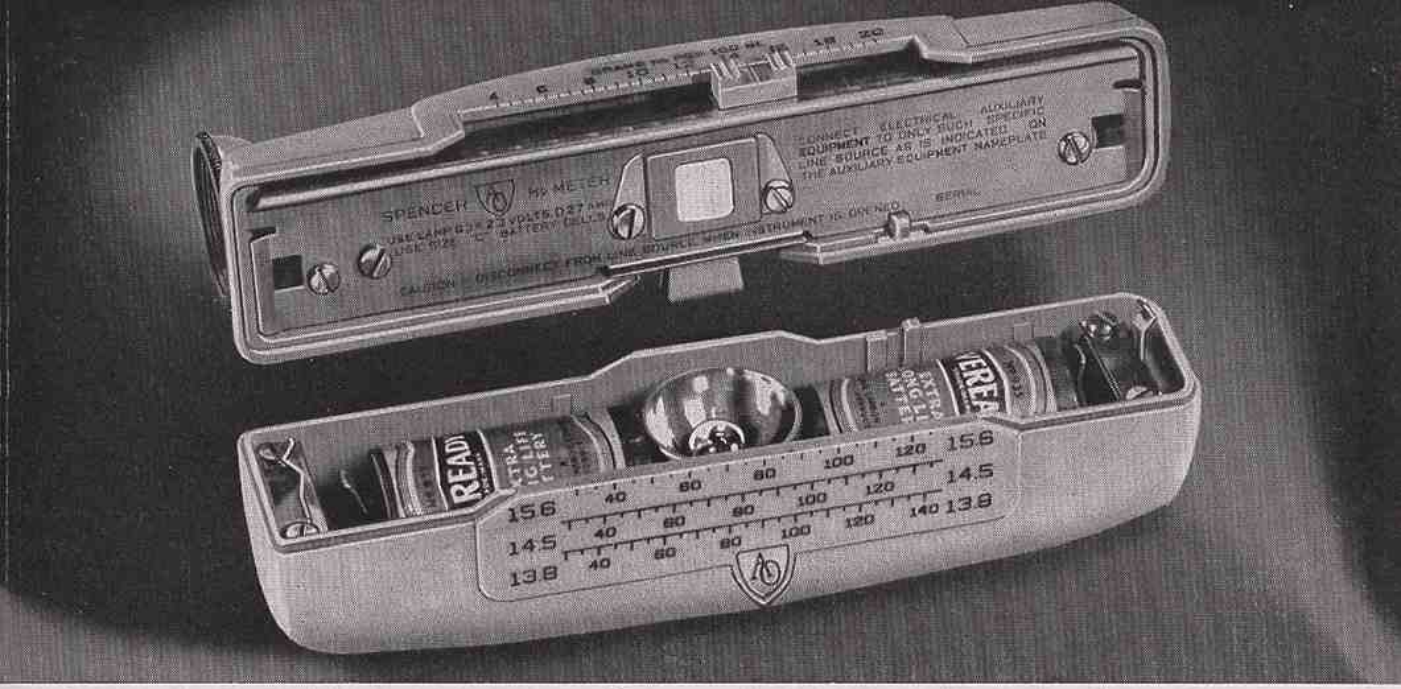
Blood Quickly Hemolyzed

With the chamber offset so that one plateau is exposed, a drop of blood is placed directly on it.

The drop of blood is then hemolyzed by agitating gently with a hemolysis applicator consisting of a small wooden stick tipped with a hemolyzing agent.

The hemolyzing process can be followed visually, and is complete when the blood loses its cloudy appearance and becomes a clear red solution. At this point the chamber is pushed completely into the clip, where it is held firmly against the cover glass as one unit. The complete clip is inserted in a slot in the instrument, and is now ready for use.

With laboratory samples of blood the hemolysis may preferably be made in a small test tube. The assembled chamber



Spencer Hb-Meter disassembled to show position of batteries and bulb

may then be filled with hemolyzed blood by capillary action and each side of the chamber may be used successively without cleaning between two samples.

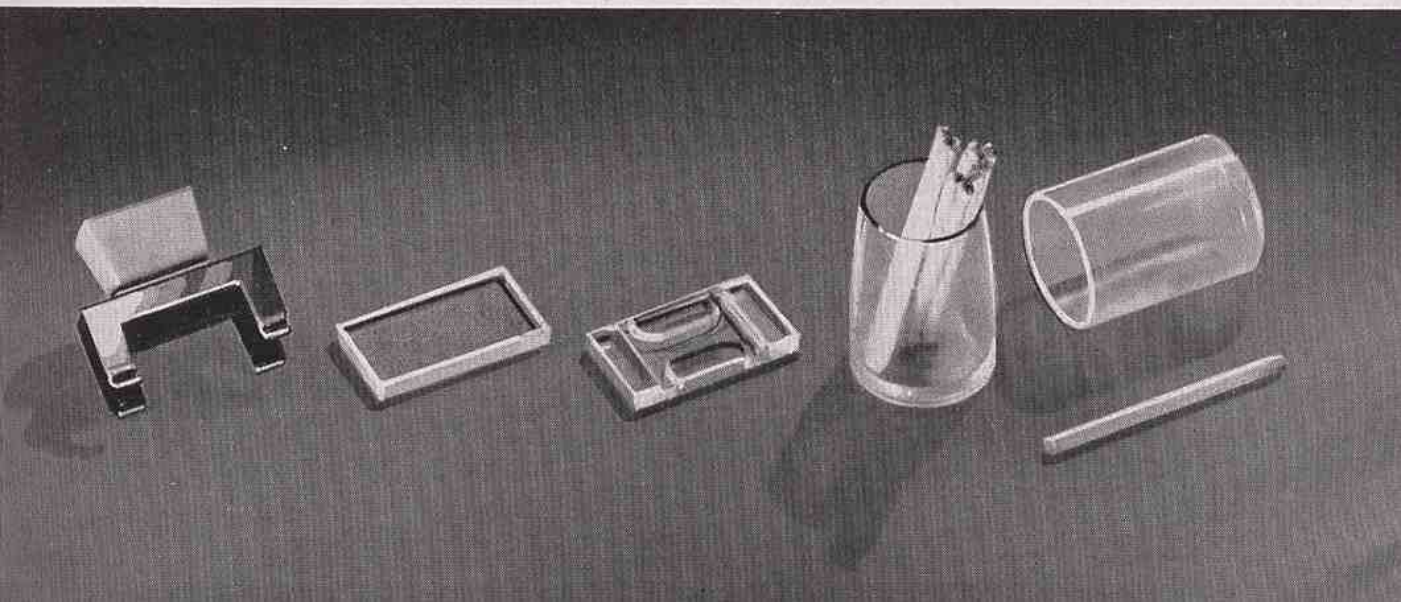
Built-in Illumination

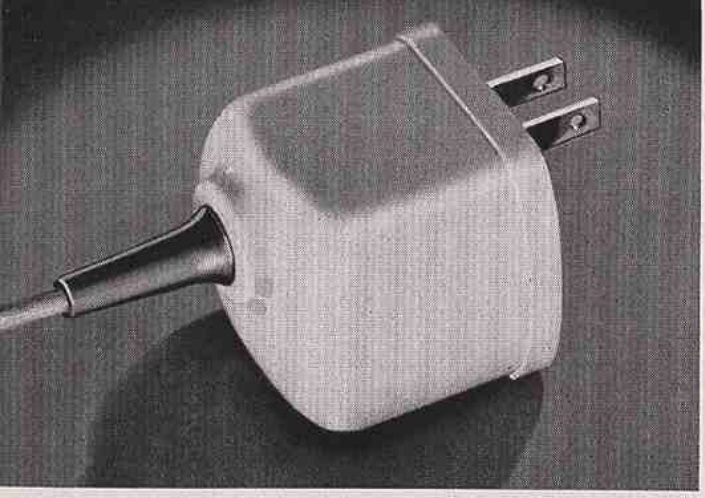
The Spencer Hb-Meter has its own built-in light source which can be operated either with batteries or from a 110-120 volt outlet by means of an accessory transformer or resistance. When the transformer is plugged in, the batteries are automatically cut out of the circuit. The lamp illuminates an aperture, one half of which is covered by a glass wedge, and one half by the chamber and cover glass when in position. Light coming through each half of the aperture is directed by a combination right angle biprism, and viewed through the eyepiece.

Direct Reading Scales

The glass comparison wedge is moved by a small metal knob extending through a slot in the side of the instrument. Once the fields have been matched, the hemoglobin concentration is read directly from the scale, using the index mark on the knob as an indicator. A single setting permits

Left to right: Clip, Cover Glass, Chamber, Hemolysis Applicators





Transformer No. 1025



Resistance No. 1030

reading of hemoglobin in grams per 100 milliliters, or in terms of percentage based on 15.6, 14.5, or 13.8 grams per 100 milliliters equalling 100 per cent.

Benefits from New Construction

1. The Spencer Hb-Meter yields hemoglobin determinations comparable with those of the best laboratory methods.

2. Complete readings can be made in 2 or 3 minutes.

3. Easily carried in the hand, in the pocket, or in the doctor's bag with his other instruments.

4. Matching of the green split field is easy and contributes to precision. The comparison wedge of permanent glass has light absorption characteristics almost identical with those of hemoglobin for the wavelength range in which comparisons are made.

5. The use of hemolyzed blood eliminates errors due to turbidity so that the intensity variations of light passing through the blood samples are caused only by true absorption of the light by hemoglobin.

6. Inexpensive, disposable hemolysis applicators are the only supplies necessary.

7. The instrument is easy to clean and dry for subsequent use.

Cat. No.	Description	Price
1000	Hb-Meter outfit, consisting of Hb-Meter, complete with 1 bulb and 2 batteries, in dust-proof pouch; accessory case containing one clip, one double-sided chamber, one chamber cover glass, and a vial of 25 hemolysis applicators.	
1002	Chamber Clip	
1003	Chamber Cover Glass	
1004	Chamber	
1005	Bulb, Mazda No. 233 (with purple bead)	
1006	Battery, standard size C flashlight	
1008	Dust Pouch	
1010	Accessory Case, empty	
1015	Complete Blood Chamber, consisting of clip, chamber cover glass, and chamber	
1025	Transformer, 50-60 cycle, for adapting Hb-Meter to 115 volt A. C. outlet	
1030	Resistance for adapting Hb-Meter to any 115 volt outlet	
1035	Hemolysis Applicators, 4 vials of 25 each, in box	

Spencer Microtomes

From the early "cutting engines" to the fine precision microtomes of today, many ingenious instruments have been developed to cut thin sections for microscopic investigation. Several outstanding designs were refined and improved by the engineering department. Numerous convenience features were added. Today, Spencer microtomes are recognized throughout the world as the standard instruments for fine work.

The various Spencer microtomes are described in the following pages.

ROTARY MICROTOMES are most convenient for cutting serial sections from paraffin embedded specimens up to 1½ inches.

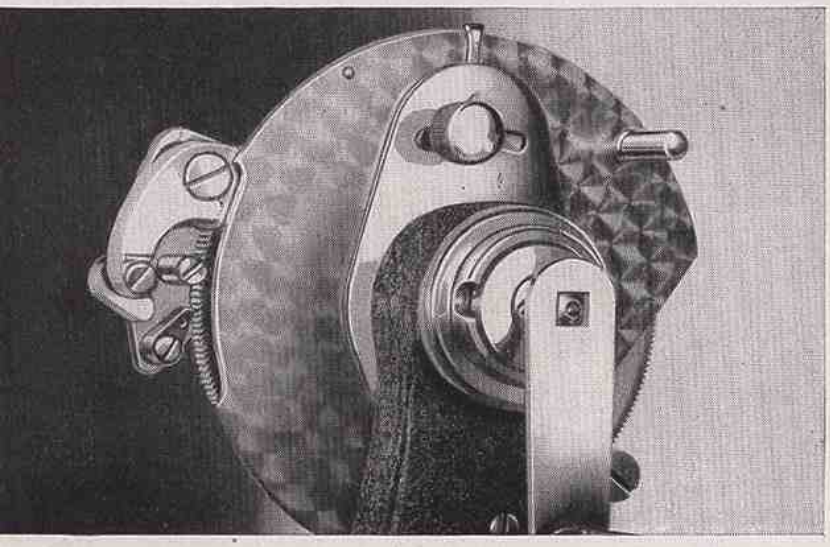
SLIDING MICROTOMES will accommodate larger specimens than rotary microtomes. They are used to cut materials embedded in celloidin, frozen and hard materials as well as those in paraffin.

AUTOMATIC CLINICAL MICROTOMES are useful where speed in examining frozen sections is important. They may be used to cut specimens in paraffin and celloidin.

TABLE MICROTOMES are used for demonstration of the principles of microtomy in the class room, preparing plant sections for class use and for occasional use not justifying a more complete instrument.

The Effective Use and Proper Care of the Microtome, an instructive booklet written by Oscar W. Richards, Ph.D., is available from the factory or any branch office at a cost of 25 cents. Staff scientists and technicians are ready at all times to answer questions and help solve your problems.





Above: No. 810 Rotary Microtome.

Left: The pawl turns the feed screw, automatically advancing the specimen, on the upward stroke.

No. 810 Rotary Microtome

Those who desire the convenience of a rotary microtome at a moderate cost will choose this model. It is sturdy, smooth in operation and balanced so that it can be stopped at any position.

Feed Mechanism

A feature of all Spencer Rotary Microtomes which protects the feed mechanism from shock is the complete independence of this mechanism from the vertical movement of the object. A spring holds the object block under tension in positive contact with the feed screw, but the block is free to move up and down as the crank is turned. The substantial feed screw is attached to a ratchet wheel. A pawl, working in the notches, feeds on the upward stroke and is released, returning free of the teeth on the downward stroke.

The total excursion of the feed is 22mm. Sections can be cut from two to forty microns in thickness. A crank at the end of the feed screw provides a convenient means of adjusting the object to the knife and of returning the object clamp to the beginning of the feed screw when starting a new series of sections. When the object clamp reaches the extreme forward position, the feed mechanism automatically ceases to work.

Object Clamp

The ball and flange type object clamp has three adjusting screws to hold the object rigidly in position and provide the means for orienting it to any desired position which may be changed in any plane without interfering with that already obtained in another plane. The entire clamp may be rotated on its axis if any one of the screws is loosened. Blocks 32mm. wide and 17mm. high may be used. By removing an adapter, a block 27mm. high is accommodated. Three object discs, 7/8", 1 1/8" and 1 1/2" in diameter are supplied.

Knife Holder

The holder is simple, rigid and easily adjusted to and from the object. The angle of the cutting edge is adjustable through a small arc.

Knife

Spencer No. 940 knife, 110mm. long and of the highest quality steel, is supplied complete with No. 960 back and No. 955 handle for sharpening.

Finish and Case

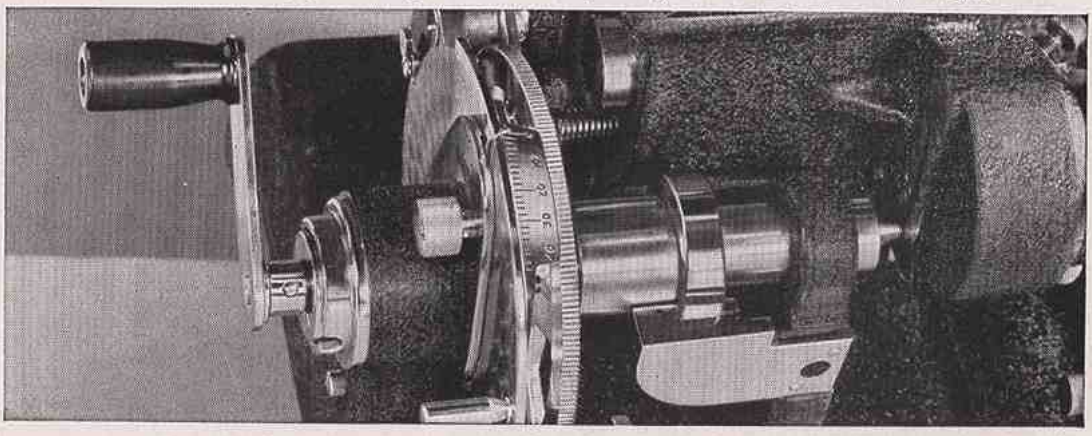
The finish is durable black alcohol-proof enamel and chromium plating. The instrument is shipped in a suitable wooden case.

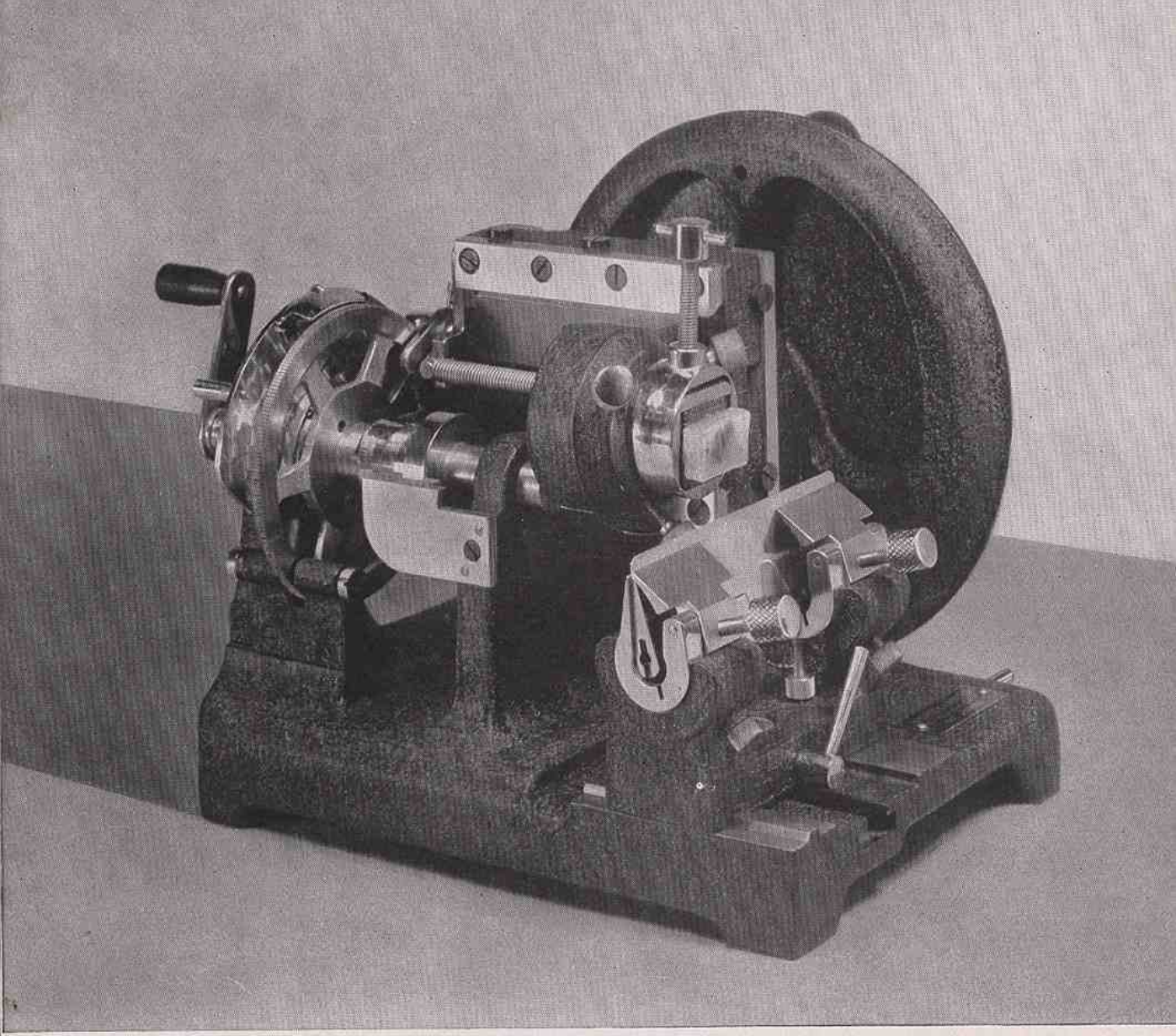
Size and Weight

Length 9 3/4" Height 8"
Width 8" Net Weight 31 lbs.

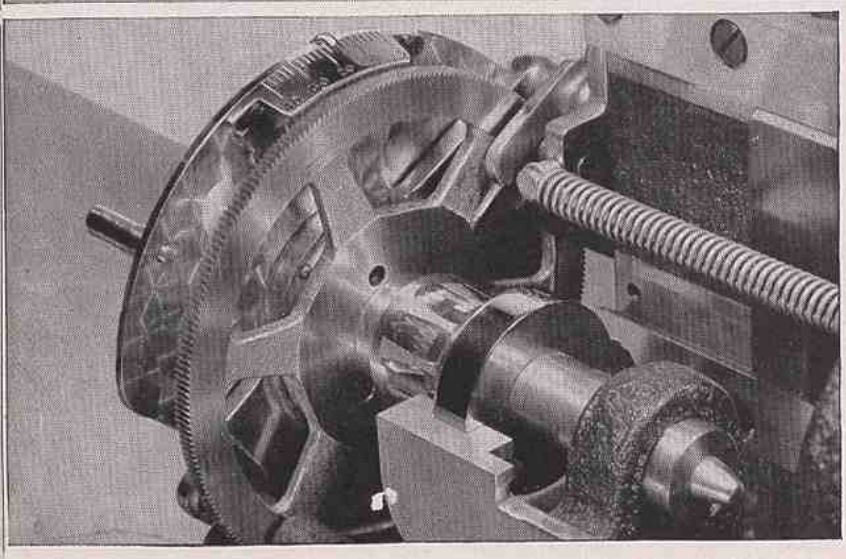
Cat. No.	Description	Price
810	Spencer Rotary Microtome with No. 940 knife, 960 back, 955 handle, three object discs and 969 oil can	

The feed mechanism of Spencer Rotary Microtomes is independent from the vertical movement of the object.





Above: No. 815 Rotary Microtome.



Left: The sturdy independent feed screw will cut specimens from two to forty microns in thickness.

No. 815 Rotary Microtome

Catalog No. 815 Rotary Microtome is of medium size and weight and provides extra smooth action as well as an adaptable type of knife holder.

Feed Mechanism

The feed mechanism is independent of the vertical movement of the object. The threads of the large feed screw are ground and lapped into the feed screw nut. The ratchet wheel, actuated by a pawl working in the notches, is attached to the feed screw and forward movement of the object block is accomplished only after the specimen has passed upward beyond the knife. The pawl is automatically lifted from the teeth of the ratchet wheel on the downward or cutting stroke.

Total excursion of the feed is 22mm. Sections can be cut from two to forty microns in thickness. A crank at the end of the feed screw provides a convenient means of adjusting the object to the knife and of returning the object clamp to the position necessary for starting a new series of sections. When the object clamp reaches the extreme forward position, the feed mechanism automatically ceases to work.

Object Clamp

The ball and flange type object clamp has three adjusting screws to hold the object rigidly in position and provide the means for orienting it to any desired position which can be changed in any plane without interfering with that already obtained in another plane. The entire clamp may be rotated on its axis if any one of the screws is loosened. For the usual work, blocks 32mm. wide and 17mm. high can be used. By removing an adapter a block 27mm. high can be accommodated. Three object discs, 7/8", 1 1/8" and 1 1/2" in diameter are supplied.

Knife Holder

Double width clamps each support the knife along 1 1/2" at the cutting edge and provide for tilting the knife.

Knife

Spencer No. 942 knife, 120mm. long and of the highest quality steel is supplied complete with No. 961 back and No. 955 handle for sharpening.

Finish and Case

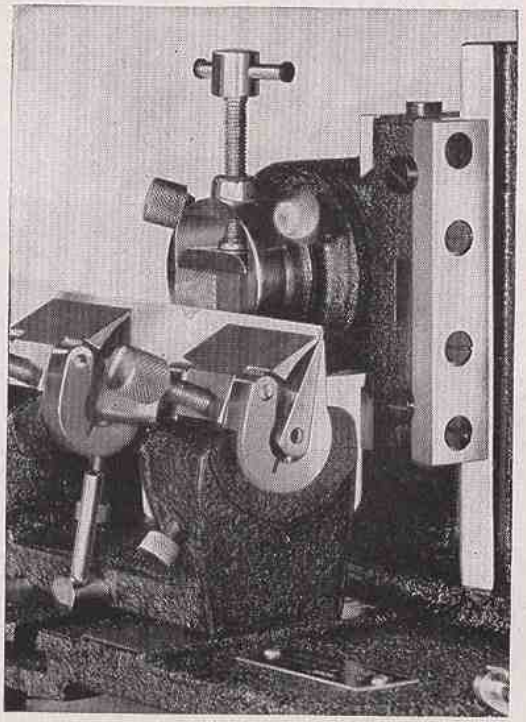
The finish is durable black alcohol-proof enamel and chromium plating. The instrument is shipped in a strong wood case.

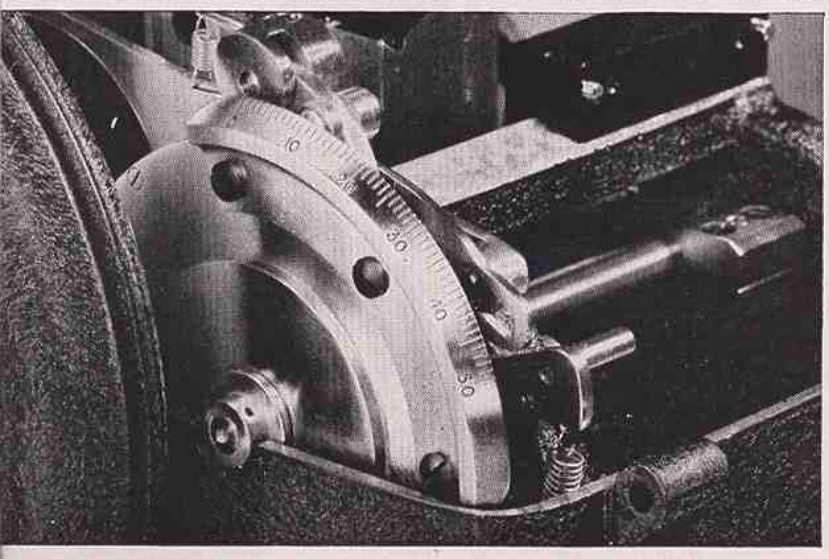
Size and Weight

Length 9 3/4" Height 8 1/2"
Width 8 1/2" Net Weight 38 lbs.

Cat. No.	Description	Price
815	Spencer Rotary Microtome with No. 942 knife, 961 back, 955 handle, three object discs and 969 oil can...	
	To substitute No. 827 knife holder on No. 815 add.....	

Slideways on Spencer No. 815 Microtome maintain the precision of object movement.





Above: No. 820 Precision Rotary Microtome.

Cover removed from Microtome No. 820 to show feed mechanism.

No. 820 Precision Rotary Microtome

The Spencer Precision Rotary Microtome No. 820 is designed for the most critical serial sectioning. It has proven outstanding for cutting sections as thin as one micron—for cutting serial sections of unvarying uniformity. There are probably more of these instruments than any similar type of microtome in laboratory use today. Their success arises from sound engineering, exactness in specification of the materials used, and from control throughout their manufacture. This instrument is rigid and massive in construction—yet precise and convenient to use.

Feed Mechanism

The feed mechanism—a very important element in a microtome—is entirely independent of the vertical movement of the object. It is built rigidly into the base casting. The extra large feed screw is carefully ground and lapped into the feed screw nut. The ratchet wheel is attached to the feed screw, and notched so that specimens may be cut any desired thickness from one to fifty microns. A pawl, working in the teeth, feeds on the forward stroke and is released, returning free of the teeth (preventing wear) on the return stroke. The force of the feed screw is transmitted to the specimen through an inclined plane. The setting is accomplished by turning a knurled button at the back of the case. The number representing the feed thickness appears opposite the indicator at the small opening in the side of the case near the balance wheel. A new positive feature on the feed mechanism facilitates the exact setting on the indicator so that even slight errors in setting are now impossible.

The total excursion of the feed is 28mm. allowing a sufficient range for cutting a long series without resetting the knife and the feed mechanism.

A crank at the end of the feed screw provides a convenient means of adjusting the object to the knife and of returning the object clamp to the beginning of the feed when starting a new series of sections. When the object clamp reaches the extreme forward position, the feed mechanism automatically ceases to work.

Object Clamp

The object clamp is the standard ball and flange type which has been such a valuable feature on Spencer microtomes. Three screws hold the object in position and provide the means for orienting it to any desired position. The entire clamp can be rotated on its axis if any one of the screws is loosened.

The object clamp is large enough to take a block 32mm. wide and 17mm. high, with an adapter that may be removed to provide for a possible height of 27mm. Three object discs are regularly supplied.

The up-and-down stroke of the object clamp is 2 inches, which permits the cutting of large sections and gives sufficient stroke for cutting celloidin material. The clamp is held at its upper limit, for orienting or trimming the block, by a lever under the balance wheel.

Knife Holder

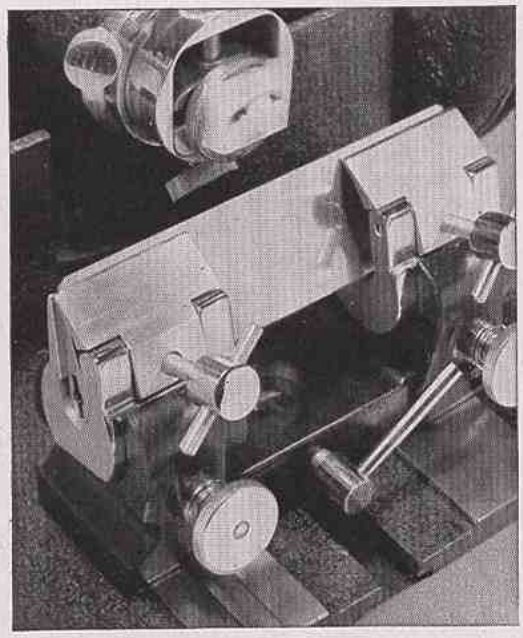
No. 820 Microtome is equipped with a rigid knife holder. There are two wide clamps each supporting the knife along 1¼ inches of the edge. The knife may be tilted through an exceptionally wide range of cutting angles. Adjusting screws provide for knives of different widths. The whole knife support is adjustable to and from the object, and is clamped easily and conveniently in any location by a lever operating with an eccentric cam.

Knife

Spencer No. 942 knife, 120mm. long and of the highest quality steel is supplied complete with No. 961 back and No. 955 handle for sharpening.

The amount of feed, in microns, is shown at the side of the case.





Wide clamps support the knife at the preferred cutting angle.

Case

The feed mechanism and other moving parts are covered to protect them from dust. The attractive cover of the instrument is hinged to the base casting, permitting easy access to the mechanism.

Finish and Cabinet

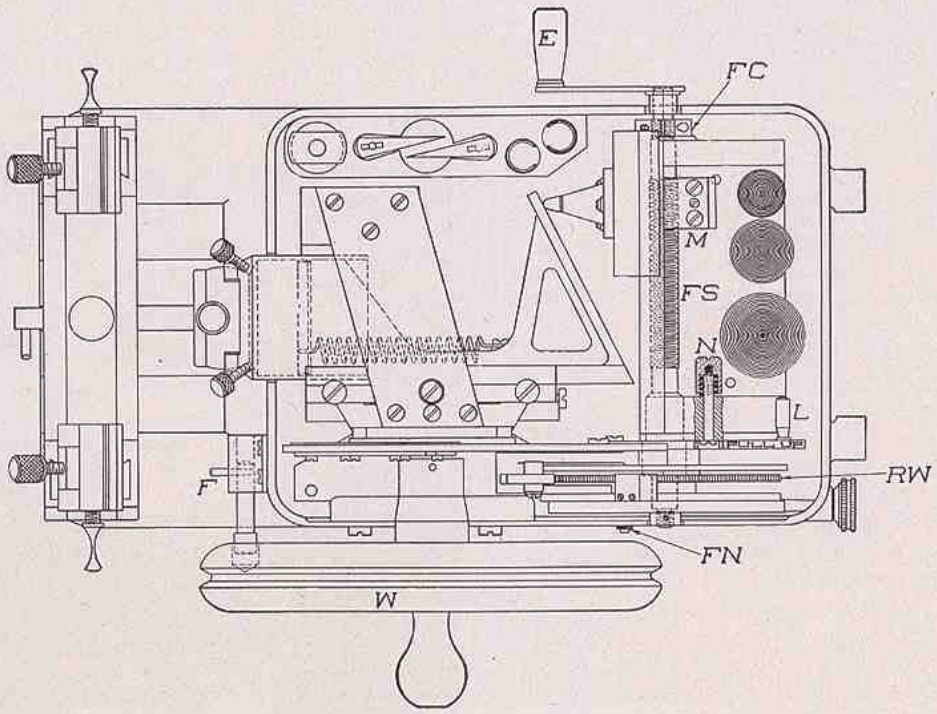
The finish is durable black alcohol-proof enamel and chromium plating. The instrument is shipped in a substantial oak cabinet having a hinged door with a latch.

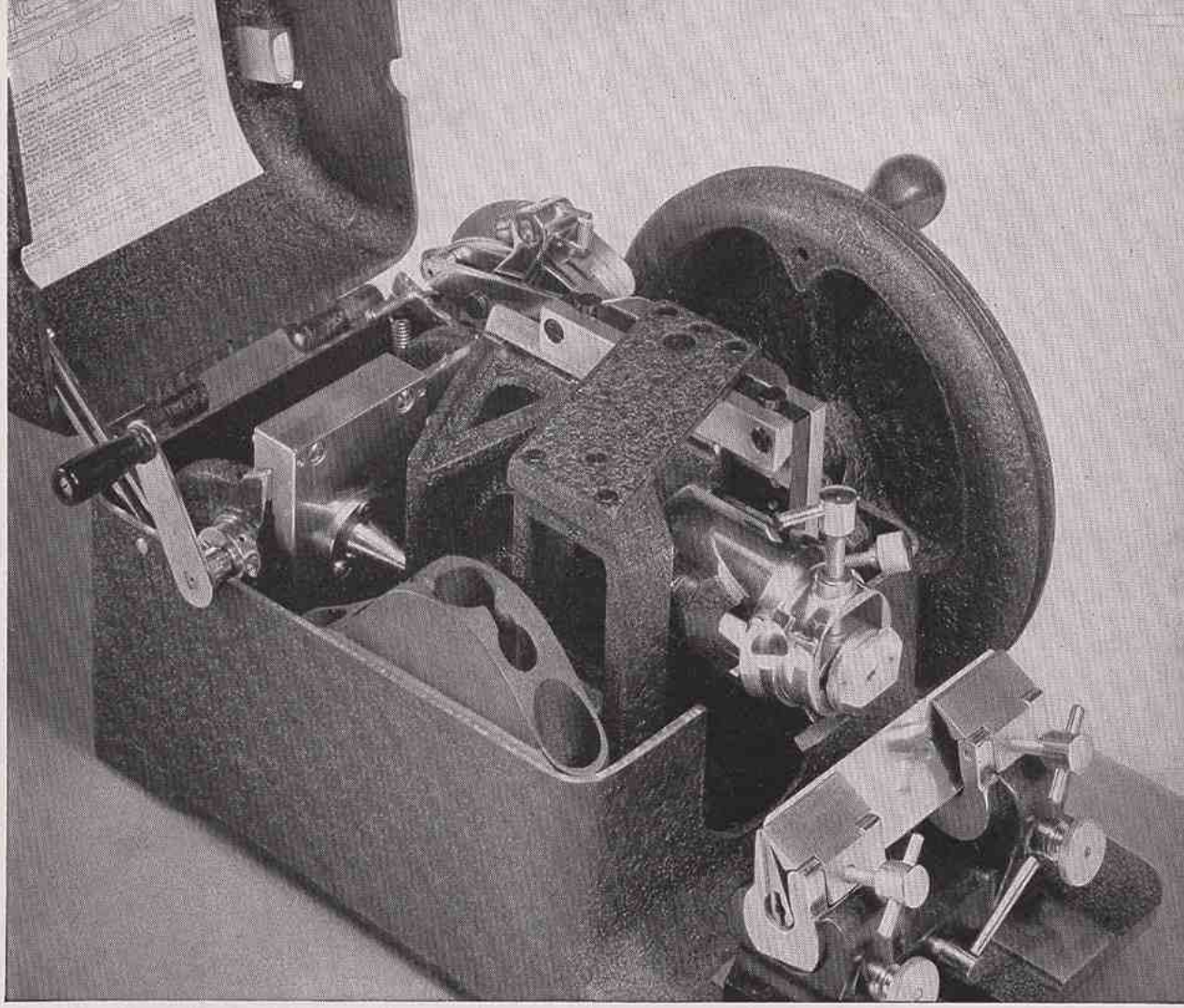
Size and Weight

Length 14″ Height 8⅜″
Width 8⅝″ Net Weight 60 lbs.

Cat. No.	Description	Price
820	Spencer Precision Rotary Microtome with No. 942 knife, 961 back, 955 handle, three object discs and 969 oil can	

Plan drawing shows the details of No. 820 Microtome. K, knife block; SE, knife clamp; E, feed crank; C, object clamp; F, locking lever; FC, thrust nut; P, feed screw tip; SP, inclined plane surface; FS, feed screw; M, feed screw nut; N, releasing plunger; FN, friction nut; RW, ratchet wheel; L, releasing lever.



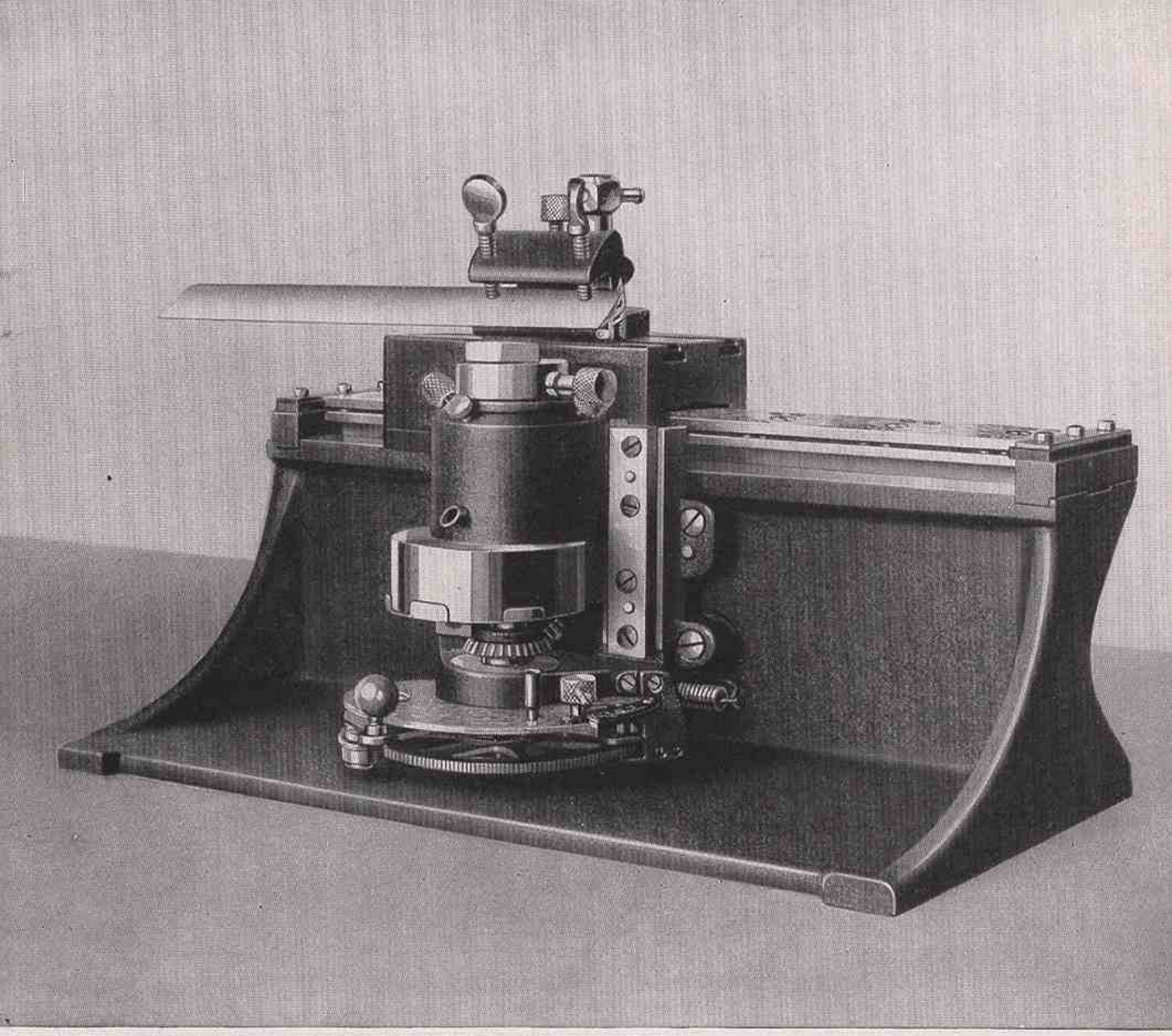


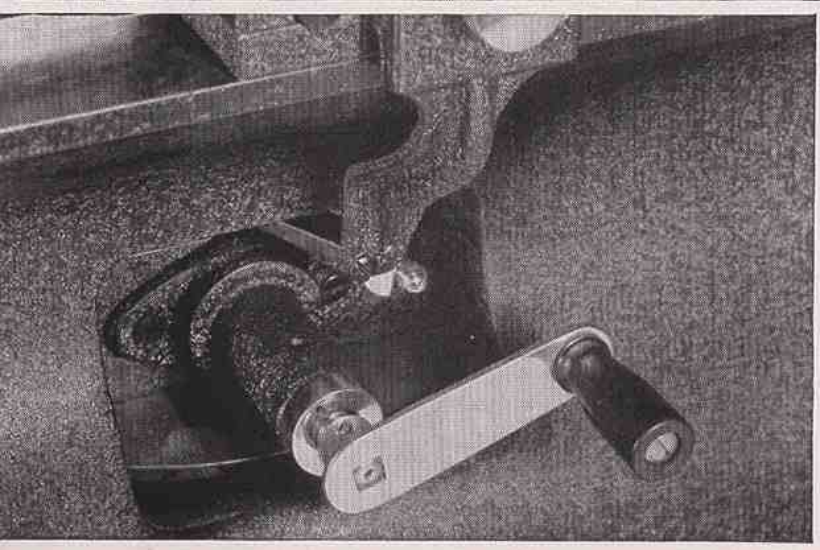
820 Microtome with hinged case open to show the independent feed mechanism and sturdy slides

Rotary Microtomes

Catalog Number	Unit of Feed Automatic	Excursion of Feed	Object Clamp	Knife Number	Knife Holder	Over-all size of Instrument	Approximate Net Weight in Pounds	Price
810	2 microns	22 mm.	Ball and Flange	940 knife 960 back 955 handle	Simple clamp cutting angle adjustable through small angle	9¾″ long 8 ″ wide 8 ″ high	31	
815	2 microns	22 mm.	Ball and Flange	942 knife 961 back 955 handle	Double supporting clamp with adjustable cutting angle	9¾″ long 8½″ wide 8½″ high	38	
820	1 micron	28 mm.	Ball and Flange	942 knife 961 back 955 handle	Double supporting clamp with cutting angle adjustable through wide angle	14″ long 8⅝″ wide 8⅜″ high	60	

Three object discs, ⅞, 1⅛ and 1½ inches in diameter, are supplied on all rotary microtomes.
All rotary microtomes have an object clamp that will accommodate object blocks up to 32x27 mm.





Above: No. 850 Sliding Microtome.

Left: A crank is geared to the feed screw for making quick adjustments.

No. 850 Sliding Microtome

When a wide variety of assignments including the cutting of frozen preparations, celloidin and hard specimens is likely to reach the laboratory, a Spencer sliding microtome is preferred. Rigid construction, freedom from play and smooth action are essential in obtaining uniform results. The two most important considerations are the knife slide and the feed mechanism. Success depends largely upon the precision of these two movements.

Knife Slide

Years of experience and continuous development account for the excellent slides on these Spencer microtomes, recognized by authorities to be an engineering achievement.

The knife block, 3″ wide and 5¼″ long, to which the knife is clamped, slides on a horizontal surface at the top of the main casting and is held in contact with the 13¼″ long top surface by carefully adjusted opposing bearings on the under surface. The oil contact between these different surfaces (15 square inches) produces an exceptionally easy action.

Feed Mechanism

The specimen, fed either automatically or by hand, moves upward at the end of each return stroke of the knife. Total excursion of the feed is 30mm., the specimen moving in units of two microns up to a maximum thickness of forty microns. An indicator shows the amount of feed in microns. Excess alcohol or water used in cutting drain into a removable drip pan provided for the protection of the feed mechanism. A crank, geared to the large (½″ diameter) feed screw, provides a rapid means of moving the object up to or away from the cutting position.

To maintain the accuracy of the feed, the bearings supporting the object clamp are heavy, wide and carefully fitted.

Object Clamp

The ball and flange type object clamp has three adjusting screws for orienting the specimen to any desired angle. By loosening any one of the screws the entire clamp may be rotated on its axis. An object disc 1½″ in diameter is supplied.

Knife Holder

Many different kinds of material may be handled since provision has been made for setting the knife at any angle to the direction of travel as well as tilted to any desirable cutting angle. A scale indicates the angle of tilt of the knife. Adjusting screws facilitate the use of knives of different widths.

Knife

Spencer No. 945 knife, 185mm. long and of the highest quality steel is supplied complete with No. 962 back and No. 955 handle.

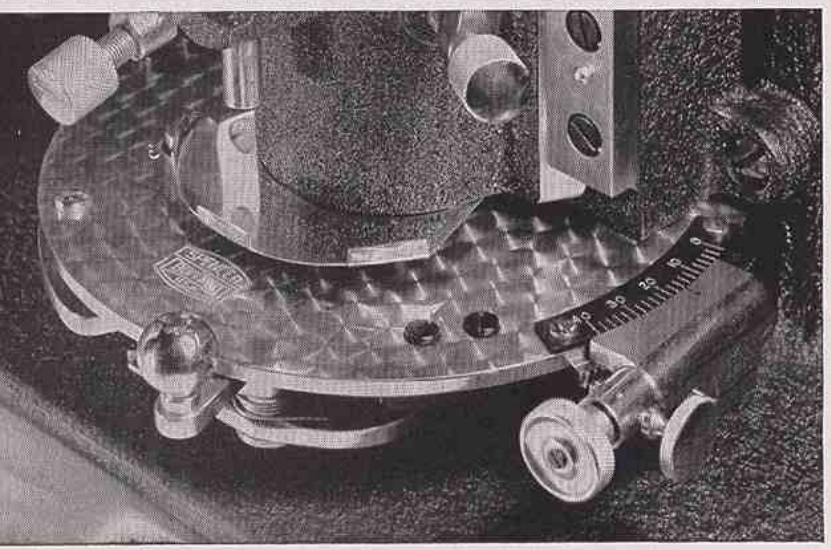
Finish and Cabinet

The finish is durable black alcohol-proof enamel and chromium plating. It is shipped in a substantial oak cabinet with handles and a hinged door with latch.

Size and Weight

Length 14½″ Height 11″
Width 10¼″ Net Weight 63 lbs.

Cat. No.	Description	Price
850	Spencer Sliding Microtome with No. 861 knife clamp, 945 knife, 962 back, 955 handle, one object disc, 1½″ diameter and 969 oil can.....	



Above: No. 860 Sliding Microtome.

Left: The feed mechanism can be set to cut sections automatically or by hand from 2 to 40 microns in thickness.

No. 860 Precision Sliding Microtome

This Spencer heavy duty sliding microtome is ideal for cutting large or unusually tough specimens. Extra overall size and weight make it capable of many assignments, such as cutting celloidin, paraffin embedded, frozen or hard preparations. No. 860 is the most useful microtome for the busy hospital or research laboratory.

Knife Slide

The knife block, 3½″ wide and 6″ long, to which the knife is clamped, slides on a horizontal surface at the top of the main casting. It is held in contact with the 16″ long top surface by carefully adjusted opposing bearings on the under side. The oil contact between these different bearing surfaces (20 square inches) insures an exceptionally easy action.

Feed Mechanism

The specimen may be fed automatically, and moves upward at the end of each return stroke of the knife. Total excursion of the feed is 42mm., the specimen moving in units of 2 microns up to a maximum thickness of 40 microns. An indicator determines the specimen thickness. Excess alcohol or water used in cutting drain into a removable drip pan provided for the protection of the feed mechanism. A crank, geared to the ½″ diameter feed screw, provides a rapid means of moving the object up to or away from the cutting position.

Object Clamp

The ball and flange type object clamp has three adjusting screws for orienting the specimen to any desired angle. By loosening any one of the screws the entire clamp may be rotated on its axis. An object disc 1½″ in diameter is supplied.

Feed Screw

The support for the object clamp is a large casting with wide, carefully fitted slide bearings, providing rigidity and freedom from lost motion.

Knife Holder

Provision has been made for setting the knife at any angle to the direction of travel as well as to any desirable cutting angle. A scale indicates the angle of tilt of the knife. Adjusting screws facilitate the use of knives of different widths.

Catalog No. 862 Adjustable Knife Holder, which supports the knife at both ends, is available at extra cost. It is recommended for cutting large specimens. It is described and listed with the microtome accessories.

Knife

Spencer No. 950 Knife, 250mm. long and of the highest quality steel is supplied complete with No. 963 back and No. 957 handle.

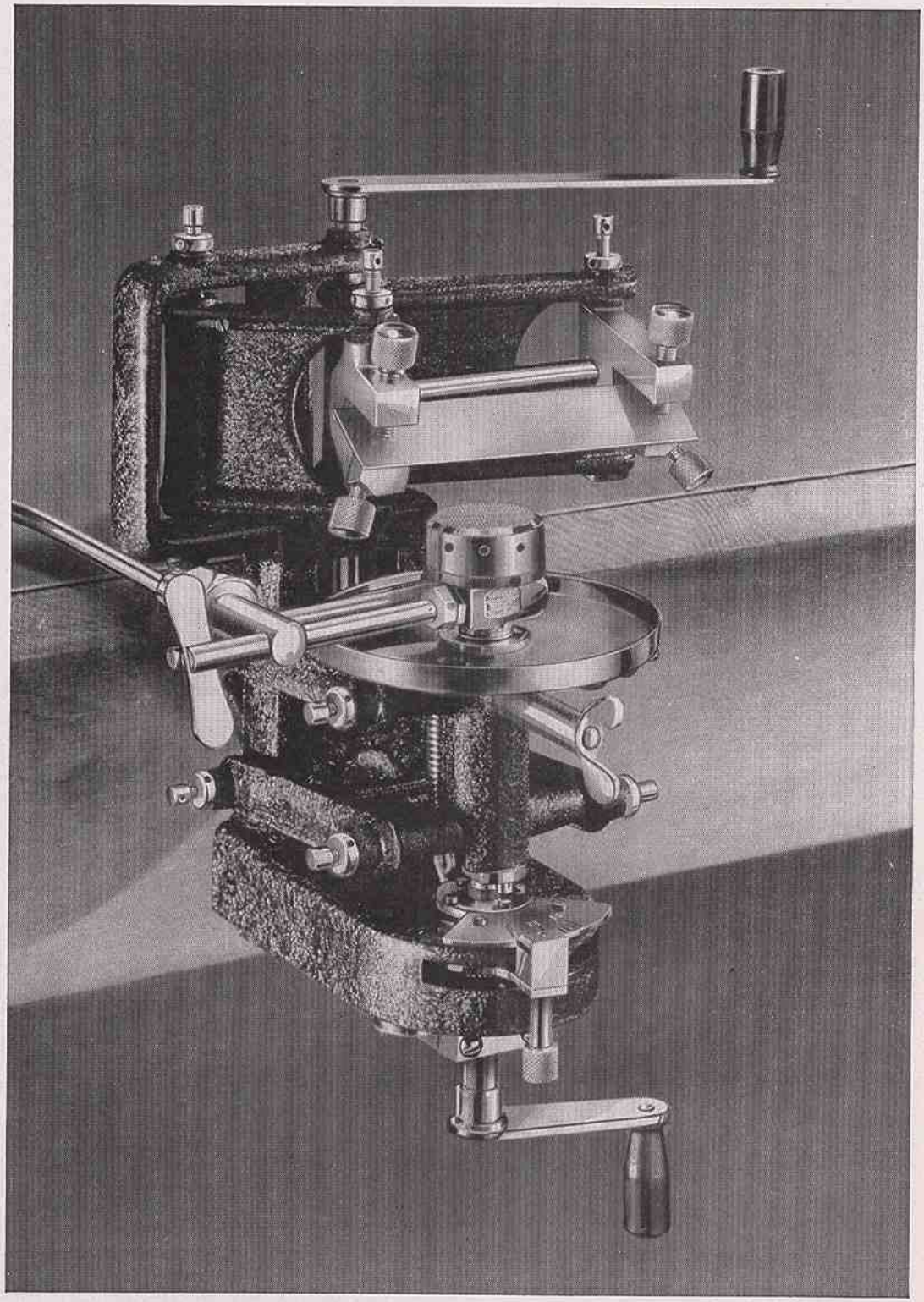
Finish and Cabinet

The finish is durable black alcohol-proof enamel and chromium plating. The microtome is mounted permanently on a heavy wood base and is shipped in a substantial oak cabinet with handles and a hinged door with latch.

Size and Weight

Length 17½″ Height 11½″
Width 11″ Weight 83 lbs.

Cat. No.	Description	Price
860	Spencer Precision Sliding Microtome with No. 861 knife clamp, 950 knife, 963 back, 957 handle, one object disc, 1½″ diameter and 969 oil can.....	



Above: No. 888 Automatic Clinical Microtome is completely equipped with freezing attachment.

No. 888 Automatic Clinical Microtome

Designed to fill a definite need in hospitals where speed is important to successful surgery, the No. 888 Microtome makes it possible to cut frozen tissue almost as fast as it can be mounted: in less than 1½ minutes from the time the tissue is placed on the freezing plate.

Feed Mechanism

The feed mechanism consists of a ratchet wheel keyed to a vertical feed screw which moves the specimen automatically with each stroke of the handle. It can be disengaged by setting at 0, or set to cut specimens from 5 microns to 50 microns in thickness. The graduations are in 5 micron intervals.

Freezer or Object Holder

The carbon dioxide freezing chamber and copper connecting tube, supplied as standard equipment, can be removed easily. For cutting paraffin or celloidin specimens a standard 1⅛" object disc is provided. A large drip pan, removable for cleaning, is mounted beneath the object holder.

Knife Holder

Two non-parallel arms hold the knife in such a way that the slicing cut utilizes much of the cutting edge. When the handle is turned, the knife describes a flattened arc corresponding to the double movement of free-hand sectioning.

The swinging arms and knife holder are sufficiently rigid to avoid deflection of the knife, thus assuring uniformity of thickness.

Table Clamp

The main supporting frame has a heavy clamp at the back by which the microtome can be fastened securely to the laboratory table.

Knife

Spencer No. 940 knife, 110mm. long and of the highest quality steel, is supplied complete with No. 960 back and No. 955 handle for sharpening.

Finish

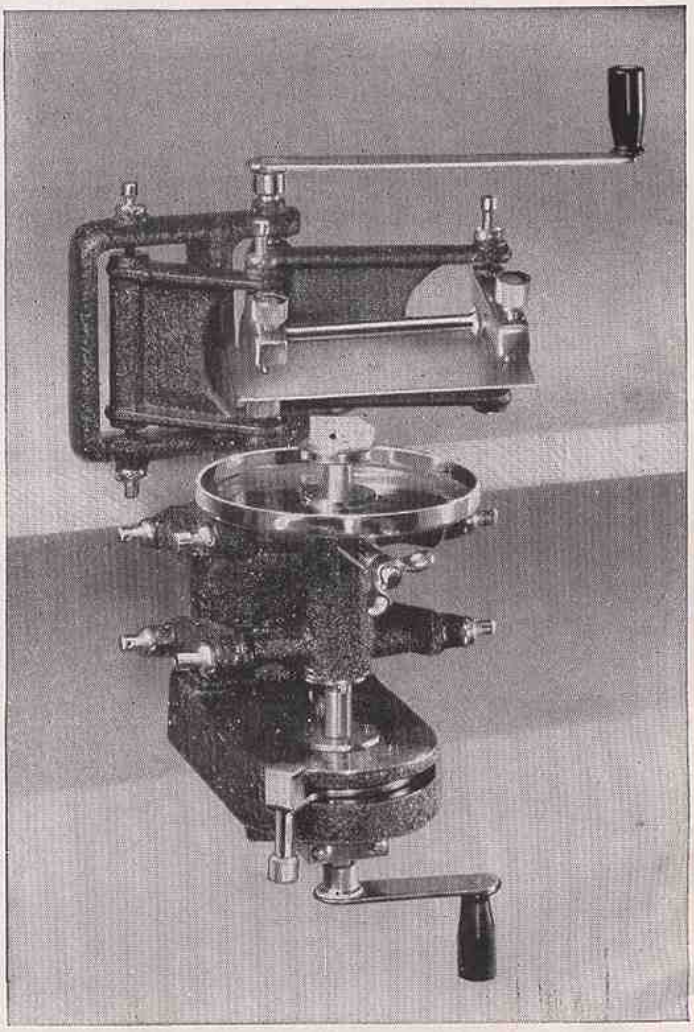
The finish is durable black alcohol-proof enamel and chromium plating.

No. 880 Automatic Clinical Microtome

This microtome is exactly the same as the No. 888 except that it is not equipped with the freezing attachment. The usual paraffin or celloidin sectioning is possible and, when necessary, a freezing chamber can be attached easily.

Cat. No.	Description	Price
880	Spencer Automatic Clinical Microtome with No. 940 knife, 960 back and 955 handle and with one object disc, 1⅛" diameter.....	
885	Object clamp for paraffin or celloidin	
888	Spencer Automatic Clinical Microtome with No. 940 knife, 960 back and 955 handle with one 1⅛" diameter object disc and 930 freezing attachment for CO_2.....	

No. 880 Microtome is the same as 888 but does not have the freezing attachment.



No. 900 Table Microtome

When speed is not essential and a hand operated feed is sufficient, No. 900 Table Microtome will be satisfactory. It is widely used in schools for section cutting in elementary biology and is adequate for much plant material. Using a razor or a microtome knife with handle attached, one can cut sections from 5 to 500 microns thick.

Feed

Movement on the parallelogram principle is regulated by a micrometer screw with graduated disc and index plate by which any desired thickness of sections may be cut in steps of 5 microns.

Object Holder

Specimens up to $1\frac{1}{16}''$ can be handled.

Knife Slide

Horizontal glass plates $3\frac{7}{8}''$ long by $\frac{7}{16}''$ wide provide travelling ways upon which the knife slides so that the knife will be supported for more than the length of the cut. A slicing cut may be made.

Table Clamp

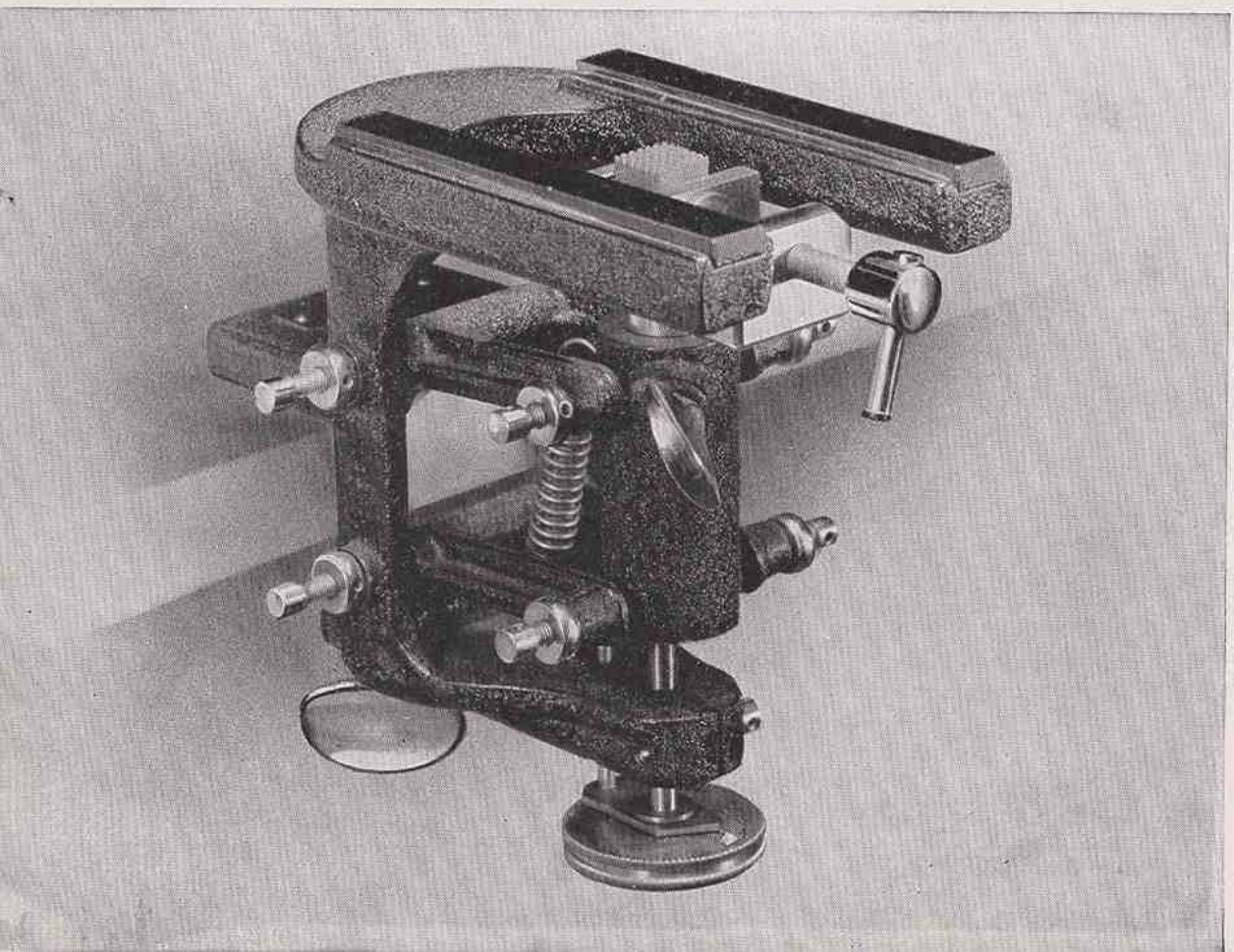
The main frame has a heavy clamp at the back by which the microtome can be fastened securely to the laboratory table.

Knife

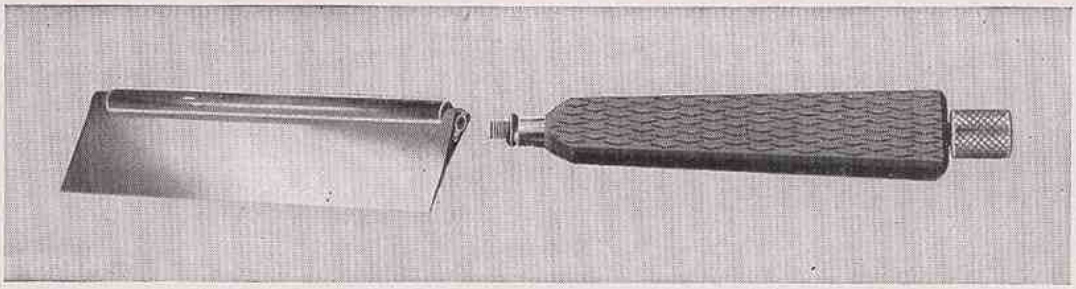
This microtome is supplied without a knife. Either a section razor (straight edge) or a Spencer knife with back and handle may be used.

Cat. No.	Description	Price
900	Spencer Table Microtome without knife	
902	Spencer Table Microtome without knife but with 930 freezing attachment for CO_2	

Below: The No. 900 Table Microtome.



Spencer Microtome Knives



Spencer Knife, Back and Handle.

Most of this space is devoted to the mechanical construction of microtomes, yet the finest microtome is useless without a good knife, properly sharpened and set at the right angle.

The Company has fully appreciated its responsibility to produce knives of the highest quality and has carried on continued research and experimentation. This theoretical work has supplemented the experience of manufacturing and sharpening many thousands of microtome knives since the start of the present century.

Today technical control throughout the manufacturing processes assures uniform quality. Steel is heated to the proper temperature—quenched to obtain the maximum hardness—partially drawn to bring out toughening characteristics—tested for hardness and micro structure, then finish-ground and honed for critical use in the laboratory.

Steel of a suitably high carbon content is specified for Spencer microtome knives to provide myriads of carbide particles (almost as hard as diamonds) imbedded in the matrix. These carbide particles maintain the maximum cutting efficiency.

Spencer knives are broad and heavy. They are sufficiently rigid to maintain a true edge even when cutting very large hard specimens.

SPENCER MICROTOME KNIVES

Cat. No.	Length in mm.	Type	For Use with Microtome				Price
940	110		810	880	888	900	
942	120		815	820		900	
943	120	Hollow Ground	815	820			
945	185			820	850		
946	185	Hollow Ground		820	850		
950	250		860				
951	250	Hollow Ground	860				

It is recommended that an individually fitted knife back be ordered with each knife. (See chart below.)

SPENCER MICROTOME KNIFE BACKS

Cat. No.	Length in mm.	For Use with Knife		Price
960	110	940		
961	120	942	943	
962	185	945	946	
963	250	950	951	

SPENCER MICROTOME KNIFE HANDLES

Cat. No.	For Use with Knife	Price
955	940 942 943 945 946	
957	950 951	

Sharpening Microtome Knives

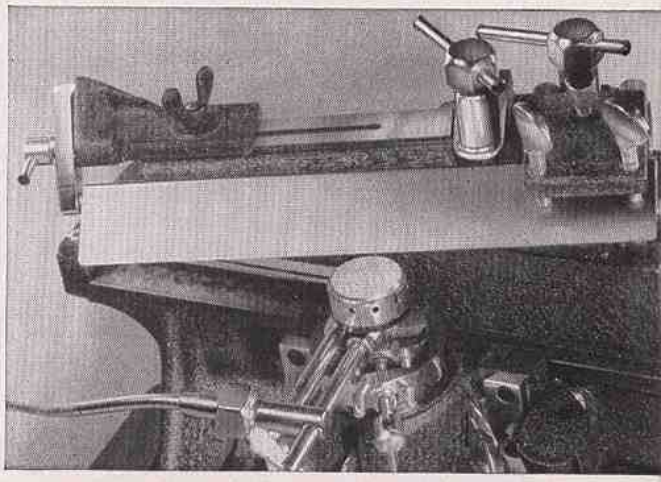
Special machinery has been developed for sharpening microtome knives and laboratory methods have been set up for testing them. All new knives are put into their original excellent condition with this method and it is just as useful for re-sharpening.

Cat. No.	Description	Price
	SHARPENING SPENCER KNIVES	
940	110 mm. knife	
942-43	120 mm. knife	
945-46	185 mm. knife	
950-51	250 mm. knife	

Knife Holders

Spencer Knife Holders prevent deflection of the knives, even with very tough materials. The wide clamps of the No. 827 hold the knife rigid at the edge. For the longer knives on the sliding microtomes, the No. 862 supports both ends firmly.

Cat. No.	Description	Price
827	Spencer Standard Knife Holder regularly supplied on No. 820 Microtome can also be supplied for No. 815	
861	Spencer Standard Knife Holder regularly supplied on Nos. 850 and 860	
862	Spencer Adjustable Knife Holder for supporting the knife at both ends may be used on No. 850 and No. 860	



Razor Blade Holder

The Spencer Holder No. 966 for safety razor blades can be used on any rotary microtome provided with a knife clamp except No. 810.

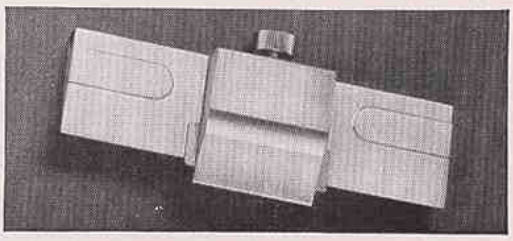
A new principle for holding the blade is used: a wedge, pulled into place by a screw, exerts even pressure throughout the length of the blade and the design is such that very little strength is necessary to tighten the blade immovably in place. Thus, rigidity equal to that of a standard microtome knife can be obtained.

There are two hard steel inserts dovetailed into the body of the holder which will prevent marking by the screws of the microtome knife holder.

Designed to hold any of the flat razor blades or non-backed knives not over 1 mm. thick, this holder is an efficient aid to good sectioning.

Cat. No.	Description	Price
966	Spencer Holder for safety razor blade for use on rotary microtome	
967	Gillette Microtome Razor Blade, extra heavy, per pkg. of 10	

Spencer Razor Blade Holder No. 966.

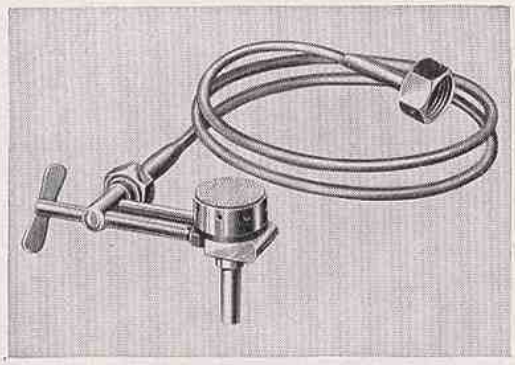


Spencer Freezing Attachment for CO_2 No. 930

The Spencer Freezing Attachment No. 930 incorporates an insulating ring between the knurled plate, to which the object is frozen, and the rest of the apparatus. This prevents the conduction of heat to the specimen from the other parts, thus saving time and gas.

The chamber is provided with a pin, like that on the object clamp, which fits into the socket on the microtome. The chamber is connected with the carbon dioxide cylinder by a flexible copper tube. This can be used on Nos. 850, 860, 880 and 900 microtomes.

In operating, the valve at the chamber should first be closed and the valve at the cylinder be slightly opened to admit the gas into the tube; then by opening and closing the small valve at the chamber in quick succession, the tissue is frozen without waste of gas or inconvenience caused by the chamber or connections freezing up.



Freezing Attachment No. 930 as used on No. 888 and 900 Microtome.

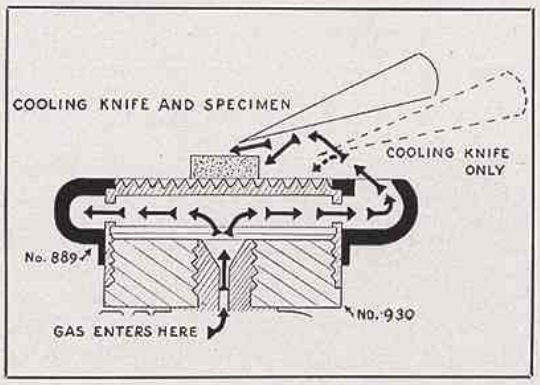
Cat. No.	Description	Price
930	Freezing attachment complete with copper tube connections with $1\frac{3}{16}''$ diameter freezing chamber.....	

Knife Cooling Deflector

The Knife Cooling Deflector fits around the specimen holder of the 930 Freezing Attachment and directs the exhaust gas against the under surface of the knife rather than in all directions around the head, thus cooling the knife simultaneously with the specimen.

The Deflector serves a dual purpose since some of the gas after striking the knife strikes the upper surface of the specimen which results in quicker and more uniform freezing of the specimen.

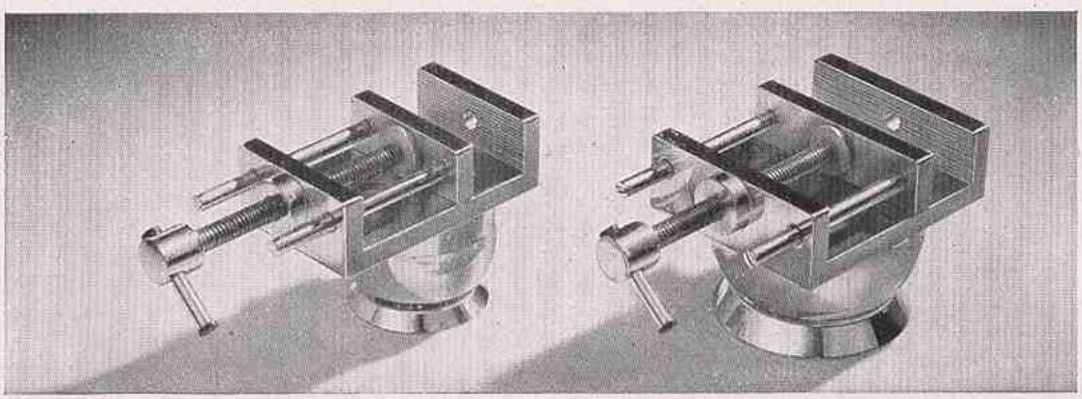
The amount of gas deflected on the tissue may be regulated by moving the knife nearer to or farther from the exhaust slot.



Knife Cooling Deflector No. 889.

Cat. No.	Description	Price
889	Knife Cooling Deflector.....	

Spencer Large Object Clamps



No. 828 Object Clamp. *No. 863 Object Clamp.*

The Spencer Large Microtome Object Clamps Nos. 828 and 863 are designed to hold larger specimens. No. 828 may be used on Spencer Microtomes Nos. 820, 815, or 850. No. 863 may be used on No. 860.

The No. 828 clamp is 1¾″ wide and the jaws will open a maximum of 1⅞″. The depth is ⅝″.

The No. 863 clamp is 2¼″ wide and the jaws will open a maximum of 2″. The depth is ⅝″. Both are heavily plated with nickel and chromium, and are easy to clean.

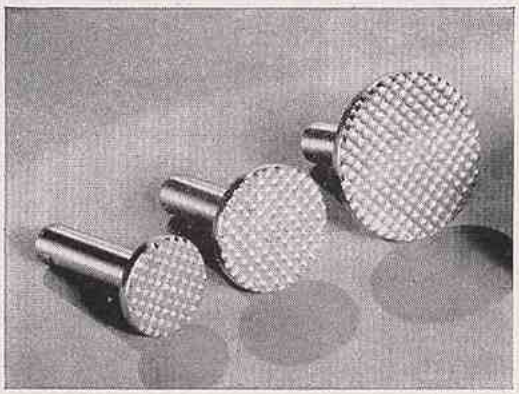
Cat. No.	Description	Price
828	Large Object Clamp, as described...	
863	Large Object Clamp, as described...	
885	Object Clamp for paraffin or celloidin for use on 880 Microtome.....	

Other Microtome Accessories

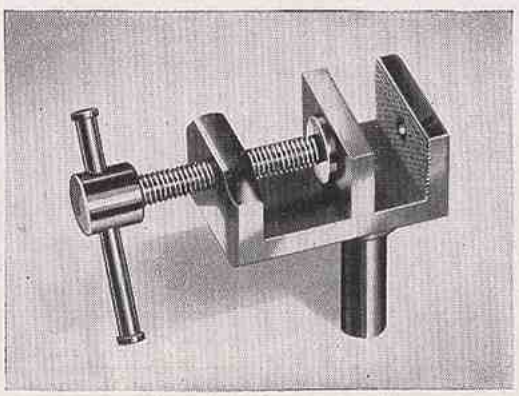
Cat. No.	Description	Price
813	⅞″ diameter object disc for all microtomes.....	
812	1⅛″ diameter object disc for all microtomes.....	

Cat. No.	Description	Price
811	1½″ diameter object disc for all microtomes.....	
969	Pike Oil for microtomes and hones—3 oz. can.....	

Object Discs No. 813, 812, 811.

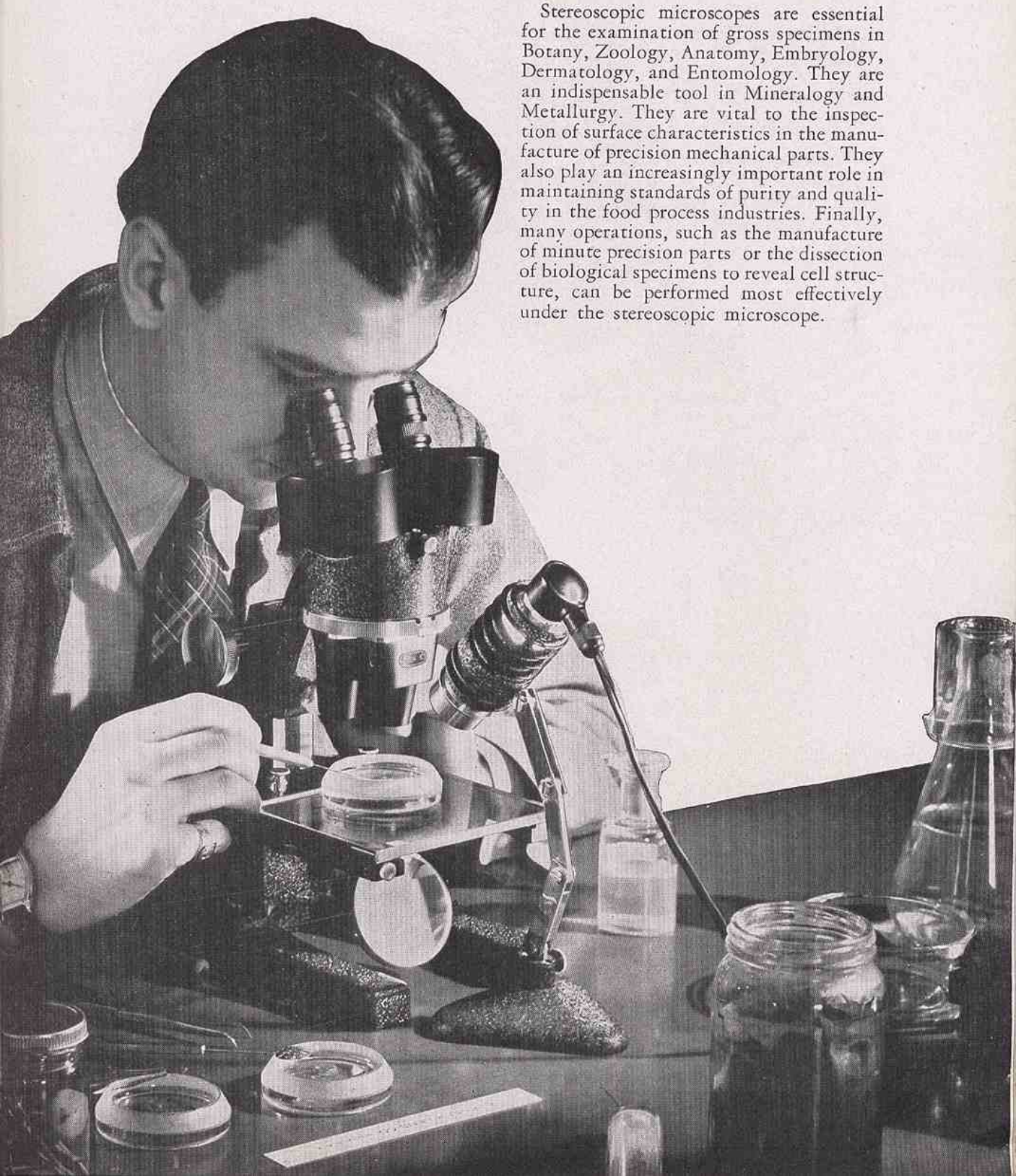


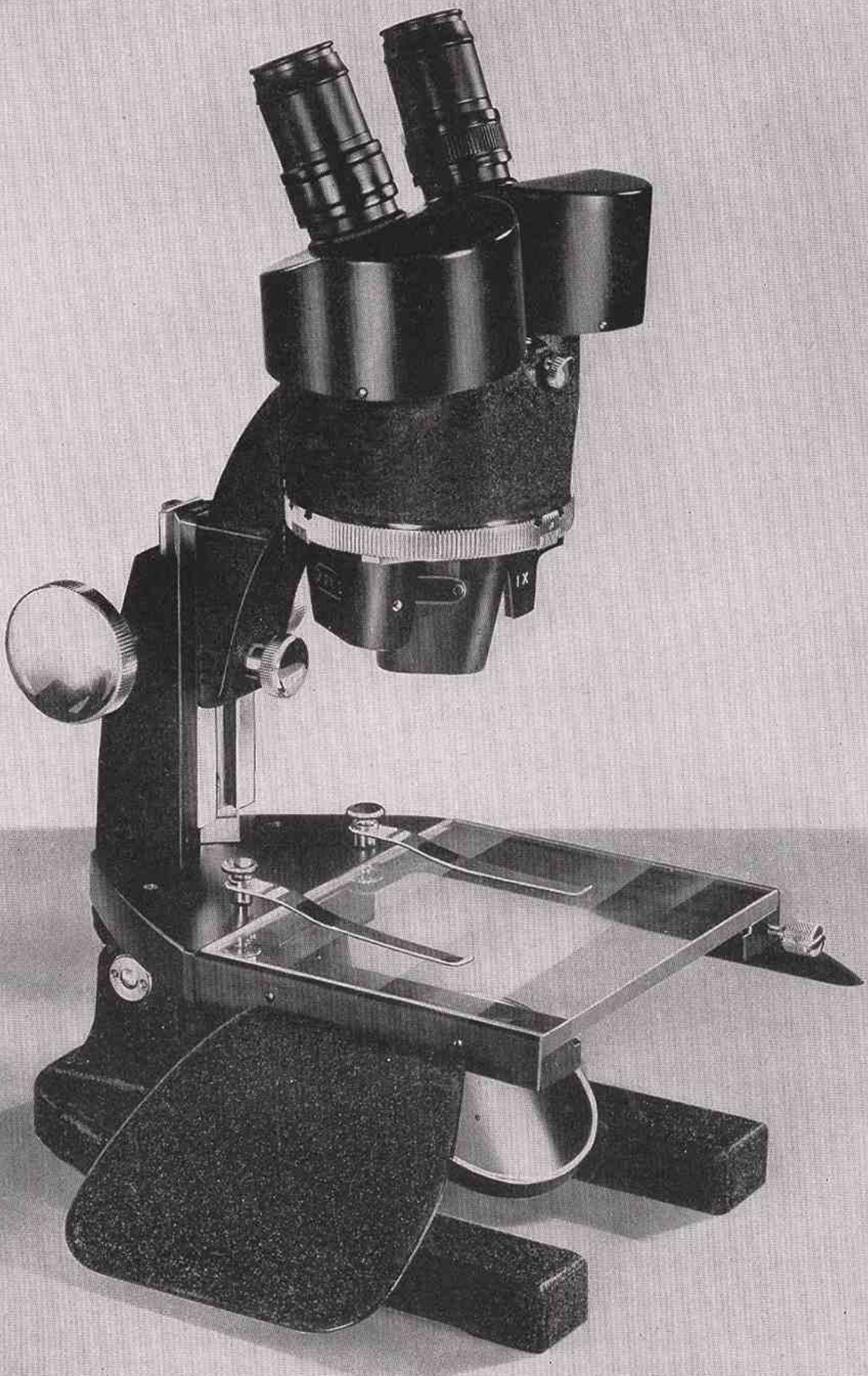
No. 885 Object Clamp.



Stereoscopic Microscopes

Stereoscopic microscopes are essential for the examination of gross specimens in Botany, Zoology, Anatomy, Embryology, Dermatology, and Entomology. They are an indispensable tool in Mineralogy and Metallurgy. They are vital to the inspection of surface characteristics in the manufacture of precision mechanical parts. They also play an increasingly important role in maintaining standards of purity and quality in the food process industries. Finally, many operations, such as the manufacture of minute precision parts or the dissection of biological specimens to reveal cell structure, can be performed most effectively under the stereoscopic microscope.




1X

Stereoscopic Microscopes

also commonly called

Greenough Microscopes
Binocular Dissecting Microscopes
Wide Field Binocular Microscopes
Low Power Binocular Microscopes

Two distinctive characteristics of Spencer Stereoscopic Microscopes make them especially adaptable for a wide variety of applications. First, the image is erect, rather than inverted as with the regular monobjective microscope, and all movements of the object appear in their actual directions, not reversed. Second, the image has a real and natural depth which shows the characteristics of the specimen in their true perspective, rather than flat.

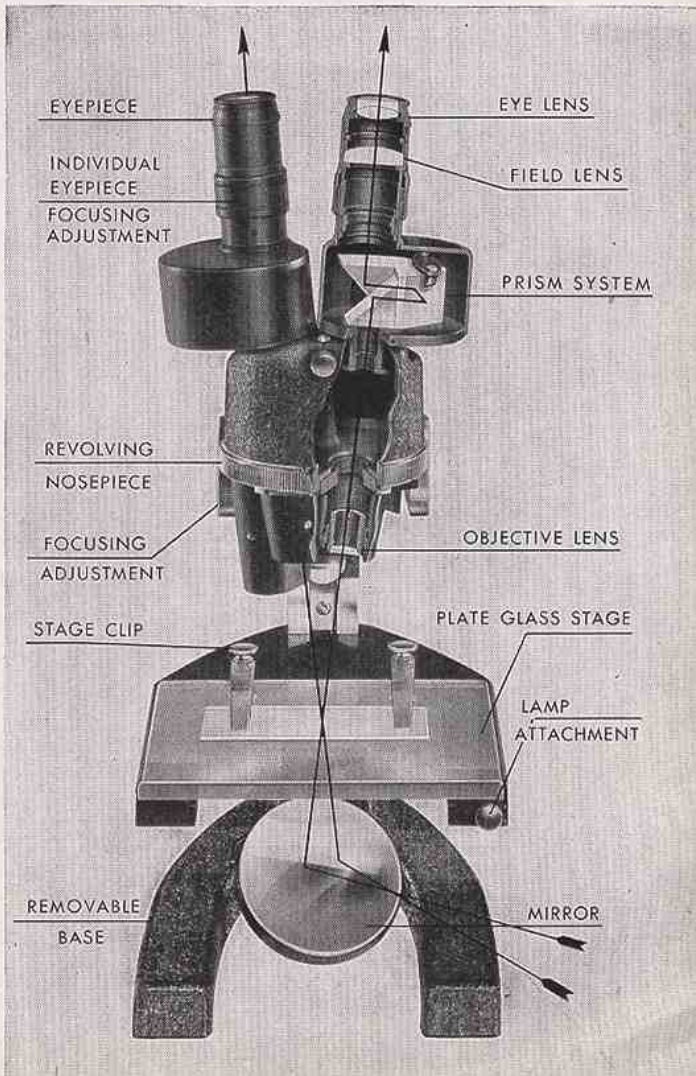
Features of Construction

The design of the prism system in all stereoscopic microscopes provides an erect image, so that in this respect all are equal. The unique prism system in Spencer Stereoscopic Microscopes, however, noticeably increases the perception of depth in the image. This is accomplished by having the axes of the paired objectives converging at 12°. The prism system then bends the pencil of rays 2° toward the center, so that the axes of the eyepieces converge at only 8°, which is the normal convergence of the eyes for reading and other close work. This accounts for the unusual comfort and ease in using the Spencer Stereoscopic Microscope.

Optical Features

Objectives

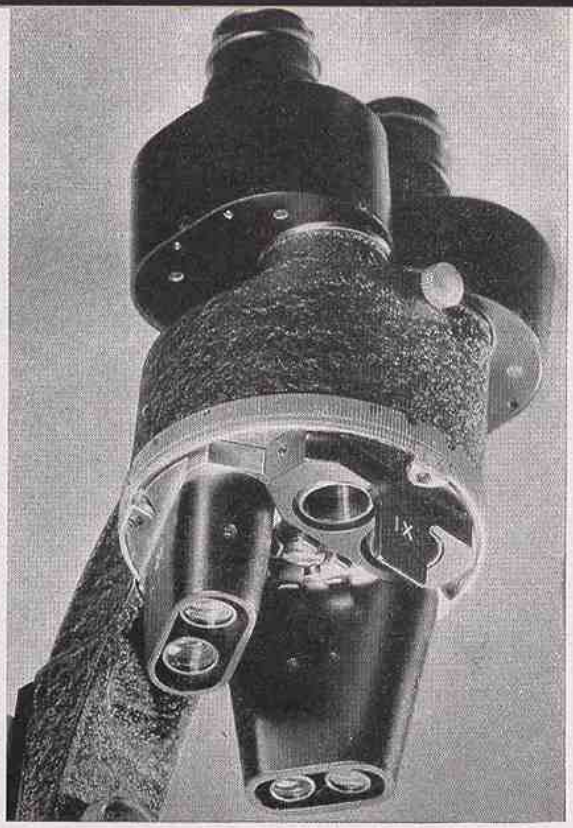
An important optical part of any microscope is the objective. Spencer paired objectives consist of two achromatically corrected lens combinations, centered and securely mounted in the holder. Satisfactory stereoscopic vision depends on depth of focus as well as angle. American Optical Company's scientists have found a



Spencer Stereoscopic Microscope No. 25LF.



Single paired objective adapter.



Multiple revolving nosepiece, showing three paired objectives.

practical balance between depth of focus and aperture, that provides depth as well as brilliant resolution.

The objective mounts are designed so that the objectives can be clipped quickly and easily on the nosepiece. Because of the positive method of attachment, the paired objective will always return to center.

Eyepieces

The eyepieces for the Spencer Stereoscopic Microscope are designed to cover the exceptionally large field made available by the objectives. They are corrected for both chromatic aberration and curvature of field. The eye lenses are large and have unusually high eye-points.

Range of Magnification

The wide range of magnification available on the Spencer Stereoscopic Microscope, from 6.3X to 144X, is a real convenience. Seven different powers in paired objectives, and four different powers in paired eyepieces provide a total of 23 different magnifications within this range.

Table of Magnifications and Fields of View

OBJECTIVES		EYEPIECES							
Designation	Catalog Number	9X Catalog No. 1184		12X Catalog No. 1185		15X Catalog No. 1186		18X Catalog No. 1187	
		Magnif.	Field	Magnif.	Field	Magnif.	Field	Magnif.	Field
0.7X	294	6.3	26.2mm.	8.4	24.6mm.	10.5	24.0mm.	12.6	16.5mm.
1.0X	295	9.0	19.7mm.	12.0	18.3mm.	15.0	16.8mm.	18.0	12.0mm.
2.0X	296	18.0	9.6mm.	24.0	9.0mm.	30.0	8.4mm.	36.0	6.0mm.
3.0X	297	27.0	6.5mm.	36.0	6.0mm.	45.0	5.6mm.	54.0	4.0mm.
4.0X	298	36.0	4.9mm.	48.0	4.5mm.	60.0	4.2mm.	72.0	3.0mm.
6.0X	299	54.0	3.3mm.	72.0	3.0mm.	90.0	2.8mm.	108.0	2.0mm.
8.0X	300	72.0	2.5mm.	96.0	2.2mm.	120.0	2.1mm.	144.0	1.5mm.

Two Binocular Bodies

In addition to the vertical binocular bodies, inclined bodies which have the eyepieces inclined toward the observer can be supplied at a small additional cost. Inclined bodies are available on all stands and are selected almost universally for research work, or in any application requiring prolonged periods of observation. The inclination of the eyepieces enables the observer to maintain comfortable posture. Eyes, neck, and shoulders are in a normal, restful position during observation.

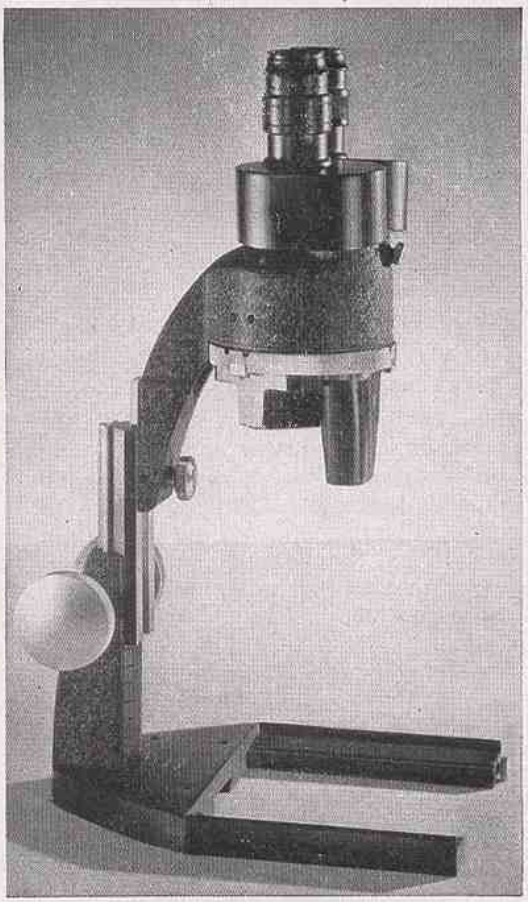
Mechanical Features

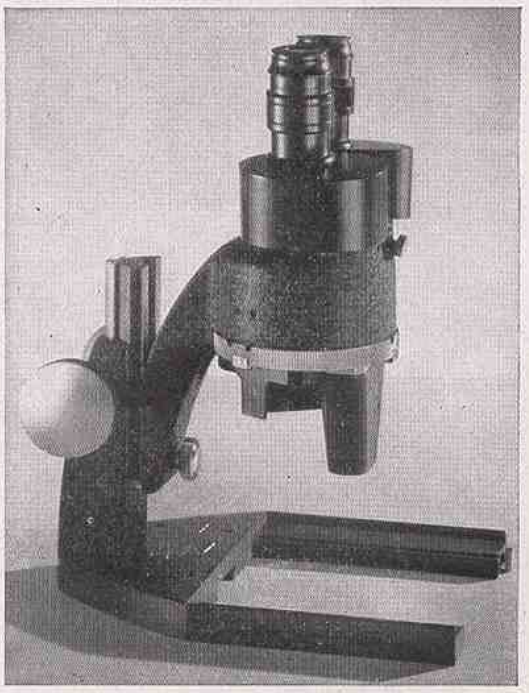
Adjustments

In addition to the adjustment for interpupillary distance, all instruments are provided with a means of adjusting one eyepiece to compensate for differences in vision between the eyes of the observer. Vertical adjustment of the microscope is by diagonal rack and spiral pinion. The microscope body is attached to the rack by means of a slide which greatly extends the range of movements over that which would be possible with the rack and pinion alone.

The Multiple Revolving Nosepiece

The multiple revolving nosepiece has important advantages. Dust will not settle on the back lenses of the objectives, because of the dust-tight construction of the nosepiece, nor on the front lenses, since the objectives are never tipped out of the vertical position. It will accommodate any three Spencer paired objectives and affords a most convenient means of changing magnifications. The periphery is knurled, providing a good grip to assure smooth rotation. The paired objectives not in use are between the optical axis and the arm. This arrangement facilitates rapid positioning of the specimen and eliminates the possibility of shadows on the subject under observation, as there are no parts extending out in front of the optical axis.





Illustrations show exceptionally great range of adjustment: top, set for high object; below, focused on table.

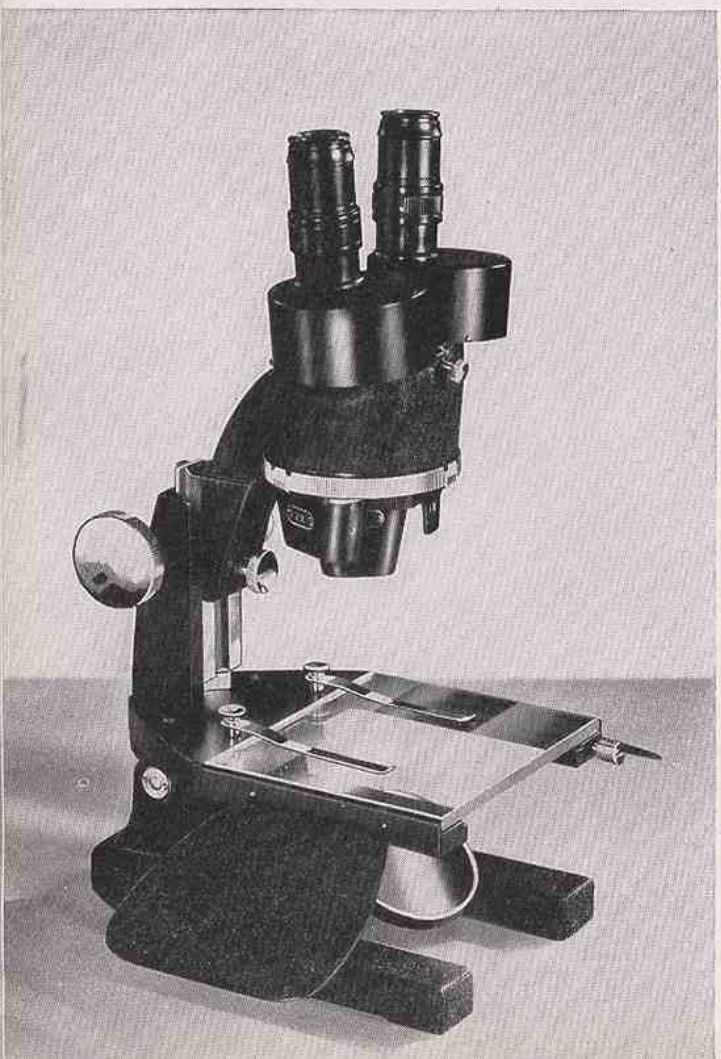
Spencer Stereoscopic Microscopes No. 25 and No. 25L

These microscopes are identical except for their binocular bodies. The No. 25 has a vertical binocular body. The No. 25L has an inclined binocular body. The angle of inclination is 22° from the vertical.

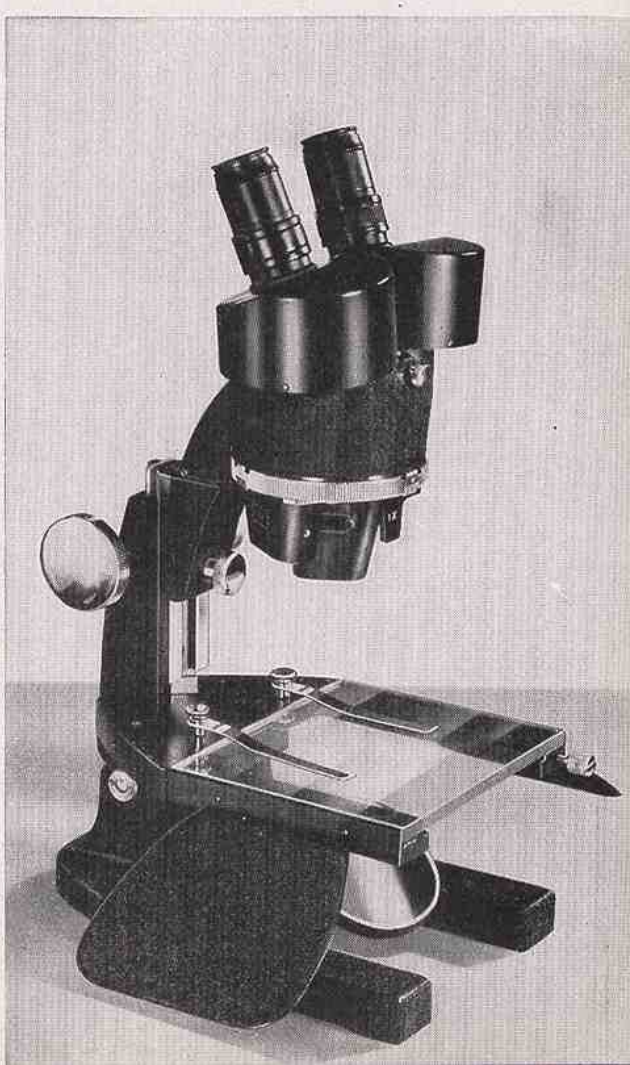
The Spencer Stereoscopic Microscope No. 25 is supported on a large, heavy, stable base, 5¼″ wide and 8″ long. Careful study was given to the stage height to provide sufficient space (3¼″) above the table, thereby insuring proper illumination from the large (60mm.) reversible mirror. As a result, maximum comfort can be maintained in manipulation. The large level stage, 5″ x 7″, has a flush top and provides for the use of the No. 484 ungraduated mechanical stage. The stage clips can be used in two positions so that a very large or a comparatively small object can be fixed securely in position. A long distance is provided (3½″) between the optical axes and the arm.

A 2⅛″ excursion of the rack and the movement in the slide mounting of the body gives a total range of 4½″ and makes possible observations on exceptionally large objects. The instrument has an inclination joint permitting inclination to

Spencer Stereoscopic Microscope No. 25F.



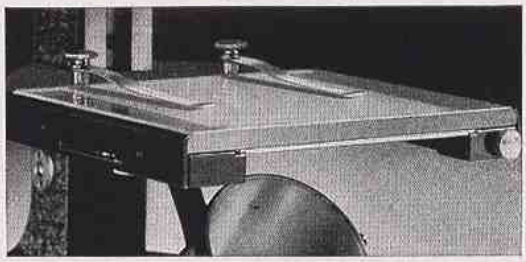
Spencer Stereoscopic Microscope No. 25LF.



an angle of 45° and insuring stability in any position. A metal background plate, black on one side and white on the other, fits into a slot beneath the glass stage. The glass stage is removable so that it can be washed easily when dirty, or replaced with a new one if damaged.

A thumb screw holds the base and upper part of the instrument together. By releasing this screw, the base can be removed if it is found desirable to use this instrument as No. 26. Hand rests are included.

A selection of various optical combinations which have proved most generally useful is shown below. The stands are also listed without optics, so that by selecting objectives and eyepieces listed on page of accessories and consulting the price list, the price of any combination for individual requirements can be readily determined.



The large level table, shown above, has a flush top.

The equipments listed are only suggestions for useful combinations. The purchaser can make up his own equipment by taking the price of stands 25A or B and 25LA or LB and adding to them the objectives and eyepieces desired. See page of accessories for listings of these optics.

Cat. No.	Description	Price
25A	Spencer Stereoscopic Microscope stand with vertical binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.....	
25B	Same as above but with **multiple** revolving nosepiece.....	
25C	Spencer Stereoscopic Microscope with vertical binocular body, having a single paired objective adapter, with 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. Furnished in a leatherette covered hardwood cabinet.....	
25F	Spencer Stereoscopic Microscope with vertical binocular body, having a multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.....	
25G	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.....	
484	Mechanical Stage to fit No. 25....	

Cat. No.	Description	Price
25LA	Spencer Stereoscopic Microscope stand with inclined binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.....	
25LB	Same as above but with **multiple** revolving nosepiece.....	
25LC	Spencer Stereoscopic Microscope with inclined binocular body, having a single paired objective adapter, with 2X paired objectives, 9X paired eyepieces. Magnification 18X. Furnished in a leatherette covered hardwood cabinet.....	
25LF	Spencer Stereoscopic Microscope with inclined binocular body, having a multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.....	
25LG	Spencer Stereoscopic Microscope with inclined binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.....	

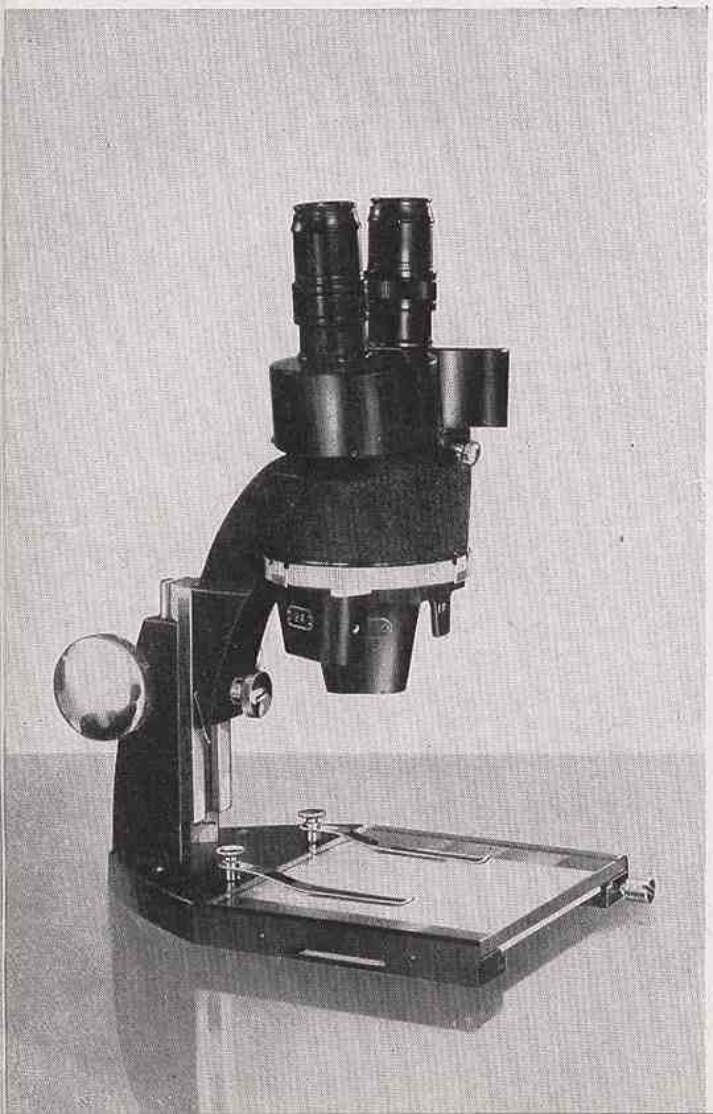
Spencer Stereoscopic Microscope No. 26 and No. 26L

These microscopes are identical except for their binocular bodies. The No. 26 has a vertical binocular body. The No. 26L has an inclined binocular body. The angle of inclination is 22° from the vertical.

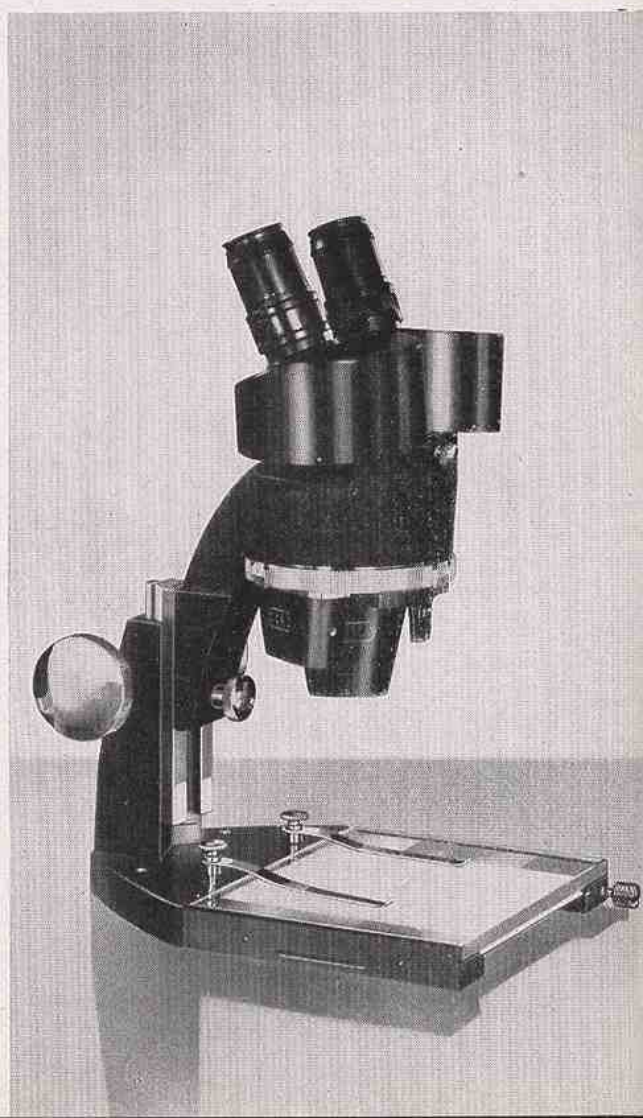
The Spencer Stereoscopic Microscope No. 26 is the same as the upper part of No. 25, but with the V base, mirror, and inclination joint removed. The glass stage is removable. The arm may be lowered to a point where (with the glass stage removed) one may focus on any portion of any large area on which the instrument may be placed. This instrument is satisfactory for any work where transmitted light is not used, and it can be equipped with a base and converted into a No. 25 at any future time.

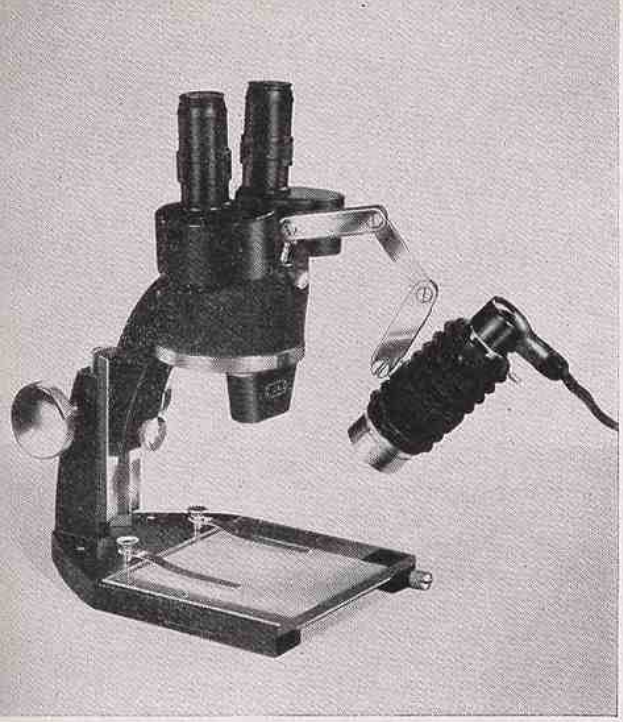
The equipments listed are only suggestions for useful combinations. The purchaser can make up his own equipment by taking the price of stands 26A or B and 26LA or LB and adding to them the objectives and eyepieces desired. See page of accessories for listings of these optics.

Spencer Stereoscopic Microscope No. 26F.

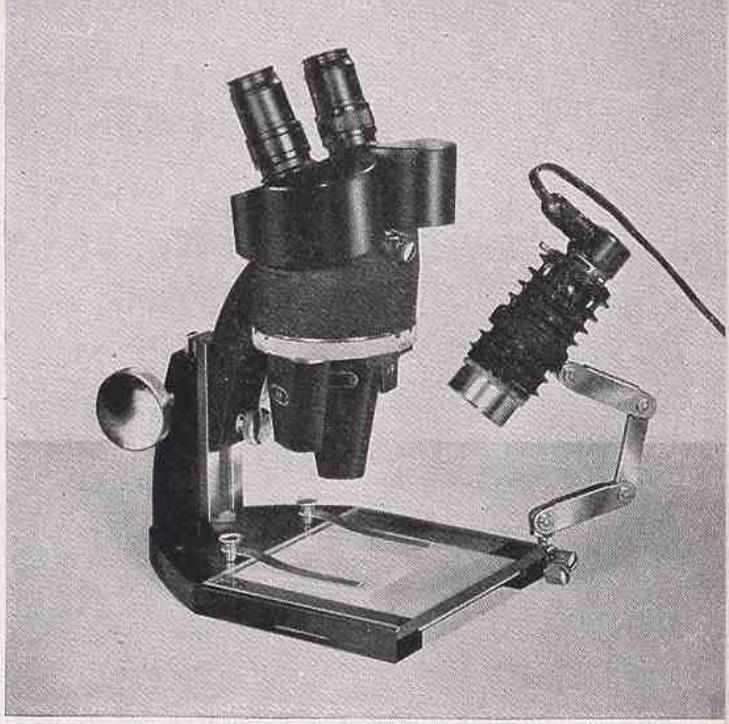


Spencer Stereoscopic Microscope No. 26LF.





No. 353 Lamp mounted on body of No. 26C.



No. 353 Lamp mounted on stage of No. 26LG by means of No. 478 Bracket.

Cat. No.	Description	Price
26A	Spencer Stereoscopic Microscope stand with vertical binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.....	
26B	Same as above but with **multiple** revolving nosepiece.....	
26C	Spencer Stereoscopic Microscope with vertical binocular body, having a single paired objective adapter, with 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. Furnished in a leatherette covered hardwood cabinet.....	
26F	Spencer Stereoscopic Microscope with vertical binocular body, having a multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.....	
26G	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.....	
24	Base to convert No. 26 into a No. 25	

Cat. No.	Description	Price
26LA	Spencer Stereoscopic Microscope stand with inclined binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.....	
26LB	Same as above but with **multiple** revolving nosepiece.....	
26LC	Spencer Stereoscopic Microscope with inclined binocular body, having a single paired objective adapter, 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. Furnished in a leatherette covered hardwood cabinet.....	
26LF	Spencer Stereoscopic Microscope with inclined binocular body, having a multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.....	
26LG	Spencer Stereoscopic Microscope with inclined binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.....	

Spencer Stereoscopic Microscope No. 28 and No. 28L

These microscopes are identical except for their binocular bodies. The No. 28L has an inclined binocular body. The angle of inclination is 22° from the vertical.

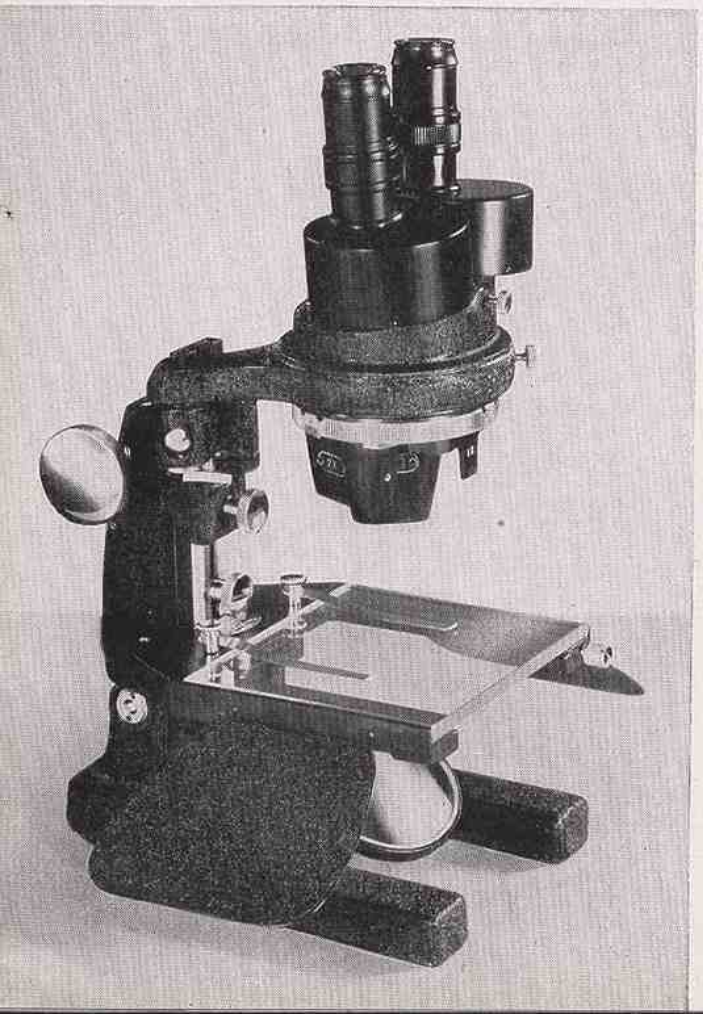
In certain types of work, the advantages of the No. 25 microscope should be combined with the flexibility of movement of the No. 23. Such a combination is presented in the Spencer model No. 28.

The stand is sturdy, rigid, and well proportioned, with the long slide of the focusing mechanism so designed that it permits focusing on the table when the base of the instrument is removed. The binocular body is fastened to this slide by a jointed arm which carries the microscope body to any position in a horizontal plane over the specimen. The two parts of the arm may be folded together to bring the binocular body over the center of the 5″ x 7″ glass stage, in which position it is often used.

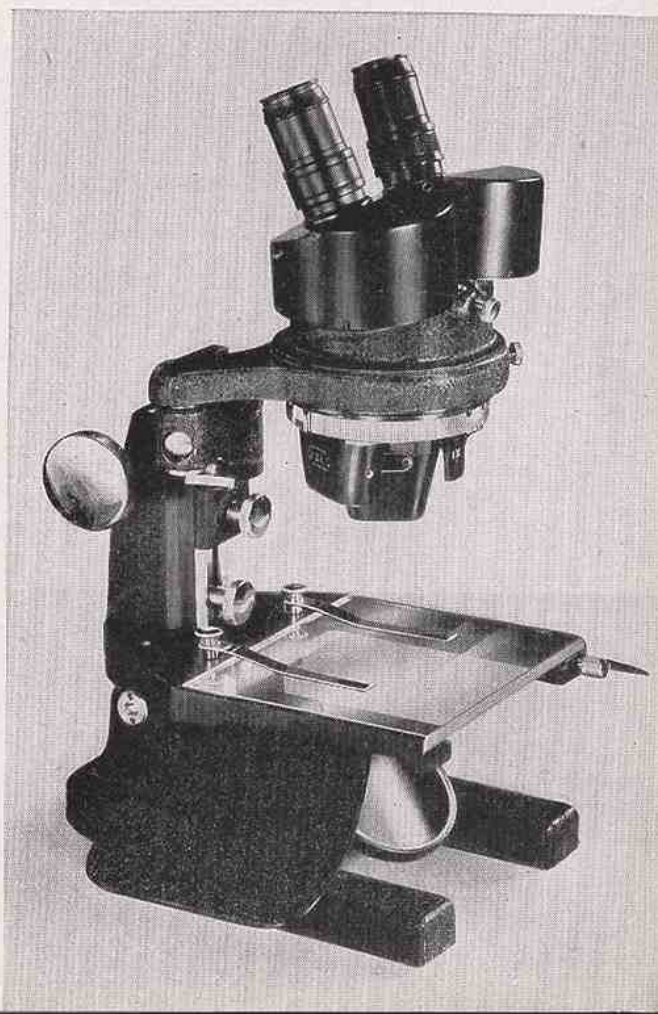
The mirror is mounted in a universal joint. Hand rests accompany the microscope. A horizontal dovetail slide holds the upper part of the microscope to the base. A single set screw clamps this tightly in position.

A nicely finished hardwood board, 12¾″ x 8¼″, grooved on the underside, is provided for covering the stage of the microscope. This large plane surface is ideal for holding herbarium sheets, fossils, or other large objects. It is also useful for quick scanning of groups of small mechanical parts, such as bearings and filament wires.

Spencer Stereoscopic Microscope No. 28F.

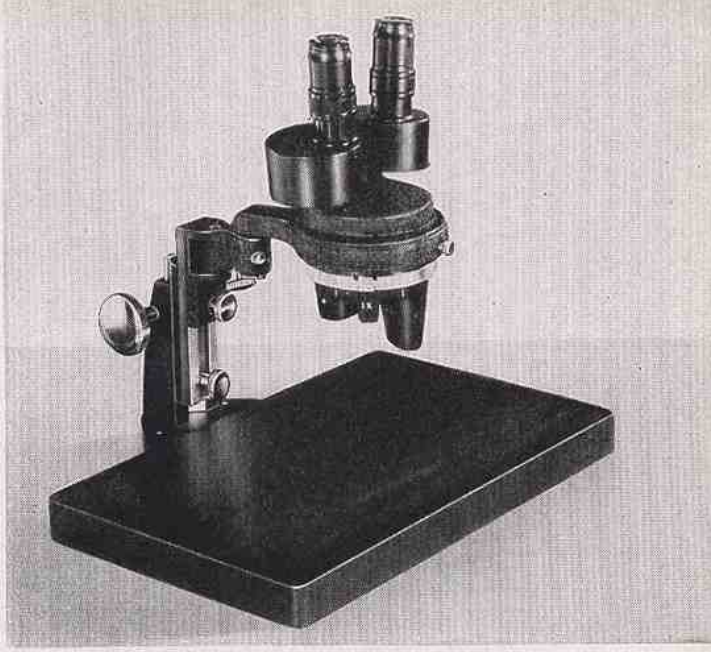


Spencer Stereoscopic Microscope No. 28LF.



Because of the manner in which the binocular body is swiveled and revolves 360° in its ring mount, it is possible to examine a large area quickly, always keeping the eyepieces in a comfortable relation to the eyes by grasping the binocular body and moving as desired. When a fixed position is desired, the joints may be firmly clamped.

The equipments listed are only suggestions for useful combinations. The purchaser can make up his own equipment by taking the price of stands 28A or B and 28LA or LB and adding to them the objectives and eyepieces desired. See page of accessories for listings of these optics.



Upper part of No. 28F equipped with hardwood board instead of glass stage.

Cat. No.	Description	Price
28A	Spencer Stereoscopic Microscope stand with vertical binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.....	
28B	Same as above but with **multiple** revolving nosepiece.....	
28C	Spencer Stereoscopic Microscope with vertical binocular body, having a single paired objective adapter, with 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. Furnished in a leatherette covered hardwood cabinet.....	
28F	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.....	
28G	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.....	

Cat. No.	Description	Price
28LA	Spencer Stereoscopic Microscope stand with inclined binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.....	
28LB	Same as above but with **multiple** revolving nosepiece.....	
28LC	Spencer Stereoscopic Microscope with inclined binocular body, having a single paired objective adapter, with 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. Furnished in a leatherette covered hardwood cabinet.....	
28LF	Spencer Stereoscopic Microscope with inclined binocular body, multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.....	
28LG	Spencer Stereoscopic Microscope with inclined binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in leatherette covered hardwood cabinet.....	

Spencer Stereoscopic Microscope No. 23 and No. 23L

Spencer Stereoscopic Microscope No. 23 is designed for work on large objects which could not be placed conveniently on the stage of the No. 25 or No. 26. The object may be observed anywhere within a circle four feet in diameter by means of this equipment.

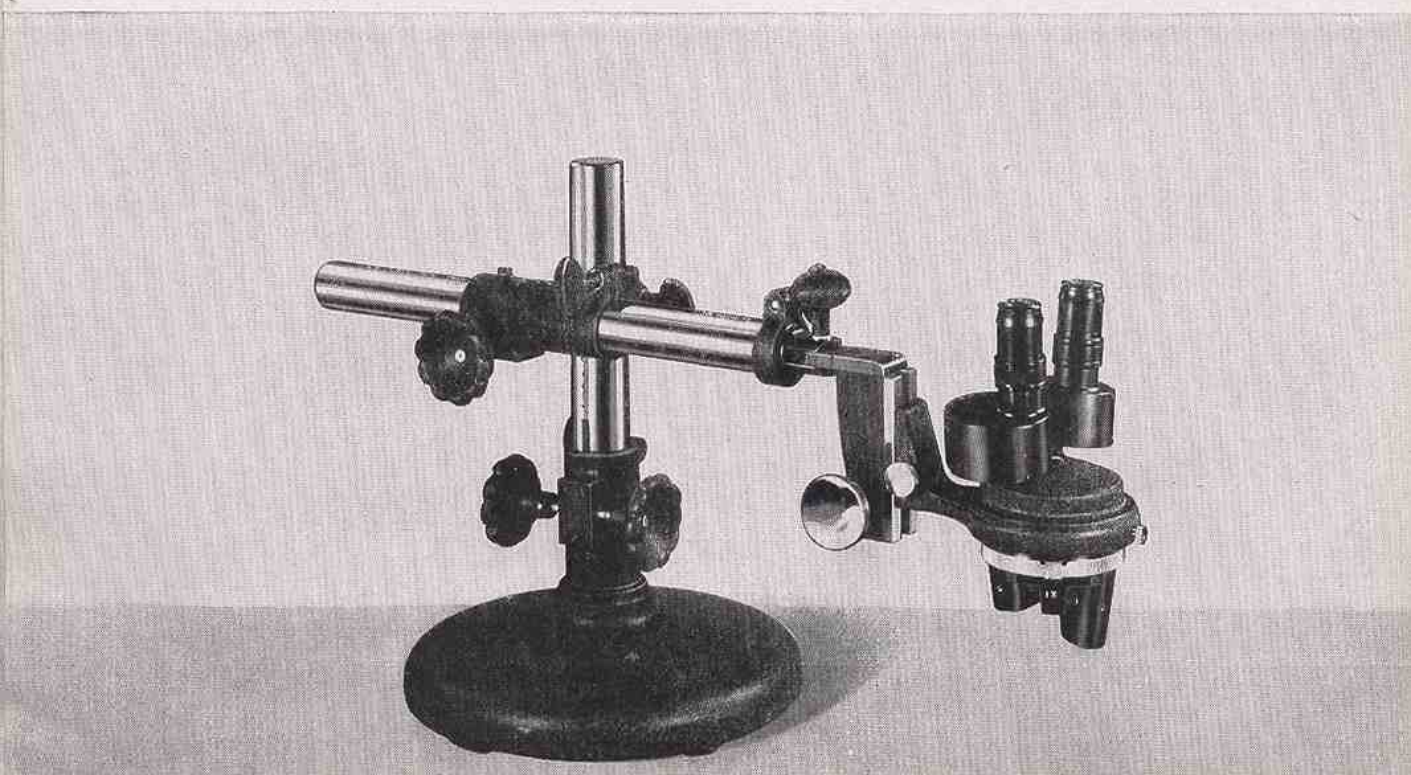
The regular microscope rack and pinion is employed for vertical movement in focusing. The heavy 10″ diameter base raises the vertical pillar 2½″, carrying both horizontal arm and microscope. The horizontal arm is moved through 4¼″ by rack and pinion and has an inner tube which extends the arm 7″—a total range of horizontal movement of 11¼″. The horizontal arm can be set at the most convenient height for viewing the surface details of large bodies. The microscope can be adjusted to the most convenient distance from the central pillar. Clamps are provided for fixing the instrument in any position.

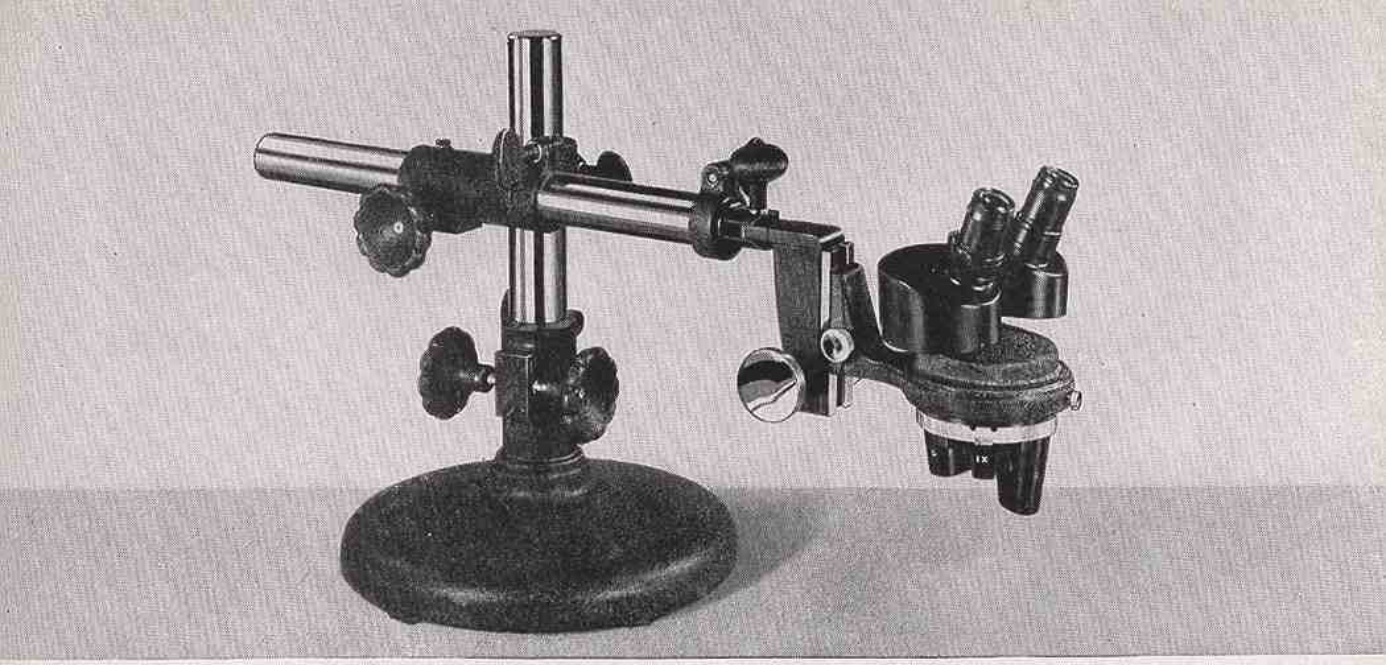
The binocular body is mounted in a ring that permits rotation (360°) to the most convenient position for observations, a very desirable feature for certain types of work. Note that the objectives are mounted below the other parts so that objects may be observed in a deep dish without interference from the sides of the dish. Vertical and inclined binocular bodies are available. The designation "L" in the catalog number indicates the inclined binocular body.

There is no case for the stand, but a leatherette covered hardwood cabinet is provided for the binocular body and optics.

The equipments listed are only suggestions for useful combinations. The purchaser can make up his own equipment by taking the price of stands 23A or B and 23LA or LB and adding to them the objectives and eyepieces desired. See page of accessories for listing of these optics.

Spencer Stereoscopic Microscope No. 23F.

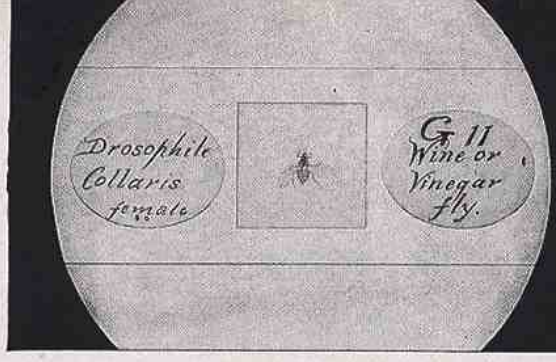




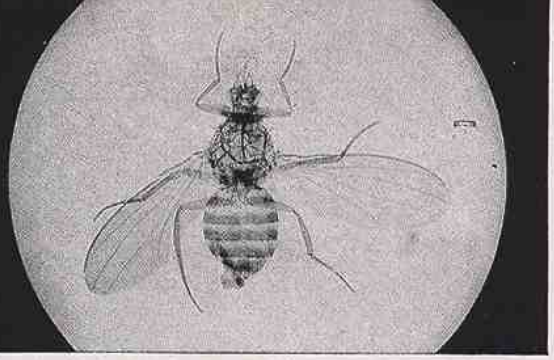
Spencer Stereoscopic Microscope No. 23LF.

Cat. No.	Description	Price
23A	Spencer Stereoscopic Microscope stand with vertical binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	
23B	Same as above but with **multiple** revolving nosepiece.....	
23C	Spencer Stereoscopic Microscope with vertical binocular body, having a single paired objective adapter, with 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	
23F	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	
23G	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	

Cat. No.	Description	Price
23LA	Spencer Stereoscopic Microscope stand with inclined binocular body, having a **single** paired objective adapter, but **without** paired objectives or paired eyepieces. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	
23LB	Same as above but with **multiple** revolving nosepiece.....	
23LC	Spencer Stereoscopic Microscope with inclined binocular body, having a single paired objective adapter, 2.0X paired objectives, 9X paired eyepieces. Magnification 18X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.	
23LF	Spencer Stereoscopic Microscope with inclined binocular body, multiple revolving nosepiece, with 1.0X, 2.0X, and 3.0X paired objectives; 9X and 12X paired eyepieces. Magnifications 9X to 36X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	
23LG	Spencer Stereoscopic Microscope with inclined binocular body, multiple revolving nosepiece, with 1.0X, 3.0X, and 6.0X paired objectives; 9X and 15X paired eyepieces. Magnifications 9X to 90X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.....	
23S	Stand only, of No. 23 Microscope with rack and pinion.....	



1X



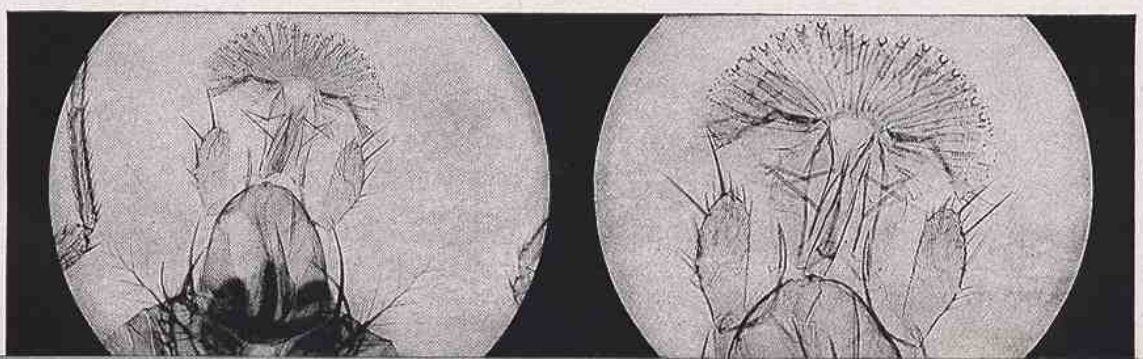
6.3X

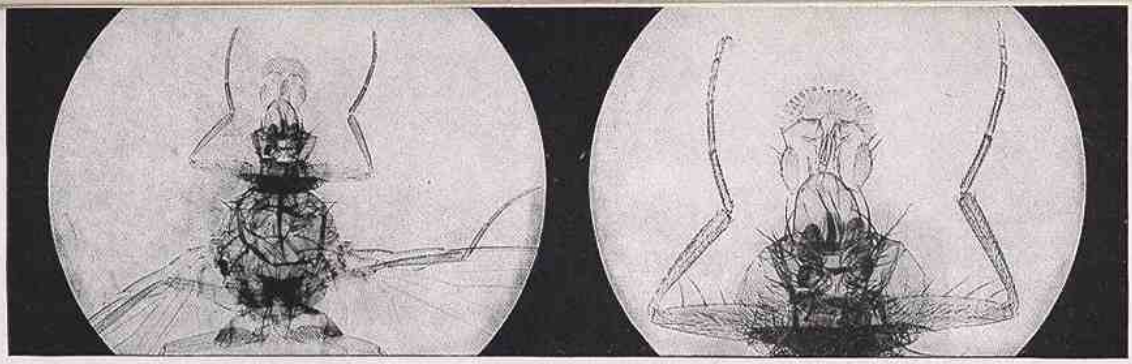
Recommended Equipment

Field	Application	Recommended Optics		Recommended Microscope Stands
		Obj.	Eyepieces	
Agriculture	Seed analysis, plant pathology.	.7, 2, 6	9, 12, 15	25
Biology, Botany	Identification and examination; histology, pathology.	1, 2, 4	9, 12	25, 28
		.7, 2, 6	9, 15	25, 26
Embryology Instr.—Exp.	Organology, development and experimental procedure.	1, 3, 6 or 2, 4, 8	9, 12, 15, 18	26, 28
Entomology	Identification. Dissection. Infection studies.	1, 3, 6	9, 15	26
Parasitology	Identification, infection, pathology.	1, 3, 6	9, 15	25, 26, 23
Pathology	Examination of specimens, dissection.	1, 3, 6	9, 15	25
Protozoology	Identification and isolation.	1, 3, 8	9, 15	25
Zoology	Identification. Dissection.	1, 3, 6	9, 15	25, 26
		1, 2, 4	9, 12	23, 28
Canning	Condition of produce before and after packing. Identification and estimation of molds, insect fragments, and extraneous material.	1, 3, 6	9, 15	25
Ceramics	Glaze, structure and fractures Raw materials.	1, 3, 6	9, 15	26, 23
Chemical control of manufacturing	Depth of impregnation of textiles, and pressed boards.	0.7, 2, 6	9, 15	
		1, 2, 4	9, 15, 12	25, 26
Dairy	Feed analysis. Molds	1, 3, 6	9, 15	25. 26
Food and Drugs	Identification and evaluation of adulterants, extraneous and infectious matter.	.7, 2, 4, 8	9, 12, 15, 18	25, 26
Geology	Cf. Mineralogy and Paleontology.	1, 2. 4, 8	9, 12	25, 26, 23
Manufacturing	Inspection and control of small parts, spindles, jewel bearings.	Recommendations on specific requests		
Metal Products	Fractures in castings. Defects in worked metals.	.7, 2, 6	9, 15	26, 23
Mineralogy	Examination and identification of rocks and minerals.	1, 3, 6	9, 12, 15	25, 23
Petroleum	Examination of borings and identification of Forams, etc.	.7, 2, 4	9, 15	26, 25
Paleontology	Examination and preparation of fossils.	.7, 2, 6	9, 15	25, 26, 23
Textiles	Examination of weave, curl and quality.	.7, 2, 4	9, 12, 15	25, 26

45X

72X





12X *24X*

Selecting Your Instrument

After studying the general features of the Spencer Stereoscopic Microscope, the following data may assist you in deciding on the type of instrument most convenient for your use and the optical equipment it should carry.

There are four different mechanical arrangements.

1. No. 26 for small opaque objects requiring only vertical adjustment of focus.
2. No. 25 for small opaque or transparent objects requiring only vertical adjustment of focus.
3. No. 28 for small opaque or transparent objects requiring both vertical and horizontal adjustments.
4. No. 23 for large opaque objects that require universal adjustment for special observations.

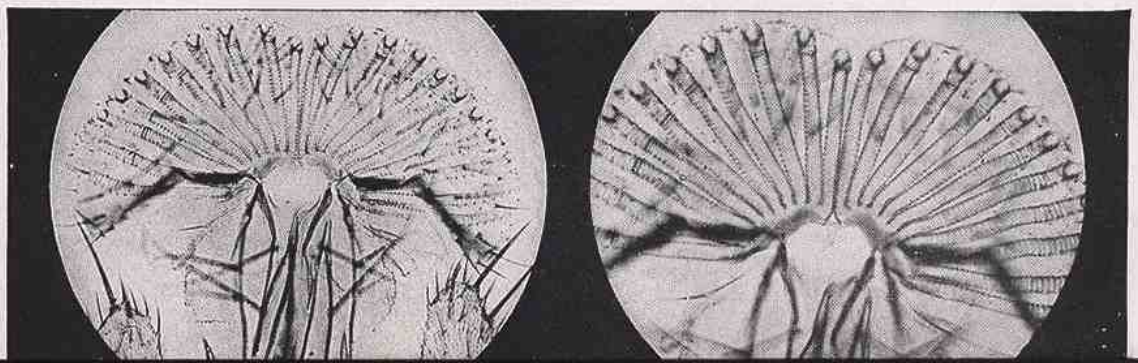
Selecting the most useful magnification is often difficult. Too often, an observer selects high magnification and is then troubled by the disadvantage of smaller fields and limited depths of focus. It is best to select the lowest power that you believe will give satisfactory detail.

Compare the smallest unit that you wish to examine with the insect (fruit fly) shown above, marked *1X*, and follow this through to higher magnifications. The photomicrographs illustrate the decreased field of view which accompanies increased magnification.

Catalog Designation	Nosepiece	Objectives	Eyepieces	Magnifications
A	Single	None	None	
B	Multiple	None	None	
C	Single	2X	9X	18X
F	Multiple	1X, 2X, 3X	9X, 12X	9X, 12X, 18X, 24X, 27X, 36X
G	Multiple	1X, 3X, 6X	9X, 15X	9X, 15X, 27X, 45X, 54X, 90X

The photomicrographs on these pages were made with Spencer photomicrographic equipment.

108X *144X*



Accessories
for Stereoscopic Microscopes

Paired Objectives

Cat. No.	Description	Price
294	0.7X Paired Objectives	
295	1.0X Paired Objectives	
296	2.0X Paired Objectives	
297	3.0X Paired Objectives	
298	4.0X Paired Objectives	
299	6.0X Paired Objectives	
300	8.0X Paired Objectives	

Paired Eyepieces

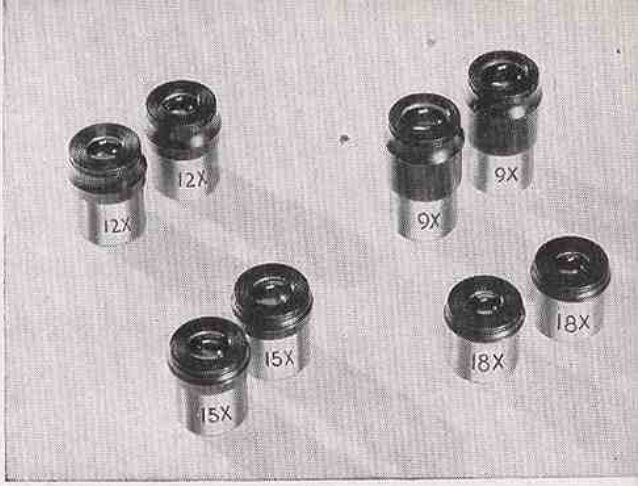
Cat. No.	Description	Price
1184	9X Paired Eyepieces	
1185	12X Paired Eyepieces	
1186	15X Paired Eyepieces	
1187	18X Paired Eyepieces	

Mechanical Stage

Cat. No.	Description	Price
484	Ungraduated Attachable Mechanical Stage to fit Spencer Nos. 25 and 28 Microscopes.	

Miscellaneous Accessories

Cat. No.	Description	Price
24	Base, with mirror and arm rests for converting No. 26 Microscope to No. 25	
598	Glass Stage Plate for Nos. 25, 26, and 28 Microscopes	
446	Multiple Nosepiece	
442	Single Objective Adapter	
1625	Cabinet for No. 25	
1626	Cabinet for No. 26	
1628	Cabinet for No. 28	



Paired Eyepieces for Stereoscopic Microscopes.

Universal Microscope Lamps

The Spencer Universal Microscope Lamp was designed especially for use with the Spencer Stereoscopic Microscopes. It attaches without special adaption to the body tube of any of the stereoscopic microscopes except the Junior series or can be used on its own base. By using the No. 478 adapter, this lamp can be attached to the stage of the Nos. 25, 26, or 28 Microscopes.

Cat. No.	Description	Price
353	Universal Microscope Lamp with 6.5 volt, 2.75 ampere, clear bulb, blue glass, and transformer	
354	Iris Diaphragm for No. 353	
360	Clear Bulb, 6.5 volt, 2.75 ampere .....M.C.P.	
478	Bracket for attaching No. 353 to stage of microscopes Nos. 25, 26, or 28	
477	Bracket for attaching No. 353 Lamp to body tube of old style low power binocular microscopes, No. 55 series, and Junior Stereoscopic Microscopes.	

Accessories are available for adapting the rotatable body of the No. 23 Microscope to the No. 25 or No. 26 stand. Price and description will be furnished on request.

Paired Objectives.



Micrometer and Reticule Accessories

for Stereoscopic Microscopes

In all eyepieces (Catalog Nos. 1184, 1185, 1186 and 1187) listed for the Spencer Stereoscopic Microscope, the diaphragms are constructed to hold reticules or micrometer discs. The combination diaphragm and reticule holder screws into the lower end of the eyepiece and can be adjusted to the best position to provide sharp focus for an individual's eye. A spanner wrench, included with each Steroscopic Microscope, is used to make the correct setting.

The discs listed will be found useful in measuring small details, in drawing and in counting.

Directions

With the spanner wrench, unscrew the diaphragm from the bottom of the eyepiece. Place the reticule or micrometer disc (with etched lines down) in the diaphragm. Then place the retaining ring over the reticule or micrometer disc to hold it securely.

Next replace the diaphragm in the eyepiece tube. Fit the spanner wrench into the slot in the bottom of the diaphragm with the left hand. With the right hand hold the eyepiece in the line of vision, toward a diffusely illuminated object such as the sky or a frosted lamp. While holding the spanner wrench in the diaphragm slot, the eyepiece should be rotated with the right hand until the etched lines appear in sharp focus. The wrench is so constructed that the light entering the eyepiece is not obstructed and a clear view of the etched lines is obtained.

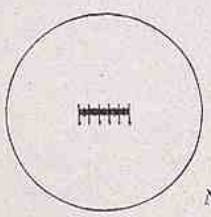
The eyepiece in which the reticule or micrometer disc has been inserted is now ready for use and should be placed in the fixed eyepiece tube.†

The lower magnifications may be calibrated against an accurate millimeter scale (preferably divided in half millimeters) and the higher magnifications with a stage micrometer. You will note the true length (x) on the scale which corresponds to a given number of divisions (y) in the eyepiece micrometer. Then the scale value of the single eyepiece division is $x \div y = c$. When measuring, the actual value is c times the number (and fractional) divisions of the eyepiece micrometer subtended by the object. The value of c must be determined for each combination of eyepiece and objective used; once determined it will not change unless a change is made in the lenses or microscope.

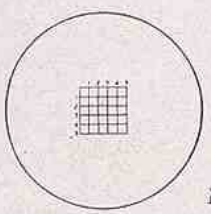
†The adjustable eyepiece tube varies the tube length slightly which changes the calibration factor (c) of the micrometer scale.

Cat. No.	Description	Price
1406	Micrometer Disc, 20.0mm. diameter 10mm. scale divided into 100 parts..	
1407	Micrometer Disc, 20.0mm. diameter, 10mm. scale divided into 200 parts .	
1405	Micrometer Disc, 20.0mm. diameter with 5mm. scale divided into 50 parts.	
1410	Micrometer Disc, 20.0mm. diameter, with 5mm. scale divided into 100 parts.....	
1408*	Reticule (Net Micrometer) 20.0mm. diameter, 10mm. square ruled in 1mm. squares.....	
1409*	Reticule (Net Micrometer) 20.0mm. diameter, 10mm. square ruled in 0.5 mm. squares.....	
1421	Reticule (Net Micrometer) 20.0mm. diameter, 5mm. square ruled in 1mm. squares.....	
1427	Cross Hair Disc, 20.0mm. diameter.	
472	Spanner Wrench for diaphragms of Nos. 1184, 1185, 1186, and 1187 eyepieces.....	

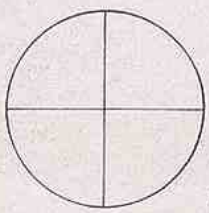
*When used with 18X eyepieces, there is a partial cut-off at the corners on account of the diaphragm.



No. 1405



No. 1421



No. 1427

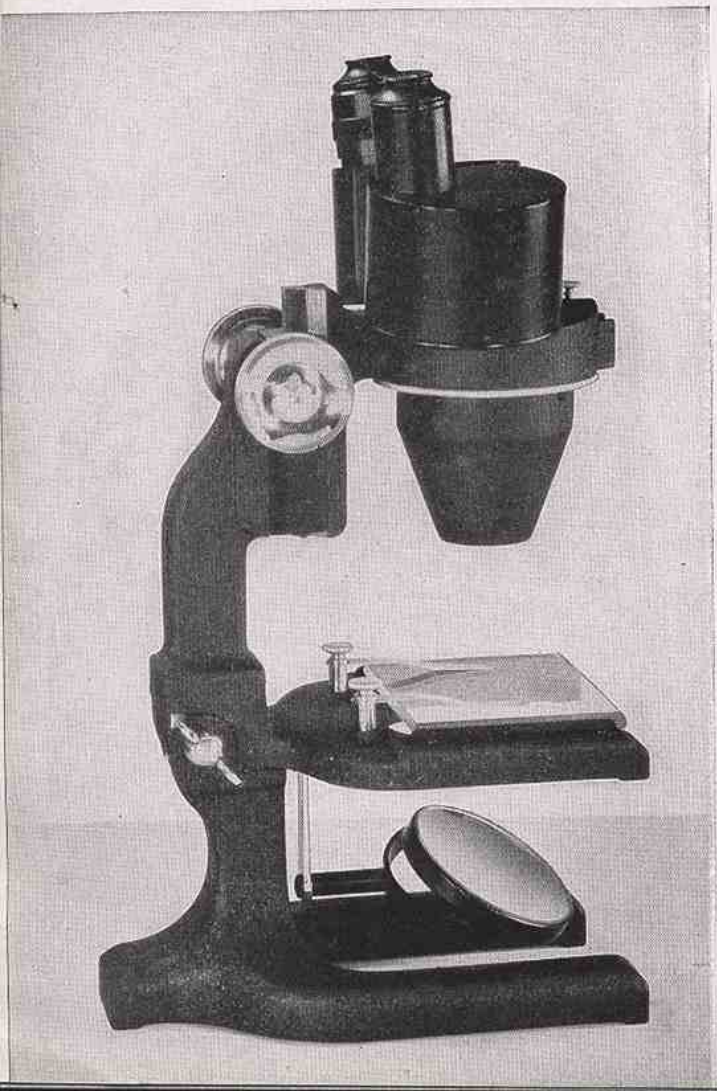
Illustrations show entire reticules. Size of etched area appearing in field depends upon power of the eyepiece.

Junior Stereoscopic Microscopes

The Spencer Junior Stereoscopic Microscopes Nos. 57, 67, and 77 were designed for classroom and industrial routine work where the range of magnification and mechanical conveniences are not of great importance.

In developing these instruments, the aim was to reduce costs at every point where it would not affect the quality of the final result. This reduction could not be great, for every double objective microscope is really two instruments with two objectives, two eyepieces, and in addition, two sets of prisms.

Spencer Junior Stereoscopic Microscope No. 57W.



Features of Construction

Aside from a somewhat simpler and less pretentious stand, the principal saving lies in the fact that the objectives are mounted integrally with a part corresponding to the revolving nosepiece, and to the simplified prism system. Two pairs of objectives instead of three pairs are included. Each objective is mounted in a quadrant of the revolving part, one of each pair being in opposite quadrants, on either side of the center of revolution. To put one pair of objectives out of operative relation, and the other pair in, requires a revolution of the unit through 90°. The objectives in each unit are protected from dust by a surrounding shield. A single nosepiece adapter is supplied instead of the revolving mount, when only one paired objective is ordered.

Objectives

The objectives are so mounted that the axes of the objectives in each pair subtend an angle of 16°; the beam of light from each objective is bent 4° toward the normal in the bakelite prism boxes. This means that the observer looks into the microscope at the normal, natural angle of 8° convergence. The erection of the image in the prism boxes is accomplished by means of two porro prisms in each box instead of three as in higher priced instruments.

Eyepieces

The eyepiece tubes are of standard diameter to take any of the eyepieces used on the single objective microscopes. The regular Huyghenian eyepieces give very good results, especially in the lower powers. For the higher powers we strongly recommend the Wide Field eyepieces, which give a very large flat field and a pleasing picture.

Range of Magnifications

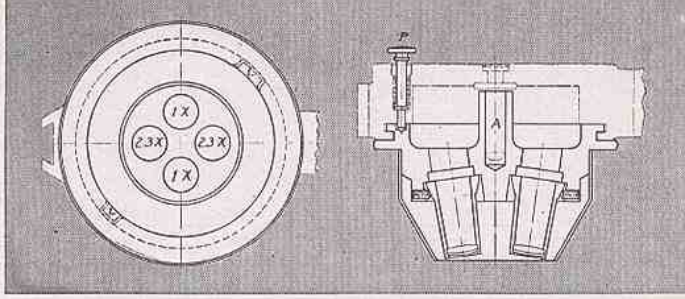
Magnifications from 6X to 136X are available. The most useful combinations

are offered in revolving nosepiece units. Unit A consists of a pair each of 1.0X objectives and 2.3X objectives shown on No. 67V; the other unit, C, includes the 1.7X and 3.4X objectives shown on No. 57W. The bulk of the work is done with these powers. With 10X eyepieces they represent magnifications of 10, 23, 17, and 34 respectively. Where one pair of objectives will suffice, as shown on No. 77, they may be had in the regular mounts. The adapter holding these mounts is interchangeable with the double units, and the mounts are interchangeable on the adapter, as they are on the multiple nosepiece used on the larger microscopes.

Stands

The stand is well proportioned as shown by the illustration. The glass stage, 75mm. x 100mm., is so mounted on the stage arm that the white or black background may be used beneath the glass. The free distance between the optical axis and the arm is 75mm. The inclination joint is separable. By this means the base and mirror (60mm. diameter) may be removed from the rest of the microscope. This microscope then becomes No. 67. Using a still simpler and less expensive base, the stand becomes No. 77.

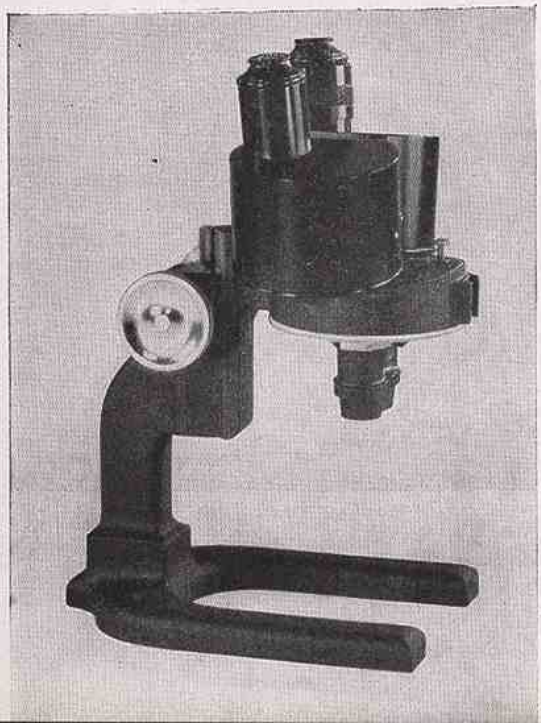
Each instrument is regularly supplied in a substantial leatherette covered hardwood cabinet.



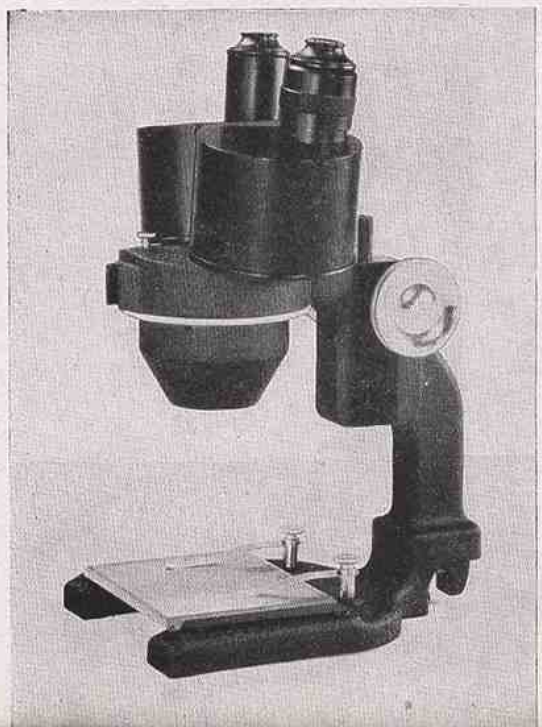
Construction of revolving nosepiece.

Cat. No.	Description	Price
57R	Junior Stereoscopic Microscope with paired objective 1.0X and paired Huyghenian eyepieces 10X. Total magnification 10X.....	
57V	Junior Stereoscopic Microscope with Unit A composed of 1.0X and 2.3X paired objectives and paired Huyghenian eyepieces 10X. Total magnifications 10X and 23X.....	
57W	Junior Stereoscopic Microscope with Unit C composed of 1.7X and 3.4X paired objectives and paired Huyghenian eyepieces 10X. Total magnification 17X and 34X.....	
57X	Junior Stereoscopic Microscope with Unit A composed of 1.0X and 2.3X paired objectives and paired Wide Field eyepieces 15X. Total magnifications 15X and 34.5X.....	
57Z	Junior Stereoscopic Microscope with Unit C composed of 1.7X and 3.4X paired objectives and paired Wide Field eyepieces 15X. Total magnifications 25.5X and 51X.....	
67R	With same optics as No. 57R.....	
67V	With same optics as No. 57V.....	
67W	With same optics as No. 57W.....	
67X	With same optics as No. 57X.....	
67Z	With same optics as No. 57Z.....	
77R	With same optics as No. 57R.....	
77V	With same optics as No. 57V	
77W	With same optics as No. 57W.....	
77X	With same optics as No. 57X.....	
77Z	With same optics as No. 57Z.....	

Spencer Junior Stereoscopic Microscope No. 77.



Spencer Junior Stereoscopic Microscope No. 67V.



Magnifications and Fields of Junior Stereoscopic Microscopes

EYEPIECE	UNIT A 1.0X Objective Field Width in mm.	Mag.	UNIT C 1.7X Objective Field Width in mm.	Mag.	UNIT A 2.3X Objective Field Width in mm.	Mag.	UNIT C 3.4X Objective Field Width in mm.	Mag.
10X Wide Field	13.0	13.5X	10.3	17.2X	7.2	24.4X	5.0	35.4X
15X Wide Field	11.7	20.2X	9.2	25.8X	6.5	36.6X	4.5	53.1X
20X Wide Field	9.8	27.0X	7.7	34.4X	5.4	48.8X	3.7	70.8X
6X Ramsden	13.2	8.1X	10.5	10.3X	7.5	14.6X	5.2	21.2X
10X Ramsden	13.2	13.5X	10.4	17.2X	7.3	24.4X	5.0	35.4X
15X Ramsden	11.4	20.2X	9.0	25.8X	6.4	36.6X	4.4	53.1X
6X Huyghenian	14.5	8.1X	11.5	10.3X	8.2	14.6X	5.7	21.2X
10X Huyghenian	10.8	13.5X	8.5	17.2X	6.0	24.4X	4.2	35.4X

EYEPIECE	1.0X Objective Field Width in mm.	Mag.	1.7X Objective Field Width in mm.	Mag.	2.3X Objective Field Width in mm.	Mag.	3.4X Objective Field Width in mm.	Mag.	4.8X Objective Field Width in mm.	Mag.
10X Wide Field	15.5	11.3X	11.0	15.8X	7.7	22.9X	5.1	34.3X	3.6	49.0X
15X Wide Field	14.2	17.0X	10.0	23.7X	6.9	34.4X	4.6	51.4X	3.2	73.5X
20X Wide Field	11.9	22.6X	8.4	31.6X	5.8	45.8X	3.8	68.6X	2.7	98.0X
6X Ramsden	16.0	6.8X	11.5	9.5X	7.9	13.7X	5.3	20.6X	3.7	29.4X
10X Ramsden	16.0	11.3X	11.3	15.8X	7.8	22.9X	5.1	34.3X	3.6	49.0X
15X Ramsden	13.9	17.0X	9.7	23.7X	6.7	34.4X	4.5	51.4X	3.1	73.5X
6X Huyghenian	17.2	6.8X	12.3	9.5X	8.7	13.7X	5.8	20.6X	4.0	29.4X
10X Huyghenian	12.8	11.3X	9.2	15.8X	6.4	22.9X	4.3	34.3X	3.0	49.0X

Accessories
for Spencer Junior Stereoscopic Microscope

Paired Objectives

Cat. No.	Description	Price
285	1.0X Paired Objectives	
286	1.7X Paired Objectives	
288	2.3X Paired Objectives	
289	3.4X Paired Objectives	
290	4.8X Paired Objectives	
291	6.8X Paired Objectives	
283	Unit A 1.0X and 2.3X Paired Objectives included in revolving mount	
287	Unit C 1.7X and 3.4X Paired Objectives included in revolving mount	

Paired Eyepieces

Cat. No.	Description	Price
1138	6X Paired Huyghenian Eyepieces	
1142	10X Paired Huyghenian Eyepieces	
1177	6X Paired Ramsden Eyepieces	
1178	10X Paired Ramsden Eyepieces	
1179	15X Paired Ramsden Eyepieces	
1135	10X Paired Wide Field Eyepieces	
1137	15X Paired Wide Field Eyepieces	
1139	20X Paired Wide Field Eyepieces	

Note: All of the above eyepieces accommodate micrometer discs and reticules which are 21.15mm. diameter.

Miscellaneous Accessories

Cat. No.	Description	Price
599	Glass Stage Plate for No. 57 and 67	
477	Bracket for attaching No. 353 Lamp to body tube	

Cabinets

Cat. No.	Description	Price
1651	Cabinet for No. 67 and No. 77	
1657	Cabinet for No. 57	

Spencer Metallurgical Microscopes

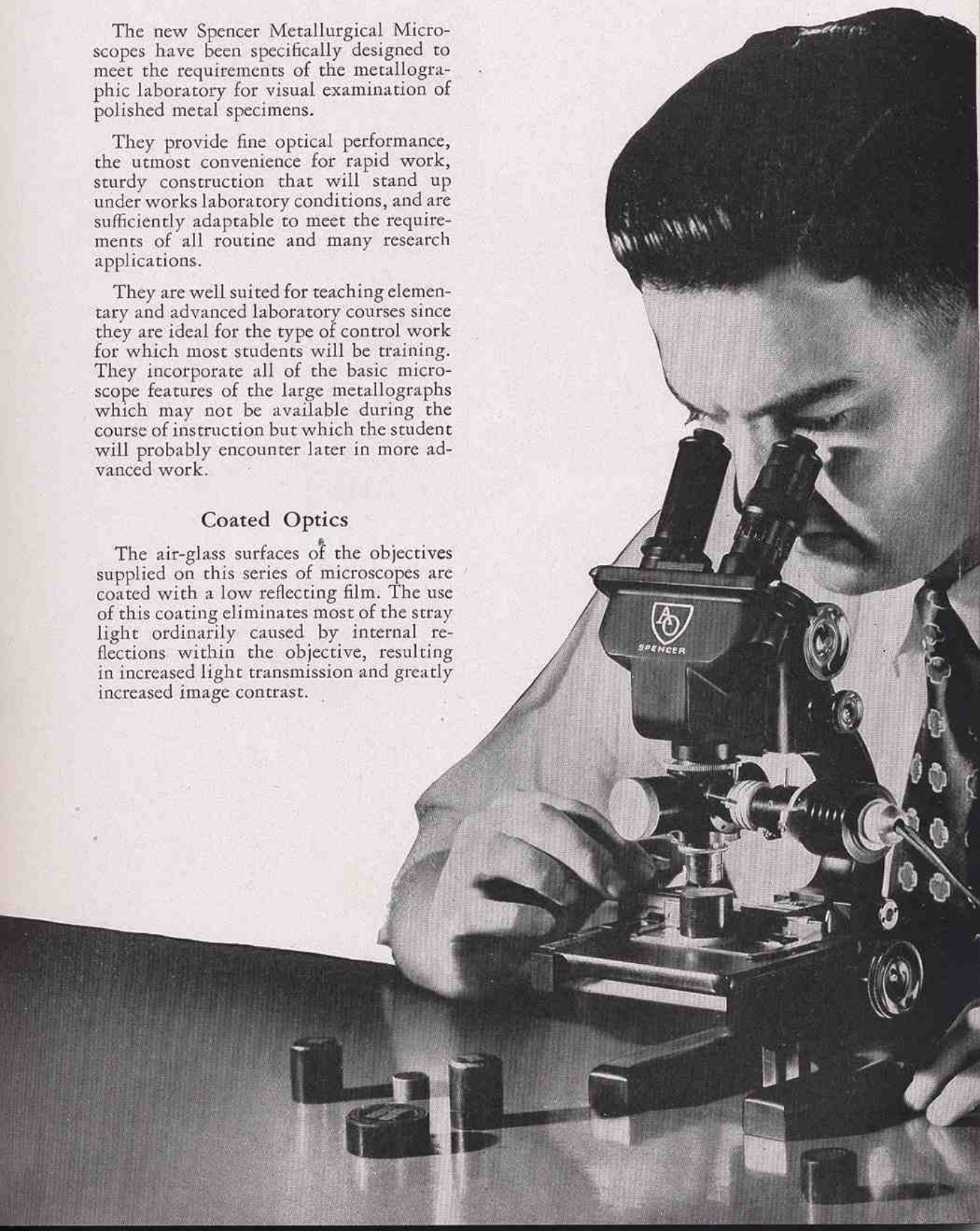
The new Spencer Metallurgical Microscopes have been specifically designed to meet the requirements of the metallographic laboratory for visual examination of polished metal specimens.

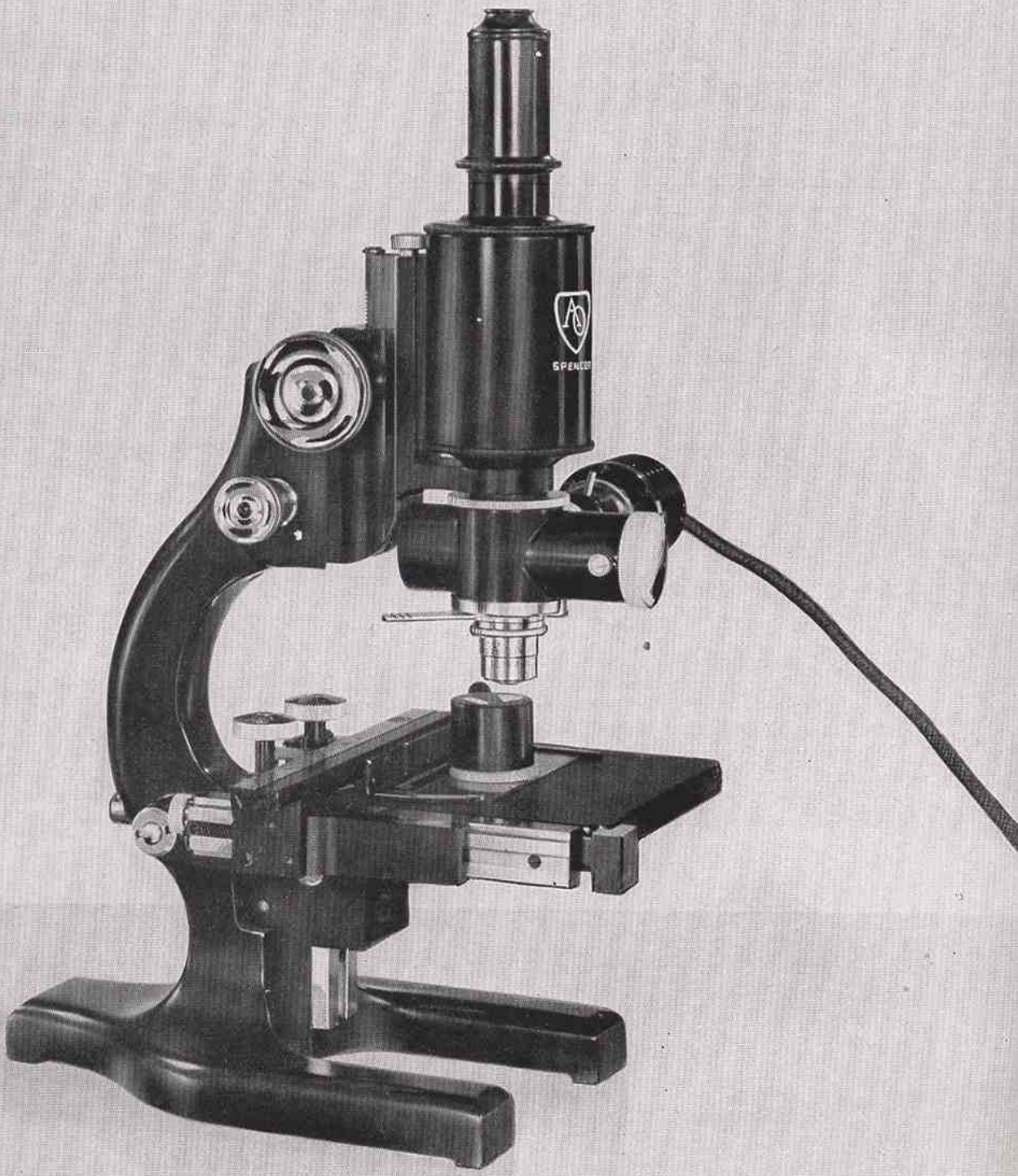
They provide fine optical performance, the utmost convenience for rapid work, sturdy construction that will stand up under works laboratory conditions, and are sufficiently adaptable to meet the requirements of all routine and many research applications.

They are well suited for teaching elementary and advanced laboratory courses since they are ideal for the type of control work for which most students will be training. They incorporate all of the basic microscope features of the large metallographs which may not be available during the course of instruction but which the student will probably encounter later in more advanced work.

Coated Optics

The air-glass surfaces of the objectives supplied on this series of microscopes are coated with a low reflecting film. The use of this coating eliminates most of the stray light ordinarily caused by internal reflections within the objective, resulting in increased light transmission and greatly increased image contrast.




SPENCER

Vertical Illuminator

The newly designed Spencer Vertical Illuminator is the result of studies of past instruments and new scientific developments. Adjustments have been kept to a minimum without sacrificing good performance. The Vertical Illuminator is attached to the microscope stand in a position which allows the operator to make the necessary adjustments conveniently with manipulations divided between the left and right hands.

Field and Aperture Diaphragms

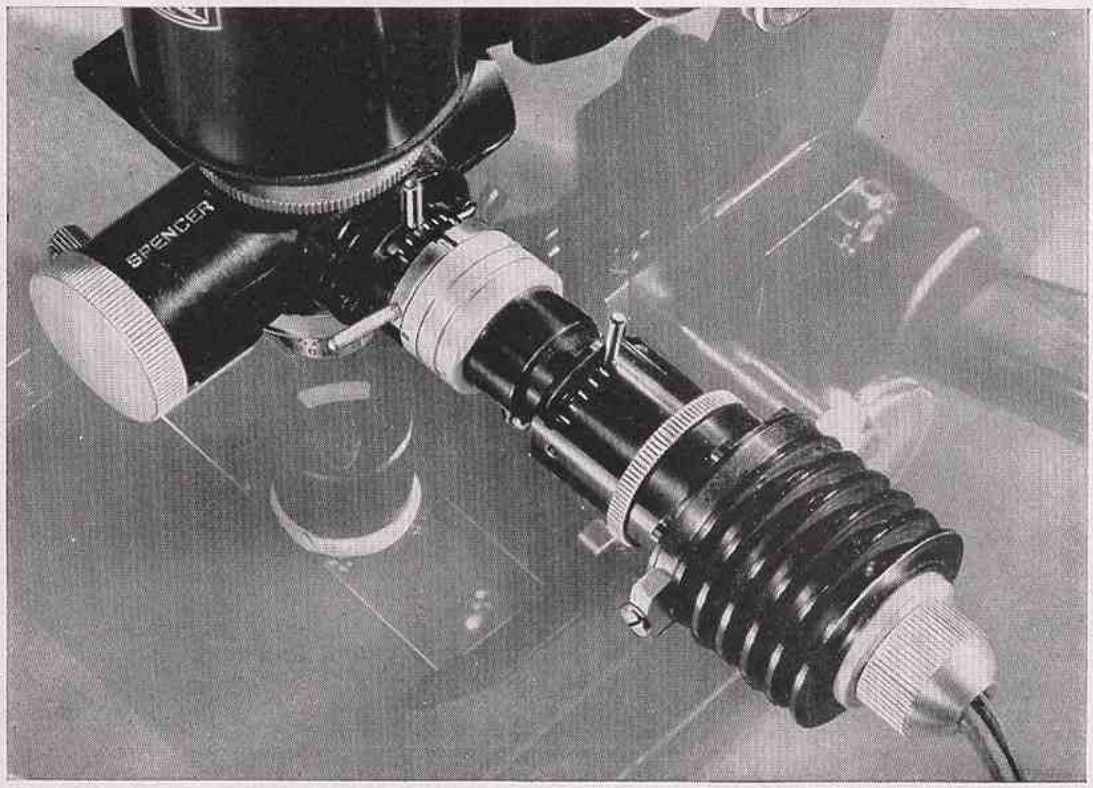
To eliminate unnecessary glare and obtain maximum contrast, a field diaphragm is provided which restricts the area of specimen illuminated to correspond with the field covered by the objective-eyepiece combination. An aperture diaphragm provides regulation of numerical aperture for best results with each objective.

Prism and Coated Reflector

The light is directed down through the objective by means of a plano-reflector or prism. These are mounted on a horizontal bearing so that either the prism or the reflector can be brought into operating position by sliding the bearing to one of two definite positions. The prism and plano-reflector can be removed readily for cleaning.

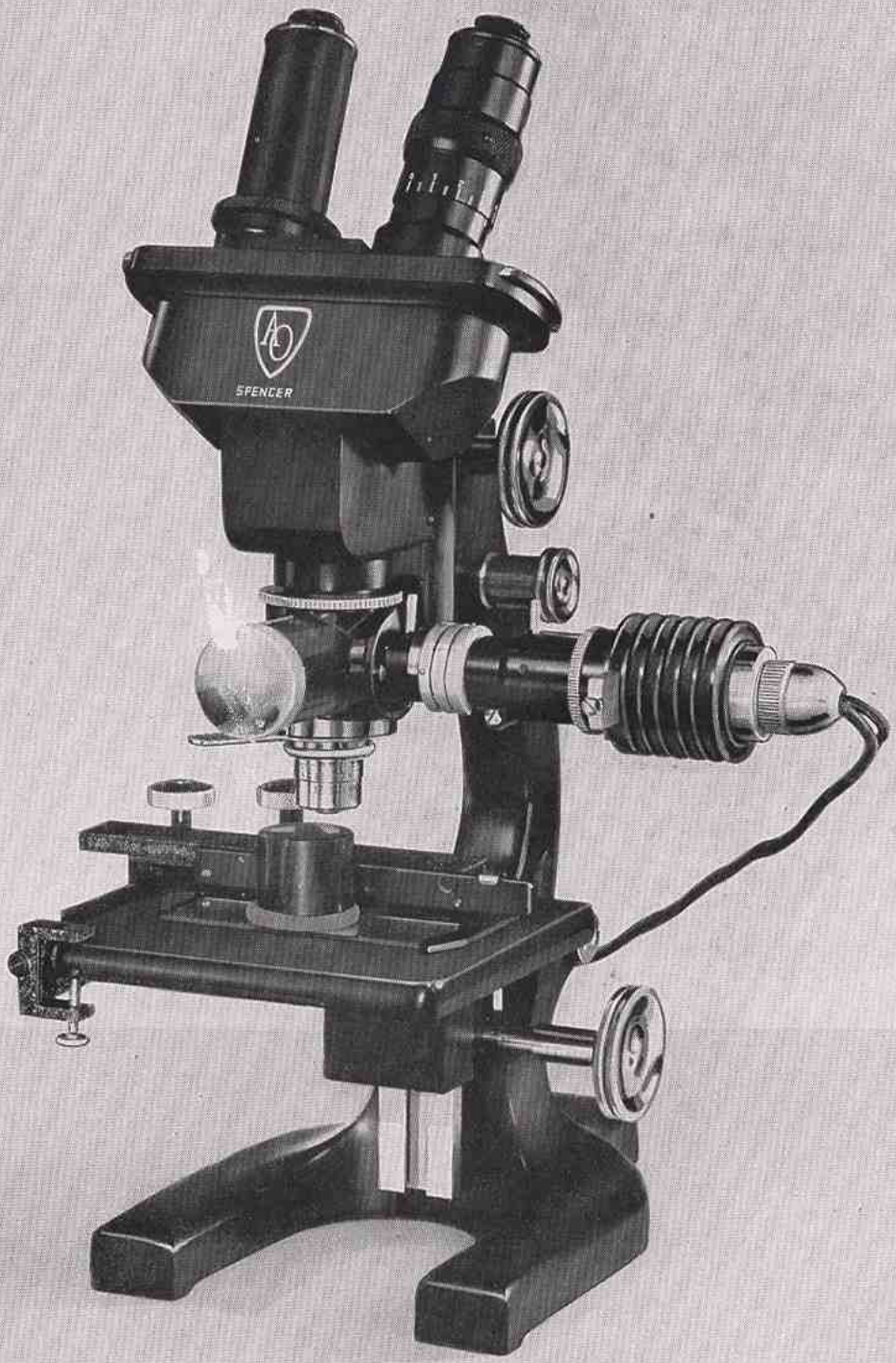
Since the image forming rays must pass through the plano-glass reflector after passing through the objective, it is made with the same degree of precision as the optical elements in the microscope objective. Its surfaces are optically flat and parallel. These reflectors are inspected individually with an interferometer to meet exacting optical specifications.

Both surfaces of the plano-reflector are coated. One surface is coated with a high reflecting film to concentrate a maximum amount of light on the specimen. The



Vertical Illuminator complete with Illuminating Unit.

← *Metallurgical Microscope No. 46M with graduated mechanical stage.*


SPENCER

other surface is coated with a low reflecting film to transmit the light which would otherwise be reflected from the second surface. This increases the illumination and eliminates the double image of the field diaphragm. This is a unique Spencer feature based on technics developed by our research scientists. The Vertical Illuminator is offered for student use with an uncoated reflector.

Illuminating Unit

An efficient, compact, illuminating unit which is designed to attach to the Vertical Illuminator provides a complete permanently aligned optical system with an integral light source.

The source is a concentrated filament, low voltage, low wattage bulb of high intensity, giving off a minimum amount of heat. Current is supplied by a transformer or resistance from a 110 volt 60 cycle alternating or direct current line. The lamp housing remains remarkably cool due to the low wattage of the bulb and the efficient design of the lamp house employing fins for heat radiation. The bulb can be centered quickly, and locked in position. This adjustment need not be changed during the life of the bulb.

Because of the high efficiency of the optical system ample illumination is obtained for visual work at the highest magnification, even when using the binocular body. The Spencer Vertical Illuminator is designed to yield uniform illumination at all magnifications.

The light intensity can be changed quickly by a slide in the illuminating unit. In one position maximum illumination is provided for use with binocular microscopes; the other position reduces the illumination to a comfortable level for monocular observation.

The illuminating unit is easily removed so that the microscope may be used with a light scource of higher intensity for photomicrography.

Filters

Filters are available, readily interchangeable, and locked in place in a positive manner. A green filter with a spectral distribution which corresponds to the most favorable color correction of the optical system, is included as standard equipment. A blue filter is available which gives light of near daylight quality and is recommended for identification of non-metallic inclusions.

A polarizer filter and cap analyzer are available for studies of non-metallic inclusions and other work in polarized light.

Nosepiece

Objectives are changed in a positive and convenient manner. Each objective is mounted in an adapter with a handle which is instantly attached to the quick-change nosepiece on the Vertical Illuminator.

The quick-change nosepiece and adapter together, require very little space. Thus, full advantage is taken of the short objective mount designed to bring the rear focal plane of the objective as close as possible to the reflecting element of the Vertical Illuminator.

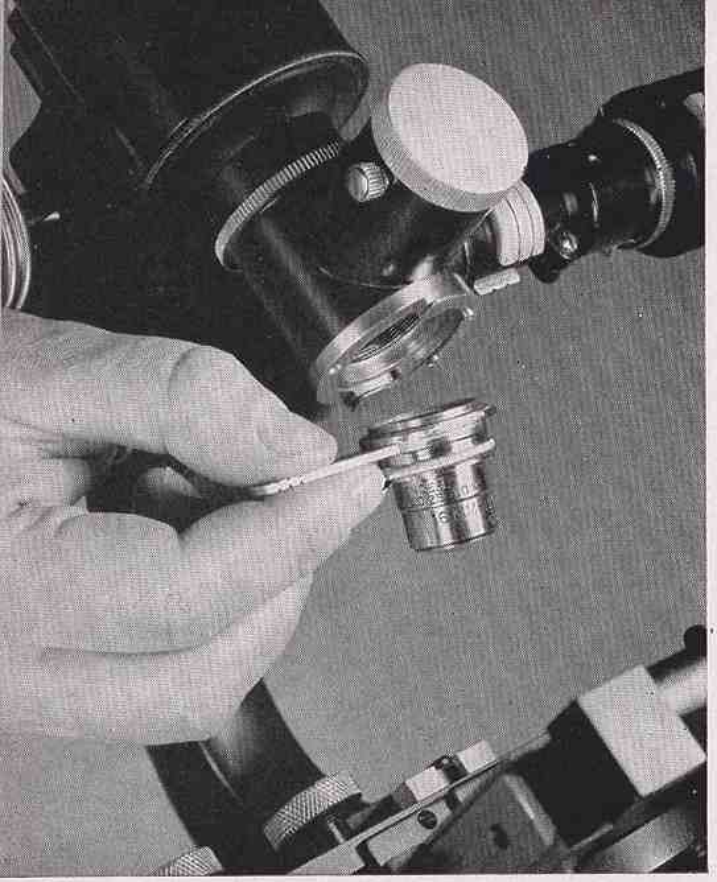
General Specifications

Five different microscopes are offered—Monocular Microscopes Nos. 46, 47 and 48 and Binocular Microscopes Nos. 50 and 51. Following are outstanding features:

STAND

The stand has a forged brass arm with a standard taper axle inclination joint, and a heavy cast base that insures stability in all positions.

← *Metallurgical Microscope No. 50M with ungraduated mechanical stage.*



Rapid and convenient method of changing objectives.

RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design.

MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment, graduated in 2.5 micron intervals, automatically compensates for wear and ceases to function when the objective contacts the specimen. All except No. 48 have a means of compensating for difference of weight between monocular and binocular body.

MONOCULAR BODY TUBE

The body tube has a length of 180mm. when used with the Vertical Illuminator. It has an adjustable draw tube with graduations, to calibrate the instrument for making grain size and case depth measurements. The No. 48 stand is equipped only with fixed monocular tube.

BINOCULAR BODIES

Microscopes Nos. 50 and 51 are furnished with either the inclined or vertical binocular body. They relieve eyestrain and provide maximum comfort during long periods of observation. The eyepieces are adjusted quickly to exact inter-pupillary distance by turning a knurled ring on the right eyepiece tube. An adjustable collar on the left eyepiece tube provides a focusing adjustment to compensate for difference in vision of the two eyes. An exclusive feature is the eight degree convergence angle for normal visual work.

The inclined binocular body permits a comfortable posture. Eyes, neck and shoulders are in a normal restful position; muscles do not become tired, enabling the observer to work more efficiently.

STAGE

The solid, durable Bakelite stage 108mm. X 120mm., with a distance of 105mm. from arm to optical axis, is resistant to all common reagents and will not warp or fade. It is provided with chromium plated spring steel clips. Microscopes Nos. 46 and 50 have stages without circular opening. Nos. 47, 48 and 51 have a circular opening in the center for transmitted light. Mechanical stages Nos. 484 and 485, operated by the right hand in a normal, comfortable position are recommended as an aid to convenient and thorough inspection of the specimen. The entire stage (except on No. 48) is focusable by rack and pinion to accommodate large specimens. When using a more intense light source for photomicrography the stage can be raised and lowered by its rack and pinion adjustment instead of using the coarse adjustment on the body tube. Thus, it is not necessary to disturb the alignment of the lamp and Vertical Illuminator when changing objectives or specimens.

The stage of Nos. 46, 47, 50, and 51 is rigidly supported by a horseshoe type bracket to insure freedom from vibration.

OPTICS

Standard magnifications of 75X, 100X, 200X, 500X, 1000X and 1500X are provided with proper combinations of eyepieces and objectives. Eyepieces are truncated cone shape for ease of observation—especially desirable for those wearing glasses. Lenses are easily cleaned. Objectives are standard Spencer achromatic type designed for finest performance with the Spencer Metallurgical Microscope.

The special micrometer eyepiece No. 2515 is for making measurements directly in thousandths of an inch and is recommended for case depth, and other linear measurements. For measurement of thickness of electroplating we recommend a Screw Micrometer Eyepiece No. 425.

FINISH

The finish is baked black enamel and chromium plating.

CABINET

The Metallurgical Microscope is furnished in a leatherette covered hardwood cabinet. The cabinet for all stands except the No. 48 is furnished with a drawer in the upper part of the cabinet for storage of objectives, eyepieces and other accessories. The cabinet for the No. 48 has a slide to hold additional objectives and eyepieces.

Microscopes Nos. 47 and 51

Spencer Metallurgical Microscope No. 47 is the same as No. 46 but has a stage with a center opening and is equipped with a substage condenser N.A. 1.25 and mirror for use with transmitted light. Microscope No. 51 is equipped with binocular body and substage equipment for transmitted light.

Microscope No. 48

Spencer Metallurgical Microscope No. 48 is similar to No. 46 and No. 47 but does not have a rack and pinion focusing stage and cannot be equipped with the binocular bodies. There is ample range of coarse adjustment for use at all magnifications with average size specimens. The No. 48 microscope is adequate for most types of routine visual work and is very satisfactory as a teaching instrument.

In Placing Your Order, Follow These Instructions:

Use the chart on page 9 to select the features and accessory equipment required. Order by catalog number—no further description is necessary.

Substitutions from standard catalog numbers shown on the chart can be made from the complete listing of objectives and eyepieces, together with the list of accessories.

The following notes may be helpful in making substitutions not readily found in these listings of accessory equipment.

1. The No. 485 Graduated Mechanical Stage, suitable for making measurements and locating areas within the specimen, can be substituted for the No. 484 Ungraduated Mechanical Stage. Add.
2. Uncoated reflector in vertical illuminator can be substituted for the coated reflector. Deduct . .
3. Vertical binocular body can be substituted for inclined binocular on Nos. 50 and 51. Deduct. . . . .
4. If fixed monocular tube is desired instead of adjustable. Deduct.


SPENCER

Cat. No.	Stage	Body Tube	Vertical Illuminator	Achromatic Objectives	Eyepieces	Substage Condenser	Standard Magnifications (Approx)	Price
46A	Solid, focusable	Adjustable Monocular	Complete with coated reflector, illuminating unit, variable transformer, 2 objective adapters.	16mm. 4mm.	12X Huyghenian	None	100X 500X	
46MB	Solid, focusable with No. 484 Mechanical Stage	Adjustable Monocular	Complete with coated reflector, illuminating unit, variable transformer, 3 objective adapters.	3.5X 16mm. 4mm.	8X Huyghenian 12X Huyghenian	None	25X 75X 100X 500X	
46MC	Solid, focusable with No. 484 Mechanical Stage	Adjustable Monocular	Complete with coated reflector, illuminating unit, variable transformer, 3 objective adapters.	16mm. 8mm. 4mm.	6X Huyghenian 12X Huyghenian	None	50X 100X 200X 500X	
47MD	Stage with center hole, focusable, No. 484 Mechanical Stage	Adjustable Monocular	Complete with coated reflector, illuminating unit, variable transformer, 5 objective adapters.	3.5X 16mm. 8mm. 4mm. 1.8mm.	8X Huyghenian 12X Huyghenian 15X Comp.	Abbe N.A. 1.25 with mirror	25X 75X 100X 200X 500X 1000X 1500X	
48A	Stage with center hole, not focusable	Fixed Monocular	Complete with uncoated plano-reflector, illuminating unit, fixed transformer, 2 objective adapters.	16mm. 4mm.	12X Huyghenian	None	100X 500X	
48MA	Stage with center hole, not focusable, No. 484 Mechanical Stage	Fixed Monocular	Complete with uncoated plano-reflector, illuminating unit, fixed transformer, 2 objective adapters.	16mm. 4mm.	12X Hugghenian	None	100X 500X	
48MB	Stage with center hole, not focusable, No. 484 Mechanical Stage	Fixed Monocular	Complete with uncoated plano-reflector, illuminating unit, fixed transformer, 3 objective adapters.	3.5X 16mm. 4mm.	8X Huyghenian 12X Huyghenian	None	25X 75X 100X 500X	
50MB	Solid, focusable, with No. 484 Mechanical Stage	Inclined Binocular	Complete with coated reflector, illuminating unit, with variable transformer, 3 objective adapters.	3.5X 16mm. 4mm.	Paired 8X Huyghenian 12X Huyghenian	None	25X 75X 100X 500X	
50MC	Solid, focusable, with No. 484 Mechanical Stage	Inclined Binocular	Complete with coated reflector, illuminating unit, with variable transformer, 3 objective adapters.	16mm. 8mm. 4mm.	Paired 6X Huyghenian 12X Huyghenian	None	50X 100X 200X 500X	
50MD	Solid, focusable, with No. 484 Mechanical Stage	Inclined Binocular	Complete with coated reflector, illuminating unit, with variable transformer, 5 objective adapters.	3.5X 16mm. 8mm. 4mm. 1.8mm.	Paired 8X Huyghenian 12X Huyghenian 15X Comp.	None	25X 75X 100X 200X 500X 1000X 1500X	
51MD	Stage with center hole, focusable, No. 484 Mechanical Stage	Inclined Binocular	Complete with coated reflector, illuminating unit, with variable transformer, 5 objective adapters.	3.5X 16mm. 8mm. 4mm. 1.8mm.	Paired 8X Huyghenian 12X Huyghenian 15X Comp.	Abbe N.A. 1.25 with mirror	25X 75X 100X 200X 500X 1000X 1500X	

HUYGHENIAN EYEPIECES

Cat. No.	Magnification	Price
138	6X	
140	8X	
142	10X	
144	12X	
1138 (Paired)	6X	
1140 (Paired)	8X	
1142 (Paired)	10X	
1144 (Paired)	12X	

COMPENSATING EYEPIECES

Cat. No.	Magnification	Price
167 (High Eyepoint)	10X	
168	10X	
170	15X	
1167 (Paired High Eyepoint)	10X	
1168 (Paired)	10X	
1170 (Paired)	15X	

ACHROMATIC OBJECTIVES—SHORT MOUNT FOR USE WITH VERTICAL ILLUMINATOR

Cat. No.	Focal Length	Magnification	Numerical Aperture	Price
102	40mm.	2.8X	.08	
104	32mm.	4X	.10	
C105	30.2mm.	3.5X	.09	
107	25mm.	5.1X	.17	
C1279	16mm.	10X	.25	
C1283	8mm.	20X	.50	
C1289	4mm.	40X	.85	
C1294	1.8mm. (oil immersion)	95X	1.25	

NOTE: Objective Adapter No. 2510 necessary for use on Vertical Illuminator. One furnished with 2530, 2540

VERTICAL ILLUMINATOR AND ACCESSORIES

Cat. No.	Description	Price
2530	Vertical Illuminator with coated reflector, prism, quick-change nosepiece, green filter, without illuminating unit, without leatherette case	
2540	Vertical Illuminator, same as above but with uncoated reflector	
2505	Illuminating Unit with one bulb but without transformer or resistance	
2506	Fixed Transformer for use with No. 2505 on 110 volt, A.C.	
395	Variable Transformer for use with No. 2505 on 110 volt, A.C.	
2508	Fixed Resistance for use with No. 2505 on 110 volt, D.C.	
2510	Quick-Change Objective Adapter	
2512	Blue Daylight Filter in metal mount	
2515	Micrometer Eyepiece to read in thousandths of an inch with 16mm. objective	
2517	Leatherette Case for vertical illuminator, illuminator unit and accessories	
425	Screw Micrometer Eyepiece	

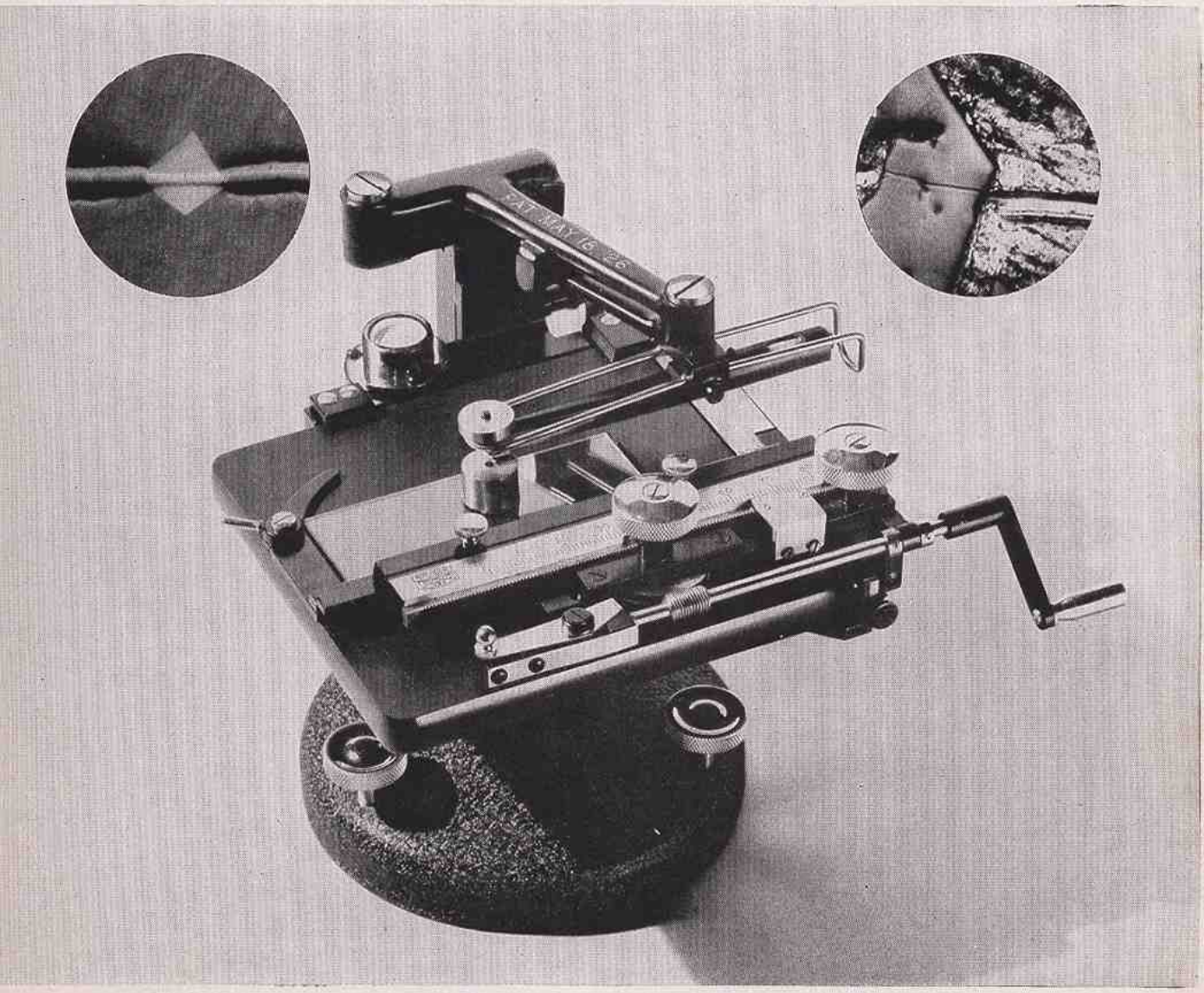
REPLACEMENT PARTS

2501	Uncoated Plano-Glass Reflector as supplied with No. 2540	
2502	Special Coated Plano-Glass Reflector as supplied with No. 2530	
2509	Bulb, 8 volt, 0.6 amp. for No. 2505	MCP
2518	Protective Glass Window (supplied with No. 2530 and 2540)	

The Spencer Bierbaum Microcharacter

The Spencer Bierbaum Microcharacter* is an instrument designed and patented by Christopher H. Bierbaum, formerly Chairman of the Bearing Metals Research Committee of the American Society of Mechanical Engineers.

Although the Microcharacter was originally designed to determine the hardness of the different microscopic constituents in bearing metals, it is now being used successfully on many different types of materials for the measurement of hardness of small microscopic areas and particles within a metal. In most applications this



Spencer Bierbaum Microcharacter on the leveling stand.

Inserts showing diamond cut—Left: Zirconium Nitride crystal, distinctly in relief, on a steel surface of an airplane engine crank, magnification 2000X; Right: Tin oxide crystal, magnification 1000X.

**Registered U. S. Pat. Off.*

type of measurement is impossible with any other instrument. For example, the testing of electrolytically deposited chrome plate and case hardened steel has been accomplished with the Microcharacter with unique success. Its application in the rapidly expanding plastics industry is particularly promising.

The procedure consists of moving, with a micrometer feed, a highly polished lubricated surface of the material to be tested beneath a very accurately ground diamond point which is under a definite pressure. After a cut is made, its width is measured under the microscope and the hardness determined from a convenient formula.

The Spencer Bierbaum Microcharacter is a precision instrument manufactured in accordance with the exacting specifications demanded by the basic principles of the microcut method to insure accurate and reliable results.

A considerable amount of study has been devoted to the shape and proportion of a suitable cutting point, not only as to the best and most efficient for such service requirements, but also with a view to enabling the duplication of the cutting point in accordance with exact specifications. The corner of a cube was finally adopted as the most desirable shape, since it can be duplicated exactly and at the same time is very durable. One of the world's outstanding diamond cutters has developed a technique of grinding specially selected diamonds for use in the Microcharacter with no flaws or inaccuracies visible under magnification of 2000 diameters.

It is essential that the cutting point be held elastically in order for it to respond to the different depths of microcut, and also that the movement should be very slow and even so that no additional penetration is effected by stopping. In order that the width of cut shall, under all conditions, be a direct function of its depth, and the square of the width of cut be directly proportional to the cross sectional area, it is necessary that the cutting point be exceedingly accurate, that the three facets be true plane surfaces, that the three lines of intersection of these three facets be straight lines, and that the point shall be exceedingly sharp. These conditions are absolutely necessary in order that a rational scale of hardness may be established which will apply equally well to all degrees of hardness of the various substances tested, thereby giving an accurate means of consistent hardness determination.

The diamond is attached to a spring in such a manner that if the solid right angle or cutting point is considered as constituting one corner of an imaginary cube, the diagonal of this cube would then be normal to the test surface. One of the edges, formed by the intersection of two facets, is the advance or cutting edge, and is in direct line with the microcut. This advanced edge makes an angle of 35.25° with the test surface, constituting the angle of incision. The depth of cut is always slightly less than 4/10 of its width; therefore, the force of indentation is always greater than that of translation.

For the most satisfactory results with the Microcharacter, it is necessary to have a good metallurgical microscope. It is particularly important to have a vertical illuminator equipped with a means for proper control of illumination and a rigid stand with a responsive fine adjustment. An oil immersion objective is necessary for the required accuracy in measuring the width of microcuts, especially so with very hard materials. For most purposes a dry objective of 4mm. focal length is also very useful for preliminary study. A screw micrometer eyepiece of high magnification, not less than 15 or 25 diameters is also required.

Cat. No.	Description	Price
10002	Microcharacter complete with 3 gram weight, diamond and leveling stand	
	ACCESSORIES	
10009	Replacement diamond mounted on spring mount	
10006	Screw micrometer eyepiece with 25X compensating eyepiece	
10008	15X compensating eyepiece for 10006 screw micrometer	

For best results we recommend use of the Spencer Metallurgical Microscope and vertical illuminator. Details furnished on request.

Polarizing Microscopes

The Polarizing Microscope, long an indispensable aid of the petrographer, has come into its own in many branches of science in recent years. Micro techniques in chemistry, employing polarized light, have effected significant economies of time and material. The metal, petroleum, plastics, and synthetic fibers industries find this instrument of increasing importance in fundamental research and process control. The biologist has found a steadily increasing number of applications for it. The optical activity of various materials is adding daily to our knowledge of life, disease, and death.

Because of the many different uses for Spencer Polarizing Microscopes, several variations of each model are listed. Simple designations of these optional features are described in the following paragraphs.

Each microscope is available with either a rotatable or a non-rotatable analyzer in the body tube. This is indicated by the use of one of the following letters immediately after the model number:

A. Designates a Rotatable Analyzer.

B. Designates a Non-Rotatable Analyzer.

Research Polarizing Microscopes are listed only with the centerable quick-change nosepiece, but Standard Polarizing Microscopes may be ordered with a non-centerable revolving nosepiece. These differences in the Standard Polarizing Microscopes are indicated by a second letter following the catalog number.

C. Designates a centerable Quick-Change Nosepiece and a non-centerable stage.

D. Designates a non-centerable Triple Revolving Nosepiece and a centerable stage.

All Spencer Polarizing Microscopes have the same type of focusing adjustments, inclination joint, mirror, and finish. They are characterized by Spencer sturdiness, precision of movement, and fine appearance.

The rack and pinion coarse adjustment consists of a diagonal rack and spiral pinion. The bearing surfaces are provided with oil grooves, and different metals are used in the two contacting surfaces to provide smooth, easily-controlled motion.

The fine adjustment, the most important mechanical feature in a microscope, as on other Spencer microscopes, consists of a micrometer screw working in conjunction with a bell-crank lever, thereby providing a degree of precision found only in the finest measuring instruments.

Since the action of the screw is applied only in moving the body tube upward, the possibility of breaking the cover glass is greatly reduced.

The inclination joint works with exceptional smoothness, yet holds the instrument at any desired angle.

All stands are provided with a 50mm. substage mirror, plane on one side and concave on the other.

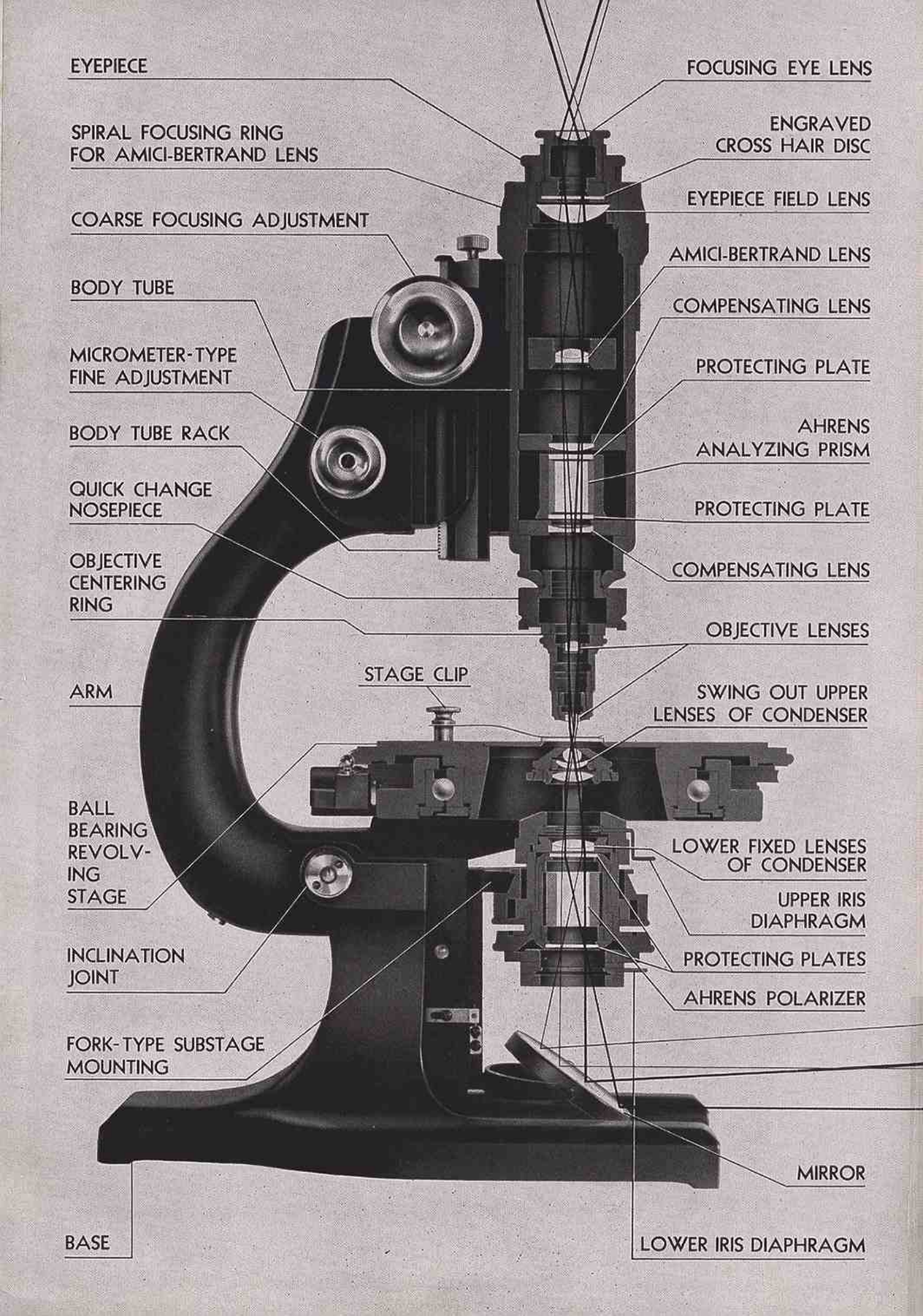
The lines on all graduations are distinct and easily read.

The instruments are finished in satin black enamel, and the graduated circles, verniers, and adjustment buttons are chromium plated to resist the fumes of reagents commonly used in chemical microscopy and petrography.

Stands

Microscopes Nos. 37 and 39 have the same heavy rigid stand, designed to meet the critical needs of the petrographer, whose work is of the most exacting nature, and are fully adapted to all types of microscopical research in polarized light. The stands will accommodate the largest universal stages. The top of the stage is 145mm. from the table, providing ample space for substage manipulation. The distance from the inside curve of the arm to the optical axis is 116mm. The body tube has a dovetail slide which provides 32mm. excursion in addition to the 80mm. range of movement available in the rack and pinion adjustment. The fine adjustment is graduated in units of 1 micron.

On Spencer Polarizing Microscopes Nos. 40, 41, 42, 43, a slightly smaller stand is supplied. The model numbers indicate differences in body tube and substage assembly. These are described fully in the list-


EYEPIECE
SPIRAL FOCUSING RING FOR AMICI-BERTRAND LENS
COARSE FOCUSING ADJUSTMENT
BODY TUBE
MICROMETER-TYPE FINE ADJUSTMENT
BODY TUBE RACK
QUICK CHANGE NOSEPIECE
OBJECTIVE CENTERING RING
ARM
BALL BEARING REVOLV-ING STAGE
INCLINATION JOINT
FORK-TYPE SUBSTAGE MOUNTING
BASE
FOCUSING EYE LENS
ENGRAVED CROSS HAIR DISC
EYEPIECE FIELD LENS
AMICI-BERTRAND LENS
COMPENSATING LENS
PROTECTING PLATE
AHRENS ANALYZING PRISM
PROTECTING PLATE
COMPENSATING LENS
OBJECTIVE LENSES
STAGE CLIP
SWING OUT UPPER LENSES OF CONDENSER
LOWER FIXED LENSES OF CONDENSER
UPPER IRIS DIAPHRAGM
PROTECTING PLATES
AHRENS POLARIZER
MIRROR
LOWER IRIS DIAPHRAGM

ing of each microscope. The stand is heavy and built for critical work. It will accommodate the smaller universal and integrating stages, and is so adaptable that, except for advanced research work, it will satisfy the requirements of the petrographer, mineralogist, biologist, and chemist. The distance from the optical axis to the arm is 103mm., and the stage height is ample. Body tube construction permits great latitude of adjustments for the observation of all types of material. The fine adjustment is graduated in units of 2.5 microns.

Circular Revolving Stages

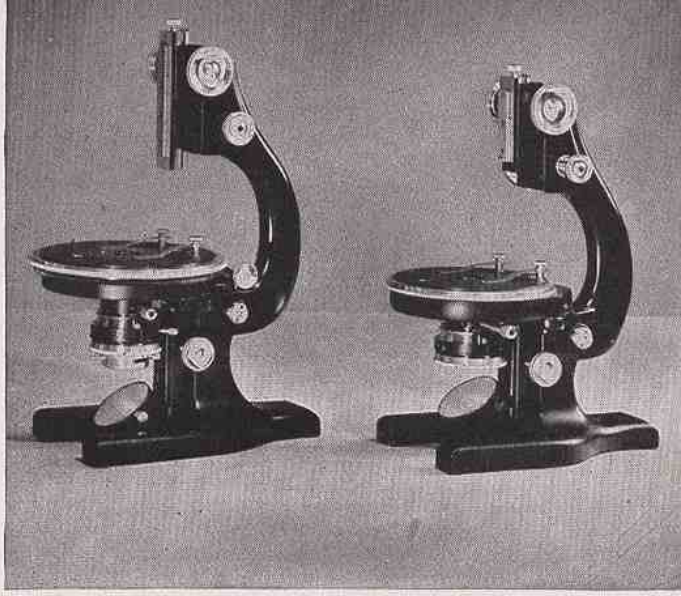
The precision of the revolving stages is due to careful centering and fitting. They are free from play or "creeping". The peripheries of the stages are graduated in single degrees, with the vernier reading to three minutes of arc.

A centerable stage, with conical bearings, is supplied whenever a non-centerable revolving nosepiece is ordered. On all stages provision is made for locking the stage at any desired position of rotation.

Two sizes of stage are used on Spencer Polarizing Microscopes. Microscopes Nos. 40, 41, 42, and 43 are equipped with a plain bearing stage, either centerable or non-centerable, which is 125mm. in diameter. Microscopes Nos. 37 and 39 are equipped with a non-centerable, ball-bearing stage 150mm. in diameter. A slow motion adjustment will be supplied with the ball-bearing stage at a slight additional cost. The stages are drilled and tapped to accommodate all universal stages in addition to the No. 495 Mechanical Stage.

Crystal Optics

The Ahrens prism has long been accepted as the most satisfactory means for polarizing light. The finest quality calcite prisms



The basic stands for all Polarizing Microscopes.

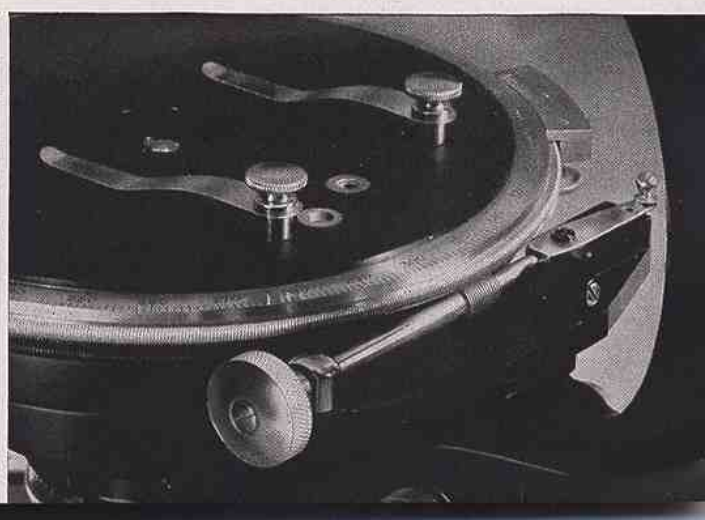
are used in Spencer Research (Nos. 37 and 39) and Standard (Nos. 40 and 41) Polarizing Microscopes. Improvements in cementing and mounting methods developed by Spencer insure a maximum period of service.

New opportunities in the design of optical instruments have been presented by the recent scientific achievements in the synthesis of crystalline polarizing materials and in the development of new plastics. Scientists of American Optical Company who have been testing these materials for several years have enjoyed splendid cooperation from the manufacturers.

The Spencer Simplified Polarizing Microscopes (Nos. 42 and 43) employ these new materials. These instruments use polarizers of the most advanced type Polaroid material. Outstanding petrographers have examined them and expressed their satisfaction. Thorough tests indicate the permanence of these materials under adverse conditions. They were found to resist vapors and fumes in concentrations far beyond what can be tolerated by the user. Heat resistance has also been carefully investigated and it has been shown that the

Spencer Circular Revolving Stage: left, verniers; right, slow-motion adjustment for ball-bearing stage.





materials are unaffected by temperatures well in excess of the limits of climatic variations. (Note: As with calcite prisms, focusing a concentrated light source in the plane of the polarizer should be avoided.)

The optical characteristics of the synthetic crystal system have been found to parallel closely calcite equipment. The sensitivity of the extinction point is found to compare favorably with calcite, and there is remarkable freedom from residual color. Furthermore the shorter length of the polarizing unit and the elimination of several glass-air surfaces reduce the amount of stray light. A noticeable increase in contrast in the image results. This is particularly important in the added crispness apparent in interference figures.

Spencer research, in cooperation with the plastics industry, has also developed retardation plates for determining the nature of double refraction. Careful tests indicate that they are stable under extremes of temperature and resistant to fumes. The manufacturing process used to produce these plates is capable of more accurate control than can be achieved through the cleavage of natural crystal. As a result the retardation is more accurately controlled. A quartz wedge, designed to give a true zero order, is also available. See following pages for listing of these accessories.

Body Tubes

The body tubes on all Spencer Polarizing Microscopes are exceptionally large, (45mm. in diameter) in harmony with the large stands. Special attention has been given to achieve convenience and smooth operation of the body tube accessories. Dovetailed slideways for analyzers are chromium against brass to assure lasting precision. Small knurled heads are located at both ends of the sliding parts so that they may be operated with either hand.

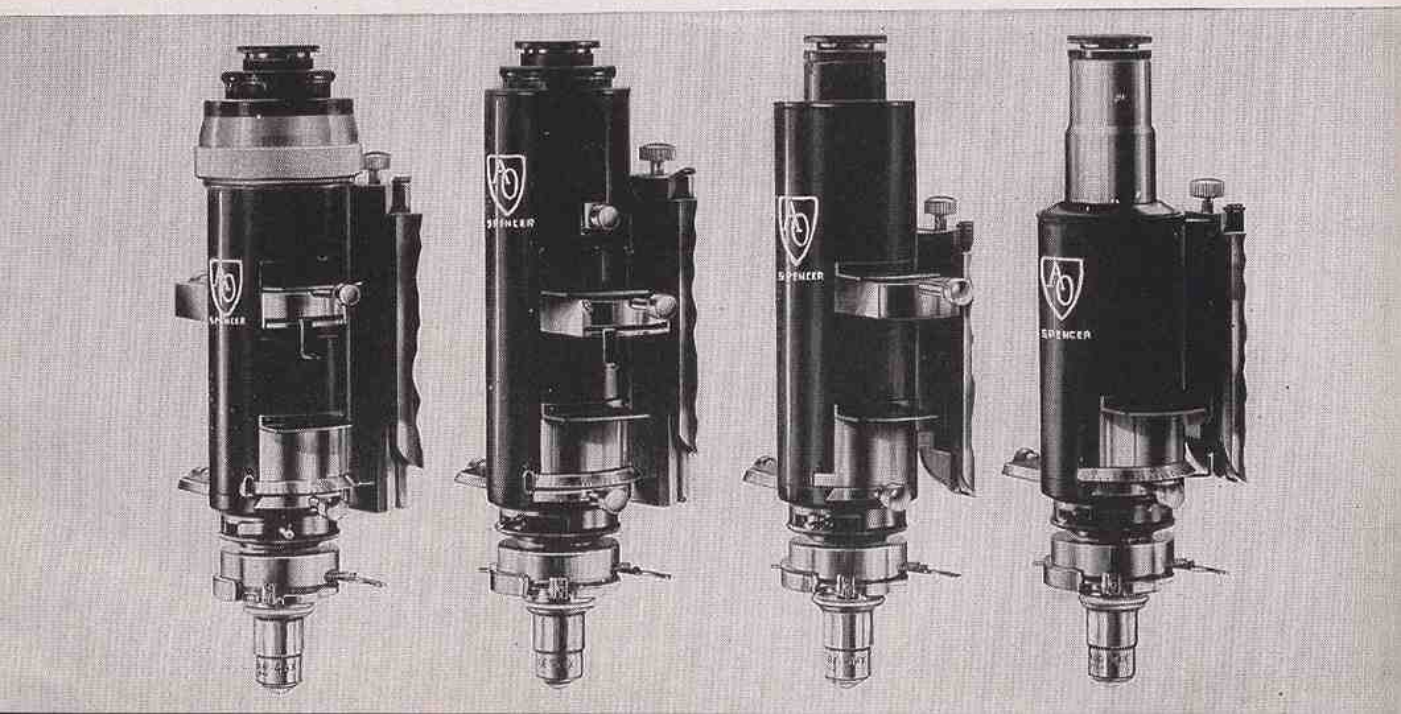
All body tubes, of which there are four, are equipped with a built-in body tube analyzer. Two are equipped with 12 millimeter Ahrens prism analyzers and accommodate large diameter eyepieces. Two are equipped with high grade Polaroid analyzers and accommodate standard diameter eyepieces. The analyzer may be mounted in either a fixed mount or a rotatable one having graduations from 0° to 90°. The terminal positions of this range are indicated by a click; however, an additional 5° is available beyond the 0° and 90° positions.

Focusable Amici-Bertrand lenses are available in the two body tubes having Ahrens prism analyzers. In these body tubes the Bertrand lens is centerable in its mount and is equipped with an iris diaphragm.

The spiral focusing Bertrand lens, as supplied on the body tube for the Nos. 37 and 40 Microscopes, is actuated by a graduated knurled ring at the top of the body tube.

The hand sliding, focusing Bertrand lens, as supplied on the body tubes of the Nos. 39 and 41, is focused by means of a knob extending from a slot in the side of the body tube.

Body tubes (left to right) for: Nos. 37 and 40, Nos. 39 and 41, No. 42, No. 43.



Body tubes having Polaroid analyzers are available with a fixed focus Amici-Bertrand lens, adjusted at the factory, as offered on the No. 42 Microscope, or without Bertrand lens, as offered on the No. 43 Microscope. The fixed focus Bertrand lens is precentered at the factory and is not equipped with an iris diaphragm.

Quick-Change Nosepiece

The Spencer Quick-Change Centering Nosepiece, with three objective centering rings, is available for all instruments. The quick-change equipment consists of two parts: the nosepiece, which remains permanently attached to the body tube, and the objective centering ring, to which the objective is attached. The nosepiece has an ingenious spring clamp for holding the objective in positive alignment by applying tension to the objective centering rings. The convenient lever releases the tension for removing or replacing objectives. Each objective should be equipped with an objective ring and carefully centered for subsequent use. Two keys are supplied for turning the centering screws. If the most critical centering of objectives is not essential, a revolving nosepiece is a real convenience and time saver. The Nos. 40, 41, 42, and 43 Microscopes are listed with revolving nosepieces as well as with the quick-change. A centerable stage is provided when the non-centerable revolving nosepiece is supplied. The revolving nosepiece is not recommended for use on the research stands, Nos. 37 and 39, and a centerable stage is not available on these models.

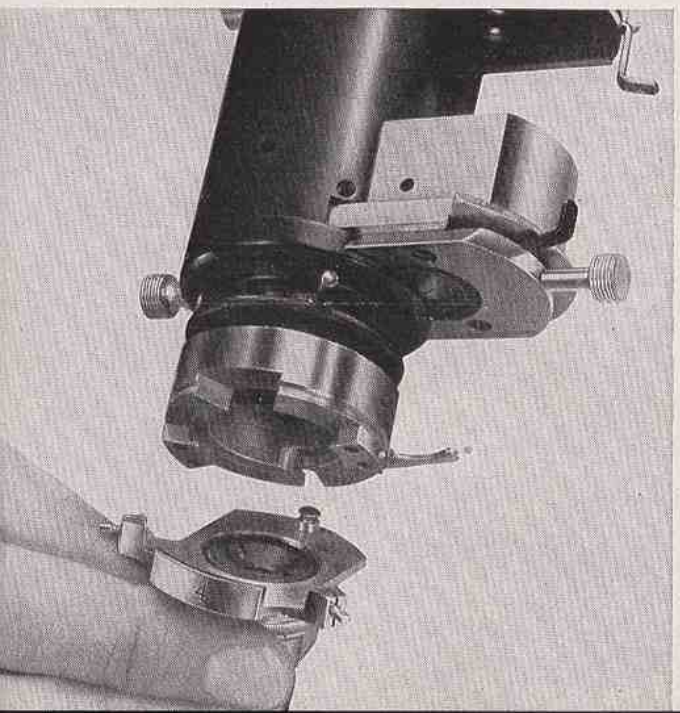
Substage Equipment for Polarizing Microscopes

Because of the construction of the Spencer substage equipment and the method of attaching it to the microscope, this equipment may be used in a variety of ways. For example, the condenser may be used without the polarizer; the polarizer may be used without the condenser; the lower fixed lens may be used entirely alone; or the entire substage may be removed easily from the fork-type support. There are two general types of substage equipment for Spencer Polarizing Microscopes.

Biological Style: This type of condenser has been designed so that the source of illumination, when placed at a distance of approximately 10 inches from the substage mirror, is focused on the object.

Petrographical Style: This type represents the more conventional form of petrographic substage condenser. Instead of the light source, either the lower iris diaphragm or the lower face of the polarizing prism (in case no lower iris is used) is focused on the specimen. In using this equipment, the concave side of the substage mirror is used to condense the light from the source at the position of the lower iris diaphragm.

Spencer quick-change nosepiece and objective centering ring.



The velvet lined accessory case, standard equipment with all Polarizing Microscopes.





Substage Condenser No. 532, standard equipment on No. 37. It can also be used on No. 39.



Substage Condenser No. 530 with swing-out unit tilted.

Becke Line: A shutter is provided on each condenser for Becke line effect.

Catalog No. 532: This substage equipment (Petrographical Style), which is standard equipment on the No. 37 and which may also be used on the No. 39, has a five-lens condensing system with a numerical aperture of 1.40. The entire system is achromatic. The three-lens, swing-out unit may be replaced by a unit providing a numerical aperture of 1.0.

When only the lower fixed unit of the condensing system is used, a numerical aperture of 0.28 is provided. This lower unit is fully achromatic. The condenser is equipped with both upper and lower iris diaphragms. A feature of this condenser is that the lower iris may be locked at any desired opening by means of a lock screw. A 15 millimeter Ahrens polarizer is used.

Catalog No. 530: This substage equipment (Petrographical Style) is standard equipment for the Nos. 39, 40, and 41 Microscopes. It is a three-lens combination with a numerical aperture of 1.0. When the two upper lenses are swung out as a unit, the lower fixed lens provides a numerical aperture of 0.28. An upper condenser unit having sufficient numerical aperture for use with the oil immersion objective is available. It replaces the N.A. 1.0 swing-out unit in the stirrup mount. If a lower iris diaphragm is desired, No. 526 is used. The polarizing prism is a 12 millimeter Ahrens.

Catalog No. 533: This substage equipment (Petrographical Style), which is standard equipment on Nos. 42 and 43 Microscopes, is a three-lens combination with a numerical aperture of 1.0. Optically it is identical with the No. 530 Condenser, except that Polaroid is used as a polarizer instead of a calcite prism.

Catalog No. 528: This substage equipment (Biological Style) is designed for use on the Nos. 37 and 39 Microscopes. The condenser consists of a six-lens system having a numerical aperture of 1.30. It is suitable for use with most oil immersion objectives. The condenser is aplanatic and fully achromatic. The upper three-lens unit is mounted in a stirrup support which permits swinging it in and out of the path of light. When only the lower fixed lens system is used, a numerical aperture of 0.28 is provided. The mechanical equipment includes both upper and lower iris diaphragms. The three-lens, swing-out unit may be replaced by a unit providing a

numerical aperture of 1.0, which is also supplied. A 15 millimeter Ahrens polarizing prism is used. This unit may be ordered in place of the No. 532 if desired.

Catalog No. 529: This substage equipment (Biological Style), which may be used with the Nos. 39, 40, and 41 Polarizing Microscopes, has a numerical aperture of 1.0. It has a three-lens condenser with the two upper lenses, as a unit, mounted on a stirrup, which can be swung out of the optical axis. The fixed lower lens has a numerical aperture of 0.28.

The condenser is regularly provided with an iris diaphragm located between the condenser and the polarizer. A second iris diaphragm, placed below the polarizer, is available as optional equipment. A 12 millimeter Ahrens polarizing prism is used. This unit may be ordered in place of No. 530 when desired.

Optical Parts

The objectives and eyepieces for Polarizing Microscopes, like other Spencer optical parts, are carefully computed to give the finest results in the work for which they are intended. Long experience in manufacturing, the most modern and efficient equipment, and the skill of experienced workmen are combined to produce the finest optical parts for work with polarized light.

Each element in a Spencer objective is carefully mounted and centered in its cell, and the optical centers of the elements are permanently secured at proper distances from each other in one straight line, which is the optical axis of the objective. In addition to the correction required in standard achromatic objectives, those for use with Polarizing Microscopes must be mounted strain-free. Each objective is plainly marked with its initial magnification. The strain-free objectives listed for Polarizing Microscopes are corrected for use with an 0.18mm. cover glass and 166.4mm. tube length. See pages of accessories for listing of objectives, eyepieces, and accessories.

Compensators of high optical quality are available for studying the nature of birefringence. These compensators are mounted in metal plates which fit into a slot in the body tube. All Spencer Polarizing Microscopes are provided with a slot, properly oriented, so that the compensators can only be inserted with the slow ray in the proper relation to the polarizer and analyzer.

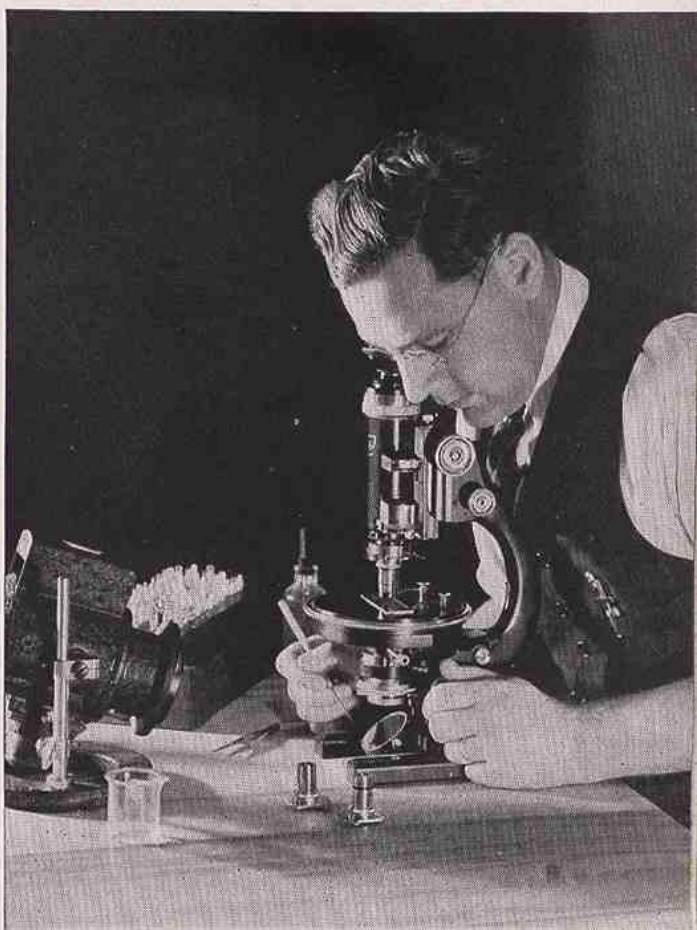
Three compensators are made from stressed plastic material which can be controlled in manufacture more accurately than the natural crystal sections generally used for this purpose.

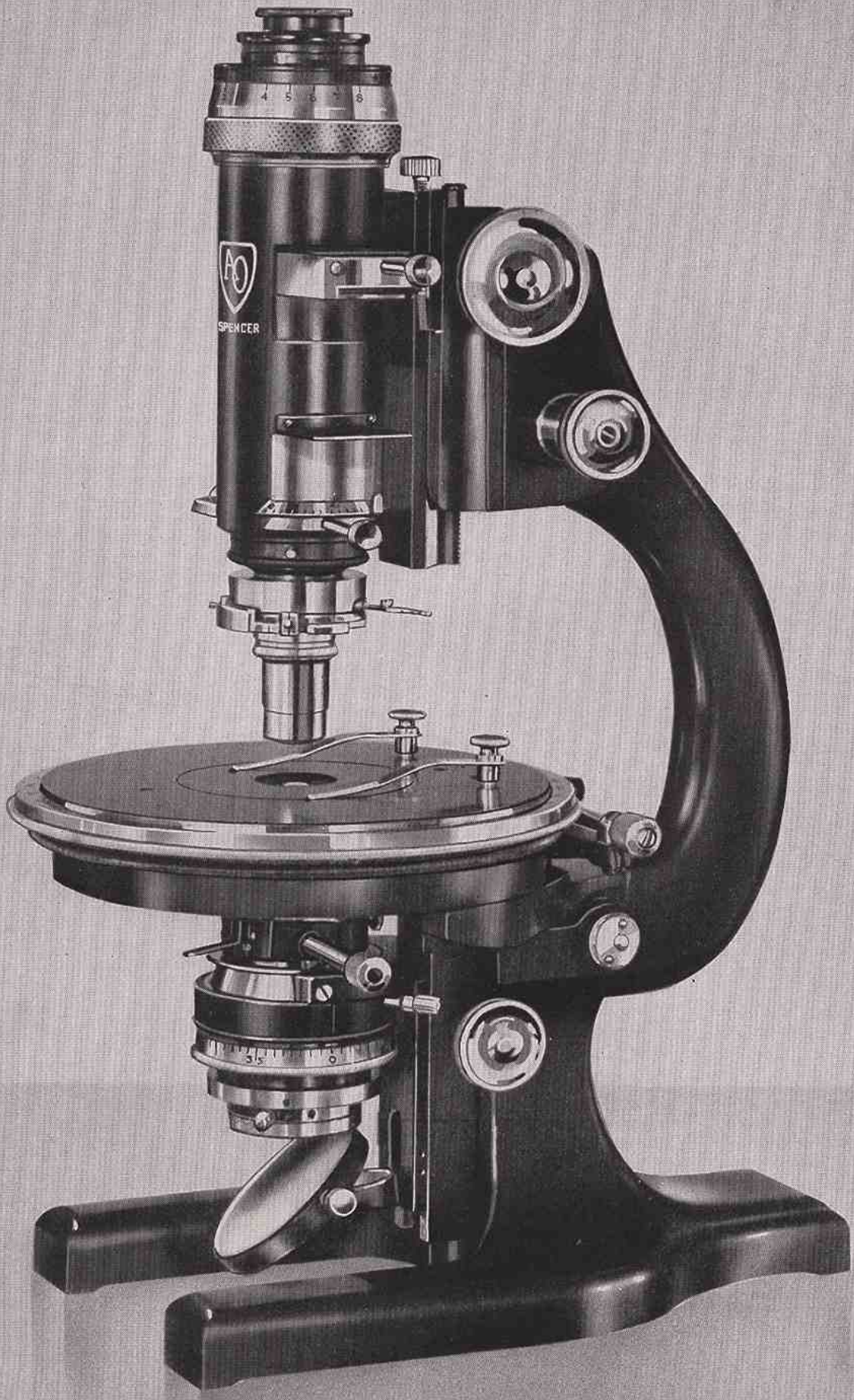
The quarter-wave plate and full-wave plate are useful in routine determinations of birefringence and optical signs.

The Becke aperture plate consists of two diagonal apertures at right angles to each other, a clear circular aperture, and a full-wave plate. This accessory is particularly useful in determining refractive index by means of the Becke line method.

In addition to the compensators already mentioned, a quartz wedge is available for use in the body tube slot. It provides compensation from a true zero order to the third order.

A graduated quartz wedge, complete with upper analyzer, is also available. It is more fully described on the accessories pages.




AO
SPENCER

Research Polarizing Microscope No. 37

Spencer Research Polarizing Microscope No. 37 offers great convenience and adaptability to the petrographer. It has features of precision ample for practically any measurements and is suitable for many different types of work. This is the instrument usually selected for advanced crystallographic work in government laboratories, and for microscopical research with polarized light in all types of laboratories. It will accommodate the integrating stages and universal stages.

STAND

The stand is large, 116mm. from optical axis to arm, 145mm. from table to stage, and 74mm. above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 80mm. A dovetail slide permits 32mm. additional excursion.

The micrometer screw-type fine adjustment is graduated to show .001mm. of movement.

BODY TUBE

A large sized body tube with large eyepiece tube and pinhole eyepiece is included.

The analyzer, a 12 millimeter Ahrens prism, is available in either a fixed or rotatable graduated mount.

The spiral focusing Bertrand lens is in a centerable mount with iris diaphragm. A quick-change centerable nosepiece with three objective centering rings is standard equipment.

STAGE

The 150mm. ball-bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A slow motion adjustment is available at slight additional charge.

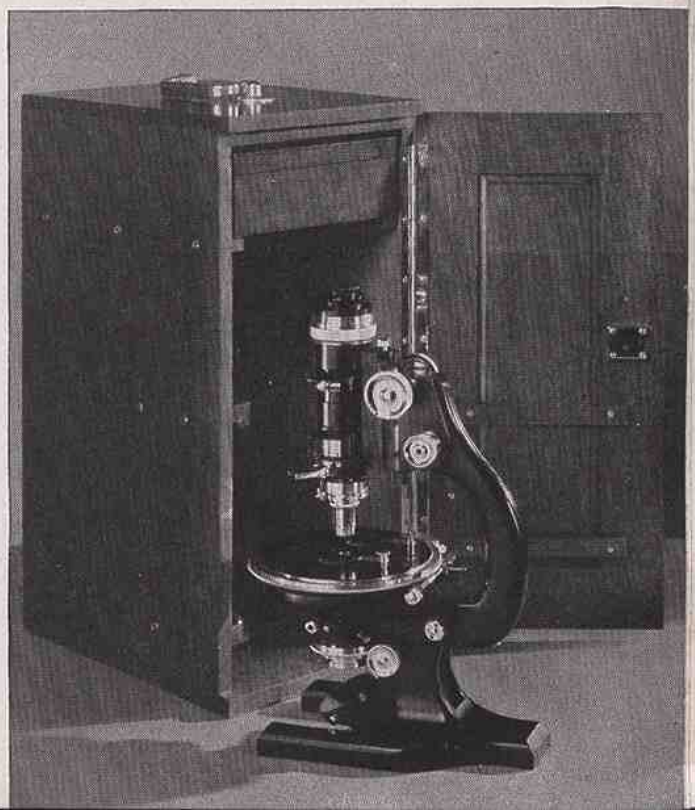
SUBSTAGE EQUIPMENT

No. 532 combined condenser is supplied. It has interchangeable front elements providing N.A. 1.40 and N.A. 1.0, complete with 15 millimeter Ahrens prism polarizer in graduated rotatable mount with lower iris diaphragm.

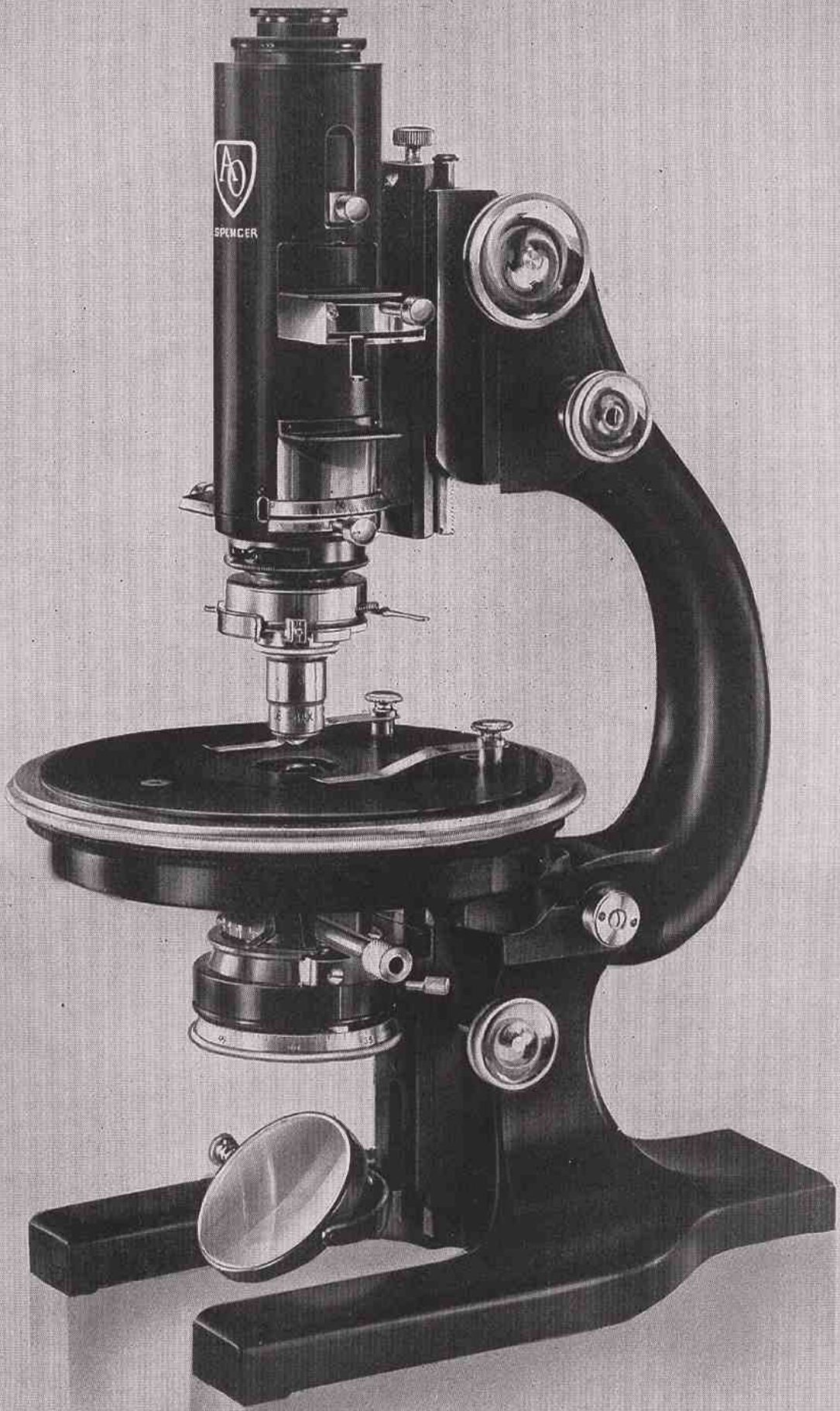
CABINET

The microscope comes in a polished hardwood cabinet with velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
37A	Spencer Research Polarizing Microscope as described, having spiral focusing Bertrand lens, pinhole eyepiece, combined condenser N.A. 1.40 and N.A. 1.0, with 15 millimeter Ahrens polarizing prism and graduated rotatable analyzer, in cabinet, but without objectives, eyepieces, or compensators.....	
37B	Spencer Research Polarizing Microscope, same as above, but with non-rotatable analyzer.....	



Spencer Polarizing Microscope No. 37A.


SPENCER

Large Polarizing Microscope No. 39

Spencer Large Polarizing Microscope No. 39 provides a large, rigid, stable stand with adequate distance below the stage for any illuminating accessories, and sufficient space above the stage to accommodate any of the universal stages. This instrument differs from No. 37 only in body tube and condenser equipment and is included to meet the requirements of those who do not need the high aperture condenser and the convenience of the spiral focusing Bertrand lens.

STAND

The stand is large, 116mm. from optical axis to arm, 145mm. from table to stage, and 74mm. above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 80mm. A dovetail slide permits 32mm. additional excursion.

The micrometer screw-type fine adjustment is graduated to show .001mm. of movement.

BODY TUBE

A large sized body tube with large eyepiece tube and pinhole eyepiece is included.

The analyzer, a 12 millimeter Ahrens prism, is available in either a fixed or rotatable graduated mount.

The hand focusing (sliding) Bertrand lens is in a centerable mount with iris diaphragm.

A quick-change centerable nosepiece with three objective centering rings is standard equipment.

STAGE

The 150mm. ball-bearing revolving stage has the periphery graduated in degrees with verniers reading to three minutes of arc. A slow motion adjustment is available at a slight additional charge.

Spencer Polarizing Microscope No. 39A.

SUBSTAGE

The No. 530 combined condenser is supplied. It has a numerical aperture of 1.0. The 12 millimeter Ahrens prism polarizer is in a graduated rotatable mount.

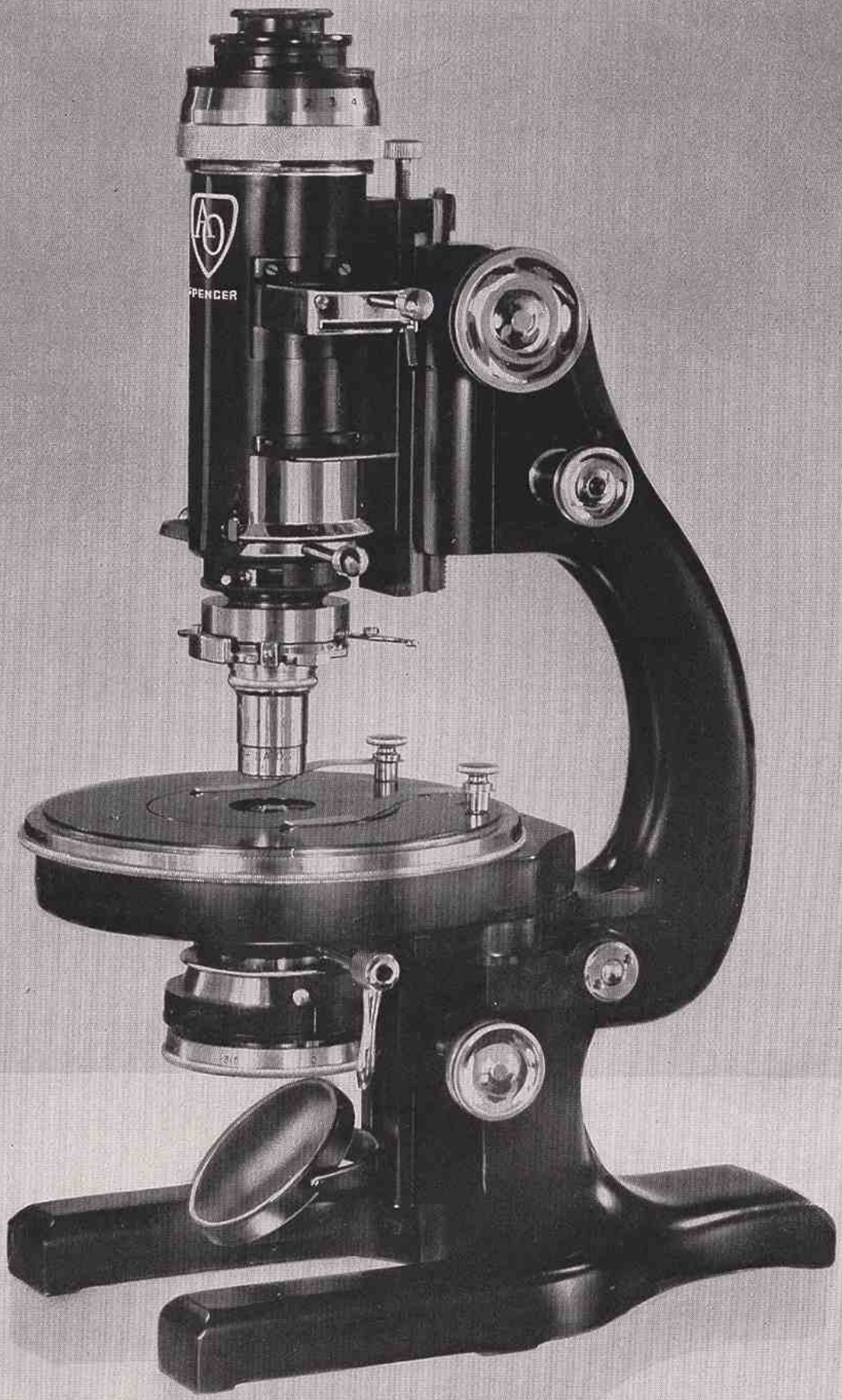
CABINET

The microscope comes in a polished hardwood cabinet with velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
39A	Spencer Large Polarizing Microscope as described, having hand focusing Bertrand lens, pinhole eyepiece, N.A. 1.0 condenser with 12 millimeter Ahrens polarizing prism and graduated rotatable analyzer, in cabinet, but without objectives, eyepieces, or compensators.....	
39B	Spencer Large Polarizing Microscope, same as above, but with non-rotatable analyzer.....	

Body tube showing quartz wedge in place.




PENCER

Polarizing Microscope No. 40

Spencer Polarizing Microscope No. 40 is a complete instrument for work in polarized light. This instrument, and No. 41 described on the following pages, are widely used in industrial laboratories. It will accommodate the integrating stages and the smaller universal stages. The convenience of the spiral focusing Bertrand lens is a real advantage during extensive routine examination of interference figures. The plain bearing stage is adequate for all but the most critical work. The wide field afforded by the large diameter eyepieces is another feature appreciated where a large volume of work is handled regularly.

STAND

The stand is standard in dimensions: 103mm. from optical axis to arm, 132mm. from table to stage, and 64mm. above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 70mm. A dovetail slide permits 32mm. additional excursion.

The micrometer screw-type fine adjustment is graduated to show .0025mm. of movement.

BODY TUBE

A large sized body tube with large eyepiece tube and pinhole eyepiece is included.

The analyzer, a 12 millimeter Ahrens, is available in either a fixed or rotatable mount.

The spiral focusing Bertrand lens is in a centerable mount with iris diaphragm. A quick-change nosepiece with three objective centering rings or a non-centerable, triple revolving nosepiece may be specified.

STAGE

The 125mm. plain bearing, non-centerable, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

SUBSTAGE EQUIPMENT

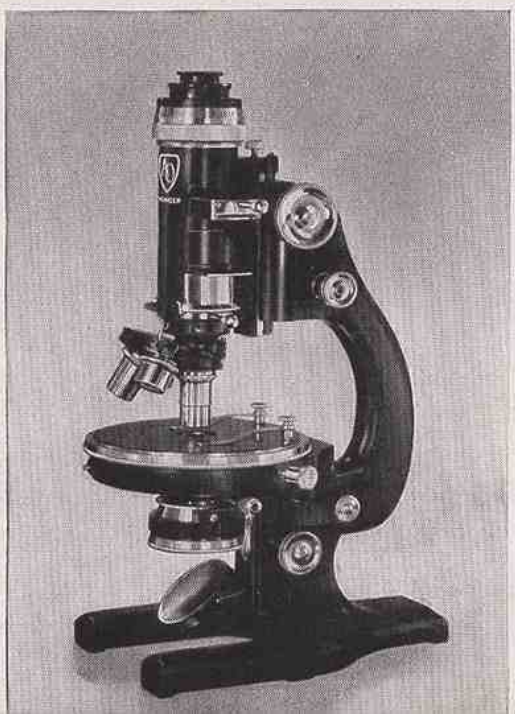
The No. 530 combined N.A. 1.0 condenser includes a 12 millimeter Ahrens prism polarizer in a graduated rotatable mount.

CABINET

The microscope comes in a leatherette covered hardwood cabinet with a velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
40AC	Spencer Polarizing Microscope as described, having spiral focusing Bertrand lens, large eyepiece tubes, pinhole eyepiece, rotatable analyzer, quick-change centerable nosepiece with three objective centering rings, in cabinet, but without objectives, eyepieces, or compensators.....	
40BC	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	
40AD	Spencer Polarizing Microscope, same as No. 40AC, but with a non-centerable, triple revolving nosepiece and centerable stage.....	
40BD	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	

Spencer Polarizing Microscope No. 40AD.



Spencer Polarizing Microscope No. 40AC.


PENCER

Polarizing Microscope No. 41

Spencer Polarizing Microscope No. 41 is identical with No. 40 described on the preceding page, except that the sliding focusing Bertrand lens is supplied instead of the spiral focusing feature.

This microscope, like other Spencer Polarizing Microscopes, can be equipped with any of the objectives, eyepieces, or compensators for either routine or advanced work.

STAND

The stand is standard in dimensions: 103mm. from optical axis to arm, 132mm. from table to stage, and 64mm. above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 70mm. A dovetail slide permits 32mm. additional excursion.

The micrometer screw-type fine adjustment is graduated to show .0025mm. of movement.

BODY TUBE

A large sized body tube with large eyepiece tube and pinhole eyepiece is included.

The analyzer, a 12 millimeter Ahrens prism, is available in either a fixed or rotatable mount.

The sliding focusing Bertrand lens is in a centerable mount with iris diaphragm. A quick-change centerable nosepiece with three objective centering rings or a non-centerable triple revolving nosepiece may be specified.

STAGE

The 125mm. plain bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

SUBSTAGE EQUIPMENT

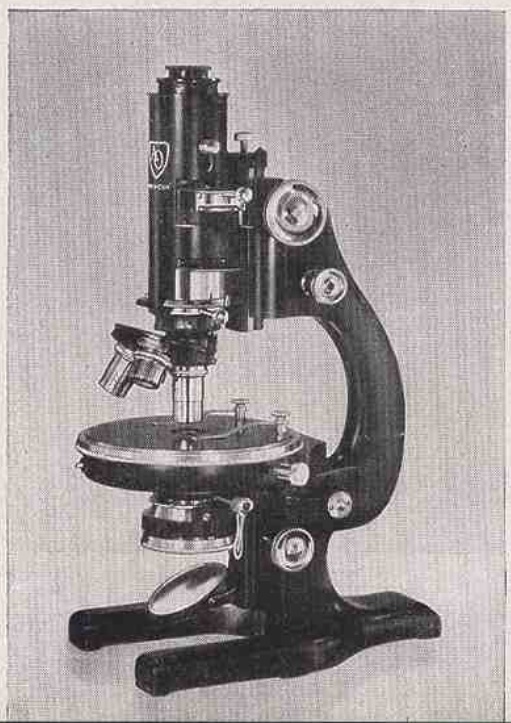
The No. 530 combined N.A. 1.0 condenser includes a 12 millimeter Ahrens prism polarizer in a graduated rotatable mount.

CABINET

The microscope comes in a leatherette covered hardwood cabinet with a velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
41AC	Spencer Polarizing Microscope as described, having hand focusing Bertrand lens, large eyepiece tubes, pinhole eyepiece, rotatable analyzer, quick-change centerable nosepiece with three objective centering rings, in cabinet, but without objectives, eyepieces, or compensators.....	
41BC	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	
41AD	Spencer Polarizing Microscope, same as No. 41AC, but with a non-centerable, triple revolving nosepiece and centerable stage.....	
41BD	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	

Spencer Polarizing Microscope No. 41AD.



Spencer Polarizing Microscope No. 41AC.


SPENCER

Polarizing Microscope No. 42

Spencer Polarizing Microscope No. 42 is a complete microscope for work in polarized light at a minimum price. The use of Polaroid of precision optical quality instead of Ahrens prisms, the fixed focus Bertrand lens, and the standard diameter eyepieces make significant economies possible. Optically and mechanically the instrument is capable of the finest work. It is particularly well suited to satisfy the need for a complete instrument for students. It is also well adapted to the needs of the industrial control laboratory.

STAND

The stand is standard in dimensions: 103mm. from optical axis to arm, 132mm. from table to stage, and 64mm. above the stage.

The coarse adjustment, by diagonal rack and spiral pinion, provides a movement of 70mm. A dovetail slide permits 32mm. additional excursion.

The micrometer screw-type fine adjustment is graduated to show .0025mm. of movement.

BODY TUBE

A large sized body tube with standard diameter eyepiece tube and pinhole eyepiece is included.

The analyzer, a synthetic crystal (Polaroid), is available in either a fixed or rotatable mount.

The prefocused Bertrand lens is in a sliding mount.

A quick-change centerable nosepiece with three objective centering rings or a triple revolving nosepiece may be specified.

STAGE

The 125mm. plain bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

Spencer Polarizing Microscope No. 42AC.

SUBSTAGE EQUIPMENT

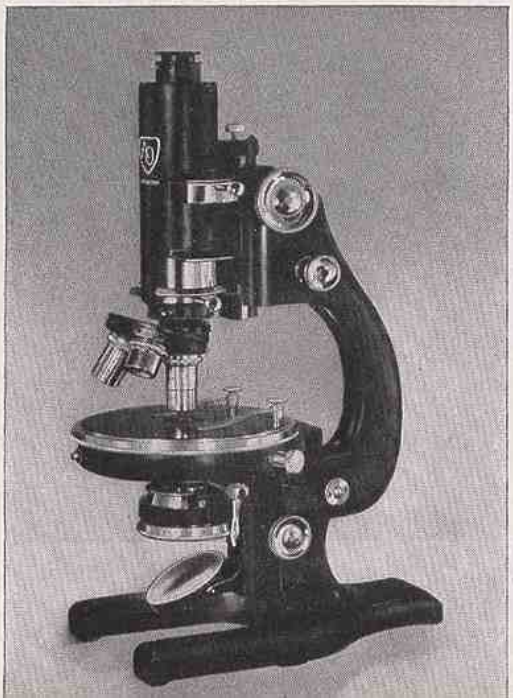
The No. 533 combined N.A. 1.0 condenser includes a Polaroid polarizing filter in a graduated rotatable mount.

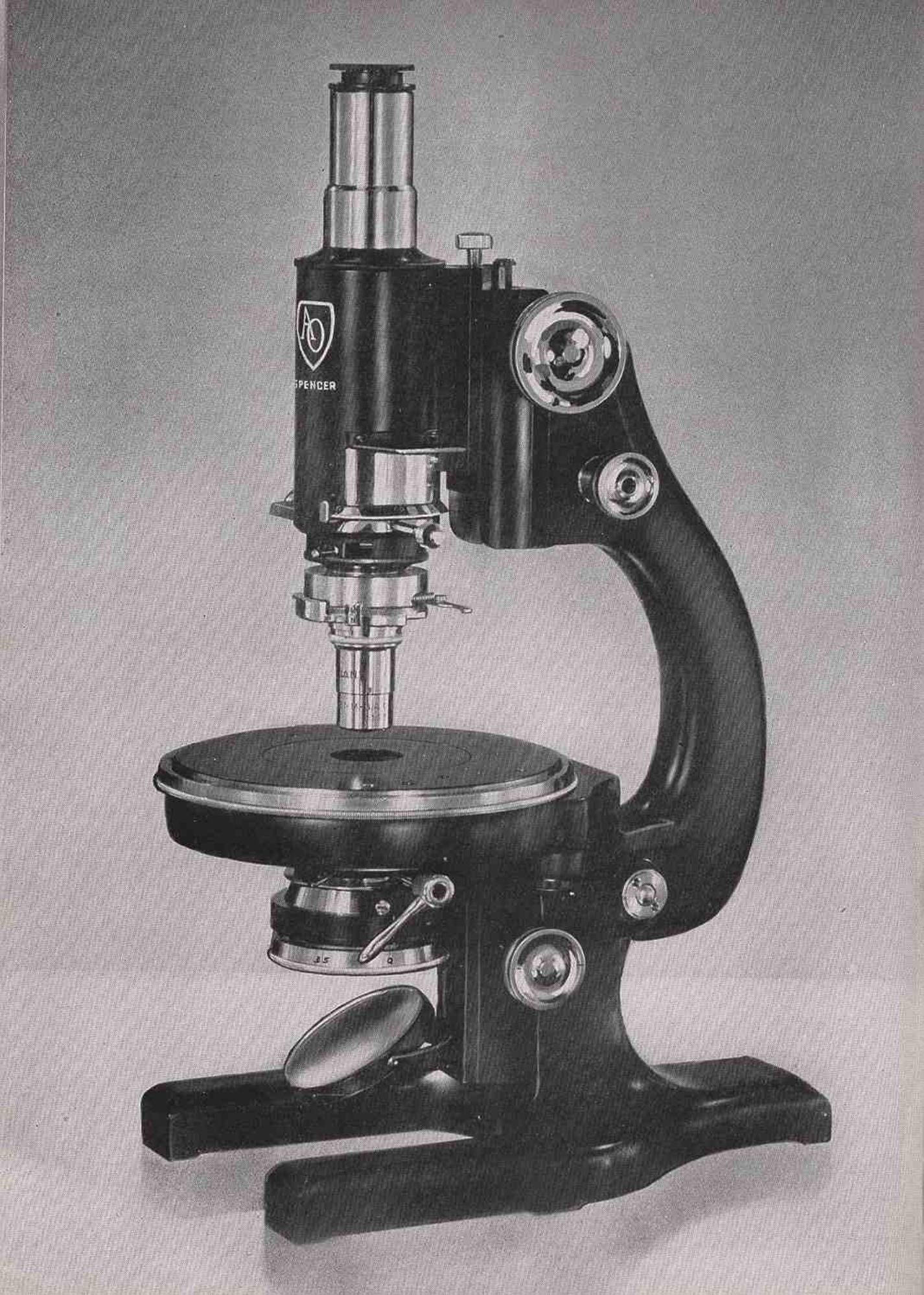
CABINET

The microscope comes in a leatherette covered hardwood cabinet with a velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
42AC	Spencer Polarizing Microscope as described, having Polaroid polarizer and analyzer, prefocused Bertrand lens, standard eyepiece tubes, pinhole eyepiece, rotatable analyzer, quick-change centerable nosepiece with three objective centering rings, in cabinet, but without objectives, eyepieces, or compensators.....	
42BC	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	
42AD	Spencer Polarizing Microscope, same as No. 42AC, but with a non-centerable, triple revolving nosepiece and centerable stage.....	
42BD	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	

Spencer Polarizing Microscope No. 42AD.




SPENCER

Polarizing Microscope No. 43

Spencer Polarizing Microscope No. 43 represents a distinct advance over the conventional "chemical" microscope. The analyzer in the body tube affords a considerably larger and more usable field than the cap analyzer, and eliminates the very low eyepoint. This instrument offers the same optical and mechanical features as the No. 42, except that no Bertrand lens is supplied. Where examination of the interference figure with the pinhole eyepiece only will suffice, the No. 43 Microscope offers a low cost instrument of a quality fully comparable with the other Spencer Polarizing Microscopes.

STAND

The stand is standard in dimensions: 103mm. from optical axis to arm, 132mm. from table to stage, and 64mm. above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 70mm. A dovetail slide permits 32mm. additional excursion.

The micrometer screw-type fine adjustment is graduated to show .0025mm. of movement.

BODY TUBE

A large sized body tube with standard diameter eyepiece tube and pinhole eyepiece is included.

The analyzer, a Polaroid disc of optical quality, is available in either a fixed or rotatable mount.

A quick-change centerable nosepiece with three objective centering rings or a triple revolving nosepiece may be specified.

STAGE

The 125mm. plain bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

Spencer Polarizing Microscope No. 43AC.

SUBSTAGE EQUIPMENT

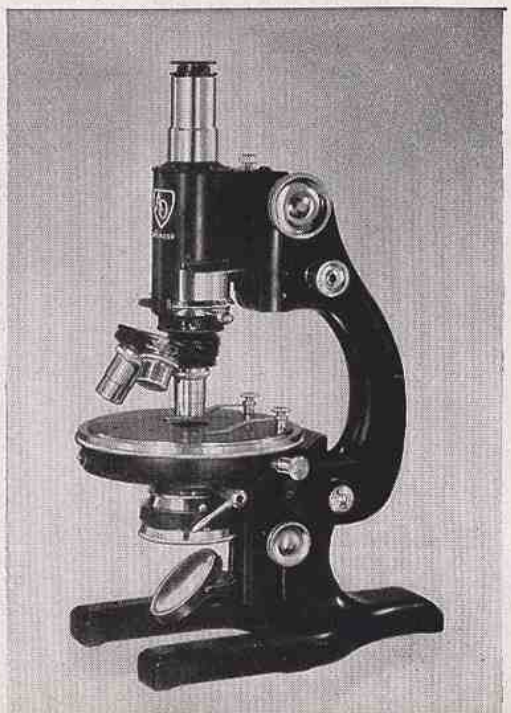
The No. 533 N.A. 1.0 condenser includes a Polaroid disc in a graduated rotatable mount.

CABINET

The microscope comes in a leatherette covered hardwood cabinet with a velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
43AC	Spencer Polarizing Microscope without Bertrand lens, as described, having Polaroid polarizer and analyzer, standard eyepiece tube, pinhole eyepiece, rotatable analyzer, quick-change centerable nosepiece with three objective centering rings, in cabinet, but without objectives, eyepieces, or compensators.....	
43BC	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	
43AD	Spencer Polarizing Microscope without Bertrand lens, same as No. 43AC, but with a non-centerable, triple revolving nosepiece and centerable stage.....	
43BD	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer.....	

Spencer Polarizing Microscope No. 43AD.



Accessories for Polarizing Microscopes

Strain-Free Achromatic Objectives

All Spencer Strain-Free Objectives are plainly marked with the equivalent focus, the numerical aperture, and the initial magnification. They are corrected for a tube length of 166.4mm. The magnification resulting from any combination of objective and eyepiece is always the product obtained by multiplying together the initial magnification of the objective and that of the eyepiece. The Spencer objectives, eyepieces, and condensers are designed to work together and, when used in proper combination, will give the finest results.

All Spencer Strain-Free Objectives listed are corrected for a cover glass thickness of 0.18mm.

Cat. No.	Equiv. Focus in mm.	Initial Magnification	Type	Numerical Aperture	Working Distance in mm.	Price
1270	48	2.2	dry	0.08	52.5	
1271	40	2.8	dry	0.08	35.2	
1272	32	4.0	dry	0.10	21.0	
1275	25	5.1	dry	0.17	21.0	
1280*	16	10.0	dry	0.25	4.5	
1284	8	20.0	dry	0.50	1.44	
1287	4	44.0	dry	0.66	0.63	
1290	4	45.0	dry	0.85	0.20	
1291	3	60.0	dry	0.85	0.20	
1295	1.8	95.0	oil imm.	1.25	0.13	

*This objective is separable. When the front system is removed, the back system becomes a 32mm.

Cross Hair Eyepieces

Cross Hair Eyepieces for Spencer Polarizing Microscopes have focusing eye lenses. They are made in large diameter, 30.00mm., for microscopes having the large diameter eyepiece tube, as well as in standard diameter, 23.22mm. An adapter is listed to fit the large diameter eyepiece tubes so that standard diameter eyepieces may be used.

Cat. No.	Description	Price
447	Cross Hair Eyepiece, 6X standard size	
448	Cross Hair Eyepiece, 8X standard size	
449	Cross Hair Eyepiece, 10X standard size	
451	Cross Hair Eyepiece, 5X large size.	
453	Cross Hair Eyepiece, 8X large size.	
454	Cross Hair Eyepiece, 10X large size.	
456	Cross Hair Eyepiece, 15X large size.	
457	Cross Hair Eyepiece, 20X large size.	
550	Adapter for standard size eyepieces in large eyepiece tubes	

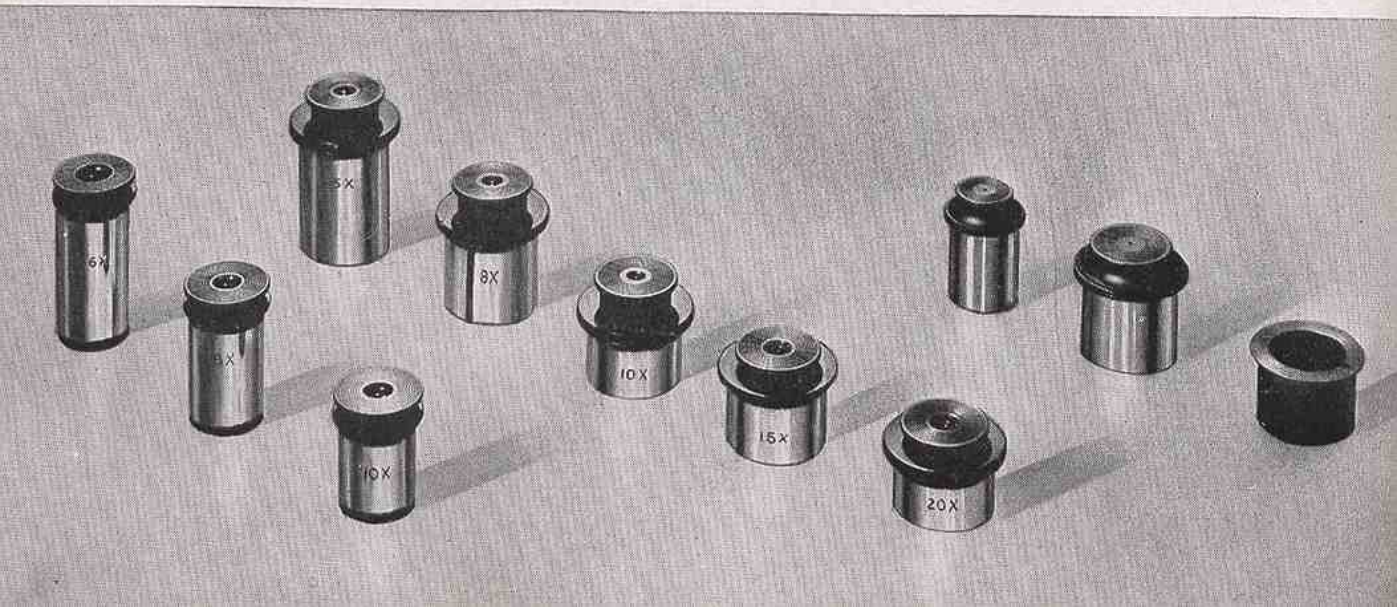
Pinhole Eyepieces

Cat. No.	Description	Price
546	Pinhole Eyepiece (standard diameter, 23.22mm.)	
547	Pinhole Eyepiece (large diameter, 30.00mm.)	

Nosepieces

Cat. No.	Description	Price
450	Double Revolving Nosepiece (non-centerable)	
455	Triple Revolving Nosepiece (non-centerable)	
460	Quadruple Revolving Nosepiece (non-centerable)	
462	Quick-Change Nosepiece	
463	Objective Centering Ring	

Eyepieces: left, standard diameter; center, large diameter; right, pinhole and No. 550 adapter



Substage Equipment

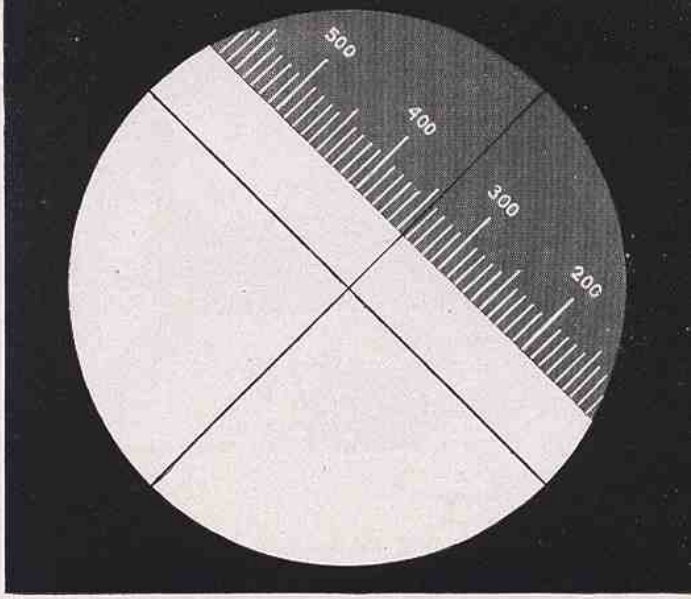
Substage equipment is described completely in the introductory material. The following chart shows the microscopes on which they may be used.

Substage Cat. No.	Microscope Cat. No.
528	37, 39
529	39, 40, 41
530	39, 40, 41
532	37, 39
533	42, 43

Cat. No.	Description	Price
528	Combined Condenser N.A. 1.30 with 15 millimeter Ahrens prism polarizer, Biological Style, with extra N.A. 1.0 top element and upper and lower iris diaphragms.....	
529	Combined Condenser N.A. 1.0 with 12 millimeter Ahrens prism polarizer, Biological Style.....	
530	Combined Condenser N.A. 1.0 with 12 millimeter Ahrens prism polarizer, Petrographical Style.....	
532	Combined Condenser N.A. 1.40 with 15 millimeter Ahrens prism polarizer, Petrographical Style, with an extra N.A. 1.0 top element and upper and lower iris diaphragm.....	
533	Combined Condenser N.A. 1.0 with Polaroid polarizer, Petrographical Style.....	
526	Iris Diaphragm mounted below polarizer (for Nos. 529 and 530).....	

Graduated Quartz Wedge

The Graduated Quartz Wedge consists of three principal parts: a quartz wedge with a scale on the top surface mounted in a slide; a holder which clamps over the top of the body tube and contains the cross line disc and a Polaroid disc; and a special Ramsden eyepiece which may be focused on the scale and cross lines.



Appearance of field using graduated quartz wedge.

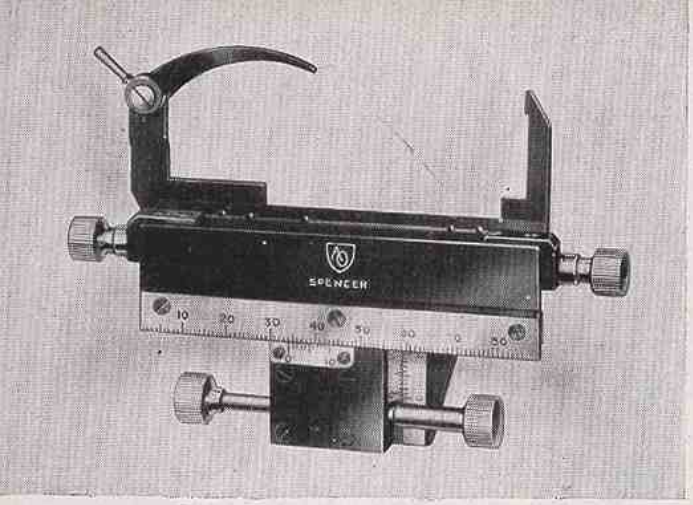
The graduations on the quartz wedge are from —500 to +2500mμ. with lines at 10mμ intervals. Estimates can be made to 2mμ. The lines and numerals are engraved through a semitransparent metalized surface. After the engraving, the metal is fused to the quartz so that the engraving is permanent.

The graduations appear bright on a semitransparent area at the edge of the field. This construction contributes materially to the comfort and ease of making accurate quantitative measurements of birefringence.

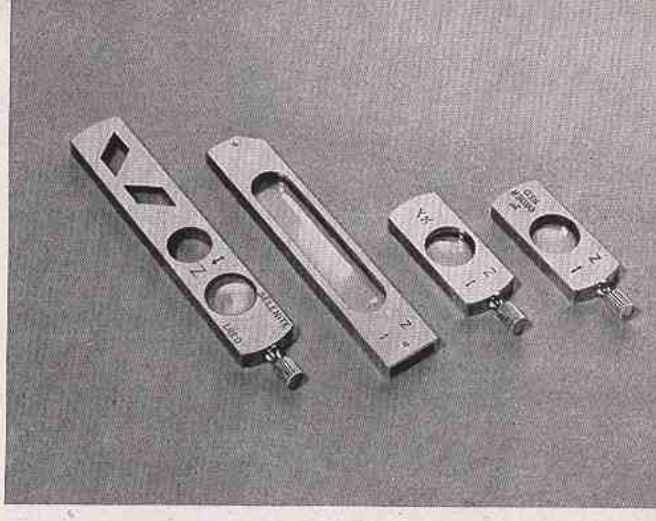
Cat. No.	Description	Price
555	Graduated Quartz Wedge complete as described above.....	

No. 555 Graduated Quartz Wedge.





No. 495 Mechanical Stage.



Compensators: left to right, Nos. 545, 542, 544, 540.

Mechanical Stage

All Spencer Polarizing Microscope Stages are drilled and tapped to take the Mechanical Stage No. 495. It is easily attached, revolves with the stage, and when removed, leaves a clean, even surface. This stage has a lateral excursion of 75mm. and a to-and-fro movement of 25mm. It is graduated in millimeters with verniers reading to 0.1mm. There are operating buttons on either side of the microscope, available for either hand.

Cat. No.	Description	Price
495	Mechanical Stage for Spencer Polarizing Microscopes. In leatherette case	

Compensators

Below are listed accessories for determining the nature of birefringence. These are in metal mounts fitting the slot in the lower end of the body tubes of all Spencer Polarizing Microscopes. The mount is marked with an arrow to indicate the direction of the retarded or so-called slow ray.

Cat. No.	Description	Price
540	Full-Wave Plate, 1st. order red	
542	Quartz Wedge, I to III order	
544	Quarter-Wave Plate	
545	Becke Aperture Plate	

Optical Measuring Instruments

Of great importance in industry and education are the instruments designed for investigation of the physical properties of materials by means of light and for the study of the properties of light itself.

Under this classification are described and illustrated:

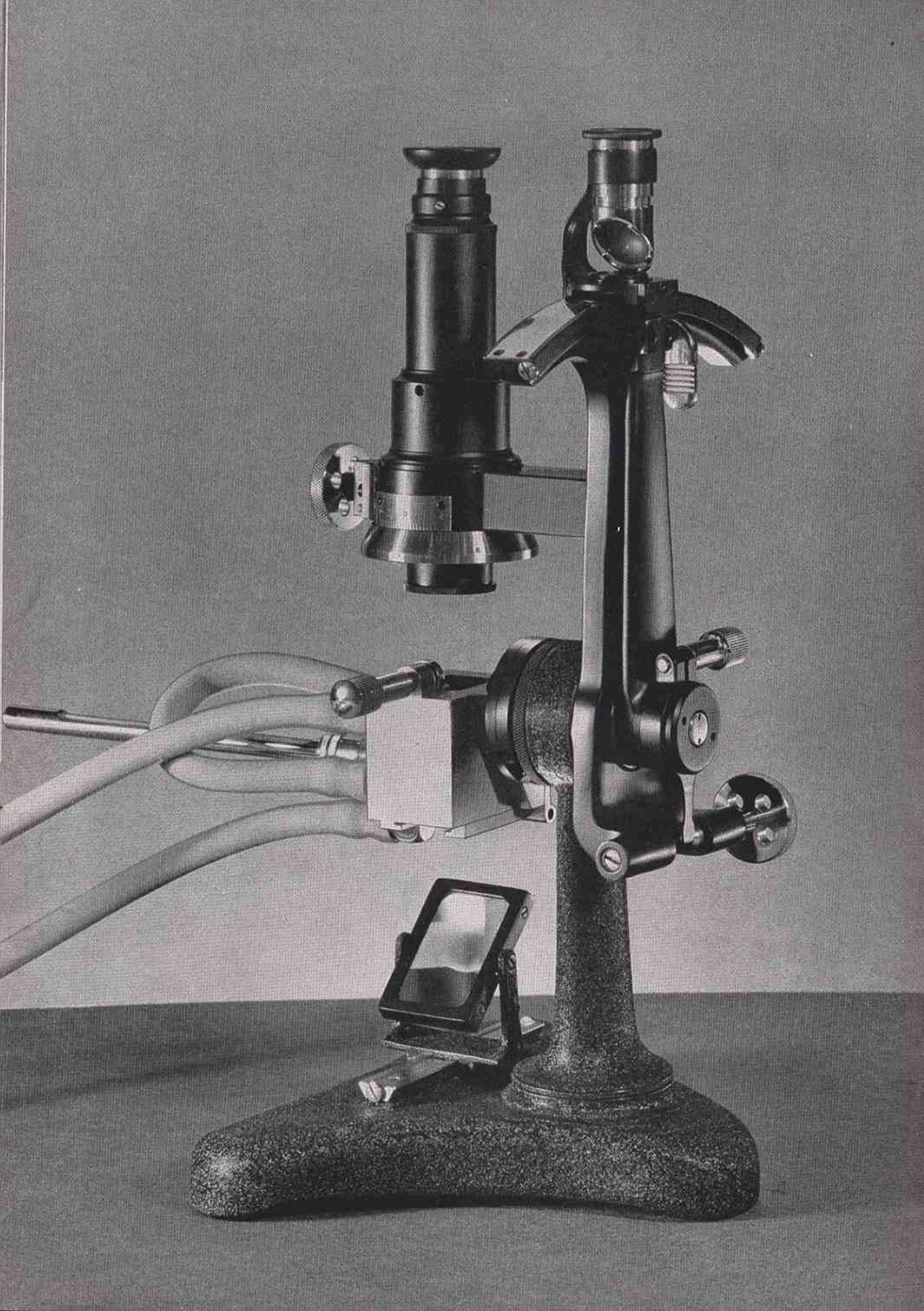
A. Refractometers in three types: Standard, Sugar, and High Index.
B. A Graduated Circle Spectrometer and accessories for measuring angles and refractive index and for studying spectra.
C. A Dubosq-type Colorimeter of advanced design.

Optical measurements, such as the determination of refractive index, often provide a quick and convenient method of control when correlated with industrial processes. Wherever a definite relationship exists between refractive index and the variables of the process, the refractometer is invaluable for guarding quality, increasing output, and reducing costs. Every day new uses are being found for it in the food processing, petroleum, paint and varnish, chemical, rubber, oil and fat, distilling, pharmaceutical, plastics, and many other industries.

The graduated circle spectrometer provides a means of study of spectra and of measuring angles and refractive index. It is valuable to many industrial laboratories, and has long been the ideal classroom instrument for demonstration of the optical properties of prisms and for teaching goniometry. In fact, this instrument and its accessories form the major part of the equipment needed in an optics course.

The measurement of light absorption in solution is an important step in numerous analyses made by chemical and clinical laboratories. The Spencer Dubosq-type Colorimeter provides rapid, positive means of comparing color densities. In industries such as petroleum, canning, oil and fat, brewing, chemical, metals, drug, paint and varnish, paper, and textile, and in the medical laboratories, it is being given an increasingly prominent role.





Spencer Refractometers

The Spencer Abbe Refractometer provides a quick and convenient means of determining the refractive index and dispersion of liquids and solids. These optical constants, as correlated with many industrial processes, form a convenient basis of control. The high precision of the Spencer Refractometer also makes it a valuable instrument for research.

Scale Graduations and Range

Six types of Spencer Refractometers are available. There are three instruments with different scales, either with or without Amici prisms. The scales are graduated so that the refractive index (n_D) can be read directly to the third decimal place and can be estimated to the fourth. All scales are graduated directly in indices of refraction for the D line of the sodium spectrum.

The Standard Abbe Scale

The scale which is supplied on Spencer Standard Refractometers, Catalog Nos. 10074 and 10075, covers a range of n_D 1.300 to n_D 1.710. The graduations are numbered in both directions so that they may be read easily from either side of the instrument.

The Sugar Scale

The scale on Spencer Sugar Refractometers, Catalog Nos. 10084 and 10085, is graduated on one side to read directly in percentages of sugar in solution from 0 to 85%. The other side is graduated in refractive index and covers a range of n_D 1.300 to n_D 1.710.

The High Index Scale

The scale on Spencer High Index Refractometers, Catalog Nos. 10090 and 10091, having special high index base prisms, covers an index range of n_D 1.450 to n_D 1.840.

Color Compensation and Dispersion Measurement

Instruments with Amici prisms are produced for those who prefer to work with white light. The purpose of these direct vision, compensating prisms is to achromatize the spectrum produced by refraction of white light going through the sample and primary prism. By rotation of the Amici prisms, the spectrum is concentrated into a sharp dividing line which is seen through the telescope. The scale reading is in terms of monochromatic sodium light even though white light is used for illumination. Dispersion ($n_F - n_C$) of the sample can be estimated, using a table furnished with the instrument and the reading from the compensator adjustment drum.

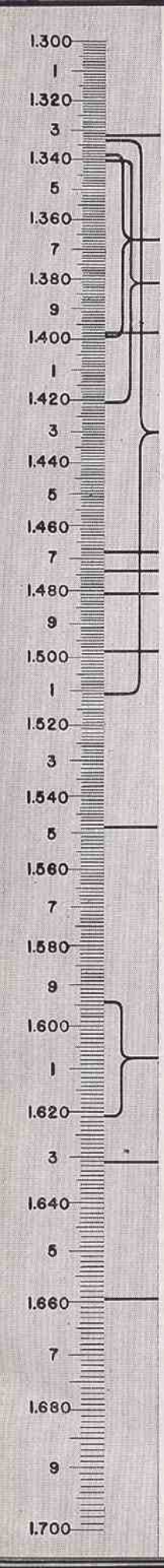
Spencer Refractometers without Amici compensating prisms are available for use with monochromatic light for those who prefer the utmost precision in an Abbe type instrument. These instruments are graduated to give index of refraction directly when used with monochromatic sodium light (589mμ). By using special conversion tables, other monochromatic light sources can be utilized in measuring refractive index. Thus, by employing conversion tables for the F (486mμ) and C (656mμ) lines of the hydrogen spectrum, dispersion ($n_F - n_C$) of the sample can be determined directly, using a hydrogen discharge tube for the light source with suitable filters.

Construction

A heavy cast iron base maintains the stability of the Spencer Refractometer even at the maximum working inclination. All mechanical parts are carefully fitted to facilitate smooth, precise settings. The dividing line of the field is set to coincide with the cross hairs by manual positioning of the prism alidade, and fine adjustment is made by means of a tangent screw.

An achromatic objective brings all rays of any one emergence angle to a sharp focus in the plane of the cross hairs. An eye lens, focusable in a spiral mount, facilitates the

Spencer Refractometer with Amici Prisms



setting of the instrument by providing a sharp, enlarged image of the dividing line and cross hairs.

Water jackets around the base prism and the illuminating prism provide a means for controlling temperature. A window in the back of the base prism water jacket may be opened to admit light for obtaining the refractive index of materials that do not transmit sufficient light for the usual procedure, or have no side through which grazing incidence light can be admitted. The illuminating prism may be removed for the examination of solids.

The Spencer Refractometer is finished in black baked enamel and chromium plating. A glass test block, a thermometer, thermometer guard, and a small bottle of monobromonaphthalene for making immersion contact in measuring solids are supplied with each instrument.

Industrial Applications of the Refractometer

FOOD: Helpful in the dairy laboratory to estimate sugar in sweetened milk, casein in skim milk, etc. Canners determine the total dissolved solids in tomato products, jams, jellies, eggs, etc. Useful for determination of fat in meal and cocoa products.

PETROLEUM: Used for control of fractionation and estimation of aromatic constituents.

PAINT AND VARNISH: Used in the identification of oils, the control of heat treatment, of oxidation, of hydrogenation, and in determination of the purity of solvents.

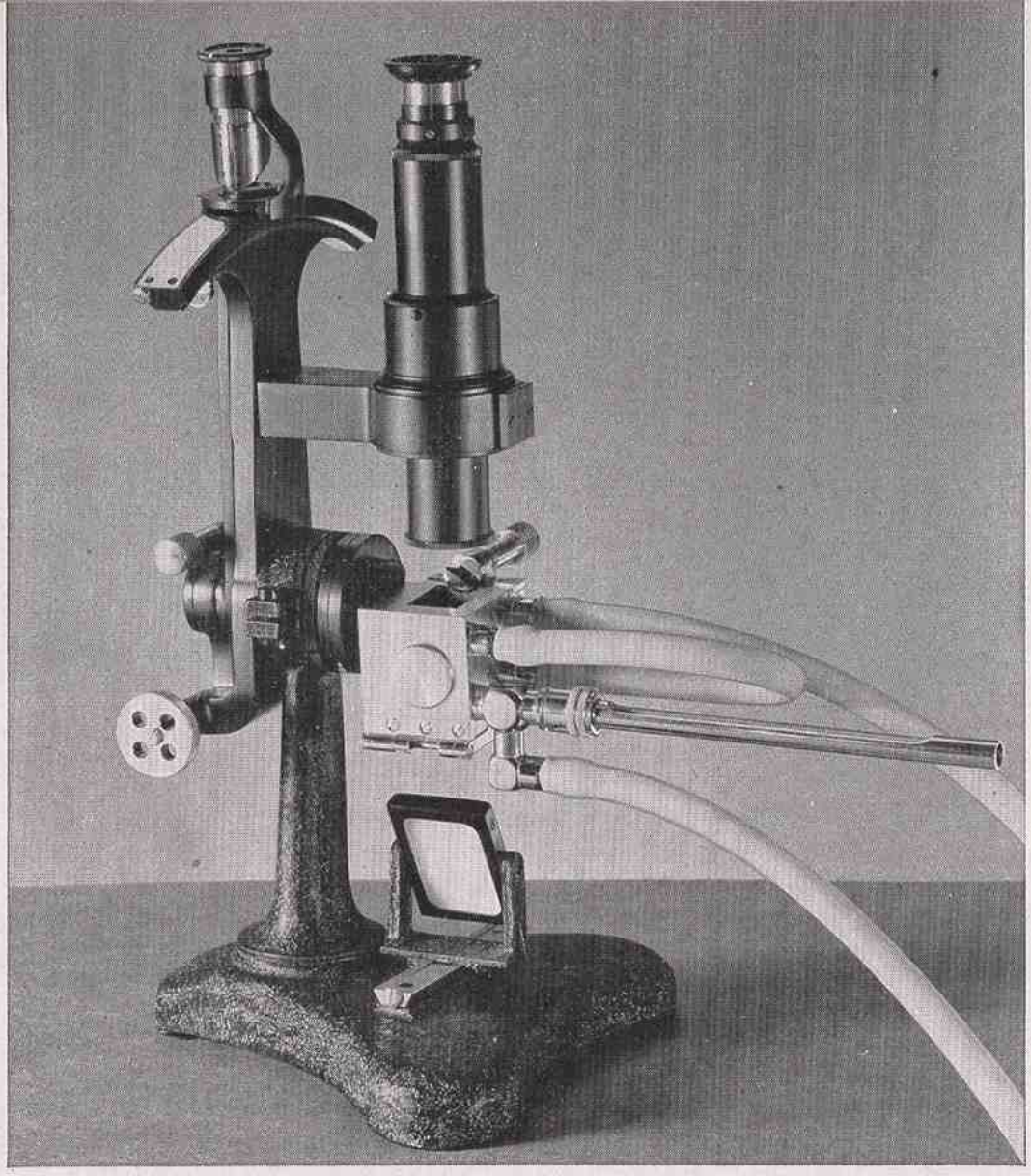
CHEMICAL: Used as an aid in the identification of many transparent liquids and solids. Extremely useful for process control, where the progress of chemical changes shows corresponding changes in refractive index.

RUBBER: Used in checking solvents.

OIL AND FAT: Useful in the identification of fats and the estimation of concentration of soap stocks. It also serves in process control (e.g. hydrogenation) and estimation of iodine number.

DISTILLING: Helpful for checking alcoholic content and for determining total solids in solution.

Path of light through Spencer Refractometer



Spencer Refractometer without Amici Prisms

PHARMACEUTICAL: Used for the identification of essential oils and waxes and in determining the strength of extracts.

OPTICAL: Used to determine refractive index and dispersion of glass.

PLASTIC: Used to determine optical characteristics of transparent plastics, and control the process of manufacture.

Cat. No.	Description	Price
10074	Spencer Standard Refractometer, complete as described, WITHOUT Amici prisms	
10075	Spencer Standard Refractometer, complete as described, WITH Amici prisms	
10084	Spencer Sugar Refractometer, complete as described, WITHOUT Amici prisms	
10085	Spencer Sugar Refractometer, complete as described, WITH Amici prisms	
10090	Spencer High Index Refractometer, complete as described, WITHOUT Amici prisms	
10091	Spencer High Index Refractometer, complete as described, WITH Amici prisms	
10078	Stem Thermometer (0-100°C.) for use with Refractometer	

Refractometer prices include a durable leatherette covered wood cabinet.



The Spencer 10025 Spectrometer with prism and prism clamp.

Spencer Spectrometer

The Spencer divided circle Spectrometer is particularly adapted for use in teaching optics, and together with the accessories available, it finds many useful applications in industrial laboratories.

In the physics class Spencer Spectrometers are used for demonstration and study of the optical properties of prisms by measurement of the rays passing through them: for measuring angles, for measuring refractive index of transparent objects, and for determining the change of refractive index as wave-lengths are changed.

The Spectrometer is increased in usefulness by an attachment which converts it into a Bunsen-type Spectroscope for laboratory demonstration of the spectral lines. A specially designed camera is available for use in place of the telescope tube, converting it into a Spectrograph.

The Spencer Spectrometer is so adaptable that, with a few accessories, it constitutes much of the laboratory equipment needed in a course in optics.

The Spencer 10025 Spectrometer showing 10033 Prism Table Cover and 10028 Camera in place of the telescope.



Structural Features

The Spencer Spectrometer is unusually low, compact, and sturdy in every respect, with a widely spaced, three-point support that contributes to stability. High precision is secured by the special design of the central cone bearing. Cast iron used against bronze of special composition insures unusually smooth action and freedom from wear.

The telescope and collimator supports are designed to hold these optical systems rigidly in perfect alignment, even when subjected to constant student use. The easily manipulated clamping device for the vertical adjustment locks the telescope and collimator securely in their supports, thus precluding the annoyance of "creeping." The telescope support is counterbalanced to provide smooth action even when the camera is substituted for the telescope. The slow motion adjustments for the telescope and prism table are built with the same skill and care that goes into the making of the bearing and other parts of the instrument.

The 5 in. diameter divided circle of the Spencer Spectrometer is graduated to half degrees, with verniers on two opposite sides which read to single minutes of arc.

The chromium plated brass circle and verniers are located in the same plane to eliminate parallax, and the close fit between them aids in the ease and rapidity with which readings can be made. The circle and verniers are viewed through glass windows in a dust-tight cover. Magnifiers are mounted above the verniers to increase the accuracy of the readings.

The telescope and collimator objectives are well-corrected, have a focus of 150mm., and are 25mm. in aperture. This insures more illumination than is usually needed. These objectives have a ratio of focal length to aperture which gives a speed of f/6.

The usual Gauss type eyepiece, with a focus of 25mm., gives a telescope magnification of 6 diameters. The eyepiece is focusable and has an opening in the side which uncovers a reflector for illuminating the cross hairs.

The slit in the collimator is opened by a cam which is controlled by a knurled ring surrounding the slit housing. The slit is closed by spring action to prevent damage to the edges of the slit which might occur by the action of a non-yielding mechanism.

The prism table has three leveling screws.

All parts are sturdily built to withstand abuse and still function with precision. The instrument is finished in black with chromium plated bright parts.

Accessories

Spectrographic Camera

A camera has been designed for use with the Spencer Spectrometer. It is used in place of the telescope and is easily mounted in the telescope support by thumb screws.

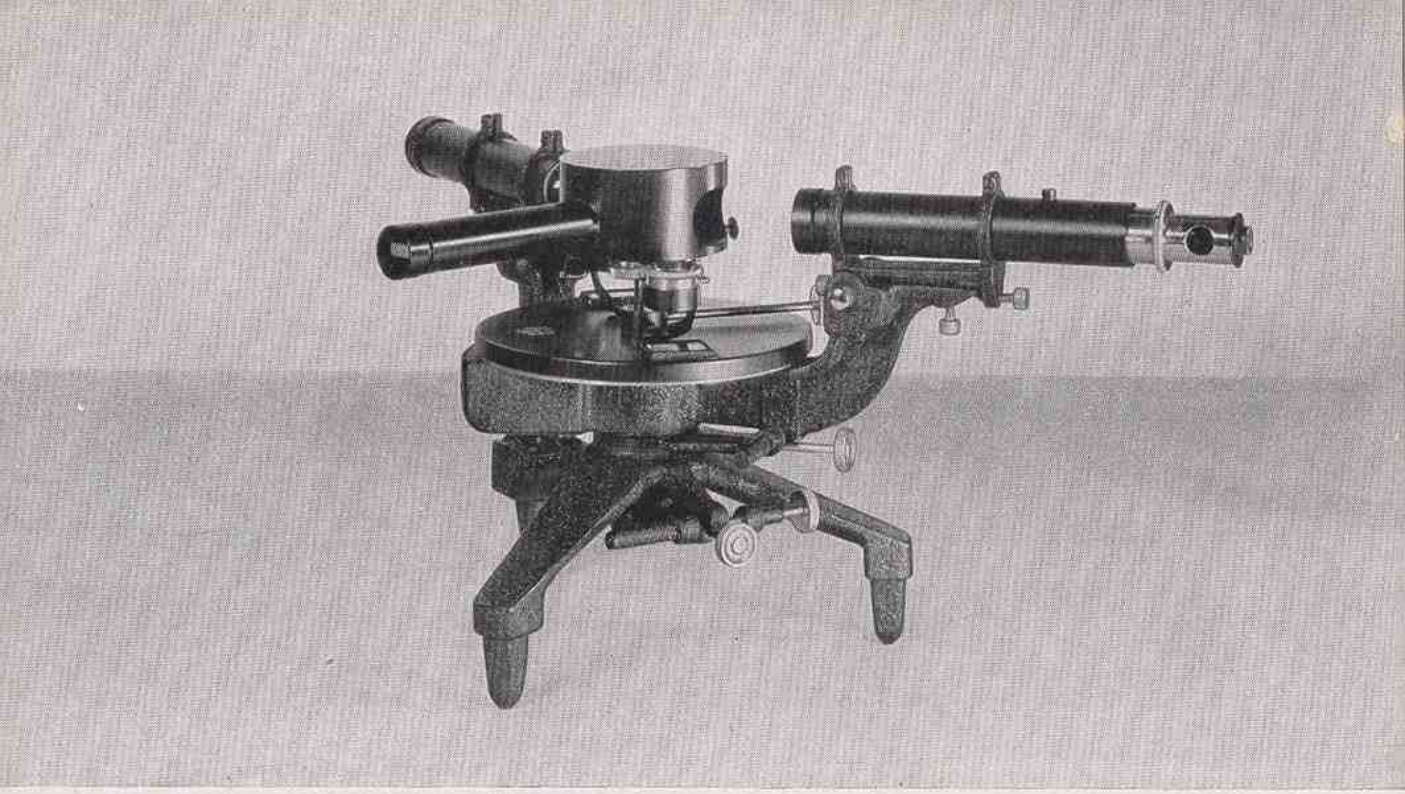
The camera objective, a triplet, is well adapted for use in this particular instrument. It has an unusually flat field and is well-corrected for chromatic aberration. It is mounted in a draw tube for focusing. A scale is engraved on the draw tube so that it will be easy to repeat focal settings. The lens has a free aperture of 25mm. and a focal length of 300mm.

The camera accommodates 6.5 x 9cm. plates and can be adjusted with the same degree of precision as the telescope.

A slide is provided for shifting the plate up and down, making it possible to obtain a series of exposures on one plate. The position of the plate at each exposure is indicated on a vertical scale. The frame carrying the plate holder is pivoted in the center and provided with a bellows so that the plate can be inclined to focus sharply on the different lines of the spectrum. A scale shows the amount of inclination for future reference. The tilt adjustment is independent of the focusing adjustment because the pivots have been brought into the plane of the photographic emulsion by a special design which allows the vertical slide to carry both the plate holder and the tilt mechanism.

With this camera and the No. 10042 prism, it is easy to obtain a spectrum 40mm. long between the mercury lines 405 and 579 millimicrons. With a slightly different adjustment, the near ultra-violet can be photographed somewhat beyond 365 millimicrons. Using suitable plates it is also possible to record the mercury line in the near infra-red at 1014 millimicrons.

A single plate holder and a ground glass for focusing are supplied with each camera.



The Spencer Spectrometer with 10029 Bunsen Spectroscope Attachment

Bunsen Spectroscope Attachment

To convert the Spencer Spectrometer into a Spectroscope for visual demonstrations and comparisons of spectra of the chemical elements, an additional tube with a numbered scale is provided. This scale is 15mm. in length and divided into tenths of millimeters, with each millimeter numbered. When the scale is illuminated by pointing the tube in the direction of a window, or by artificial illumination of proper intensity, the collimator lens at the other end of the tube forms an image of the scale which is reflected from the surface of the prism and seen in the eyepiece of the telescope. This serves as an arbitrary reference in comparing the relative positions of the Fraunhofer, or other spectral lines. The scale is in a sliding mount for focusing. The auxiliary collimator is mounted in a prism table cover which shields the prism from stray light and forms a support for the tube. The prism and its clamp need not be disturbed when using this accessory. It slips into place easily on the prism table.

Condenser

A condenser on a separate stand is used to form an image of the light source on the slit, and is particularly valuable with the camera, or when using flame sources, which should not be brought too close to the instrument or to the observer.

Comparison Prism and Two-Aperture Diaphragm

A comparison prism is available for mounting in front of the top half of the slit. This makes it possible to observe two sources of light with the telescope at the same time. In using this prism, one light source is placed directly in front of the slit, while light from the other source is directed through the comparison prism from the side of the slit. The two spectra may then be seen one above the other in the field of the telescope.

For photography, a two-aperture diaphragm is provided for use in front of the slit. By making an exposure through one diaphragm opening and then through the other, two spectra can be photographed in juxtaposition, one above the other. This prints an accurate comparison of two spectra without danger of movement because of any shifting in the position of the photographic plate.

Prisms

Four prisms are available for use with this instrument. The prism having an index of 1.65 is satisfactory for use with the telescope. The prism with index 1.72 is preferable with the camera because of its 30 per cent greater dispersion. A 30°—60° constant deviation prism with index 1.72 and a hollow prism for measuring the refractive index of liquids, are also available.

A compact but effective clamp of new design can be had for holding any of the prisms on the table. A grating clamp can also be supplied. The prism table cover reduces stray light and is particularly valuable for use with the camera.

Cat. No.	Description	Price
10025	Spencer Spectrometer as described	
10028	Spencer Camera for Spectrometer with ground glass focusing screen, and single metal plate holder	
10029	Bunsen Spectroscope attachment for Spectrometer, with wave-length scale	
10030	Prism Clamp	
10031	6½ x 9cm. Single Metal Plate Holder	
10032	Grating Clamp	
10033	Prism Table Cover	
10034	Two-Aperture Diaphragm for use over Slit	
10035	Comparison Prism	
10037	Condensing Lens with adjustable stand	
10040	Prism, 60°, 18mm. x 36mm. n_D 1.65	
10041	Prism, 30°—60° Constant Deviation 18mm. x 62mm. n_D 1.72	
10042	Prism, 60° High Index 18mm. x 36mm. n_D 1.72	
10045	Hollow Prism 18mm. x 36mm. cemented without metal frame	



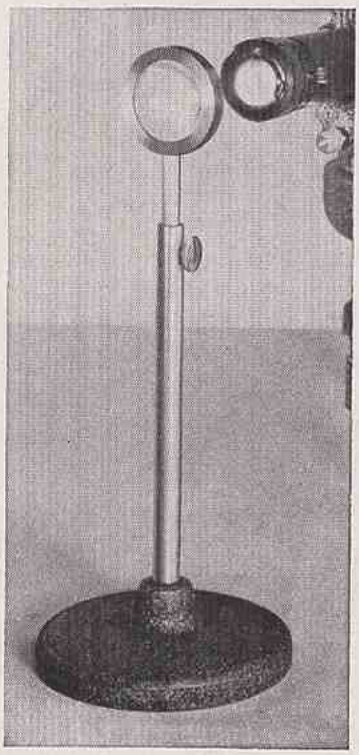
Comparison Prism



Two-Aperture Diaphragm



Divided Circle and Vernier



Condensing Lens



The Spencer Direct Result Colorimeter showing one cup disassembled. 1. Cup Body, 2. Light Shield, 3. Cup Washer, 4. Glass Bottom Plate, 5. Plastic Cap.

Spencer Direct Result Colorimeter

The radically different appearance of the Spencer Direct Result Colorimeter is the result of many worthwhile improvements made while redesigning the basic instrument—the Duboscq-type Colorimeter. Actual experience has established the value of its sturdy construction and simple design. It is easy and comfortable to operate, highly accurate, and easy to clean.

It is applicable to all chemical and biological tests in which color density is a quantitative indication of composition. Hospital technicians, food processors, petroleum refiners, brewers, and oil, paper, textile, and metal manufacturers—all find this instrument valuable in analysis and control.

Stand

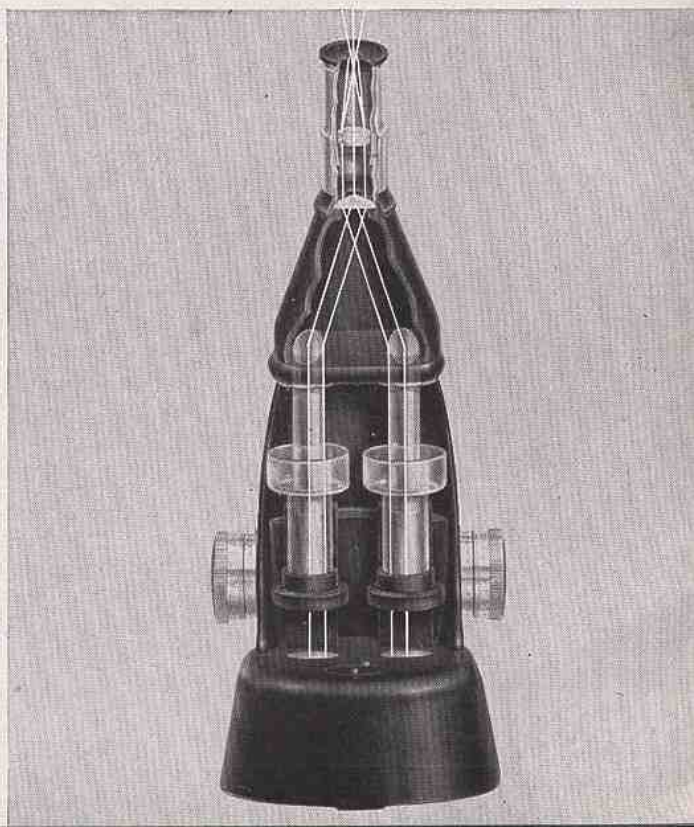
The smooth, unadorned simplicity of the forward-sweeping arm and dust-tight base and prism housing, with their minimum of moving parts, makes the Spencer Direct Result Colorimeter unusually easy to clean, light in weight, and sturdy. The chemically resistant, black, baked enamel finish and chromium plated control parts make it exceptionally resistant to corrosive substances and laboratory fumes.

Ample, precisely controlled illumination, provided by a light built into the base, and diffused through windows set flush with the base, can be equalized by a simple, easily reached control, and locked in the desired adjustment. A blue eyepiece filter modifies the illumination to resemble daylight more closely. This provides a constant light, preferable to the variable daylight, and eliminates the necessity for mirrors or accessory lamps.

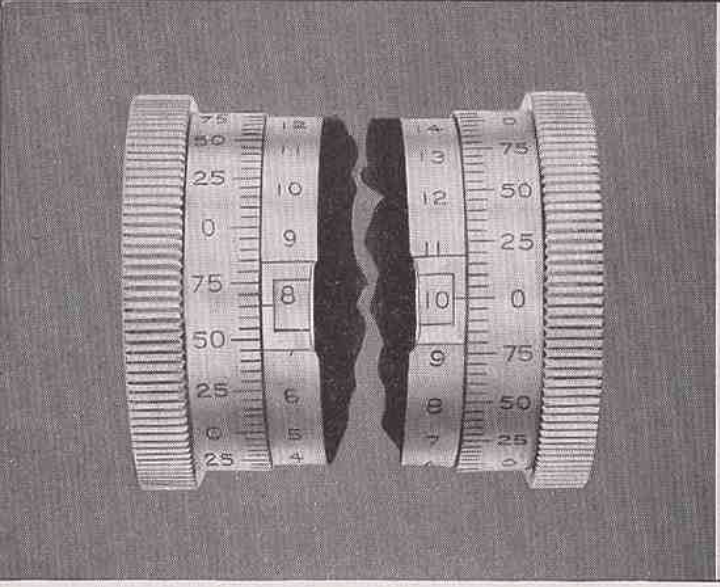
Direct Reading Drums

Low on the sides of the instrument, within easy reach of hands resting on the table, are drums, each actuating one of the colorimeter cups, and calibrated with scales on which the percentage concentration may be read directly, without need for tables or calculations. These drums, on which fractional parts are read, and their number rings, divided into units, are calibrated with identical scales so that either cup may be used for the standard.

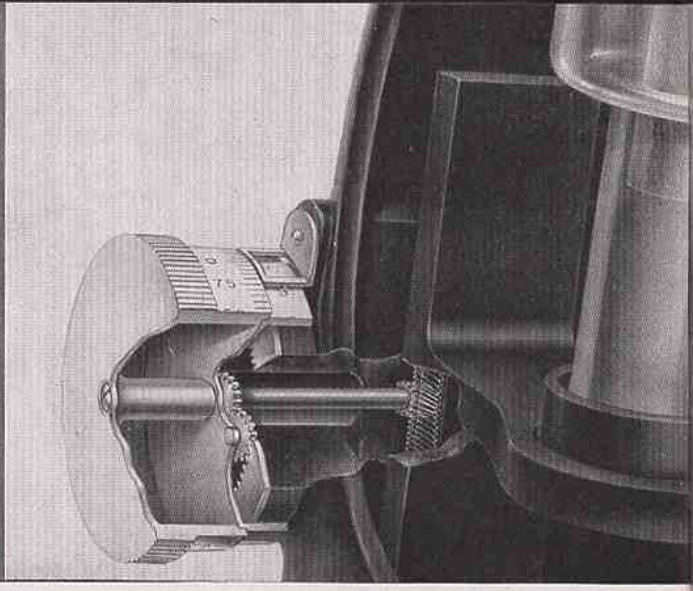
By setting the *sample* at 10.00 (which corresponds to a depth of 40mm.) and then adjusting the depth of the *standard* to match the color fields, the scale on the standard side, when multiplied by ten, shows directly the percentage concentration of the sample. Since the scales are graduated in units from 0.00 to 14.00, the Colorimeter has a range from 0 to 140 percent when used in this way. The working range may be extended by setting the depth of the sample to other values. Because these drums are stationary at a comfortable reading distance from the eyepiece, and because no magnifiers are needed, the scales are easily read from the eyepiece position.



Path of light through Spencer Direct Result Colorimeter



Percentage of concentration is read directly (left drum)



Construction of the number ring gearing

Inclined Eyepiece Tube

Long periods of observation without fatigue are made possible by the inclined eyepiece tube and light path housing, which permit use of the instrument from a comfortable sitting position. The deviation of light necessitated by this inclination of the immovable eyepiece section is obtained by accurately adjusted oblique surfaces at the upper ends of the plungers. Plungers are easily replaceable by means of correctly placed locating pins.

Plungers

The plungers are inclined at a slight angle so that the lower ends enter the liquid obliquely to provide a wiping action, which effectively cleans bubbles and scum from the lower surfaces. This action occurs automatically without attention from the observer. The light beams from the two plungers are combined in a biprism which forms the sensitive dividing line between the two fields. When these fields are matched, the dividing line virtually becomes invisible, making very accurate readings possible.

Cups

The separable cups also contribute to ease and convenience in use, because they load from the front, where they are visible and easily reached. They combine the best features of other colorimeter cups. The bottoms are separable for easy cleaning. The cup body is flared sufficiently to prevent overflow when the cup is filled to a depth of 50mm. All parts are interchangeable for economy. The zero adjustment is uniform for convenience. This uniformity is secured by careful standardization of the thickness of the caps and bottom plates for all cups. For use with substances deleterious to rubber, fused cups are available.

Cat. No.	Description	Price
10131	Spencer Colorimeter with Direct Result Scales, as described with 2 cups and 115 volt bulb	
10130	Same as above, but with 2 fused cups	
10132	Cup complete with washer, plastic cap, and glass bottom plate	
10133	Plunger for No. 10131 or ———	
10134	Cup with fused bottom plate	
10135	Glass Cup Body only for No. 10132	
10137	Plastic Cap for cup	
10138	Glass Bottom Plate	
10139	Washer for No. 10132	
10141	Light Shield for cup	
10136	Cabinet	
388	Bulb, 15 watt, 115 volt for Colorimeter	
389	Bulb, 15 watt, 220 volt for Colorimeter	

Spencer Delineascopes

As far back as the early Greeks, visual aids were used by pedagogues to supplement lessons. Class journeys were considered very valuable and actual objects were used for demonstration purposes.

Through the years, these ideas were carried on by such noted educators as Froebel, Herbart and Dewey, who were constantly striving to limit formalism and bookishness.

Today, through the efforts of these individuals and the arts of photography and printing, the facts of the world are presented in the classroom in charts and pictures as well as in words.

The surgeon uses color slides in talks to nurses in training. The grade school teacher lets her pupils prepare their projects for presentation with an opaque projector. The Army finds speedy visual methods of training men and women for service. Industrial plants build morale and train workers with illustrated lectures and motion pictures. High school and college instructors clip articles from newspapers and other periodicals so that their courses will be brought up to the minute by the projection of timely material.

If an instructor could afford to have a good motion picture made to use in his course, results would be ideal. Unable to do this he must use available pictures when he can obtain them. He can, however, afford to make or purchase his own set of slides or assemble materials for opaque projection. Here are some of the benefits:

1. There is ample time to discuss material projected.
2. The projector can be operated easily either by adults or children.
3. Group attention is centered on the illustration.
4. The right pictures or material can be presented at the logical time since the lecturer can select and determine the sequence.

Instruments are listed in this catalog for projecting 2″ x 2″ and 3¼″ x 4″ slides, slidefilms and opaque materials. Combination projectors are very popular. All Spencer classroom projectors are known as Delineascopes.

Opaque Combination

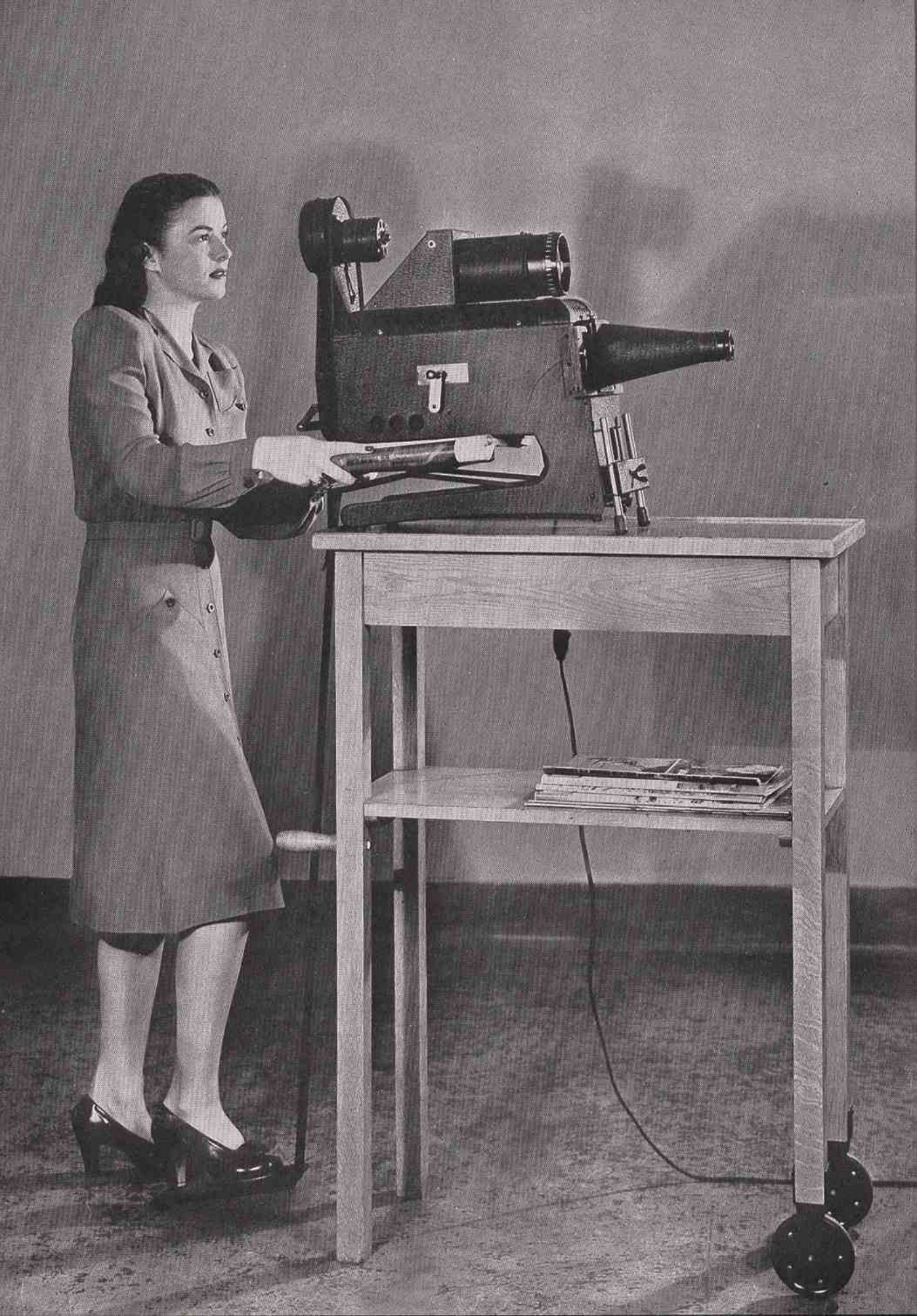
One of the most useful and adaptable instruments is the Combination Opaque and Lantern Slide Projector. It is an invaluable aid in the rapidly growing field of visual education to project lantern slides, postcards, photographs, drawings, pages in books, mineral or biological specimens and small objects. Since it can be used in the teaching of all subjects at all levels, it meets the demands of city or rural schools, high schools and universities. It is a time and money saver. Today, when so many phases of our life are changing rapidly, this instrument can be used to keep us up-to-date on world developments. Illustrations which were timely a year ago are now becoming obsolete and must be replaced in order to keep up with current trends and developments. With an Opaque Projector, it is a simple matter to omit slides or pictures from a unit and substitute new illustrations.

The following are some of the advantages in using the Opaque Projector:

1. Materials made or assembled by the instructor or students can be used.
2. A tremendous amount of material can be used that is not available on films or slides.
3. Current illustrations from books, periodicals and newspapers can be inserted between films or slides to complete a lecture.
4. The Opaque Projector and the materials used with it are inexpensive.
5. The darkened room centers attention on the projected image.

A Spencer Opaque Delineascope is, in effect, a magnifying glass which dramatically enlarges teaching material on your projection screen. Its value is widely recognized.

Combination instruments will project opaque material, lantern slides, currently popular 2″ x 2″ slides, slidefilms and micro slides, providing flexibility in the use of visual materials. For example, current interest can often be added to a regular lantern slide lecture by including a few clippings from recent periodicals. A swing of the handle changes the path of light from slides to opaque illustration.



Opaque Delineascopes—Model V,VA,VAC

Photographs, pages in books or periodicals, maps, charts or small objects—any of these inexpensive materials, within the 6″ x 6″ area of the opaque aperture—can be projected on the screen.

Spencer Opaque Projectors provide clear, brilliantly projected pictures that often transform indifference into eager interest. Their use is increasing rapidly in the grade schools where improved teaching efficiency is saving community funds. Hundreds of instruments have been used by the Services to train American men and women in the arts of war.

Model V projects opaque material only; Model VA, opaque material, lantern slides and 2″ x 2″ slides; Model VAC, opaque, lantern and 2″ x 2″ slides, slidefilms and micro slides.

By the addition of accessories, Model V may be converted into a VA or VAC.

Standard Features

1. The lamphouse is supported at the front end only, to permit placing large books or periodicals under the opaque aperture.
2. The first surface mirror is aluminized rather than silvered for much greater durability and for maintaining screen brightness.
3. A stream of cool air is forced directly across the face of the copy by a universal motor-driven fan. Manual control of the fan speed is accomplished with a variable rheostat.
4. Images from opaque objects or lantern slides coincide on the screen at a 20 foot projection distance.
5. The opaque aperture is 6″ by 6″. However, larger illustrations may be inserted and 6″ square areas projected.
6. *Dimensions Model V:* Height, 16″; Width, 8½″; Length, 17″. Weight approx. 40 lbs.

Valuable Accessories

1. The patented foot control is new, exclusive and, in the opinion of many, the greatest improvement in instruments for opaque projection since the addition of the cooling fan. A slight pressure of the foot lowers the platen leaving both hands free to insert, properly position or remove the illustrations.
2. A masking plate and paper guide is available for presenting single lines of printed copy and to facilitate the handling of reading material mounted on paper strips or rolls.
3. Elevating legs provide a convenient means for centering the image on the screen.
4. Double slide carrier for 2″ x 2″ slides.

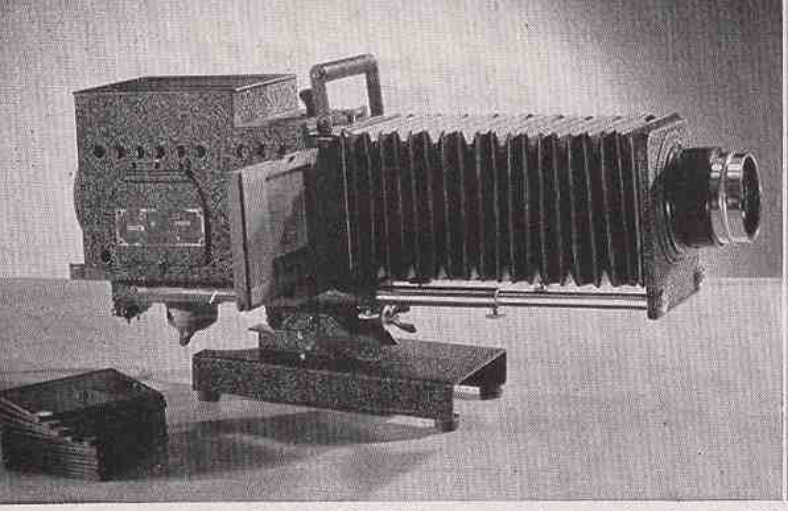
Magnification Table

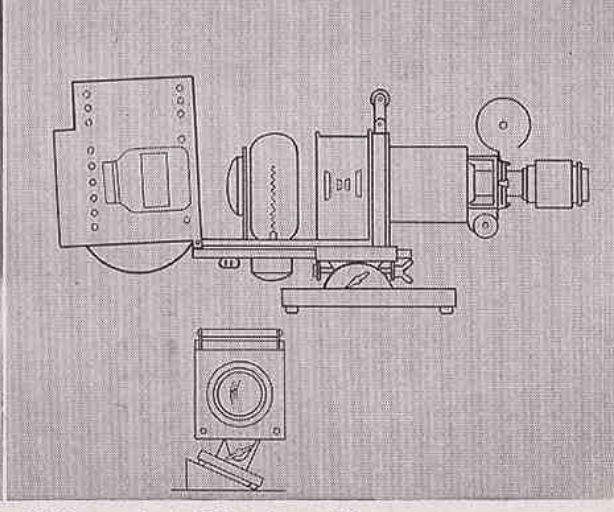
(Figured on basis of 6 inch square opening)

Focus of Lens in Inches		Distance from Screen, in Feet					
		8	10	15	20	25	30
16	Size of Screen Picture in Feet	2.5	3.2	5.1	7.0	8.9	10.8
18		2.1	2.8	4.5	6.2	7.9	9.5

Cat. No.	Description	Price
3724	Model V Delineascope for opaque material, with one 500 watt, 115 volt, medium prefocus base bulb, 4″ diameter, 16″ or 18″ focus objective, as selected, platen for loose sheets, two post card holders, with cooling fan and adjustable rheostat, 15 foot detachable rubber covered cord with switch.....	
3726	Model VA Delineascope for opaque materials and standard 3¼″ x 4″ glass slides equipped same as No. 3724, and in addition a lantern slide front including condenser lenses, double slide carrier and lens of 1⅝″ diameter, 8″ or 10″ focus.....	
3728	Model VAC Delineascope for opaque materials, glass slides, slidefilms, and micro slides, same as No. 3726 with the addition of No. 3674.....	
3674	Combined Slidefilm and Micro Slide Attachment.....	
3722	Elevating device for above models..	
3737	Lantern Slide Front to convert Model V into VA (Current Models).....	
1726	Leatherette Covered Carrying Case .	
4105	Slide Carrier for 3¼″ x 4″ slides...	
4106	Slide Carrier for 3¼″ x 4″ and 3¼″ x 3¼″ English, slides.....	
4113	Slide Carrier for 2″ x 2″ slides.....	
3738	Foot Control for operating platen ..	
3739	Masking Plate and Paper Guide to fit on platen.....	
4022	500 watt, 115 volt Bulb, Med. P. F. Base.....MCP	
4028	500 watt, 120 volt Bulb, Med. P. F. Base.....MCP	

Spencer Model VA Opaque and Lantern Slide Projector.





Left: Model D Delineascope. Right: Open lamphouse and the slidefilm attachment. Tilting feature below.

Classroom Delineascope—Model D

Model D Delineascope is designed for classroom use and will project brilliant, clear cut, screen images. The 500 watt illumination is ample to meet the unfavorable class room conditions frequently encountered. The instrument is strongly built to withstand years of hard use. It is simple to use and has many operating conveniences.

Light weight construction and a heat proof handle make it easy to carry from room to room.

Bright screen images up to 10 ft. or more in width may be secured. Standard equipment includes an objective lens of 2½″ diameter, 12″ focus, ideal for average classrooms. Other objectives of 6½″, 8½″, 10″, 16″ and 20″ may be specified. Objectives 1⅝″ diameter, 8″ and 10″ focus are available.

Additional Features

1. Tilting and elevating adjustments permit its use from the top of a slanting desk or a table.
2. A reading light is obtained by opening an aperture on the right side of the lamphouse. It aids in reading notes in a darkened room.
3. Slide carriers have automatic slide lifters to aid changing.
4. Sturdy, trouble free, spiral focusing adjustment.
5. Hinged lamphouse permits quick bulb change.
6. Carrying handle and lamphouse handle of non-heat-conducting material.
7. Non-sagging bellows—supported by double extension rods.
8. Projection lenses of 6½″ to 16″ focus may be used without change of condensers.
9. Durable black crinkled finish beautifies and protects the metal parts. Bright parts are chromium plated.
10. Due to the whiteness of the projected light, slides containing colors are imaged authentically.
11. Fairly satisfactory projection of 2″ x 2″ slides can be accomplished by the addition of a special slide carrier.
12. *Dimensions:* Height, 10½″; Width, 5″; Length, with bellows closed 15½″; Base 4⅝″ x 9″; Weight, 16 lbs.

An accessory that is useful with this equipment is the combined Slidefilm and Micro Slide attachment which fits in place of the bellows.

Heat absorbing glass for additional protection to color slides is available.

Cat. No.	Description	Price
3475	Model D Delineascope for 3¼″ x 4″ slides, with one 500 watt, 115 volt, medium prefocus base bulb, 2½″ diameter, 12″ focus lens (specify if other focus is desired), 15 foot detachable rubber covered cord with switch, complete in metal carrying case	
3472	Same as above but with lens of 1⅝″ diameter and 8″ or 10″ focus	
4105	Slide Carrier for 3¼″ x 4″ slides	
4106	Slide Carrier for 3¼″ x 4″ and 3¼″ x 3¼″ English, slides	
4113	Slide Carrier for 2″ x 2″ slides	
3671	Combined slidefilm and micro slide attachment	
3488	Model DC includes 3475 and 3671	
4022	500 watt, 115 volt Bulb, Med. P. F. Base	MCP
4028	500 watt, 120 volt Bulb, Med. P. F. Base	MCP
4110	Heat-Absorbing Glass	

Science Delineascope—Model B

By means of this unusual Delineascope, an entire experiment can be conducted at the desk or lecture table and projected right side up onto a screen for all the class to see. Translucent or transparent materials in true colors, 3¼″ x 4″ slides, contours of opaque materials, motion—all can be shown vividly. The instructor can even make pencil sketches on a ground glass during the lecture.

Here are but a few of the experiments which can be dramatized effectively by projection to the entire class:

Magnetic lines of force
Properties of magnetic fields
Surface tension
Mechanics
Polarized light
Electrolysis
Precipitation and thermometer experiments in chemistry
Thermometer and other meter readings
Contours of insects, small animals, plants, etc.

The instrument occupies very little space on the lecture table (5″ x 13″) and may be left permanently set up, ready for immediate use. A solid back, beaded, projection screen should be hung on the wall back of the lecturer at a height and angle to bring the picture into view of the entire class.

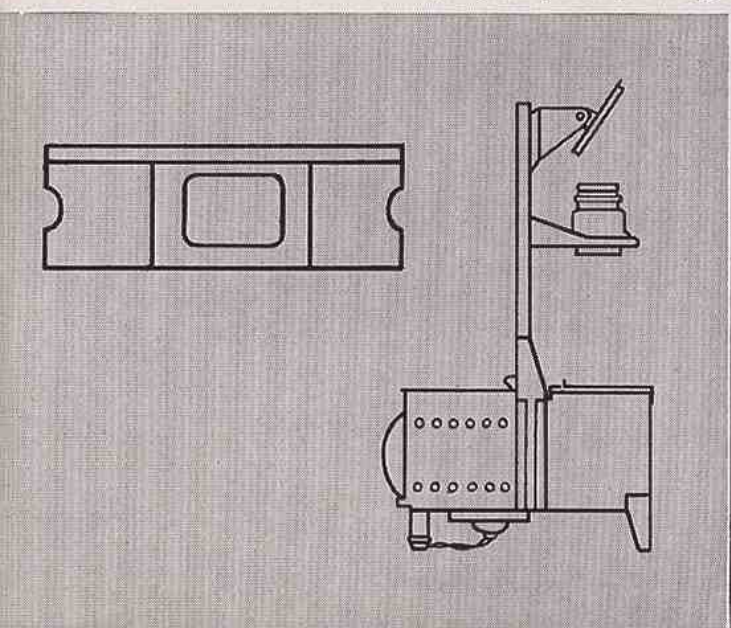
When the Delineascope is set up 5½ feet from the wall and the screen is hung 6 feet from the floor, a 6½ inch focus projection objective provides a 30″ x 36″ picture.

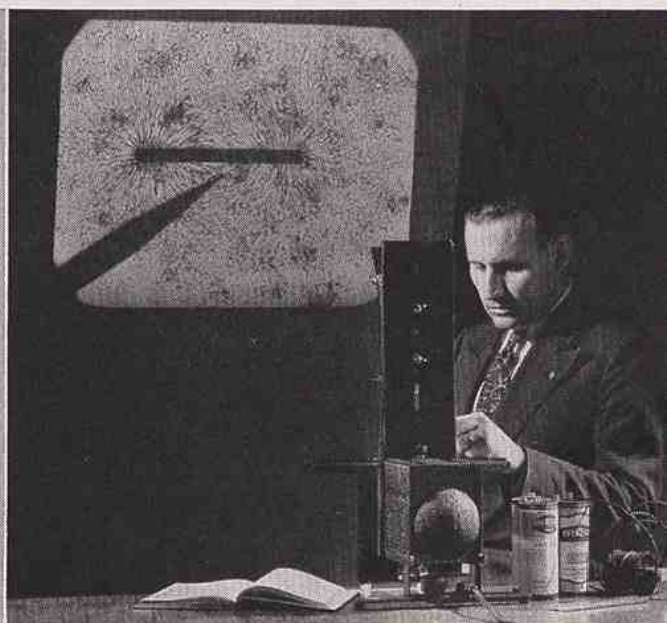
Additional Features

1. An adjustable mirror permits centering the picture on the screen.
2. Hinged lamp house permits quick bulb change.
3. Lamp house handle of non-heat conducting material.
4. Durable black crinkled finish beautifies and protects the metal parts. Bright parts are chromium plated.
5. Due to the whiteness of the projected light, color-slides or specimens are imaged authentically.
6. Projection table with a guide for slides is 4″ x 13½″ with a clear glass plate 4″ x 5¾″ over the 2⅞″ x 3⅝″ aperture.
7. Sturdy, trouble-free, spiral focusing adjustment.
8. *Dimensions:* Height, 23″; Width, 5″; Length, 13″; Weight, 14 lbs.

Cat. No.	Description	Price
3375	Model B Science Delineascope for 3¼″ x 4″ slides, translucent or transparent specimens, with one 500 watt, 115 volt, medium prefocus base bulb; 2½″ diameter, 6½″ or 8½″ focus lens as selected; 15 foot detachable rubber covered cord with switch; complete in metal carrying case.....	
3859	Solid back, beaded screen 30″ x 40″	
4022	500 watt, 115 volt Bulb, Med. P. F. Base.....MCP	
4028	500 watt, 120 volt Bulb, Med. P. F. Base.....MCP	

Left: Large table with flush glass plate and guide for slides. Drawing of Model B showing front surface mirror at top, and spiral focusing mount for holding lens. Right: Model B in use.







Auditorium Colorslide Delineascope—Model GK

New brilliance, vividness, and realism have been brought to the projection screen by Model GK Auditorium Colorslide Delineascope. It is a 750 watt instrument and projects 2″ x 2″ or 3¼″ x 4″ slides.

Clear, sharp definition and a flat field is secured with objectives 2½″ in diameter. For 2″ x 2″ slides, the 6½″ (f/2.75), 8½″ (f/3.60), 10″ (f/4.3), or 12″ (f/4.8) focal lengths are available. For the larger slides these objectives may be used, and in addition lenses of 12″, 16″, 20″ and 24″ are listed. Critical focusing is accomplished smoothly by rack and pinion.

Different condensing systems are used to direct the light efficiently through the small and large slides. Each condensing system is mounted in a container which may be lifted out as a unit and replaced by the other.

Especially important is the protection against film damage afforded by an ingenious cooling system.

For large auditorium audiences the full brilliance of Model GK is appreciated. For smaller, intimate gatherings, illumination for slides of different density can be controlled with an iris diaphragm.

Two carrying handles make it possible to remove the instrument from the projection table immediately after prolonged use.

The electrical system includes 15 feet of rubber covered non-kinking cord, a toggle switch, a rheostat to control the speed of the cooling fan (when used on other than 60 cycle A.C.), a 750 watt, 115 volt medium prefocus type projection lamp.

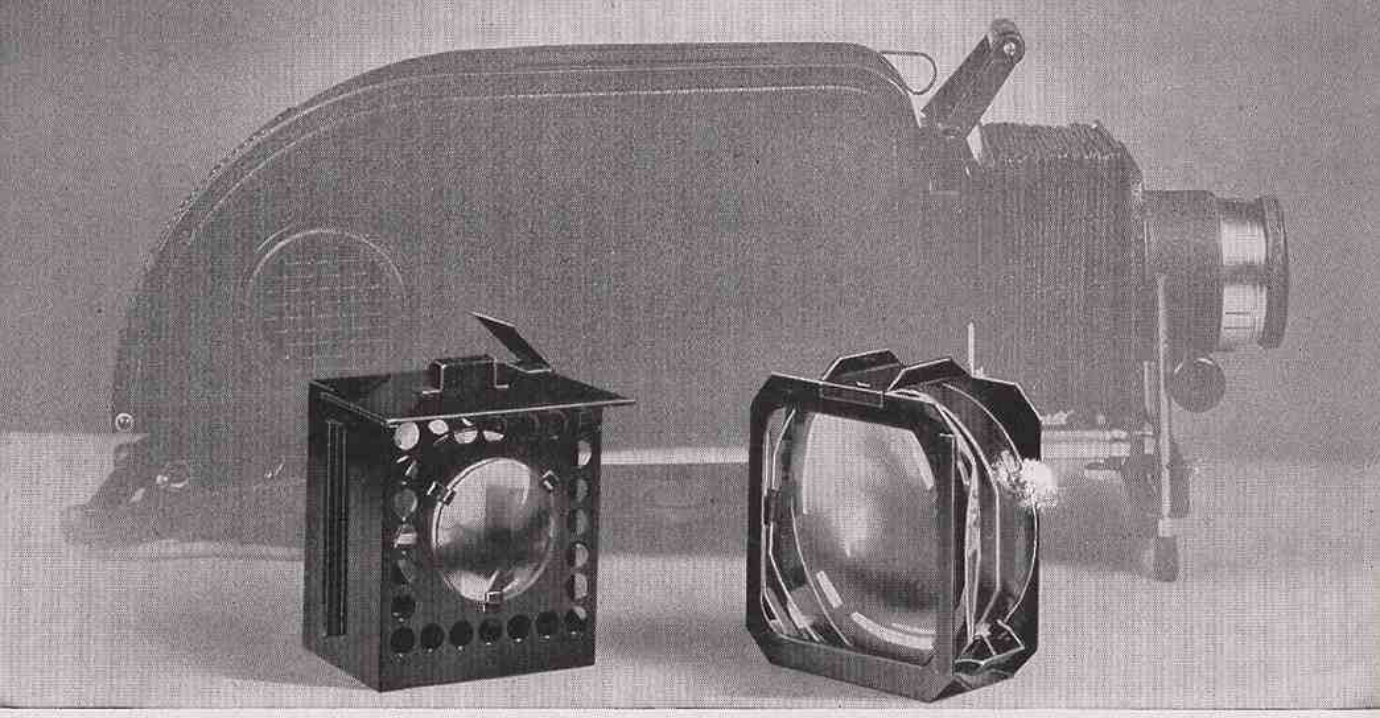
Additional Features

1. Elevating legs are located on the front. Handle support on the rear allows for inclining the instrument when operating from a balcony position.
2. Hinged lamphouse permits quick bulb or condenser change.
3. Non-sagging bellows is supported by double extension rods.
4. Cooling fan has a rheostat to control the speed when operating on other than 60 cycle A.C.
5. *Dimensions:* Height, 8¾″; Width, 7½″; Length, bellows closed, 21″; Weight, 21 lbs.

Magnification Table

Focus of Lens in inches	Upper figures show the width in feet of image on the screen for 2″ x 2″ slides, with an opening 36 mm. Lower figures are for 3¼″ x 4″ slides with 3″ opening. Distance from screen in feet									
	10	20	30	40	50	60	70	80	90	100
6½	2.06 4.4	4.24 9.0	6.42 13.6	8.60 —	10.78 —	12.96 —	15.15 —			
8½	1.55 3.3	3.22 6.8	4.88 10.3	6.55 —	8.22 —	9.89 —	11.55 —	13.22 —	14.89 —	
10	1.2 2.8	2.6 5.8	3.9 8.8	5.2 11.8	6.6 14.8	7.9 —	9.3 —	10.6 —	12.0 —	13.3 —
12	1.0 2.3	2.1 4.8	3.2 7.3	4.4 9.8	5.5 12.3	6.6 14.8	7.7	8.8	9.9	11.0
16	— 1.6	— 3.5	— 5.4	— 7.3	— 9.1	— 11.0	— 12.9	— 14.8		
20		— 2.8	— 4.3	— 5.7	— 7.3	— 8.8	— 10.2	— 11.8	— 13.2	— 14.8
24		— 2.2	— 3.5	— 4.7	— 6.0	— 7.2	— 8.5	— 9.7	— 11.0	— 12.3

Auditorium Colorslide Model GK. Inset: Iris diaphragm.



Condensing lens systems for Model GK Delineascope; left, for 2″ x 2″ slides; right, for 3¼″ x 4″ slides.

COMPLETE DELINEASCOPES, ready for operation, with metal carrying case.

Catalog No.	Description	Price
3591	Model GK Delineascope for 2″ x 2″ slides. Equipped with an objective of either 6½″ or 8½″ focus as selected	
3596	Same as above, but with 12″ focus lens	
3597	Model GK Delineascope for 3¼″ x 4″ slides. Equipped with an objective 12″ to 24″ focus as selected (see listing below)	
3598	Same as above but with 6½″ or 8½″ focus lens	
3599	Model GK Delineascope for both 2″ x 2″ and 3¼″ x 4″ slides. Equipped with objective 6½″ or 8½″ focus as selected	
NOTE: (Two objectives are necessary if both sizes of slides are used and same sized screen images are desired. See magnification table.)		

Diameter of all objectives listed is 2½″

ACCESSORIES, for above instruments.

3602	Deluxe Leatherette Covered Carrying Case with storage space for slide boxes, extra objectives, extension cords etc., can be furnished with any of the above Delineascopes (instead of the metal case) extra	
3602	Same as above when purchased separately	
3592	Condensing Lens System for 2″ x 2″ slides, (complete in unit mounting)	
3607	Condensing Lens System for 3¼″ x 4″ slides (complete in unit mounting) for use with objectives 6½″ to 12″	
3608	Condensing Lens System for 3¼″ x 4″ slides (complete in unit mounting) for use with objectives 16″ to 24″	
4105	Slide Carrier for 3¼″ x 4″ slides	
4106	Slide Carrier for 3¼″ x 4″ and 3¼″ x 3¼″ English, slides	
4113	Slide Carrier for 2″ x 2″ slides	
4030	750 Watt, 115 Volt Bulb, Med. P. F. Base	MCP
4031	750 Watt, 120 Volt Bulb, Med. P. F. Base	MCP
3603	Iris Diaphragm to reduce light intensity for small screens or for thin films	

For Use with 2″ x 2″ Slides

3961	Projection Lens 2½″ diameter 6½″ focus	
3962	Projection Lens 2½″ diameter 8½″ focus	
3964	Projection Lens 2½″ diameter 10″ focus	
3966	Projection Lens 2½″ diameter 12″ focus	

For Use with 3¼″ x 4″ Slides

3964	Projection Lens 2½″ diameter 10″ focus	
3966	Projection Lens 2½″ diameter 12″ focus	
3970	Projection Lens 2½″ diameter 16″ focus	
3974	Projection Lens 2½″ diameter 20″ focus	
3978	Projection Lens 2½″ diameter 24″ focus	

Colorslide Delineascope—Model MK

In brilliance of screen results, Spencer Model MK Delineascopes will exceed your expectations. The ratings of these projectors, 100, 150, 200 and 300 watts, do not indicate the true magnitude of illumination which reaches the screen. Only an actual demonstration can reveal how brilliantly the full beauty and quality of your slides are magnified and projected.

Film Protection

The powerful illumination is also safe for your color slides. Our engineers have designed these models to provide efficient ventilation, have included heat-absorbing glass where necessary and have designed a cooling attachment to be used with the 300 watt instrument.

Four Models

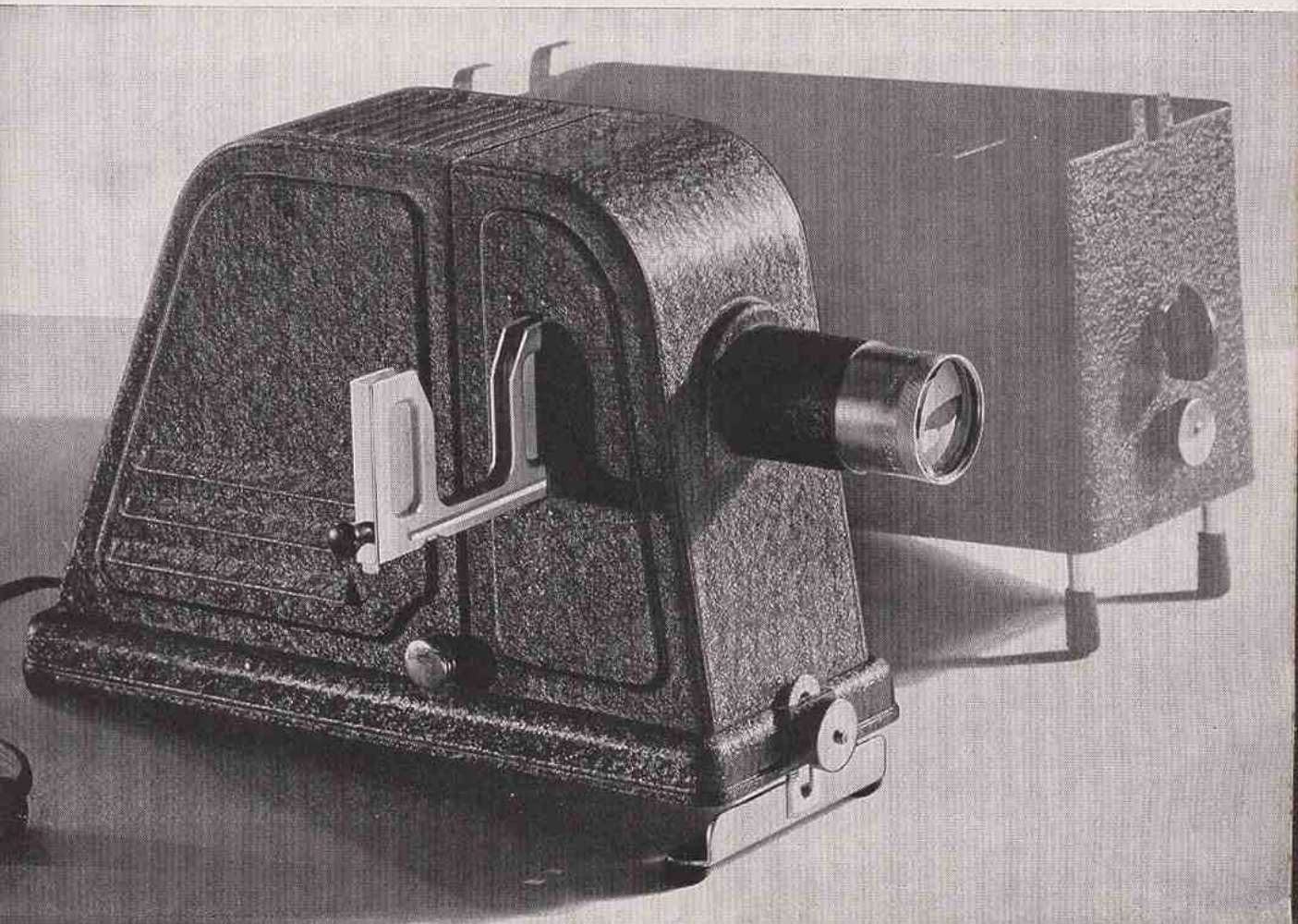
The 100 watt model has a large diameter, two element condensing system (made of glass with heat absorbing qualities) producing a brilliant, evenly illuminated area.

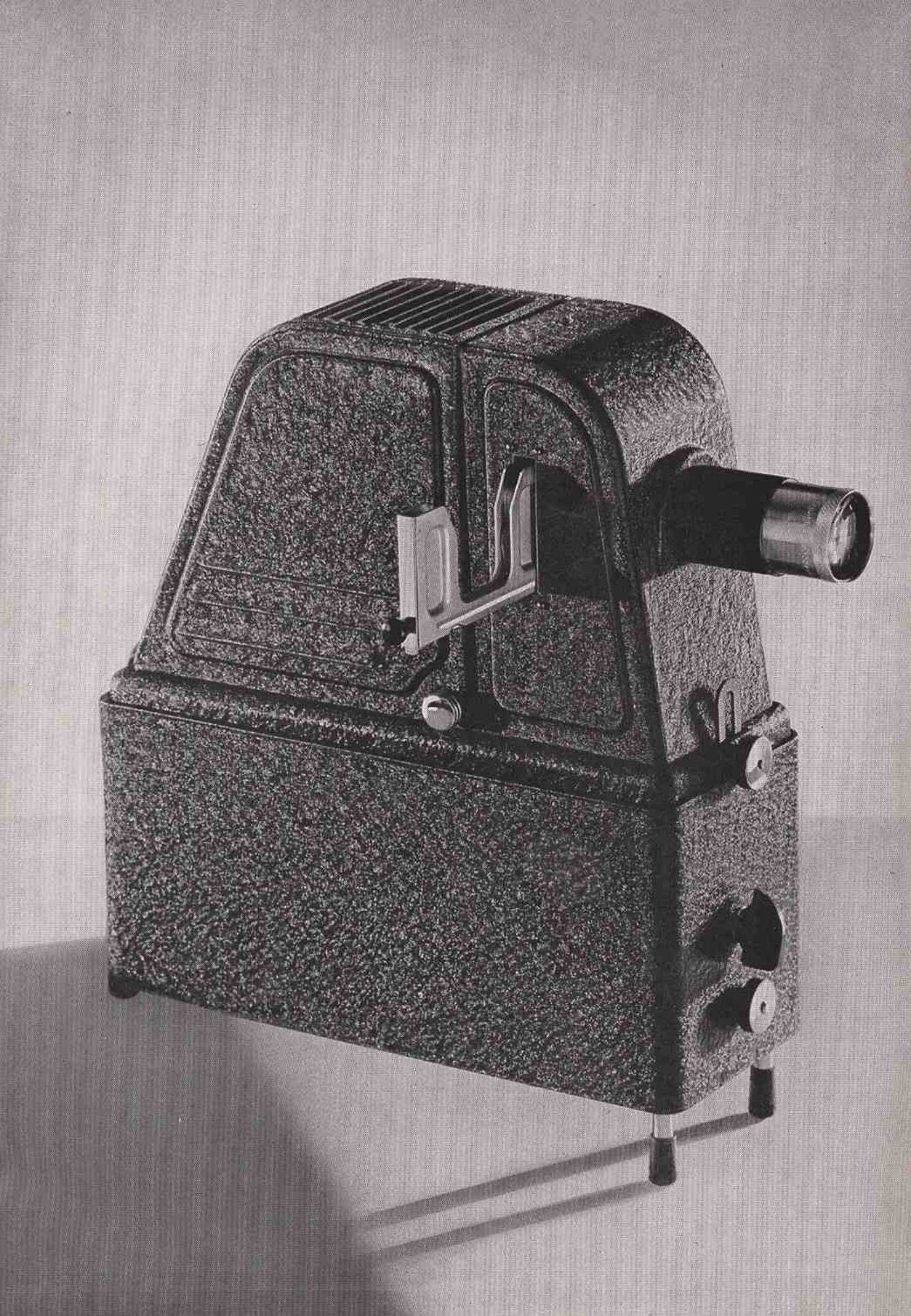
The 150 watt model is the same as the 100 watt model except for the bulb and the addition of a separate heat absorbing glass. The 100 watt model may be converted readily into a 150 watt by adding the heat absorbing glass and substituting a 150 watt bulb.

The 200 watt model has a three element condensing system and highly efficient heat-absorbing glass. It can be converted into a 300 watt instrument by substituting a 300 watt bulb and adding the fan cooling unit.

Except for the bulb and fan cooling unit, the 200 and 300 watt models are identical.

Model MK (100, 150, or 200) Delineascope for 2" x 2" slides. Cooling fan unit in background can be used with Model MK 200.





Selecting Your Projector

For projection in a small or medium sized room, the 150 watt model will be very satisfactory. For large classrooms, small auditoriums, or where it is difficult to darken the room, a 200 or 300 watt model is preferable.

NOTE: MK 100 can be converted only to MK 150. Only MK 200 can be converted to MK 300.

Sturdy Construction

These instruments are designed for a lifetime of service, with a cast base, heavy gage steel lamp house, reinforced with cross members and embossed for added strength. The finish is a durable wrinkle enamel.

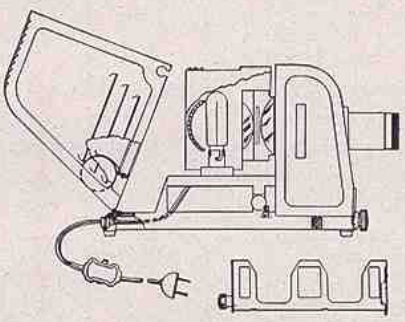
Additional Features

1. Sharp definition is secured with the well corrected Spencer projection lens of 5″ focal length and a speed of f/3.75.
2. Has a self-leveling elevating device to locate the picture on the screen.
3. Hinged lamphouse permits quick bulb change.
4. Efficient cooling provides safety for color slides.

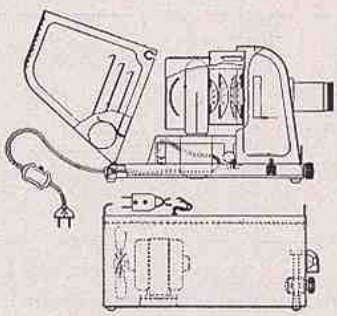
The chart below gives the widths of screen images (in feet) obtained with Model MK Delineascopes when used at various distances from the screen. The 5″ focus objective is the only one available for these instruments.

Magnification Table

Distance from screen in feet	*Width of image on the screen*
10 feet	2.7 feet
20 feet	5.6 feet
30 feet	8.4 feet
40 feet	11.2 feet



Details of MK 100 or 150 with slide carrier.



Details of MK 200 or 300 with cooling fan unit.

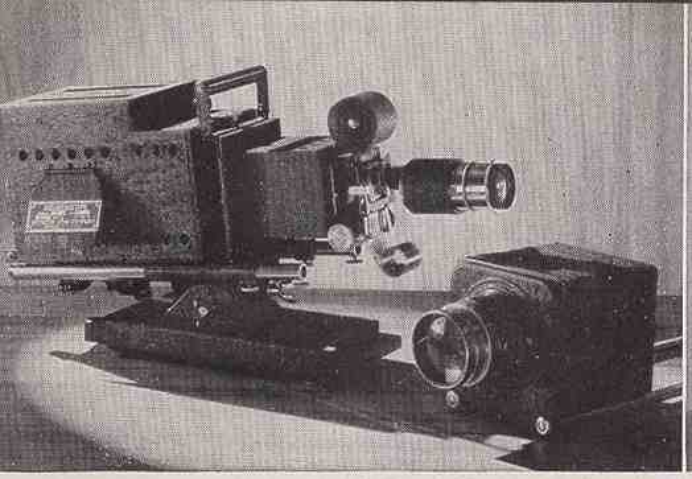
Catalog No.	Description	Price
3783	Model MK 100 Delineascope for 2″ x 2″ slides, *100 watt Bulb*, 5″ Focus Objective, Slide Carrier	
3780	Model MK 150 Delineascope for 2″ x 2″ slides, *150 watt Bulb*, Heat Absorbing Glass, 5″ Focus Objective, Slide Carrier	
3784	Model MK 200 Delineascope for 2″ x 2″ slides, *200 watt Bulb*, 5″ Focus Objective, Slide Carrier	
3785	Model MK 300 Delineascope for 2″ x 2″ slides, *300 watt Bulb*, 5″ Focus Objective, Slide Carrier and Cooling Fan Unit	
	ACCESSORIES	
4006	100 watt, 115-120 Volt Bulb, S. C. Bayonet Base for Model MK 100	MCP
4017	150 watt, 120 Volt Bulb, S. C. Bayonet Base for Model MK 150	MCP
4010	200 watt, 120 Volt Bulb, Med. P. F. Base for Model MK 200	MCP
4009	300 watt, 115 Volt Bulb, Med. P. F. Base for Model MK 300	MCP
4029	300 watt, 120 Volt Bulb, Med. P. F. Base for Model MK 300	MCP
3718	Heat-Absorbing Glass for Model MK 150	
3785-606	Heat-Absorbing Glass for Models MK 200 and MK 300	
3708	Slide Carrier for all MK Models	
3719	Cooling Fan Unit	
3713	Leatherette Covered Carrying Case for Models MK 100, 150 or 200 with storage space for slides and extra bulb	
3714	Leatherette Covered Carrying Case as above for Model MK 300 and MK 200 when supplied with Cooling Fan Unit	

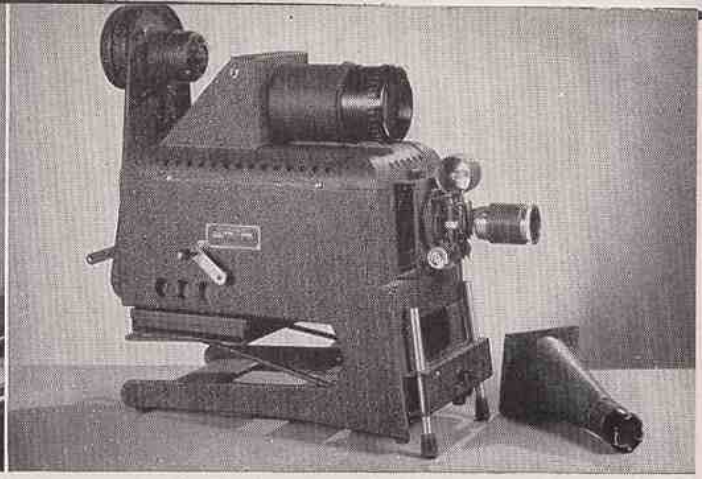
Model MK 300 Delineascope for 2″ x 2″ slides.

Projection Objectives and Condenser Lenses Used on Delineascopes

For Model	Obj.	Cat. No. Objective	Dia.	REAR				MIDDLE				FRONT			
				Cat. No. Condenser	Description			Cat. No. Condenser	Description			Cat. No. Condenser	Description		
					Dia.	Focus	Form		Dia.	Focus	Form		Dia.	Focus	Form
B	6½″	3961	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	8½″	3962	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	
D	6½″	3961	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	8″	3956	1⅝″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	8½″	3962	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	10″	3958	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	10″	3964	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	12″	3966	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	16″	3970	2½″	3431	4½″	6½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
	20″	3974	2½″	3432	4½″	7½″	Pl.Cx.					3440	4½″	6½″	Dl.Cx.
GK* See note below	6½″	3961	2½″	3592–603	62mm	125mm	Cc.Cx.	3592–602	74mm	135mm	Cc.Cx.	3592–601	75mm	125mm	Dl.Cx.
				3607–602	111mm	153mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
	8½″	3962	2½″	3592–603	62mm	125mm	Cc.Cx.	3592–602	74mm	135mm	Cc.Cx.	3592–601	75mm	125mm	Dl.Cx.
				3607–602	111mm	153mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
	10″	3964	2½″	3592–603	62mm	125mm	Cc.Cx.	3592–602	74mm	135mm	Cc.Cx.	3592–601	75mm	125mm	Dl.Cx.
				3607–602	111mm	153mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
	12″	3966	2½″	3592–603	62mm	125mm	Cc.Cx.	3592–602	74mm	135mm	Cc.Cx.	3592–601	75mm	125mm	Dl.Cx.
				3607–602	111mm	153mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
	16″	3970	2½″	3608–601	111mm	224mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
	20″	3974	2½″	3608–601	111mm	224mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
	24″	3978	2½″	3608–601	111mm	224mm	Pl.Cx.					3607–601	133mm	174mm	Dl.Cx.
MK100	5″	3706	1½″	3783–605	48mm	67mm	Pl.Cx.					3783–604	61mm	81mm	Pl.Cx.
MK150	5″	3706	1½″	3783–605	48mm	67mm	Pl.Cx.					3783–604	61mm	81mm	Pl.Cx.
MK200	5″	3706	1½″	3785–604	46mm	84mm	Cc.Cx.	3785–602	61mm	96mm	Pl.Cx.	3785–601	61mm	94mm	Dl.Cx.
MK300	5″	3706	1½″	3785–604	46mm	84mm	Cc.Cx.	3785–602	61mm	96mm	Pl.Cx.	3785–601	61mm	94mm	Dl.Cx.
VA	8″	3956	1⅝″	3437	4½″	6″	Pl.Cx.					3442	4½″	6½″	Dl.Cx.
	10″	3958	1⅝″	3437	4½″	6″	Pl.Cx.					3442	4½″	6½″	Dl.Cx.
	16″	3985	4″	No condenser lenses used with objectives for opaque projection.											
	18″	3987	4″												
Microfilm Reader	42mm	3400–852	1″	3783–605	48mm	67mm	Pl.Cx.					3783-605	48mm	67mm	Pl.Cx.
Slidefilm Att.															
No. 3671	3″	3949	1⅝″	3671–601	63mm	497mm	Dl.Cx.	Only one condenser lens in slidefilm attachments.							
No. 3674	3″	3949	1⅝″	3674–601	47mm	17 mm	Dl.Cx.								

*NOTE—With 6½″, 8½″, 10″ and 12″ focus objectives, use No. 3592 condenser unit when projecting 2 x 2 slides.
With 6½″, 8½″, 10″ and 12″ focus objectives, use No. 3607 condenser unit when projecting standard or English size slides (3¼ x 4 or 3¼ x 3¼)
With 16″, 20″ or 24″ focus objectives, use No. 3608 condenser unit when projecting standard or English size slides (3¼ x 4 or 3¼ x 3¼)





Slidefilm attachment shown, left on Model DC, and right on Model VAC.

Delineascope Accessories

Projection Bulbs

The prices of projection bulbs are changed frequently. Therefore, we are not pricing bulbs.

All orders for bulbs are accepted at manufacturer's current prices, MCP.

When ordering bulbs, give us the following information:

(1) Model of Delineascope—B, D, V, etc.

(2) Wattage of Bulb

(3) Voltage of Bulb

(4) Type of Base

Projection bulbs for 220 volt circuit are available for Models B, D, V, VA, MK 150.

Screens and Tables

We do not supply screens nor projection tables. These are available through most of our distributors.

Mirrors and Reflectors

Cat. No.	Description	Price
3783-606	Reflector for MK 100 or 150	
3785-605	Reflector for MK 200 or 300	
3474-601	Reflector for Models B, D, or GK	
3374-602	Condenser chamber mirror for Model B	
3374-603	First surface mirror for Model B	
3721-602	First surface mirror for Models V, VA, and VAC	
3721-603	Crinkle reflector for Models V, VA, and VAC	
3721-604	Back mirror for Models V, VA, and VAC	
3721-605	Side mirror, left or right, for Models V, VA, and VAC	

Slide Carriers

Cat. No.	Description	Price
4105	For standard size 3¼″ x 4″	
4106	For 3¼″ x 4″ and 3¼″ x 3¼″ (English)	
4113	For 2″ x 2″. Fits D, VA, GK	
3708	For 2″ x 2″. Fits all Model MK	

Combination Slidefilm and Microslide Attachments

These attachments are for use with Lantern Slide or Combination Opaque and Lantern Slide Delineascopes. They project 35mm. single frame slidefilm. Also, they have slideways for 3″ x 1″ microscope slides.

To secure the correct attachment it is necessary to specify the Delineascope Model with which it is to be used. Objective of 1⅝″ diameter, 3″ focus is included.

Magnification Table

(Figured on basis of 18mm. x 24mm.—standard 35mm. single frame film).

Focus of Lens in Inches	Distance From Screen, in Feet								
	6	10	15	20	25	30	40	50	60
3	1.7	2.9	4.5	6.0	7.5	9.0	12.0	15.0	18.0

Cat. No.	Description	Price
3671	For Model D	
3674	For Model VA	

Heat-Absorbing Glass and Mounts

Cat. No.	Description	Price
3607-604	Glass only for 3607 or 3608 Condenser Unit on GK	
3780-601	Glass only, for MK 150	
3780-1	Metal mount only, for MK 150	
3718	Glass in metal mount for MK 150	
3785-606	Glass only, for MK 200 or 300 and GK for 2" x 2"	
3785-5	Metal mount only, for MK 200 or 300	
3785-827	Glass in metal mount, for MK 200 or 300	
4110	Glass 4½" diameter, for Model D	

Projection Data

The efficient minimum and maximum projection distances of the different models of Delineascopes are as follows:

Models V, VA, VAC	—10 feet to 30 feet
Model D	—10 feet to 70 feet
Model B	— 6 feet to 15 feet
Model GK	—10 feet to 100 feet
Model MK	—10 feet to 30 feet
Slidefilm Attachment for Models VAC and D	—10 feet to 30 feet

Brighter pictures are obtained at the shorter projection distance. Illumination obviously decreases as the projection distance increases.

Consult the magnification tables to select the objective that produces the proper sized image to fill your screen at the projection distance desired.

Condensing lenses for use with the various optical combinations are shown.

Reference to the table below makes it possible to determine what focus objective is required to give the size of picture desired at a given distance, or the various sizes of pictures which can be obtained with an objective at varying distances.

For Standard Lantern Slides, 3¼" x 4":
(Figured on basis of 3-inch clear opening in slide).

Focus of Lens in Inches	Distance from Screen, in Feet																	
	4	5	6	8	10	15	20	25	30	40	50	60	70	80	90	100	110	120
6½	1.6	2.0	2.5	3.4	4.4	6.7	9.0	11.3	13.6									
8	1.3	1.6	2.0	2.7	3.5	5.4	7.2	9.1	11.0	14.8								
8½	1.2	1.5	1.9	2.6	3.3	5.1	6.8	8.6	10.3	13.9								
10		1.3	1.6	2.2	2.8	4.2	5.8	7.3	8.8	11.8	14.8							
12			1.3	1.8	2.3	3.5	4.8	6.0	7.3	9.8	12.3	14.8						
16				1.3	1.6	2.6	3.5	4.5	5.4	7.3	9.1	11.0	12.9	14.8				
20	Width of Screen Image (in feet)					2.0	2.8	3.5	4.3	5.7	7.3	8.8	10.2	11.8	13.2	14.8		
24						1.6	2.2	2.9	3.5	4.7	6.0	7.2	8.5	9.7	11.0	12.3	13.5	14.8

To determine (approximately) the focus objective required when using "double frame" film (24mm. by 36mm.), use lantern slide table above and divide image width by 2.

Spencer Microfilm Reader

The Spencer Scholar's Microfilm Reader is a low cost, efficient instrument for projecting microfilm. It can be used to project 16mm. and 35mm. film. Academic institutions derive particular benefit from this type of instrument because it makes available material from libraries throughout the world. It can also be used in the business office for simple commercial applications. Designed by the Committee on Scientific Aids to Learning, it is based on careful scientific studies of operation and performance.



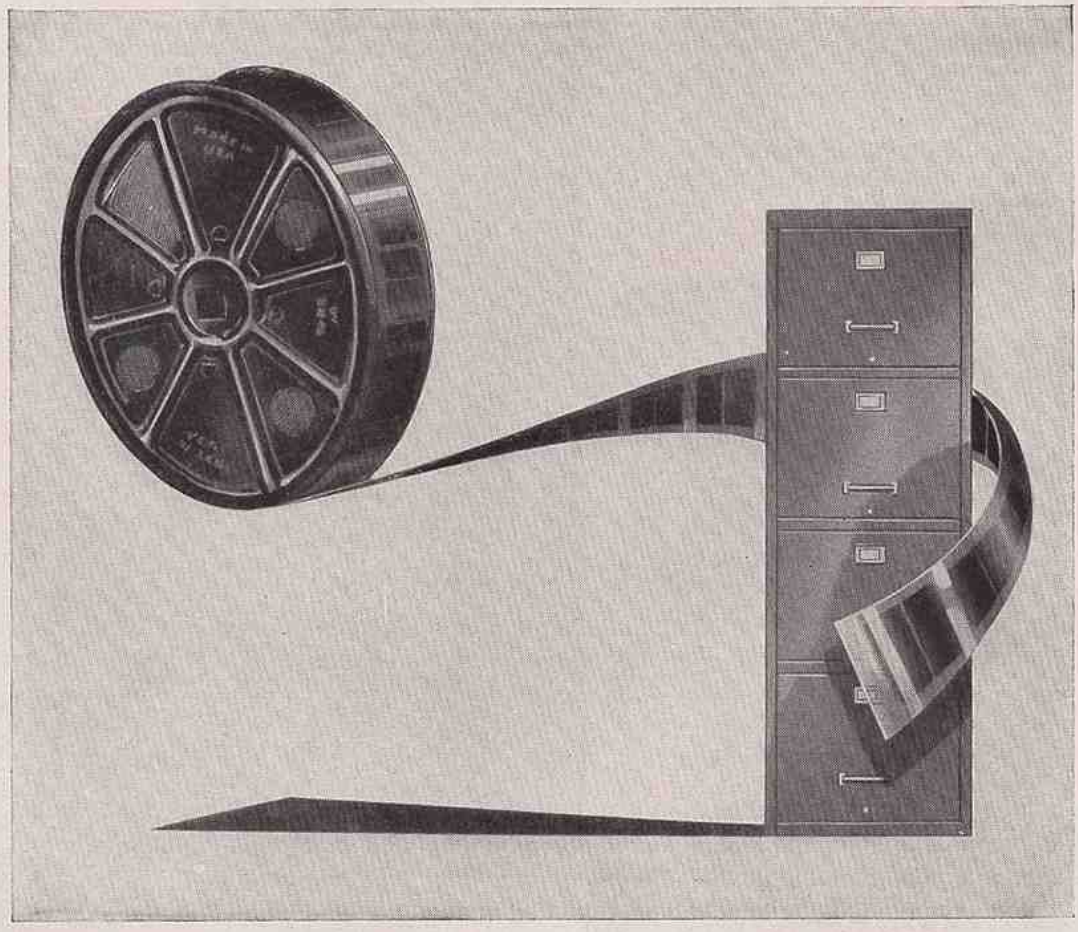
Purposes of Microfilm

The purpose of microfilm is to make available at relatively low cost and with great convenience in handling and storage, copies of the documentary information of the world which would otherwise be difficult, if not impossible, to obtain.

Scientists, research workers, graduate students and librarians, can read on microfilm the references so important to their work. Most of the repositories of the world have means for producing microfilm copies of documents too precious or rare to lend.

Microfilm has an important place in the administration of business records. Occupying less than 5 percent of the space originally used by the records it replaces, this medium reduces the cost of storing and maintaining files of important data. Microfilm copies of irreplaceable correspondence, engineering records, formulas, contracts and other such material can be stored in safety deposit vaults away from the business premises and safe from the hazards of fire and theft. Once photographed in order, a file cannot be upset. Copies of individual parts of the record can be made readily by standard photographic methods. Where duplicate files are necessary in separate locations, inexpensive copies can be printed and made available to those who must have access to the information they contain.

International correspondence by air can be handled by microfilm at a fraction of the cost for transporting paper letters.



Scholar's Microfilm Reader

The Spencer Scholar's Microfilm Reader consists of a projection head mounted upon a shadow box which protects the screen from extraneous light. The projection head is a modern well designed optical projection system incorporating an inexpensive, long life 100 watt, 115 volt, spotlight bulb, the proper condensing system and a specially designed projection lens. The lamp house is so well ventilated that there is no danger of the heat of the bulb damaging the film. The head unit is held to the shadow box with simple spring clips and may be rotated to project film in either vertical or horizontal azimuth as may be necessary.

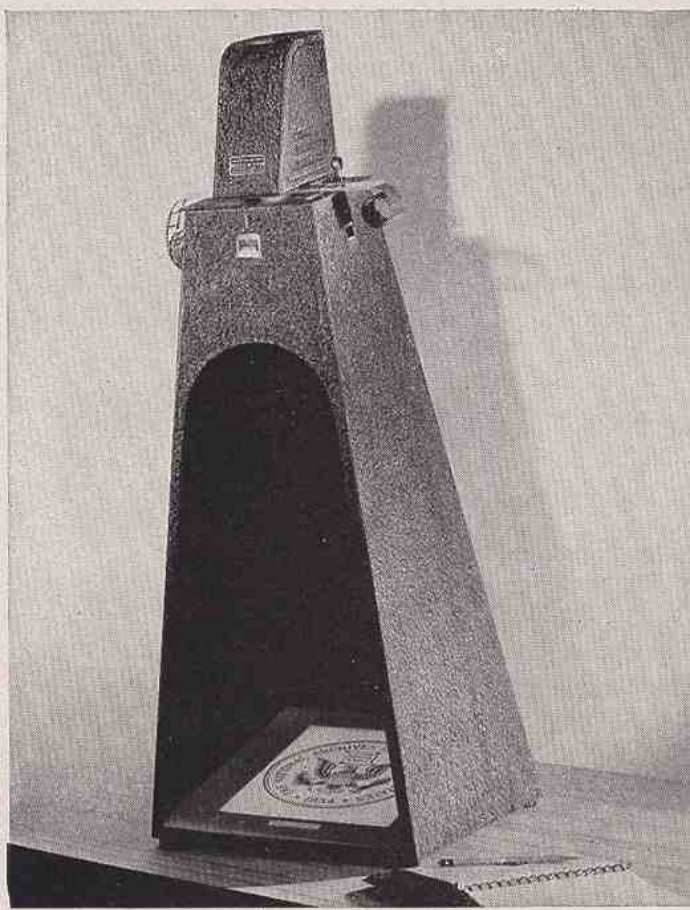
The objective is a well corrected system producing a flat undistorted image. An iris diaphragm in the objective permits adjustment of the amount of light to the comfort of the user. Magnification is 15X.

The screen is of heavy paper, specially tinted to render a projected image of agreeable color and contrast and microfilm material may be read with this instrument for hours without ocular fatigue or discomfort. The screen is easily replaceable when soiled or damaged.

The film is held in the Glass Filmbook or the Roll Film Attachment and moved under the projection aperture to show the desired page or illustration.

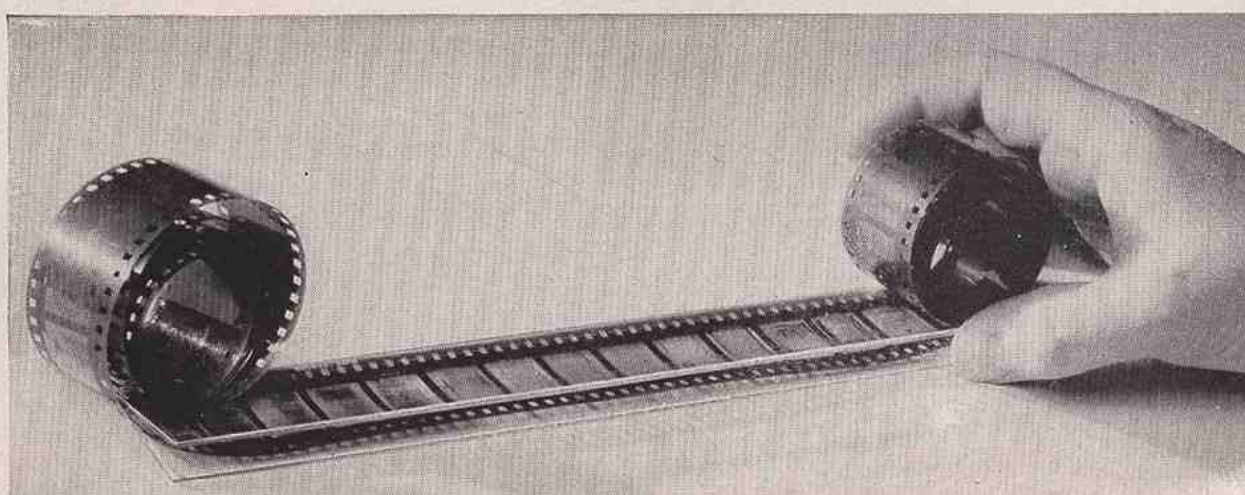
The Glass Filmbook consists of two pieces of glass hinged along one edge to permit easy insertion of the film. The film is protected from scratching and held flat in the focal plane of the objective.

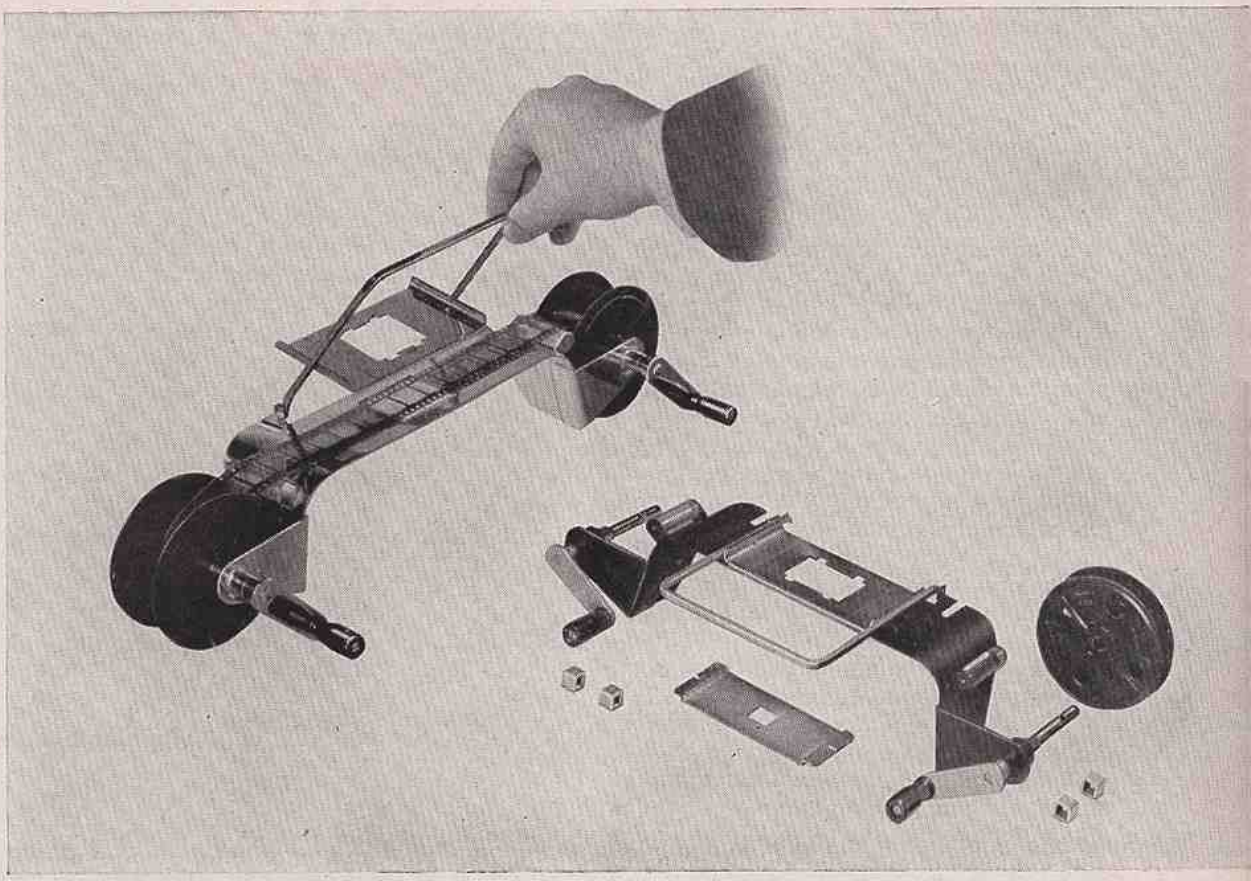
The Roll Film Attachment, available at extra cost, accommodates film on 100 foot reels and is simple, sturdy and easy to use. One empty 100 foot 35mm. Film Reel is supplied with this attachment. A set of accessories, consisting of the proper spacing washers, a mask to fit the aperture plate of the Roll Film Attachment and an empty 100 foot 16mm. Film Reel is available also for reading 16mm. microfilm.



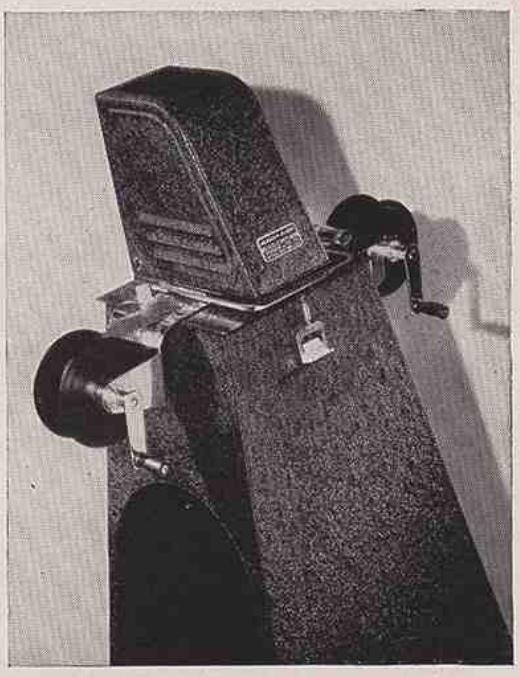
Film Reader No. 3400 showing glass film book in place.

Placing film in Glass Film Book.





Above left: Roll Film Attachment No. 3401 showing yoke lifted to load long roll of film; right: Accessories for 16mm. microfilm in roll film attachment.



Film Reader showing Projection Head rotated through 90° (with Roll Film Holder in place).

Cat. No.	Description	Price
3400	Spencer Microfilm Reader with one Glass Film book.....	
3410	Same as above, but for use with 230 volt current.....	
3401	Roll Film Attachment with one 100 foot Film Reel.....	
3402	100 Foot Film Reel, 35mm.....	
3403	100 watt, 115 volt, G16½ Spotlight Bulb .....MCP	
3408	100 watt, 230 volt, G16½ Spotlight Bulb.....MCP	
3404	Extra Screens [package of six].....	
3405	Glass Film Book.....	
3406	16mm. Accessories for use with No. 3401 including 4 spacers, one aperture mask and one 100 Foot Film Reel, with instructions.....	
3407	100 Foot Film Reel—16mm.....	

American Optical
COMPANY

OPHTHALMIC INSTRUMENTS

For many years, American Optical Company has pioneered in research, development, manufacture, and refinement of ophthalmic instruments. Today this enables AO to furnish the professions with the finest and most complete line of instruments obtainable for all phases of refraction and orthoptic training.



De Luxe Refracting Unit—completely integrated means for adjusting instruments to individual patients.

REFRACTING UNIT

OPHTHALMOMETER

STEREO ORTHOPTOR

LLOYD CAMPIMETER

ADDITIVE PHOROPTOR

LENSOMETER

OPERATING LAMP

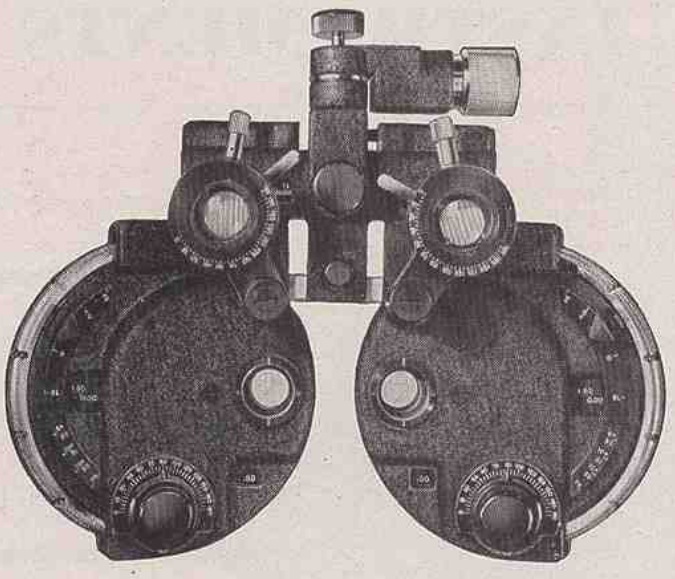
DIAGNOSTIC SET

PROJECT-O-CHART

GIANTSCOPE

TRIAL FRAME

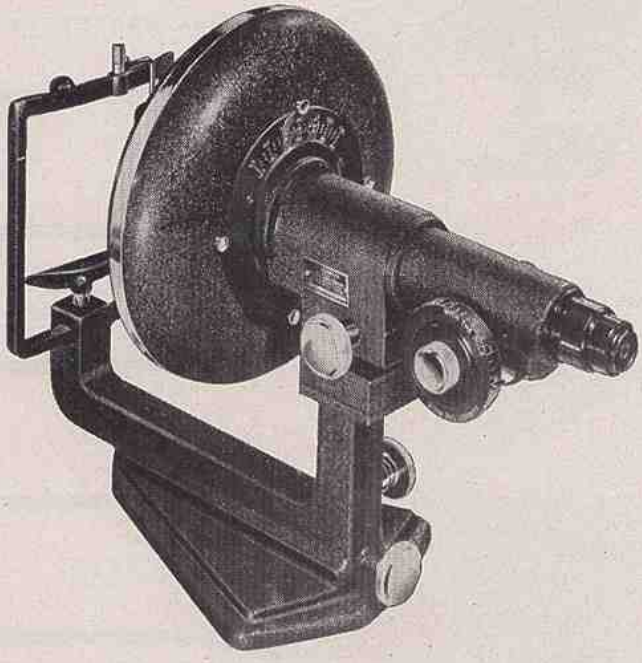
OPHTHALMIC



Additive Phoroptor

combines necessary refractive devices in a single convenient form.

Every AO ophthalmic instrument is designed and manufactured to meet exacting standards for precision and quality. Their dependability is based on scientific principles, fine materials, improved design, and skilled craftsmanship. In AO's research laboratories, scientists in many fields contribute constantly to the attainment of greater perfection in the instruments and materials provided for use by the professions in the preservation and correction of vision.



Ophthalmometer

measures objectively anterior corneal surface and determines corneal astigmatism.



AO Polaroid Giantscope

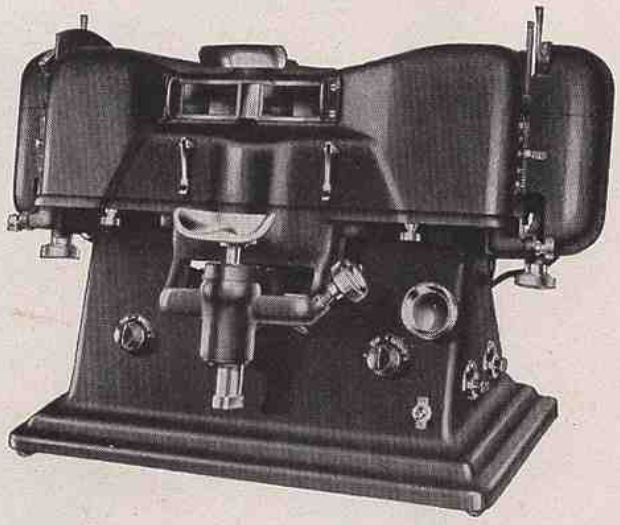
for examination of the interior of the eye.

INSTRUMENTS



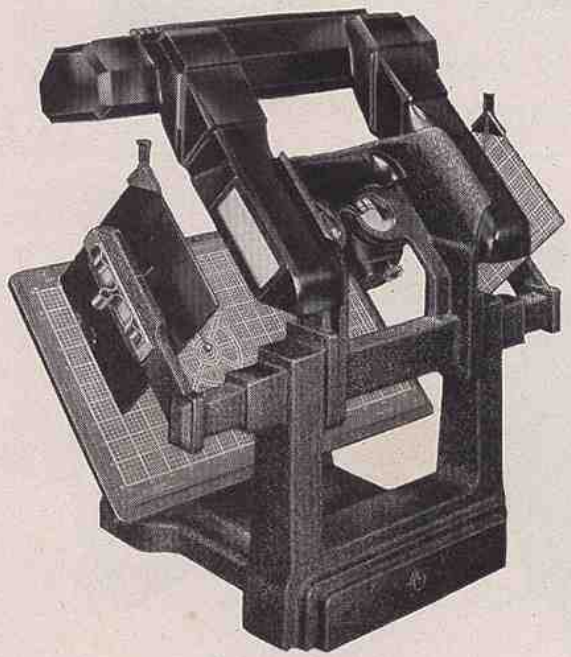
Diagnostic Sets

Ophthalmoscope and Otoscope, for eye and ear examination.



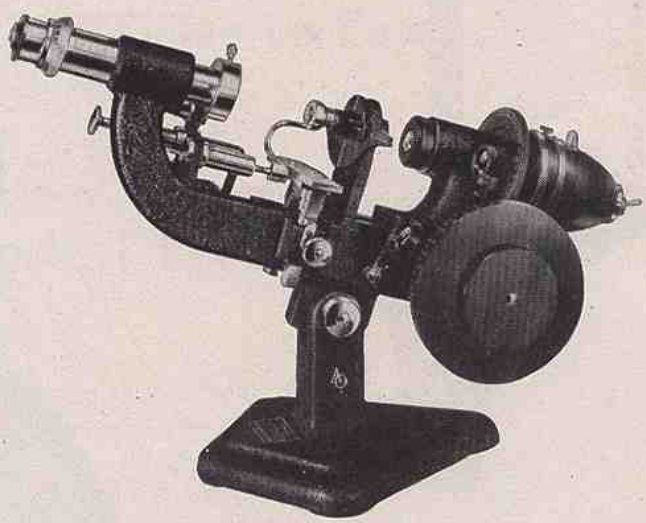
Stereo Orthoptor

combines many orthoptic exercises in one automatic training instrument.



Lloyd Campimeter

enables exploration of central and paracentral visual fields.



Lensometer

determines the focal strength and axis of any ophthalmic lens.

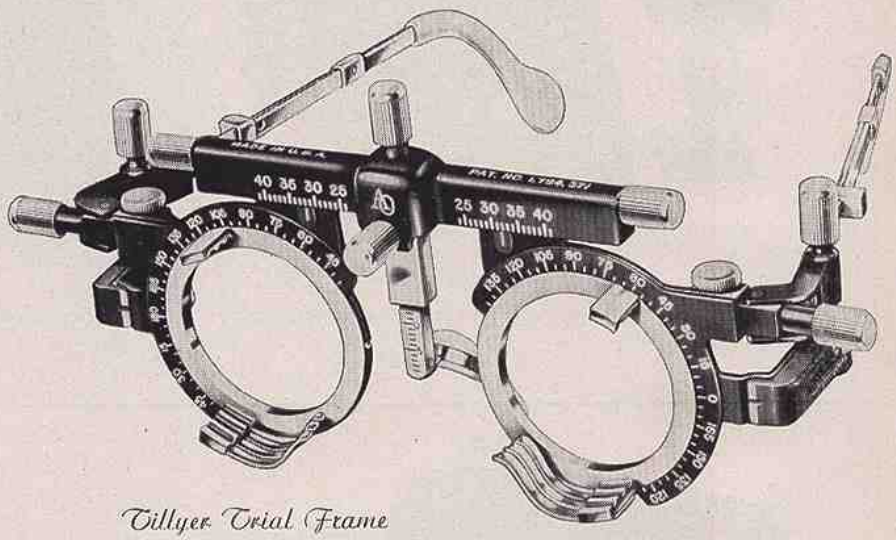
Ophthalmic Instruments

In resources, in service, and in the scope and volume of the instruments offered, AO leadership is widely recognized. The AO monogram on an ophthalmic instrument assures full value, precision operation, and long satisfaction.



Project-O-Chart

projects accurate, easily controlled ophthalmic test charts.



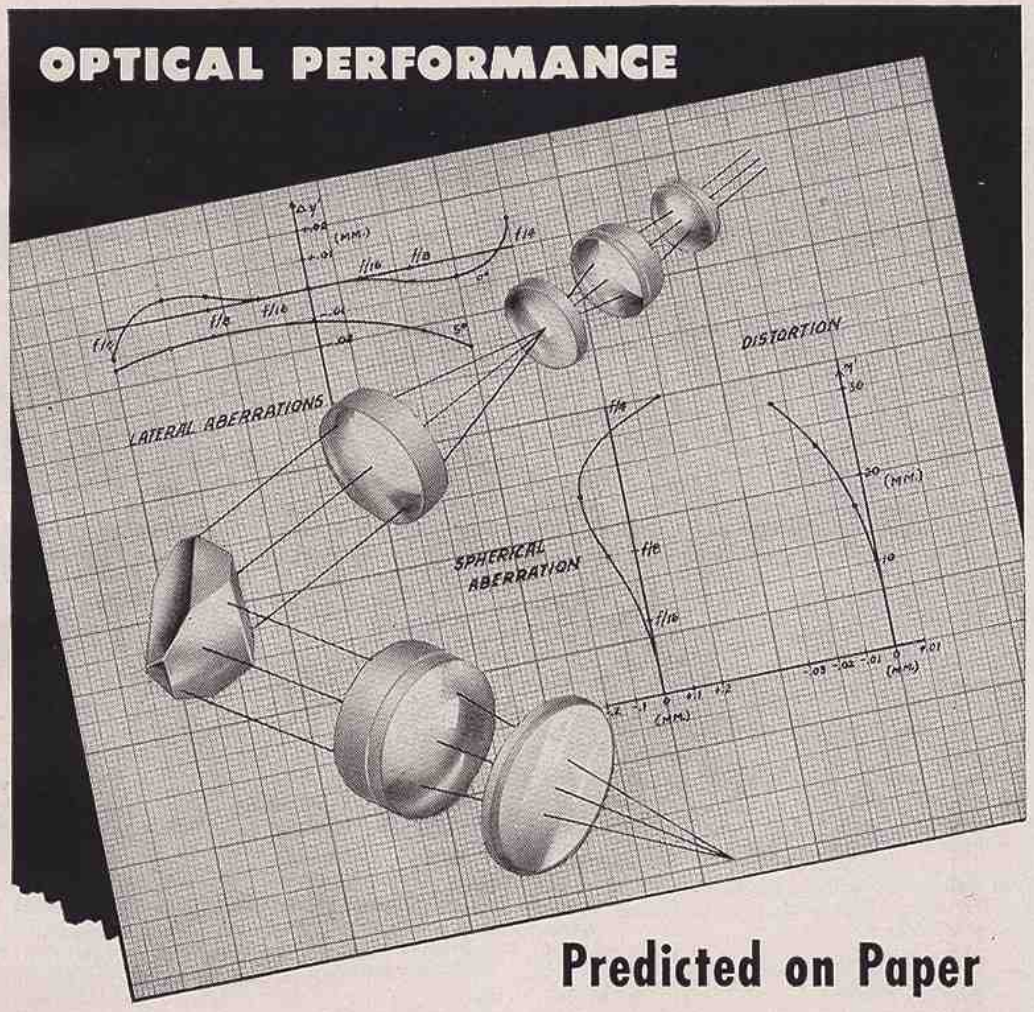
Tillyer Trial Frame

adjustable spectacle frame to hold test lenses during refraction.



Operating Lamp

provides powerful and intensive illumination for examination and operation.



Specialized Optical Products

Some of our most widely used instruments have in some instances been developed first to take care of a specific need in solving an unusual problem where optics could be applied. For this reason we welcome inquiries concerning the possible application of optics to meet the needs that may arise in any field of endeavor.

Quite often we can recommend an adaptation of standard equipment which will cost much less than an instrument that has to be specially designed. If, on the other hand, your requirements should necessitate the development of a new instrument, our Research and Engineering Divisions stand ready to offer their aid in recommending the proper optical and mechanical design for such an instrument.

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