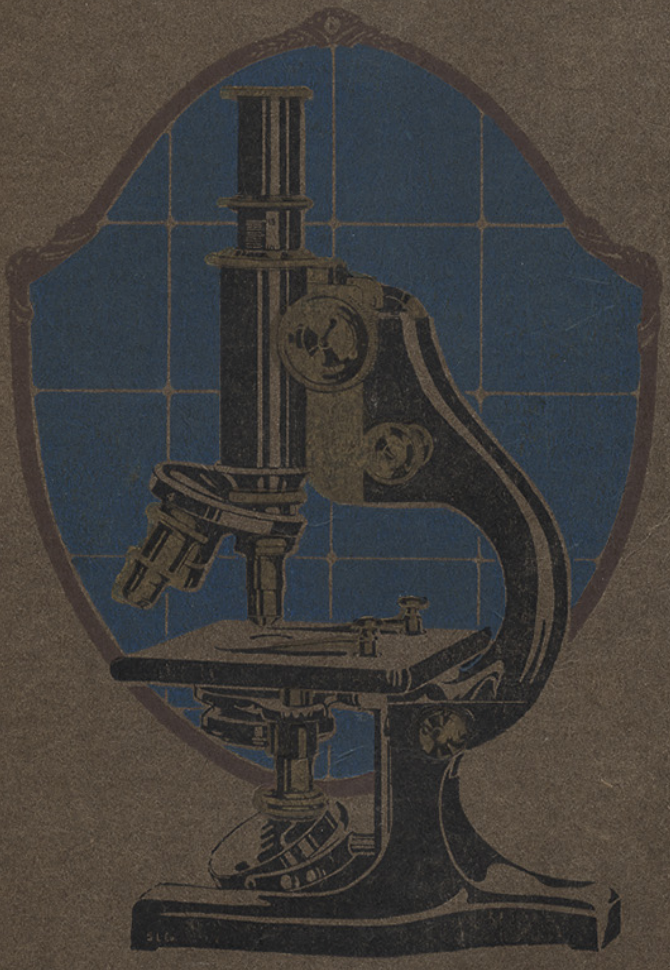
SPENCER LENS COMPANY



BUFFALO, N. Y.
U. S. A.

INDEX

PAGES

Acetylene Burner 90-107
Acetylene Generator 107
Acetylene Tank 107
Adjustments, Fine 7
Aluminum Coated Screens 103
Analyzers 70
Arc Lamp 61

Barnes Dissecting Microscope 46
Batteries, Storage 90-107
Binocular Attachment, see Diocular
Binocular Body, Greenough 31-32
Binocular Microscopes,
  Dissecting 32-38
  Mon-Objective 10-20
Blood Counting Apparatus 87-88
Blood Testing Apparatus 88-113-114
Boxes,
  for Lantern Slides 106
  for Microscope Slides 85
Bulbs 90
Bulbs, all kinds for Delineascopes 107

Cabinets for Automatic Delineascopes 96
Cabinets, Slide 84
Camera Lucida 69
Camera, Photo-Micrographic 71
Case for Delineascope 92
Chalet Lamp 63
Chemical Microscope 26
Colorimeter, Duboscq 112
Condensers
  Bull's Eye 48
  Substage 8-9-11-54
Condensing Lenses for Delineascopes 106
Cover Glasses 83

Dark Field Illuminators 55
Delineascopes 89-102
  Automatic 95-96
  Opaque 97-102
  Portable 91-94
Demonstration Microscope 48
Demonstration Oculars 65
Diaphragm Substage 8-9-54
Diocular 11
Dissecting Magnifier 47

PAGES

Dissecting Microscopes 45-46
Dissolver, Electric 106
Drawing Apparatus 59-60-69
Duboscq Colorimeter 112

Electric Dark Field Illuminator 55
Erecting Body 47
Eyepiece Holder 51

Filar Micrometer 64
Freezing Apparatus 80

Goniometer 116

Haemacytometers 87-88
Haemoglobinometers,
  Newcomer 112-113
  Sahli 88
Hardness Tester 115
Heat Absorbing Glass 106
Holder, for Dissecting Lenses 47
Holder, Razor Blade 82

Illuminants for Delineascopes 90-107
Illuminators,
  Dark Field 55
  Vertical 61

Knives, Microtome 81

Labels 86
Lamps, all kinds 61-63
  for Delineascopes 107
  Miniature Arc 61
  Substage 62
Lens Holder 47
Lens Paper 86
Lenses, Projection 105
Lenses, Photographic 117

Magnifiers 47-53
  Pocket 53
  Tripod 53
Mechanical Finger 66

INDEX—*Continued*

PAGES

Mechanical Stages 67-68
Metallurgical Microscope 29-31
Micro-Character 115
Micrometers,
  Eyepiece 64
  Stage 64
Micro-Projector 57-58
Micro-Projector Support 58-60
Microtomes 72-79
  Freezing 78-79
  Hand 79
  Rotary 73-75
  Sliding 76-77
  Table 79
Micro-Teleplat Objectives 58
Monocular Erecting Body 47

Nephelometer 112-113
Newcomer Glass Disc for Haemoglobin 112-113
Nomenclature 50
Nosepieces,
  Quick Changing 31
  Revolving 11-65
Numerical Aperture 49

Objectives,
  Achromatic 50
  Apochromatic 52
  Fluorite 50
  Micro-Projection 58
  Micro-Photographic 58
  Paired 33
  Photographic 117
  Projection 105
  Special for Dark Field Illuminator 56
Objective Changer 31
Objective Mountings 49
Oblique Light Apparatus 8-9
Oculars
  Compensating 52
  Demonstration 65
  Huyghenian 51
  Paired 33
  Planoscopic 51
  Projection 58
Ocular Holder 51
Oil Dropper 66
Opaque Projectors 97-102

PAGES

Paired Objectives 33
Paired Oculars 33
Paper, Lens 86
Photographic Lenses 117
Photo-Micrographic Apparatus 71
Pocket Microscope 43
Polarizing Apparatus 70
Portable Microscope 39-43
Prisms, Nicol 70
Projection Apparatus, Microscopic 57-58

Reading Microscope 44
Receptacles, Slide 84-85
Refractometer, Abbe 114
Resistances for Delineascope Bulbs 107
Revolving Stage, Attachable 66

Screens, all kinds 103
Slides,
  Microscopic 83
  Prepared Microscopic 86
Slide Boxes,
  for Lantern Slides 106
  for Microscope Slides 85
Slide Holders for Staining 85
Slide Receptacles 84
Spectrometer 110-111
Spectroscopes, Pocket 109
Stages,
  Mechanical 67-68
  Attachable Revolving 66
Strops 82
Substages 8-9
Support for Micro-Projector 48-60

Tables, for Delineascopes 104
Table, of Sizes of Screen Pictures 105
  of Magnification for Binocular Microscopes 33
Terms 5
Translux Screens 103
Transposer for Lantern Slides 93
Tripod, for Delineascopes 91-92-104
Tripod Magnifiers 53
Tube Length, Correction for 50

Vertical Illuminators 61

Working Distance 49

CATALOG
OF
SPENCER PRODUCTS

INCLUDING
MICROSCOPES · MICROTOMES
DELINEASCOPES
AND THEIR ACCESSORIES
WITH OTHER
SCIENTIFIC OPTICAL
INSTRUMENTS

19 SPENCER BUFFALO U.S.A. 24

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MALLERS BUILDING, 5 S. WABASH AVENUE AT MADISON, CHICAGO

3 BURNSIDE PL., MONTREAL, QUEBEC, CANADA

A-24-Printed in U. S. A.



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JANUARY 1, 1924

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INTRODUCTION

WE take pleasure in presenting this new catalog of Spencer products. In it we have incorporated a wider line of Scientific Optical Instruments than we have heretofore offered. In addition to Microscopes, Microtomes, Delineascopes, etc., we include also Spectrometers, Refractometers, Colorimeters and Goniometers. We shall add to our list from time to time other optical instruments such as Polarimeters, Sacarimeters, Dipping Refractometers, Telescopes and other instruments for scientific work.

¶ We are in position to supply not only the instruments listed in this catalog, but to undertake any special optical work of a scientific nature. We operate one of the most completely equipped glass plants in the world from which we produce regularly a wide variety of optical glass. We have successfully poured the largest telescope discs that have ever been produced on the American continent, and our constantly expanding facilities warrant us in undertaking the manufacture of discs of any required size. Correspondence is invited regarding any optical requirements.

Terms

¶ In compiling this catalog, every effort has been made to indicate correct prices for each item, but fluctuating conditions make it impossible for us to guarantee these prices. They are subject to change without notice. We shall always take pleasure in quoting prevailing prices to those interested. To educational, municipal and state institutions, or to hospitals of recognized standing, we offer special terms which we are always pleased to quote on request.

¶ For all domestic shipments prices include packing of the goods and delivering them to responsible transportation companies, but do not include transportation; in other words, they are F. O. B. Buffalo. Boxing and packing are charged on export orders. If customers specify the method of transportation which they prefer, their instructions will be rigidly adhered to, but if no instructions are given, we shall exercise our best judgment as to means of shipment. All goods are very carefully checked and packed by experienced packers; our responsibility for them ceases when they are delivered in good condition to transportation companies. If received in imperfect condition, the matter should be promptly reported to us and claims for damage made against the company transporting the goods.

¶ Goods that are, for any reason, unsatisfactory should be returned to us, plainly marked to show whence they come and a full explanation of the cause of dissatisfaction should be mailed at the time the goods are returned.

¶ In ordering goods please be absolutely specific, giving the name and catalog number and if different sizes or specifications are included under one number, be sure to indicate definitely what is required. Telegraph codes are given for the convenience of our customers, but they should be relied on only where absolutely necessary. It is advisable to send by mail confirmation of all telegraphic orders.

SPENCER LENS COMPANY.

FOREWORD

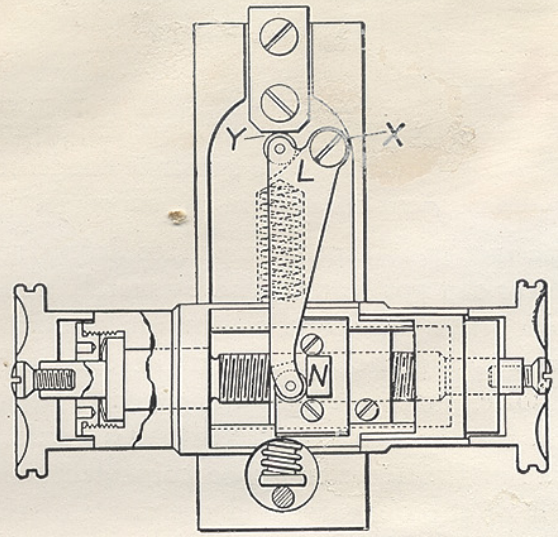
WHAT do you purchase in buying a microscope? Some chunks of cast iron and brass, a little hardened steel, a bit of bronze, some lacquer and a few pieces of glass! That is the visible part of your purchase, but that does not complete the transaction. You purchase *workmanship!* And you express your faith in the workman and in the firm which stands between you and the workman, to guarantee the quality of his output

¶ You purchase *service!* You expect lasting satisfaction and in making your purchase you express your confidence that the manufacturer is able and willing to stand back of his product; to give you not alone a perfect piece of machinery, but to retain his interest in this machinery to see that it continues to function to your permanent satisfaction.

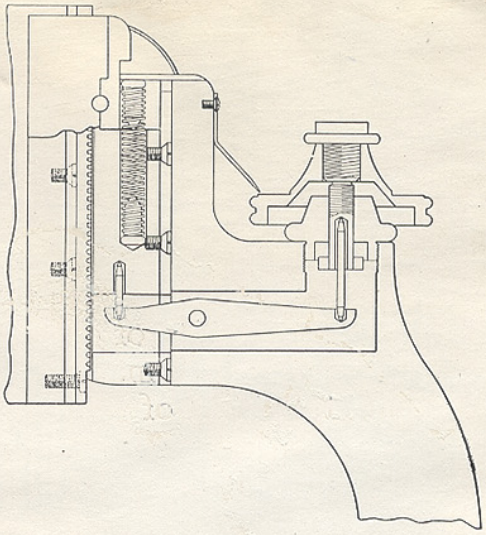
¶ Lastly, and above all, you purchase experience, research. You benefit by the work of a long line of scientists, opticians and mathematicians, who have devoted their lives to the perfection of an optical instrument and who are justly proud of their accomplishment. In making your purchase, you testify to your confidence that the pride of the manufacturer in his output is not misplaced. You have a right to expect flawless material, perfect workmanship and scientific design combined to make a dependable instrument of precision.

¶ In the construction of Spencer apparatus, special attention has been given not alone to symmetry of design and beauty of finish, but to convenience of operation and durability under long continued usage. To this end, only that material is employed which has been carefully analyzed and tested for the special type of instrument in which it is used.

¶ The illustrations in the following pages indicate clearly the general form of the several instruments, many parts of which have become too well standardized to require minute description. We describe in detail only a few peculiarities of construction that are not revealed by the general appearance.



FINE ADJUSTMENT B



FINE ADJUSTMENT C

SPENCER FINE ADJUSTMENTS

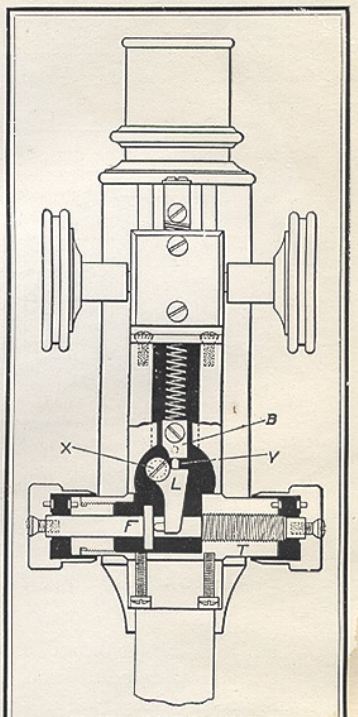
FINE ADJUSTMENT B is exceedingly sensitive; one complete revolution moving the body tube one-tenth millimeter. The heads are graduated into one hundred divisions; thus one division represents one thousandth millimeter or one micron. ¶ The nut N is free to travel laterally but can not rotate; thus when the horizontal buttons are turned it moves along its axis. If the direction of motion is to the left as illustrated in the diagram, the lever L is swung about its axis X producing a direct upward thrust at Y against a block attached to the body tube of the microscope. The reverse direction of rotation carries the nut away from the end of the lever, permitting the latter to swing back under the influence of the weight of the body tube assisted by a coiled spring.

Steel pins inside the heads of the micrometer buttons come in contact with other pins which are automatically forced out into position at either end of the excursion of the nut producing an absolute stop and effectually preventing the jamming or tightening of the screw.

FINE ADJUSTMENT C is an old and standard type of adjustment that has proven by many years of use to be serviceable and satisfactory. In this type, the movement is transmitted by means of a straight lever pivoted in the relation of 2:1*; thus the movement of the tube is one-half that of the screw which is raised or lowered five-tenths millimeters by each revolution. The motion of the screw which carries it downward raises the end of the lever that acts on the body tube, and the reverse direction permits the tube to move downward under gravity assisted by the spring.

FINE ADJUSTMENT D is sufficiently delicate for the focusing of high power objectives but not so slow as to make its use tedious in rapid work, one revolution moving the body tube two-tenths millimeters.

A lever L is pivoted at X. The lower end of the lever bears against a heavy flange F attached to the axis of the screw. When the latter is turned in a direction that carries it to the right, the lever is swung about its axis raising the block B which is attached to the body tube. The reverse direction permits the lever to swing back under the influence of gravity assisted by a coiled spring. The limit of motion in either direction is set by steel pins striking solidly together preventing the possibility of jamming or tightening the screw.



FINE ADJUSTMENT D

All these adjustments are characterized by the following features:

First A thread is engaged by a nut completely surrounding it furnishing a large and uniform bearing surface not attainable in any worm gear movement.

Second The force of the screw is applied only in raising the tube; the reverse motion being accomplished by the action of a coiled spring assisting gravity. Thus the movement ceases when the objective strikes the cover.

Third All wear and lost motion is automatically taken up by a spring so that " back lash " *can not* develop.

Fourth The force raising the tube is applied in a vertical direction *only* producing no lateral thrust to move the body tube side-wise with the consequent displacement of the field.

* On numbers 45 and 65, this relation is 1:1.

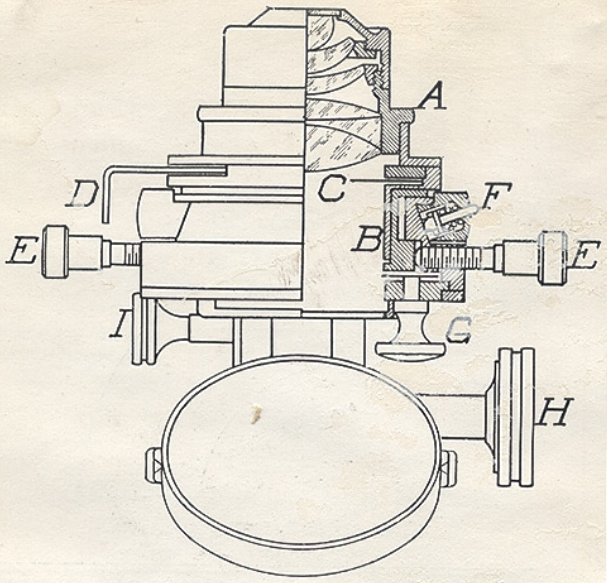


DIAGRAM OF NEW SPENCER
COMPLETE SUBSTAGE

A. Removable condenser mount.
B. Removable iris diaphragm mount.
C. Iris diaphragm.
D. Handle for operating iris diaphragm.
EE. Centering screws.
F. Spring plunger holding condenser in position in the fork.
G. Button for regulating obliquity of illumination.
H. Rack and pinion adjusting button.
I. Fine adjustment button.

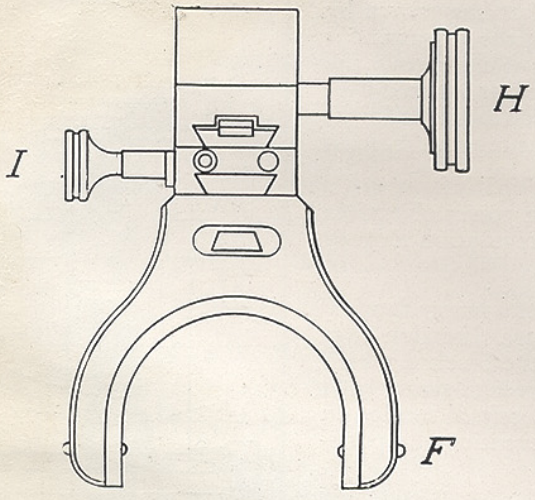


DIAGRAM OF FORK OF NEW SPENCER
COMPLETE SUBSTAGE

H. Rack and pinion adjustment button.
I. Fine adjustment button.
F. Spring plunger for holding condenser in position.

THE SUBSTAGE

AMONG the recent developments in the microscope none have been more important than the improvement in the substage condensers and the consequent changes in the substage.

The fact is evident that perfect definition of an object can not be obtained by merely flooding it with light. The best results are obtained only by bringing the light from the condenser to a definite, sharp focus at the plane of the object and rigidly holding it there. The axis of the cone of the light must be coincident with the axis of the objective and the angle of the cone carefully modified to suit the aperture of the objective used, by a diaphragm placed at the focal plane of the condenser. On the older substage the mechanical construction has been such that this has been impossible.

Recognizing these important facts, our Scientific and Mechanical Departments have co-operated to produce a complete substage equipment which should rigidly conform to these standard requirements. *See list of condensers on page 54.* The result has been an entirely new and unique design, making for unusual rigidity and convenience of operation: also providing a capacity for a variety of condensers; for high power and low power objectives to be used as condensers with the iris in the proper relation; for the dark field illuminator, and for polarizers to be used in any desired relation to the condenser (or without them).

The whole substage is adjustable for height by a rack and pinion movement, *and a fine adjustment*. The latter is a feature of special utility, since for high grade work accurate focusing of the condenser is as essential as of the objective. The substage arm consists of a fork open at the front into which may be easily slipped a unit bearing any required accessory. This unit is held in place by two spring plungers, one on each arm of the fork, which, together with the inclined contact surfaces between this unit and the inner surface of the fork, hold the upper flange of the unit firmly down onto the upper surface of the fork. Two slight depressions in the inclined surface of the unit into which the spring

plungers fit, locate the ring as to azimuth, so that it may always be placed in the fork in the same position. By using a slight pressure, however, the unit may be revolved if desired.

This unit consists of a ring to which the new oblique light device (described later) is attached and into which is fitted a centerable ring which in turn carries the iris diaphragm, condensers, etc., all of which fit in from above and rest on broad flanges to insure proper alignment. The large diaphragm with its condensers is placed immediately above the ring. The condenser, however, is separable from the iris for the easy interchange of the condensers, or the substitution of a low power objective as a condenser, or of a dark field illuminator; all of which with proper adapters work above the same iris. When it is desirable to use the small iris near to the surface of the stage all of the above mentioned parts are removed from the centerable ring and the stage iris substituted. This stage iris also serves the purpose of a diaphragm for high power objectives when they are used as condensers. (When objectives are to be thus used, the portion of the objective mount carrying the optical parts is unscrewed from the back portion having the Society thread and attached to a suitable ring for holding it in the required position. The diaphragm is thus brought into correct relation with the optical parts, a result that can be accomplished in no other way).

For some critical work a polarizer is used in connection with these objective-condensers and must be placed as near as possible to the condenser. To accomplish this result a polarizer is mounted within the mounting of the stage iris to bring it close to the objective-condenser. It is easily removed when the iris is wanted for ordinary purposes. By means of an adapter this same polarizer may be placed in the centerable ring beneath the large iris for use when the regular condensers are functioning.

¶ In this substage is incorporated an entirely new device for obtaining oblique illumination. It consists of three leaves which by turning a small handle are made to act in a manner analogous to the leaves of a regular iris, except that they close toward one side only and give any desired degree of obliquity. The ring to which they are attached may be revolved through 360° to obtain this obliquity from any azimuth. The simplicity and compactness of this device appeal to good judgment and the fact that a greater volume of light can be obtained from any degree of obliquity makes for a distinct optical advantage.

We are developing a new source of illumination which may be secured to the mounting beneath the substage to make the light source one integral part with the rest of the substage equipment. It is small and compact, giving plenty of room beneath the substage when the mirror is removed.

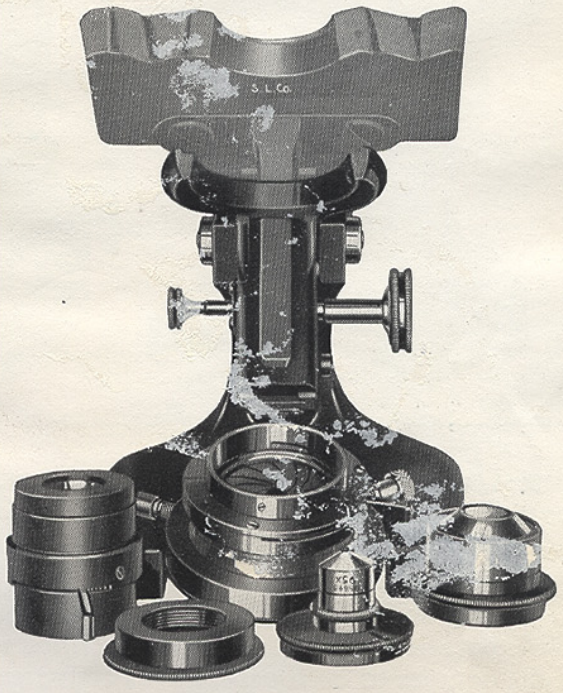
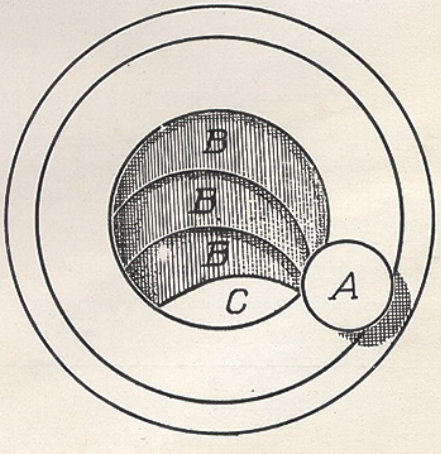
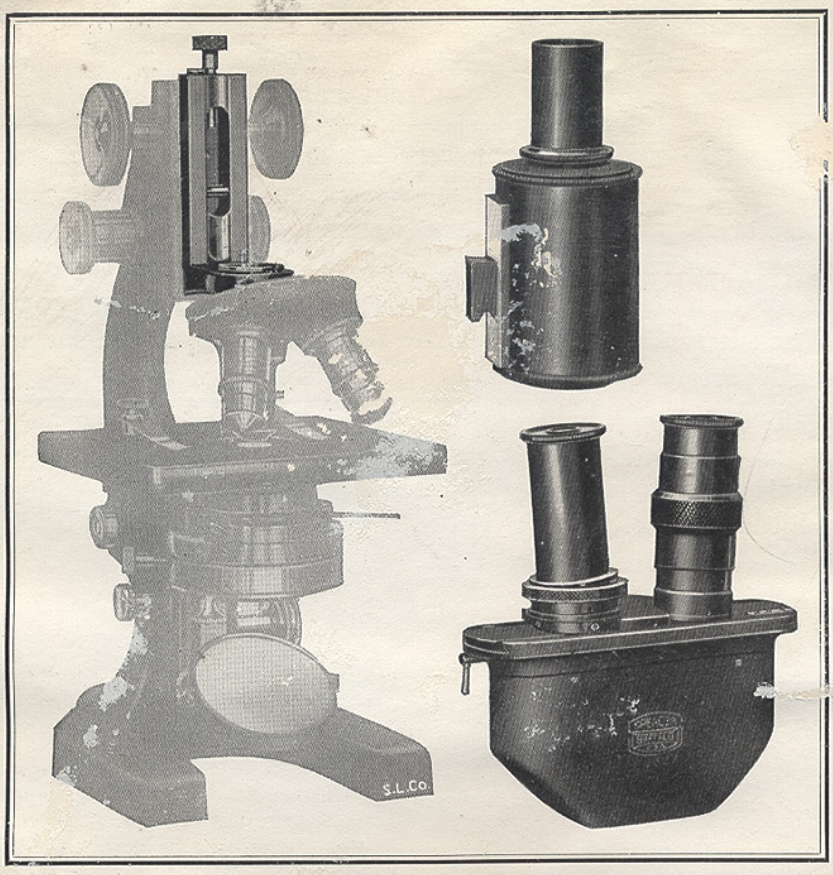


DIAGRAM OF NEW SPENCER DEVICE FOR OBTAINING OBLIQUE ILLUMINATION

A. Button by which the leaves are controlled.
BBB. Opaque leaves.
C. Oval shaped opening admitting light at one side of condenser.





Mon-Objective Binocular Microscopes require no introduction. They have passed well beyond the experimental stage and the fact is now thoroughly established that these instruments possess a real value in relieving eye-strain and in conveying a correct impression of depth or perspective.

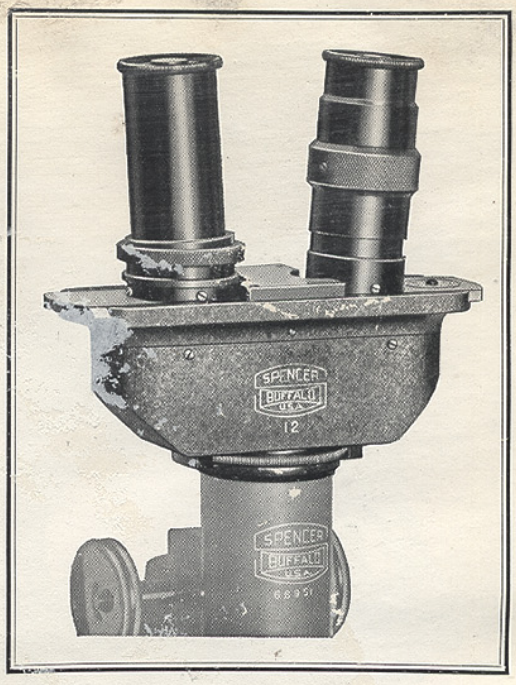
¶ For the purpose of making these advantages available on our high grade microscopes without impairing their efficiency for photographic purposes, for use with the camera lucida, or for any other work where the standard single tube instrument is required, we offer our new line of combination instruments in which the single and double tubes are more easily interchangeable than they have been heretofore. This is accomplished by attaching the revolving nose-piece to an independent sliding block that is actuated by the rack and pinion and to which either tube may be affixed as required, the interchange being accomplished without upward or downward pressure and thus free from danger of forcing the objective against the object under examination or even of throwing it out of focus.

In our binocular body, we have departed from stereotyped design, in which the ocular tubes are made parallel. Our eyepieces are inclined at four degrees from the normal, giving them an angle of eight degrees to each other. This convergence results in the optical axes; in other words, the lines of vision of the two eyes meeting at a distance of about eighteen inches from eyes having average pupillary separation. Such convergence conforms to the position assumed by normal eyes in examining ordinary objects or in reading common print. With tubes thus arranged, it is unnecessary to acquire a new art in order to successfully use the instrument; perfect binocular vision being obtained with the first attempt as well as after prolonged practice. Extensive experience as well as the advice of skillful opticians has convinced us that this arrangement is logical and scientifically correct, *but if parallel tubes are preferred, they will be so made on special order at no extra charge.*

Adjustment for accommodation to pupillary separation is accomplished by turning a knurled ring conveniently placed on the right hand ocular tube. A similarly placed ring on the left hand tube furnishes a means of focusing for one eye independently of the other. Conveniently located shutters are provided for shutting off the light to either eye to facilitate focusing for the other. These shutters remain closed only while held, automatically opening when released.

Catalog No.	DESCRIPTION	Price
1 SB	Single body tube adaptable to all combination microscopes except number 4	$15.00
1 MOB	Binocular body adaptable to all combination microscopes except number 4	80.00

SPENCER DIOCULAR



THIS device, attachable to any standard compound microscope, possesses many advantages of the monobjective binocular.

The optical system in this apparatus is in all respects identical with that employed in our complete binocular microscopes, except that a negative lens has been introduced compensating optically for the increased tube length that results from adding the binocular body to the tube of the ordinary microscope. The reduced field and higher magnification incidental to the greater tube length is practically balanced by the use of 6x in place of 10x oculars.

The features which characterize our binocular microscopes such as convenient adjustment for pupillary distance, the register for individual settings and the focusing of one ocular independently of the other are all incorporated in this attachment.

The instrument is usable with all standard oculars, the only necessary precaution being to see that they are properly matched. (We recommend the use of 6x oculars.)

Telegraph Code	Catalog No.	DESCRIPTION	Price
Forforo	440	Diocular without oculars	$50.00

READERS of our catalog will note that in listing our several microscope equipments we use a uniform nomenclature for indicating certain standard sets of accessories, and that we indicate by numbers the type of stand on which the accessories are assembled. For example, one of our most popular stands is listed under number " 44." A standard set of accessories consisting of achromatic objectives 16mm., 4mm. and 1.8mm. oil immersion on a revolving triple nosepiece, huyghenian oculars 6x and 10x (one each on monocular outfits and two each on binocular outfits) and condenser suitable for the stand on which it is used, is designated by letter "H." Thus catalog number "44-H" means stand 44, with equipment above enumerated. Other letters indicate other sets of accessories. Thus "A" means achromatic objectives 16mm. and 4mm. and huyghenian ocular 10x. "B" refers to the same equipment with the addition of a double revolving nosepiece, etc., an outfit being fully indicated by a number and a letter.

It is neither practical nor desirable to list every possible combination of objectives, nosepiece, eyepiece, and condenser but for the convenience of our customers we are here indicating the change in price involved in some of the variations from standard equipment frequently called for.

If it is desired to substitute for the Abbe condenser N. A. 1.20:—

A wide angle condenser N. A. 1.40	Add	$ 2.00
An achromatic condenser N. A. 1.30	Add	22.50
An achromatic condenser N. A. 1.40	Add	32.50

It will be noted that our higher grade instruments are listed with the achromatic condenser N. A. 1.30. If this is to be replaced by achromatic condenser N. A. 1.40 Add $10.00

If it is desired to substitute for huyghenian oculars:—

Planoscopic oculars 6x or 8x	Add each	$1.75
Planoscopic oculars 10x, 12x, 15x, 20x	Add each	2.75
Compensating oculars 1.5x, 5x	Add each	3.50
Compensating oculars 10x, 15x, 20x	Add each	5.50

If it is desired to substitute for the 1.8mm. achromatic oil immersion objective:—

The 2mm. fluorite oil immersion objective	Add	$15.00
The 32mm., 40mm. or 48mm. objective	*Subtract*	33.50

If it is desired to substitute for the achromatic 4mm. objective:—

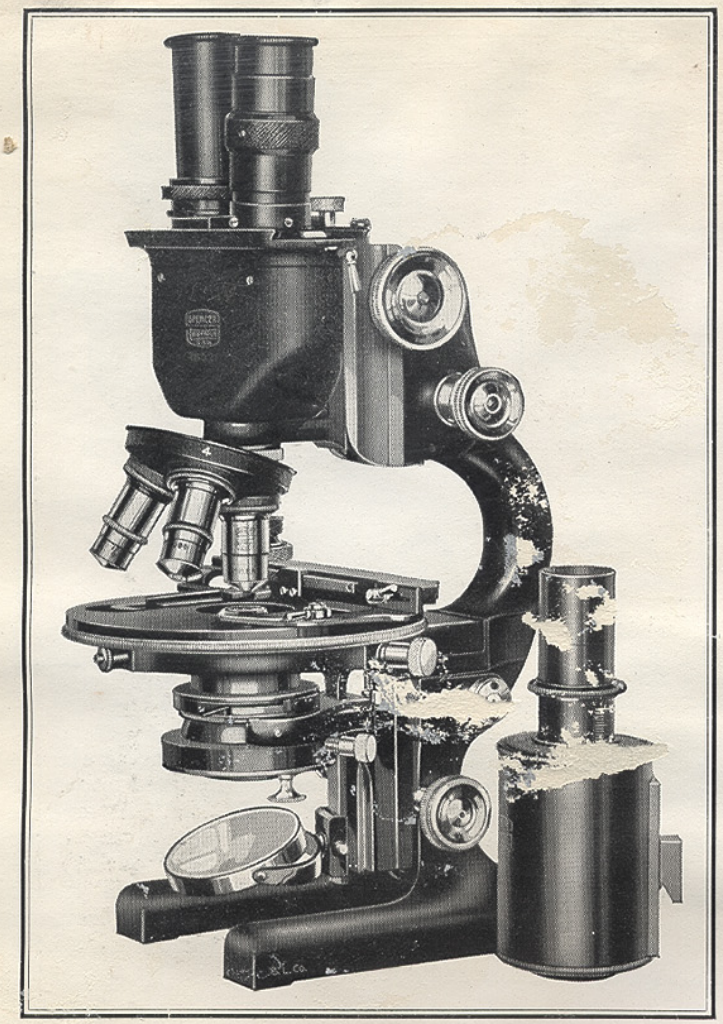
The fluorite 4mm. objective Add $6.50

For standard set of achromatic objectives:—

The corresponding set of apochromatic objectives Add $106.50

For the double nosepiece:—

The triple nosepiece	Add	$1.75
The quadruple nosepiece	Add	4.25



SPENCER MICROSCOPE NO. 1

THIS stand is so arranged as to receive the binocular body and single tube interchangeably without removing either nosepiece or objectives. *See page 10.*

BINOCULAR BODY—Spencer standard attachment No. 1 MOB with tubes converging to a point at normal working distance from the eyes. *For complete description and price see page 10.*

SINGLE TUBE—Spencer standard attachment, 50 millimeters in diameter, No. 1 SB. Easily interchangeable with the binocular body. *For description and price see page 10.*

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Revolving type, 120 millimeters diameter with centering screws: regularly supplied with standard size mechanical stage No. 493. *See description, page 68.* May be supplied with plain revolving stage of same diameter at a reduction of $30.00 from list prices given below.

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

SUBSTAGE—Complete new substage providing for easy manipulation and interchangeability of substage accessories and insuring stability and permanence of alignment. Focusable by rack and pinion and by *fine adjustment. See complete description, pages 8 and 9.*

CABINET—Polished hardwood, with lock and key.

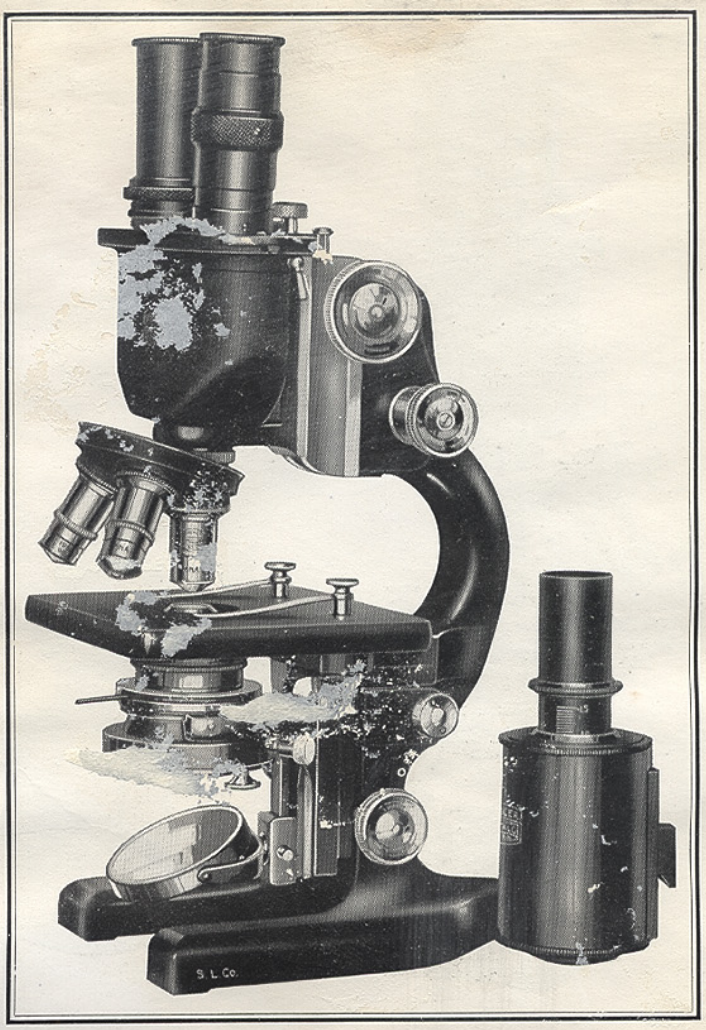
Code	Catalog No.	DESCRIPTION	Price
On	1	Stand only with achromatic condenser, N. A. 1.30, without binocular body, single tube or nosepiece.	$184.50

The following outfits include stand with achromatic condenser, N. A. 1.30, revolving nosepiece carrying the objectives listed and binocular body interchangeable with the single tube. (*Both are included.*)

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Once	1E	16-4	10-44	10X	$313.25	16-4	10-44	10X	$386.75
Onf	1F	16-4	10-44	6X-10X	318.75	16-4	10-44	5X-10X	399.25
Onh	1H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	360.50	16-4-2 Oil-imm.	10-44-82	5X-10X	485.00
Onj	1J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	375.50				

SPENCER MICROSCOPE NO. 2



THIS stand is so arranged as to receive the binocular body and single tube interchangeably without removing either nosepiece or objectives. *See page 10.*

BINOCULAR BODY—Spencer standard attachment No. 1 MOB, with tubes converging to a point at normal working distance from the eyes. *For complete description and price see page 10.*

SINGLE TUBE—Spencer standard attachment, 50 millimeters in diameter, No. 1 SB. Easily interchangeable with the binocular body. *For description and price see page 10.*

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout, harder and more durable than rubber, will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment " B." *See description, page 7.*

SUBSTAGE—Complete new substage providing for easy manipulation and interchangeability of substage accessories and insuring stability and permanence of alignment. Focusable by rack and pinion and by *fine adjustment. See complete description, pages 8 and 9.*

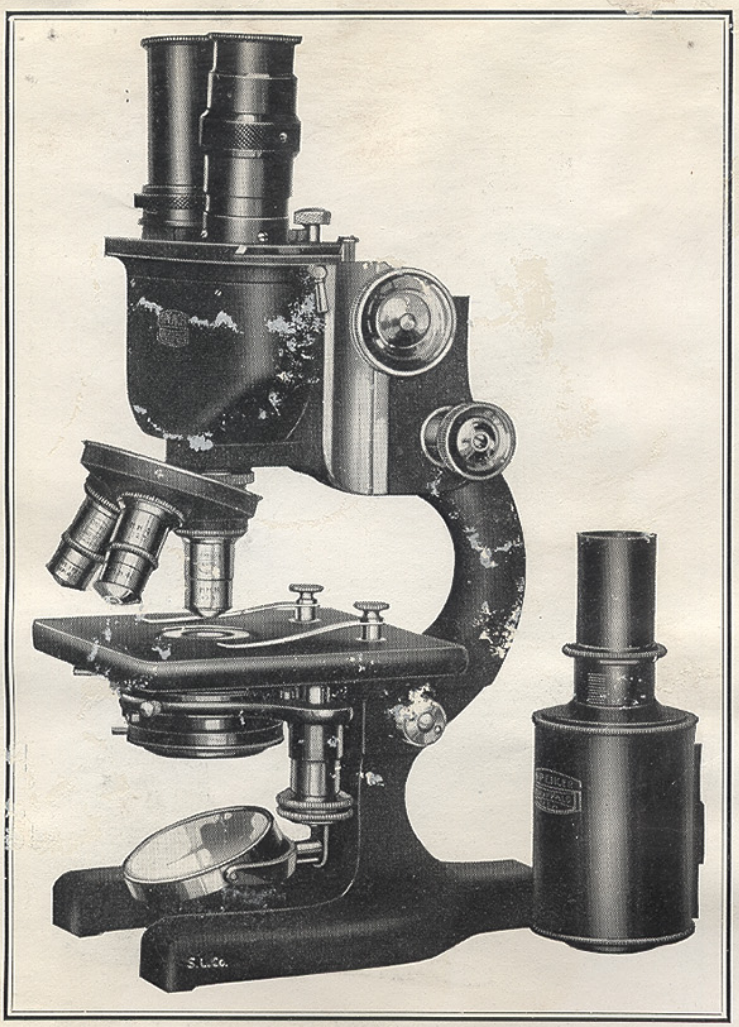
CABINET—Polished hardwood with lock and key.

Code	Catalog No.	DESCRIPTION	Price
To	2	Stand only with achromatic condenser N. A. 1.30, without binocular body, single tube or nosepiece.	$124.50

The following outfits include stand with achromatic condenser, N. A. 1.30, revolving nosepiece carrying the objectives listed and binocular body interchangeable with the single tube. (*Both are included.*)

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix " apo " to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Toe	2E	16-4	10-44	10X	$253.25	16-4	10-44	10X	$326.75
Tof	2F	16-4	10-44	6X-10X	258.75	16-4	10-44	5X-10X	339.25
Toh	2H	16-4-1.8 Oil imm.	10-44-95	6X-10X	300.50	16-4-2 Oil-imm.	10-44-82	5X-10X	425.00
Toj	2J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	315.50				



SPENCER MICROSCOPE NO. 3

THIS stand is so arranged as to receive the binocular body and single tube interchangeably without removing either nosepiece or objectives. *See page 10.*

BINOCULAR BODY—Spencer standard attachment No. 1 MOB, with tubes converging to a point at normal working distance from the eyes. *For complete description and price see page 10.*

SINGLE TUBE—Spencer standard attachment, 50 millimeters in diameter, No. 1 SB. Easily interchangeable with the binocular body. *For description and price see page 10.*

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout, harder and more durable than rubber, will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

SUBSTAGE—Of standard "quick screw" form with condenser permanently centered.

CABINET—Polished hardwood, with lock and key.

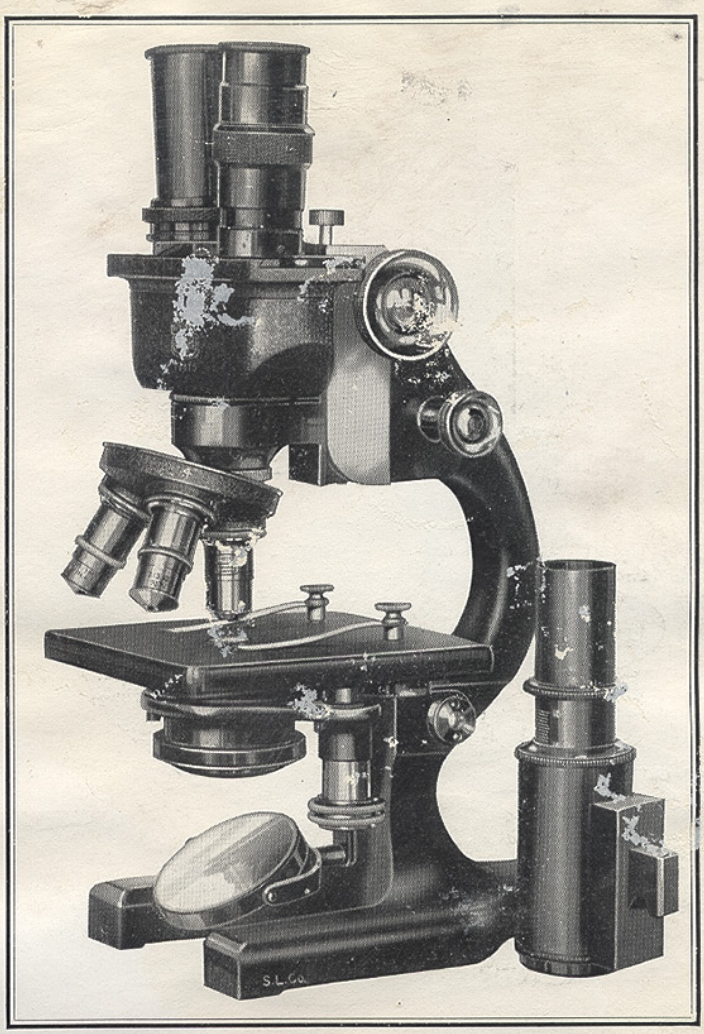
Code	Catalog No.	DESCRIPTION	Price
Thre	3	Stand only with wide angle condenser, N. A. 1.40, without binocular body, single tube or nosepiece.	$ 71.00

The following outfits include stand with wide angle condenser, N. A. 1.40, revolving nosepiece carrying the objectives listed and binocular body interchangeable with the single tube. (*Both are included.*)

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Three	3E	16-4	10-44	10X	$199.75	16-4	10-44	10X	$273.25
Thref	3F	16-4	10-44	6X-10X	205.25	16-4	10-44	5X-10X	285.75
Threh	3H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	247.00	16-4-2 Oil-imm.	10-44-82	5X-10X	371.50
Threj	3J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	262.00				

SPENCER MICROSCOPE NO. 4



THIS instrument, while somewhat simplified in construction, embraces the essential features of all our mon-objective binocular microscopes. The single tube and binocular body are interchangeable by the same methods and with the same results as on our larger instruments.

The stand is similar to that of the Spencer No. 44, which has already established its reputation as a most practical instrument for general laboratory purposes.

BINOCULAR BODY—The standard attachment optically identical with that employed in all other Spencer binoculars. It is slightly shorter than those of the larger microscopes, to accommodate it to the smaller stand.

SINGLE TUBE—This tube is identical in size and length with that regularly used on the Spencer Microscope No. 44, so that the stand equipped with this tube is virtually identical in all particulars with No. 44.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulating large objects; the distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout, harder and more durable than rubber, will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment D. *See description, page 7.*

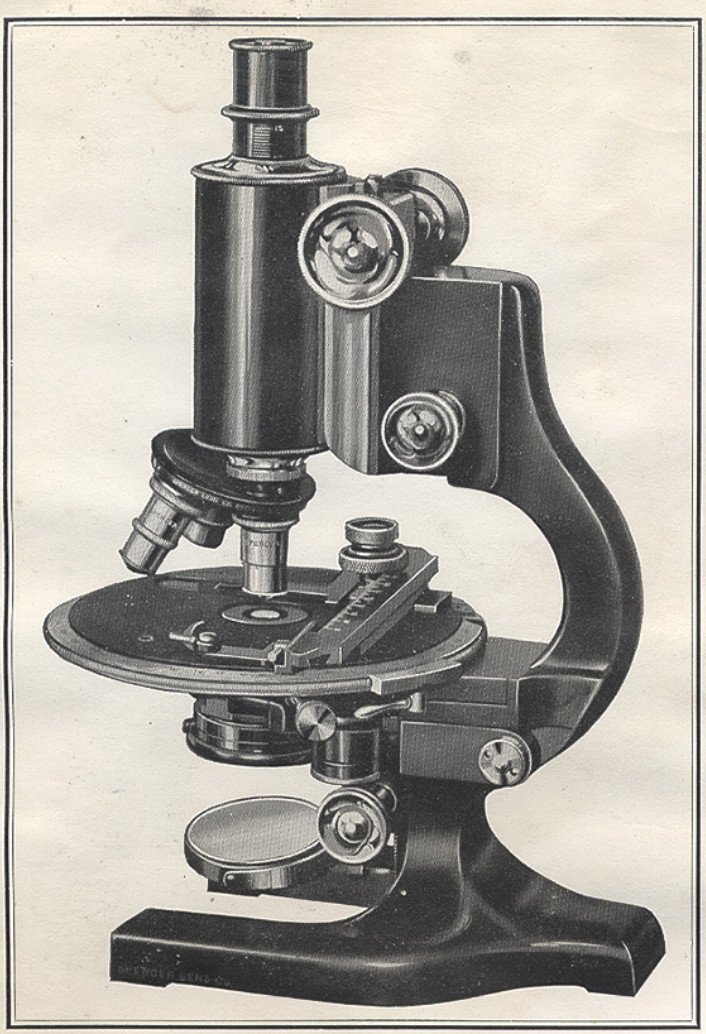
SUBSTAGE—Of standard "quick screw" form, with condenser permanently centered.

CABINET—Polished hardwood, with lock and key.

Code	Catalog No.	DESCRIPTION	Price
For	4	Stand only without condenser, binocular body, single tube or nosepiece	$31.75
Formob	4MOB	Binocular body	55.00
Forsb	4SB	Single Tube	15.00

The following outfits include *both* single tube and binocular body. Other accessories as indicated in the list.

Code	Catalog No.	Substage Condenser N. A. 1.20	Revolving Nosepiece	Achromatic Objectives		Paired Huyg. Oculars	Price
				Equivalent focus-mm.	Initial magnifications		
Forb	4B	Not included	Double	16-4	10-44	10X	$145.25
Ford	4D	Not included	Double	16-4	10-44	6x-10X	150.75
Fore	4E	Included	Double	16-4	10-44	10X	157.75
Forf	4F	Included	Double	16-4	10-44	6x-10X	163.25
Forh	4H	Included	Triple	16-4-1.8 Oil-imm.	10-44-95	6x-10X	205.00
Forj	4J	Included	Triple	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	222.00



SPENCER MICROSCOPE NO. 5

A SINGLE tube instrument of the highest type designed to meet the most exacting demands of technicians and trained investigators.

BODY TUBE of aluminum, 50 millimeters in diameter and so arranged as to permit the use of either standard objectives or special size photo-micrographic objectives for covering large fields without oculars. Has graduated draw tube fitting in cloth-lined sleeve.

ARM—Curved form, furnishing a convenient handle and providing ample space (100 millimeters) from the arm to center of stage.

STAGE—Revolving type, 150 millimeters in diameter, with centering screws. Equipped with large mechanical stage. *See complete description, page 68.* Has graduated periphery with clamp and vernier reading to three minutes of arc.

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

SUBSTAGE—Complete rack and pinion substage with centering screws for condenser, upper and lower iris diaphragms. Lower diaphragm decenterable by rack and pinion for oblique illumination.

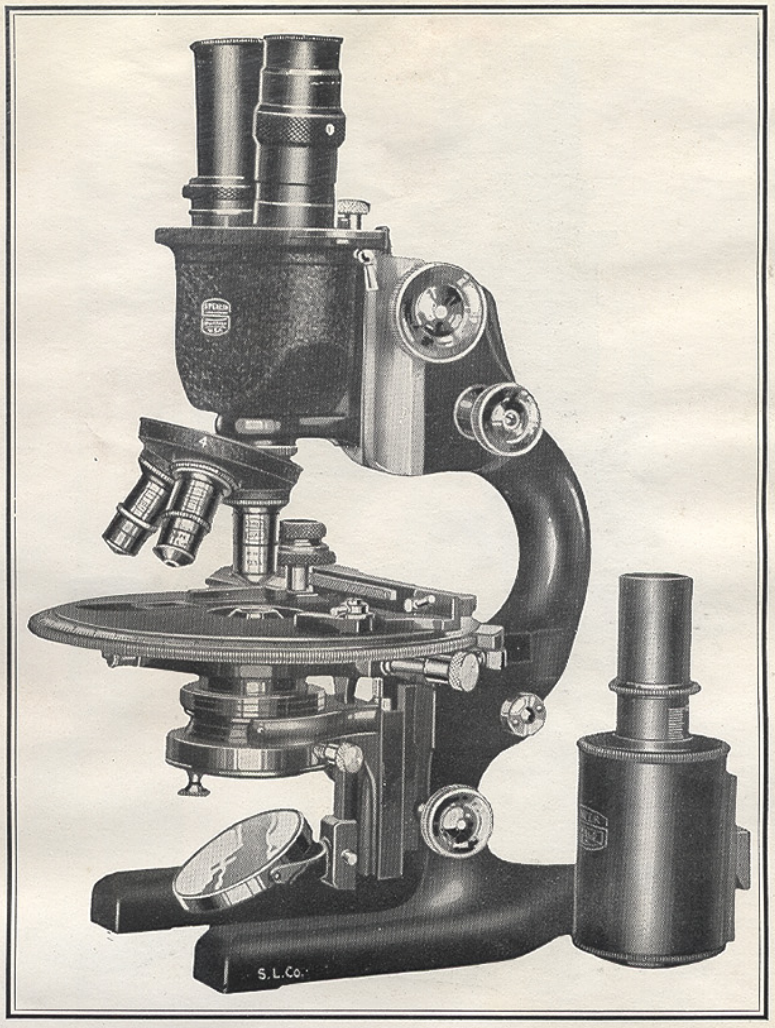
CABINET—Polished hardwood, with lock and key.

The following outfits include stand with wide angle condenser N. A. 1.40, and revolving nosepiece suitable for the objectives liste.

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Huyg. Oculars	Price	Apochromatic Objectives		Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Five	5E	16-4	10-44	10X	$210.50	16-4	10-44	10X	$278.50
Fivf	5F	16-4	10-44	6x-10X	213.25	16-4	10-44	5x-10X	284.75
Fivh	5H	16-4-1.8 Oil-imm.	10-44-95	6x-10X	255.00	16-4-2 Oil-imm.	10-44-82	5x-10X	370.50
Fivj	5J	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	270.00				

SPENCER MICROSCOPE NO. 7



THIS stand is so arranged as to receive the binocular body and single tube interchangeably without removing either nosepiece or objectives. *See page 7.*

BINOCULAR BODY—Spencer standard attachment No. 1 MOB, with tubes converging to a point at normal working distance from the eyes. *For complete description and price see page 10.*

SINGLE TUBE—Spencer standard attachment, 50 millimeters in diameter, No. 1SB. Easily interchangeable with the binocular body. *For description and price see page 10.*

ARM—Curved form furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 100 millimeters.

STAGE—Revolving type, 150 millimeters in diameter, with centering screws. Has clamp and graduated periphery with vernier reading to three minutes of arc. Equipped with large mechanical stage. *See complete description, page 68.*

In addition to the usual features this mechanical stage is provided with supports by which the slide is carried entirely free of the microscope stage, so that it is moved about without contact with the stage surface (a feature of considerable importance when oil contact is made between the slide and condenser).

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 10.*

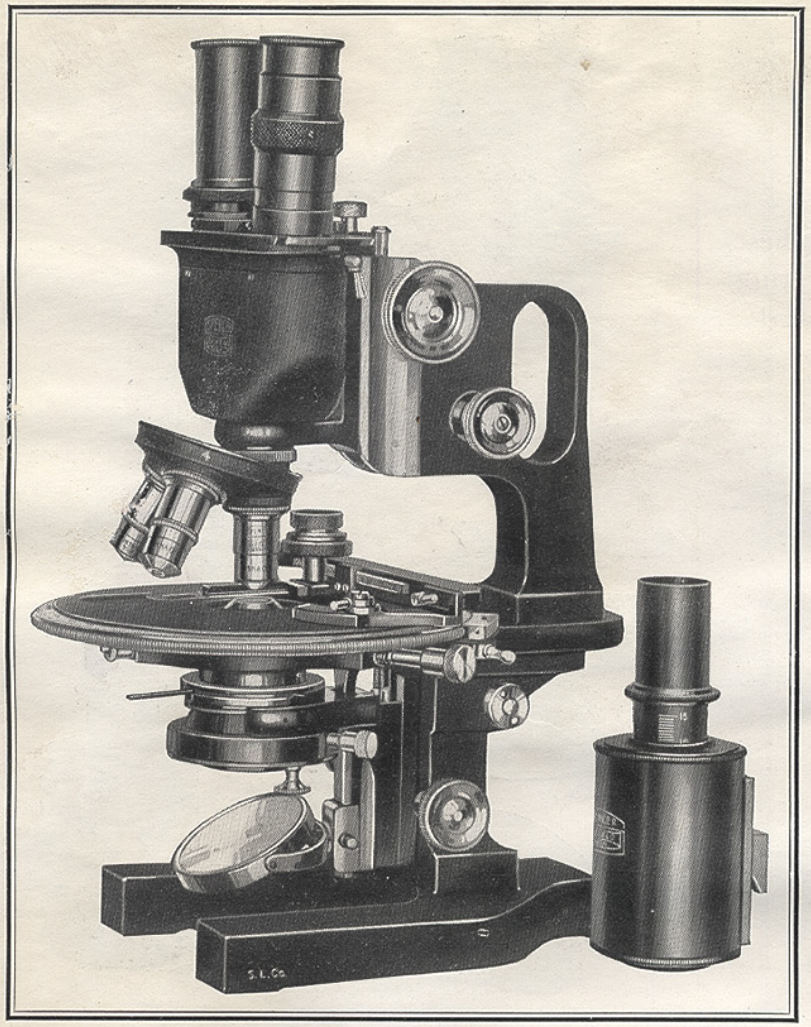
SUBSTAGE—Complete new substage, providing for easy manipulation and interchangeability of substage accessories and insuring stability and permanence of alignment. Focusable by rack and pinion, *and by fine adjustment. See complete description, pages 8 and 9.*

CABINET—Polished hardwood, with lock and key.

Code	Catalog No.	DESCRIPTION	Price
Sevn	7	Stand only, with achromatic condenser, N. A. 1.30, without binocular body, single tube or nosepiece.	$210.00

The following outfits include stand with achromatic condenser, N. A. 1.30, revolving nosepiece, carrying the objectives listed and binocular body interchangeable with the single tube. (*Both are included.*)
Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Seve	7E	16-4	10-44	10X	$338.75	16-4	10-44	10X	$412.25
Sevf	7F	16-4	10-44	6X-10X	344.25	16-4	10-44	5X-10X	424.75
Sevh	7H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	386.00	16-4-2 Oil-imm.	10-44-82	5X-10X	510.50
Sevj	7J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	401.00				



SPENCER MICROSCOPE NO. 9

THIS stand is so arranged as to receive the binocular body and single tube interchangeably without removing either nosepiece or objectives. *See page 10.*

BINOCULAR BODY—Spencer standard attachment No. 1 MOB with tubes converging to a point at normal working distance from the eyes. *For complete description and price* *see page 10.*

SINGLE TUBE—Spencer standard attachment, 50 millimeters in diameter, No. 1 SB. Easily interchangeable with the binocular body. *For description and price* *see page 10.*

ARM—of the original "handle arm" type which has stood the test of many years' service; convenient for handling the instrument and very attractive in appearance.

STAGE—Revolving type 150 millimeters in diameter with centering screws. Identical with that of No. 7. *See page 17.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

SUBSTAGE—Complete new substage providing for easy manipulation and interchangeability of substage accessories and insuring stability and permanence of alignment. Focusable by rack and pinion and by *fine adjustment*. *See complete description, pages 8 and 9.*

CABINET—Polished hardwood, with lock and key.

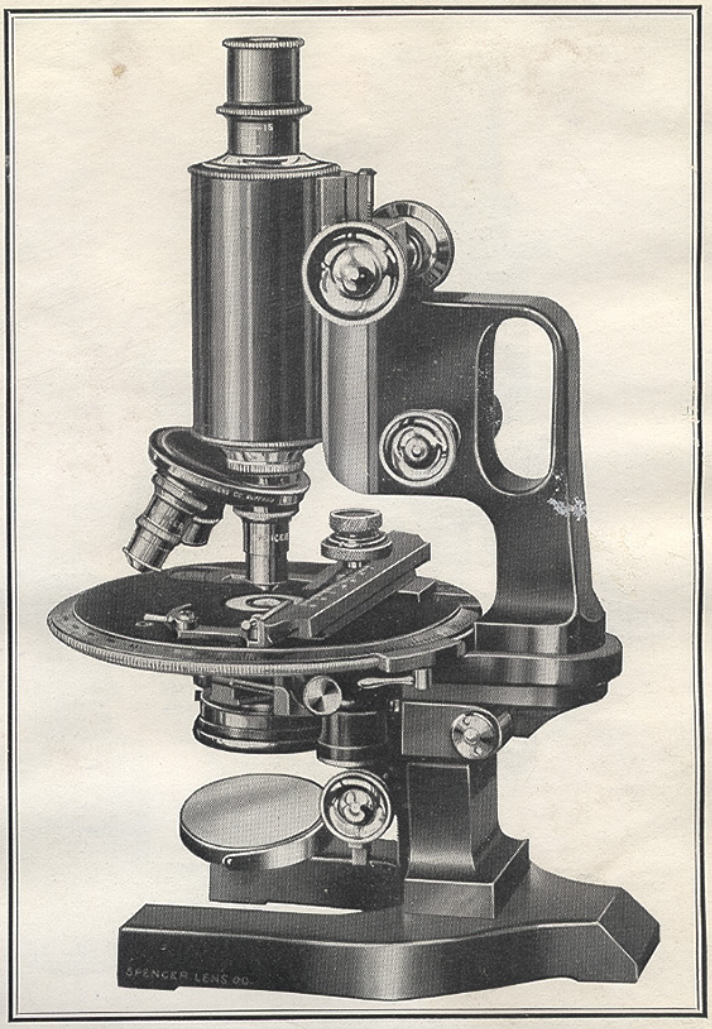
Code	Catalog No.	DESCRIPTION	Price
Nin	9	Stand only, with achromatic condenser, N. A. 1.30, without binocular body, single tube or nosepiece.	$210.00

The following outfits include stand with achromatic condenser, N. A. 1.30, revolving nosepiece carrying the objectives listed and binocular body interchangeable with the single tube. (*Both are included.*)

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Nine	9E	16-4	10-44	10X	$338.75	16-4	10-44	10X	$412.25
Ninf	9F	16-4	10-44	6X-10X	344.75	16-4	10-44	5X-10X	424.75
Ninh	9H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	386.00	16-4-2 Oil-imm.	10-44-82	5X-10X	510.50
Ninj	9J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	401.00				

SPENCER MICROSCOPE NO. 10



A SINGLE tube instrument of the highest type designed to meet the most exacting demands of technicians and trained investigators.

Body Tube of aluminum, 50 millimeters in diameter and so arranged as to permit the use of either standard objectives or special size photo-micrographic objectives for covering large fields without oculars. Has graduated draw tube fitting in cloth-lined sleeve.

Arm—of the original " handle arm " type which has stood the test of many years service; convenient for handling the instrument and very attractive in appearance.

Stage—Revolving type 150 millimeters in diameter with centering screws. Equipped with large mechanical stage. *See complete description, page 68.* Has graduated periphery with clamp and vernier reading to three minutes of arc.

Focusing Adjustments—Diagonal cut rack and pinion and fine adjustment " B." *See description, page 7.*

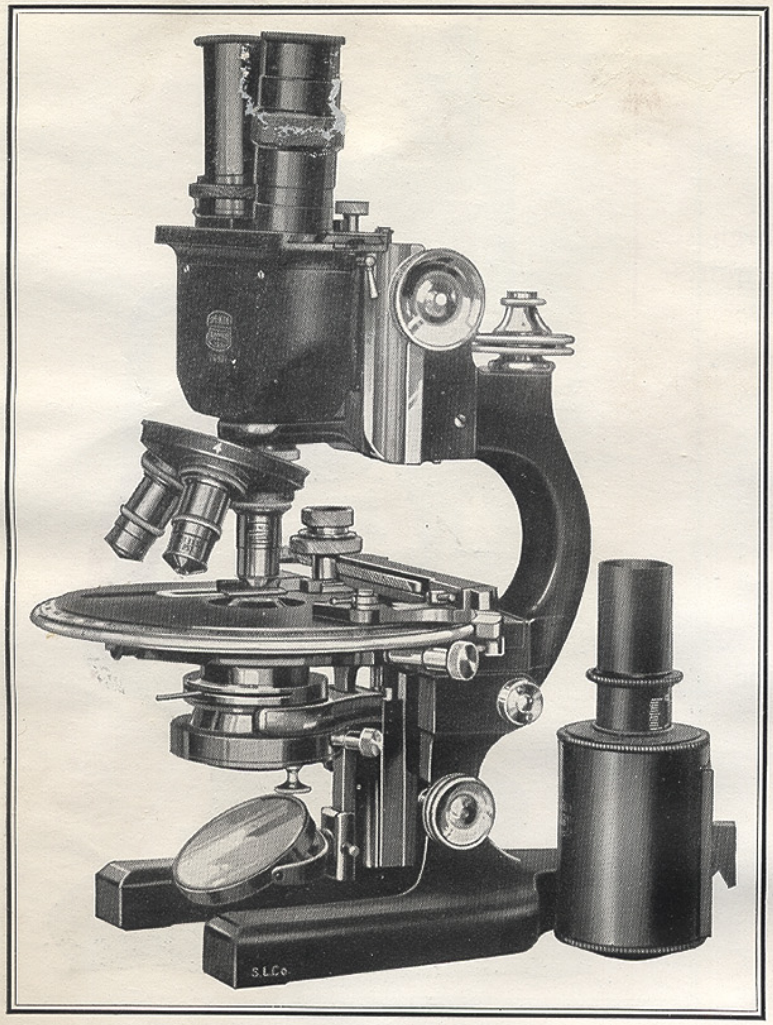
Substage—Complete rack and pinion substage with centering screws for condenser, upper and lower iris diaphragms. Lower diaphragm decenterable by rack and pinion for oblique illumination.

Cabinet—Polished hardwood, with lock and key.

The following outfits include stand with wide angle condenser, N. A. 1.40, and revolving nosepiece suitable for the objectives listed.

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Tene	10E	16-4	10-44	10X	$210.50	16-4	10-44	10X	$278.50
Tenf	10F	16-4	10-44	6X-10X	213.25	16-4	10-44	5X-10X	284.75
Tenh	10H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	255.00	16-4-2 Oil-imm.	10-44-82	5X-10X	370.50
Tenj	10J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	270.00				



SPENCER MICROSCOPE NO. 14

THIS stand is so arranged as to receive the binocular body and single tube interchangeably without removing either nosepiece or objectives. *See page 10.*

BINOCULAR BODY—Spencer standard attachment No. 1 MOB with tubes converging to a point at normal working distance from the eyes. *For complete description and price see page 10.*

SINGLE TUBE—Spencer standard attachment, 50 millimeters in diameter, No. 1 SB Easily interchangeable with the binocular body. *For description and price see page 10.*

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 100 millimeters.

STAGE—Revolving type 150 millimeters in diameter with centering screws. Has clamp and graduated periphery, with vernier reading to three minutes of arc. Equipped with large mechanical stage. *See complete description, page 68.* In addition to the usual features this mechanical stage is provided with supports by which the slide is carried entirely free of the microscope stage so that it is moved about without contact with the stage surface (a feature of considerable importance when oil contact is made between the slide and the condenser).

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "C." *See description, page 7.*

SUBSTAGE—Complete new substage providing for easy manipulation and interchangeability of substage accessories; and insuring stability and permanence of alignment. Focusable by rack and pinion and by *fine adjustment. See complete description, pages 8 and 9.*

CABINET—Polished hardwood, with lock and key.

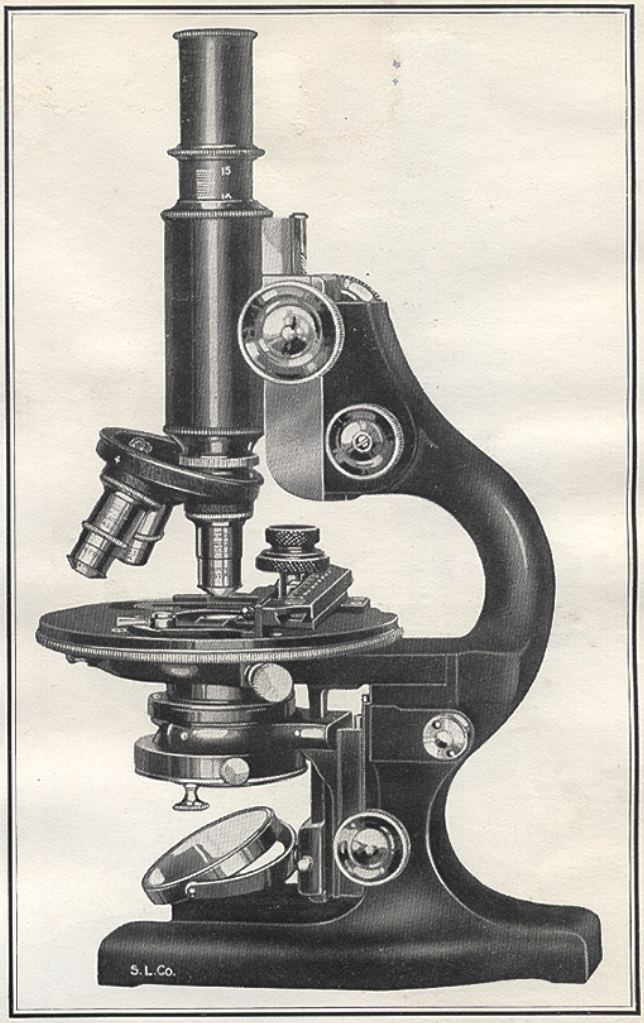
Code	Catalog No.	DESCRIPTION	Price
Onfor	14	Stand only with achromatic condenser, N.A. 1.30, without binocular body, single tube or nosepiece.	$200.00

The following outfits include stand with achromatic condenser, N. A. 1.30, revolving nosepiece carrying the objectives listed and binocular body interchangeable with the single tube. (*Both are included.*)

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Paired Huyg. Oculars	Price	Apochromatic Objectives		Paired Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Onfore	14E	16-4	10-44	10X	$328.75	16-4	10-44	10X	$402.25
Onforf	14F	16-4	10-44	6X-10X	334.25	16-4	10-44	5X-10X	414.75
Onforh	14H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	376.00	16-4-2 Oil-imm.	10-44-82	5X-10X	500.50
Onforj	14J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	391.00				

SPENCER MICROSCOPE NO. 15



A SINGLE tube instrument of the highest grade, meeting the most exacting requirements of advanced laboratory workers.

Body Tube—Of standard size with graduated draw tube fitting in cloth-lined sleeve.

Arm—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

Stage—Revolving type, 120 millimeters diameter with centering screws; regularly supplied with standard size mechanical stage No. 493. *See description, page 68.* May be supplied with plain revolving stage of same diameter at a reduction of $30.00 from list prices given below.

Focusing Adjustments—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

Substage—Complete new substage providing for easy manipulation and interchangeability of substage accessories and insuring stability and permanence of alignment. Focusable by rack and pinion and by *fine adjustment. See complete description, pages 8 and 9.*

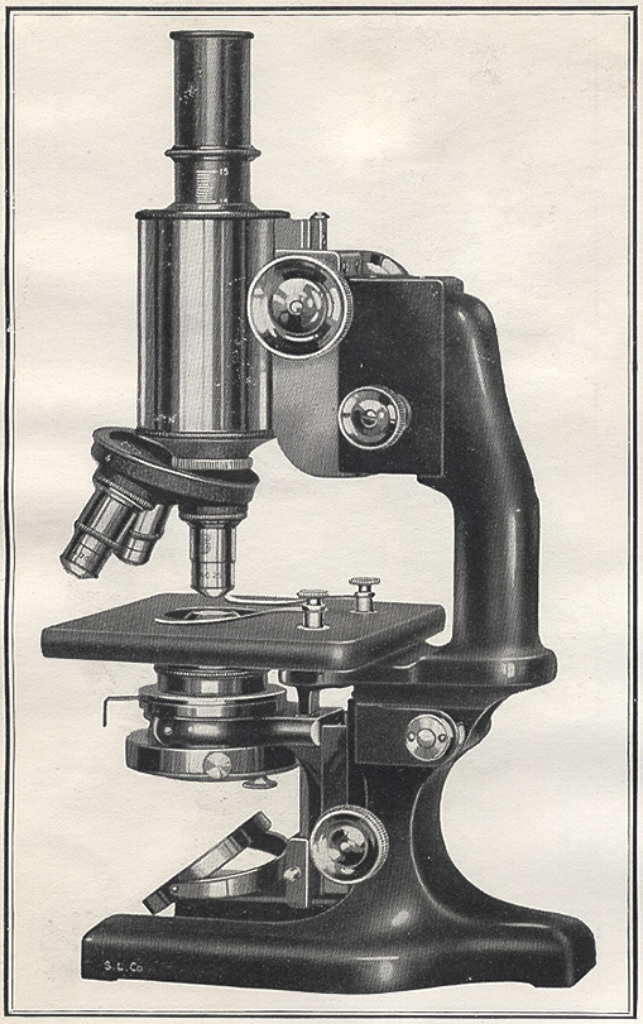
Cabinet—Polished hardwood, with lock and key.

The following outfits include stand with wide angle condenser, N. A. 1.40* and revolving nosepiece suitable for the objectives listed.

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Huyg. Oculars	Price	Apochromatic Objectives		Compens. Oculars	Price
		Equivalent focus mm.	Initial magnifications			Equivalent focus mm.	Initial magnifications		
Onfive	15E	16-4	10-44	10X	$215.50	16-4	10-44	10X	$283.50
Onfivf	15F	16-4	10-44	6X-10X	218.25	16-4	10-44	5X-10X	289.75
Onfivh	15H	16-4-1.8 Oil-imm.	10-44-95	6X-10X	260.00	16-4-2 Oil-imm.	10-44-82	5X-10X	375.50
Onfivj	15J	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	275.00				

* Achromatic condenser N. A. 1.30 may be substituted for the wide angle condenser at an additional cost of $20.50



SPENCER MICROSCOPE NO. 18

THIS is a unique instrument suitable for ordinary visual work or for use in photomicrography or projection, while its exceptional symmetry of design and beauty of finish adapt it especially for the physician's office where dignified appearance as well as utility are matters of prime importance.

The base is large and extra heavy, giving the instrument perfect stability not only in its upright position but placed horizontally for projection or photography.

The arm is of exceptional size and rigidity and is so shaped as to constitute a very convenient handle for carrying the instrument.

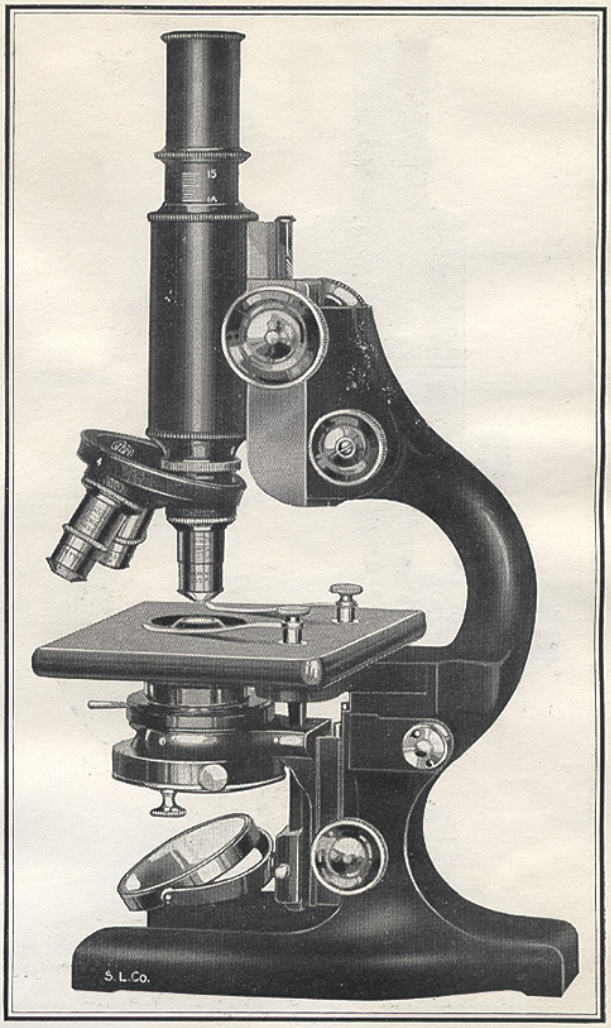
The microscope is equipped with the most carefully fitted diagonal cut rack and pinion and with our sensitive and accurate fine adjustment "D," in which all wear is automatically taken up so that lost motion can not develop even under long continued use. This adjustment is protected by stops which prevent the possibility of turning it beyond its range, while a special safety device by which the mechanism ceases to operate when the objective strikes the slide, effectually protects both the specimen and the objective against damage by forcing the fine adjustment.

The brass body tube is of extra large size, blackened on the inside to prevent reflections. It is finished with beautiful gold lacquer that will not tarnish or discolor. The draw tube is of standard size, graduated and fitted in a cloth lined sleeve, giving perfect freedom of action, excluding all dust from the back of the objective and at the same time retaining its perfect alignment.

All outfits are equipped with a complete substage including a standard substage condenser and iris diaphragm. Objectives are of the highest type, achromatic, mounted on revolving dust-proof nosepieces and accurately par-centralized and par-focalized.

Code	Catalog No.	Substage Condenser	Achromatic Objectives Equivalent focus-mm.	Huyghenian Oculars	Price
Onateh	18H	N. A. 1.20	16-4-1.8 Oil-imm.	6x-10x	$200.00

SPENCER MICROSCOPE NO. 19



AN instrument of the highest grade, meeting the most exacting requirements of advanced laboratory workers.

BODY TUBE—Of standard size with graduated draw tube fitting in cloth-lined sleeve.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout; harder and more durable than rubber; will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical No. 493 stage. *See illustration and list, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

SUBSTAGE—Complete new substage providing for easy manipulation and interchangeability of substage accessories and insuring stability and permanence of alignment. Focusable by rack and pinion and by *fine adjustment*. *See complete description, pages 8 and 9.*

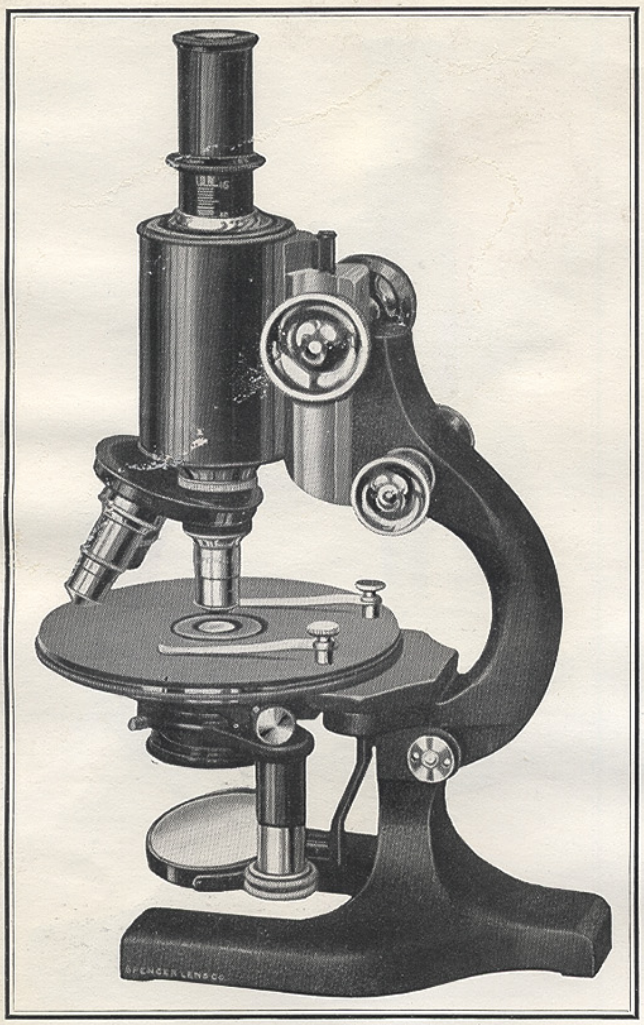
CABINET—Polished hardwood, with lock and key.

The following outfits include stand with wide angle condenser, N. A. 1.40* and revolving nosepiece suitable for the objectives listed.

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Huyg. Oculars	Price	Apochromatic Objectives		Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Onnine	19E	16-4	10-44	10X	$165.50	16-4	10-44	10X	$233.50
Onninf	19F	16-4	10-44	6x-10X	168.25	16-4	10-44	10X-15X	239.75
Onninh	19H	16-4-1.8 Oil-imm.	10-44-95	6x-10X	210.00	16-4-2 Oil-imm.	10-44-82	10X-15X	325.50
Onninj	19J	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	225.00				

*Achromatic condenser N. A. 130 may be substituted for the wide angle condenser at an additional cost of $20.50



SPENCER MICROSCOPE NO. 24

A FIRST class instrument at moderate price, suitable for photo-micrographic as well as advanced laboratory work.

Body Tube—Of aluminum, fifty millimeters in diameter and so arranged as to permit the use of either standard objectives or special size photo-micrographic objectives for covering large fields without oculars. Has graduated draw tube, fitting in cloth-lined sleeve.

Arm—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm, 93 millimeters.

Stage—Revolving type 120 millimeters in diameter with centering screws; may be equipped with standard size mechanical stage No. 493. *See description, page 68.*

Focusing Adjustments—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

Substage—Of standard "quick screw" form, with screws for centering the condenser.

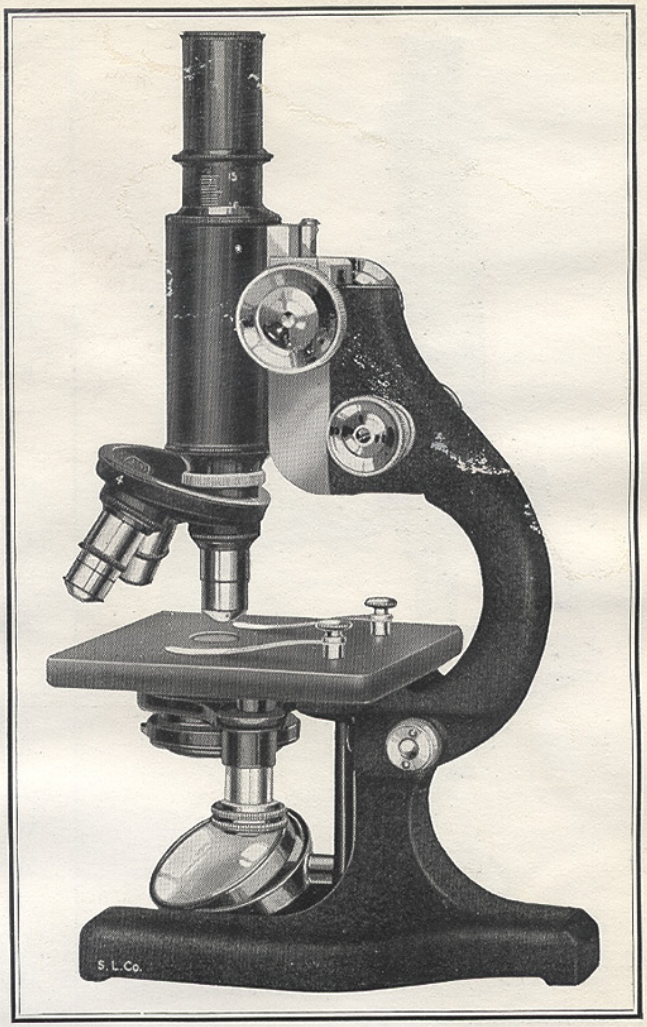
Cabinet—Polished hardwood, with lock and key.

The following outfits include stand with wide angle condenser, N. A. 1.40, and revolving nosepiece suitable for the objectives listed.

Catalog numbers and code words refer to achromatic objectives with huyghenian oculars. If apochromatic objectives and compensating oculars are required, prefix "apo" to catalog number or code word.

Code	Catalog No.	Achromatic Objectives		Huyg. Oculars	Price	Apochromatic Objectives		Compens. Oculars	Price
		Equivalent focus-mm.	Initial magnifications			Equivalent focus-mm.	Initial magnifications		
Tofore	24E	16-4	10-44	10X	$ 95.50	16-4	10-44	10X	$163.50
Toforf	24F	16-4	10-44	6x-10X	98.25	16-4	10-44	5x-10X	169.75
Toforh	24H	16-4-1.8 Oil-imm.	10-44-95	6x-10X	140.00	16-4-2 Oil-imm.	10-44-82	5x-10X	255.50
Toforj	24J	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	155.00				

SPENCER MICROSCOPE NO. 25



A FIRST class instrument at moderate price; especially designed for those who prefer, for routine laboratory work, a fine adjustment as slow as is usually employed in more strictly research microscopes.

BODY TUBE—Of standard size with graduated draw tube fitting in cloth-lined sleeve.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout, harder and more durable than rubber; will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 68.*

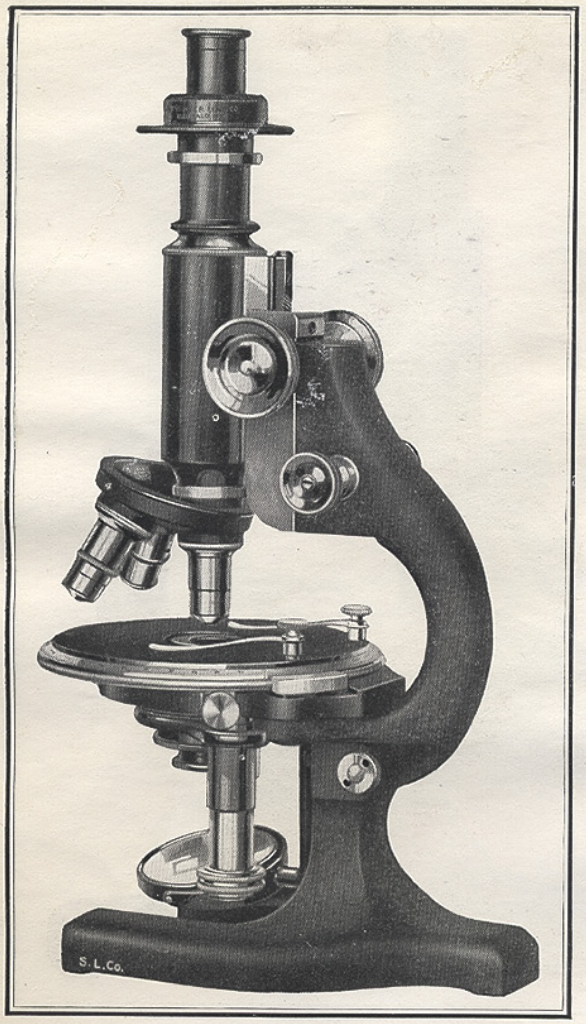
FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "B." *See description, page 7.*

SUBSTAGE—Of standard "quick screw" form with condenser permanently centered.

CABINET—Polished hardwood, with lock and key.

The following outfits include revolving nosepiece suitable for carrying the objectives listed.

Code	Catalog No.	Substage Condenser N. A. 1.20	Achromatic Objectives		Huyghenian Oculars	Price
			Equivalent focus-mm.	Initial magnifications		
Tofivb	25B	Not included	16-4	10-44	10X	$ 77.75
Tofivd	25D	Not included	16-4	10-44	6X-10X	80.50
Tofive	25E	Included	16-4	10-44	10X	90.25
Tofivf	25F	Included	16-4	10-44	6X-10X	93.00
Tofivh	25H	Included	16-4-1.8 Oil-imm.	10-44-95	6X-10X	130.00
Tofivj	25J	Included	16-4-2 Oil-imm. Fluorite	10-44-82	6X-10X	145.00



SPENCER CHEMICAL MICROSCOPE NO. C42

THIS instrument is designed primarily for use in the *chemical laboratory* and is regularly equipped with the accessories required for chemical work, but it is entirely satisfactory for any work where a high-grade compound microscope is required. The optical equipment is of Spencer standard quality and serves equally well for use in either the chemical, biological or bacteriological laboratory.

BODY TUBE—Of standard size with graduated draw tube fitting in cloth-lined sleeve.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulating large objects; the distance from center of stage to arm is 93 millimeters.

STAGE—Revolving type, 120 millimeters in diameter, with centering screws. The periphery is graduated to single with vernier reading to three minutes. Can be supplied with standard size mechanical stage No. 493 at an addition of $30.00 to list prices given below. *See description of revolving mechanical stages, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "D." *See description, page 7.*

SUBSTAGE—Of standard "quick screw" form.

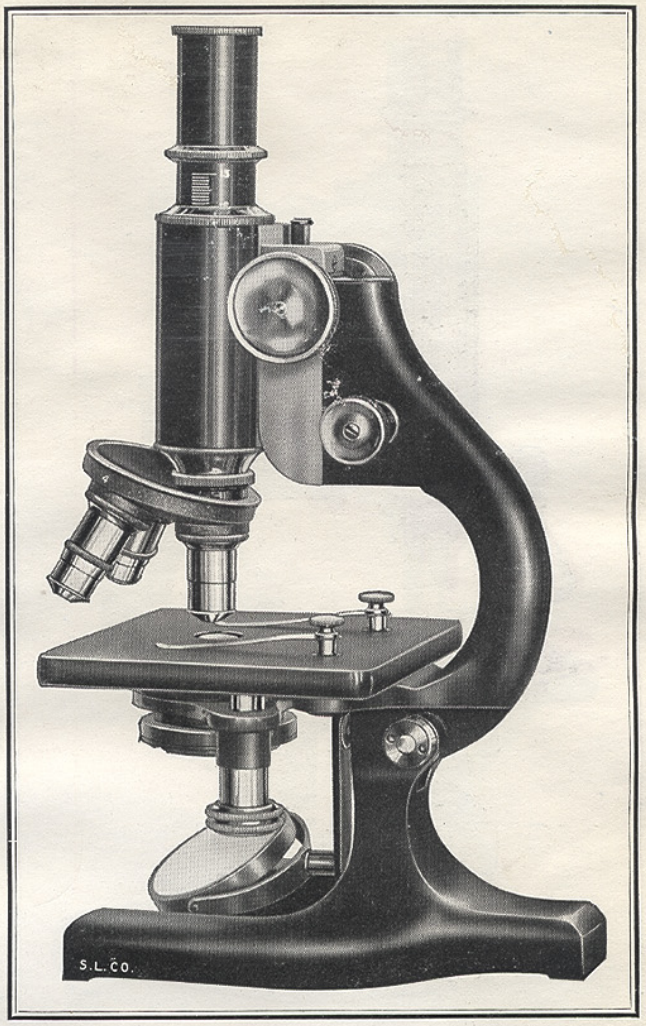
CABINET—Polished hardwood, with lock and key.

The following outfits include revolving nosepieces* suitable for carrying the objectives listed, *analyzer "B," polarizer "B,"* and *substage condenser*. The two latter attachments are readily interchangeable in the substage ring. If the instrument is desired with either condenser or polarizer and analyzer omitted, deductions may be made according to the price of omitted parts. *See pages 54 and 70.*

Telegraph Code	Catalog No.	Achromatic Objectives		Cross Hair Oculars	Price
		Equivalent Focus-mm.	Initial Magnification		
Cfortof	C42F	16-4	10-44	6x-10x	$157.00
Cfortog	C42G	16-8-4-1.8 Oil-imm.	10-20-44-95	6x-10x	213.00
Cfortoh	C42H	16-4-1.8 Oil-imm.	10-44-95	6x-10x	197.00
Cfortoj	C42J	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10x	212.00
Cforton	C42N	32-16-4	4-10-44	6x-10x	163.50

*If objectives are preferred with short mounts and quick changing rings for use with vertical illuminators, they are so supplied instead of with nosepieces—No change in price. See page 31.

SPENCER MICROSCOPE NO. 44



THIS is the most popular of all Spencer instruments for routine work in the laboratory of the hospital, medical school or general practitioner. It is simple in design, durable in construction, and entirely adequate for all standard requirements.

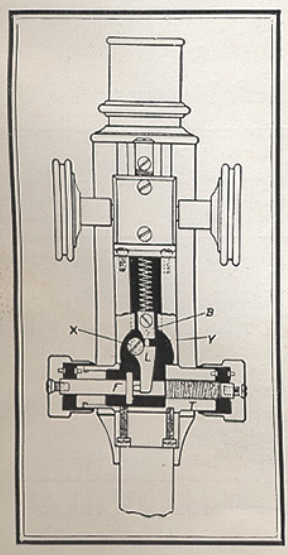
BODY TUBE—Of standard size with graduated draw tube fitted in cloth-lined sleeve.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulating large objects; the distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout; harder and more durable than rubber; will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment. This adjustment is one of the simplest, most durable and most responsive that has ever been offered on any microscope at any price.

A screw, S, works through a nut, T, moving to the right or left according to the direction of rotation. A steel flange, F, constitutes an integral part of the screw axis and moves with it. When the direction of rotation is such as to carry the screw toward the right in the illustration, the lever, L, is swung about its axis, X, raising the block, B, which is attached to the body tube. The reverse motion carries the flange away from the lever permitting it to swing back under the influence of the coiled spring, as shown in the figure. In this adjustment, it will be noted, *First:* that the force of the screw is applied in the upward direction only so that the objective can not be driven through the specimen; *Second:* that all wear is automatically taken up by the spring, so that lost motion *can not* develop even with long use; and *Third:* that the thread of the screw actuating the lever is engaged throughout its entire length and clear around.

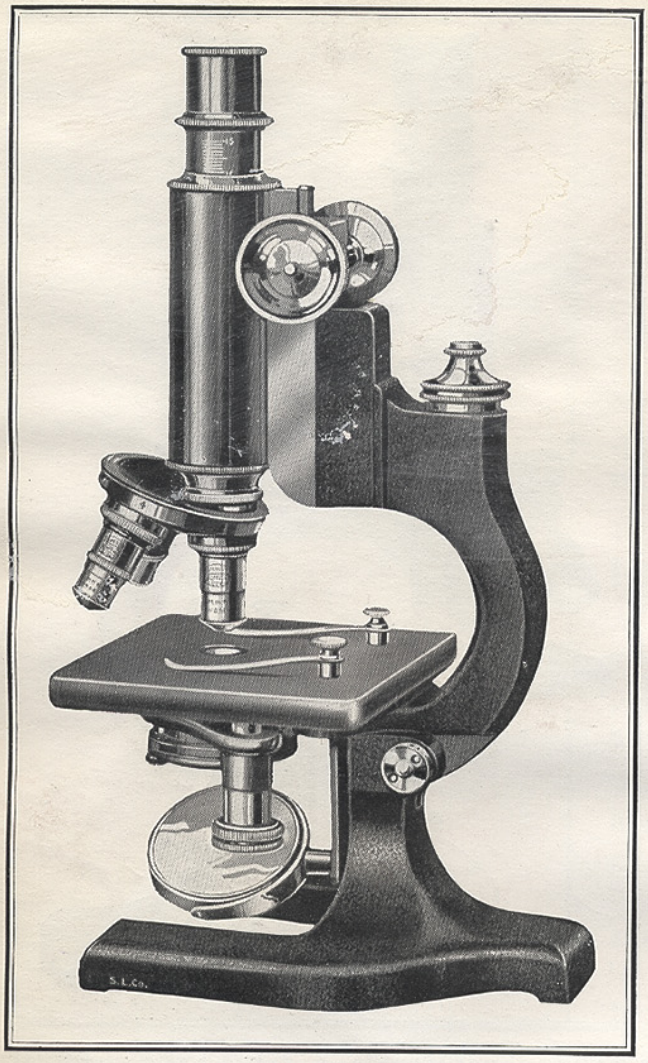


SUBSTAGE—Of standard "quick screw" form with condenser permanently centered.

CABINET—Polished hardwood, with lock and key.

The following outfits include revolving nosepieces suitable for carrying the objectives listed.

Telegraph Code	Catalog No.	Substage Condenser N.A. 1.20	Achromatic Objectives		Huyghenian Oculars	Price
			Equivalent Focus-mm.	Initial Magnification		
Fortiforb	44B	Not included	16-4	10-44	6x	$ 77.75
Fortiford	44D	Not included	16-4	10-44	6x-10x	80.50
Fortifore	44E	Included	16-4	10-44	10x	90.25
Fortiforf	44F	Included	16-4	10-44	6x-10x	93.00
Fortiforh	44H	Included	16-4-1.8 Oil-imm.	10-44-95	6x-10x	130.00
Fortiforj	44J	Included	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10x	145.00



SPENCER
MICROSCOPE NO. 45

A THOROUGHLY established and highly satisfactory instrument, appreciated by those who, in spite of the popularity of the side fine adjustment, still prefer to use the older design.

Body Tube—Of standard size with graduated draw tube fitting in cloth-lined sleeve.

Arm—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

Stage—Rectangular, 110 x 105 millimeters; of new composition, solid throughout; harder and more durable than rubber, will not fade or warp. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 68.*

Focusing Adjustments—Diagonal cut rack and pinion and fine adjustment "C." *See description, page 7.*

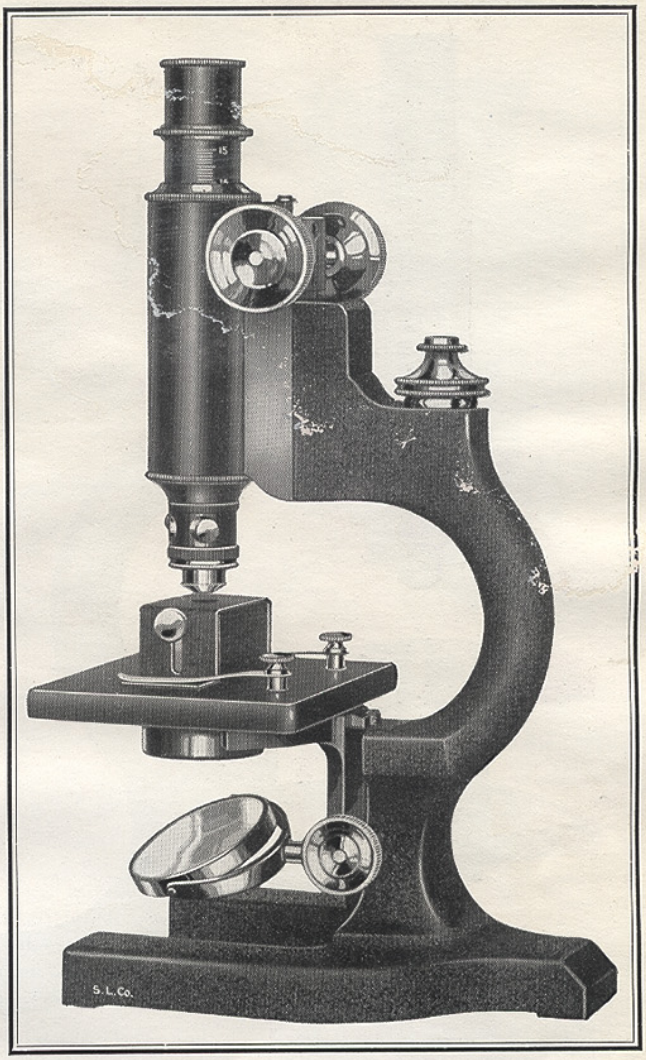
Substage—Of standard "quick screw" form, with condenser permanently centered.

Cabinet—Polished hardwood, with lock and key.

The following outfits include revolving nosepieces suitable for carrying the objectives listed.

Telegraph Code	Catalog No.	Substage Condenser N. A. 1.20	Achromatic Objectives		Huyghenian Oculars	Price
			Equivalent focus-mm.	Initial magnification		
Forfivb	45B	Not included	16-4	10-44	6x	$ 77.75
Forfivd	45D	Not included	16-4	10-44	6x-10x	80.50
Forfive	45E	Included	16-4	10-44	10x	90.25
Forfivf	45F	Included	16-4	10-44	6x-10x	93.00
Forfivh	45H	Included	16-4-1.8 Oil-imm.	10-44-95	6x-10x	130.00
Forfivj	45J	Included	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10x	145.00

SPENCER METALLURGICAL MICROSCOPE NO. 49



THIS instrument is designed especially to be used with vertical illuminators for the examination of opaque objects, but it can be readily adjusted for examining transparent specimens using the substage mirror; also for use with polarizer and analyzer.

BODY TUBE—Of standard size with graduated draw tube fitting in cloth-lined sleeve.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout; harder and more durable than rubber; will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage No. 493. *See illustration and list, page 67.* A rack and pinion movement is provided by which the stage is adjusted vertically through a distance of 45 millimeters, thus providing ample range for focusing on specimens of exceptional thickness or for bringing objects into focus without disturbing the relation between the vertical illuminator and the light source. A frame with an adjustable support for holding small specimens is included.

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "C." *For description see page 7.*

SUBSTAGE—Consists of a simple ring of standard size for receiving a polarizer or other substage accessories.

Prices indicated in the following list include a vertical illuminator, either No. 350 or 355. If illuminator No. 357, with electric light attached, is required, add $20.00 to the list price. *For description of vertical illuminators see page 61.*

All objectives are provided in short mounts and corrected for use without covers.

Furnished in hardwood cabinet, with lock and key.

Code	Catalog No.	Achromatic Objectives		Huyghenian Oculars	Price
		Equivalent focus mm.	Initial magnifications		
Fornina	49A	16-4	10-44	10X	$116.50
Forninc	49C	16-4	10-44	6X-10X	119.25
Forninl	49L	32-16-4	4-10-44	6X-10X	125.75

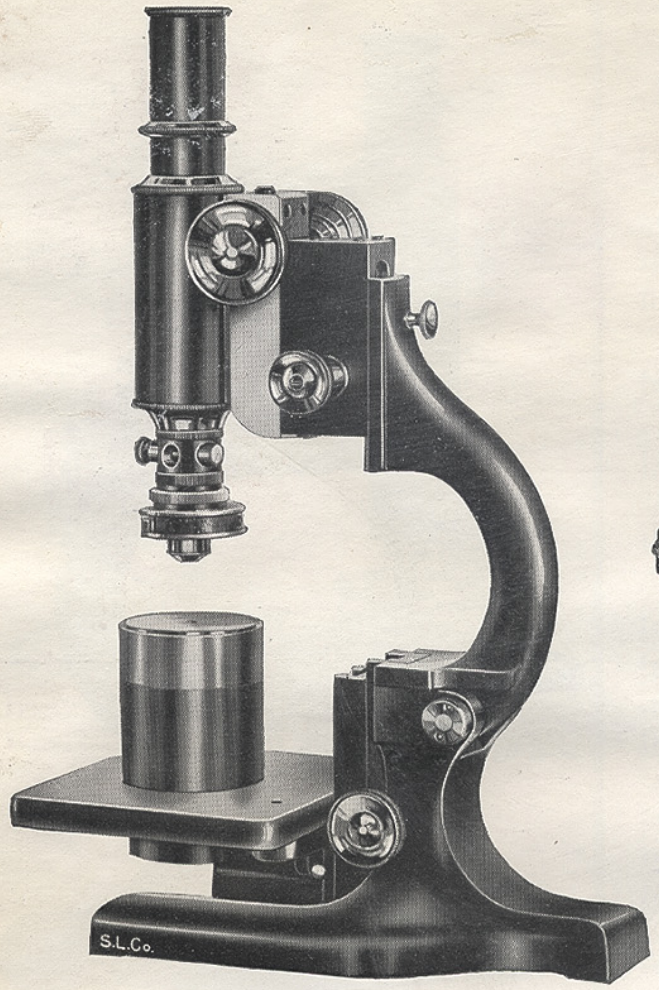


Fig. 1

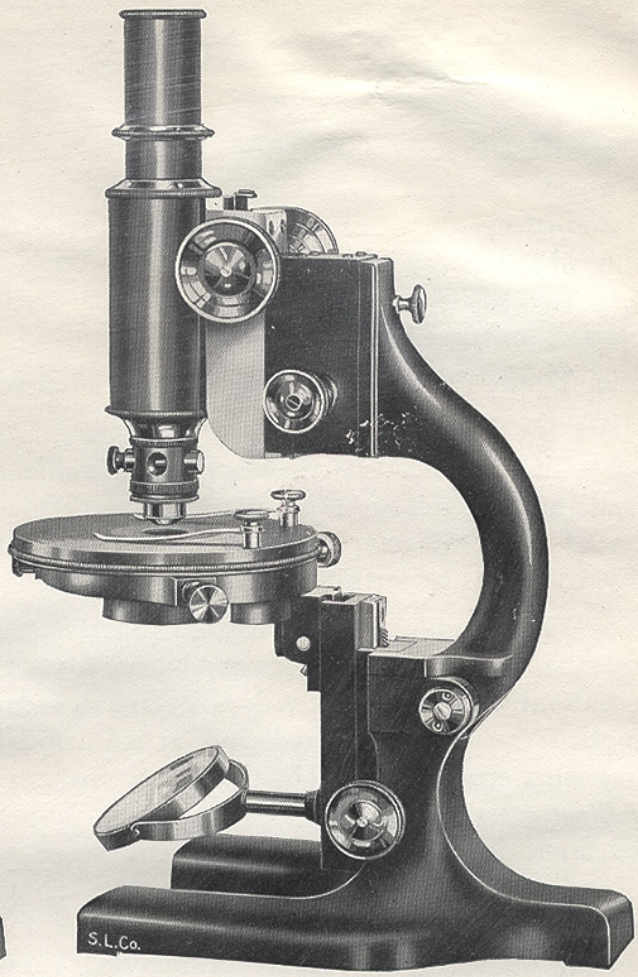


Fig. 2

SPENCER MICROSCOPES NOS. 46 and 48

IN these instruments we offer an exceptionally adaptable set of interchangeable parts, capable of being combined into a wide range of instruments. A standard part, consisting of a base, with arm attached by inclination joint, carries a rack and pinion unit equipped with a substage mirror, and capable of receiving either the circular or the rectangular stage. When equipped with the square stage it becomes microscope No. 46. With the revolving circular stage it is listed under No. 48.

In either microscope, No. 46 or No. 48, the block carrying the tube, with rack and pinion and fine adjustments, is removable, and may be replaced by a smiliar block carrying the binocular body, identical with that of binocular microscope No. 54, described on pages 32 to 35.

A small stand, without stage, but designed to focus the microscope on the surface supporting the stand, is capable of receiving either the single tube, with its coarse and fine adjustments, or the binocular body above indicated.

Figure 1 illustrates microscope No. 46, with the stage lowered in its block, and the part carrying the single tube, with adjustments raised on the stand, resulting in an operating distance sufficient to permit the placing of large objects on the stage. In this figure also is shown our new, quick-changing device, for the interchange of the several objectives, all of which, when supplied with metallurgical microscopes, are mounted in short mounts.

Figure 2 shows how the stage may be raised to bring its surface close to the objective, even though the latter is used direct in the vertical illuminator, without the interposition of any changing device.

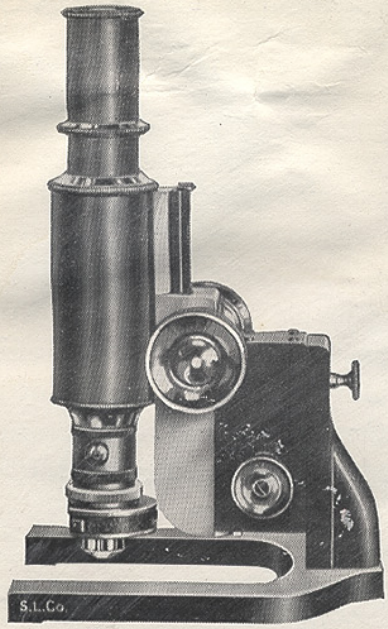
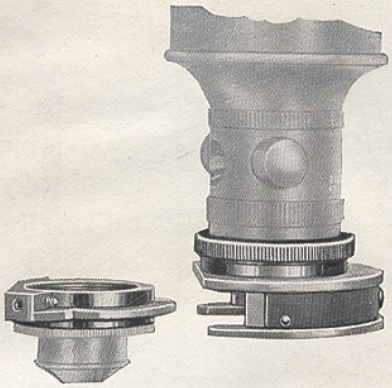


Fig. 3



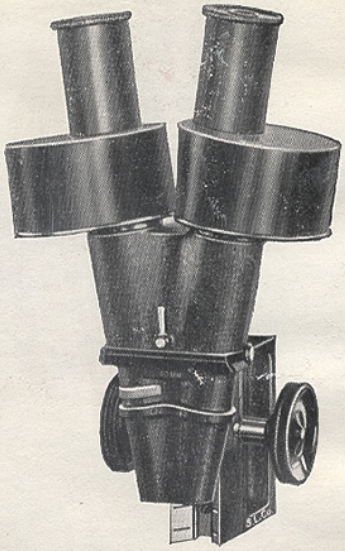


Fig. 4

Figure 3 illustrates the small stand, with single tube, having a vertical illuminator and objective changer in position. It will be noted that the range of the rack and pinion adjustment is sufficient to permit the focusing of the objective on the surface of the table, either with or without the objective changer.

Figure 4 shows the binocular body above referred to, which is attachable to the stand of either No. 46 or No. 48, or to the small stand, No. 46S.

The outfits tabulated below include the large stand, with rectangular or circular stage, as indicated by the number, and with vertical illuminator, either No. 350 or No. 355. They can be supplied with vertical illuminator with electric light attached, No. 357. For description of vertical illuminators *see page 60*. The binocular body is not included in the list, but may be added as an accessory to any stand. For prices of binocular body objectives and oculars *see pages 32 to 35*.

Telegraph Code	Catalog No.	Achromatic Objectives		Huyghenian Oculars	Price
		Equivalent Focus mm.	Initial Magnification		
Forsixa	46A	16-4	10-44	10X	$137.00
Forsixc	46C	16-4	10-44	6X-10X	139.75
Forsixl	46L	32-16-4	4-10-44	6X-10X	146.25
Foratea	48A	16-4	10-44	10X	$152.00
Foratec	48C	16-4	10-44	6X-10X	154.75
Foratel	48L	32-16-4	4-10-44	6X-10X	161.25

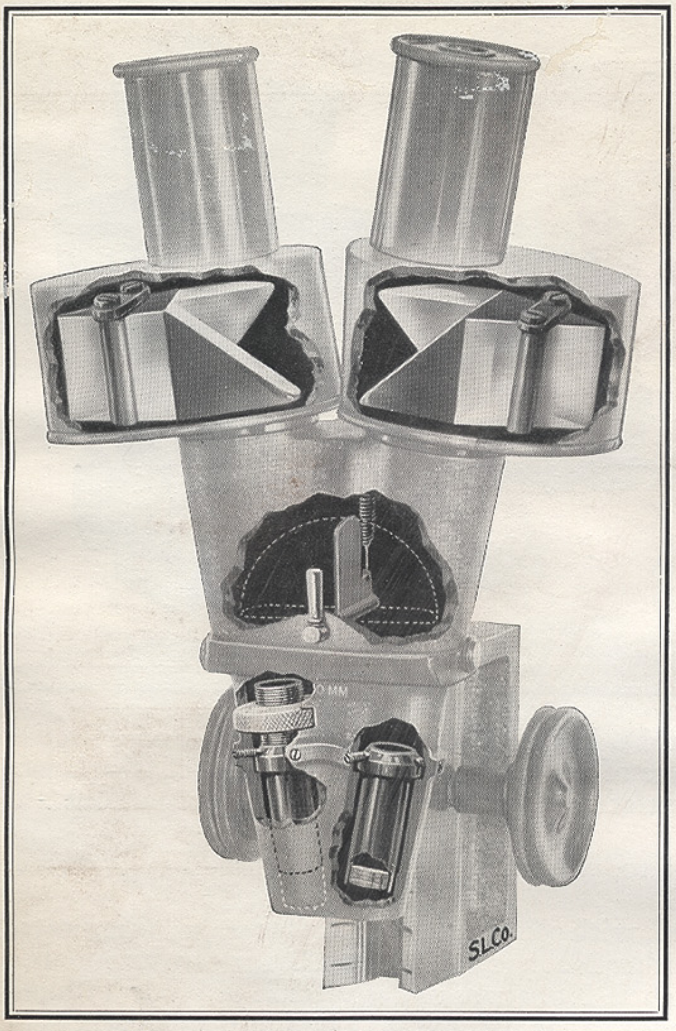
Cat. No. 46S—Small stand only, without case $4.00

SPENCER NEW QUICK-CHANGE OBJECTIVE CARRIER

THIS attachment provides a means of quickly interchanging any number of objectives on the body tube.

A receptacle with society thread is screwed into the tube. Into this fits a ring, carrying the objectives. Centering screws are provided, by which each ring can be adjusted to bring its objective to exact position, which is retained by spring plungers in the receptacle fitting into recesses in the ring.

Telegraph Code	Cat. No.	DESCRIPTION	Price
Forsixto	462	Receptacle for objective ring	$8.00
Forsixthre	463	Objective ring	3.00



BINOCULAR DISSECTING MICROSCOPES

THE binocular dissecting microscope, consisting of two complete optical systems converging to a common focal point, reveals small objects in a *true perspective* which is absolutely unattainable with any monocular or single tube instrument and is, therefore, especially suitable for the examination of uneven metal surfaces, small crystals, precious stones, fibers and textiles, seeds, moulds, insects and insect parts, embryos; in fact, anything in which relatively high magnification is required while still retaining an appearance of solidity.

Furthermore, these instruments are equipped with a set of porro-prisms or "erecting body" in each system which serve to "erect" the image instead of showing it inverted as in ordinary compound microscopes. The advantages of this system are very obvious in making fine dissections since all movements of dissecting instruments are seen in their true directions, not reversed.

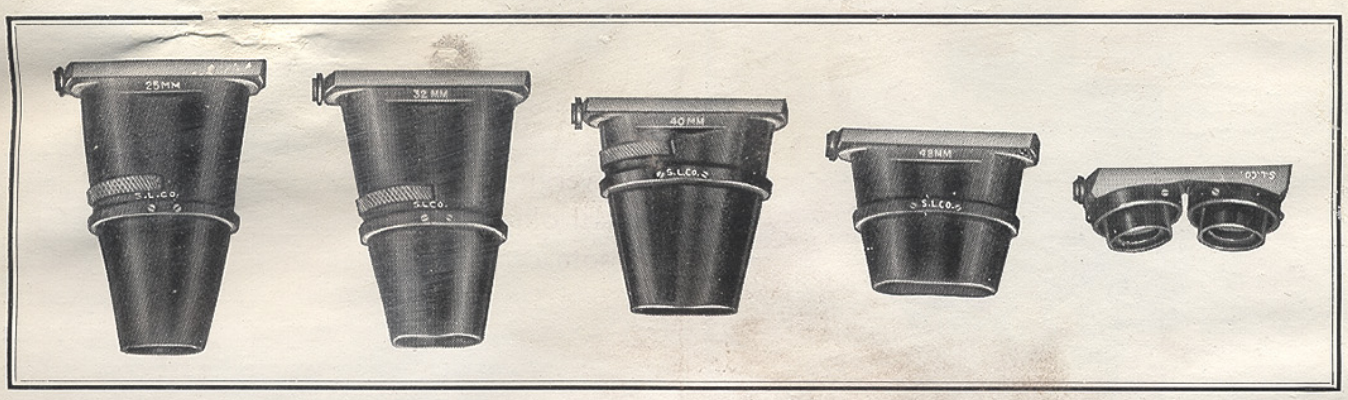
The prisms are constructed from the highest grade of glass; absolutely homogeneous and free from strain, ground to mathematically correct forms and polished optically plane. By a new process of mounting they are held in place in metal supports that remove practically all danger of their coming loose or getting out of alignment.

All our binocular microscopes are equipped with shutters by means of which the light to either eye may be stopped out, enabling the operator more easily to determine the correct position of the oculars for his interpupillary distance; to manipulate the substage mirror for directing light into each system and to focus for one eye independently of the other. The shutter is so designed that while either tube may be stopped at will, both can not be stopped at the same time and when released both tubes are always open, avoiding any possibility of confusion due to one tube being left accidentally closed.

Adjustment for interpupillary distance is very easily accomplished and has a range sufficient to accommodate the most extreme variation of separation.

Objectives are interchanged on the binocular body by sliding in bronze bearings with screw stops that insure absolute uniformity of position.

SPENCER PAIRED OBJECTIVES

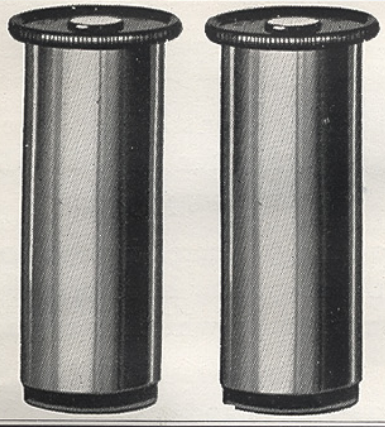


SPENCER paired objectives are supplied in patented mounts in which the two objectives are encased in a solid metal sheath (*see illustration, page 32*), completely protecting them against the improper handling that results in decentering. They are centered within the mount by substantial screws available from the outside and of such size as to insure absolute rigidity. All objectives are mounted on brass plates, accurately fitted to slide-ways in the binocular body. They will not corrode or get sticky with long use and they insure absolute uniformity of position of the objectives. A collar is provided for focusing one objective independently of the other on 40, 32 and 25 millimeters objectives.

PRICES—PAIRED OBJECTIVES IN PATENTED UNIT MOUNT

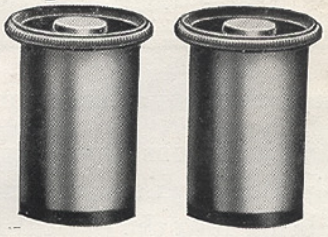
Catalog No.	100P	101P	102P	104P	107P	107 PL*
Equiv. Focus-mm.	55	48	40	32	25	25
Price per pair	$18.00	$18.00	$20.00	$20.00	$20.00	$25.00

*Water Immersion



PAIRED OCULARS

These oculars are matched with special care to insure absolutely identical magnification and afford complete freedom from eye strain.

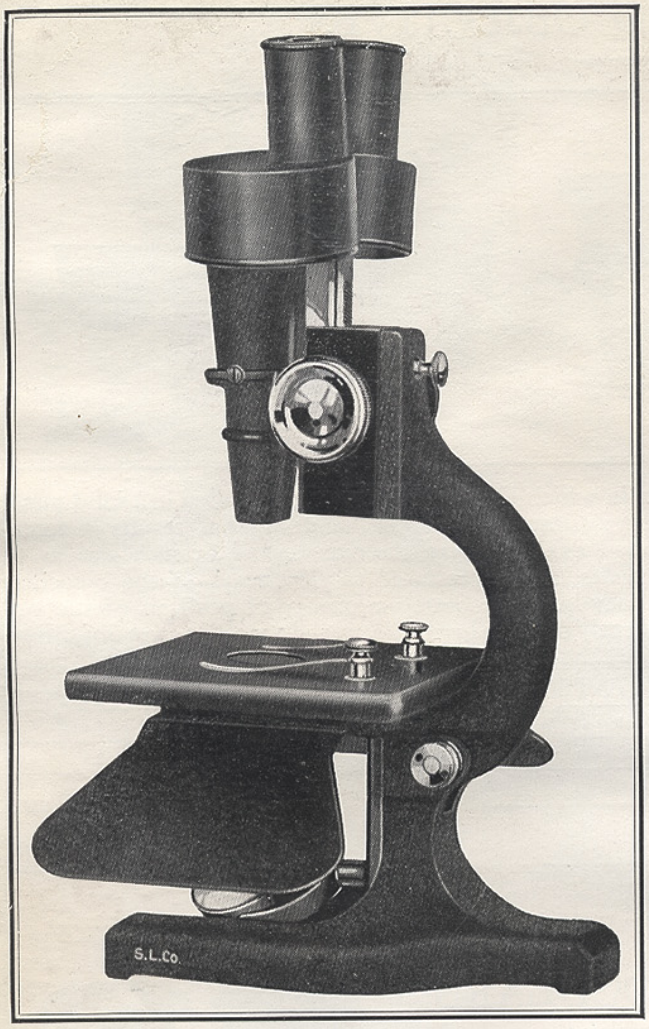


PRICES—PAIRED OCULARS

	Huyghenian						Planoscopic	
Catalog No.	134P	136P	138P	140P	142P	144P	179P	180P
Power	4X	5X	6X	8X	10X	12X	15X	20X
Price per pair	$5.50	$5.50	$5.50	$5.50	$5.50	$5.50	$11.00	$11.00

TABLE OF MAGNIFICATION—BINOCULAR MICROSCOPES

Objectives	Oculars							
	4X	5X	6X	8X	10X	12X	15X	20X
55mm.	8	10	12	15	19	22	27	38
48mm.	11	12	15	21	25	29	36	58
40mm.	13	18	22	27	34	40	51	68
32mm.	20	24	29	35	46	52	69	92
25mm.	30	37	45	60	74	90	117	148



SPENCER BINOCULAR MICROSCOPE NO. 54

THIS is Spencer's original model modified and improved by the addition of an inclination joint and by slight changes in the form of the stand, which have added to its symmetry. The growing popularity of this instrument attests the fact that it meets the requirements of a wide range of scientists, while its moderate cost makes it available as part of the average laboratory equipment.

The block carrying the binocular body with its rack and pinion adjustment is grooved to fit a suitable receptacle on the arm of the stand, where it is held firmly in place by a single thumb screw at the back. Loosening this thumb screw permits the vertical adjustment of the block through a range of about 37 millimeters, thus increasing the range of adjustment to permit the focusing on thick specimens or on insects mounted on upright pins, etc., or the block may be entirely removed for use on stands 54S and 54T. *See page 35.*

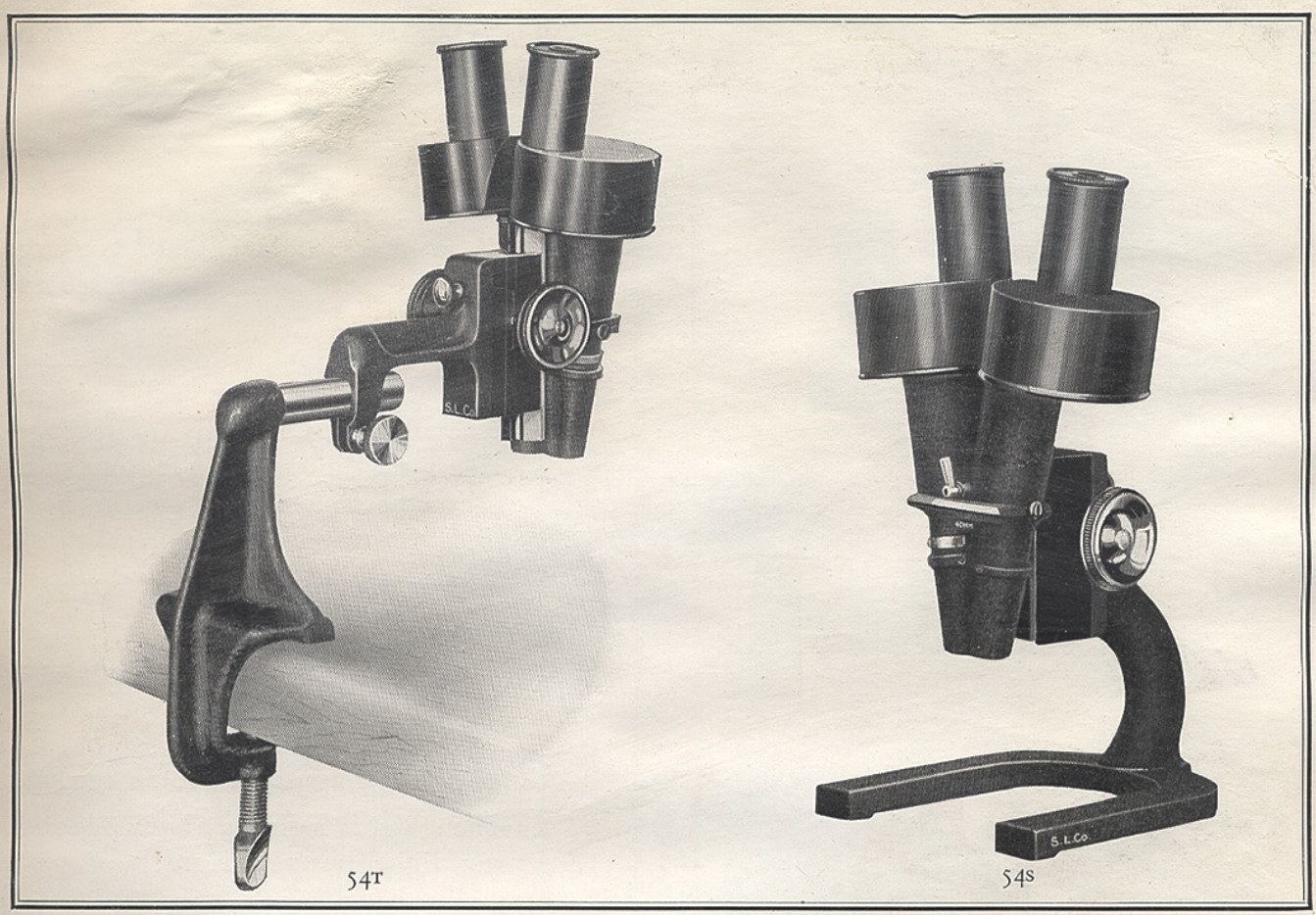
¶ The binocular body is Spencer standard attachment with ample adjustment for pupillary distance and convenient shutter for stopping of either optical system. *See description, page 32.*

The dimensions of the stage are 110 x 105 millimeters. The central opening, covered by a removable disc, is 31 millimeters in diameter. A revolvable disc beneath the stage may be so placed as to bring into the optical axis either an unobstructed opening, a translucent, a white or a black back ground.

Standard hand rests, as shown in the illustration, are included. Extra-sized hand rests, reaching to the level of the table, may be substituted at an addition of $1.00 to the list price. Furnished hardwood cabinet, with lock and key.

Outfits listed in the following tabulation are to be regarded only as suggestions. Substitutions in equipment may be made as required. For prices of optical parts see page 33.

Telegraph Code	Catalog No.	Paired Objectives Equiv. Foc.-mm.	Paired Huyghenian Oculars	Price
Fivfora	54A	40	10X	$111.00
Fivforb	54B	48, 32	6x, 10x	134.50
Fivforc	54C	55, 40, 25	4x, 6x, 10x	160.00
Fivford	54D	55, 48, 32, 25	4x, 6x, 10x	178.00
Fivfore	54E	55, 48, 40, 32, 25	4x, 6x, 10x	198.00



54T 54S

SPENCER BINOCULAR MICROSCOPES NOS. 54S and 54T

THE two stands illustrated on this page may be purchased either as accessories for microscope No. 54, or complete as illustrated. As accessories for No. 54 they constitute very inexpensive and convenient additions.

The binocular body, with rack and pinion block used on these stands is identical with that of No. 54, and is easily interchangeable among either stands No. 54, No. 54S or No. 54T.

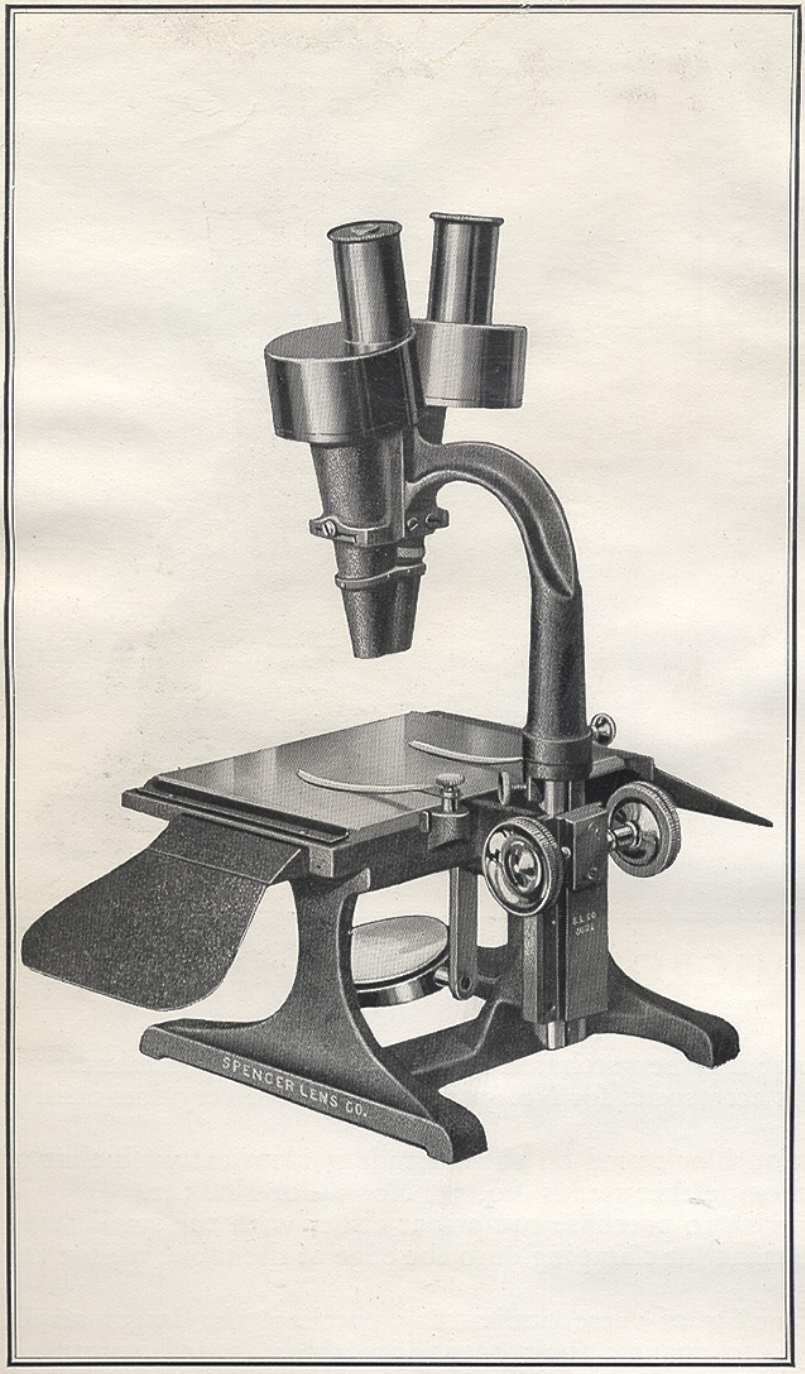
For the convenience of those who may wish to purchase equipment either with the small stand for use on the surface of the table or the stand for clamping onto the edge of the table, we list the following complete outfits.

It will be observed that possessors of either of these outfits may purchase the larger stand, No. 54, as listed on the previous page, to convert their outfit into the standard instrument listed under that number.

Combinations of objectives and eyepieces listed under the several letters are in the nature of suggestions only, but any selection of optical equipment may be chosen as required. *For prices of objectives and oculars see page 33.*

Telegraph Code	Catalog No.	Price	Equipment		Telegraph Code	Catalog No.	Price
			Paired Objectives	Paired Oculars			
Fivforsa	54SA	$ 96.00	40	10X	Fivforta	54TA	$100.00
Fivforsb	54SB	119.50	48-32	6x-10X	Fivfortb	54TB	123.50
Fivforsc	54SC	145.00	55-40-25	4x-6x-10X	Fivfortc	54TC	149.00
Fivforsd	54SD	163.00	55-48-32-25	4x-6x-10X	Fivfortd	54TD	167.00
Fivforse	54SE	183.00	55-48-40-32-25	4x-6x-10X	Fivforte	54TE	187.00

Cat. No. 54S—Small stand only, without case . . . . . $ 4.00
Cat. No. 54T—Clamp Stand only, without case 8.00
Binocular body in case 66.50



SPENCER BINOCULAR MICROSCOPE NO. 57

THE special features of this instrument are: the large plate glass stage provided with white and black backgrounds, the "gooseneck" arm which permits the examination of objects in deep dishes and the fact that the binocular body is easily interchangeable with an arm carrying our ordinary dissecting lenses or erecting body No. 87, thus making it virtually two microscopes in one. *See illustration of No. 80, page 45.*

Binocular body and objectives are Spencer standard parts. *See description and specifications, pages 32 and 33.*

The plate glass stage is 142 x 100 mm.

The stand is a single aluminum casting, light, but very rigid.

Metal hand rests, as illustrated, are included. Extra sized hand rests, reaching to the table, may be substituted for those illustrated at an additional cost of $1.00 per pair.

Suggested outfits are listed under "A," "B," "C," etc., but any combination of objectives and eyepieces will be supplied as required. *For list of objectives and eyepieces see page 32.*

Furnished in hardwood cabinet, with lock and key.

Code	Catalog No.	Paired Objectives Equivalent focus-mm.	Paired Huyghenian Oculars	Price
Fivseva	57A	40	10X	$112.00
Fivsevb	57B	48, 32	6x-10X	135.50
Fivsevc	57C	55, 40, 25	4x-6x-10X	161.00
Fivsevd	57D	55, 48, 32, 25	4x-6x-10X	179.00
Fivseve	57E	55, 48, 40, 32, 25	4x-6x-10X	199.00

Binocular body and arm, no objectives or oculars, without case $52.50

Combination base and stage, in case 36.00

SPENCER CONVERTIBLE BINOCULAR MICROSCOPE NO. 58

THIS instrument meets every demand that can be put upon a dissecting binocular microscope. Its adaptability and utility have not been equalled.

Figure 1 illustrates the instrument with the jointed arm adjusted in the form of an elbow placing the binocular body over the center of the stage.

The stage, 127 x 114 millimeters in size, consists of a metal frame-work into which may be slipped a black composition plate carrying black, white, and translucent backgrounds, or an accurately fitted piece of plate glass. A mirror with universal joint is provided.

¶ Figure 2 shows the instrument with the stage removed: this is made possible by loosening one small thumb screw. The arm may be straightened out and by leaving the joints unlocked can be freely swung over the entire baseboard, 324 x 212 millimeters, which is provided for covering the horseshoe feet. The binocular body is swiveled at the end of the arm. The two hinged joints may be securely locked in any position.

Into the arm is fitted a grooved bar which is operated by rack and pinion through a range of 110 millimeters, while the jointed arm slides in the groove through a distance of about 125 millimeters, giving a range of focus of from the level of the table to over 200 millimeters above it.

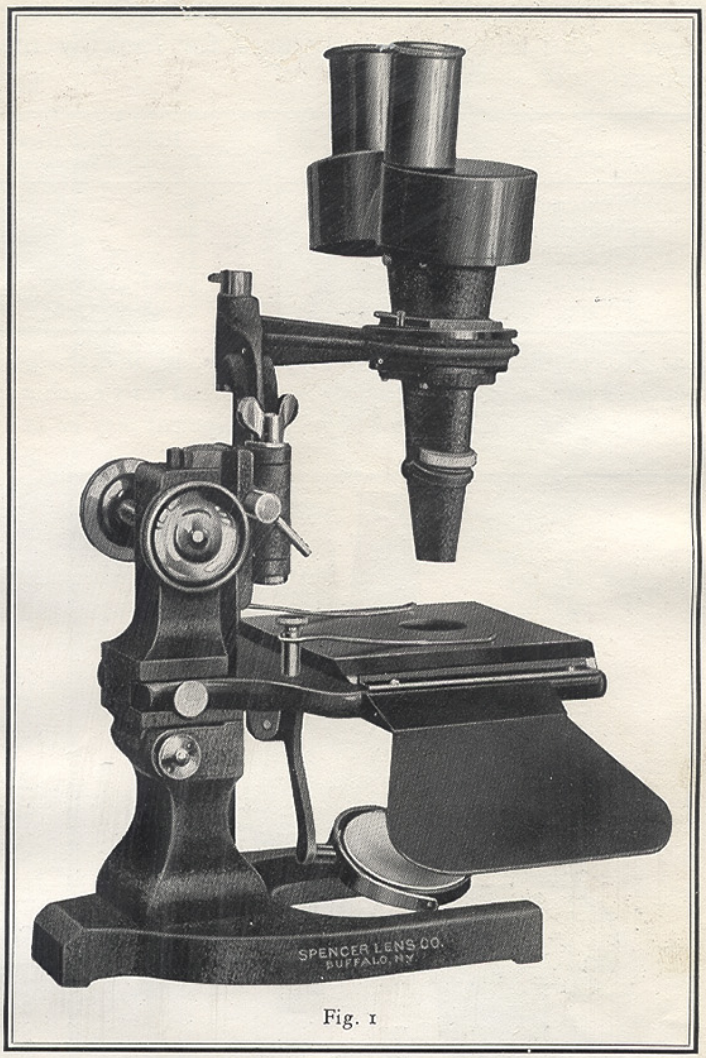


Fig. 1

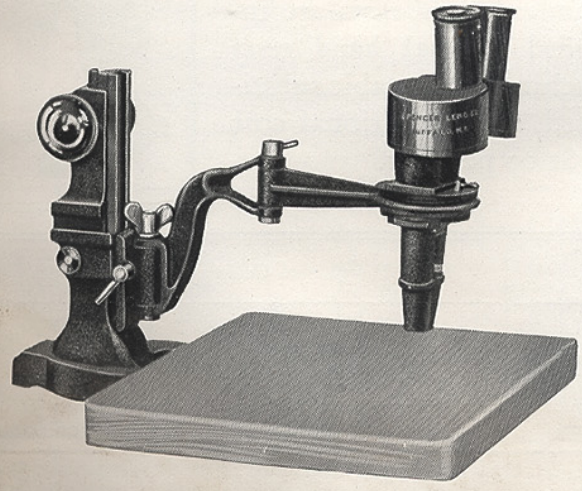


Fig. 2

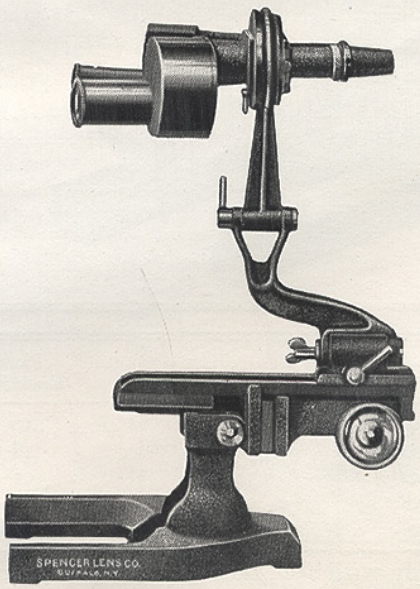


Fig. 3

Figure 3 illustrates the instrument with inclination joint turned back through 90° and shows how it can be conveniently used for looking into the side of an aquarium, reading daily plant growth, etc.

Telegraph Code	Catalog No.	Paired Objectives Equivalent Focus-mm.	Paired Huyghenian Oculars	Price
Fivatea	58A	40	10X	$126.00
Fivateb	58B	48-32	6x-10X	149.50
Fivatec	58C	55-40-25	4x-6x-10X	175.00
Fivated	58D	55-48-32-25	4x-6x-10X	192.00
Fivatee	58E	55-48-40-32-25	4x-6x-10X	213.00

Cat. No. 58—Stand, only, with binocular body, in case $101.00
Standard hand rests are included. Special hand rests reaching to the table may be substituted, at an additional cost of $1.00 per pair. Substitution in optical equipment may be as desired. For prices of objectives and oculars see page 33.

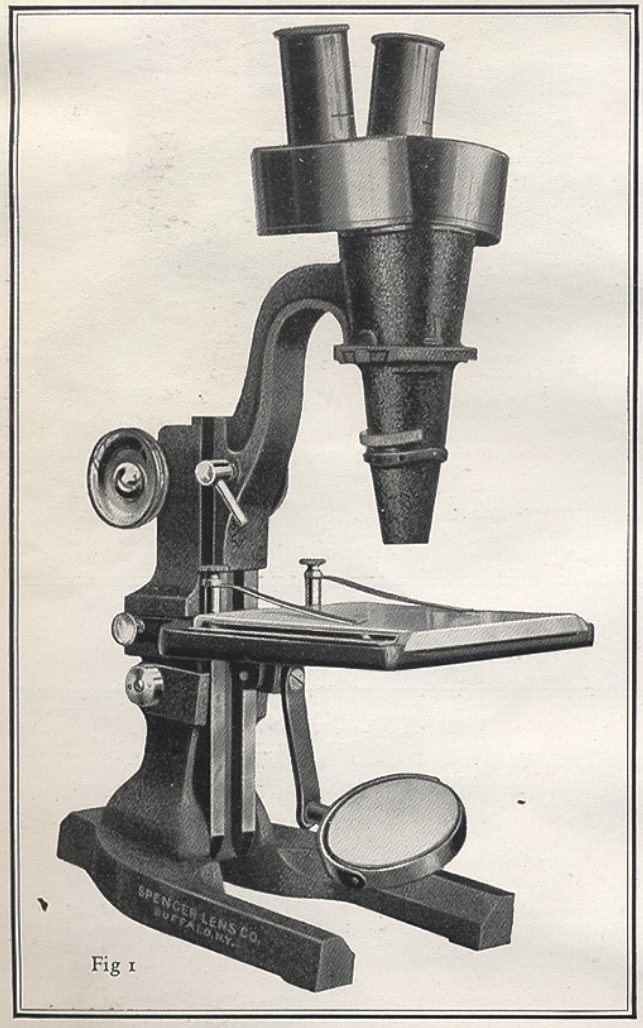


Fig 1

SPENCER BINOCULAR MICROSCOPE NO. 58S

THIS instrument is a modification of the Spencer Convertible Binocular Microscope No. 58. It is simplified by leaving off the long jointed arm, substituting for it a goose neck arm, as shown in the illustration. This instrument includes the advantages of the inclination joint, the easily removable stage, the exceptional weight and stability, and wide range of vertical adjustment.

Figure 1 illustrates the instrument as set up for ordinary work, and figure 2 with the stage removed and the arm lowered to bring the objectives into focus at the plane of the table.

Standard hand rests are included. Special hand rests reaching to the table substituted, at an additional cost of $1.00 per pair.

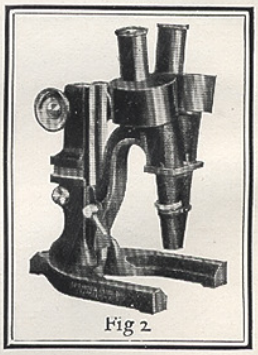
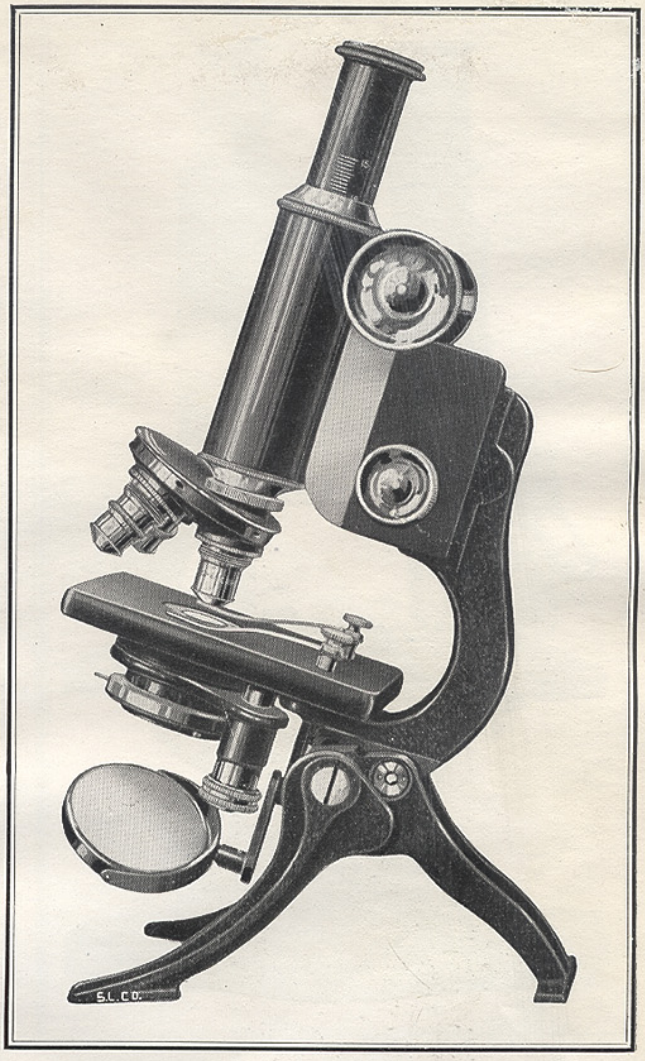


Fig 2

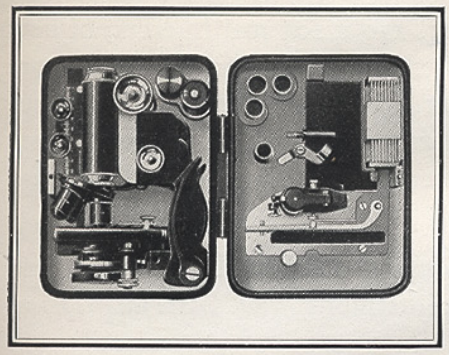
Telegraph Code	Catalog No.	Paired Objectives Equivalent Focus-mm.	Paired Huyghenian Oculars	Price
Fivatesa	58S-A	40	10X	$119.50
Fivatesb	58S-B	48-32	6x-10X	143.00
Fivatesc	58S-C	55-40-25	4x-6x-10X	168.50
Fivatesd	58S-D	55-48-32-25	4x-6x-10X	185.50
Fivatese	58S-E	55-48-40-32-25	4x-6x-10X	206.50

Binocular body with arm, no objectives or oculars. Without case. $65.00
Stand, only, in case 29.00
Substitutions in optical equipment may be made as desired. For prices of objectives and oculars see page 33.

SPENCER
PORTABLE MICROSCOPE NO. 60



THIS is a *standard* compound microscope, equipped with a set of first-class achromatic objectives and huyghenian oculars. It is a thoroughly satisfactory instrument for use in the laboratory of the hospital, medical school or private practitioner, meeting all the requirements that are ordinarily made of a high grade microscope, and at the same time so compact as to be packed in about one-quarter the space occupied by the case of ordinary instruments. The objectives are not removed from the nose-piece for packing. They are mounted in short mounts for compactness and provided with dust-proof caps to be screwed over them when the instrument is not in use. ℂ The body tube is 95 millimeters in length with graduated draw tube sliding clear down to the end, thus aiding in the compactness.



The substage is of standard "quick screw" form, with condenser permanently centered. The mirror is mounted on a special jointed arm that permits its being brought close to the stage for packing.

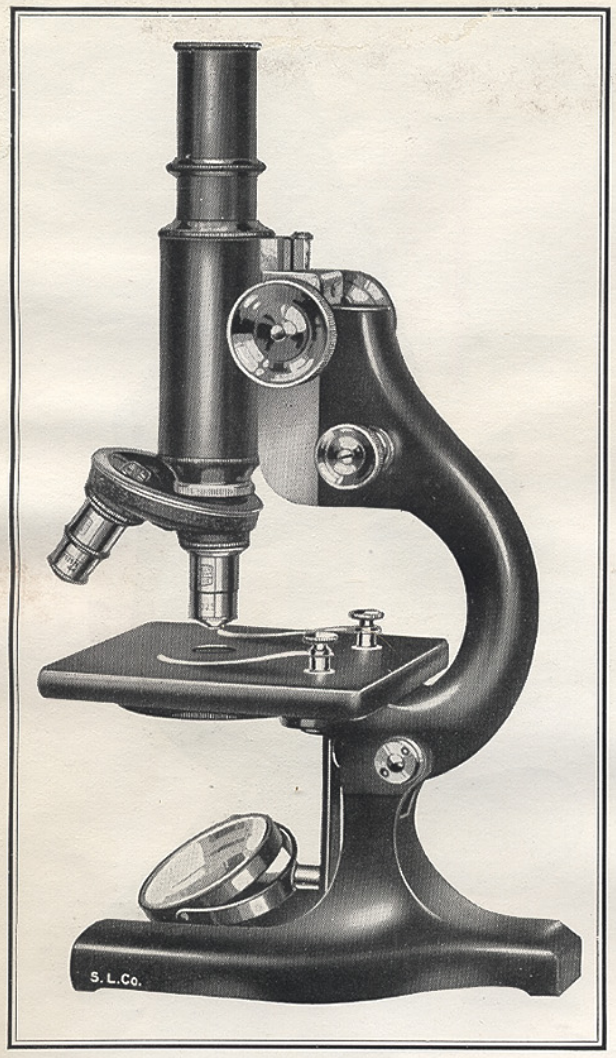
Three legs which fold back replace the base and pillar of the ordinary stand. They are securely fitted at the inclination joint and make a stable support for the microscope when set up.

The case is made of aluminum and has lock and key. The outside dimensions are 8¾ x 6½ x 3¾ in. It is entirely dust-proof. Provision is made for carrying, in addition to the complete microscope, a special mechanical stage, a haemaglobinometer and a haemacytometer or special camera lucida.

The following outfits include revolving nosepieces suitable for carrying the objectives listed.

Telegraph Code	Catalog No.	Substage Condenser N.A. 1.20	Achromatic Condenser		Huyghenian Oculars	Price
			Equivalent Focus-mm.	Initial Magnification		
Sixob	60B	Not included	16-4	10-44	10X	$103.00
Sixod	60D	Not included	16-4	10-44	6x-10X	105.75
Sixoe	60E	Included	16-4	10-44	10X	115.50
Sixof	60F	Included	16-4	10-44	6x-10X	118.25
Sixoh	60H	Included	16-4-1.8 Oil-imm.	10-44-95	6x-10X	160.00
Sixoj	60J	Included	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	175.00

No. 485 Mechanical Stage modified to pack in case $35.00
No. 500 Camera Lucida modified to pack in case 32.00
No. 505 Camera Lucida modified to pack in case 22.00



SPENCER MICROSCOPE NO. 64

THIS is an especially satisfactory instrument for use in the botany and zoology laboratories of high schools and colleges where simplicity and durability are paramount requirements. It is particularly recommended in the simpler outfits where the condenser is not required.

BODY TUBE—Of standard size with draw tube fixed at 160 millimeters.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout; harder and more durable than rubber; will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage. *See illustration and list, page 68.*

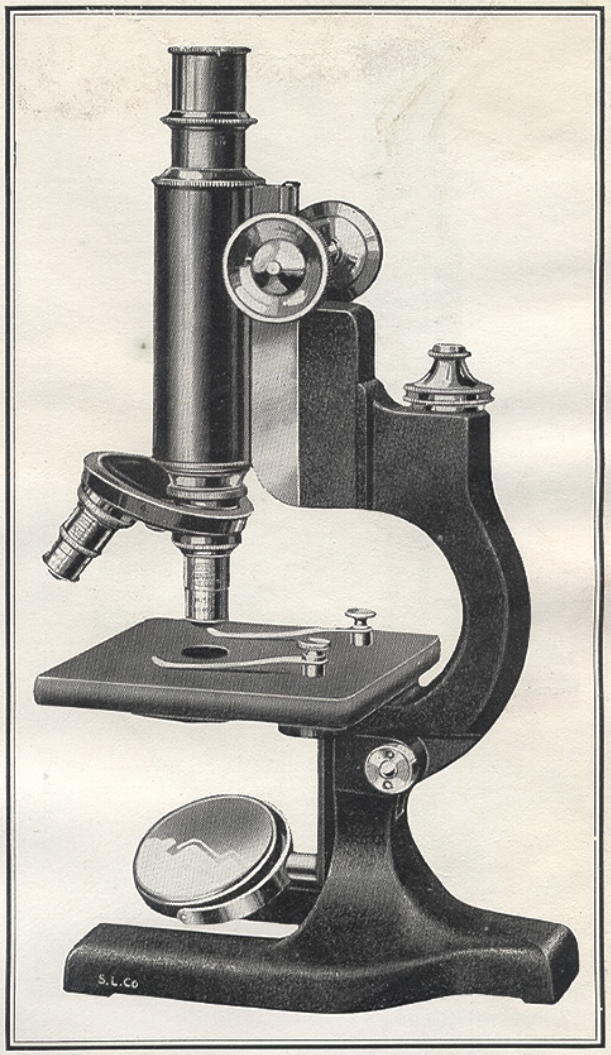
FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "D." *See description, page 7.*

SUBSTAGE—An iris diaphragm, operated by a knurled ring easily grasped at any position on its circumference, is placed at the lower plane of the stage. This provides a most satisfactory means of regulating the intensity of illumination. When so ordered, a ring is also provided for receiving the substage condenser.

CABINET—Polished hardwood, with lock and key.

Telegraph Code	Catalog No.	Substage Condenser N. A. 120	Revolving Nosepiece	Achromatic Objectives		Huyghenian Oculars	Price
				Equivalent focus-mm.	Initial magnifications		
Sixfora	64A	Not included	None	16-4	10-44	10X	$ 66.25
Sixforb	64B	Not included	Double	16-4	10-44	10X	73.00
Sixforc	64C	Not included	None	16-4	10-44	6x-10X	69.00
Sixford	64D	Not included	Double	16-4	10-44	6x-10X	75.75
Sixfore	64E	Included	Double	16-4	10-44	10X	85.50
Sixforf	64F	Included	Double	16-4	10-44	6x-10X	88.25
Sixforh	64H	Included	Triple	16-4-1.8 Oil-imm.	10-44-95	6x-10X	125.25
Sixforj	64J	Included	Triple	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	140.25
Sixform	64M	Not included	Triple	32-16-4	4-10-44	6x-10X	84.00
Sixforn	64N	Included	Triple	32-16-4	4-10-44	6x-10X	96.50

SPENCER MICROSCOPE NO. 65



THIS instrument was introduced by Spencer over ten years ago and has long been a favorite in high school and college laboratories, where it meets all requirements. Its popularity is the natural result of efficiency and reliability combined with moderate cost.

BODY TUBE—Of standard size with draw tube fixed at 160 millimeters.

ARM—Curved form, furnishing a convenient handle and providing ample space for manipulation of large objects; distance from center of stage to arm is 93 millimeters.

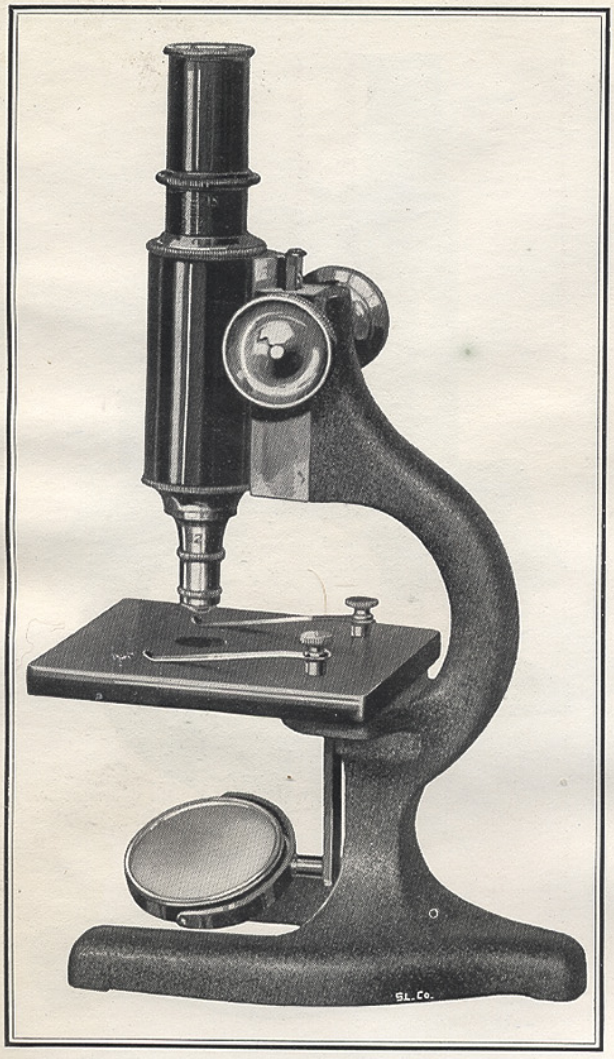
STAGE—Rectangular, 110 x 105 millimeters; of new composition, solid throughout; harder and more durable than rubber; will not warp or fade. Supplied (when so ordered and at additional cost) with grooved-in mechanical stage. *See illustration and list, page 68.*

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion and fine adjustment "D." *See description, page 7.*

SUBSTAGE—An iris diaphragm, operated by a knurled ring easily grasped at any position on its circumference, is placed at the lower plane of the stage. This provides a most satisfactory means of regulating the intensity of illumination. When so ordered, a ring is also provided for receiving the substage condenser.

CABINET—Polished hardwood, with lock and key.

Telegraph Code	Catalog No.	Substage Condenser N. A. 1.20	Revolving Nosepiece	Apochromatic Objectives		Huyghenian Oculars	Price
				Equivalent focus-mm.	Initial magnifications		
Sixfiva	65A	Not included	None	16-4	10-44	10X	$ 66.25
Sixfivb	65B	Not included	Double	16-4	10-44	6x-10X	73.00
Sixfivc	65C	Not included	None	16-4	10-44	6x-10X	69.00
Sixfivd	65D	Not included	Double	16-4	10-44	6x-10X	75.75
Sixfive	65E	Included	Double	16-4	10-44	10X	85.50
Sixfivf	65F	Included	Double	16-4	10-44	6x-10X	88.25
Sixfivh	65H	Included	Triple	16-4-1.8 Oil-imm.	10-44-95	6x-10X	125.25
Sixfivj	65J	Included	Triple	16-4-2 Oil-imm. Fluorite	10-44-82	6x-10X	140.25
Sixfivm	65M	Not included	Triple	32-16-4	4-10-44	6x-10X	84.00
Sixfivn	65N	Included	Triple	32-16-4	4-10-44	6x-10X	96.50



SPENCER MICROSCOPE NO. 74

IS satisfactory for elementary school purposes, or in any laboratory work in which the required magnification is not over 350 diameters. It serves for commercial purposes in examining starches, drugs, earths, cements, fibers, meats for suspected parasites, paper-making materials, etc.

BODY TUBE—Of standard size with draw tube fixed at 160 millimeters.

ARM AND BASE—Made from a single casting providing a convenient handle for the instrument and ample space for manipulation of large objects on the stage. Its rigidity especially recommends it for use by non-technical workers.

STAGE—Rectangular, 110 x 105 mm.; of new composition, solid throughout; harder and more durable than rubber; will not warp or fade.

FOCUSING ADJUSTMENTS—Diagonal cut rack and pinion only.

SUBSTAGE—A disc diaphragm with a series of circular openings to provide for varying intensity of illumination. A plane and concave mirror of standard size is mounted on a swinging arm.

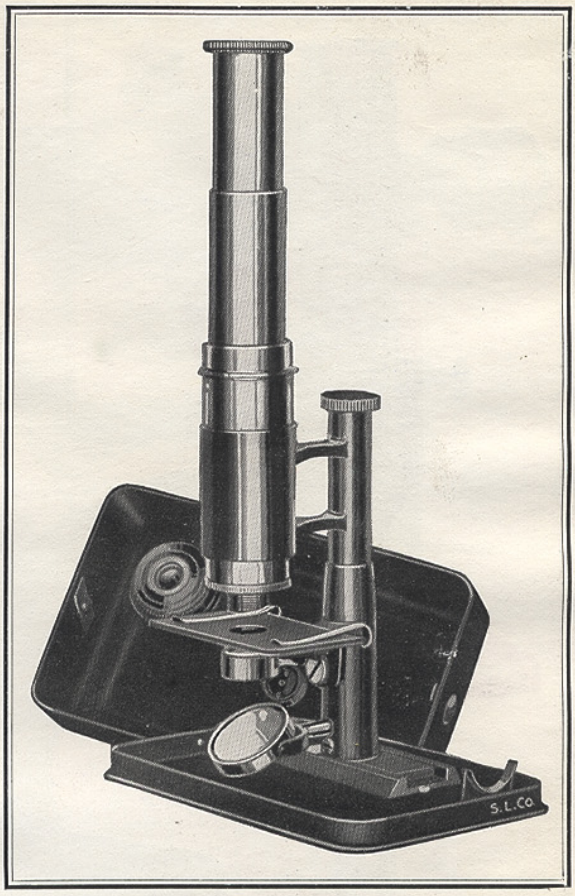
CABINET—Polished hardwood

Telegraph Code	Catalog No.	Nosepiece	Special Achromatic Objectives Equivalent focus-mm.	Huyghenian Oculars	Price
Sevforx	74x	None	Divisible 32-14	10x	$38.00
Sevfory	74y	None	Divisible 32-14 -Special 5	6x-10x	48.25
Sevforz	74z	Double	Divisible 32-14—Special 5	6x-10x	55.00
Onothre	103	Special	Special 32-14—Divisible objective		5.00
Ononthre	113	Special	Special 5 mm.—Objective		7.50

The divisible objective, 32-14 mm., gives with 6x ocular, magnifications of 24 and 65 diameters; with the 10x ocular, 40 and 120 diameters. The special 5 mm. objective, with the 6x ocular 216, with the 10x ocular 360 diameters.

SPENCER MICROSCOPE NO. 75

A Real Pocket Microscope



THIS instrument is designed to meet the requirements of a large class of scientists who do not confine their work to their own laboratories but who frequently desire to carry a microscope to their work. For prospectors and scientific collectors, this instrument will prove an invaluable asset. It is not to be classed with toy instruments that have from time to time been placed on the market. This is a real workable microscope, having a body tube of standard length focusable by a smoothly sliding motion and by *standard fine adjustment*.

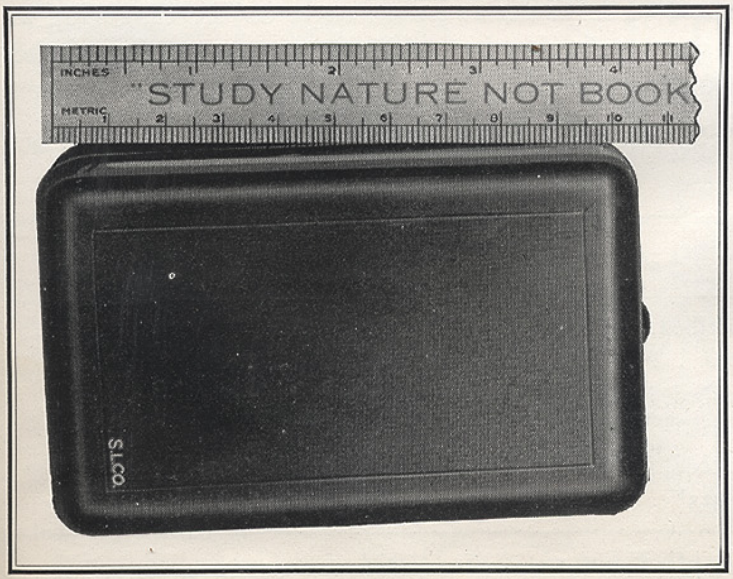
It is regularly equipped with a special divisible objective having a focal length of 6 millimeters when used complete, and 12 millimeters with the front element removed, and with a 10x huyghenian ocular. These combinations give powers sufficient for detecting minute botanical structures or for making standard blood counts with the haemacytometer. If desired, additional objectives of greater focal length for lower powers, or a specially mounted 4 millimeters objective for even higher power, may be added.

The illuminating device consists of a concave mirror so mounted on a fork as to be inclinable in all directions, and a special condenser of aperture suitable to the objectives listed with the instrument. The condenser is mounted on a swinging arm to be brought in or out of the optical axis as required.

The dimensions of the brass stage are 32 x 54 millimeters. Special clips with a double bend are attached to the under side of the stage in such a way that they can be easily brought into position for holding the slide and at the same time permit the latter to extend over the stage in any direction. Thus standard 3 x 1 slides may be used.

The body tube consists of four telescoping elements collapsing to a total length of 65 millimeters and readily extending to the standard 160 millimeters.

The entire instrument is mounted on a bed in the base of the case in such a way as to permit it to be slipped into the center of the support when required for use or brought to one end for folding. In packing, the divisible objective mentioned above is left in position on the tube while storage is provided in the cover for an additional objective.



The instrument and case are entirely of metal, neatly finished in alcohol-proof black enamel.

The dimensions of the case are 4 x 2½ x 1 1/16 inches and the weight complete in case, is 13 ounces.

Telegraph Code	Catalog No.		Price
Sevfiva	75A	Instrument as described, including special divisible objective 6 and 12 mm. focal length, one 10x huyghenian ocular and condenser.....	$40.00

No. 1158—4 mm. objective in special short mount $15.00

SPENCER READING MICROSCOPE NO. 78



THIS is a very convenient instrument for use in physical and industrial laboratories. It is designed especially for making accurate measurements of small objects or for measuring slight lateral displacements and it is therefore listed with suitable micrometer eyepieces for this work. It also finds use in examining fabrics, seeds, insects, surfaces of metals, anything in which the required magnification is not in excess of 100 diameters and where illumination only from above is required.

The cast iron base is of sufficient weight to insure stability.

The microscope tube is supported by a curved arm which carries it to one side of the base, so the instrument may be placed on the surface of objects on which it is desired to make observation.

Focusing is accomplished by sliding the tube in a cloth-lined sleeve in which it fits accurately but not too tightly to permit easy sliding. The tube is clamped in any required position by means of a set screw.

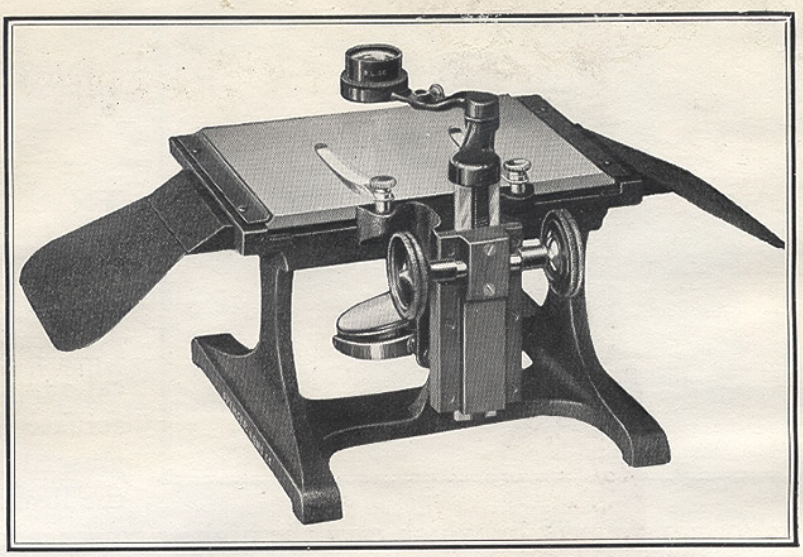
The objective regularly supplied is our standard 32 millimeters achromatic objective, giving an initial magnification of approximately 4 and a total magnification with a 10x eyepiece of 40. Other objectives giving either higher or lower power may be substituted or added at any time.

¶ The tube is of fixed length so that when the micrometer lines are standardized they are not subject to variation.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Sevater	78R	Microscope as described, including 32 mm. objective and Huyghenian ocular 10x	$25.00
Sevates	78S	Microscope as described, inlcuding 32 mm. objective and micrometer eyepiece No. 420*	31.75
Sevatet	78T	Microscope as described, including 32 mm. objective and micrometer eyepiece No. 425*	61.25

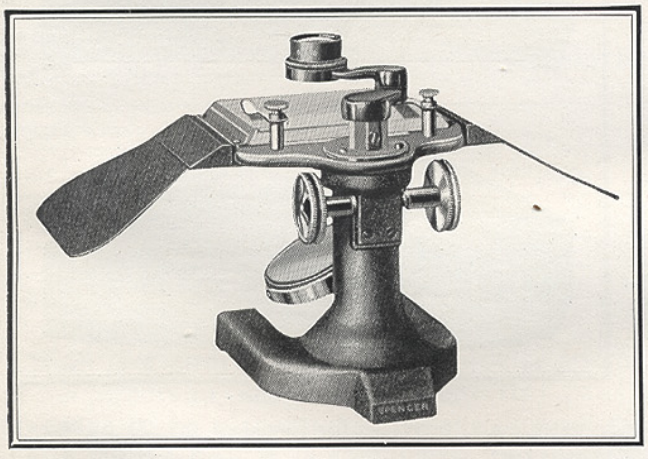
For complete description of micrometer eyepieces supplied with the outfits listed above, see page 64.

SPENCER DISSECTING MICROSCOPE NO. 80



IN this dissecting microscope we use the aluminum stand of binocular microscope No. 57. *See page 36.* This stand is of exceptional size and, while light in weight, is very substantial and rigid. It is capable of receiving not only the lens arm and magnifiers with which it is listed, but also the compound erecting body No. 87 (*see page 47*) and binocular body of No. 57, thus making it truly a *universal dissecting microscope*. It will also carry a standard camera lucida when used with simple magnifiers or with the compound erecting body.
The plate glass stage, 146 x 100 millimeters, is securely attached to the base by spring brass clips. A metal plate, black on one side and white on the other, slips into a suitable support beneath the glass, furnishing either desired type of background.
ADJUSTMENT is by diagonal cut rack and pinion, having a range of 75 millimeters.
The Lens Arm is of extra length for swinging over large areas of the stage.
Detachable metal hand rests are included.
Furnished in hardwood case, with lock and key.

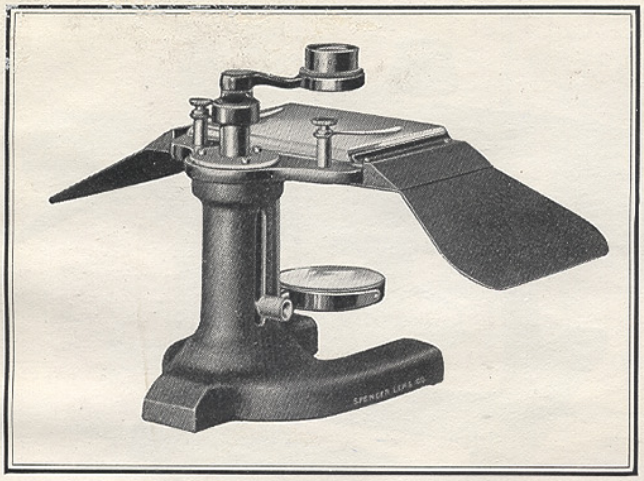
Telegraph Code	Catalog No.	Type and Magnification of Lens	Equivalent Focus-mm.	Working Distance-mm.	Price
Ateoa	80A	9x Doublet	27.8	15.	$40.00
Ateob	80B	6x and 12x Doublets	41.6 and 20.8	22. and 12.	41.75
Ateoc	80C	9x Triple Aplanat	27.8	24.5	44.00
Ateod	80D	6x and 12x Triple Aplanats	41.6 and 20.8	36.8 and 18.4	49.75



SPENCER DISSECTING MICROSCOPE NO. 82

THIS is a well made, thoroughly serviceable and convenient instrument. It finds wide use in elementary biological laboratories.
STAGE—is of polished plate glass, 100 x 75 millimeters. It is provided with black and white backgrounds and detachable metal hand rests.
BASE AND PILLAR—are one solid casting, perfectly rigid and of sufficient weight to insure stability to the instrument.
ADJUSTMENT is by diagonal cut rack and pinion.
LENS ARM—is jointed in such a way as to permit the lens to be carried over any part of the stage.
Furnished in hardwood case.

Telegraph Code	Catalog No.	Type and Magnification of Lens	Equivalent Focus-mm.	Working Distance-mm.	Price
Atetoa	82A	9x Doublet	27.8	15.	$22.00
Atetob	82B	6x and 12x Doublets	41.6 and 20.8	22. and 12.	23.75
Atetoc	82C	9x Triple Aplanat	27.8	24.5	26.00
Atetod	82D	6x and 12x Triple Aplanats	41.6 and 20.8	36.8 and 18.4	31.75



SPENCER
DISSECTING MICROSCOPE NO. 84

IN this dissecting microscope efficiency and durability are combined with very low cost.

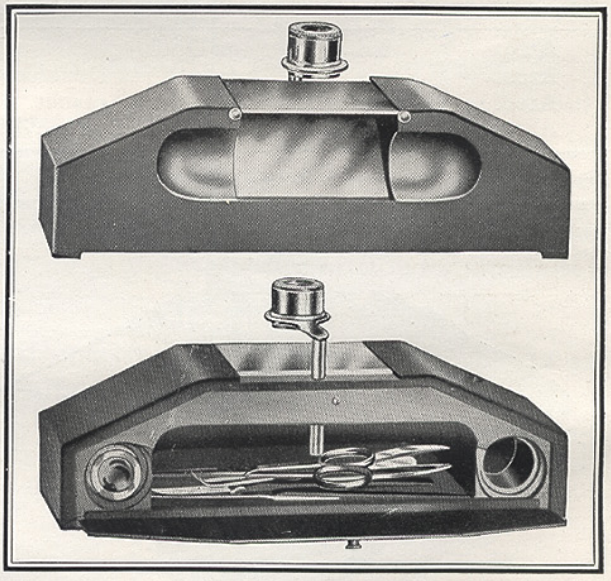
The STAGE, BASE and PILLAR are identical with those of dissecting microscope No. 82.

FOCUSING is accomplished by sliding the cylindrical support up or down in its bearing. This is actuated by a knob so placed as to be conveniently grasped by the right hand. A spring bearing at the lower end of the pillar insures a steady and uniform movement by which even the highest power magnifiers can be accurately focused.

Furnished in hardwood case.

Telegraph Code	Catalog No.	Type and Magnification of Lens	Equivalent Focus-mm.	Working Distance-mm.	Price
Atefora	84A	9x Doublet	27.8	15.	$20.00
Ateforb	84B	6x and 12x Doublets	41.6 and 20.8	22. and 12.	21.75
Ateforc	84C	9x Triple Aplanat	27.8	24.5	24.00
Ateford	84D	6x and 12x Triple Aplanats	41.6 and 20.8	36.8 and 18.4	29.75

SPENCER
DISSECTING MICROSCOPE NO. 86



THIS instrument is well known to biologists under the name of the " Barnes Dissecting Microscope." Its extreme simplicity and durability, as well as its low cost, have combined to make it very popular in high school or other laboratories where a really reliable instrument is required to be purchased with limited funds.

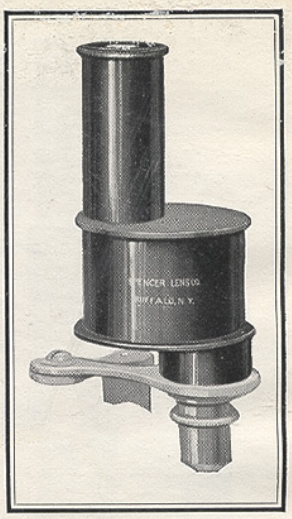
The supporting block is so shaped as to make convenient hand rests for dissecting.

The dimensions of the glass stage are 65 x 85 millimeters. Beneath this is set a reflecting mirror inclined at 45 degrees to the horizontal. The sides of the block are cut out in such a way that light is reflected to the object even when the instrument does not directly face the light source. Black and white backgrounds are furnished. The lens arm swings freely from side to side and provides for focusing.

The back of the block is hollowed out to form a convenient storage place for dissecting instruments and extra lenses and covered by a metal door hinged at the lower edge of the block.

Telegraph Code	Catalog No.	Type and Magnification of Lens	Equivalent Focus-mm.	Working Distance-mm.	Price
Atesixa	86A	9x Doublet	27.8	15.	$ 6.50
Atesixb	86B	6x and 12x Doublets	41.6 and 20.8	22. and 12.	8.25
Atesixc	86C	9x Triple Aplanat	27.8	24.5	10.50
Atesixd	86D	6x and 12x Triple Aplanats	41.6 and 20.8	36.8 and 13.4	16.25

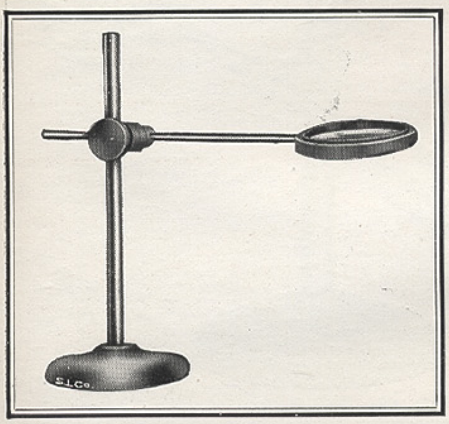
SPENCER MONOCULAR ERECTING BODY NO. 87



THIS erecting body consists of a set of poro prisms, mounted in a suitable protecting box with society thread and tube for receiving any standard objectives and eyepieces. It is adaptable to dissecting microscopes and gives the advantage of an " erected " image with capacity for using higher magnifications than are obtainable either with the dissecting binocular or with the single magnifier of simple dissecting microscopes.

It is regularly furnished with a long jointed arm with pin to fit into the opening in the top of the adjustable pillar of dissecting microscopes Nos. 80 and 82.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ateseva	87A	Erecting body without objective or ocular	$30.00
Atesevb	87B	Erecting body with 10x ocular	32.75
Atesevc	87C	Erecting body with 16 mm. objective, 10x ocular	40.75

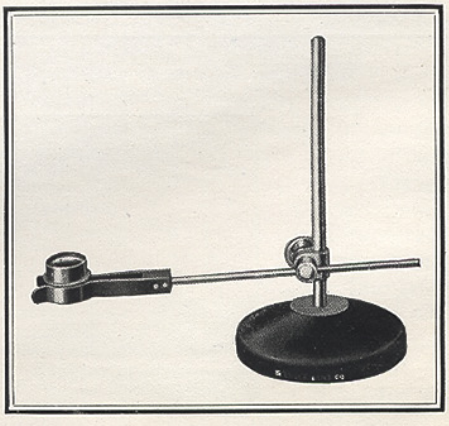


SPENCER DISSECTING MAGNIFIER NO. 88

THIS is a useful instrument for relatively gross dissections where it is desirable to cover a large field with low magnification. It consists of a lens two inches in diameter and six inches focal length so mounted as to be easily clamped in any required position by tightening a single thumb screw. The lens is accurately ground and polished and will give good results.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ateate	88	Magnifier, complete	$7.00

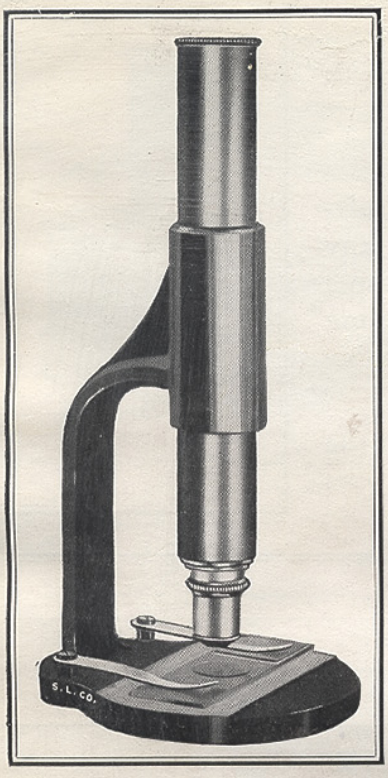
LENS HOLDER NO. 93



THIS is a simple and effective device for holding ordinary magnifiers in position over dissecting pans or other objects too large to be placed on the stage of dissecting microscopes. The spring holder is sufficiently flexible to grasp lenses of a variety of sizes.

The range of vertical adjustment is 170 millimeters. The rod carrying the lens has a horizontal movement of about 150 millimeters. Thumb screws are provided for clamping in any required position.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninthre	93	Holder, without lens	$5.50



DEMONSTRATION MICROSCOPE NO. 96

THIS instrument is capable of being used with any low or medium power objectives and is very convenient for passing from hand to hand for class demonstration. A set screw is provided for clamping the tube in position to retain the focus. The instrument is made of aluminum; is light in weight and sufficiently rigid to withstand rough handling.

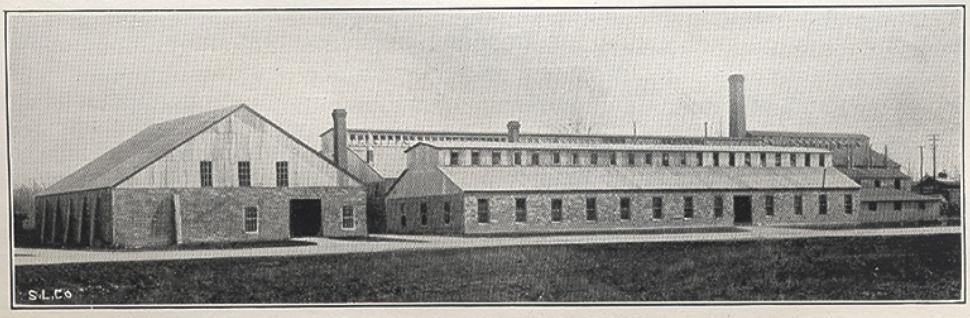
Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninsixa	96A	Microscope stand with 8x ocular.	$12.50
Ninsixb	96B	Microscope stand with 8x ocular and 16 mm. objective	20.50



BULL'S EYE CONDENSER NO. 100

THIS is a convenient device for concentrating light (either daylight or artificial) onto opaque objects. Lenses are 75 millimeters focal length, well ground and polished to form a definite image of the light source. They are mounted on universal supports and adequately counterpoised. Height of supports: "A"—7"; "B"—8".

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onooa	100A	Diameter of lens, 50 mm.	$6.00
Onoob	100B	Diameter of lens, 75 mm.	7.50



SPENCER LENS CO. GLASS PLANT, AT HAMBURG, N. Y.
(Moulding and Pressing Department)

SPENCER OPTICAL SYSTEMS

EXPERIENCED and discriminating microscopists have long recognized Spencer microscope lenses as standing in the front rank of optical attainment. They are characterized not only by sharpness of definition, flatness of field, clearness and brilliancy of illumination, but by a uniformity of quality that is indicative of constant and competent supervision at every step in the production and a final rigid inspection that accepts no compromise, but recognizes only two grades: *perfect* and unacceptable.

In the Spencer factory nothing is left to chance. Every element of every lens is completely computed by our technical staff, the specifications indicating not only every curve, but the physical qualities of the glass and the separations between the several elements. With such specifications the responsibility of the workman ceases when he has performed every operation exactly as specified, and to do this, men of the highest quality and years of careful training are employed. These men work under the direct supervision of the most capable technical experts that this country—or any other—has ever produced. The result has been the production of a series of achromatic lenses that have set a new standard which has been recognized the world over.

We have in recent years been aided in maintaining this standard by the fact that we own and operate one of the most—if not the most—completely equipped optical glass plants in the entire world, where we produce over half a hundred varieties of optical glass, ranging from the softest crown with a refractive index as low as 1.507, to the heaviest flint with the remarkably high index of 1.783. All these are available to our mathematicians for formulating new lenses or for improving old ones. Furthermore, our complete records of the chemical composition and physical conditions prevailing in the manufacture of each melting of glass enables us, when a type of glass is found exactly suitable for a specific requirement, to reproduce that type at such times and in such quantities as is required; making it always available. This condition never did and never could prevail when it was necessary to place dependence on a foreign source for our basic material.

Mounting of Objectives

Spencer objectives have borne an enviable reputation, not only because of their exceptional optical qualities, but also on account of the stability and permanence with which they are mounted. This is especially true of our oil immersion objective, in which the front element is so held as to insure exceptional rigidity and permanence of " seal " against the leaking of oil. Having this purpose in view, we mount the lens directly into its metal support without the use of any gum or adhesive material to be affected by cleaning solvents. In thus spinning the metal around the glass, it is absolutely unavoidable that a narrow margin around the periphery of the lens should be covered and the aperture thereby slightly reduced, so that our oil immersion lenses are regularly supplied with a numerical aperture of 1.25, instead of 1.30 or 1.32, as is sometimes considered desirable. We recognize the superiority of the higher aperture for certain types of work, but the lower aperture is sufficient for practically all laboratory requirements, and the slight sacrifice is more than compensated for in additional stability. However, for those who prefer the high aperture, we supply lenses so mounted as to give it, retaining the highest degree of permanence possible under the conditions specified.

Numerical Aperture

This is a term about which considerable confusion exists in the minds of microscope users. It is a mathematical expression which indicates certain properties of a lens dependent on the angle of light from a point in the center of the field which is utilized in forming the image. It is often believed that the higher the aperture the better the lens. This is true only within certain very definite limitations.

While it is a fact that " resolving power,"—that is, the capacity to interpret two bodies slightly separated as such, instead of one larger body—is directly proportional to the numerical aperture, it is also true that " depth of focus " or " penetration " is inversely proportional to the same aperture. Furthermore, *working distance* of a " low aperture " objective can be made much greater than of one in which the highest aperture is retained. Thus, for practical results, a lens having an aperture just sufficient for the work required of it is often preferable to one having an unnecessarily high aperture at the sacrifice of penetration and working distance. The latter qualification is of especial importance in 4 mm. objectives. We, therefore, manufacture two objectives of this focal length; one having a numerical aperture of 0.66 for routine laboratory work and another of 0.85, for use where the last degree of resolution is required. Between these, no distinction as to quality is to be drawn. Each is of the highest possible grade in its class, and each is capable of accomplishing certain results not obtainable with the other.

Correction for Tube Length and Cover Glass Thickness

All objectives are computed to bring the several rays passing through them to the best possible focus at a fixed distance from the objective. In making this computation attention must be given to the fact that microscopic objects are practically always covered with a thin glass which becomes virtually a part of the optical system. It is possible to make complete compensation for a cover glass of any specified thickness, but since no specific thickness is adhered to in general practice, the best that can be done is to choose an average thickness and compute the objective for it. The cover glass thickness chosen in computing Spencer objectives is .18 mm. For a cover of either greater or less thickness than this, the correction will be slightly in error. This error, however, may be compensated for by adjusting the tube length.

In Spencer microscopes, the optimum correction is attained when the draw tube is set to read 160 mm. *provided* the cover glass used is .18 mm. If covers of a different thickness are used, the best correction is obtained at a tube length determined by experiment. It is sufficient to say here that a very slight variation of cover glass thickness compensates for a considerable change of tube length. For example, a 4 mm. objective N. A. .85 corrected for a cover glass .18 mm. in thickness would, if used with a cover glass .15 mm. in thickness, require that the tube be extended by about 30 mm.

We can, on special order, correct objectives for any specified tube length and cover glass thickness or for use without cover glass.

In this connection, the further fact should be noted, that standard sets of objectives on revolving nosepieces are parfocalized at a draw tube setting of 160 mm. and that they will *not* be parfocal at any other tube length.

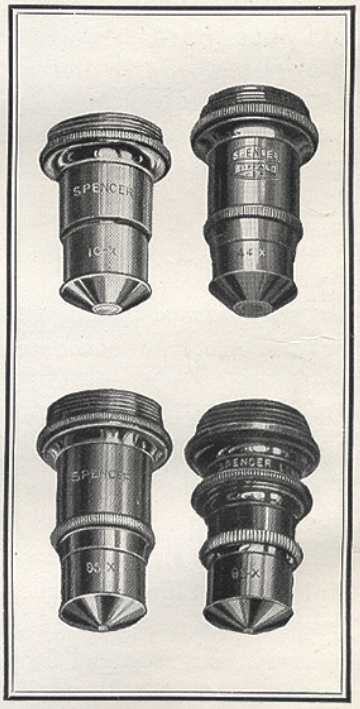
Nomenclature

It is now several years since we introduced the system of marking all optical parts with their respective magnifications. For instance, each objective is engraved with a number which indicates the number of times that the image formed by it at 160 mm. tube length, is greater than the object from which it is formed. This image is in turn magnified by the ocular a number of times indicated by a numeral engraved on the ocular, thus the total magnification of any combination is obtained by multiplying together the magnification numbers on the objective and the ocular used. This nomenclature has since been adopted by practically all manufacturers.

SPENCER ACHROMATIC OBJECTIVES

Telegraph Code	Catalog No.	Equivalent Foc.-mm.	Initial Magnification	Num. Aperture	Working Distance mm. (With 160 mm. tube length and 10x eyepiece)	Diam. of the real field mm. (With 160 mm. tube length and 10x eyepiece)	Price
Onoon	101	48	2.2		40.0	6.8	$ 6.50
Onoto	102	40	2.8		28.0	5.5	6.50
Onofor	104	32	4	0.10	15.0	4.7	6.50
Onosev	107	25	6	0.25	9.5	3.3	6.50
Onoate	108*	16	10	0.25	5.0	2.1	8.00
Ononto	112	8	20	0.50	1.5	1.0	13.50
Ononfiv	115	4	44	0.66	0.68	0.36	13.50
Ononate	118	4	44	0.85	0.46	0.40	13.50
Ontoto	122	3	60	0.85	0.26	0.30	13.50
Ontosev	127	1.8 Oil-imm.	95	1.25	0.13	0.20	40.00
Ontoate	128	1.5 Oil-imm.	109	1.25	0.10	0.14	60.00

*This objective is so constructed that the front element may be removed and the back element alone used. The focal length of the back element is approximately 32 millimeters.



SPENCER FLUORITE OBJECTIVES

The chromatic correction of objectives is improved by the substitution of a fluorite element for one of the glass elements. Owing to the difficulty of obtaining optically clear fluorite, and to the greater difficulty of working it, the prices of these objectives are higher than of the standard achromatic series. Their superiority is readily observed in the crispness of their definition and in the freedom of the field from color haze.

Telegraph Code	Catalog No.	Equiv. Foc. mm.	Initial Magnification	Num. Aperture	Working Distance mm. (With 160 mm. tube length and 10x eyepiece)	Diam. of the real field mm. (With 160 mm. tube length and 10x eyepiece)	Price
Ontoo	120	4	44	0.85	0.46	0.40	$20.00
Onthreo	130	2 oil-imm.	85	1.25	0.13	0.22	55.00

HUYGHENIAN OCULARS

THESE oculars are constructed with the same careful attention to details as is given to the manufacture of objectives or condensers. They will be found to be of uniformly high quality.

They are engraved with numbers indicating the number of times that they magnify the objective image. Unless otherwise ordered, they are supplied in mounts of suitable size to fit standard microscope draw tubes (23 mm.).

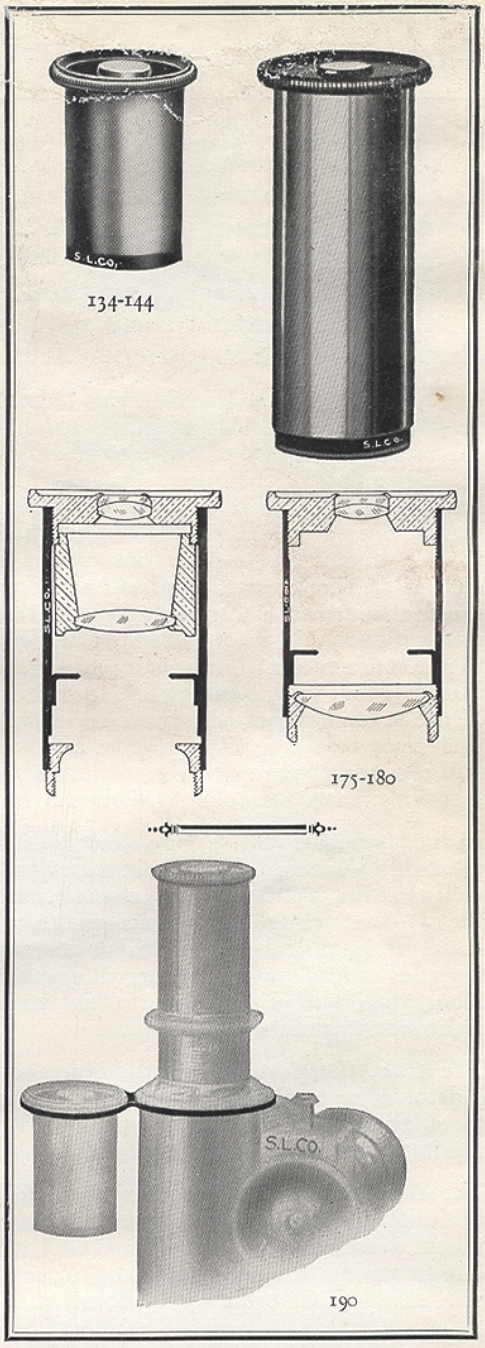
Telegraph Code	Catalog No.	Power	Equivalent Focus	Price
Onthrefor	134	4x	62.5 mm.—2½ in.	$2.75
Onthresix	136	5x	50 mm.—2 in.	2.75
Onthreate	138	6x	40 mm.—1⅝ in.	2.75
Onforo	140	8x	30 mm.—1⅕ in.	2.75
Onforto	142	10x	25 mm.—1 in.	2.75
Onforfor	144	12x	20 mm.— ⅘ in.	2.75

SPENCER NEW PLANOSCOPIC OCULARS

RECOGNIZING the need for an eyepiece superior to that of the huyghenian type which has so long been the accepted standard, our technical bureau has produced an eyepiece of entirely new design by means of which is obtained a field not only larger and flatter than is shown by huyghenian oculars, but in which is incorporated a compensating element which to a remarkable degree corrects certain defects that are inherent in all achromatic objectives. In fact, such is their degree of correction that they are properly classified as partial compensating oculars and are satisfactorily used with apochromatic objectives.

A test of these oculars demonstrates their superior qualities.

Telegraph Code	Catalog No.	Power	Equivalent Focus	Price
Onsevfiv	175	6x	40 mm.—1⅝ in.	$4.50
Onsevsix	176	8x	30 mm.—1⅕ in.	4.50
Onsevsev	177	10x	25 mm.—1 in.	5.50
Onsevate	178	12x	20 mm.— ⅘ in.	5.50
Onsevnin	179	15x	16 mm.— ⅔ in.	5.50
Onateo	180	20x	12 mm.— ½ in.	5.50



A NEW EYEPIECE HOLDER

THE value of the extra eyepiece which accompanies most microscopes is often greatly diminished by the fact that it is seldom immediately at hand when wanted. The eyepiece carrier effectively overcomes this difficulty by furnishing a convenient storage for the eyepiece on the instrument itself. It consists of a ring easily inserted between the body tube and the draw tube ring of the microscope, to which is attached a receptacle of suitable size for the purpose.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onnino	190	Eyepiece holder	$0.45

APOCHROMATIC OBJECTIVES & COMPENSATING OCULARS

ONE of the most elementary facts regarding the behavior of light in passing through a refracting medium, such as glass, is that white light is separated into its component colors, so that if we attempt to bring light from a given point to a focus by a single lens we shall find that the several colors do not focus at the same distance from the lens, but that the violet light will be focused considerably nearer the lens than will the red, and that other colors will be distributed along a line between these two extremes. This imperfection of focus is known as " chromatic aberration " and to overcome it is one of the fundamental problems of the lens designer.

The first step in this direction was to put together two lenses of different kinds of glass, and having opposite curvatures, the effect of one lens being in a measure to neutralize that of the other. That is, if a single convex lens of one kind of glass tends to focus the colors in a certain order, a concave lens can be combined with it that will act to reverse this order. Such a combination constitutes a wonderful improvement. So great, in fact, is the improvement, and so nearly is the " chromatic aberration " overcome that the term " *achromatic* " is applied to the combination. But unfortunately this combination is not all that its name implies, for while the separation of the several colors is very much reduced, and two of them may be brought to exactly the same focus, there still remains a fringe of other colors around the point of focus of the two that are thus combined.

In the " *apochromatic* " lens an effort is made to overcome even this slight defect. The lens designer realizes full well that his problem is incapable of complete solution; that is, that while he may narrow the color fringe and may even by skilful manipulation of curves and different varieties of lens material, bring three colors to the same focus, there will still remain a slight margin of diffused light around the image point.

The task, therefore, of the designer of apochromatic objectives is: to bring three primary colors to the same focal point and to reduce to its narrowest possible minimum the color fringe surrounding this point.

The superiority of lenses thus corrected is especially noticeable in examining very minute unstained particles where there are no colors with which to confuse those due to chromatic imperfections of the lens. Such objects will show under ordinary " achromatic " objectives a decided color which practically disappears under the apochromatic objective.

The higher degree of color correction is also especially easily observed by focusing on a " test plate " (a glass slide on which has been deposited a thin coating of silver that is subsequently scratched by a very finely pointed instrument) illuminated by oblique light: Under these conditions, the color margin with ordinary objectives is very pronounced, while with apochromatic objectives it is much less prominent, being both narrower and dimmer.

¶ While the differences between the two types of lenses may not be readily noted in examining ordinary stained specimens, they are just as real as in the special test objects mentioned, and they manifest themselves in critical examinations where it is necessary to observe the finest detail that can be brought out.

To get the best results from apochromatic objectives, two precautions should be carefully observed: First, they should be used with the cover glass thickness and the tube length for which they are designed (or should be carefully adjusted by their correction collar), and, Second, they should be used with " compensating oculars " especially adapted to them. The latter are necessary because of the fact that, although three different colors of the spectrum have been brought to the same focal plane, the magnifications of the image formed by the several colors are not exactly identical, so that if the field is viewed with ordinary eyepieces, it will appear well corrected only at the center, while the margin will show decided colors; but compensating oculars produce a varying magnification of different colors and in the opposite order from that produced by the objectives, so that with them the field appears uniformly well corrected throughout its entire area.

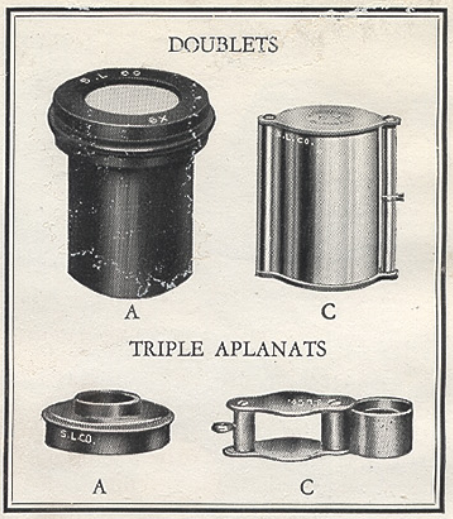
APOCHROMATIC OBJECTIVES

Telegraph Code	Catalog No.	Equiv. Foc. mm.	Initial Magnification	Num. Aperture	Working Distance mm.	Diam. of the real field mm.	Price
					With 160 mm. tube length and 10x eyepiece		
Onfivo	150	16	10	0.30	2.6	1.5	$ 31.00
Onfivto	152	8	20	0.60	1.2	0.75	41.00
Onfivfor	154	4	44	0.95	0.26	0.32	53.00
Onfivsix	156	3	60	0.95	0.16	0.24	63.00
Onfivate	158	2 oil-imm.	85	1.30	0.17	0.16	84.00
Onsixo	160	1.5 oil-imm.	130	1.30	0.13	0.12	110.00

COMPENSATING OCULARS

Telegraph Code	Catalog No.	Power	Equivalent Focus		Price
			mm.	inches	
Onsixfor	164	1.5x	170	7	$6.25
Onsixsix	166	5x	50	2	6.25
Onsixate	168	10x	25	1	8.25
Onsevo	170	15x	16	2/3	8.25
Onsevto	172	20x	12.5	1/2	8.25

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 to be used. *A* mounts are black lacquered brass for dissecting stands. *C* mounts are heavily nickeled brass in folding case.

Doublets are composed of two plano-convex lenses accurately ground and polished and substantially set in suitable mounts. They will be found to give excellent definition over a large field. The working distance is greater than is usually attained with lenses of this type.

Triple aplanats are corrected both spherically and chromatically. They are remarkable for their large, flat field, freedom from distortion, brilliancy of illumination and *great working distance*.

Telegraph Code	Doublet Magnifiers					Mount	Price	Telegraph Code	Triple Aplanat Magnifiers					Mount	Price
	Catalog Number	Magnification	Focal Length-mm.	Working Distance	Diameter of Field				Catalog Number	Magnification	Focal Length-mm.	Working Distance	Diameter of Field		
Tooto	202	6x	41.6	22	22	A	$1.75	Tofivsix	256	6x	41.6	36.8	30	A	$5.75
Toofor	204	9x	27.8	15	16	A	1.75	Tofivate	258	9x	27.8	24.5	20	A	5.75
Toosix	206	12x	20.8	12	11	A	1.75	Tosixo	260	12x	20.8	18.4	15	A	5.75
Tooate	208	18x	13.9	8	8	A	1.75	Tosixon	261	15x	16.7	14.9	12	A	5.75
Toten	210	24x	10.4	6	5.5	A	1.75	Tosixto	262	18x	13.9	12.1	10	A	5.75
Tototo	222	6x	41.6	22	22	C	2.00	Tosixfor	264	24x	10.4	9.2	7.5	A	5.75
Totofor	224	9x	27.8	15	16	C	2.00	Tosevsix	276	6x	41.6	36.8	30	C	6.00
Totosix	226	12x	20.8	12	11	C	2.00	Tosevate	278	9x	27.8	24.5	20	C	6.00
Totoate	228	18x	13.9	8	8	C	2.25	Toateo	280	12x	20.8	18.4	15	C	6.00
Tothreo	230	24x	10.4	6	5.5	C	2.50	Toateon	281	15x	16.7	14.9	12	C	6.00
								Toateto	282	18x	13.9	12.1	10	C	6.00
								Toatefor	284	24x	10.4	9.2	7.5	C	6.00

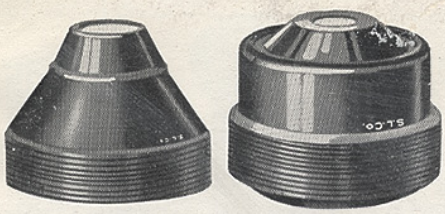


NO. 240 TRIPOD DISSECTING MAGNIFIER

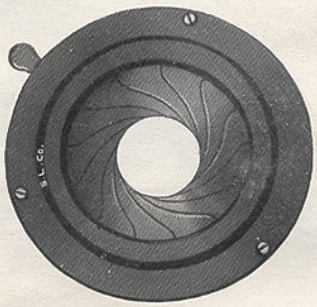
This dissecting magnifier gives a large, clear field and magnification sufficient for elementary work. The lens is focused by screwing it up or down in its frame.

Telegraph Code	Catalog Number	DESCRIPTION	Price
Toforo	240	Tripod dissecting magnifier	$0.75

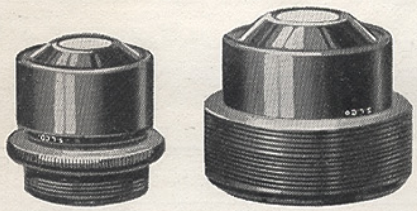
SPENCER SUBSTAGE CONDENSERS



No. 300 No. 305



No. 325



No. 315 No. 320

WE offer two distinct types of substage condenser: the ordinary or Abbe type and the achromatic type. The former has as good a degree of spherical correction as is practical with the simple design employed: they concentrate parallel rays of light to a small area and serve not only to increase the intensity of illumination, but also to utilize a wider angle of light than is otherwise employed, thereby taking advantage of a larger numerical aperture in the objective.

Spencer achromatic condensers are also aplanatic. That is, they are corrected both spherically and chromatically with the same degree of exactness as are our standard achromatic microscope objectives, so that the pencil of light directed through the object and into the objectives is as nearly as practical the theoretically correct cone of white light.

The advantage of the achromatic condenser, either for photography or for refined visual work, can not be too strongly emphasized, since no objective can transmit an image free from color haze if the light delivered to it by the condenser is already separated into its component colors.

In selecting condensers for any given purpose the fact should be borne in mind that the full resolving power of an objective is utilized only when the numerical aperture of the condenser is as great as that of the objective.

In ordering, state the type of instrument with which the condenser is to be used. If required for use with microscopes equipped with the Spencer new complete substage, no diaphragm is required, but if for microscopes having the simple quick screw substage, a diaphragm should be ordered with the condenser.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Threoo	300	Standard Condenser N. A. 1.20 without diaphragm	$ 7.50
Threofiv	305*	Wide Angle Condenser N. A. 1.40 without diaphragm	9.50
Threonfiv	315	Achromatic Condenser N. A. 1.30 without diaphragm	30.00
Thretoon	321*	Achromatic Condenser N. A. 1.40 without diaphragm	40.00
Thretofiv	325	Iris diaphragm for use with any Spencer substage condenser	5.00

*The front combination of these condensers can be removed and the rear combinations used as a low power condenser. When thus used the focal length of No. 305 is two inches and its numerical aperture about 0.30. The focal length of the back element of No. 321 is one inch and the numerical aperture about 0.40.

SPENCER DARK FIELD ILLUMINATORS

DARK Field Illuminators have now come to be accepted as a necessary accessory to the microscope for certain types of work, such as the detection of minute colloidal particles held in suspension in fluids or for examining unstained and living bacteria—a part of routine procedure in many diagnostic laboratories.

Although this method of illumination is not the most common in microscopic work, it corresponds much more nearly to that employed in ordinary vision of gross objects than does the method of examination by transmitted light, as in ordinary microscopy. Under this illumination particles too small to be revealed by ordinary methods are seen as brilliantly lighted bodies in a dark field. The result is accomplished by directing onto the specimen from below a broad cone of light from which has been blocked out all but the marginal rays of such obliquity that, if unobstructed, they would not enter the objective at all and are thus observed only when intercepted by some object which reflects them. We supply dark field illuminators in three different types of mounts.

The first and simplest, No. 340, is that in which the apparatus is mounted in a metal plate to be placed on the stage of the ordinary microscope. This possesses certain advantages of simplicity and quickness of operation that make it especially desirable for those who use the same microscope for a variety of purposes.

No. 342 is the standard substage type designed to replace the substage condenser. This possesses the advantage of centering screws and can thus be more accurately adjusted, and when properly aligned it is much less likely to be accidentally moved. This was by far the most extensively used and satisfactory instrument until the introduction of the newer instruments with electric light included.

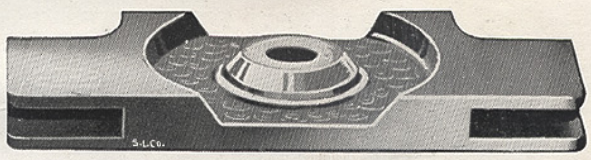
The newest, most satisfactory, and most easily adjusted instrument is No. 330, in which an electric light is included as an integral part of the apparatus. This instrument was designed especially to meet the requirements of the U. S. Army Medical School and Hospitals where compactness as well as ease and convenience of manipulation are prime requisites.

The instrument consists of substage illuminator No. 342, modified by the addition of a small condensing lens and a low voltage electric bulb. The lens serves to approximately parallelize the light from the bulb so that the apparatus behaves in all respects as does the standard instrument when correctly illuminated from an outside source. To permit correct adjustment of the lamp, it is so mounted as to be easily moved in a sleeve to and from the condenser and to be centerable relative to the condenser by centering screws.

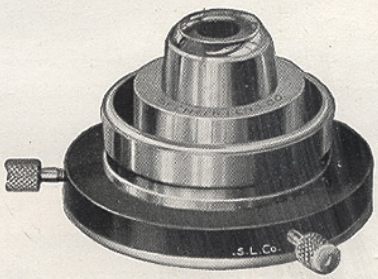
The entire apparatus fits into the substage of the microscope and occupies but little more space than the ordinary substage condenser.

The necessary current for lighting the bulb may be obtained from any lighting circuit by the introduction of a suitable resistance (or, in the case of alternating current, transformer) or from a storage or dry cell battery. A commercial battery known as the " Hot Shot " battery has been found to give excellent satisfaction when used with a four volt bulb. *See list, page 56.*

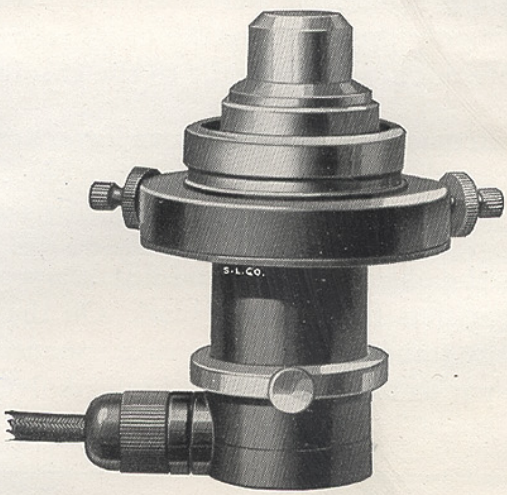
The instrument is supplied in a plush-lined case with receptacles for funnel stop, light cord, slides and an extra bulb.



No. 340



No. 342



No. 330

Telegraph Code	Catalog No.	DESCRIPTION	Price
Threforo	340	Dark field illuminator to be used above the stage with objective stop* . . .	$15.00
Threforto	342	Substage dark field illuminator with objective stop*	22.00
Threthreo	330	Substage dark field illuminator with built-in electric light, including one bulb and objective stop*	35.00
Threthreon	331	Six volt bulb	$0.65
Threthreto	332	Four volt bulb.	.65
Threthresix	336	Resistance to adapt 6 volt bulb No. 331 to a 220 volt circuit	8.00
Threthresevn	337	Resistance to adapt 6 volt bulb No. 331 to a 110 volt circuit	6.00
Threnino	390	Transformer to step down a 220 volt alternating current to six volts	6.00
Threninon	391	Transformer to step down a 110 volt alternating current to six volts	6.00

CORRECTED PRICES

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

A SPECIAL OIL IMMERSION OBJECTIVE
FOR USE WITH
THE DARK FIELD ILLUMINATOR

THE fact is well known that in order to use an oil immersion objective having a numerical aperture greater than unity with the dark field illuminator it is necessary to insert into the back of the objective mount a special diaphragm or " stop," to reduce its aperture so as to cut out the most oblique light from the dark field illuminator. Failure to observe this precaution results in a field only partially darkened, giving it a gray, rather than a black, appearance. These " stops " are included as a part of the standard equipment with all dark field illuminators, but at best they are not absolutely free from defects: they are small and liable to be lost; it is some bother to separate the objective and insert the " stop " whenever the dark field illuminator is to be used; they fit only the special make of objective for which they are designed, and, most serious of all, they are not always brought to the absolutely correct center.

To overcome these difficulties we have, at the suggestion of Dr. S. H. Gage, of Cornell University, constructed a 1.8 mm. oil immersion objective, having a numerical aperture reduced to 0.85, which gives uniformly excellent results for this work.

While the objective thus modified is especially adapted for use with the dark field illuminator, it is not useless for ordinary work. On the contrary, it has a flatter field and greater penetration than the standard objective, thus enhancing its value for routine requirements. It falls short only when put to the rigid test of high resolving power.

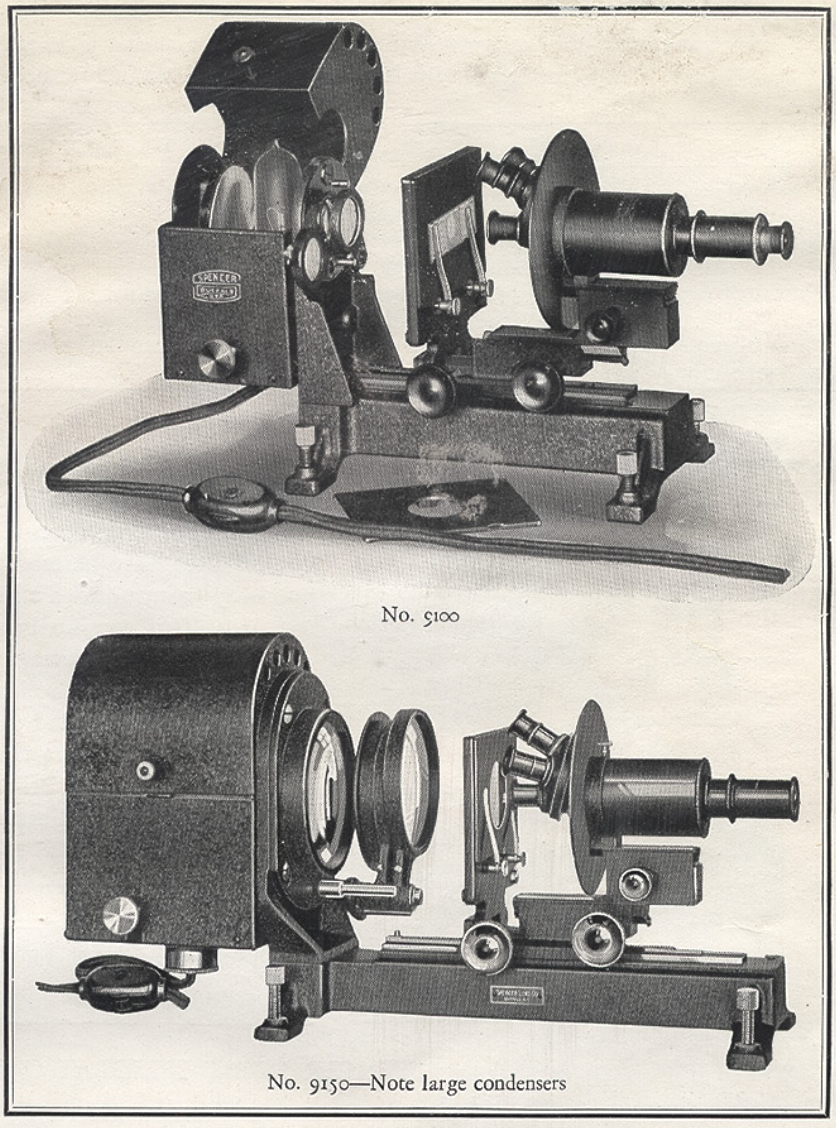
Catalog No.	DESCRIPTION	Price
127 s	Oil immersion objective 1.8 mm. focal length N. A. 0.85, for use with dark field illuminator	$40.00

A NEW SPENCER MICROPROJECTOR

MANY successful instruments for microprojection have already been designed and put on the market. The obstacles in the way of their popularity have been the fact that they were too heavy and cumbersome to move about; that often they required much skill and practice for their manipulation and that the hand feed arc which served as illuminant was satisfactory only on direct current (which is seldom available), and even then required constant attention to maintain its proper adjustment.

In the NEW SPENCER MICROPROJECTORS these defects have been overcome to a remarkable degree. The instruments are light, compact and easy to operate. They can be attached to any standard lighting circuit; can be adapted to either 110- or 220-volt systems and are equally efficient on alternating or direct current.

¶ The illuminant is a 12-volt, 72-watt Mazda bulb mounted on standard base. This is enclosed in a light-tight, well-ventilated hood, sufficient in size to afford ample radiation.



No. 5100

No. 9150—Note large condensers

The optical equipment, in addition to the microscope, consists of a spherical reflector and a triple condensing system. The reflector is so placed as to throw an image of the filament back through the light source, thereby practically doubling the available illumination: three centering screws projecting through the back of the hood provide a means for its accurate centering.

Condensing systems are carefully computed for the definite purpose for which they are used, and accomplish results far superior to those attainable with any system designed for " all-around " work. They consist of three elements usable either singly or together. The single elements are adapted for low power objectives and the combination for those of high power.

A disc of special heat-absorbing glass is so mounted that it may be swung in or out of the optical axis as required. This glass affords a remarkable degree of protection against overheating the slides.

The microscope is of standard size, with coarse and fine adjustments, having ample range. The entire instrument is adjustable to and from the condensing system by rack and pinion. This movement, corresponding to the adjustment of the substage in ordinary microscopes, enables the operator, after correlating the lamp and condenser, to bring the microscope into exactly the right position in the cone of light.

The body tube of the microscope is two inches in diameter and carries a standard size draw tube. It is removable to permit the use of wide angle objectives without ocular. Two interchangeable stages having circular apertures of 17 mm. and 36 mm. respectively are provided. A blackened metal disc 5 inches in diameter intercepts any stray light from the condenser that might otherwise " fog " the screen.

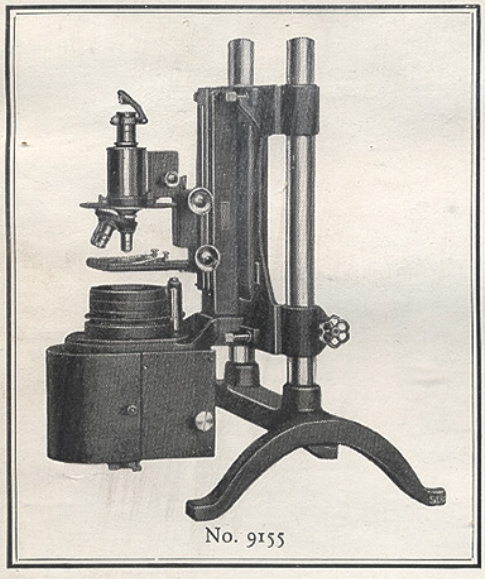
The instruments are mounted on substantial beds with leveling screws.

No. 9100 has 1½ inch condensers of high aperture especially suitable for use with objectives of 16 mm. and shorter focal lengths. Length of bed, 10½ inches; length of entire apparatus, 14 inches; height, 10 inches.

No. 9150 has 4 inch condensers adapted to covering very large areas with low power objectives or for use with drawing apparatus (*see page 57*) where evenness of illumination and easy adjustment are particularly desirable. Length of bed, 13½ inches; length of entire apparatus, 20 inches; height, 10½ inches.

Telegraph Code	Cat. No.	DESCRIPTION	Price
Ninonoo	9100	Micro-Projector as described, with 15 foot cord, switch and plug	$150.00
Ninonfivo	9150	Micro-Projector as described, with 15 foot cord, switch and plug	175.00
Ninontoo	9120	*Resistance with ammeter attached for use on 110-volt circuit, direct or alternating current	35.00
Ninontofiv	9125	*Resistance with ammeter attached for use on 220-volt circuit, direct or alternating current	45.00
Ninonthreo	9130	12-volt, 72-watt, Mazda Bulb, standard base . . . . . NET	1.85
Ninonthrefiv	9135	Case for Projector and Resistance	15.00

*If required without ammeter, deduct $10.00



No. 9155

In microscopic projection it is frequently desirable to project from the slide while it is lying in a horizontal position so that freshly mounted specimens, or even specimens in water, are conveniently handled. In the devices that have heretofore been offered for this purpose it has been necessary to introduce a mirror to throw the light through the horizontal specimen. This necessarily sacrifices some light and introduces another attachment to be adjusted. We have overcome this by providing a substantial stand to which either micro-projector No. 9100 or No. 9150 is very easily attached, and placing a right angle prism over the end of the projection ocular. Thus the desired results are accomplished with the same facility and with practically the same intensity of illumination as with the instrument in its horizontal position.

Telegraph Code	Cat. No.	DESCRIPTION	Price
Ninonfivfiv	9155	Stand for supporting in a vertical position micro-projector 9100 or 9150, including prism	$25.00

SPENCER MICRO-TELEPLAT OBJECTIVES

These objectives are constructed after a formula similar to that employed in the manufacture of high grade photographic objectives. They have apertures of from F.5 in the lower powers to F.3 in those of high power. Their covering power is excellent and their illumination exceptionally brilliant.
The mountings are dull black, avoiding all reflections.
These lenses also give excellent results in photo-micrography. When desired for the latter purpose it should be so stated in the order.

SPENCER MICRO-PROJECTION OBJECTIVES

These objectives are constructed more nearly after the formulæ of the regular microscope objectives. They are achromatic and give excellent results. The fields are unusually flat and the definition sharp and distinct. Finished in dull black to prevent reflections.

MICRO-TELEPLATS			STANDARD MICRO-PROJECTION		
No.	Focus	Price	No.	Focus	Price
8760	60 mm.	$38.00	8780	60 mm.	$ 6.50
8762	48 mm.	31.00	8781	48 mm.	6.50
8764	32 mm.	31.00	8782	40 mm.	6.50
8766	24 mm.	31.00	8784	32 mm.	6.50
			8786	16 mm.	8.50
			8788	8 mm.	13.00
			8790	4 mm.	13.00

SPENCER PROJECTION OCULARS

Designed to give a flat, brilliant field. The "eye lens" is focusable on the diaphragm for different screen distances so that it can always be adjusted to give a sharp margin to the picture.

No. 8794—Projection Ocular 3x. . . . . Price, $9.00 No. 8796—Projection Ocular 6x. . . . . Price, $9.00

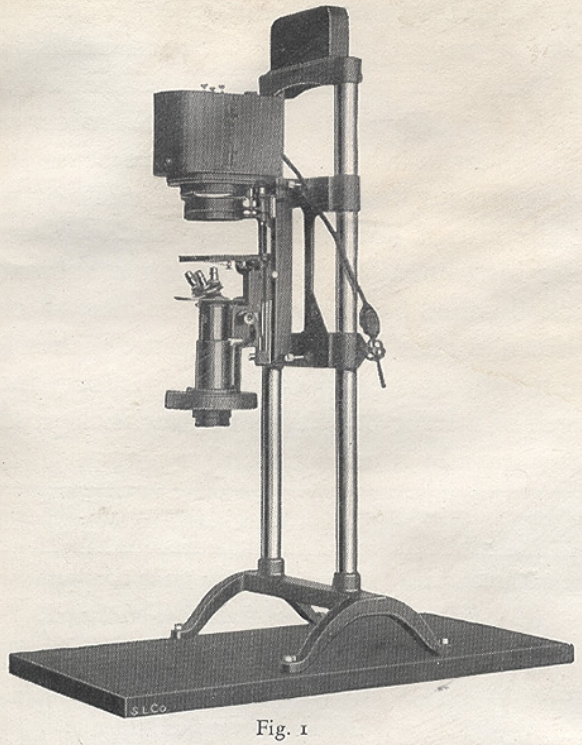


Fig. 1

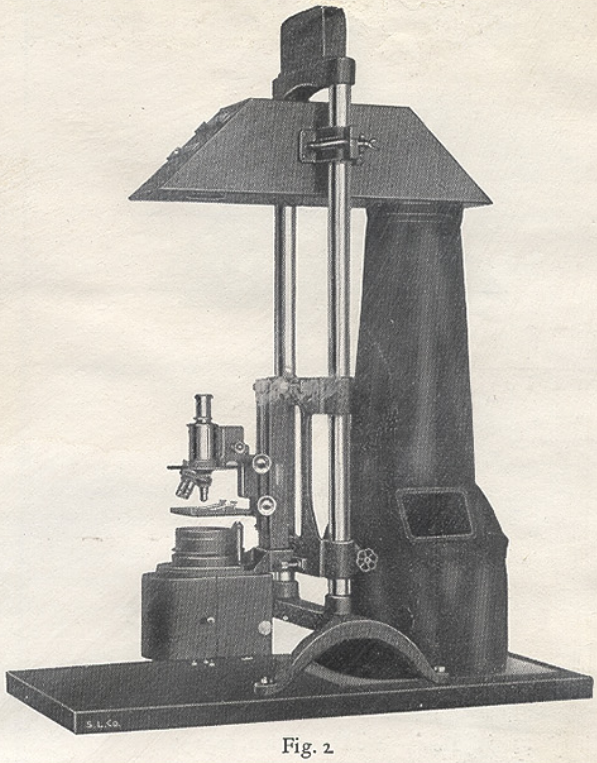


Fig. 2

SPENCER DRAWING APPARATUS NO. 343

THIS is a device designed to support Spencer Projector No. 9100 or No. 9150. *See pages 57 and 58.* It consists of two heavily nickeled steel rods two inches in diameter, supported by a heavy cast iron base, and carrying a suitable frame for supporting the projection microscope either inverted, as shown in figure 1, or upright, as shown in figure 2. This frame is counterpoised by coiled springs of sufficient strength to practically balance its weight with the projection microscope. When assembled as shown in figure 1 the image is projected straight down onto the drawing board, where it may be traced. This is a method of procedure familiar to all laboratory workers.

¶ In devices of this kind, if any considerable projection distance is employed, the instrument is brought to an inconvenient distance from the drawing table, so that the operator must reach to a considerable height for any manipulation of the specimen or drawing apparatus. To overcome this difficulty we have introduced the accessories illustrated in figure 2. Here the projection instrument has been reversed so that the image is projected vertically upward into the metal box illustrated in the diagram. In this box are two first surface mirrors, each placed at 45° to the horizontal, and so arranged that the light rays are reversed and projected back downward onto the drawing board close beside the projection apparatus. This box, like the frame for the projection microscope, is adjustable to any required height. By this means there is attained a projection distance of such length as may be required for high magnification with good penetration, while retaining the convenience of having the drawing and projection apparatus placed side by side.

¶ A hood attached to a ring on the mirror box, or to a suitable frame suspended from the microscope when used without the mirror box, excludes extraneous light from the drawing paper.

The mirror at one end of the box is hinged so that it may be raised as illustrated in figure 3, page 60. When thus arranged the image, instead of being thrown downward onto the drawing paper, is directed

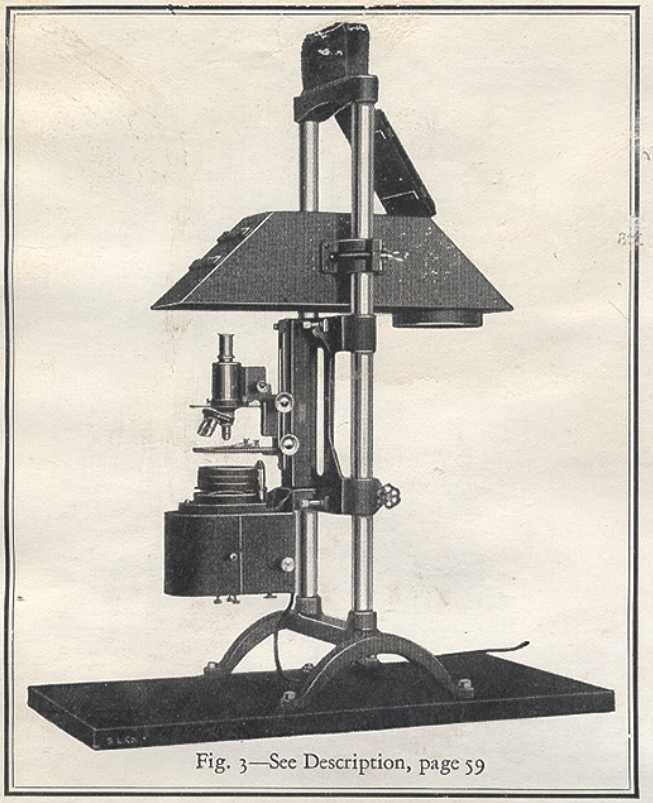
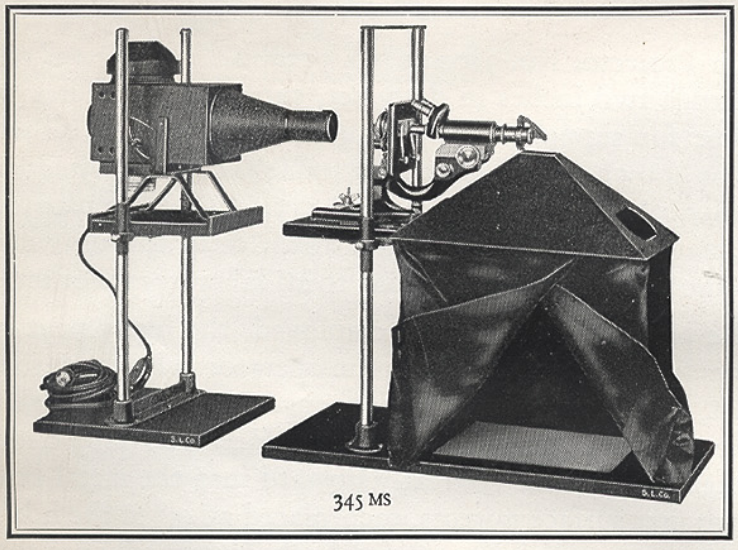


Fig. 3—See Description, page 59

out through the end of the box and may be shown on a vertical screen. This constitutes a convenient means of projection while the specimen is placed in a horizontal position and furnishes an ideal method for displaying to interested observers a specimen from which drawings are being made. The apparatus may be purchased with or without the mirror box, as required. *See list below.* The entire instrument is supported on a substantial black finished base board, two inches thick by eighteen inches wide by thirty-six inches long. The height of the supporting rods is forty inches; length of mirror box, twenty-four inches; size of mirrors, six by nine inches.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Threforthrea	343A	Upright support with counter-balanced frame with hood, but without mirror box. . .	$75.00
Threforthreb	343B	Mirror box for use with drawing apparatus No. 343A . .	50.00

SPENCER DRAWING APPARATUS NO. 345MS



345 MS

THIS is a simple but remarkably efficient apparatus suitable for making drawings with any compound microscope, utilizing a full range of objectives including the oil-immersion. It is capable of a sufficient range of adjustment to meet practically all requirements.

The lamp shown in the illustration, and which we especially recommend, is our No. 394 with 400-watt bulb. *See description, page 63.* Independent adjustment of microscope and lamp tables permits of the use of any type of lamp having the requisite intensity.

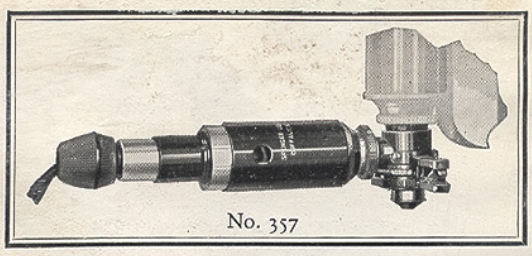
The metal hood, with window conveniently located, serves as a rigid and satisfactory support for the curtain, so that, while the paper is always in full view, it is completely shaded from extraneous light.

The reflector at the end of the tube, by which the image is thrown down onto the paper, is a high grade right angle prism, completely avoiding any "double image" effect.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Threforfivms	345MS	Complete apparatus as illustrated, including drawing board with curtains, supports, etc., with No. 394 lamp and with prism to fit over the ocular, without microscope	$58.50

SPENCER VERTICAL ILLUMINATORS


No. 350


No. 357

NO. 350 vertical illuminator is constructed to screw into the body tube of the microscope between it and the objective. The light is directed into the opening in the side, where it strikes the silvered surface of a prism by which it is reflected through the objective to the object to be examined. It is then reflected back through the objective to the eye. The opening in the side is arranged so that it can be turned in any direction and the prism is so mounted that it can be rotated on its axis.

Vertical illuminator No. 355 is like No. 350, except that the reflecting prism is replaced by a plate glass disc.

The electric vertical illuminator No. 337 consists of a standard type of vertical illuminator of either prism or plate glass construction, as preferred, to which is added a tube about six inches in length containing a low voltage electric bulb. The position of this bulb in the tube is adjustable to meet the varying requirements of different objectives. Near the bulb is a disc of finely ground glass, which becomes quite brilliantly illuminated; an image of this disc is projected by a condensing lens through the objective of the microscope, giving an even and brilliant illumination over the entire field. An iris diaphragm controls the intensity of the light.
The instrument is light in weight and very simple to operate.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Threfivo	350	Vertical Illuminator, with prism reflector	$35.00
Threfivfiv	355	Vertical Illuminator, with plate glass reflector	6.00
Threfivsev	357	Electric Vertical Illuminator complete, as illustrated	8.00
Threthresev	337	Resistance to adapt above 110 V circuit	.65
Threthresix	336	Resistance to adapt above 220 V circuit	13.00
Threthreon	331	Extra bulbs—6 volt Net	.65

SPENCER ELECTRIC ARC LAMP NO. 360


No. 360

THE arc lamp furnishes a more intense light radiating from a smaller source than any other type of illuminant; it is, therefore, especially useful where a strong light is required to be concentrated onto a small area for such purposes as dark field illumination, vertical illumination, photo-micrography, etc. The Spencer arc lamp No. 360 is especially designed to meet these requirements. The carbons are firmly held at an angle of about 70° to each other, which has been found to be the most satisfactory angle for alternating current and is also entirely suitable for direct current. It is so mounted on a vertical rod as to be adjustable for both height and angle. The protecting hood is provided with smoked glass windows, through which the position of the carbons may be observed when the arc is burning. The instrument is equipped with a focusable bullseye condenser and five feet of cord with plug.

The current necessary for the operation of the lamp may be drawn from any standard lighting circuit by the interposition of a suitable rheostat. (Direct current is always to be preferred, but very satisfactory results are obtained from alternating current.)

Telegraph Code	Catalog No.	DESCRIPTION	Price
Thresixo	360	Lamp with blue glass and ground glass	$27.50
Thresixob	360B	Lamp with Daylite glass	29.75
Thresixto	362	Fixed rheostat for 110 volts—5 amperes	8.75
Thresixfor	364	Fixed rheostat for 220 volts—5 amperes	12.50
Thresixsix	366	Carbons each	.06



No. 374

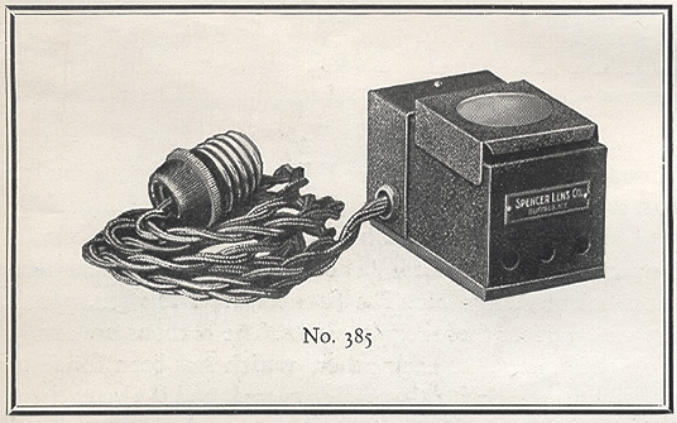
SPENCER MICROSCOPE LAMP NO. 374

THIS is an exceedingly practical lamp for general laboratory work. It consists of a standard commercial 100-watt, 110-volt gas-filled pear-shaped Mazda bulb mounted in a well ventilated hood in such a way as to provide ample adjustment.

By means of a reflector back of the bulb and a bullseye condenser in front of it, the light is well concentrated to a small area; it is, therefore, serviceable for illuminating opaque objects for examination with binocular microscopes as well as for the more ordinary microscope requirements.

Five feet of cord, with plug and key socket, are included with the outfit.

Telegraph Code	Cat. No.	DESCRIPTION	Price
Thresevfor	374	Lamp with one bulb, blue and ground glass	$17.50
Thresevforb	374B	Lamp with one bulb and Daylite glass	18.85
Thresevate	378	100-watt, 110-volt P. S. 25 Mazda bulb	.75
Thresevatea	378A	100-watt, 220-volt P. S. 25 Mazda bulb	1.00
Threateo	380	Resistance for 100-watt bulb in series on 220-volt current	7.50



No. 385

SPENCER MINIATURE ELECTRIC LAMP NO. 385

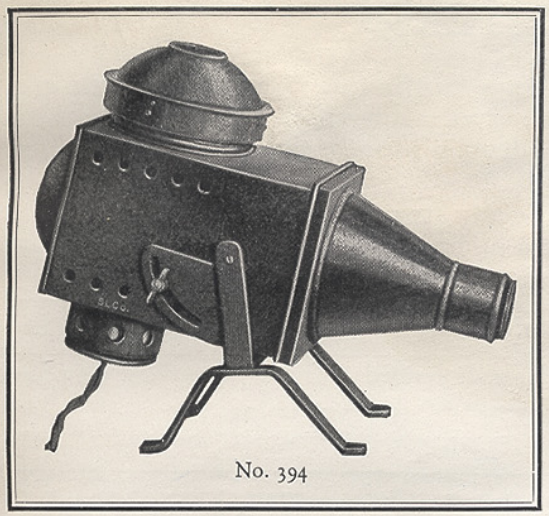
THIS is an exceedingly popular and convenient lamp for use with any microscope. It is small enough to be placed directly beneath the stage of the instrument, and when so placed gives illumination sufficient for even high power objectives. It may be used either with or without the substage condenser.

The back and base are made of wood to avoid scratching surfaces of desks or tables on which it may be placed. The covering is of sheet metal finished in durable dull black and is so designed that light escapes only through the glass window by which the microscope is illuminated.

The illuminant is a 15-watt, 110-volt, gas-filled bulb, with concentrated filament. Back of the bulb is a spherical concave reflector that adds very greatly to the intensity of the illumination.

Five feet of flexible silk insulated wire, with plug, is included.

Telegraph Code	Cat. No.	DESCRIPTION	Price
Threatefiva	385A	Lamp with one bulb, blue and ground glasses	$5.50
Threatefivb	385B	Lamp with one bulb and Daylite glass	6.50
Threatesix	386	15-watt, 110-volt concentrated filament bulb	1.00
Threatesev	387	Resistance for a 15-watt bulb in series on 220-volt current	4.25



No. 394

SPENCER HIGH POWER MAZDA MICROSCOPE LAMP NO. 394

THIS lamp furnishes a strong beam of light without the objections incident to an arc. It is equipped with a 400-watt Mazda gas-filled concentrated filament bulb, back of which is a silvered glass reflector. Directly in front of the bulb is a pair of four and one-half inch diameter condensing lenses, which throw a converging beam of light, very intensely illuminating an area about two inches in diameter. It thus becomes an excellent instrument for use with the dark field illuminator, for photo-micrography and other microscope work. The apparatus may be tilted at any desired angle.

This lamp may be supplied with an attachable section and projection lens to form an efficient, compact and very convenient stereopticon. See list below.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Threninfor	394	Lamp with bulb, one blue and ground glass	$30.00
Threninforb	394B	Lamp with one bulb and Daylite glass	32.25
Ateotoate	8028	Set of accessories to convert 394 lamp into a stereopticon for lantern slide projection, including lens	20.00
Threatefivthre	3853	Resistance for 400-watt bulb, in series on 220-volt current	8.75
Threateono	3810	400-watt, 110-volt Mazda bulb	3.10
Threateonon	3811	400-watt, 220-volt Mazda bulb	6.00

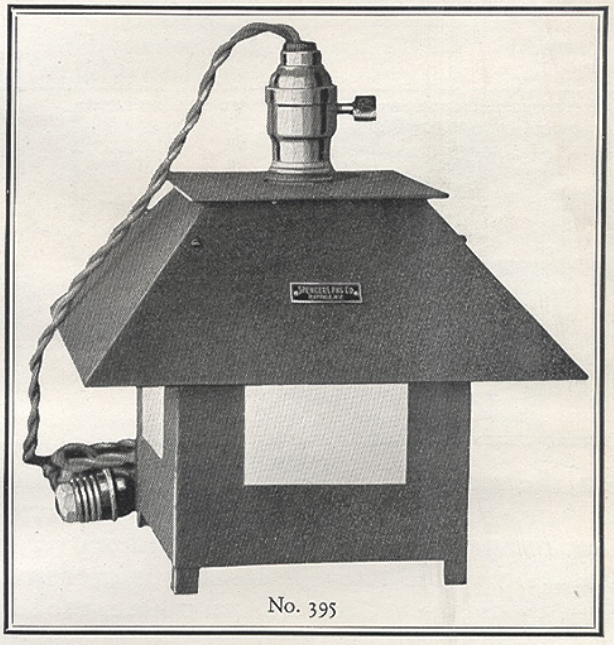
THE CHALET LAMP NO. 395

THIS lamp was designed by Prof. S. H. Gage, of Cornell University, for use in his own and his students' laboratories. It has been found to be an eminently practical instrument.

The outfit consists of a sheet metal box, six inches square by eleven inches high, having wide, overhanging eaves on two or four sides, as required. The overhang of these eaves is such that light does not reach the eyes directly but that an even illumination is diffused over the table for general work. Illumination for microscopic work is obtained from three inch square windows of special Daylite glass, which gives a light that is practically ideal for the purpose.

The inside of the lamp house and the under side of the overhanging eaves are finished in white enamel.

The illuminant is a 100-watt, 110-volt pear-shaped Mazda bulb.



No. 395

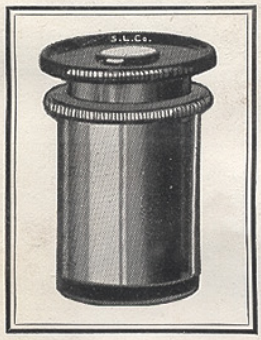
Telegraph Code	Catolog No.	DESCRIPTION	Price
Threninfiva	395A	Lamp with one Daylite glass window	$13.00
Threninfivb	395B	Lamp with two Daylite glass windows	16.00
Threninfivc	395C	Lamp with four Daylite glass windows	23.00
Thresevate	378	100-watt, 110-volt P. S. 25 Mazda bulb Net	.75
Thresevatea	378A	100-watt, 220-volt P. S. 25 Mazda bulb Net	1.00
Threateo	380	Resistance for 100-watt bulb in series on 220-volt circuit	7.50

SPENCER MICROMETERS

THE following list of micrometers for use both on the stage of the microscope and in the eyepieces is selected with especial care, having in mind the purposes for which they are to be used. We have endeavored to steer a medium course between the demands for extreme exactness and for easy visability of lines.

We are always prepared to manufacture micrometers to meet any special demands, either in design of ruling or type of line employed. The fact, however, should be borne in mind that the finer, and hence more exact, are the lines the less easily they are observed.

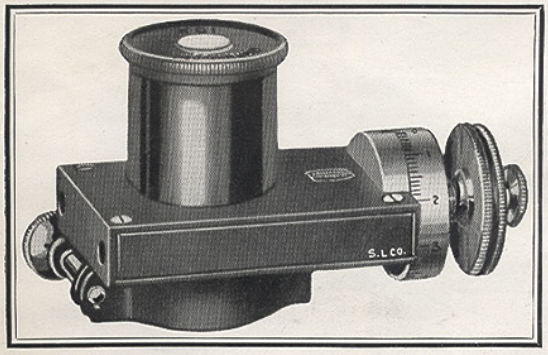
Telegraph Code	Catalog No.	DESCRIPTION	Price
Foroo	400	Stage Micrometer. Glass object slide with 2 mm. scale divided into 200 parts . . .	$7.00
Forofiv	405	Eyepiece Micrometers 5 mm. divided into 50 parts (to 0.1 mm.)	2.50
Forono	410	5 mm. divided into 100 parts (to 0.05 mm.)	2.75
Foronto	412	"Step" micrometer disc	3.50



MICROMETER EYEPIECES WITH FIXED SCALE

THESE instruments consist of standard eyepieces having the eye lens made focusable by spiral action. The micrometer disc is fixed to the diaphragm of these eyepieces and can be brought into sharp focus for any eye. They are regularly supplied in powers of 6x and 10x, but other powers can be furnished if required. In the following list the 5 millimeters scale No. 405 is supplied attached to the eyepiece diaphragm. Other discs, Nos. 410 or 412, may be substituted at an additional cost equal to the difference between the price of disc No. 405 and that of the disc selected.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Foronfiv	415	Micrometer eyepiece, 6x	$8.50
Fortoo	420	Micrometer eyepiece, 10x	8.50



FILAR MICROMETER

THIS micrometer eyepiece represents the highest type of precision in construction and guarantees the greatest possible accuracy of measurement. Instead of the usual cross hairs, a finely-ruled glass scale is used in its construction. 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 and which 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 the filar micrometer, it does not require the moving 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.

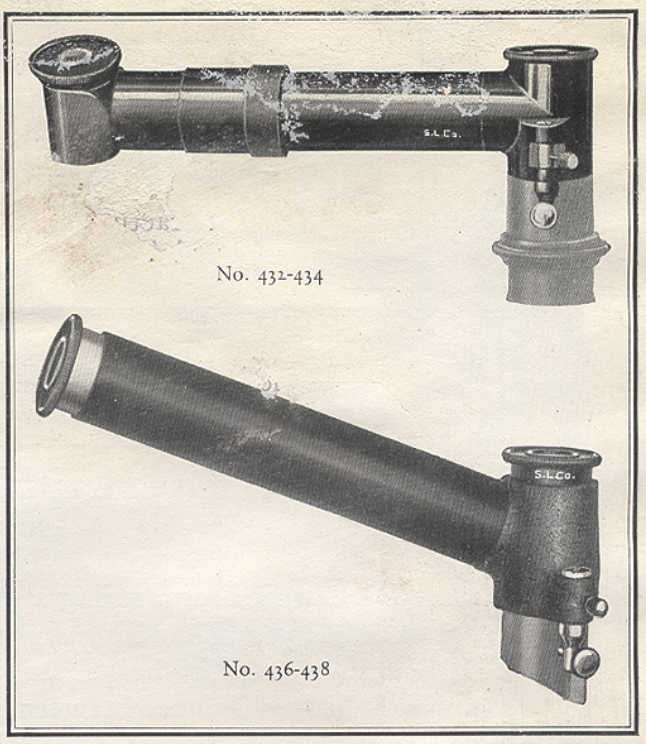
In measuring the length of an object, the scale is moved until one of the millimeter lines coincides with the margin of the object under examination; and then, by noting the amount of revolution necessary to bring another line into coincidence with the opposite side, the fractional part of the last division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

The scale has twenty-five divisions, with every fifth division indicated by a line of double length and numbered. The center of the scale is marked by a cross.

Permanence of position of the instrument on the microscope is assured by a spring collar, which is set tight on the top of the microscope tube by a thumb screw.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Fortofiv	425	Micrometer Eyepiece	$38.00

SPENCER DEMONSTRATION OCULARS



No. 432-434

No. 436-438

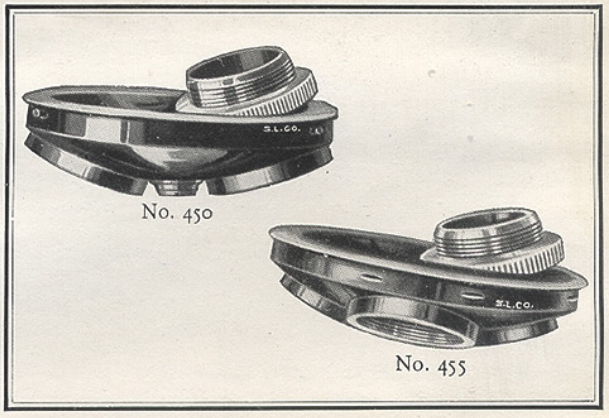
THIS is a well known device of extreme utility. It fits any standard microscope and enables the instructor to look in on the field that his pupil is studying. It is used by simply removing the ordinary eyepiece from the microscope and inserting the demonstration ocular in its place. The pupil then looks into the instrument as before and the instructor, by looking into the side tube, views the field at the same time; the instrument can thus be used either for giving instruction or for making quizzes. A conveniently located pointer, easily moved to any part of the field, is visible at the same time to both pupil and instructor.

The instrument is made in two designs. In numbers 432 and 434 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 such an angle to the vertical as he pleases, independently of the position of the microscope. In this design the auxiliary eyepiece is focusable independently of the one at the microscope tube by a knurled ring in the extension tube.

Numbers 436 and 438 have the extension tube fixed at an angle of about 120° to the microscope tube. The auxiliary eyepiece is placed in the end of this extension and is focusable independently of the other ocular by slightly varying its position in this tube.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Forthreto	432	With 6x oculars	$45.00
Forthrefor	434	With 8x oculars	45.00
Forthresix	436	With 6x oculars	40.00
Forthreate	438	With 8x oculars	40.00

SPENCER REVOLVING NOSEPIECE

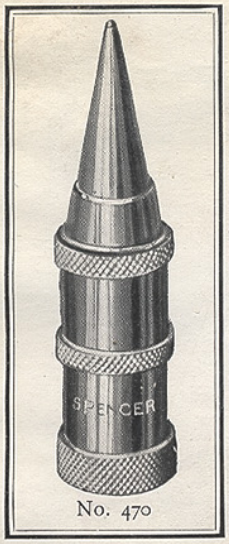


No. 450

No. 455

THESE nosepieces are made with extreme precision. The greatest care is exercised in their centering and they have the requisite rigidity for permanently retaining their adjustment. The finish is alcohol-proof black enamel with the focal lengths of the standard objective to be used in each receptacle neatly engraved on the edge of the revolving portion.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Forfivo	450	Double nosepiece	$ 6.75
Forfivfiv	455	Triple nosepiece	8.50
Forsixo	460	Quadruple nosepiece	11.00



No. 470

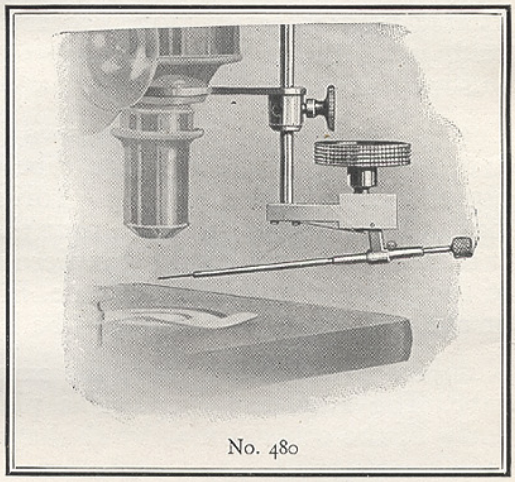
SPENCER IMMERSION OIL DROPPER

THIS is a very convenient device, not only for transporting immersion oil, but as an oil container to be used on the laboratory table.
By pressing it on the end, it is made to deliver a single drop of oil at a time and is thus very serviceable for applying oil to the specimen. When released, it automatically seals itself so that the oil is kept from drying up. The top portion is easily removed for the purpose of refilling.

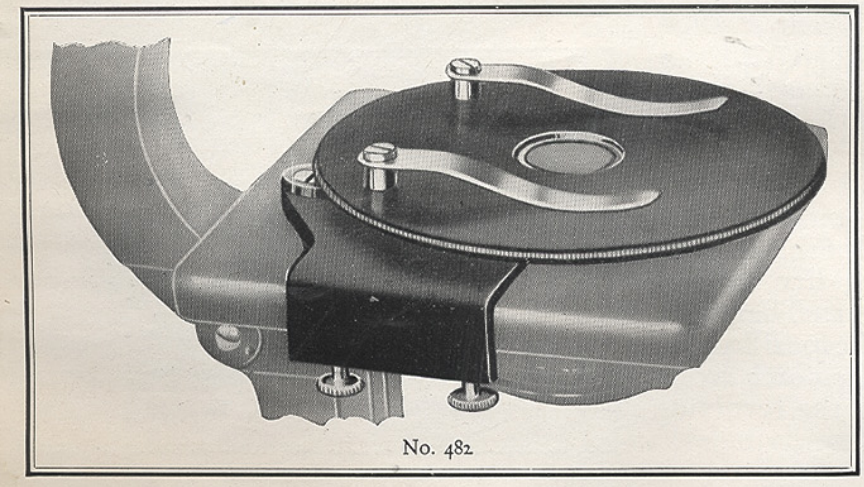
Telegraph Code	Catalog No.	DESCRIPTION	Price
Forsevo	470	Spencer Immersion Oil Dropper filled with immersion oil	$2.75

ATTACHABLE MECHANICAL FINGER

THIS instrument is designed for carrying a glass fiber for the purpose of isolating and handling objects under the microscope. It is adjustable as to height and azimuth in the forked support which is clamped between the shoulder of the objective and the tube. A small rod sliding through a sleeve is so mounted that it may be tilted to any desired angle by means of a fine screw with large knurled head which works against a light spring. By means of this instrument one is able to perform the most delicate manipulations while watching the operation under the microscope.


No. 480

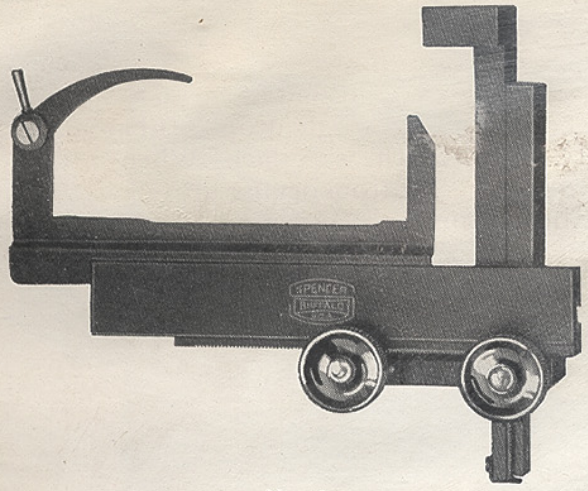
Telegraph Code	Catalog No.	DESCRIPTION	Price
Forateo	480	Mechanical finger	$28.00


No. 482

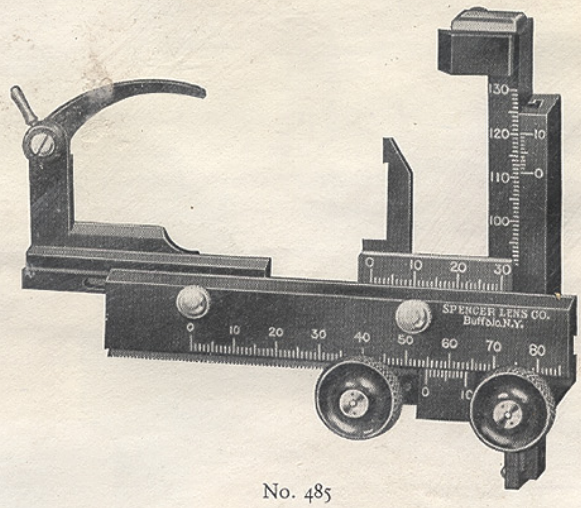
ATTACHABLE REVOLVING STAGE

THIS instrument is so constructed that it may be quickly and easily attached to any ordinary microscope and accurately centered. A removable opaque disc is provided for stopping the central opening, making the attachment equally available for handling either opaque or transparent specimens.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Forateto	482	Attachable revolving stage	$28.00



No. 484



No. 485

SPENCER MECHANICAL STAGES

THE advantage of the mechanical stage is unquestionable. It is the only means by which the entire area of a slide can be systematically examined, and by which any desired portion can be quickly and conveniently relocated.

The type of mechanical stage in which the two adjustment buttons retain a constant relative position was originated by Spencer Lens Company more than fifteen years ago and has never been materially improved upon.

Spencer mechanical stages have exceptionally rigid construction. The diagonal cut rack and pinions are of such size and rigidity as to insure a permanently smooth and uniform movement.

Numbers 484, 485 and 490 are readily attachable to any rectangular stage instrument. Number 493 is fitted to Spencer instruments only, and the fitting must be done at the factory.

MECHANICAL STAGE NO. 484

THIS stage meets the requirements of a large class of pathologists and bacteriologists whose interest is in routine examination only and who do not care to record exact positions for future reference. It is permanently adjusted to receive standard size (1″ x 3″) slides. The range of motion is sufficient to completely cover such slides on microscopes having a stage of sufficient size for the purpose.

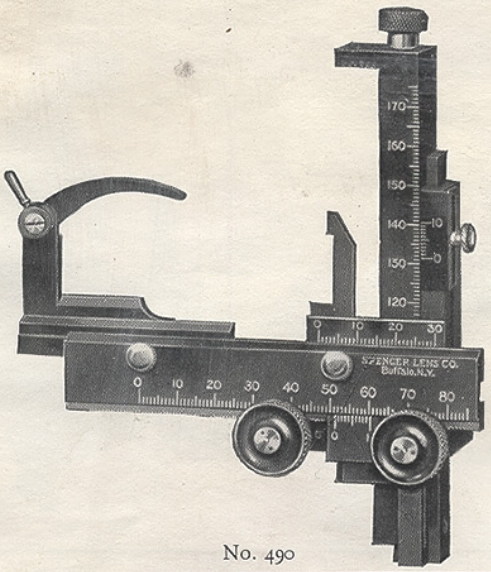
Telegraph Code	Catalog No.	DESCRIPTION	Price
Foratefor	484	Mechanical stage, in case	$25.00

MECHANICAL STAGE NO. 485

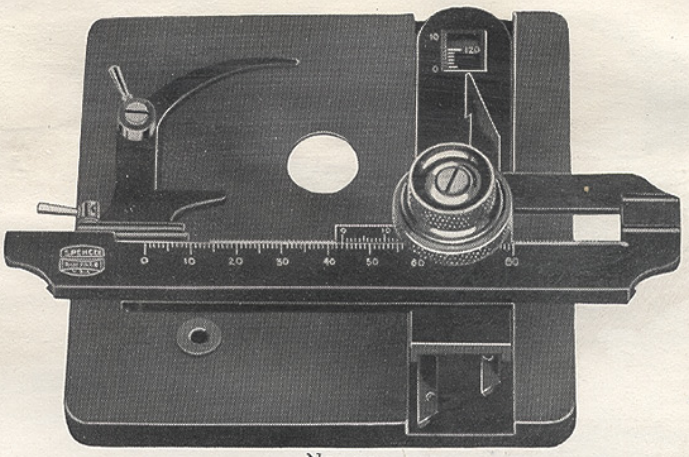
THIS is our most popular model. The arms are graduated for reading positions in two directions at right angles to each other. These graduations are in millimeters with verniers reading to tenths. It is provided with a corner stop to insure its always assuming the same position on the stage of the microscope.

Both the spring finger and the end support for the slide are adjustable laterally to make compensation for different sized stages if the attachment is transferred from one instrument to another.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Foratefiv	485	Mechanical stage, in case	$30.00



No. 490



No. 493

MECHANICAL STAGE NO. 490

THIS is a stage of exceptional size, accommodating slides up to 2″ by 3″. It attaches to the edge of the microscope stage in such a way as to permit the corner of large slides to extend over the corner of the stage so that the entire area of even the largest sized slides can be brought under observation.

Adjustments are provided in both directions to permit compensation for varying sizes of microscope stages. Thus, if the attachment is transferred from one instrument to another having a different sized stage, it can be so set that all readings made on the first microscope will be true on the second.

Positions of the slide are read by verniers to tenths millimeters.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Fornino	490	Attachable mechanical stage, in case	$32.50

MECHANICAL STAGE NO. 493

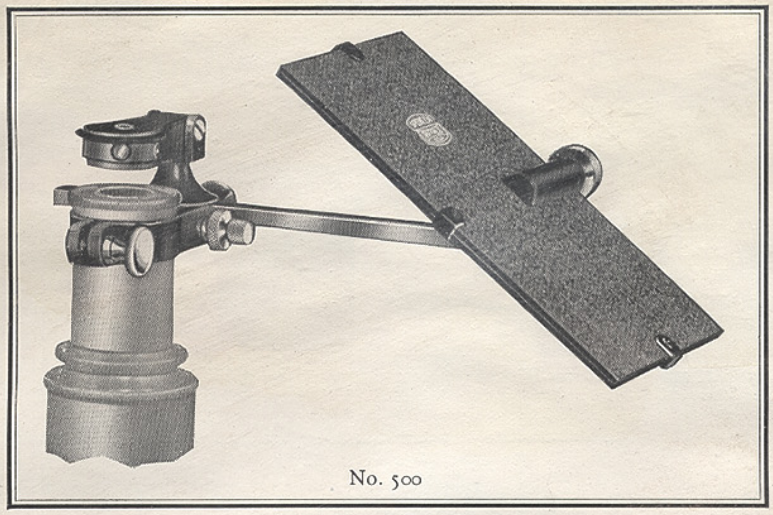
THIS type of mechanical stage has proven so popular in connection with our revolving stage microscopes that we have been led to adapt it for use on rectangular stages as well. It differs from our "attachable" mechanical stages in that one of its racks for the rack and pinion movements is embedded in the stage of the microscope. (A slide fitting flush with the top of the stage is provided for covering this rack when the mechanical stage is removed.) This method of attaching assures perfect uniformity of position, so that recorded readings are absolutely reliable and also that the slide carrier will always fit snugly to the surface of the microscope stage.

The pinion buttons are concentric, one being smaller and slightly above the other.

Positions of the slide are read by verniers to tenths of millimeters.

Each instrument is individually fitted to the microscope which it accompanies and *must be ordered with it*. If required for microscopes that have already left the factory the microscope must be returned to be fitted with an entire new stage, for which an additional charge is made.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Forninthre	493	Mechanical stage as described—when ordered with the microscope	$35.00



No. 500

SPENCER CAMERAS LUCIDA NOS. 500 AND 505

IN these well known instruments material improvements have been incorporated by which the entire field of the microscope is taken in, and the light can be so regulated as to illuminate both the object and the drawing pencil with the optimum relative intensity.

The adjustment for height is sufficient to permit the prism box to be brought to the eyepoint of any ocular from the highest to the lowest power. In No. 500 two concentric adjusting screws are provided for correct centering of the instrument over the eyepiece.

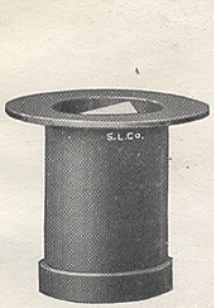
The entire prism box is so hinged as to swing on a horizontal axis and is thus easily thrown out of position for changing oculars or for careful examination of the object without the interposition of the prism.

In No. 500 the relative intensity of illumination of the object and drawing pencil is regulated by two carefully graded series of "smoked glass" discs; one between the prism and the eyepiece and the other between the prism and the mirror. By careful adjustment and correlation of these discs it is possible to divide the light to suit any individual requirements.

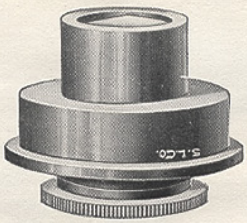
No. 505 differs from No. 500 in the omission of the centering screws from the prism box and the series of "smoked glass" discs between the prism and the eyepiece.

The mirror is of ample size (70 x 105 millimeters). It 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.

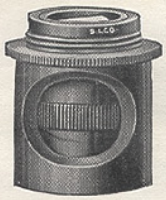
Telegraph Code	Catalog No.	DESCRIPTION	Price
Fivoo	500	Camera Lucida, in case	$30.00
Fivofiv	505	Camera Lucida, in case	20.00



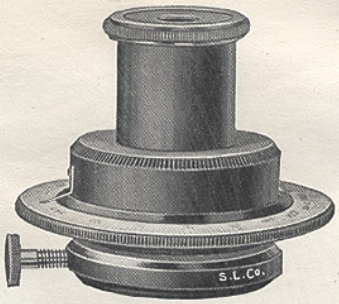
Polarizer A



Polarizer B



Analyzer A



Analyzer B

POLARIZING APPARATUS

IN our polarizers and in analyzer A we employ Nicol prisms of the well-known type. Analyzer B is equipped with a "Glan-Thompson" prism which, for this particular purpose, possesses several distinct advantages:

FIRST: It takes in a wide angular field and thus becomes available for use above higher power eyepieces than can be used with Nicols.

SECOND: Since the face of the prism is perpendicular to the optical axis of the microscope the rays of light enter it at a small angle from the normal and hence suffer little loss by reflection at the surface.

THIRD: They have no astigmatic effect on the image.

FOURTH: The image remains stationary while the analyzer is rotated—a condition that is seldom attained with Nicols.

For convenience of those who desire to select apparatus for different purposes and to fit various types of instruments, we offer both polarizers and analyzers in two designs of mount. Either polarizer may be used with either analyzer.

POLARIZER A is mounted in a ring with a flange to be supported by the iris diaphragm beneath the condenser.

POLARIZER B is mounted in a ring which replaces the substage condenser. It is free to revolve in this ring.

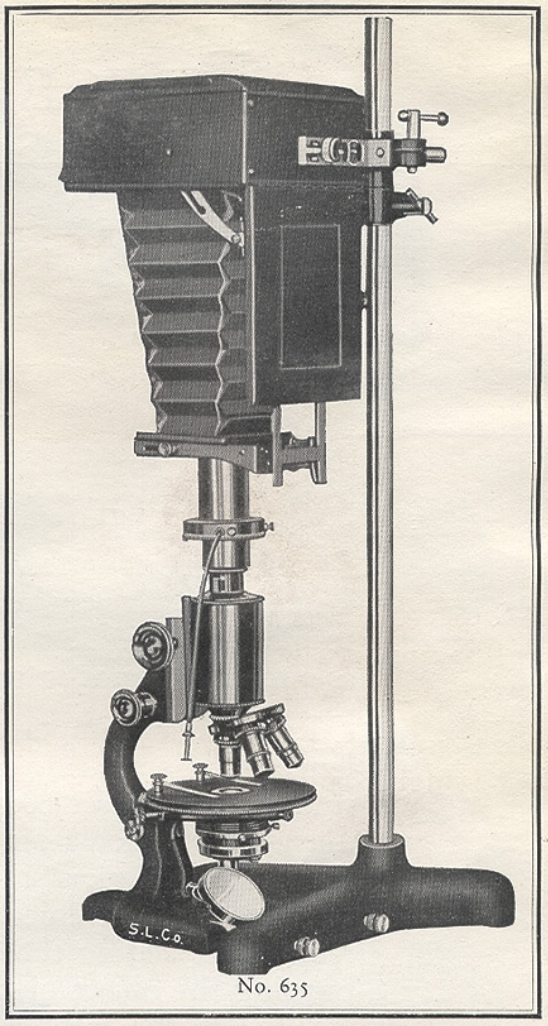
ANALYZER A is supplied in a mount with society thread so that it may be inserted between the lower end of the microscope tube and the objective.

ANALYZER B is supported in a mount to be placed over the microscope draw tube, bringing the analyzer above the eyepiece. It is provided with a graduated disc reading positions of rotation to single degrees.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Fivtothre	523	Analyzer A	$24.00
Fivtofiv	525	Analyzer B	40.00
Fivthrethre	533	Polarizer A	20.00
Fivthrefiv	535	Polarizer B	24.00

SPENCER
PHOTO-MICROGRAPHIC CAMERA

Designed by Dr. L. B. WILSON
ROCHESTER, MINN.



No. 635

THIS extremely simple apparatus finds a wide range of application in various laboratories. It is suitable for photographing with low or medium powers of the microscope using ordinary illumination—either daylight or artificial—or for copying and general photography. It is very convenient for photographing such small objects as insects, leaves, fruits, etc., or other gross laboratory specimens. In fact, the instrument fairly deserves the title of "A Universal Laboratory Camera."

The apparatus consists of a slightly modified hand camera supported on an upright rod attached to a heavy cast-iron tripod base.

Between two feet of the tripod are adjustable stops by which a constant position of any given microscope can be assured. The camera is adjustable vertically on the rod and may be rotated about the rod through a complete circle; it also rotates through a complete vertical circle, giving it *universal* adjustment. There are suitable stops for recording positions so that if the camera is centered over the microscope and swung to one side it may be brought back to exactly its original position.

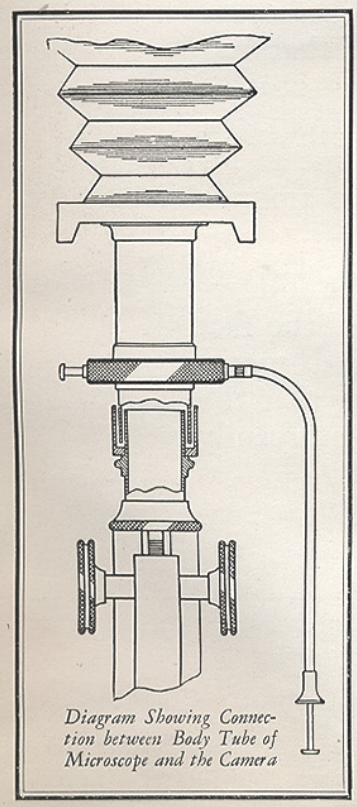


Diagram Showing Connection between Body Tube of Microscope and the Camera

It is regularly equipped with an excellent rapid rectilinear lens and automatic shutter making it available for field work. The lens is removed, and replaced by special adapters to connect the instrument with the microscope tube for photomicrography (*see diagram*).

A base consisting of two base boards separated by four rubber balls for absorbing vibration is supplied at an extra cost, if required. It is of suitable size for supporting the entire apparatus, consisting of stand, camera and microscope. This simple device very successfully absorbs vibration and is a valuable aid in securing clean-cut negatives.

Telegraph Code	Catalog No	DESCRIPTION, PHOTO-MICROGRAPHIC OUTFITS	Price
Sixthrefiv	635	Spencer photo-micrographic outfit, with Folmer & Schwing Camera, 3¼ x 4¼, with one plate holder	$100.00
Sixthresev	637	F. & S. plate holder, 3¼ x 4¼	2.00
Sixforo	640	Spencer Photo-micrographic Outfit with Folmer & Schwing Camera, 4 x 5, with one plate holder	105.00
Sixforto	642	F. & S. plate holder, 4 x 5	2.00
Sixforthre	643	Base for the absorption of vibration	7.50

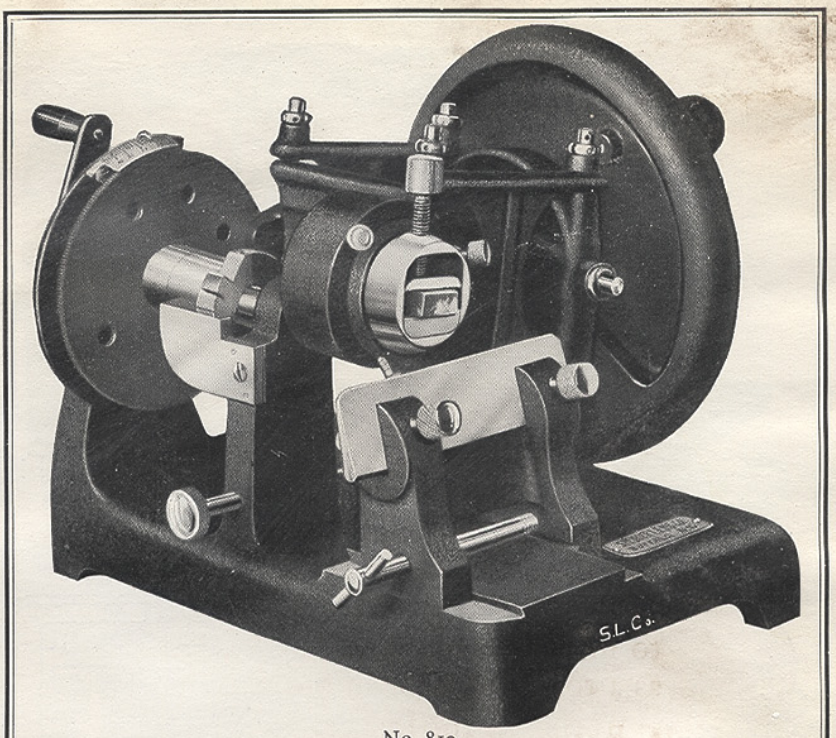
SPENCER MICROTOMES

NO instrument used in the laboratory of the scientist demands greater accuracy in construction or more rigid adherence to correct mechanical principles than does the *microtome.* Performance of absolutely the highest order is expected of these instruments. The entire distance that the object block is expected to move at a single "step" is less than what would be regarded as a tolerable error in ordinary mechanical fitting.

¶ Realizing the importance as well as the difficulty of the problem, and appreciating the fact that no really satisfactory *rotary* microtome had yet been designed, the Spencer Lens Company, during the period from 1908 to 1912, conducted an exhaustive research with view to designing an instrument that should combine the convenience of rotary instruments with the accuracy of the sliding type in which the feed is accomplished by pushing the object block up an inclined plane. This research resulted in the introduction of the Spencer Rotary Microtome No. 820, in which were incorporated two principles that had not heretofore been applied to rotary instruments, viz:—that of leaving the feeding mechanism entirely detached from the object block and of causing the feed screw to act against an inclined plane in such a way as to move the block by an amount smaller than the advancement of the screw.

¶ These two principles are explained more fully in the following detailed descriptions. Their success is attested by the fact that Spencer Microtomes have become a recognized world standard. It is a perfectly conservative statement to say that the Spencer Rotary Microtome No. 820 is the most uniformly feeding *rotary* microtome that has ever been designed.

SPENCER ROTARY MICROTOME NO. 810



No. 810

IN this instrument, the feeding mechanism consists of a substantial micrometer screw having two threads to the millimeter. This screw is actuated by a pawl engaging a wheel, having 250 notches or teeth in its periphery. Thus one tooth represents 1-250 of ½ millimeter, or 1-500 of 1 millimeter; that is, *two microns*. The pawl can be set to feed, at each stroke, any required number of teeth from one to twenty, representing thickness of sections of from two to forty microns. By means of a cam, the pawl is lifted off the teeth on its backward excursion, thus avoiding practically all wear on either the teeth or the pawl.

In feeding, the end of the screw impinges against a polished surface at the back of the object block. This block is hinged at the end of two parallel swinging arms which carry it up and down with a "rocking" motion, causing it to slide over the end of the feed screw. The surface is held against the screw by a strong coiled spring, eliminating all tendency to lost motion and varying thickness of sections.

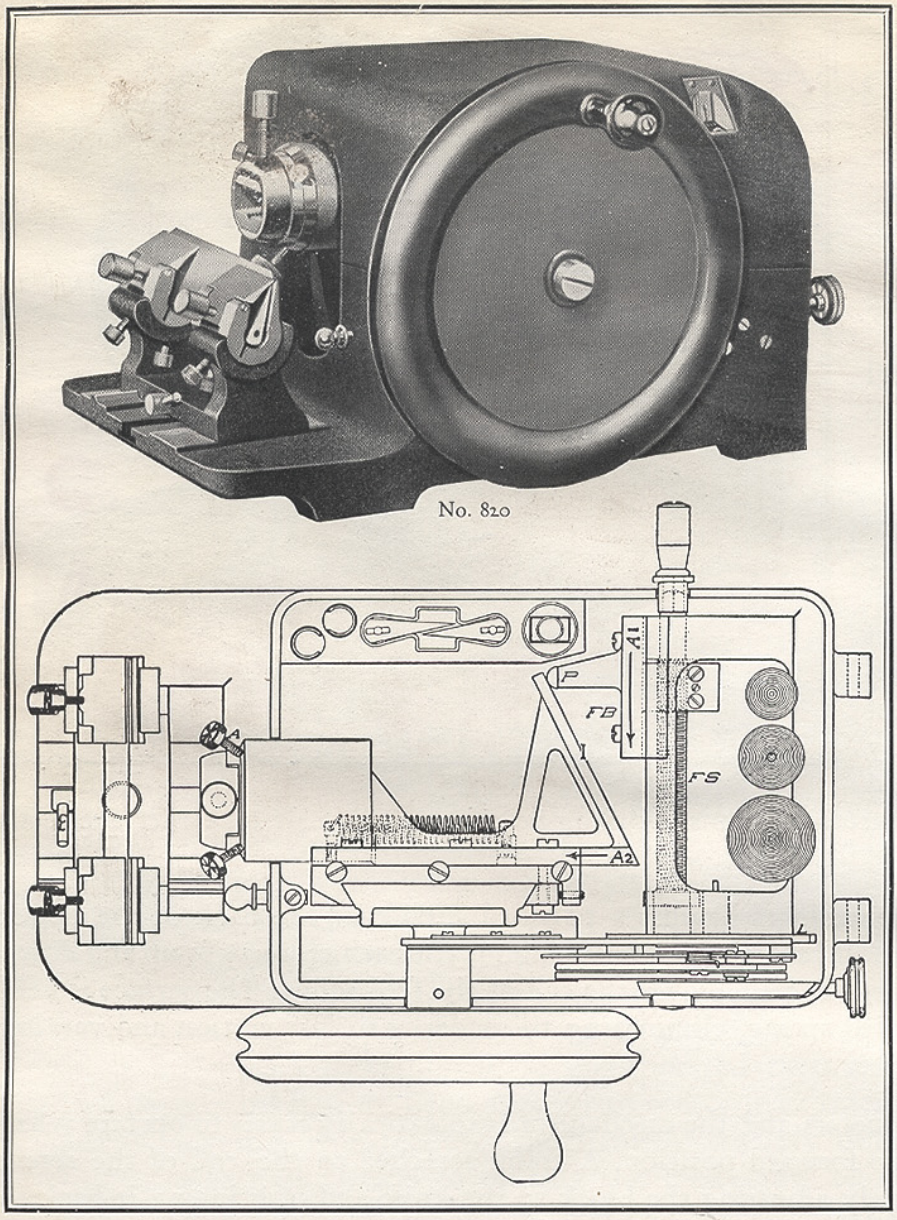
The excursion of feed is 30 millimeters and the mechanism automatically ceases to operate when the block has reached its extreme forward position. A crank attached to the end of the screw provides a means of both accurately adjusting the block to the knife and of bringing it back to its original position when it has advanced to the limit of its excursion.

The object clamp is held in our standard ball and socket holder, which is very easily adjusted and absolutely rigid. In this holder three screws act against a flange in such a way that it may be oriented to any required position and easily clamped in *exactly* the position desired The clamp regularly receives a block 28 millimeters wide by 16 millimeters thick. There is a provision by which the latter dimension may be increased to 22 millimeters. A clamp is provided for locking the block in its uppermost position for trimming specimens.

The instrument is rigidly made and runs very easily and quietly. It is finished in crystal black lacquer, durable and attractive in appearance, and supplied in a substantial case.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ateono	810	Spencer Rotary Microtome with one No. 940 knife, handle and back for sharpening and with three object discs	$125.00

SPENCER ROTARY MICROTOME NO. 820



No. 820

THIS instrument meets the most exacting demands that can possibly be made of a rotary microtome. Its rigidity, uniformity of feed and general dependability have not been equalled in any other microtome of the rotary type.

The general scheme of construction is illustrated in the accompanying diagram. A feed screw (FS) having two threads to the millimeter is actuated by a ratchet wheel having 250 teeth. This wheel is turned by a pawl so operated by a cam that any number of teeth from one to sixty may be fed at a single stroke. A feed block (FB) is threaded to the screw and advances as the screw is turned. To this block is attached a knob (P) which impinges on an inclined plane (I). Now, it is evident that, as the block advances in the direction of the arrow (A1), the sliding part attached to the inclined plane will be urged in the direction of arrow (A2.) The plane against which the knob (P) acts is inclined at such an angle to the line of motion of the object block that the latter advances by a distance equal to *just one-half the forward motion of the knob*. That is, the object block advances one micron for each notch that the ratchet wheel is fed forward. A strong coiled spring retains a constant pressure between the inclined plane and the knob (P).

By means of a mechanism entirely detached from the feeding system, the object block is carried up and down through a range of 50 millimeters, thus making the instrument available for sections of exceptional size. The block can be locked in its uppermost position.

The total excursion of feed is 37 millimeters. The mechanism automatically ceases to operate when the block has reached its extreme forward position.

The object clamp is held in our standard ball and socket holder, which is very easily adjusted and absolutely rigid. In this holder three screws act against a flange in such a way that it may be oriented and easily clamped in exactly the position desired.

The knife is held by two clamps, each of which grips it at the back and, at the same time, along 1¼ inch at the edge. These may be so rotated as to incline the knife at any desired angle to the object. They may also be slipped along the knife to bring them as close together as required, leaving only the necessary space to run the ribbon between the two clamps. This results in holding the knife with exceptional rigidity as well as permitting the use of the knife over its entire cutting edge. The whole knife support is adjustable to and from the object, and is easily clamped in any position by a lever connected with an eccentric cam.

¶ The balance wheel is grooved to permit the running of the instrument by a motor.

The mechanism is well protected from dust by a neat metal casing with hinged cover.

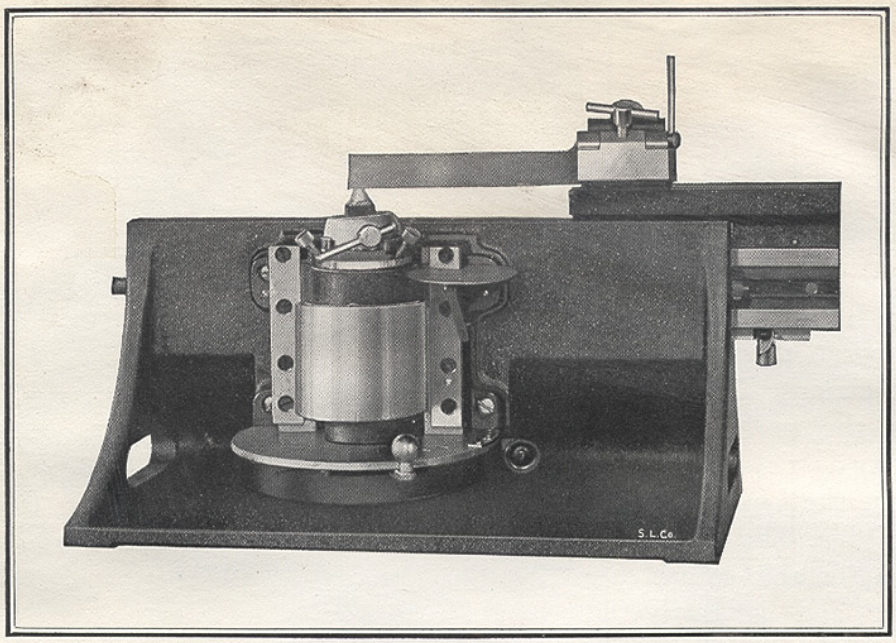
The entire instrument is finished a dull black enamel that is unaffected by alcohol or other ordinary laboratory reagents.



No. 820 Rotary Microtome Showing No. 825 Knife Holder for Celloidin Sections

Two special knife blocks are offered as additional accessories: one (No. 825) permits the inclining of the knife at any required angle up to about 55 degrees for celloidin sectioning; the other (No. 945) holds the knife horizontally but provides for a lateral motion of the entire block through a distance of about three inches, thus furnishing a truly universal adjustment for the knife.

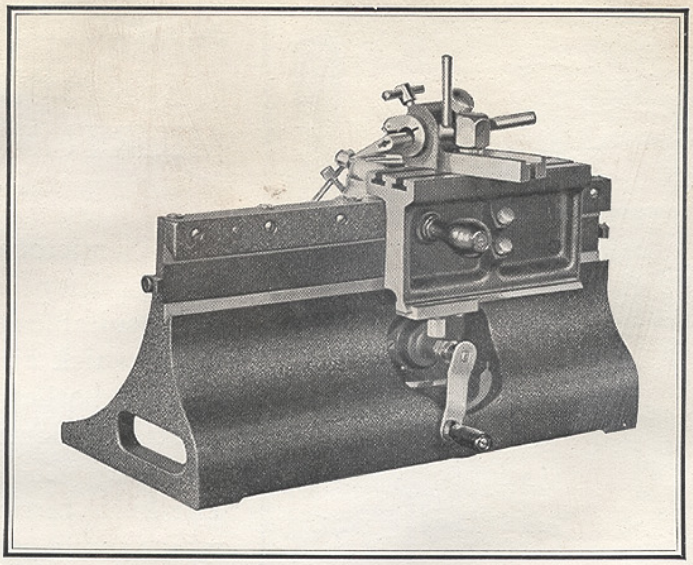
Telegraph Code	Catalog No.	DESCRIPTION	Price
Atetoo	820	Spencer Rotary microtome with one knife, handle and back for sharpening, and with three object discs	$210.00
Atetofiv	825	Knife holder for celloidin sections	25.00
Ninforfiv	945	Adjustable knife holder, permits entire block carrying knife to be shifted sidewise, 1½ inches (3 inches in all) either way, from center	15.00
Atethreo	830	Table with motor, and speed regulator enclosed for 110-volt direct current	100.00
Atethrefiv	835	Same as 830, except for 220-volt current	100.00



SPENCER SLIDING MICROTOME NO. 850

THIS instrument possesses several new and unique features that make for accuracy and convenience without incurring great expense. Chief of these are the method of feed and the position in which the knife block operates.

The feeding mechanism consists of a large feed screw (12 millimeters in diameter) acting through a solid nut directly beneath the center of the object clamp. This screw is not attached to the object clamp but impinges against it, the clamp being held firmly down against the end of the screw by two heavy coiled springs. This feature, unique in Spencer microtomes, has demonstrated its utility in overcoming any tendency to lost motion between the screw and the nut through which it acts. The screw is actuated by a gib attached to the under side of the sliding knife block. This may be placed at any required position on the knife block to operate the feed at any desired point in the backward stroke. This gib engages a lever operating a pawl in a ratchet wheel attached to the screw. The wheel has 250 notches, and the pitch of the screw is two threads to the millimeter; thus a single notch represents a feed of two microns. It may be set to feed any number of notches from one to twenty, representing section thicknesses of from two to forty microns in steps of two. Below the lever is a small crank by means of which the object is quickly and easily brought to its lowest position, or accurately set to the level of the knife. The slot for the knife block, on account of its peculiar shape and position at the back of the instrument, prevents the knife from jumping when it strikes the specimen. It also collects less dust than the old V-type of bearing, and lessens the probability of the sleeve of the operator coming in contact with the oiled surfaces.



The knife block is 150 millimeters long and travels the entire length of the instrument. It is made of case-hardened bronze, which affords an ideal surface for bearing against the cast iron of the slide ways. These bearings are automatically oiled from two small oil cups at the side of the sliding block. Two T-slots in the knife block provide a means of clamping the knife either near the edge for ordinary work or further back when an extreme angle of the knife is required.

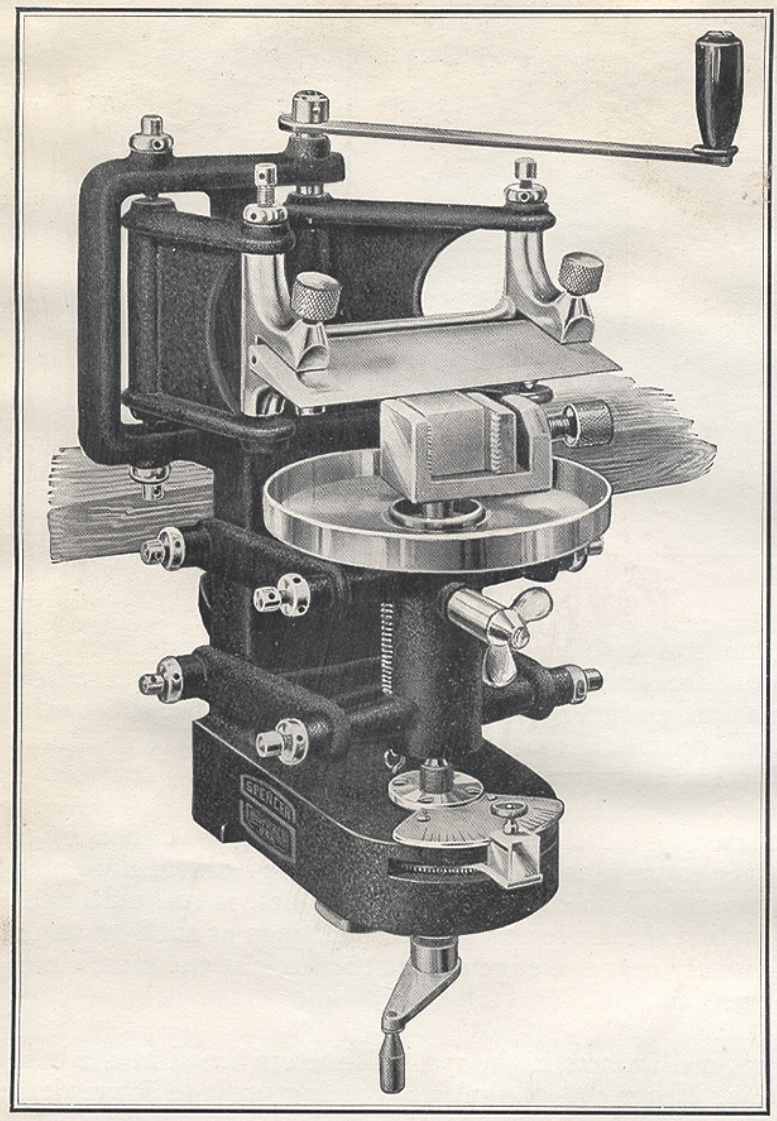
The knife clamp consists of a hollow bronze casting slotted to receive the binding post connecting it at any required angle with the T-slot of the knife block. A cylindrical knife holder, similar in design to the one that has proven entirely successful on our rotary microtomes, is so held in the clamp as to permit of a slight rotation to incline the knife toward the specimen at such an angle as is required. This holder clamps the knife firmly near the edge and at the back at the same time, thereby affording exceptionally rigid support.

The main casting is 350 millimeters long, 175 millimeters high, 170 millimeters broad at the base and weighs 21 kilos. Holes of suitable size at either end of the base casting provide convenient handles for carrying the instrument.

The special features of the microtome may be summarized as follows:

1. Unusually long knife block, with long bronze bearings, which hold it absolutely to place.
2. Extremely long excursion for the knife.
3. Protected knife bearings.
4. A rigid and easily adjustable knife holder.
5. Long bearings for the object block.
6. Extra heavy screw and nut *directly beneath the object*.
7. Screw works against heavy springs.
8. Total excursion of feed and range of thickness of sections unusually great.
9. Extreme precision in whole feeding mechanism.
10. Feeding mechanism enclosed.
11. Automatic feed enclosed and easy to operate.
12. Quick and accurate means for bringing object to any level.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Atefivo	850	Sliding Microtome with 185 mm. knife No. 945	$200.00
Atefivsix	856	Adapter for CO_2 freezing attachment (See page 80)	5.00



SPENCER AUTOMATIC LABORATORY MICRTOMOE NO. 880

THIS microtome, on account of its simplicity and reliability, is especially suitable for hospital laboratories where quick and sure results, without fuss or bother, are demanded. It is especially adapted to frozen or celloidin sections.

The knife carrier is held by two arms which swing on steel pivot screws having check-nuts. The hinged ends of these arms are separated by two inches, while the ends to which the knife clamp is attached have a separation of four inches. This results in the knife describing a peculiar curve, which is especially suited to the type of sectioning required.

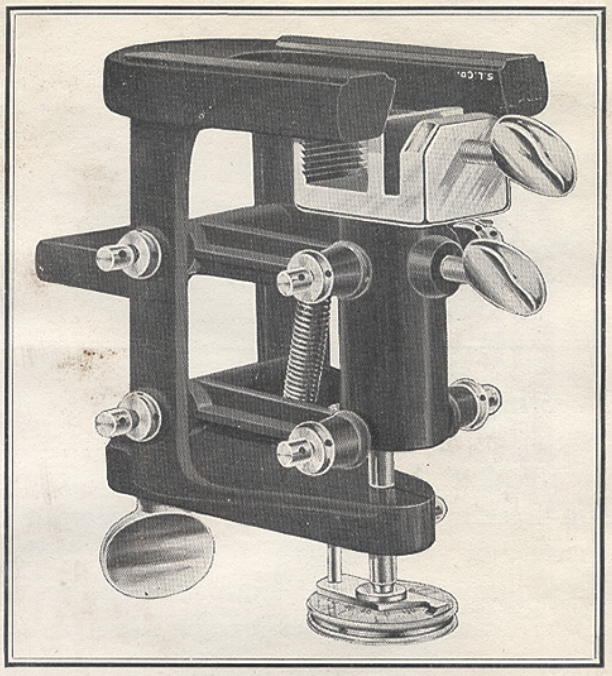
The automatic feeding mechanism, simple in design and rigid in construction, is entirely enclosed, protected from dust and drippings and does not get out of order. In this mechanism an accurately cut ratchet wheel is keyed to a vertical screw held in place by double bearing nuts, which provide for taking up lost motion. The ratchet wheel is operated by a hardened steel pawl which may be set to engage, at a single stroke, any number of teeth from one to twenty, representing section thickness of from five to one hundred microns in steps of five. A short crank attached to lower end of the feed screw provides a means of vertical adjustment of the object block independently of the automatic feed.

A drip pan (which is easily removed to make room for freezing attachments) provides an added protection against the drippings incidental to celloidin work.

The instrument is securely attached to the edge of the laboratory table by means of a heavy clamp. All screws and other exposed parts are heavily nickeled, the main frame-work is finished in alcohol-proof black enamel.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ateateo	880	Automatic Laboratory Microtome with one knife and object clamp for paraffin or celloidin	$100.00
Ateateate	888	Automatic Laboratory Microtome No. 880, with one knife, object clamp, and No. 930 freezing attachment for CO_2. See page 80	116.00
Ateatenin	889	Automatic Laboratory Microtome No. 880, with one knife, object clamp, and No. 915 ether freezer. See page 80	110.00

SPENCER TABLE MICROTOME NO. 900



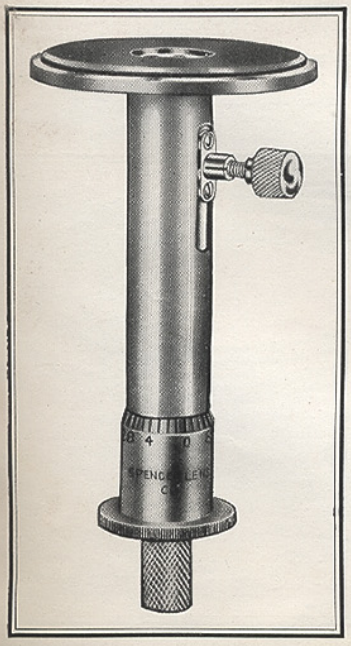
THIS instrument is designed especially for use in hospital laboratories where an inexpensive but practical apparatus is required for rapid work. It is very simple in construction but fully meets the requirements for the purpose mentioned.

The feed is accomplished by means of a simple micrometer screw having two threads to the mm. The micrometer head is divided into 200 divisions, thus each division represents a sectional thickness of 2½ microns. This screw acts directly against the lower end of the socket carrying the object block, forcing it upward against the tension of a coiled spring. This socket is supported at the end of two parallel bars which are hinged at the back of the instrument.

The outfit is especially designed for use with freezing attachments Nos. 915 or 930, *see page 80*, but it may also be satisfactorily used for paraffin or celloidin sections. Two parallel glass supports are provided as a guide for the knife, which is operated by hand. Any section razor or microtome knife may be used, but knife No. 965, listed on page 77, is especially designed for use with this instrument and is found eminently satisfactory. A clamp with a heavy thumb-screw is provided for attaching the instrument to the edge of a laboratory table.

The finish is nickel and alcohol proof black lacquer.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninoo	900	Table Microtome as shown, without knife	$20.00
Ninoto	902	Table Microtome No. 900 fitted with No. 930 Freezing Attachment for CO_2 *See page 80*	33.50
Ninofor	904	Table Microtome No. 900 fitted with No. 915 Ether Freezer. *See page 80* . .	30.00



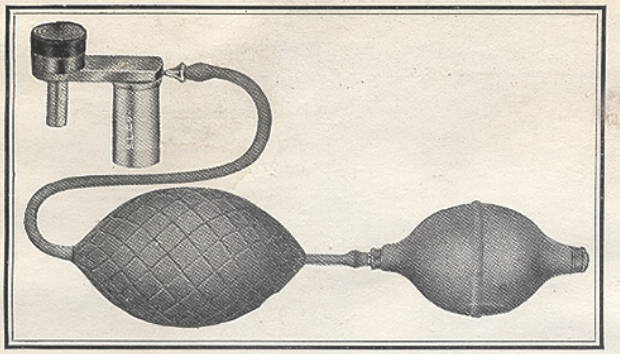
SPENCER HAND MICROTOME NO. 905

IN this convenient but inexpensive microtome the object is placed in a clamp in the upper end of the tube, and is raised through the hole in the glass plate by a carefully cut screw, which is entirely enclosed and protected from dust and injury. The feed is accurately graduated; each division represents 10 microns.

The plate at the top over which the knife is drawn is three inches in diameter, making a firm support for the knife.

Finished entirely in nickel.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninofiv	905	Hand Microtome	$15.00



SPENCER ETHER FREEZING ATTACHMENT NO. 915

THIS instrument is simple in design and thoroughly serviceable.

In operation, a jet of air, forced through a tube by the compression of a rubber bulb, passes over the end of a small pipe leading up from an ether reservoir. By this action ether is drawn from the reservoir, impregnating the air from the jet. The mixture then escapes in a fine stream into the freezing chamber, producing an ideal condition for freezing. A return pipe from the chamber conveys all unused ether back to the reservoir.

The freezing chamber, with the exception of the plate to which the specimen is frozen, is made entirely of vulcanite which so insulates the plate from the rest of the apparatus as to attain the maximum refrigeration from the freezing mixture consumed. Its degree of efficiency is such that a tissue 3 mm. in thickness can be frozen in one minute with the use of not more than 5 cc. of ether.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninonfiv	915	Ether Freezer	$10.00

SPENCER CO_2 FREEZING ATTACHMENT NO. 930

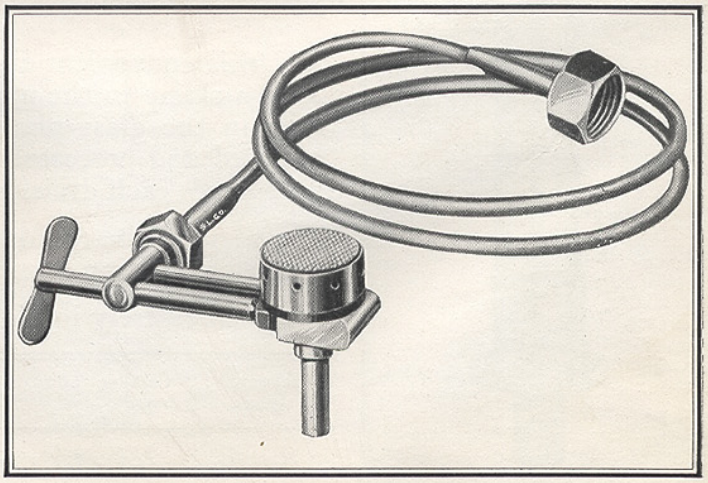
THIS attachment has stood the test of many years' service under a wide variety of conditions and has proven itself to be a simple, practical and thoroughly efficient apparatus.

The freezing chamber, with the exception of the top plate, is made entirely of vulcanite, which effectually prevents the conduction of heat from the main part of the instrument to the specimen. This not only facilitates the freezing of the specimen, but increases the length of time it will remain solid. This instrument, in good working condition, will easily freeze any ordinary specimen in from 15 to 20 seconds.

The gas is fed into the chamber by means of a needle valve operated by a wing nut.

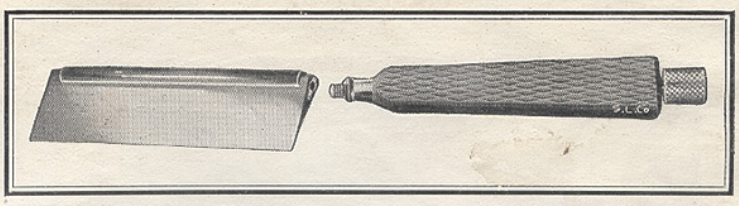
The instrument is readily attached to any sliding microtome. It is supplied with four feet of flexible copper tubing and a nut suitable for connecting to standard carbon dioxide tanks.

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 three or four times in quick succession, the tissue is frozen without waste of gas or inconvenience caused by the chamber or connections freezing up.



Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninthreo	930	CO_2 Freezing attachment	$16.00

SPENCER MICROTOME KNIVES



THE knives enumerated in the following list are manufactured in our own factory, where especial attention is given to the selection of steel best suited to the purpose, and to tempering to the exact degree of hardness that experience has shown to be necessary for holding a keen edge that will neither turn over nor crack off. They are made broad and heavy, affording exceptional rigidity, and are perfectly true to shape, so that when laid on a flat surface the edge and back touch throughout their entire lengths.

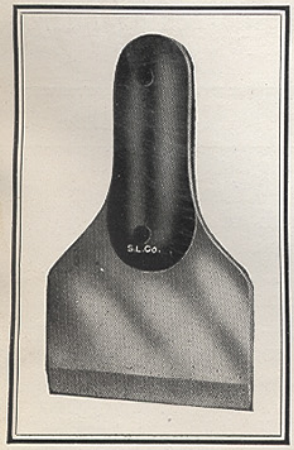
Our sharpening handles are easily and firmly attached by knurled thumb screws and hold the blade as rigidly as though they were built on as an integral part of the knife. They are beautifully finished in ebonized black, with metal parts heavily nickeled.

For sharpening, special polished spring steel backs are provided. These fit firmly on the back of the knife and constitute a perfectly true and uniform guide that insures a straight edge, correctly beveled.

All knives are furnished in plush-lined cases.

Telegraph Code	Catalog No.	SIZE:—CUTTING EDGE	Price
Ninthrefiv	935	50 mm., no handle	$ 6.00
Ninforo	940**	110 mm., no handle	8.50
Ninfortu	942	110 mm., no handle	10.00
Ninforthre	943*	110 mm., no handle	10.00
Ninforfiv	945	185 mm., no handle	15.00
Ninfivo	950	250 mm., no handle	22.00
Ninfivfiv	955	Handle for sharpening knives up to 110 mm. in length	2.25
Ninfivsev	957	Handle for sharpening 185 mm. and 250 mm. knives	2.50
Ninsixo	960	Back for No. 940 knife	1.75
Ninsixone	961	Back for No. 942-943 knife	1.75
Ninsixto	962	Back for 945 knife	2.00
Ninsixthre	963	Back for 950 knife	2.00

*Ground for celloidin.
**Narrower knife for No. 880 Laboratory Microtome, also supplied with No. 810 Rotary Microtome.

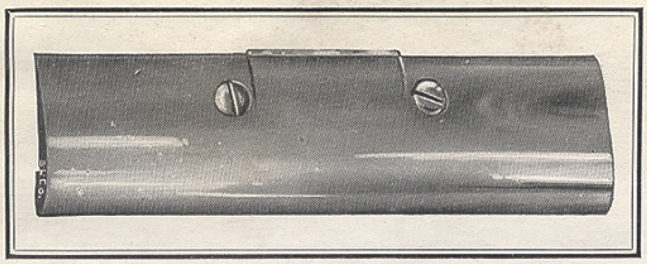


SPENCER MICROTOME KNIFE NO. 965

THIS knife is designed especially for cutting frozen sections in connection with our table microtome No. 900. It is made of the very best of steel and provided with a heavy wood handle. The cutting edge is 88 mm. in length.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninsixfiv	965	Chisel knife	$6.50

All makes of microtome knives carefully reground and sharpened. Price depends on size and condition of knife.



SPENCER RAZOR BLADE HOLDER NO. 964

THIS device can be used on practically any rotary microtome and permits the use of inexpensive razor blades that can be bought in quantities anywhere and thus serves to greatly economize on the use of the more expensive knives. These razor blades serve quite as well as the heavier knives for cutting soft or medium tissue mounted in paraffin and they possess the advantage of always being available with a keen edge.

The apparatus is made of two strips of heavily nickled brass held together by two machine screws. The parts are accurately fitted together and hold the blade with perfect rigidity in such a way that it projects by only a narrow margin above the holder.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninsixfor	964	Holder for safety razor blades	$6.75

SPENCER HONES

WE use the greatest care in the selection of our hones, choosing only those that are perfectly free from grit or other defects that can interfere with their perfect working qualities.

¶ A working outfit consists of a yellow Belgian hone to be used first and a blue-green hone for final finishing. A rubbing block accompanies each blue-green hone.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninsevo	970	Yellow Belgian, 10 in. by 2¼ in.	$8.50
Ninsevon	971	Yellow Belgian, 6 in. by 1½ in.	4.00
Ninsevto	972	Yellow Belgian, 4 in. by 1 in.	2.50
Ninsevfiv	975	Blue-green, 10 in. by 2¼ in.	2.50
Ninsevate	978	India oilstone, 3 in. long by ⅞ in. wide; a fast cutting stone, excellent for sharpening scalpels	1.00

SPENCER STROPS

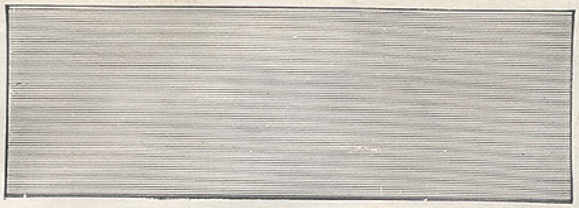
These strops are selected with view to meeting the special requirements of sharpening microtome knives. They will be found well suited to the purpose.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ninateo	980	Strop consists of a flat strip of wood with a handle at one end on one side of which is cemented a piece of leather, 1¾ inches wide and 11 inches long. Into this a very fine carborundum powder has been rubbed. The other side is covered by a very fine piece of leather of the same size for finishing	$2.00
Ninatefiv	985	Strop is similar to No. 980, except that the leather is on one side only and is 2¼ inches wide by 15 inches	2.50
Ninnino	990	Strop is like No. 985, except that the leather is the best shell butt horsehide	3.50
Ninninon	991	Black Strop of finest leather, 375 x 65 mm., perfectly blocked on a solid wood back. Coarse	3.50
Ninninto	992	Same as No. 991. Fine	3.50

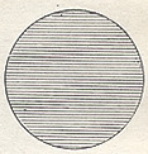
SLIDES AND COVER GLASSES



Best white glass



No. 1000



Uniform in thickness

ALL of our slides are carefully selected, free from bubbles or other defects, and all have plain faces, so that they will lie flat on the stage of the microscope. We list two types; it would be incorrect to say two grades; one pure white and the other having a slightly greenish tinge. The slight discoloration that results from the use of the greenish slides is absolutely unobservable under any ordinary conditions for microscopic work.

Catalog No.	DESCRIPTION	Price
1000	Slides, 75 x 25 mm. (3 x 1 inch) medium thickness, white. Per gross	$1.85
1002	Slides, 75 x 25 mm. (3 x 1 inch) medium thickness, slightly green. Per gross	1.75
1005	Slides, 75 x 25 mm. (3 x 1 inch) thin, white. Per gross	1.85
1020	Slides, 75 x 38 mm. (3 x 1½ inch) medium thickness, white. Per gross	2.50
1025	Slides, 75 x 50 mm. (3 x 2 inch) medium thickness, white. Per gross	2.75
1030	Slides, 75 x 25 mm. (3 x 1 inch) one concave center. Per dozen	.90
1032	Slides, 75 x 25 mm. (3 x 1 inch) two concave centers. Per dozen	1.20
1034	Slides, 75 x 25 mm. (3 x 1 inch) three concave centers. Per dozen	1.40
1035	Slides, 75 x 25 mm. (3 x 1 inch) drop culture, cavity 16 mm. diameter and 2 mm. deep, in polished plate glass. Each	.40

COVER GLASSES

Catalog No.	Shape	Thickness	Dimensions*	Price per oz.
1055	Squares	No. 1—0.13 to 0.17 mm.	15, 18, 22 or 25 mm.	$1.50
1060	Squares	No. 2—0.17 to 0.25 mm.	15, 18, 22 or 25 mm.	1.20
1065	Squares	No. 3—0.25 to 0.50 mm.	15, 18, 22 or 25 mm.	1.10
1075	Circles	No. 1—0.13 to 0.17 mm.	15, 18, 22 or 25 mm.	1.90
1080	Circles	No. 2—0.17 to 0.25 mm.	15, 18. 22 or 25 mm.	1.50
1085	Circles	No. 3—0.25 to 0.50 mm.	15, 18, 22 or 25 mm.	1.20

*Always designate size wanted with catalog number.

APPROXIMATE NUMBER OF COVERS PER OUNCE

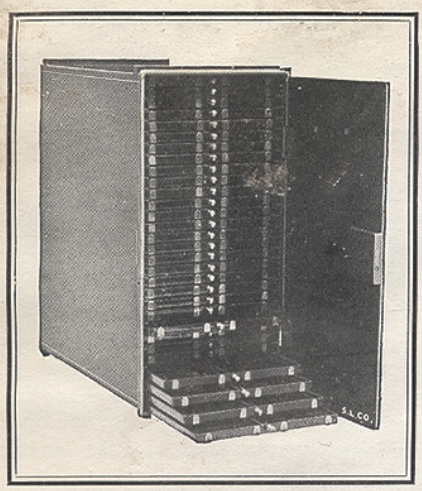
Circle	13 mm.	16 mm.	18 mm.	22 mm.	24 mm.	Squares	13 mm.	16 mm.	18 mm.	22 mm.	24 mm.
No. 0	855	550	375	254	214	No. 0	700	450	312	208	176
No. 1	564	362	280	182	142	No. 1	462	296	206	150	116
No. 2	444	286	195	157	112	No. 2	364	234	162	120	92
No. 3	372	240	166	122	93	No. 3	306	196	136	100	76

RECTANGULAR COVER GLASSES

Catalog No.	No. 1	Approx. No. per oz.	Price Per oz.	Catalog No.	No. 2	Approx. No. per oz.	Price Per oz.
1090	22 x 30 mm.	120	$1.50	1130	22 x 30 mm.	90	$1.20
1095	22 x 40 mm.	106	1.50	1135	22 x 40 mm.	65	1.20
1100	22 x 50 mm.	75	1.50	1140	22 x 50 mm.	62	1.20
1105	22 x 60 mm.	65	1.60	1145	22 x 60 mm.	48	1.30
1107	22 x 70 mm.	54	1.60	1147	22 x 70 mm.	46	1.30
1110	24 x 30 mm.	110	1.60	1150	24 x 30 mm.	86	1.30
1115	24 x 40 mm.	100	1.60	1155	24 x 40 mm.	62	1.30
1120	24 x 50 mm.	70	1.60	1160	24 x 50 mm.	60	1.30
1125	24 x 60 mm.	54	1.60	1165	24 x 60 mm.	40	1.30
1127	24 x 70 mm.	50	1.60	1167	24 x 70 mm.	38	1.30

SLIDE RECEPTACLES

MINOT'S METAL CABINET NO. 1200



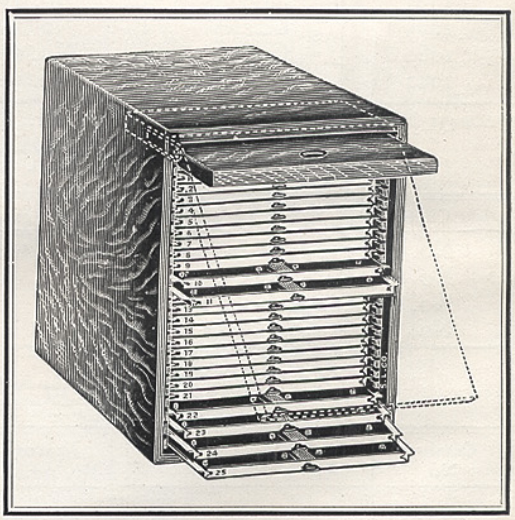
THIS cabinet was designed by Dr. Chas. S. Minot. It is very compact, occupying much less space than a wooden cabinet of the same capacity and affording better protection against fire. It is made of metal throughout, neatly finished on the outside in maroon colored japan with bronze stripes and on the inside in black japan. It contains thirty trays, each holding twenty-four slides, and provided with convenient knobs and with card holders. The new, improved construction of the trays holds each slide independently in its place, preventing it from slipping when trays are removed.

The cabinet is furnished with a good brass lock. The outside dimensions are 17.5 x 32.5 x 36.5 cm. high.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Ontooo	1200	Minot's metal slide cabinet with thirty trays. . . . . Net	$37.50

SECTIONAL UNIT SLIDE CABINET NO. 1202

THESE cabinets are made of quartered oak, nicely finished and are very serviceable. They are provided with disappearing doors similar to those of well-known types of sectional book-cases and may, therefore, be assembled in columns or rows, as dictated by preference or available space. A unit contains 25 aluminum trays, numbered consecutively; each has 20 compartments in which may be placed one or two slides as desired, giving a total capacity of 500 slides, if placed one deep, or 1000 slides, if placed two deep in the compartments. The outside dimensions of each unit are 21 x 30 x 25 cm. high.



Telegraph Code	Catalog No.	DESCRIPTION	Price
Ontooto	1202	Unit slide cabinet . . . . . Net	$27.50

SLIDE BOXES

1205 Slide Box, grooved to hold one hundred object slides, 25 x 75 mm., covered with imitation leather, hinged cover and catch. Price, each $0.85

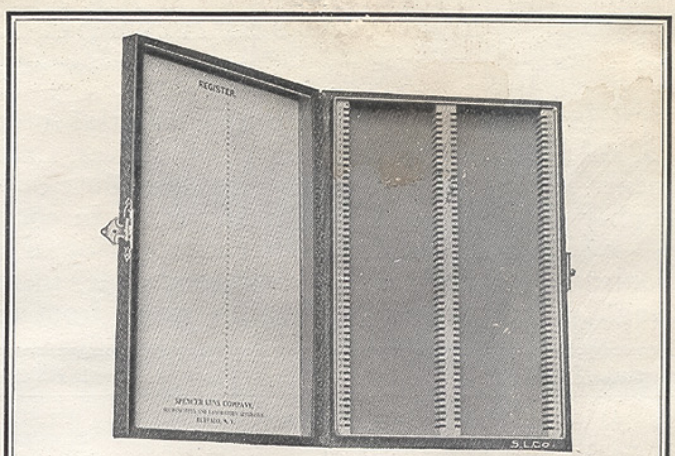
1215 Slide Boxes, made of white wood, with cover so arranged that, when removed, the ends of the slides are exposed so that they can be easily removed. Grooved to hold twenty-five objects, size 25 x 75 mm., numbered and indexed. Price, each $0.18

1220 Slide Boxes, made of white wood, with closely fitting covers. Grooved to hold twenty-five objects, 25 x 75 mm., numbered and indexed. Price, each . $0.15

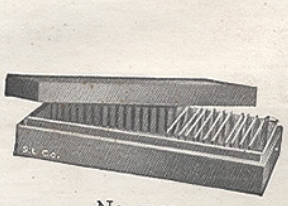
1225 Slide Boxes, same as No. 1220, but grooved to hold twelve objects, size of slide, 25 x 75 mm., numbered and indexed. Price, each $0.12

1228 Slide Boxes, same as No. 1220, grooved to hold twenty-five objects, size of slide, 50 x 75 mm. Price, each $0.30

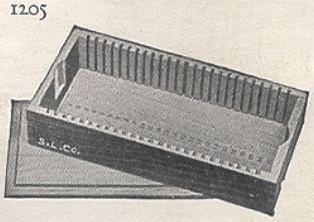
1240 Slide mailing cases for standard sized (3″ x 1″) slides—can be stacked together in any number required, each stack taking a number of slides one less than the number of pieces used. Price, per dozen pieces . . $0.20



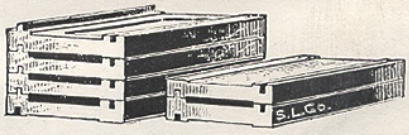
No. 1205



No. 1215



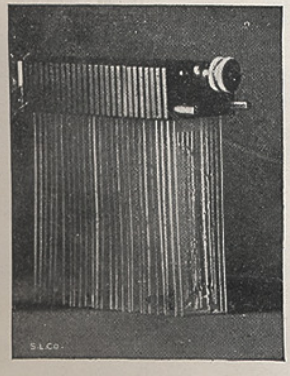
No. 1220



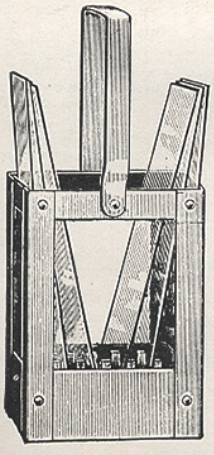
No. 1240

SLIDE HOLDERS FOR STAINING

THESE holders furnish a convenient means of staining several slides at one time and are, therefore, especially useful where it is desired to stain a number of specimens exactly alike. Since all specimens in the holder receive the same treatment, it is evident that they will be similarly stained.



No. 1245



No. 1250

1245 This slide holder was devised by Dr. Edward F. Miller, of the anatomical laboratory of the University of California. It holds any number of slides up to twenty-six, by grasping them firmly near the end. Each slide is separated from its neighbor by a hard rubber plate of sufficient thickness to permit the staining fluid to come freely in contact with its entire surface.

Price, without jar $3.00

1250 Basket Slide Holder. This holder was designed by Dr. S. H. Gage, of Cornell University. The slides are separated by a comb arrangement at the bottom. There are six receptacles, in each of which may be placed one slide, or, by placing them back to back, two slides. It is very simple and convenient to use, and permits the staining fluid to come equally in contact with each specimen. The instrument is made of brass, heavily nickeled.

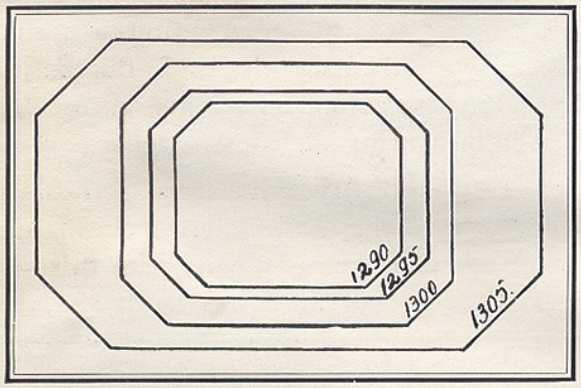
Price, without jar $2.00

JAPANESE LENS PAPER

THIS paper is the most suitable material for cleaning any kind of lenses. It is especially desirable in caring for microscope objectives, since very small scratches in them are a serious detriment. The paper is perfectly free from dust or grit and if kept clean can not damage the most highly polished objective. It is put up in convenient packages of approximately one hundred 6″ x 8″ sheets, and for the accommodation of those who require a small supply to be kept conveniently at hand on the laboratory table, in neatly bound booklets of fifty 4″ x 6″ sheets. A single sheet is ample for cleaning the oil from a microscope lens.

Catalog No.	DESCRIPTION	Price
1320	Lens Paper, Japanese, per package	$0.50
1322	Lens Paper, Japanese, per book	.15

LABELS

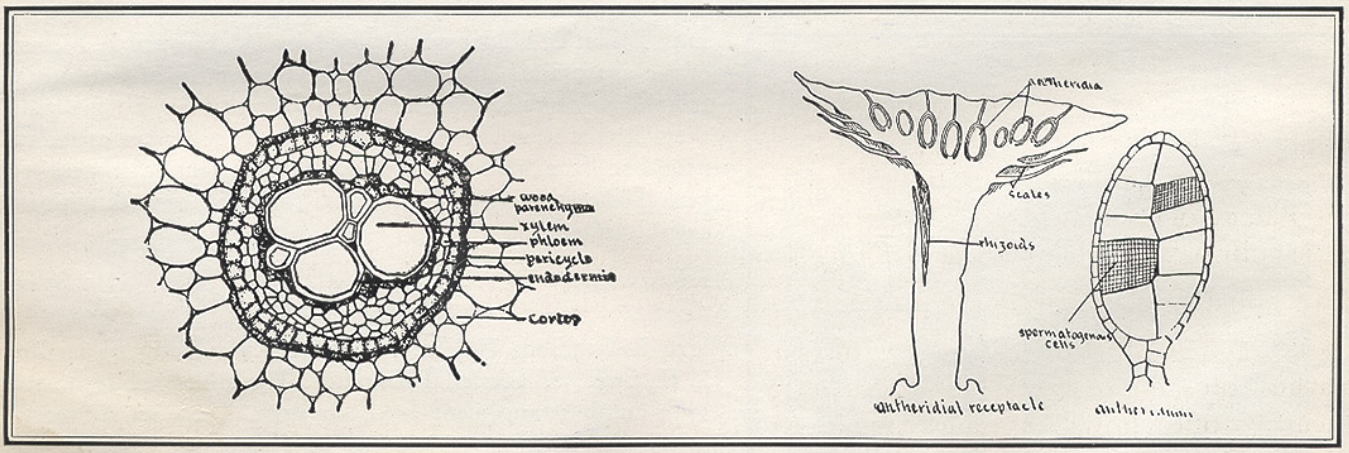


Best white paper, gummed, black border, for microscope slides, 100 in a box.

Catalog No.	DESCRIPTION	Price
1260	Labels, 22 mm. square, per 1000	$ 1.25
1265	Labels, 22mm. x 15 mm., per 1000	1.25
1275	Labels, printed like No. 1260 or No. 1265, with two lines of printing in blue or red, in lots of 12,000. Per lot	15.00
1280	Labels, printed same as No. 1275, but in black, in lots of 12,000. Per lot	15.00

We can make these rates on lots of 12,000 because this quantity can be printed at one time most economically. Smaller quantities will cost much more proportionately. We can furnish labels without borders, if desired. In ordering be sure to send sample or clear copy, and state shape. Specify color of ink wanted.

TEACHERS' HELPS IN STRUCTURAL BOTANY NO. 1325



This set consists of a set of twenty-five slides carefully prepared to illustrate the minute botanical structures. These slides have been prepared under the direct supervision of Dr. W. J. G. Land, of the University of Chicago. He has himself written a little book dealing briefly with the subject at hand.

No. 1325. Put up in neat, cloth-covered box, with hinge and clasp. Price, with book $12.00

SPENCER HAEMACYTOMETERS WITH COUNTING CHAMBER MADE FROM *ONE SOLID PIECE* OF GLASS

AMONG the possible errors in blood counting apparatus, none are more disastrous to results, or detected with greater difficulty, than variation in the depth of counting chamber. This has been a particularly insidious error, owing to the fact that either the ruled piece of glass or the supports for the cover have been cemented onto the main slide and were, therefore, liable to become loosened. They sometimes came off and had to be re-cemented, but more frequently, through expansion or contraction of the cement, they became slightly displaced, so that the depth of the chamber, even though accurate at first, was no longer reliable. This happened without the knowledge of the user, introducing an error that he had no means of detecting.

This danger has been completely removed by the introduction of counting chambers made entirely of ONE PIECE OF GLASS, thereby establishing a *new standard of accuracy*. These chambers are manufactured by an entirely new process that is analogous to that used in the grinding of high-grade lenses, so that the dimensions will not only conform to requirements of the U. S. Bureau of Standards, but present a far higher degree of accuracy. In fact, these chambers are guaranteed to exhibit no error observable by the methods ordinarily used in measuring such instruments.

RULINGS—Two requisites for ruling are accurate spacing and easy visability of lines. In both these particulars Spencer counting chambers will be found to conform to the most exacting standard. We use no method of making replicas, or reproductions. Each chamber is an original ruling, spaced by a method that permits no possibility of error, and cut with a diamond, carefully shaped to produce lines that experience has shown to be deep enough to be easily observed and not too deep so as to interfere with the perfect distribution of the fluid.

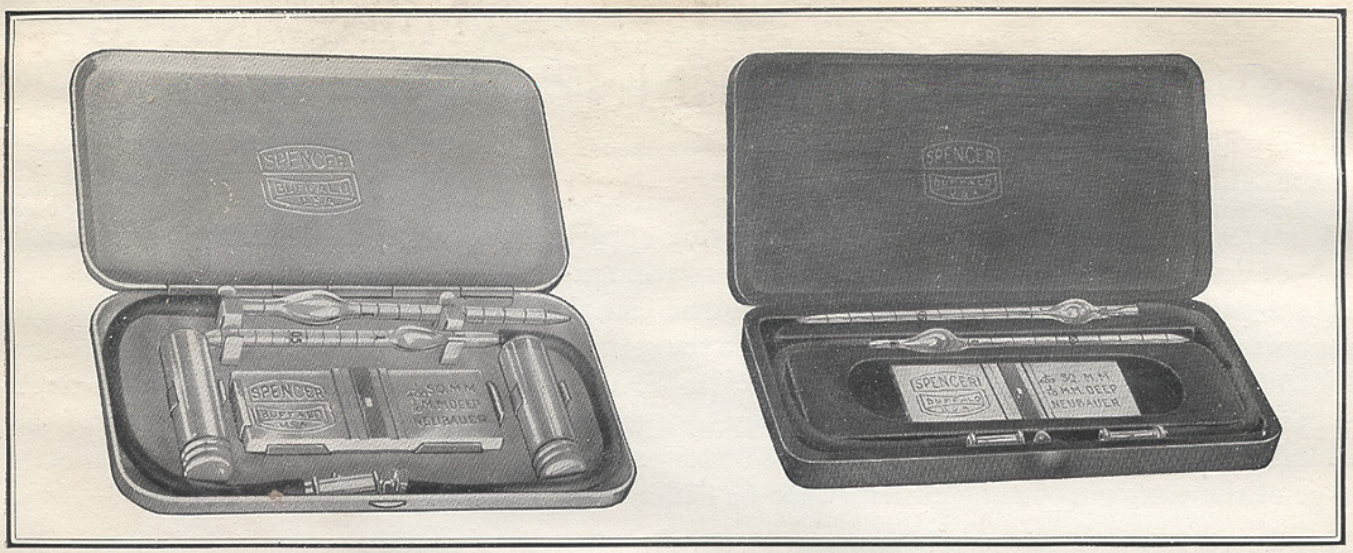
The type of ruling now almost universally preferred is that designed by Neubauer, the central portion of which is exactly like the original Thoma, and differing from it only by the addition of certain lines around the outside, which may be used or not as desired; it is, therefore, equally serviceable to those who prefer the Thoma ruling or who have become accustomed to the use of the additional lines. Unless otherwise specified, we supply the Neubauer ruling but are in position to supply any type of special ruling that may be required.

DESIGN OF CHAMBER—The transverse or "Buerker" type of chamber, in which rulings are made on a strip extending across the slide and the cover supported on two other strips, has now so completely replaced the old type with rulings made on a disc that we offer the former design only. They are supplied with single or double ruling, as required.

PIPETTES—Each pipette is carefully tested and is guaranteed accurate within the tolerance set by the Bureau of Standards. They are such length as to provide sufficient space between lines to make the reading easy. The tips are carefully ground to a convenient angle for filling.

Two polished glass covers are included with each counting chamber.

CASES—For many years, it has been our custom to supply these instruments in handsome morocco leather, plush-lined cases: we shall continue to furnish these cases to our customers who prefer them. We offer, however, as an alternate, at the same price, our new aluminum case, which possesses certain advantages of lightness, compactness and cleanliness that can not be incorporated in those of the older design. In these cases, in addition to the standard equipment, we include, held in place by suitable clips, screw-cap vials for carrying diluting fluids. Thus there is included in one case all that is necessary (except the microscope) for making blood counts.



IN ORDERING STATE TYPE OF CASE DESIRED

Catalog No.	DESCRIPTION	Price
1465*	Haemacytometer complete, single Neubauer ruling, with two cover glasses, diluting pipettes for both red and white corpuscles. In case	$14.00
1472	Single Neubauer counting chamber only, with two covers. Without case	7.00
1482*	Haemacytometer complete, double Neubauer ruling, with two cover glasses, diluting pipettes for both red and white corpuscles. In case	17.00
1492	Double Neubauer counting chamber only, with two covers. Without case	10.00
1456	Pipettes, 1 to 100—for red corpuscles	1.50
1458	Pipettes 1 to 10—for white corpuscles	1.50
1460	Cover glasses for single chambers	.30
1461	Cover glasses for double chambers	.50

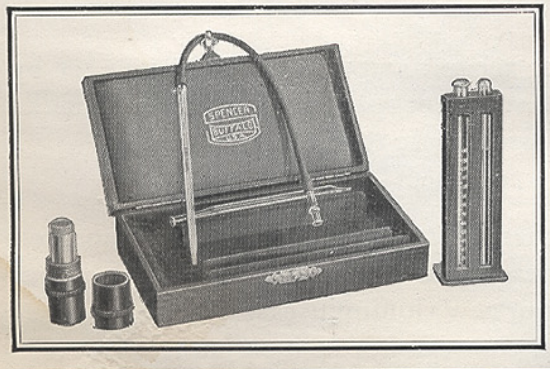
*In ordering state type of case desired.

HAEMACYTOMETERS WITH BUREAU OF STANDARDS CERTIFICATES

ALL our haemacytometers will pass the test established by the Bureau of Standards and perfect confidence may be placed in them, whether they are accompanied by certificates or not, but since there is a charge for supplying these certificates we are obliged to make a corresponding charge for them, as follows:

For each single chamber with certificate, extra $3.00
For each double chamber with certificate, extra 4.00
Pipettes are not supplied with certificate but are supplied with a Bureau of Standards number which guarantees that they are within the established tolerance. For each pipette thus numbered the charge is, extra . . . . 2.00.

SAHLI HAEMAGLOBINOMETER



DETERMINATION of the percentage of haemaglobin in the blood is often an important step in diagnosis. The Sahli haemaglobinometer furnishes a simple, easily operated, inexpensive and reasonably accurate means of making this estimation. ¶ A measured quantity of blood is diluted in a graduated tube until its color matches that of standard fluid in a sealed tube which is part of the outfit. The percentage of haemaglobin is then obtained by multiplying the graduated tube reading by a standard reduction factor. ¶ Spencer color tubes are prepared with especial care to insure not only correct standardization but permanancy of color. Since the coloring material in them is chemically identical with that of blood it is effected similarly by various kinds of illumination and the comparison is, equally reliable, whether made under artificial light or daylight.

Catalog No.	DESCRIPTION	Price
1515	Sahli Haemaglobinometer, complete in case with vial for diluting fluid	$8.00
1516	Color tubes for Sahli Haemaglobinometer	2.00

SPENCER DELINEASCOPES

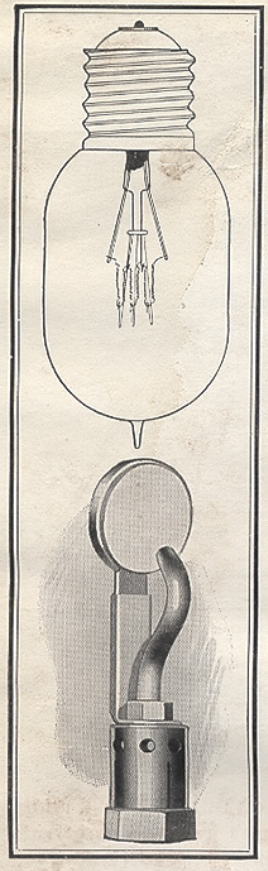
IN the modern educational system the effectiveness of appealing to the mind through the eye is coming to be recognized more and more. The old adage, "Seeing is believing," has more than a superficial meaning. New concepts or ideas are always more or less distinctly visualized and any means that aid in making such visualization definite and, above all, correct, is especially valuable as a teaching medium.

In recognition of this fact nearly ever state and municipal educational system has a separate department, known as the "Department of Visual Education," whose purpose is to aid in devising methods of illustrating the fundamental principles which it is desired to teach and to select suitable material for the purpose. The activities of these departments extend over a very wide field, including demonstrations of mechanical and mathematical principles by sketches, diagrams, curves, etc.; they make use of charts, maps and pictures. All these are of unquestionable value, but to have constantly on hand a sufficiently varied collection of such illustrations of suitable size for general class-room work would, indeed, be cumbersome, and if they were available their handling would be a difficult problem.

The stereopticon, or lantern slide projector, effectively overcomes this difficulty. Obstacles in the way of its general use have been the facts that instruments were heavy and difficult to manipulate, and that for their operation a darkened room was necessary. Recent developments have removed these obstacles. Modern instruments are light, compact, extremely simple to operate, and may be used in rooms but slightly darkened, or even not darkened at all. Furthermore, slides on all kinds of topics are constantly becoming more readily available, so that the use of projection lanterns is taking its place as a part of every-day class-room work.

In line with this development we take pleasure in presenting for the consideration of our customers the following list of DELINEASCOPES. In designing these instruments we have profited by many years' experience in optical work. We have appreciated the importance, not only of strictly high grade optics, but of correct mechanical design and construction; we have had in mind compactness and neatness as well as durability and efficiency.

We offer a well-selected list of instruments suitable for meeting a wide range of requirements. Our simpler Delineascopes are capable of being equipped with various illuminants for meeting special conditions. In these outfits the several types of illuminants are quickly and easily interchanged, so that the same instrument may be used with electric light where electricity is available, and with other forms of light, if necessity arises.



HOUSING

ALL Spencer Delineascopes are supplied with lamp houses amply ventilated, each being built with the cubic contents that the manufacturers of the bulb contained in it recommend as requisite to insure the full burning-life of the bulb. They conform to the most exacting insurance requirements. The design is such as to make lamps and condensers easily available for cleaning or replacements.

FINISH

THE instruments are finished in a dull black enamel, which will not reflect stray light, and which gives them a dignified and attractive appearance. The enamel is very durable, and will not crack or peel off. Being baked on at a high temperature, it is unaffected by the heat from the bulbs.

ILLUMINANTS

(*See price list, page 107*)

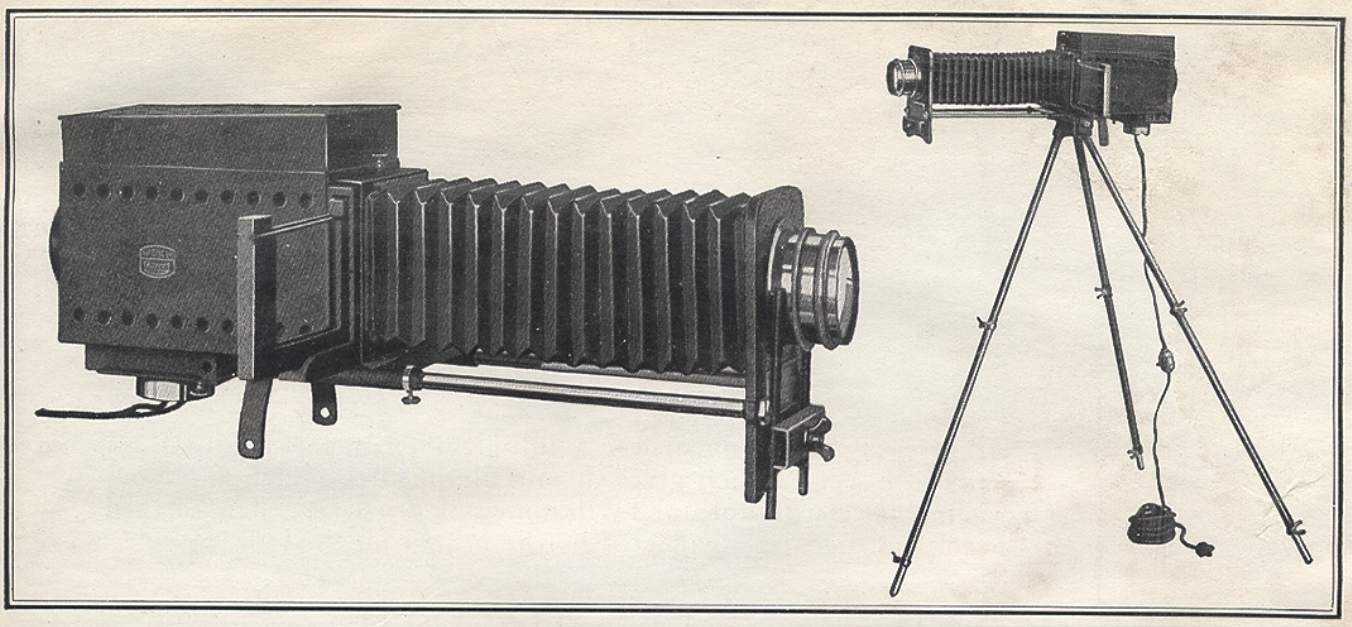
THE range of usefulness and availability of projection apparatus is limited only by the limit of the intensity of illumination. Until recently the arc has been regarded as the only light sufficiently concentrated and brilliant for projection, except at short distances and in completely darkened rooms, but the introduction of bulbs of high candle power and concentrated filament has brought them to so high a degree of efficiency that they have now practically entirely replaced the arc. We now have available for projection work, bulbs ranging in wattage from 100 to 1000, with estimated candle powers of from 140 to 2400.

However, the "candle power" of a bulb, even of concentrated filament, falls very far short of constituting a complete index of its efficiency as a projection illuminant. A new "monoplane" bulb has recently been introduced in which, as its name implies, all parts of the filament have been brought to a single plane, so that every portion can be placed at exactly the optimum distance from the condensing system. The result of this arrangement is truly remarkable. So efficiently is the current thus utilized that illumination sufficient for the most exacting conditions may be obtained from bulbs of so low a wattage that they can be operated on ordinary house wiring.

¶ All Spencer bulbs above 250-watt capacity are mounted on the *mogul base*, which is the only mount that fully accords with the recommendation of the National Board of Fire Underwriters.

¶ For use where electric current is not available we offer a NEW ACETYLENE LIGHT, which gives better illumination than has heretofore been easily available, except from electricity. In this light a small button or "pastel," made of incombustible material (the same material that ordinary gas mantles are made of after they have been burned off), is so mounted that it stands facing the condensing system, and against it is directed a small acetylene gas flame which heats it brilliantly white, so that it gives off an illumination equalled only by the electric light. This is analogous to the old "limelight," which was for many years regarded as the only light suitable for projection work.

ELECTRIC LIGHT FROM STORAGE BATTERIES. Lecturers who travel considerably by automobile in country districts, carrying their Delineascopes with them, desire, for obvious reasons, to "go as light" as possible. To such we offer a six-volt bulb of about sixty candle power, which may be operated from the storage battery of the automobile. They can be used for periods of from two to six hours on a single charge (depending on the type of battery used), and give *excellent* results. The battery, though somewhat depleted by this service, will generally "pick up" again in the next drive, so that the expense of maintenance and attention required are practically negligible.



DELINEASCOPE MODEL E

THIS instrument was introduced in response to a demand for a compact, serviceable projection outfit for use under conditions varying from those of the class room requiring small, brilliant pictures in daylight, to the auditorium using long projection distances and large screen images. It is so designed that the same instrument is readily adapted to the full range of conditions.

Although light and easily portable, it has always been characterized by exceptional rigidity and durability. Recent improvements have so accentuated these qualities that this model has won an ever-increasing appreciation wherever there is an interest in visual education.

DIMENSIONS OF CARRYING CASE included with the outfit are 14½ x 9 x 5 inches.

WEIGHT, complete in case, 13 pounds.

ILLUMINANTS: Regularly supplied with the 500-watt, 110-volt monoplane filament stereopticon bulb with mogul base. May be equipped with other illuminants. *See list below.*

EXTENSION RODS of steel, nickel-plated. They are provided with set screw to hold them in any required position. They are of sufficient length to accommodate lenses up to 20 inches equivalent focus.*

SLIDE CARRIER accommodating American size (3¼″ x 4″) slides regularly supplied. CARRIER accommodating both American and English size (3¼″ x 3¼″) supplied, if ordered.

HOOD is so made that the entire top part can be easily lifted off, making the lamp and condensers very conveniently available for replacement or cleaning.

Provision is made for convenient adjustment of the bulb in *all* directions.

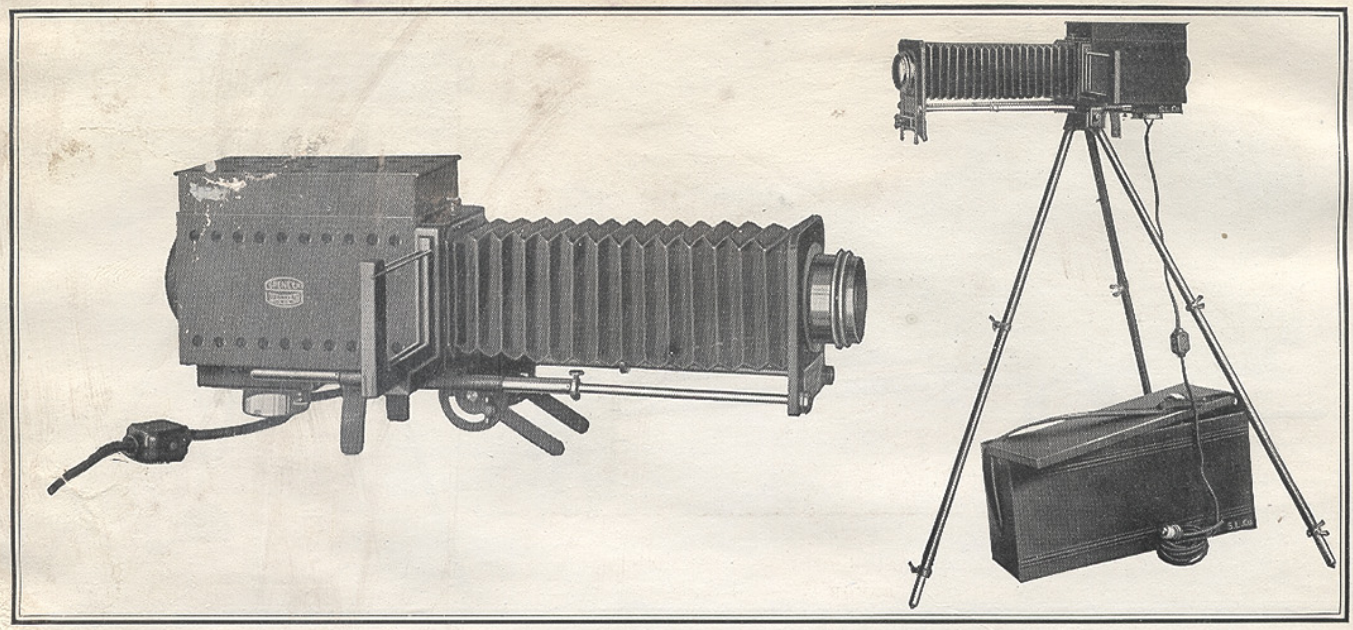
The instrument is equipped with elevating legs at the front end, which provide ample range of adjustment and which are firmly clamped in position by tightening a single wing nut.

Fifteen feet of heavy cord, with plug and switch, are included.

A supporting tripod and special carrying case for Delineascope and tripod are described on page 92.

Cat. No.	DESCRIPTION	Price
3500	Delineascope Model E, with 500-watt, 110-volt, monoplane bulb. Objective 4¼″ to 10″* focus, 1⅝″ diameter	$57.00
3503	Delineascope Model E, with 500-watt, 110-volt, monoplane bulb. Objective 5½″ to 20″* focus, 2½″ diameter	65.00
3506	Same as 3503, with complete pastel type acetylene burner *and pressure regulator*, for attaching to Prest-o-lite tank, in place of bulb	73.00
3509	Delineascope Model E, with multiple jet acetylene burner. Objective 5½″ to 16″* focus, 2½″ diameter	63.00
3512	With both 500-watt bulb and pastel acetylene burner, as listed with outfit 3506, to be used interchangeably	81.00

*To determine focal length of lens best suited for individual requirements, see table on page 105.



DELINEASCOPE MODEL F

THIS instrument constitutes a modification of model E described on page 91. It is designed especially to meet the requirements of traveling lecturers who desire an instrument light in weight, easily transportable, quickly set up for operation and usable under a wide range of conditions.

This Delineascope differs from model E, in that the front legs are made adjustable on the rods so that they can be placed near the back of the instrument when necessary to support it on a small table, or can be slipped nearer the front end of the rods if conditions permit, thus combining stability with an extreme range of adaptability. These legs are so mounted that they may be swung through an arc for either elevating or depressing the front end of the instrument, as required. ¶ DIMENSIONS OF CARRYING CASE, included with the outfit, 14½″ x 9″ x 5″. WEIGHT, complete in case, 15 pounds. ¶ Fifteen feet of heavy cord, with plug and switch, are included.

Cat. No.	DESCRIPTION	Price
3525	Delineascope Model F, with 500-watt, 110-volt, monoplane bulb. Objective 4¼″ to 10″* focus, 1⅝″ diameter	$59.00
3528	Delineascope Model F with 500-watt, 110-volt monoplane bulb. Objective 5½″ to 20″* focus, 2½″ diameter	67.00
3531	Same as 3528, with complete pastel type acetylene burner *and pressure regulator* for attaching to Prest-o-lite tank, in place of bulb	75.00
3534	With multiple jet acetylene burner. Objective 5½″ to 16″* focus, 2½″ diameter	65.00
3537	With both 500-watt bulb and pastel acetylene burner as listed under outfit 3531, to be used interchangeably	83.00

*To determine focal length of lens best suited to individual requirements, see table on page 105.

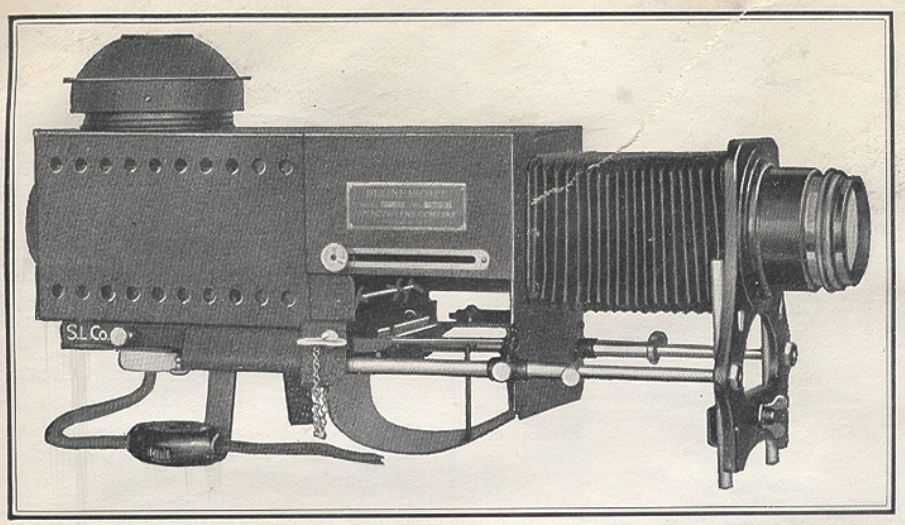
A SPECIAL TRIPOD FOR USE WITH DELINEASCOPES, MODELS E and F

THIS tripod is equipped with a head having a clamp so constructed that, by tightening a single thumb screw, it is rigidly attached to either Delineascope above-mentioned. In this head are three sockets for receiving the legs of the tripod which are firmly held at a fixed angle, so that there is no possibility of their spreading, even if placed on smooth, hardwood floors. The legs consist of three telescoping rods, giving ample range of adjustment.

Cat. No.	DESCRIPTION	Price
3912	Tripod, as described above . . . . . NET	$12.00

A special case for carrying either model E or F, together with the tripod and head, is offered in place of the case regularly supplied with these instruments. This special case, in addition to carrying the tripod as mentioned, has also a compartment for carrying an extra bulb or a supply of slides. This furnishes a very convenient means of carrying the instrument, together with its necessary accessories.

Cat. No.	DESCRIPTION	Price
3916	Special case, instead of that listed with Delineascope model E or F, when ordered with the instrument, extra	$4.00



DELINEASCOPE MODEL H

THIS Delineascope is an especially durable and efficient instrument. It is made of heavy material to withstand long continued use.

DIMENSIONS OF CARRYING CASE, included with the outfit, 15¾″ x 9″ x 6¾″.

WEIGHT, complete in case, 19 pounds.

ILLUMINANTS: Regularly supplied with the 500-watt, 110-volt monoplane filament stereopticon bulb, with mogul base. May be equipped with other illuminants. *See list below.*

EXTENSION RODS are of brass, heavily nickeled and long enough to accommodate lenses up to 20 inches equivalent focus.*

This instrument is equipped with the SPENCER PATENTED TRANSPOSER, which is very simple in operation and produces a satisfactory dissolving effect (*see description below*).

Fifteen feet of heavy cord, with plug and switch, are included. Supporting tripod is listed on page 99.

Cat. No.	DESCRIPTION	Price
3550	Delineascope Model H, with 500-watt, 110-volt monoplane bulb. Objective 5½″ to 10″* focus, 1⅝″ diameter	$67.00
3553	Delineascope Model H, with 500-watt, 110-volt monoplane bulb. Objective 5½″ to 20″* focus, 2½″ diameter	75.00
3556	Same as 3553, with complete pastel type acetylene burner *and pressure regulator* for attaching to Prest-o-lite tank, in place of bulb	83.00
3559	With multiple jet acetylene burner. Objective 5½″ to 16″* focus, 2½″ diameter	73.00
3562	With both 500-watt bulb and pastel acetylene burner, as listed under No. 3556, to be used interchangeably	91.00

*To determine focal length of lens best suited for individual requirements see table on page 105.

THE SPENCER PATENTED TRANSPOSER

THIS unique device for handling lantern slides is not only more convenient to operate than the ordinary slide carrier but produces results more nearly equivalent to those of the double dissolving outfit than have heretofore been accomplished by any single instrument.

A slide, S, is placed in a horizontal position on the fork, F. By means of a key, K, the fork is raised, bringing the slide to the position S1 (the position for projection).

The fork now drops back to its original position to receive another slide and the process is repeated.

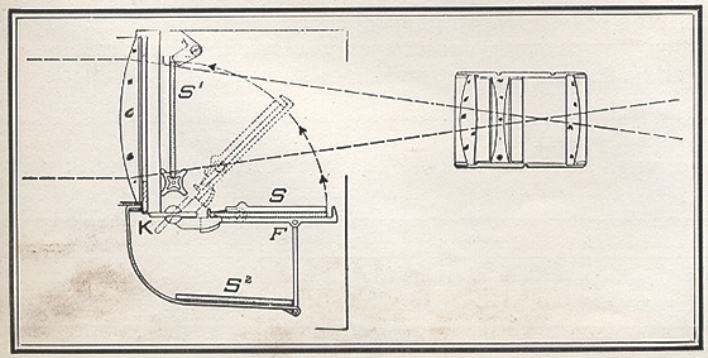
As the new slide comes into position the old one is released and drops into position S2.

Slides of either standard, American size (3¼″ x 4″) or English size (3¼″ x 3¼″) are handled with equal facility and may be used interchangeably.

The following features are to be noted:

1st. The new slide is brought into position before the old one is removed.

2nd. When released, the slide drops out of position more quickly than it could possibly be removed by the human hand.



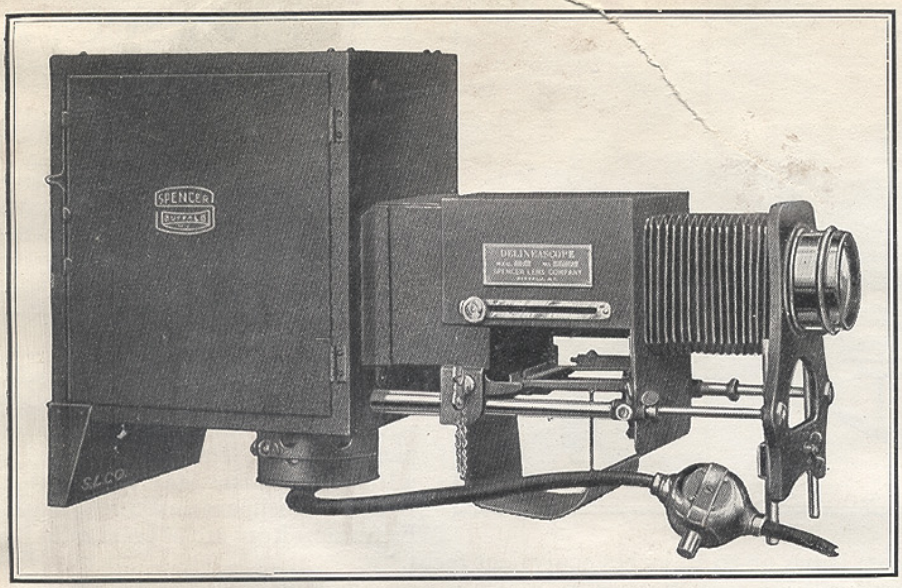
3rd. The change is accomplished with no interval of dazzling brightness or of darkness on the screen.

4th. The cross movement that is incidental to the slide carrier is entirely eliminated.

5th. The instrument is operated entirely from one side, thus avoiding the inconvenience of reaching over or around it.

6th. The opening at the side provides an opportunity of using a small pointer to call attention to various details of the slide.

7th. A very dim light is emitted at the side, not sufficient to be troublesome to the audience, but just enough to enable the operator to read labels on his slides.



DELINEASCOPE MODEL J

A SUITABLE instrument to be permanently installed in large auditoriums or lecture halls. Capable of meeting exacting requirements for all lantern slide projection and at the same time light enough to be properly classed as a "portable instrument."

Carrying case and six feet of heavy cord, with plug and switch, are included.

DIMENSIONS OF CARRYING CASE, 14" x 19¼" x 8½".

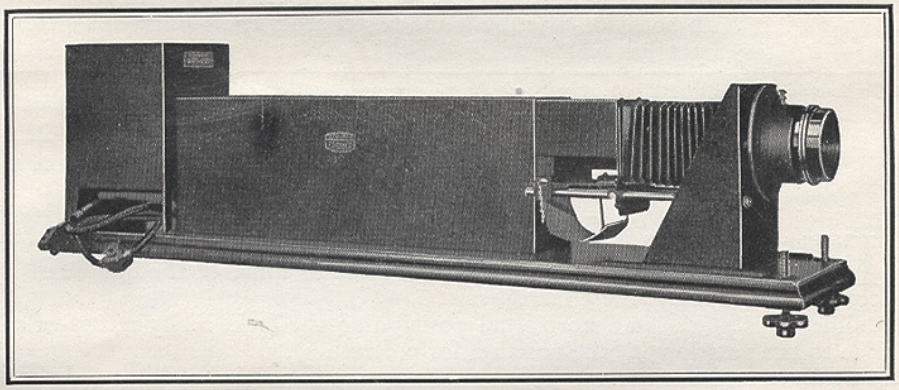
WEIGHT, complete in case, 28 pounds.

ILLUMINANTS, 1000-watt tubular stereopticon bulb, on mogul base.

EXTENSION RODS, double, will accommodate lenses up to 24 inches focal length. We recommend that this instrument be equipped with the Spencer transposer, as illustrated and described on page 93, but it will be supplied with standard slide carrier, in place of transposer, if so ordered, at a reduction of $10.00 from the list price.

Catalog No.	DESCRIPTION	Price
3572	Delineascope model J with 1000-watt, 110-volt tubular bulb. Objective 4¼" to 10" focus*, 1⅝ diameter, with Spencer transposer	$105.00
3575	Delineascope model J, with 1000-watt, 110-volt tubular bulb. Objective 5½" to 20" focus,* 2½" diameter, with Spencer transposer	87.00

DELINEASCOPE MODEL K



A NEW DELINEASCOPE for projecting at long distances, or pictures of exceptional size, while still retaining the requisite brilliancy for exhibiting to large audiences.

This instrument is equipped with our standard size hood, containing a 1000-watt monoplane bulb on a mogul base.

The condensing system is entirely new. It consists of four lenses, with the elements separated by a considerable space. This system accomplishes two results that have not heretofore been attained in ordinary projection instruments.

1st. On account of the wide separation of the elements, exceptional opportunity is provided for radiation of heat, so that even with intense illumination the slides are practically safe from damage from this source.

2nd. The system utilizes not only the light from a central point of the filament, but, to a much greater extent than with older systems, utilizes also the light from the marginal areas.

The design of the instrument permits the use of rods and bellows of such length as may be required for ANY focal length of lens that is found suitable to meet individual specifications. The projection objectives regularly supplied are 4 inches in diameter and from 16 to 28 inch focal length. Lenses can be chosen to give any size picture required at practically any working distance.

Slides are handled by the SPENCER TRANSPOSER, described in detail on page 93.

The entire instrument is mounted on a suitable base board, with elevating screws. Ten feet of heavy cord, with press switch and plug, are supplied.

Catalog No.	DESCRIPTION	Price
3590	Delineascope model K. Special delineascope, as described above, including one 1000-watt bulb; projection objective 4" diameter, focal length as specified*	$180.00

* To determine focal length of lens best suited to individual requirements, see table on page 105.

SPENCER NEW AUTOMATIC DELINEASCOPE, MODEL L



THIS is a *new* instrument, working on a *new* principle and covering an entirely *new* field.

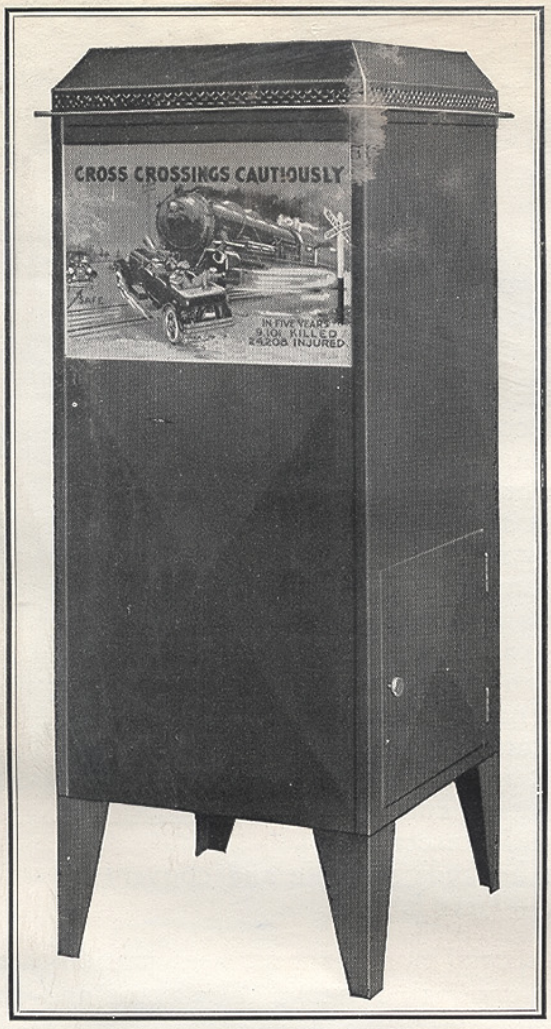
This instrument, as its name implies, is provided with an automatic control. This control may be set to exchange views in response to the pressing of a button at the end of a wire of such length as may be chosen thus leaving a lecturer entirely independent of any operator. Such an instrument can not fail to appeal to a large class of travelers who carry stereopticons as part of their outfit and have frequently been obliged to choose between breaking in a new operator at each place visited or lecturing from a position not the most suitable, and dividing his attention between his lantern and his audience. With this machine the lecturer runs his wire to such a location as he finds suitable and convenient and when he wishes the view changed he presses the button—THAT IS ALL!

Illumination is furnished by a special monoplane filament motion picture bulb, operating without resistance on standard 110-volt wiring systems. A reflector and specially designed condensing system so concentrate the radiation as to produce a projected picture of remarkable brilliancy. The apparatus is equipped with a projection lens of the highest quality, which produces a sharp and clean-cut picture to the extreme margin. Focal lengths are such as to make the apparatus available for screen pictures as much as ten feet on a side and having working distance as high as forty feet.

The entire apparatus is enclosed in a neat black casing, with a suitable handle for carrying. The dimensions are 13½″ x 7″ x 11″ high. Weight, 22 pounds.

Not only is the instrument operable by a push button, as already indicated, but may be set to operate entirely automatically, changing views at such intervals as may be chosen between five and thirty seconds, or, by a special adjustment, it may be arranged to leave each view on for a considerably longer period. This feature of the instrument gives it a wide range of usefulness in displaying pictures for advertisements, for instructions, or for entertainment. Boards of Health find it a valuable means of reaching the public with their propaganda for better health conditions. Departments of agriculture and forestry are often aided in their work by displaying, in public places, pictures illustrative of the subject in which they are interested. Public libraries may use it for announcing new books. Pictures of interest to children may be shown in the children's reading room, etc.

Catalog No.	DESCRIPTION	Price
3605	Delineascope model L, with one 250-watt, 110-volt bulb, equipped for automatic operation or push button control	$165.00



DISPLAY CABINETS

WE furnish as an accessory to Delineascope model L a neat cabinet, 60 inches high and 24 inches wide, having an especially prepared screen, 14½ x 19½ inches, on which the illustrations are shown. The Delineascope is entirely enclosed in the cabinet and the image is projected onto the screen by a simple but ingenious arrangement of mirrors within. This outfit constitutes a complete unit that is attractive in appearance and may be stood anywhere within reach of a standard electric light socket.

For convenience and economy in shipping the cabinet is packed "knocked down." It is very easily and quickly assembled.

Catalog No.	DESCRIPTION	Price
3615	Display Cabinet, with screen	$50.00

Views for use with model L for either automatic or push button operation are made on standard motion picture film at an expense far below that of ordinary lantern slides. *See list below.* Any number of views, from 20 to 300, are made on a single loop. We maintain a laboratory for furnishing these views. They may be prepared from all sorts of material, such as photographs, book or magazine illustrations, maps, charts, etchings, etc.

Price for black and white views, in numbers from 20 to 300 on a roll:

For first copies, per view 25c

Duplicates, per view 5c

Hand colored views are prepared at prices depending on the labor involved.

OPAQUE PROJECTORS

THOSE who use lanterns and find them a valuable means of instruction or entertainment are always desirous of adding to their supply of illustrative material. However complete the collection of lantern slides may be, they could be supplemented and their value enhanced by current illustrations from books, magazines, post cards, catalogs, etc. By means of a Spencer Combined Delineascpoe this material is made available, and with no sacrifice whatever of either clearness of image or convenience of manipulation in the projection of slides. The two forms of projection may be used alternately, since the interchange is as simply accomplished as is the change between two lantern slides.

In opaque projection a remarkable brilliancy of illumination is attained by means of large silvered-back glass reflectors and by plain mirrors ingeniously arranged inside the lamp house.

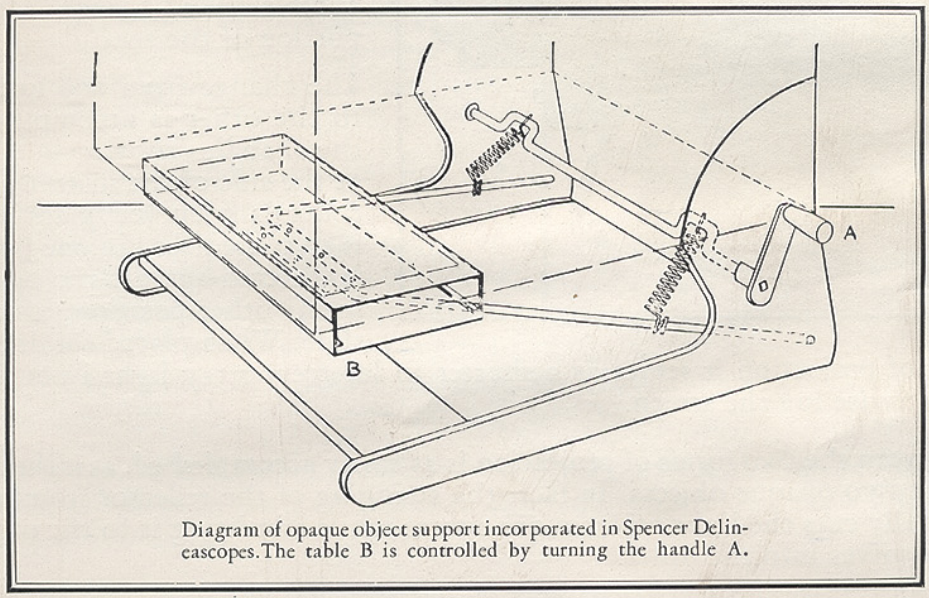
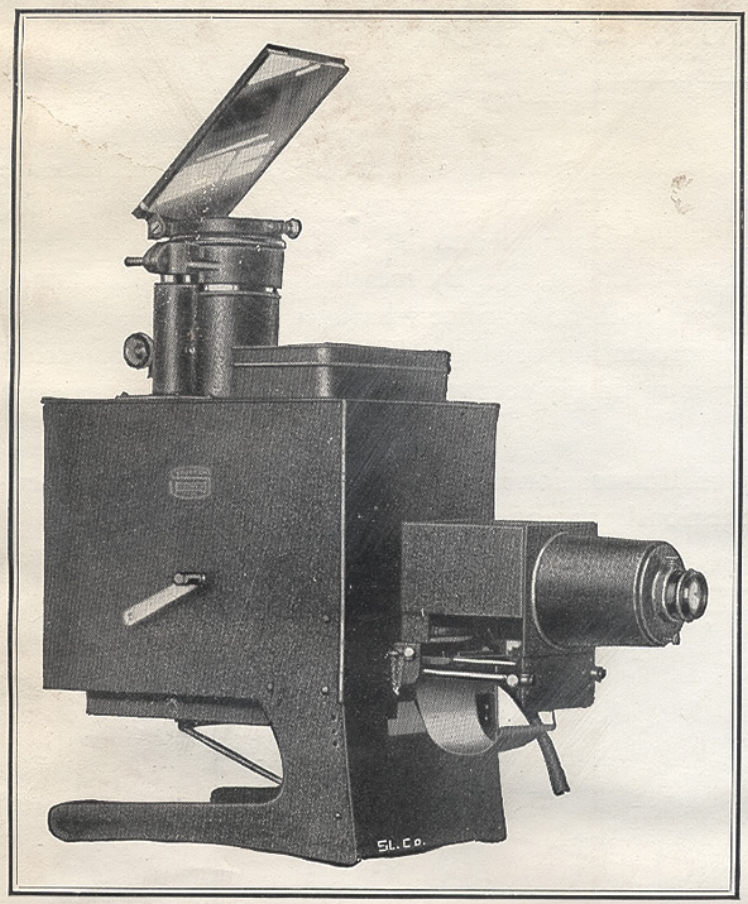


Diagram of opaque object support incorporated in Spencer Delineascopes. The table B is controlled by turning the handle A.

IN the opaque projectors that have heretofore been offered, one of the chief difficulties in manipulation has been the lack of means of conveniently controlling the table for supporting opaque objects. In order that such objects shall lie flat on the table it is a practical necessity that the table be held against the bottom of the projection chamber by springs of considerable strength. The difficulty has been to hold these tables down against the springs with one hand while manipulating the object with the other hand. We now offer a device that completely eliminates this annoyance, while still retaining the advantage of the supporting springs for the table. By means of an eccentric cam, operated by a handle conveniently located at the side of the instrument, the tension of the springs can be released, permitting the table to drop when it is required to make adjustment of the object. After the required adjustment has been made the springs can again be brought into action by simply turning the handle back to its original position.

Special carriers are also provided for exhibiting post cards or other pictures. These are so arranged as to easily grasp pictures either square or rectangular, varying in size from two to six inches on a side. They are conveniently carried on suitable tracks provided for the purpose, so that pictures follow each other on the screen in a way analogous to that of lantern slides in the ordinary slide carrier.



DELINEASCOPE MODEL N

IN this instrument the illuminant used is a 500-watt monoplane filament bulb, which requires no more current than can be drawn from standard house wiring, making it available for home use, small class rooms, Sunday schools, etc. ¶ The best operating distance is about 15 feet. At this distance a clear-cut, brilliant image of opaque objects is easily obtained. The design of the base is such as to permit of the use of large books, maps or drawings which can be easily moved about, exhibiting a 6 inch square from any portion of the area.

The change from one form of projection to the other is accomplished by turning the handle shown in the illustration at the side of the instrument. This handle controls a curved glass reflector, which is so placed that in one position the light is directed against the opaque object and in the other position through the lantern slide. When placed for directing the light for either kind of projection it serves as a shutter to intercept stray light from the other object that would otherwise fog the screen.

The change between the two forms of projection is as easily accomplished, as is the change between lantern slides or two opaque objects. In fact, the swinging of the reflector from one position to the other gradually cuts the light off from one source while admitting it to the other, so that one picture truly dissolves into the other.

The lantern slide objective is 1⅝″ in diameter, 8″ focal length; the opaque projection objective 4″ in diameter, 16″ focal length. This relation is such as to produce images of practically the same size from lantern slides and opaque objects, provided the full available area is utilized in each case.

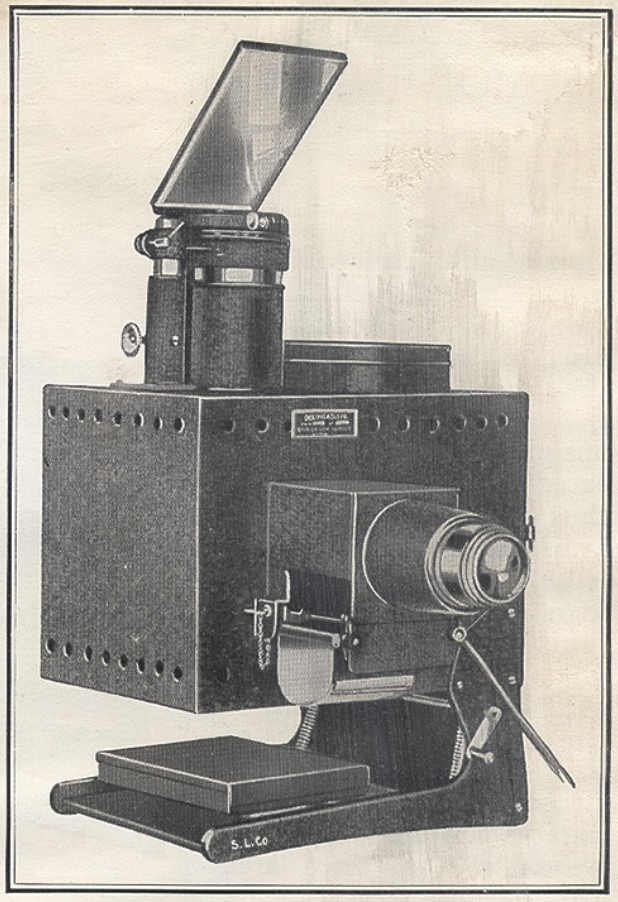
Slides are handled by the Spencer patented transposer, described on page 93. Opaque objects are carried on Spencer adjustable table. Three object carriers included. *See description, page 97.* Supplied with 15 feet of cord, with plug and switch.

Catalog No.	DESCRIPTION	Price
3705	Delineascope model N, with 500-watt, 110-volt bulb	$160.00

This instrument will project screen images of the following sizes from opaque pictures six inches on a side. A proportionately reduced image is obtained from pictures of smaller dimensions.

Distance from screen in feet	10	15	20	25	30
Size of screen image	3′ : 3″	5′ : 2″	7′	8′ : 9″	10′ : 9″

DELINEASCOPE MODEL P



A NEW instrument for lantern slide and opaque projection, possessing new and unique features which contribute to convenience and compactness, with no sacrifice of the high standard of efficiency established by Spencer instruments.

¶ The illuminant is a 1000-watt mazda bulb, which is so mounted on a sliding support that it can be easily slipped into either of two positions; in one it is suitably placed for illuminating opaque objects and in the other for lantern slides. The changing of position is accomplished by means of a conveniently located handle, without opening the instrument or interfering with any of its other adjustments.

The bulb is mounted in a mogul base and inclined at about 30 degrees from the vertical. For opaque projection it is placed at one side of the object to be projected and the illumination is accomplished both by direct radiation and by reflection from a silvered-back glass reflector and from plain mirrors. For lantern slides it is moved till it comes into line with the condensers. A stop is provided to insure the correct position.

The opaque area projected is 6 inches square but the open construction of the instrument makes it possible to very easily place in position books of any required size and show a 6-inch square area from any portion of the surface.

The lantern slide objective is 1⅝″ in diameter, 8″ focal length; the opaque projection object 4″ in diameter, 16″ focal length. This relation is such as to produce images of practically the same size from lantern slides and opaque objects, provided the full available area is utilized in each case.

Slides are handled by the Spencer patented transposer described on page 93. Opaque objects are carried on Spencer adjustable table. Three object carriers are included. *See description, page 97.*

Supplied with six feet of heavy cord, with plug and snap switch.

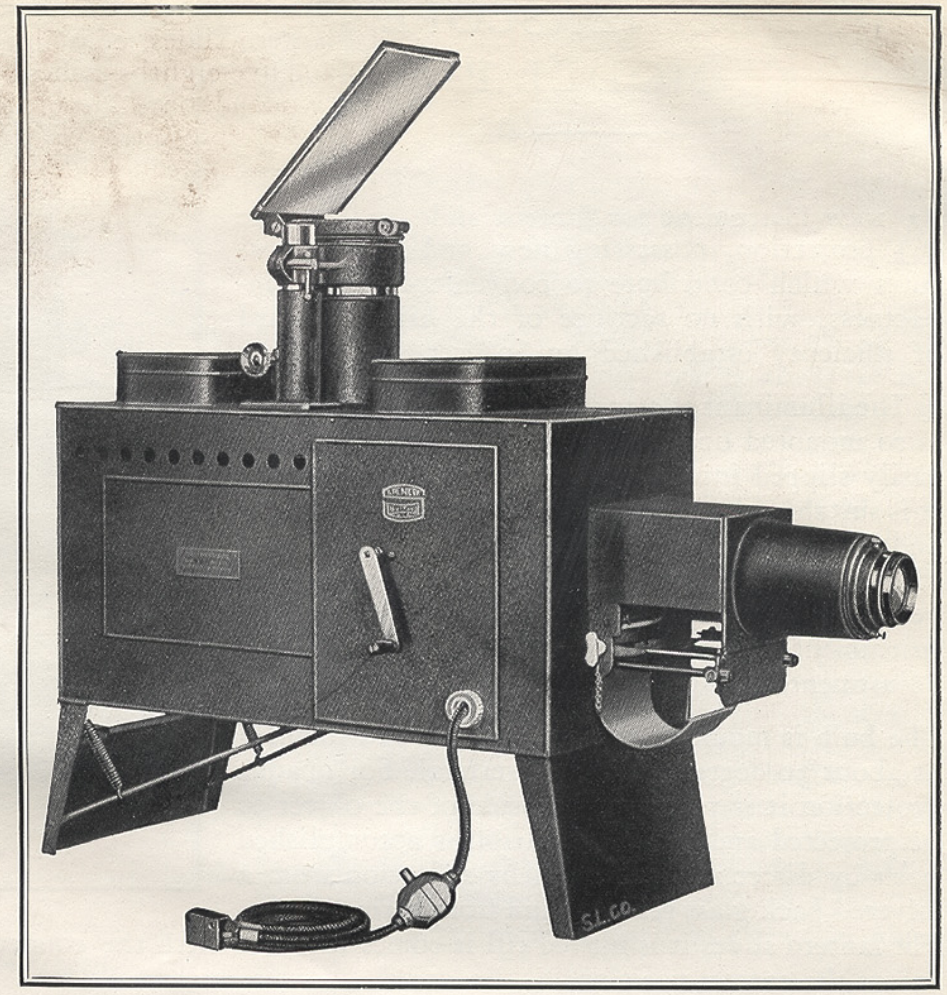
Catalog No.	DESCRIPTION	Price
3750	Delineascope, model P, with 1000-watt mazda bulb, 1⅝″ diameter objective for lantern slides	$200.00
3753	Delineascope, model P, same, with 2½″ diameter objective for lantern slides	209.00

This instrument will project screen images of the following sizes from opaque pictures six inches on a side.

A proportionately reduced image is obtained from pictures of smaller dimensions.

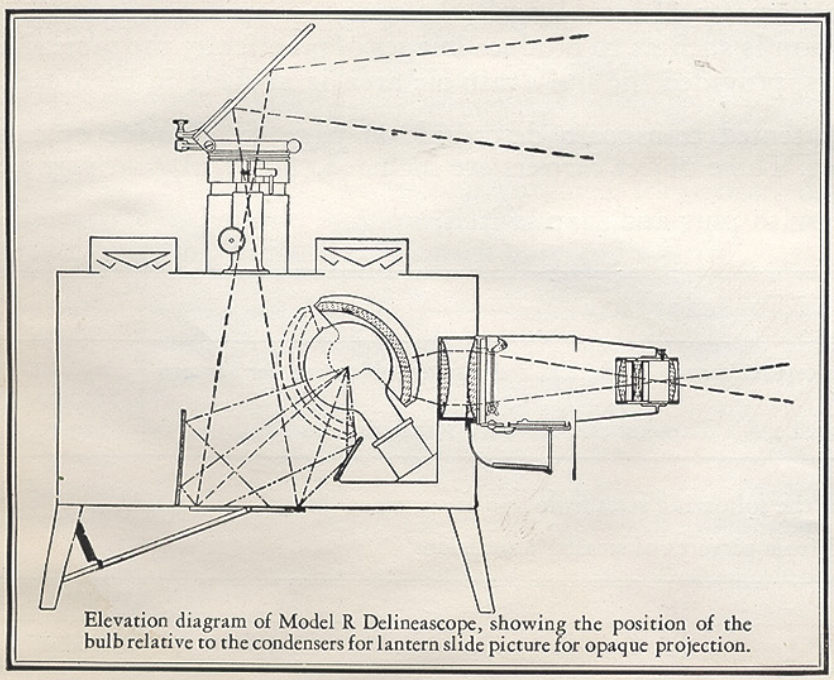
Distance from screen in feet	10	15	20	25	30
Size of screen image	3′: 3″	5′: 2″	7′	8′: 9″	10′: 9″

DELINEASCOPE MODEL R



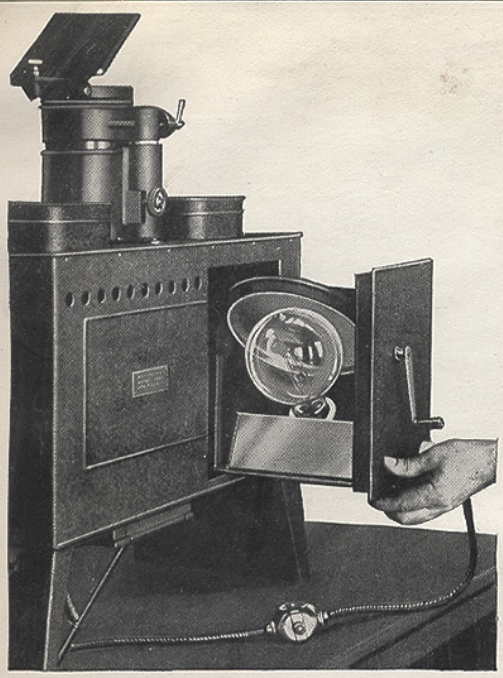
THIS is a high grade apparatus for use in school and college class rooms, Sunday schools, lodges, etc. It handles with equal facility both lantern slides and opaque objects. ¶ The area covered in opaque projection has the exceptional size of 6½″x9″ thus making the instrument available for exhibiting large maps, etc. It has been found especially useful in exhibiting before a class full written pages for the purpose of comparison or correction; thus teachers of English find it an exceedingly useful instrument. A diaphragm is provided by which the projected area can be reduced to six inches square.

The change from one form of projection to the other is accomplished by swinging the concave reflector from a position which throws light onto the opaque object to one which throws it through the condensers. This reflector also acts as a shutter to cut off the light from the object that it is not desired to illuminate. The concave reflector is controlled by a handle outside the case. (Not shown in the diagram.)



Elevation diagram of Model R Delineascope, showing the position of the bulb relative to the condensers for lantern slide picture for opaque projection.

The illuminant is a 1000-watt concentrated filament mazda bulb, operating on either alternating or direct 110-volt circuit. Requires no more current than can be drawn from most wiring systems. This bulb is so placed with reference to condensers for lantern slide work as to produce the best possible results, at the same time retaining its maximum efficiency in opaque projection. The socket is mounted in an easily removable sliding part which greatly facilitates the replacing of the bulb when broken or worn out. ¶ A curved reflector and plain mirrors are so arranged within the lamp house as to gain a better illumination than has heretofore been obtained, except with the arc light.



Detail of Model R Delineascope showing construction of removable chamber and fitting of 1000-Watt Mazda bulb. The turning of the mirror reflector, shown behind bulb, by the outside lever, is the only action required to change from "opaque" to lantern slide projection.

The projection objectives regularly supplied are: for lantern slides, eight inches equivalent focus and one and five-eighths inches diameter, or ten-inch focus and two and one-half inches diameter, as ordered; for opaque projection, four inches in diameter and eighteen inches equivalent focus, but if the instrument is desired to work at distances of greater than twenty-five feet from the screen, the focal length of the latter lens may be increased up to twenty-four inches and a corresponding focal length of lantern slide objectives made. The relative foci of the two lenses are made such as to produce images of approximately the same size from both opaque objects and lantern slides. By properly selecting projection lenses, the instrument may be made available for working distances as great as forty feet. The large lens for opaque projection is focused by rack and pinion; the lantern slide lens by spiral action.

Slides are handled by the Spencer patented transposer described on page 93. Opaque objects are carried on Spencer adjustable table. Three object carriers are included. *See description, page 97.*

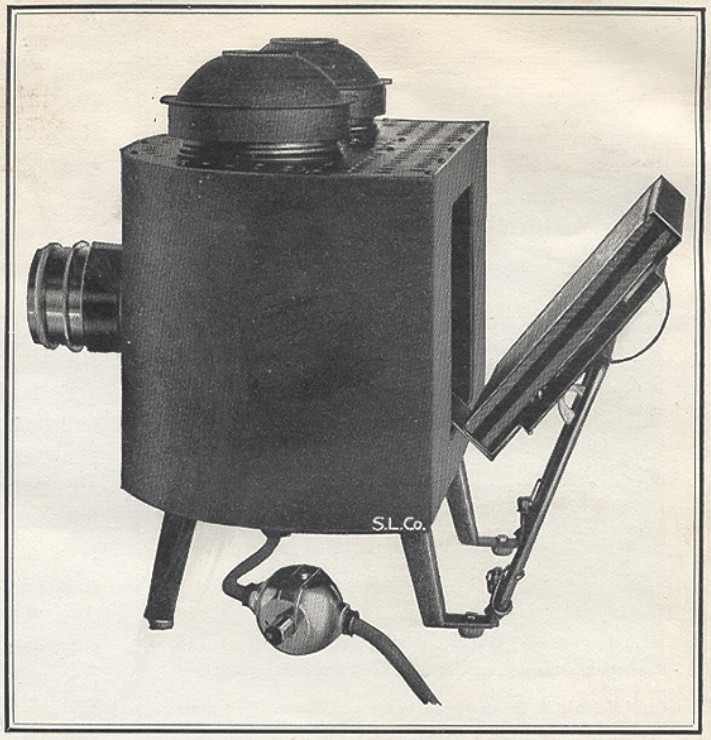
Supplied with six feet of heavy cord, with plug and snap switch.

Catalog No.	DESCRIPTION	Price
3760	Delineascope model R, with 1000-watt bulb, for 1⅝″ diameter objective for lantern slides	$225.00
3763	Delineascope model R, same, with 2½″ diameter objective	234.00

This instrument will project screen images of the following sizes from opaque pictures six inches on a side. A proportionate variation in size of screen images results from pictures of either large or smaller size.

Distance from screen in feet . . .	10	15	20	25	30
Size of screen image	2′: 10″	4′: 6″	6′: 2″	7′: 10″	9′: 6″

SPENCER DELINEASCOPE, MODEL S

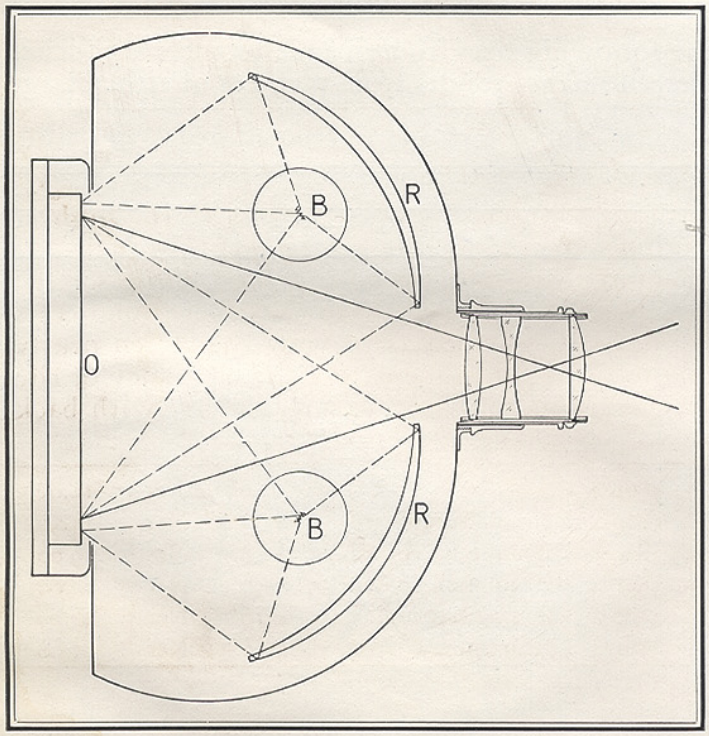


THIS instrument is designed for opaque projection only and is especially adapted to use with translucent screens, such as the "TRANS-LUX DAYLIGHT PICTURE SCREEN." *See page 103.*

The design is shown in the accompanying sketch. Two 500-watt bulbs, BB, are placed as nearly directly in front of the object, O, as is possible without bringing them between the object and the projection lens; back of them are placed silvered-back glass reflectors, RR. By thus combining the direct and reflected light from two high-power bulbs, the object becomes especially brilliantly illuminated.

The opaque area illuminated is 6 inches square. The projection lens is 2½ inches diameter and 8½ inches equivalent focus, giving a "speed" or light transmitting power, as determined by the ratio of diameter to focal length, even greater than that of lenses of greater diameter and longer focal length used in most opaque projectors.

The short focal length of lens results in a picture satisfactory in size at a very short projection distance (four to six feet). It is thus practical to place the Delineascope behind the screen and benefit by the increased brilliancy which is incidental to the Trans-Lux screen, and also obviates the necessity of using erecting mirrors, since the reversed image which would be seen on reflecting screens is erected when viewed from the other side.



Thus four factors contribute to produce a brilliant picture:

1st. Exceptional illumination of the object.

2nd. High transmitting power of projection lens.

3rd. The use of the Trans-Lux Screen with the advantage of transmitted rather than reflected light.

4th. The elimination of erecting mirrors.

The result is an illumination in opaque projection that is equivalent, if not superior to that ordinarily obtained from lantern slides with reflecting screens.

Catalog No.	Description	Price
3770	Opaque delineascope, model S with two 500-watt bulbs . . .	$100.00

Distance from screen in feet	4	5	6	8	10
Size of screen image	2′: 4″	2′: 11″	3′: 9″	5′: 2″	6′: 5″

SCREENS

THE TRANS-LUX DAYLIGHT PICTURE SCREEN

THIS screen greatly extends the range of availability of projection apparatus. So completely is the light which falls on it utilized that it becomes possible to project ordinary lantern slides under conditions that have heretofore been regarded as prohibitive of such work. With this screen and an ordinary stereopticon, a darkened, or even a shaded room, is no longer a requisite. Pictures are shown under light conditions which ordinarily prevail in the class or lecture room.

Ordinary white or silvered screens, in the use of which the observer is on the same side of the screen as the projection instrument, are useful exactly in proportion to their *reflecting* power or capacity to throw back to the eye of the observer the light which strikes them. Unfortunately, such screens have no selective capacity; they reflect light from extraneous sources in the same ratio as they reflect that from the lantern; this gives the picture a foggy appearance whenever outside light falls on the screen. With the Trans-Lux screen this is not so. This screen has very little reflecting capacity, so that, when observed under the light conditions of ordinary rooms, it appears as a dark rather than a white screen. In use, the projection instrument is placed *back* of the screen and the picture is seen by the light which is *transmitted* and *diffused*, and not at all by that which is reflected.

¶ This is not a new principle. Pictures have been shown on tracing paper, on ground glass, and even on muslin cloth, but such devices have been very defective on account of the fact that too much light passed straight through and too little was diffused, giving the picture a disagreeable glare when viewed from directly in front and a decided falling off if seen from any considerable angle. The Trans-Lux screen is covered with a series of fine vertical corrugations of a size and shape shown by experience, as well as by scientific computation, to be suitable for diffusing the light through a wide angle, giving a picture of practically uniform brilliancy when viewed from any position.

¶ The characteristics which make this screen valuable are:

1st. High transmitting capacity.
2nd. Low reflecting capacity.
3rd. High diffusing or spreading capacity.

Supplied when so ordered in fiber case, with handle for carrying.

Cat. No.	DESCRIPTION	Price without case	Price with case
3880	Trans-Lux Daylight screen, 24″ x 30″ . . . . . Net	$25.00	$32.50
3882	Trans-Lux Daylight screen, 30″ x 36″ . . . . . Net	37.50	47.50
3884	Trans-Lux Daylight screen, 36″ x 45″ . . . . . Net	55.00	67.50
3888	Trans-Lux Daylight screen, 50″ x 60″ . . . . . Net	87.50	102.50

Larger sizes quoted on request.

PLAIN AND ALUMINUM COATED SCREENS

OUR screens are selected with especial care with view to offering only those with the highest degree of opacity and the best possible reflecting surfaces.

For ordinary work, where a reflecting screen is required, we recommend the plain white screen, but for opaque projection, or for lantern slide work where it is necessary to use other illuminants than the electric light and where the observers can be so grouped as to view the screen nearly "straight on," aluminum coated screens are found to be useful in increasing the brilliancy of the picture.

¶ Both plain and aluminum coated screens are mounted on spring rollers, with back board and accessories for hanging.

3860	Plain coated, 4½′ x 4½′ . Net	$ 7.00	3862-A	Aluminum coated, 6′ x 6′ . Net	$12.00
3862	Plain coated, 6′ x 6′ . . Net	8.50	3864-A	Aluminum coated, 7′ x 7′ . Net	14.50
3864	Plain coated, 7′ x 7′ . . Net	12.00	3866-A	Aluminum coated, 8′ x 8′ . Net	19.00
3866	Plain coated, 8′ x 8′ . . Net	15.00	3868-A	Aluminum coated, 9′ x 9′ . Net	30.00
3868	Plain coated, 9′ x 9′ . . Net	24.00	3870-A	Aluminum coated, 10′ x 10′ . Net	40.00
3870	Plain coated, 10′ x 10′ . . Net	32.00	3872-A	Aluminum coated, 12′ x 12′ . Net	65.00
3872	Plain coated, 12′ x 12′ . . Net	55.00			

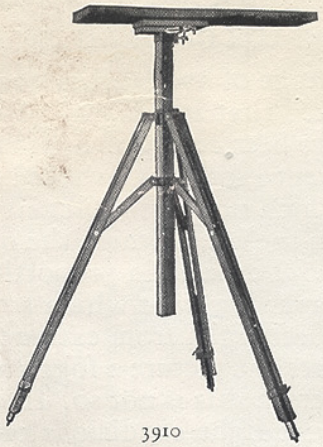
SATEEN FLEXIBLE SCREENS

Made of extra heavy sateen, bound on all four sides and fitted with a series of metal eyelets for convenient hanging.

3862-F	6′ x 6′ . . . . . Net	$ 7.00	3870-F	10′ x 10′ . . . . . Net	$20.00
3866-F	8′ x 8′ . . . . . Net	12.00	3872-F	12′ x 12′ . . . . . Net	24.00



3904-06



3910



3908

TABLES

3904 Substantial table, iron frame, with oak top, with convenient adjusting screws for inclining at any desired angle. Suitable for use with all Delineascopes. Has iron shelf for accessories and is supplied with casters. Dimensions of top, 16″ x 32″ height, 44″ . . . . . Net $35.00

3906 Similar to 3904, but of lighter construction. Especially suitable for Delineascopes models E, F and H. Made entirely of metal. Dimensions of top, 14″ x 28½″; height, 42½″ . . Net $26.00

3910 A very compact table, easily folded for storage or carrying. The top is felt covered, may be inclined at any angle and is adjustable for height. Dimensions, 7¼″ x 24″ . . . . . Net $20.00



3912-14

3908 This is an exceptionally rigid table, suitable for supporting any slide projection lantern. The legs are made of angle iron thoroughly braced by strips of such size as to give it the requisite strength to withstand rough handling. The top is of wood with black finish

Dimensions of top, 12″ x 30″.

Height, 42″.

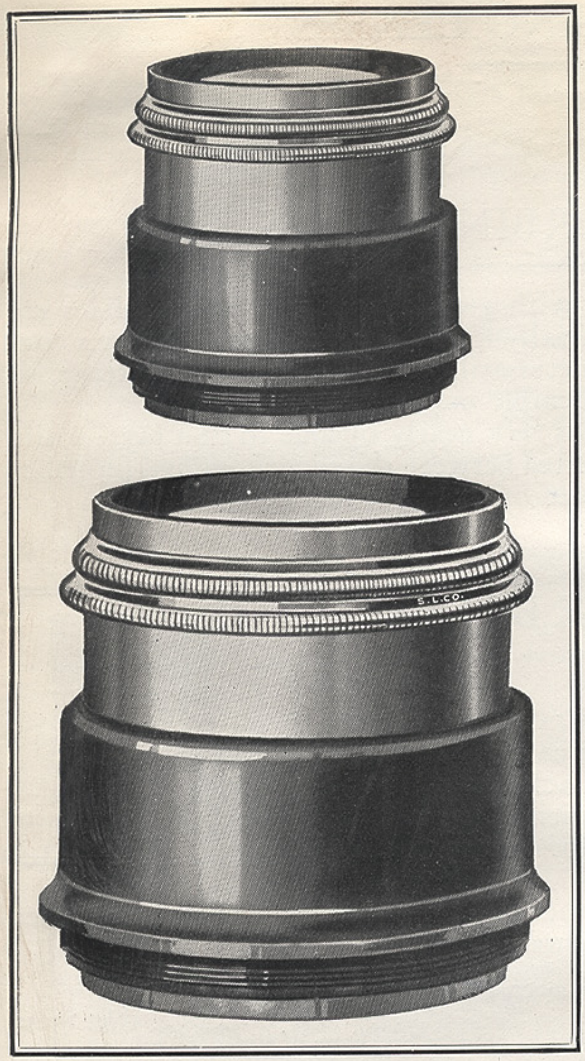
The table is shipped "knocked down," thereby reducing the transportation charges.

It is very easily assembled for use. . . . . Net $15.00

3912-14 These tripods constitute a very convenient and rigid support for Delineascopes. They are provided with heads and clamps by which they are easily and firmly attached to the instruments for which they are intended. The legs are collapsible and are easily removed from their sockets in the head, making the entire apparatus very compact for transportation or storage. The range of adjustment of length of legs is from 3′ to 4½′.

3912 Tripod for Delineascopes models E or F . . . . . Net $12.00

3914 Tripod for Delineascope model H . . . . . Net 12.00



SPENCER PROJECTION OBJECTIVES

OUR projection objectives are constructed from optical glass of the highest quality manufactured in our own factory under the direct supervision of a skilful and experienced glass maker. We utilize only those portions which are perfectly white and transparent, free from strain and striæ. Formulas are carefully computed with reference to achromatic and spherical aberration and flatness of field. The evidence of this is distinctly visible on the screen, in the whiteness, brilliancy and sharp delineation of the projected picture.

Regularly supplied in a mount threaded for standard flanges and having a sleeve in which the lens is focusable by spiral action.

Catalog No.	Equivalent Focus in Inches	Diameter of Lenses in Inches	Price
3952	4¼	1⅝	$15.00
3954	5½	1⅝	15.00
3956	8	1⅝	15.00
3958	10	1⅝	15.00
3960	5½	2½	23.00
3962	8	2½	23.00
3964	10	2½	23.00
3966	12	2½	23.00
3968	14	2½	23.00
3970	16	2½	23.00
3972	18	2½	23.00
3974	20	2½	23.00
3976	22	2½	23.00
3978	24	2½	23.00
3984	16	4	82.50
3986	18	4	82.50

Table of greatest dimension of screen pictures produced from standard sized slides at distances of from 4′ to 100′, with lenses of from 4¼″ to 24″ focal length.

Distance from Screen in feet		4	5	6	10	15	20	30	40	50	60	70	80	90	100
Focal length of lens in inches	4¼	2½	3¼	4¼											
	5½	2	2½	3	6⅓										
	8		2	2½	3¾	5⅝	7½	11¼	15						
	10		1½	2	3	4½	6	9	12	15					
	12				2½	3¾	5	7½	10	12½	15				
	14		Size of screen picture in feet		2	3¼	5¼	6½	8½	10⅝	13	15			
	16					2¾	3⅓	5½	7½	9⅜	11¼	13⅛	15		
	18						3	5	6⅔	8⅓	10	11⅞	13½	15	
	20							4½	6	7½	9	10½	12	13½	15
	22							4	5½	6¾	8⅙	9½	11	12¼	13⅔
	24							3¾	5	6¼	7½	8¾	10	11¼	12½

The above table is necessarily incomplete. For instance: let us suppose that a 4′ picture is desired at a working distance of 12′. Reference to the table will show that an 8″ lens would give, at a distance of 10′, a 3¾′ picture, and at 15′, a 5⅝′ picture. Also that a 10″ lens will give, at 10′, a 3′ picture and at 15′, a 4½′ picture. Thus, with an 8″ lens at exactly 12′, the picture would be somewhat larger than required; with a 10″ lens at the same distance, it would be slightly smaller. The choice, therefore, should be made between these two lenses with due regard to the possible variation of size of screen image or projection distance.



CONDENSING LENSES

3995 Plano-convex lens, 4½″ diameter. (Supplied, 6½, 7, 7½, 8, 8½, 9, 10, 11, 12, 14, 16 inches focus.) Be sure to state focus . . . . . Each $2.00

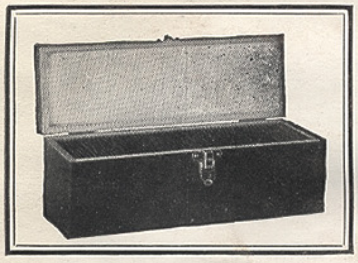
If focus is unknown, state the instrument with which it is to be used, whether next to the bulb or next to the slide; and the focal length of the objective with which it is used.

HEAT-ABSORBING GLASS

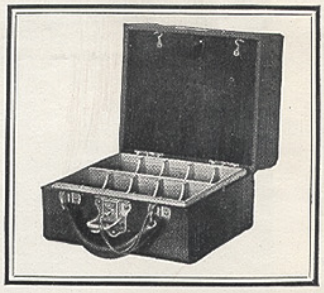
IN any instrument employing bulbs with a wattage of 500 or more, slides are somewhat endangered by heat, especially if they are left in position for a considerable length of time. The danger necessarily increases with the wattage, so that with 1000-watt bulbs it becomes a matter of considerable importance.

To overcome this, we offer a disc of special glass which is very nearly opaque to heat rays, while transmitting virtually all the light rays. This is to be inserted between the condensers and furnishes the best and most convenient protection that has yet been offered.

4110 Heat-absorbing glass $5.00



LANTERN SLIDE BOXES



TO travelers carrying a quantity of lantern slides, a suitable carrying case is a virtual necessity; and practical receptacles for storing are an unquestioned convenience, even for those who have no occasion for carrying their slides from place to place.

We offer a well selected list of slide boxes from which either class of customers may make a choice which will exactly accord with his individual requirements.

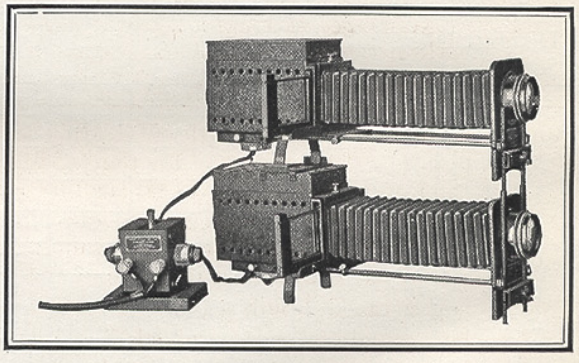
3920 Slide box of birch, natural oil finish, dovetailed corners; numbered compartment for each slide, with convenient index. Capacity, 60 slides . . . . . Net $3.50

3922 Extra heavy box with handle, brass clips, lock and key. Padded to prevent breakage of slides. Capacity, 50 slides . . . . . Net 6.00

3924 Lecturer's carrying box for slides. Has lock and key, leather handle, imitation leather cover. Capacity, 130 slides . . . . . Net 6.00

3926 Similar to 3924 but of smaller size. Capacity 65 slides . . . . . Net 5.00

SPENCER ELECTRIC DISSOLVER



PERFECT dissolving effect is produced by any device that causes one picture to fade from the screen while the new one increases in brilliance at the same rate as the old one loses. This condition is more nearly attained by the electric dissolver than by any other device. By simply throwing a lever from one side of the apparatus to the other, the current is gradually shut off from one bulb and to exactly the extent that it is taken from one, it is supplied to the other.

The dissolver can be used with any two lanterns illuminated by electric bulbs of not over 500-watt capacity, and equipped with lenses of the same diameter and focal lengths.

The illustration shows the dissolver connected to two model E Delineascopes. The advantages of two instruments thus easily separable for convenience in packing or for use singly, over any combination of inseparable instruments, is too obvious to require comment.

4115 Electric dissolver $30.00

4117 Set of accessories for supporting one model E Delineascope above another for dissolving outfit 3.00

ILLUMINANTS

FOLLOWING is a list of the various types of illuminants regularly supplied or easily adaptable to Spencer Delineascopes.

All bulbs operating on a wattage of 400 or over are supplied with the mogul base, which is recommended by the manufacturers and which alone meets the approval of the National Board of Fire Underwriters.

Workmanship is guaranteed by the manufacturers. We inspect and test each bulb, to ascertain that it has not been damaged in reaching our hands; each is packed for shipment by experienced and careful packers; beyond that our responsibility can not extend. Claims for bulbs damaged in transit should be made against the transportation company handling the shipment.

Most electric companies deliver their current under a "pressure" of 110 volts. So nearly universal is this custom that we are justified in regarding 110-volt bulbs as *standard* and supplying them on all orders, unless definitely instructed otherwise.

Systems delivering current under a 220-volt pressure are in use in a few places, while local plants generating current for use on the premises occasionally supply only a 32-volt pressure.

For the accommodation of those working under exceptional conditions we offer, in addition to the standard bulbs, a selection of 220-volt and 32-volt bulbs.

Catalog No.	DESCRIPTION	Price
4005	200-watt, 110-volt mazda, monoplane filament, tubular, standard base[1] . . . . . NET	$ 2.10
4006	250-watt, 110-volt mazda, monoplane filament, tubular, standard base[2] . . . . . NET	2.10
4010	400-watt, 110-volt mazda, monoplane filament, tubular, mogul base[3] . . . . . NET	3.65
4012	500-watt, 110-volt mazda, monoplane filament, tubular, mogul base[4] . . . . . NET	5.30
4015	1000-watt, 110-volt mazda, monoplane filament, spherical, mogul base[5] . . . . . NET	8.35
4016	1000-watt, 110-volt mazda, monoplane filament, tubular, mogul base[6] . . . . . NET	7.80
4020	400-watt, 220-volt mazda, cluster filament, spherical, mogul base[7] . . . . . NET	6.50
4023	500-watt, 220-volt mazda, monoplane filament, tubular, mogul base[8] . . . . . NET	5.95
4035	165-watt, 32-volt mazda, cluster filament, tubular, mogul base[9] . . . . . NET	2.00
4037	250-watt, 32-volt mazda, cluster filament, tubular, mogul base[10] . . . . . NET	3.25
4040	400-watt, 32-volt mazda, cluster filament, tubular, mogul base[11] . . . . . NET	4.30
4050	6-volt, 60 C. P. bulb, with adapter for use on storage battery. (State model of instrument with which it is to be used[12]) . . . . . NET	6.25
4052	6-volt, 60 C. P. bulb, for use on storage battery . . . . . NET	2.25
4053	6-volt battery . . . . . NET	28.00
4057	Pastel type acetylene burner, with adapter and two buttons interchangeable with bulb. (State model of instrument with which it is to be used.) . . . . . NET	6.00
4059	Buttons (pastel) for use on lamp No. 4057 . . . . . NET	.75
4061	Gas pressure regulator, for use with Prest-o-lite tank . . . . . NET	10.00
4063	Prest-o-lite tank, 16 hours' capacity, on lamp No. 4057 . . . . . NET	12.00
4066	Multiple jet acetylene burner, with adapter interchangeable with bulb. (State model of instrument with which it is to be used). . . . . NET	6.00
4068	Multiple jet acetylene burner (tip only) . . . . . NET	.75
4070	Acetylene gas generator . . . . . NET	12.00
4080	Resistance to adapt a 400-watt, 110-volt bulb to 220-volt circuit	8.50
4082	Resistance to adapt a 500-watt, 110-volt bulb to 220-volt circuit	10.00
4084	Resistance to adapt a 1000-watt, 110-volt bulb to 220-volt circuit	15.00

1—This is the bulb supplied with automatic Delineascope, model K.

2—This bulb may be substituted for the 500-watt or 400-watt bulbs in models E, F or H. It consumes less current than the larger bulbs and gives satisfactory illumination for short projection distances.

3—This bulb is regularly supplied with lamp No. 394. It may be used in place of the 500-watt bulb in any instrument regularly employing the latter. The illumination from this bulb is somewhat inferior to that from the 500-watt bulb. However, it consumes less current and develops somewhat less heat.

4—This is the standard bulb regularly supplied with Delineascopes models E, F, H, N and S.

5—This bulb should be used in models P and R.

6—This bulb is to be used with models J and K.

7—This bulb should be used instead of No. 4010, where 220 instead of 110-volt current must be used.

8—This bulb should be used instead of No. 4012, where 220 instead of 110-volt current must be used.

9—This bulb may be used in models E, F and H, where the low voltage and limited wattage only is available. It gives very satisfactory results.

10—This bulb will give excellent results on models E, F, or H. It is recommended for general use on the Delco system.

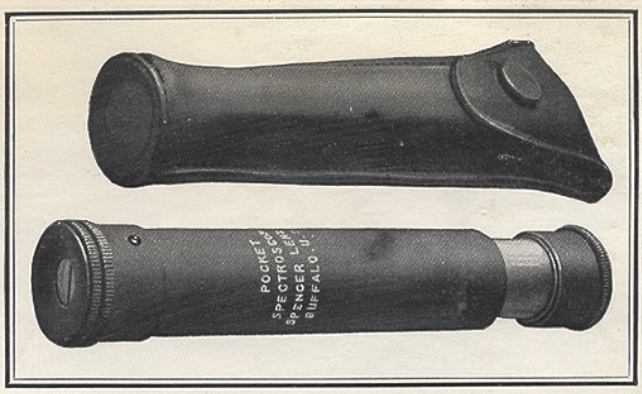
11—This bulb may be used in any instrument which employs the 500-watt, 110- or 220-volt bulb. The illumination from it is fully equivalent to that of the standard bulbs mentioned.

12—*See description, page 90.*

In the following pages we list a selection of scientific optical instruments recently developed in our factory. These instruments are characterized by the same careful workmanship, neatness and practicability of design that have contributed to make Spencer Microscopes a world standard. To this list we shall make additions from time to time, as occasion demands or further designs are completed.

We are prepared to undertake the construction of special instruments to meet individual requirements. We are especially qualified to manufacture, in accordance with exact specifications, any article of optical glass involving either plain or curved surfaces, ground and polished to any required degree of precision. Our available glasses range in indices from 1.510 to 1.783.

Our aim is not merely to produce large quantities of standardized instruments, but to ally ourselves with those engaged in research work in order that we may play some part in the advancement of science, thereby contributing to general progress as well as to the promotion of our own success.



SPENCER POCKET SPECTROSCOPES
NOS. 10010 and 10015

THESE instruments are scientifically designed and carefully constructed. They are suitable for use by physicists, signal engineers or any technician desiring to make quick and reliable observations of different kinds of spectra, but who do not require to make definite measurements of them.

¶ Dispersion is accomplished by a train of five prisms. In No. 10010 the available aperture through the train of prisms is 2 millimeters square and the dispersion between the C and F lines is 10 degrees. In No. 10015 the available aperture is 4 millimeters square and the dispersion between the C and F lines is 5 degrees and 20 minutes. Between these two instruments no distinction as to quality is to be drawn; each may be more suitable for its special purpose than the other. In any case, where the smaller dispersion is sufficient to accomplish the required purpose, No. 10010 is preferable, for the reason that the larger aperture and smaller dispersion result in greatly increased brilliancy of illumination.

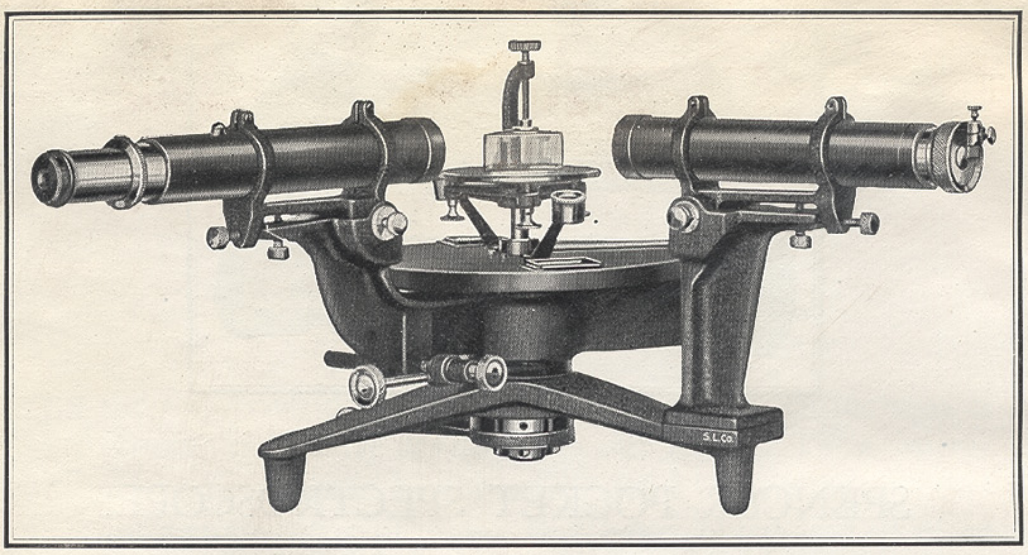
The slit is very carefully constructed and accurately adjustable by a knurled ring to any desired separation of the jaws, which open symmetrically from the optical center. This slit is covered by a screw cap with a glass window, which serves to protect both the slit and the objective from dust.

¶ The objective by which the image of the slit is projected through the prism train is achromatic, highly polished and carefully centered, resulting in sharp, clean-cut images in the several colors.

¶ The instrument is focused by telescoping the tube carrying the eye opening in and out of the prism tube. The cap containing the eye opening is removable to permit the cleaning of the only exposed prism surface.

Furnished in neat leather carrying case.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onooono	10010	Pocket spectroscope yielding dispersion of 10° between C and F lines . . .	$25.00
Onooonfiv	10015	Pocket spectroscope yielding dispersion of 5° 20′ between C and F lines . .	25.00



SPENCER MEDIUM SPECTROMETER

THIS instrument is especially suitable for use in the physics laboratories of colleges and universities. Simple in design and rigid in construction, it is built with the degree of accuracy requisite for genuine research work, while offered at a price low enough to make it available for general student use.

The collimator is six inches long. It is provided with an accurately ground and polished single achromatic lens, which forms a sharply defined image of the slit. Attached to it is a suitable support for a comparison prism.

The slit is formed between two plates of metal carefully ground to knife edges and operated by a knurled ring. They move symmetrically from the center and remain perfectly parallel at all openings

The telescope has an achromatic objective and Ramsden ocular, focusable by spiral mount.

The collimator and telescope are securely mounted in heavy supports and provided with suitable screws for maintaining their alignment.

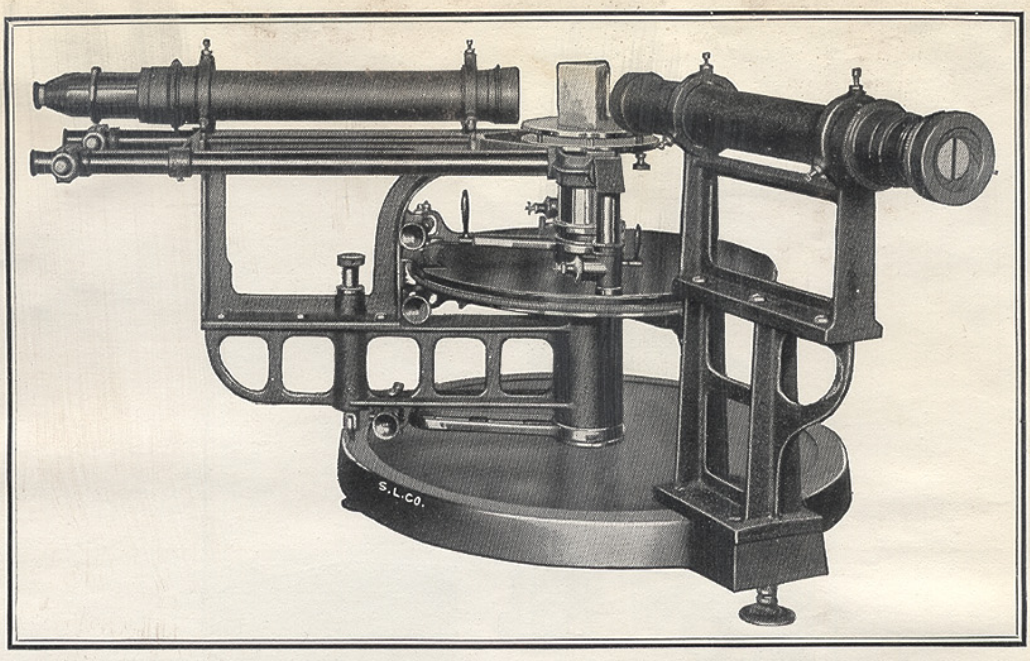
The prism table is adjustable for height and has convenient leveling screws.

A horizontal circle, five inches in diameter, graduated to 30° and read to single minutes by two verniers, separated by 180°, is attached to the telescope mount. The circle is covered by a dust-tight cap.

Reading microscopes are conveniently placed over the verniers.

Clamps and slow motion screws are provided for both the graduated circle and the prism table.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onootofiv	10025	Spectrometer complete, as described above	$110.00
Onoothreo	10030	Prism or grating clamp	3.50
Onoothrefiv	10035	Comparison prism	7.00
Onooforo	10040	Prism, 60° 18 mm. high by 36 mm. wide. Index, about 1.65	7.00
Onooforfiv	10045	Hollow prism, 18 mm. high by 36 mm. wide, cemented without metal frame	10.00



SPENCER PRECISION SPECTROMETER

A STRICTLY high-grade instrument, designed by our technicians for use in their own laboratory in making observations on Spencer optical glass. It has proven so satisfactory, being both accurate and convenient, that we were persuaded to offer it to such of our patrons as desire an absolutely reliable instrument for practical spectrometry. The instrument is constructed with special views to extreme rigidity as well as with the highest degree of refinement in mechanical workmanship.

The base is a cast iron disc, 22 inches in diameter, provided with leveling screws. The margin of the upper surface is milled flat, furnishing a track for supporting the telescope carrier.

The graduated circle is 15 inches in diameter, divided to 2′ and read to 1″ by micrometer eyepieces in the reading microscopes.

Readings are made at two positions 180° apart, by means of reading microscopes conveniently placed on either side of the observation telescope. The microscopes are provided with micrometer eyepieces having two parallel movable cross hairs reading directly to seconds. Eye lenses are focusable on the cross hairs. The scale and the cross hairs are illuminated by miniature electric bulbs.

¶ The circle is protected from dust and, to a great extent, from the tarnishing effect of air by a tightly-fitting felt lined cap.

Triple apochromatic objectives 2½ inches in diameter and 18 inches focus are used in both the collimator and the observation telescope. Thus a perfect image of the slit is obtained in all colors and parallax due to chromatic aberration of the optical system is practically eliminated.

The eyepiece of the telescope is focused on the cross hairs by a sliding collar and the entire telescope focused on the slit by a knurled ring.

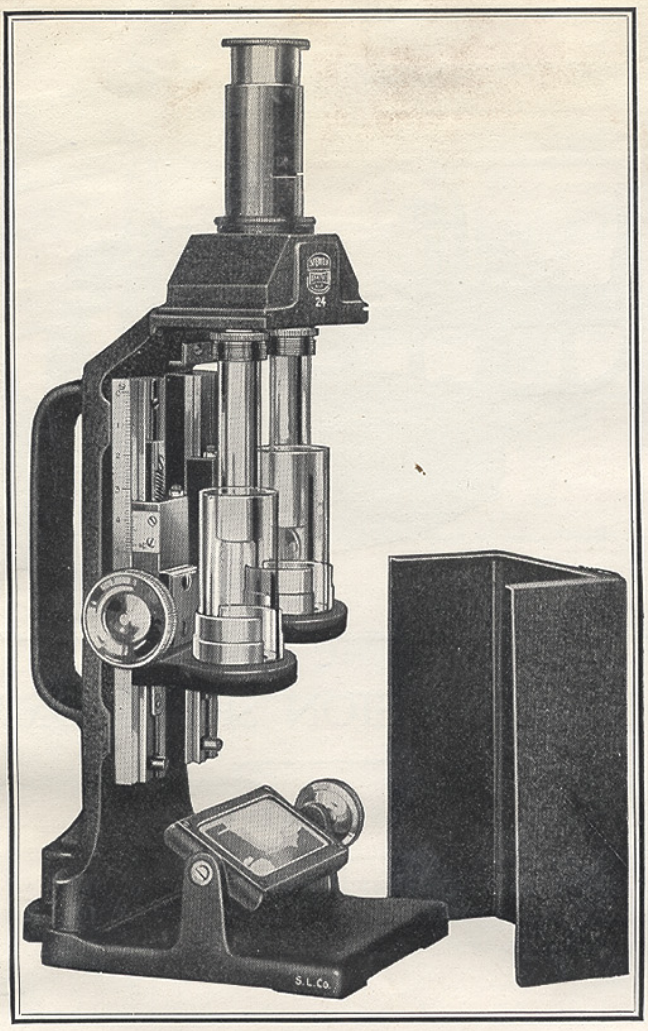
Centering screws are provided for accurate alignment of both collimator and telescope. Jaws of the slit are of tool steel and accurately ground to knife edges. Opening is adjusted by a micrometer screw giving very exact control of the width. The length of the slit is regulated by an iris diaphragm placed directly in front of it.

The prism table is conveniently adjustable for height, provided with the most carefully fitted leveling screws, and is ground to an optically plane surface.

Clamps and slow motion buttons for all movements are placed in easily accessible positions.

PRICE

Onoofivo 10050 Spectrometer, as described above $1,800.00



SPENCER DUBOSCQ COLORIMETER

This instrument, with its immediate accessories, is designed for making three distinct types of observation:

1st. For balancing the shades of colored solutions, thereby comparing their degree of concentration. When applied with care this method of balancing quantities is quite as accurate as that of comparing quantities by balancing weight against weight.

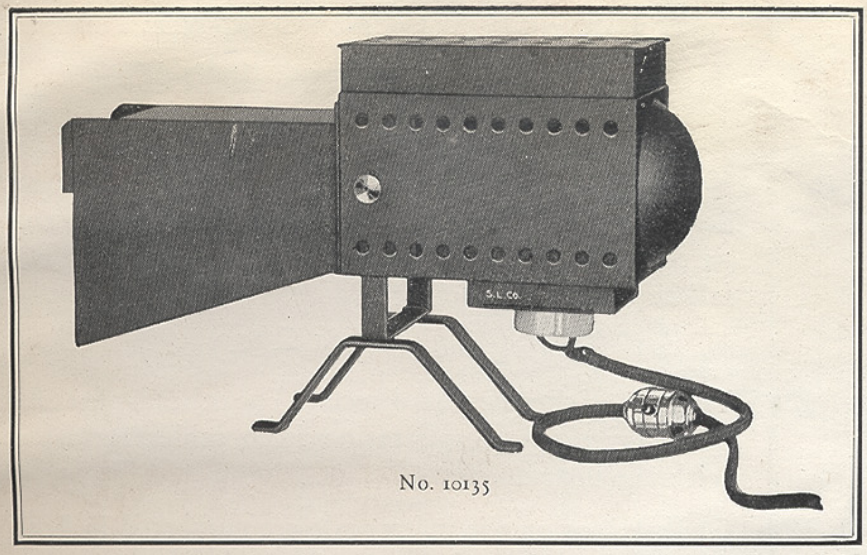
2nd. For measuring the degree of turbidity of fluids, or, in other words, of estimating the relative number of suspended particles.

3rd. With the use of a standard color disc for estimating the haemoglobin contents of blood by the Newcomer method. This method is very simply applied and furnishes a degree of accuracy not easily attained with ordinary haemoglobinometers.

The instrument is constructed with the same care that is applied to the manufacture of our microscopes and other high grade optical instruments, and is capable of making extremely accurate measurements. It is mounted on a substantial base, with convenient handle. The finish is an attractive crystal black that is impervious to the action of all ordinary laboratory reagents.

The plungers are made of optical glass, with ends highly polished. They are especially selected for transparent qualities and freedom from color and carefully matched, so that the absorption, slight though it is, shall be identical. They are mounted in adapters which are threaded to screw into the prism box and which are also threaded to receive opaque shields for the plungers when the instrument is used as a nephelometer. (For measuring turbidity.)

The cups are 50 millimeters in height with bottoms having optically plane and parallel faces. They are mounted in supports which hold them rigidly in place while in use, but from which they may easily be removed. The supports are open at the front and back clear down to the bottoms of the cups, making horizontal illumination possible for turbidity comparisons. Provision is made in the mounting of the cups for inserting opaque stops to cut out light from below.



No. 10135

The cups are adjustable independently by rack and pinion movements, and the position of each is read by verniers to tenth millimeters.

The prisms by which the light from each plunger is brought into the same field are very carefully ground and polished and so mounted that the edges which come together in the field of the eyepiece unite in a sharp, clean-cut line. They are held rigidly in place and are not easily gotten out of alignment. The eyepiece tube is easily unscrewed from the prism box, making the upper exposed surface of the prisms available for cleaning. The eyepiece is focusable by sliding in a collar, so that the line between the two halves of the field becomes sharply defined. ¶ An oblong frame below the cups supports on one side a plane mirror, and on the other side a white reflecting surface for throwing into the cups either direct or diffused light, as required.

When used for comparing shades of transparent color fluids, a quantity of the two fluids to be compared is placed one in each cup, and the mirror or white surface is so adjusted as to throw light through the bottom of the cups and the fluid in the cups into the plungers, whence they are transmitted to the field observed through the eyepiece. The cups are then raised to such a height, first, that a color density suitable for comparison is obtained, and second, that the shades in the two halves of the field are identical. The concentration of solution is then inversely proportional to the depth of the fluid through which light is transmitted. These depths are read directly from the verniers at the side of the instrument.

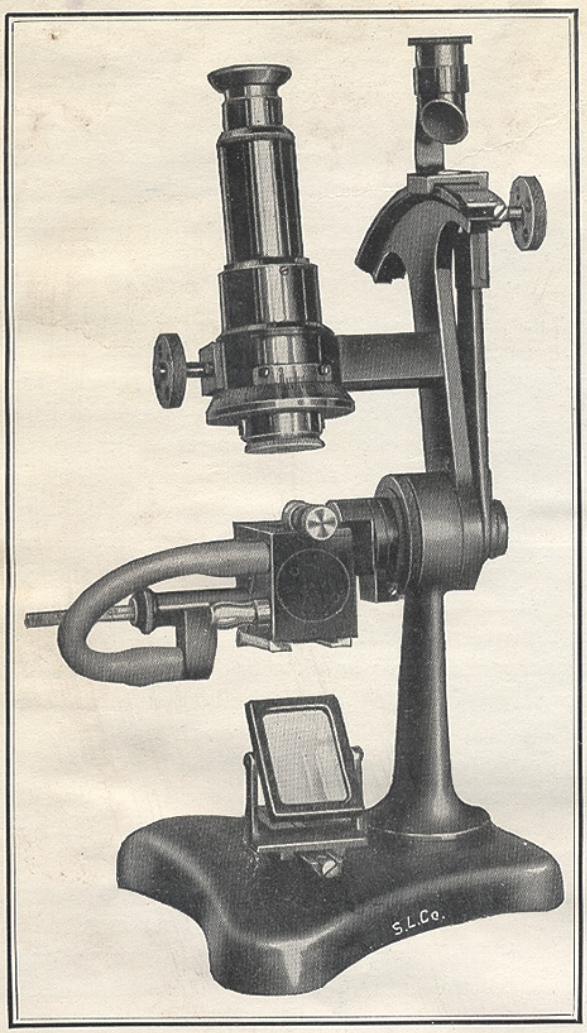
In comparing turbidity of fluids the instrument is modified, first, by placing opaque shields over the plungers, except at the ends, and second, by introducing beneath the cups opaque stops to shut off light from below. Illumination for making this comparison is obtained from a specially constructed lamp designed to project into the sides of the cups an intense beam of parallel light. This lamp consists of a 400-watt stereopticon bulb with mogul base, and a special hood and shield. The lamp is backed by a curved glass mirror and supplied with a pair of 4½″ condensing lenses, which combine to give the beam of parallel light required. It is mounted on a rigid support, which holds it in a horizontal position at the required height. Five feet of heavy cord, with plug and switch, and a hood especially designed to fit with approximately light-tight connections against the colorimeter, is included as a part of the outfit.

If the cups are empty, or if they contain fluids free from solid matter, light directed horizontally through them will not be observed in the field of the instrument, but if there are present in the cups, fluids holding solid particles in suspension, such particles will diffuse light into the ends of the plungers and the fields will become illuminated. If the cups are then adjusted to such a height that the two halves of the field are equally illuminated, the relative number of suspended particles per unit of fluid will be inversely proportional to the depth of the fluid required to produce equal illumination.

The method of making haemoglobin tests is analogous to that employed in making color comparisons. A disc of specially prepared glass is placed beneath one of the cups and clear water is used in this cup to a depth approximately, not necessarily exactly, the same as that in the other cup containing the diluted blood. The blood is diluted by a fixed percentage, and the depth of fluid necessary to produce a shade matching that of the glass is an index of the percentage of haemoglobin present.

Full directions for making haemoglobin determinations accompany each instrument.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onoontofiv	10125	Duboscq colorimeter	$80.00
Onoontosix	10126	Case for Duboscq colorimeter	3.00
Onoontosev	10127	50 mm. cups, with base for Duboscq colorimeter	5.00
Onoonthrefiv	10135	Nephelometer lamp, with one 400-watt bulb	50.00
Onoonthresev	10137	Plunger shields, with opaque stops for cups, per set of two shields and two stops	2.00
Onoonforo	10140	Newcomer glass disc	3.50
Onoonforthre	10143	20 cmm pipettes for blood dilutions for use with Newcomer disc and Dubosque Colormeter	0.00
Onoonforfiv	10145	5 cc pipette for blood dilutions for use with Newcomer disc and Duboscq colorimeter	0.00



SPENCER REFRACTOMETER

OF the well-known Abbe type, with water jacket for controlling temperature of the prism case, designed for obtaining the following data on all transparent substances (except gases) whose indices (N_D) fall between 1.30 and 1.71:

N_D and Δ_N ($=N_F - N_C$)

The first of these is read directly. The other is obtained by a very simple computation from tables furnished with the instrument.

Graduations on the index scale are numbered in both directions to be read from either side. Readings are direct in indices of the D line, to the third decimal place, with opportunity for estimating the fourth decimal place.

Setting of the cross line on the index scale is accomplished by rack and pinion operated by a knurled head. This constitutes a distinct improvement over the sliding motion, with or without slow motion screw, that has heretofore been employed. It provides a control extending over the full length of the scale; sufficiently accurate for the most refined work, and at the same time fast enough to prevent its use becoming tedious.

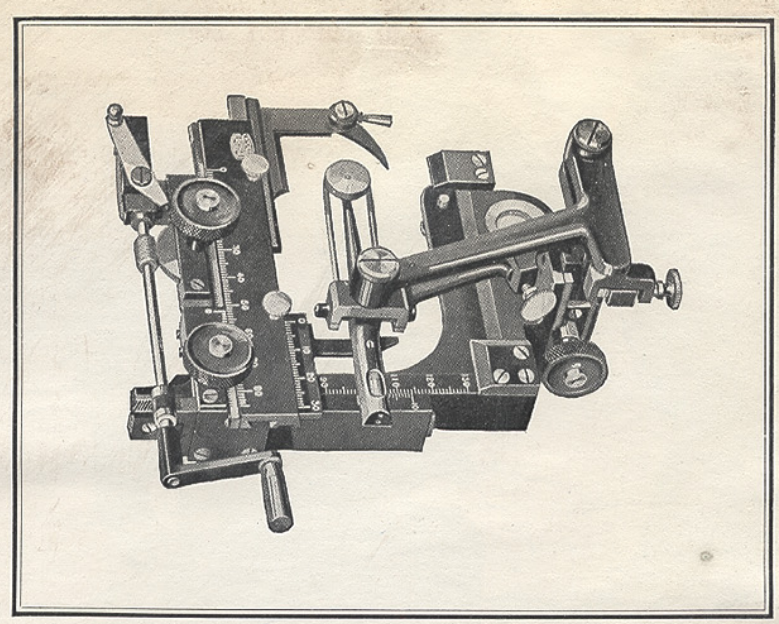
Two triple sets of Amici prisms, rotated in opposite directions by a knurled head, serve to achromatize the dividing line under observation and also provide the necessary data for determining Δ_N and V. The latter values are determined from the graduated drum which is read by vernier to 18 minutes of arc, corresponding in accuracy to the fourth decimal place in required values.

An achromatic objective sharply focuses an image of the dividing line in the plane of two crossed hairs at the upper end of the body tube. On these the eye lens is focused by a sliding tube.

The mirror slides on a horizontal bar which greatly facilitates obtaining light from various positions.

A thermometer (No. 10078) and a small bottle of monobromonapthalene, for making immersion contact in measuring solids, is supplied with each instrument.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onoosevfiv	10075	Refractometer complete, as described, including thermometer	$250.00
Onooatefiv	10085	Same with scale for reading directly in percentages of sugar solution . .	265.00
Onoosevate	10078	Stem thermometer for use with refractometer 0-100°C. graduated to degrees	2.50
Onooateo	10080	Stem thermometer for use with refractometer 0-75°C. graduated to fifths	12.75



SPENCER MICROCHARACTER

A NEW device for determining more accurately than has heretofore been possible the relative hardness of microscopic areas of various substances. This apparatus has been found especially useful in making investigations into the character of polished metal surfaces.

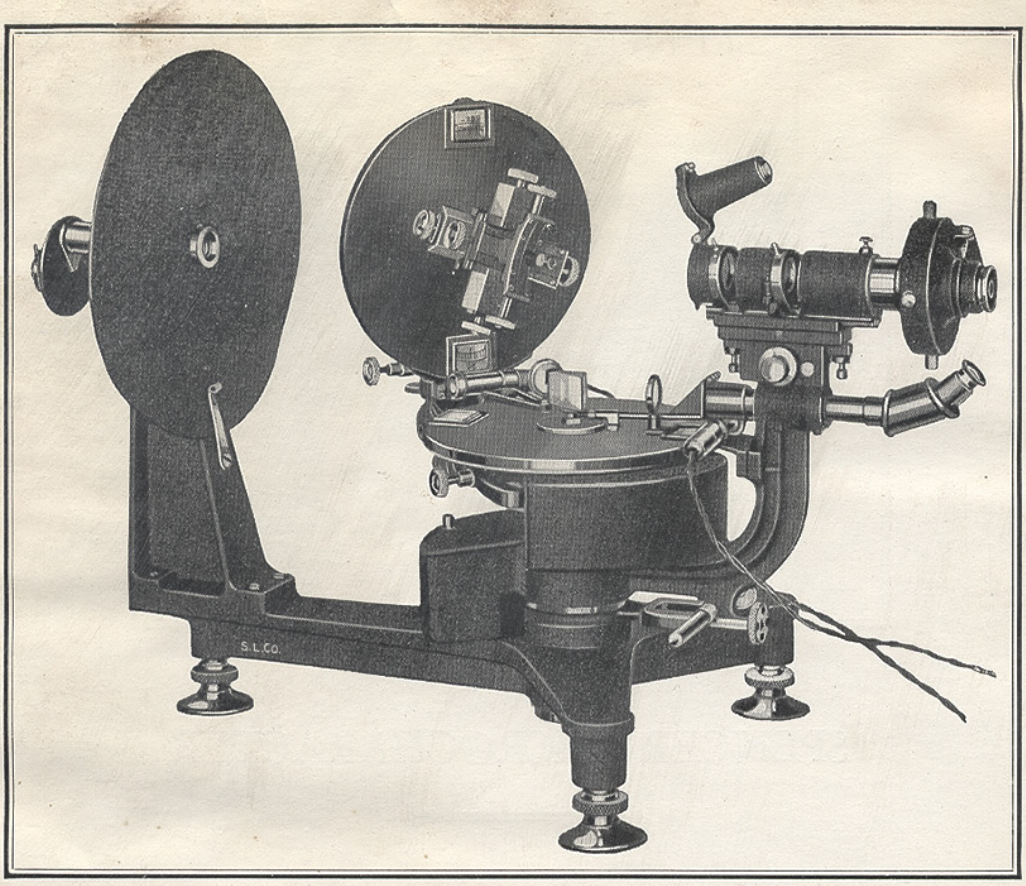
The instrument is attachable to any standard microscope having a rectangular stage. A sapphire point, very carefully cut to constitute the corner of a cube, is so mounted as to bring the diagonal of the cube leading from the corner used perpendicular to the surface to be tested. By means of a small weight, the jewel point is held with a constant pressure against the surface to be tested, and the latter is by mechanical means slowly passed under it. The scratch or cut thus made is examined under a microscope giving a magnification of about 900 diameters, and its width carefully measured by means of a filar micrometer eyepiece.

A diagram from which a scale of relative hardness, as indicated by different widths of cuts, is easily read, is supplied with the instrument. Full directions are included.

Supplied complete in case, including filar micrometer No. 425 (page 64) and vertical illuminator No. 357 (page 61).

More detailed description given on request.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onooothre	10003	Microcharacter, with filar micrometer No. 425 and vertical illuminator No. 357, as per text. Complete in case (see pages 61 and 64)	$250.00



SPENCER TWO-CIRCLE GONIOMETER

THIS instrument is designed to meet the most exacting requirements of crystalographers. It is constructed with view not only to accuracy and convenience but to extreme rigidity and durability.

The telescope has five different magnifications, which are easily interchangeable by throwing in or out different lenses in the telescope tube.

The circles, both horizontal and vertical, are protected by dust caps. They are six inches in diameter and graduated to 30′ and read by verniers to 1′. One vernier on each circle is read by a microscope conveniently placed directly beneath the observation telescope. A prism over the horizontal circle vernier permits the reading of it directly; while, by means of a lens and an adjustable prism, the image of the vertical circle, in any position, is projected into the microscope, so that it is read under the same magnification as is the horizontal circle.

The collimator is provided with an achromatic lens and four different "signals." It is carefully mounted with two sets of centering screws.

Telegraph Code	Catalog No.	DESCRIPTION	Price
Onoonoo	10100	Goniometer complete, as described	$500.00



SPENCER PORTLAND PICTORIAL LENS

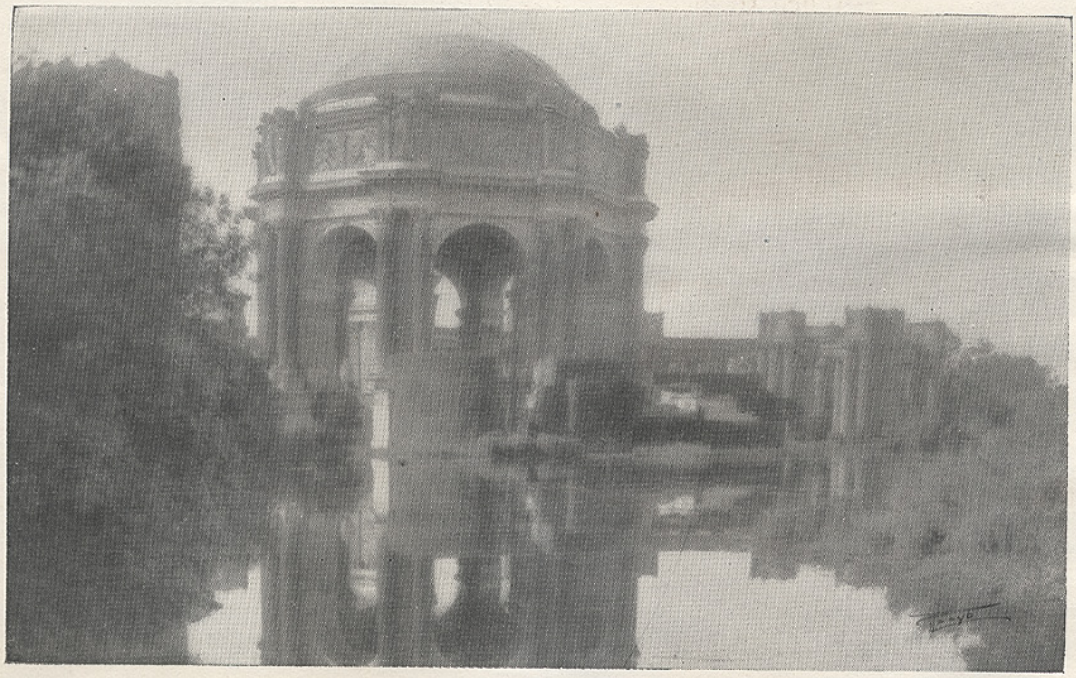
THIS lens is designed especially for those who enjoy artistic photography; who wish to portray the landscape, the home or the individual with a softness that expresses character rather than with the needle point sharpness which may be required for scientific or architectural work, but which often serves only to rob a picture of its artistic qualities. It is capable of producing any required degree of softness and at the same time of interpreting lights and shadows with remarkable fidelity.

But its use is not restricted to soft focus or art work alone. When stopped down to a speed of F-12 or lower it becomes a high grade anastigmat strictly achromatic and capable of rendering the critically sharp definition requisite for recording fine details.

The lens consists of a single cemented combination, in which the elements are most carefully and accurately fitted together to within one-quarter of a wave length, avoiding all internal reflections (which produce " ghosts ") even when used against the light.

The mounting is in aluminum and brass, neatly enameled and engraved, and supplied with standard flanges. They may be mounted in all standard makes of shutters which are supplied at manufacturers' prices or adapted for use in graphflex or other reflecting cameras.

No.	Size of Plate Covered at Full Aperture, Inches	Diameter, Inches	Equivalent Focus, Inches	Speed	Diameter Flange, Inches	Price
2	4 x 5	1½	6	F-4.5	2¾	$25.00
4	6½ x 8½	2	9	F-4.5	3¼	32.00
6	8 x 10	2	11½	F-5.6	3¼	32.00
8	11 x 14	2¾	15	F-5.6	4½	55.00
10	14 x 17	3½	18	F-5.6	5½	75.00



Made with a Spencer Portland Lens

PRINTED BY
THE ROYCROFTERS
EAST AURORA
N. Y.

Spencer Lens Company

BUFFALO, N. Y.

REVISED PRICE LIST

OF

Microscopes, Microtomes and Accessories

PAGES INDICATED REFER TO OUR 1924 EDITION COMPLETE CATALOG

APRIL 8, 1925

PAGE 10

Binocular Bodies

1 SB	$ 15.00
1 MOB	80.00

PAGE 11

440 Diocular	50.00

Substitutions

If desired to substitute for Abba Condenser N.A. 1.20:	
A Wide Angle Condenser N.A. 1.40 add	2.00
An Achromatic Condenser N.A. 1.30 add	18.50
An Achromatic Condenser N.A. 1.40 add	23.50
If desired to substitute for huyghenian oculars:	
Planorcopic oculars 6x or 8x add each	2.75
Planorcopic oculars 10x, 12x, 15x, 20x add each	5.25
Compensating oculars 1.5x, 5x add each	3.25
Compensating oculars 10x, 15x, 20x add each	5.75
If desired to substitute for 1.8 m/m achromatic immersion objective:	
The 2 m/m Fluorite immersion objective add	13.00
The 40 m/m or 48 m/m objective subtract	30.00
The 32 m/m subtract	28.50
If desired to substitute for achromatic 4 m/m objective:	
The Fluorite 4 m/m objective add	10.00
For Standard Set of Achromatic Objectives:	
The corresponding Set of Apochromatic objectives add	89.00
For double nose pieces:	
The triple nose piece add	1.50
The quadruple nose piece add	3.50

PAGE 12

1E	Microscope stand minus accessories		166.50
1E	"	Achromatic outfit	296.00
1F	"	" "	301.50
1H	"	" "	338.00
IJ	"	" "	351.00
1E	"	Apochromatic "	362.50
1F	"	" "	374.50
1H	"	" "	445.00

PAGE 13

2	Microscope stand		122.50
2E	"	Achromatic outfit	252.00
2F	"	" "	257.50
2H	"	" "	294.00

PAGE 13—Continued

2J	Microscope	Achromatic outfit	$307.00
2E	"	Apochromatic "	318.50
2F	"	" "	330.50
2H	"	" "	401.00

PAGE 14

3	Microscope stand		75.50
3E	"	Achromatic outfit	205.00
3F	"	" "	210.50
3H	"	" "	247.00
3J	"	" "	260.00
3E	Microscope	Apochromatic outfit	271.50
3F	"	" "	283.50
3H	"	" "	354.00

PAGE 15

4	Microscope Stand	47.00
4MOB	Binocular Body	55.00
4SB	Single Tube	15.00
4B	Microscope	152.00
4D	"	157.50
4E	"	163.00
4F	"	168.50
4H	"	205.00
4J	"	218.00

PAGE 16

5E	Microscope	Achromatic outfit	215.75
5F	"	" "	218.50
5H	"	" "	255.00
5J	"	" "	268.00
5E	"	Apochromatic "	276.50
5F	"	" "	282.50
5H	"	" "	353.00

PAGE 17

7	Microscope Stand		190.50
7E	"	Achromatic outfit	316.00
7F	"	" "	321.50
7H	"	" "	358.00
7J	"	" "	371.00
7E	"	Apochromatic "	382.50
7F	"	" "	394.50
7H	"	" "	465.00

PAGE 18

9	Microscope Stand		190.50
9E	"	Achromatic outfit	316.00
9F	"	" "	321.50
9H	"	" "	358.00
9J	"	" "	371.00
9E	"	Apochromatic "	382.50
9F	"	" "	394.50
9H	"	" "	465.00

PAGE 19

10E	Microscope	Achromatic outfit	$215.75
10F	"	" "	218.50
10H	"	" "	255.00
10J	"	" "	268.00
10E	"	Apochromatic "	276.50
10F	"	" "	282.50
10H	"	" "	353.00

PAGE 20

14	Microscope Stand		180.50
14E	"	Achromatic outfit	306.00
14F	"	" "	311.50
14H	"	" "	348.00
14J	"	" "	361.00
14E	"	Apochromatic "	372.50
14F	"	" "	384.50
14H	"	" "	455.00

PAGE 21

15E	Microscope	Achromatic outfit	178.75
15F	"	" "	181.50
15H	"	" "	218.00
15J	"	" "	231.00
15E	"	Apochromatic "	239.50
15F	"	" "	245.50
15H	"	" "	316.00
Ach Condenser N.A. 1.30 substituted for wide angle			16.50

PAGE 22

18H Microscope	200.00

PAGE 23

19E	Microscope	Achromatic outfit	134.75
19F	"	" "	137.50
19H	"	" "	174.00
19J	"	" "	187.00
19E	"	Apochromatic "	195.50
19F	"	" "	201.50
19H	"	" "	272.00

PAGE 24

24E	Microscope	Achromatic outfit	95.75
24F	"	" "	98.50
24H	"	" "	135.00
24J	"	" "	148.00
24E	"	Apochromatic "	156.50
24F	"	" "	162.50
24H	"	" "	233.00

PAGE 25

25B	Discontinued
25D	"
25E	"
25F	"
25H	"
25J	"

PAGE 26

C42F Microscope	$145.00
C42G "	196.50
C42H "	183.00
C42J "	196.00
C42N "	143.00

PAGE 27

44B Microscope	74.75
44D "	77.50
44E "	85.75
44F "	88.50
44H "	125.00
44J "	138.00

PAGE 28

45B Microscope	74.75
45D "	77.50
45E "	85.75
45F "	88.50
45H "	125.00
45J "	138.00

PAGE 29

49A Microscope	116.50
49C "	119.25
49L "	125.75

PAGE 31

46A Microscope	137.00
46C "	139.75
46L "	146.25
48A "	152.00
48C "	154.75
48L "	161.25
46S Small Stand	7.50
462 Receptable	8.00
463 Objective Ring	3.00

PAGE 33

100P Paired objective 55mm	17.00
101P " " 48mm	18.00
102P " " 40mm	18.00
104P " " 32mm	18.00
107P " " 25mm	23.50
107PL " " 25mm	22.50
134P Paired oculars 4x	5.50
136P " " 5x	5.50
138P " " 6x	5.50
140P " " 8x	5.50
142P " " 10x	5.50
144P " " 12x	5.50
179P " " 15x	16.00
180P " " 20x	16.00

PAGE 34

54A Binocular Micro	107.50
54B " "	131.00
54C " "	159.00
54D " "	177.00
54E " "	195.00

PAGE 35

54SA Binocular Micro	86.00
54SB " "	109.50
54SC " "	137.50
54SD " "	155.50
54SE " "	173.50
54S Small Stand	7.50
54T Clamp Stand	9.50
Binocular Body	55.00
54TA	88.00
54TB	111.50
54TC	139.50
54TD	157.50
54TE	175.50

PAGE 36

57A Binocular Microscope	$107.50
57B " "	131.00
57C " "	159.00
59D " "	177.00
57E " "	195.00
Binocular Body	50.00
Combination base and stage	34.00

PAGE 37

58A Binocular Microscope	125.00
58B " "	148.50
58C " "	176.50
58D " "	194.50
58E " "	212.50
58 Stand with Binocular Body	
58S-A Binocular Microscope	115.00
58S-B " "	138.50
58S-C " "	166.50
58S-D " "	184.50
58S-E " "	202.50
Binocular Body with Arm	55.00
Stand only in case	36.50

PAGE 39

60B Portable Micro	109.75
60D " "	112.50
60E " "	120.75
60F " "	123.50
60H " "	160.00
60J " "	173.00
485 Mech. Stage Mod.	35.00
500 Camera Lucida Mod.	32.00
505 Camera Lucida Mod.	22.00

PAGE 40

64A Microscope	65.25
64B "	71.75
64C "	68.00
64D "	74.50
64E "	82.75
64F "	85.50
64H "	122.00
64J "	135.00
64M "	82.50
65N "	93.50

PAGE 41

65A Microscope	65.25
65B "	71.75
65C "	68.00
65D "	74.50
65E "	82.75
65F "	85.50
65H "	122.00
65J "	135.00
65M "	82.50
65N "	93.50

PAGE 42

74X Microscope	38.00
74Y "	48.25
74Z "	55.00
103 Special objective	5.00
113 Special objective	7.50

PAGE 43

75A Pocket Microscope	40.00

PAGE 44

78R Reading Microscope	26.00
78S " "	30.50
78T " "	61.25

PAGE 45

80A Disst. Micro	$40.00
80B " "	41.75
80C " "	44.00
80D " "	49.75
82A Disst. Micro	26.75
82B " "	28.50
82C " "	30.75
82D " "	36.50

PAGE 46

84 Disst. Micro	20.00
84B " "	21.75
84C " "	24.00
84D " "	29.75
86A Disst. Micro	6.50
86B " "	8.25
86C " "	10.50
86D " "	16.25

PAGE 47

87A Erecting Body	30.00
87B Erecting Body	32.75
87C Erecting Body	40.75
88 Magnifier	7.00
93 Holder	5.50

PAGE 48

96A Demonstration Micro	14.00
96B Demonstration Micro	22.00
100A Bulls Eye Cond	6.00
100B Bulls Eye Cond	7.50

PAGE 50

Achromatic Objectives

101—48 mm.	5.00
102—40 mm.	5.00
104—32 mm.	6.50
107—25 mm.	6.50
108—16 mm.	8.00
112— 8 mm.	13.50
115— 4 mm.	15.00
118— 4 mm.	15.00
122— 3 mm.	18.00
127— 1.8 mm.	35.00
128— 1.5 mm.	50.00

Fluorite Objectives

120— 4 mm.	25.00
130— 2 mm.	48.00

PAGE 51

Huyghenian Oculars

134— 4x	2.75
136— 5x	2.75
138— 6x	2.75
140— 8x	2.75
142—10x	2.75
144—12x	2.75

Planoscopic Oculars

175— 6x	5.50
176— 8x	5.50
177—10x	8.00
178—12x	8.00
179—15x	8.00
180—20x	8.00
190—Eyepiece Holder	.45

PAGE 52

Apochromatic Objectives

150—16 mm.	26.00
152— 8 mm.	39.00
154— 4 mm.	52.00
156— 3 mm.	56.00
158— 2 mm.	69.00
160— 1.5 mm.	90.00

PAGE 52—Continued

Compensating Oculars

164— 1.5x	$6.00
166— 5x	6.00
168—10x	8.50
170—15x	8.50
172—20x	8.50

PAGE 53

Doublet Magnifiers

202— 6x	1.75
204— 9x	1.75
206—12x	1.75
208—18x	1.75
210—24x	1.75
222— 6x	2.00
224— 9x	2.00
226—12x	2.00
228—18x	2.25
230—24x	2.50

Triple Aplanat Magnifiers

256— 6x	5.75
258— 9x	5.75
260—12x	5.75
261—15x	5.75
262—18x	5.75
264—24x	5.75
276— 6x	6.00
278— 9x	6.00
280—12x	6.00
281—15x	6.00
282—18x	6.00
284—24x	6.00
240—Tripod Magnifier	.75

PAGE 54

300 Standard Condenser	6.50
305 Wide Angle Condenser	8.50
315 Achromatic Condenser 1.30.	25.00
321 Achromatic Condenser 1.40.	30.00
325 Iris Diaphragm	4.50

PAGE 56

340 Dark Field Ill	15.00
342 Dark Field Ill	20.40
330 Dark Field Ill	35.00
331 Six Volt Bulb	.65
332 Four Volt Bulb	.65
336 Resistance	8.00
337 Resistance	6.00
390 Transformer	6.00
391 Transformer	6.00
127S Oil Im. Objective	35.00

PAGE 58

9100 Micro. Projector	150.00
9150 Micro. Projector	175.00
9120 Resistance	35.00
9125 Resistance	45.00
9130 Mazda Bulb Net	1.85
9135 Case for Projector	15.00
9155 Stand	

Micro Teleplats

8760—60 mm.	38.00
8762—48 mm.	31.00
8764—32 mm.	31.00
8766—24 mm.	31.00

Standard Micro Projection Objectives

8780—60 mm.	6.50
8781—48 mm.	6.50
8782—40 mm.	6.50
8784—32 mm.	6.50
8786—16 mm.	8.50
8788— 8 mm.	13.50
8790— 4 mm.	15.00

PAGE 58—Continued

Projection Oculars

8794—3x	$ 9.00
8796—6x	9.00

PAGE 60

343A Upright Support	75.00
343B Mirror Box	50.00
345MS Drawing Apparatus	58.50

PAGE 61

350 Vertical Illuminator	13.00
355 " "	13.00
357 " " Electric	35.00
337 Resistance	6.00
336 Resistance	8.00
331 Extra Bulbs	.65
360 Lamp	27.50
360B Lamp	29.75
362 Rheostat	8.75
364 Rheostat	12.50
366 Carbons, each	.06

PAGE 62

374 Lamp	17.50
374B Lamp	18.85
378 Mazda Bulb	.75
378A Mazda Bulb	1.00
380 Resistance	7.50
385A Micro Lamp	5.50
385B Micro Lamp	6.50
386 Mazda Bulb	1.00
387 Resistance	4.25

PAGE 63

394 Micro Lamp	30.00
394B Micro Lamp	32.25
8028 Set Accessories	20.00
3853 Resistance	8.75
3810 Mazda Bulb	3.10
3811 Mazda Bulb	6.00
395A Chalet Lamp	13.00
395B Chalet Lamp	16.00
395C Chalet Lamp	22.00
378 Mazda Bulb Net	.75
378A Mazda Bulb Net	1.00
380 Resistance	7.50

PAGE 64

400 Stage Micrometer	7.00
405 Eyepiece Micrometer	2.50
410 Eyepiece Micrometer	2.75
412 Step Micrometer	3.50
415 Micrometer Eyepiece	7.25
420 Micrometer Eyepiece	7.25
425 Micrometer Eyepiece	38.00

PAGE 65

432 Dem. Ocular 6x	40.00
434 Dem. Ocular 8x	40.00
436 Dem. Ocular 6x	35.00
438 Dem. Ocular 8x	35.00
450 Double Nosepiece	6.50
455 Triple Nosepiece	8.00
460 Quadruple Nosepiece	10.00

PAGE 66

470 Oil Dropper	2.75
480 Mech. Finger	28.00
482 Revolv. Stage	28.00

PAGE 67

484 Mech. Stage	$ 25.00
485 Mech. Stage	30.00

PAGE 68

490 Mech. Stage	32.50
493 Mech. Stage	35.00

PAGE 69

500 Camera Lucida	30.00
505 Camera Lucida	20.00

PAGE 70

523 Analyzer A	24.00
525 Analyzer B	40.00
533 Polarizer A	20.00
535 Polarizer B	24.00

PAGE 71

635 P-M Apparatus	100.00
637 Plate Holder	2.00
640 Discontinued	
642 "	
643 Base	7.50

PAGE 73

810 Rotary Microtome	150.00

PAGE 75

820 Rotary Microtome	240.00
825 Knife Holder	25.00
945 Knife Holder	15.00
830 Table with Motor	100.00
835 Table with Motor	100.00

PAGE 77

850 Microtome	220.00
856 Adapter for CO_2	5.00

PAGE 78

880 Microtome	100.00
888 Microtome CO_2 Freezing	116.00
889 Microtome, Ether	110.00
Object Clamp	4.00

PAGE 79

900 Table Microtome	20.00
902 Table Microtome	36.00
904 Table Microtome	30.00
905 Hand Microtome	15.00

PAGE 80

915 Ether Freezer	10.00
930 CO_2 Freezer	13.50

PAGE 81

Microtome Knives

935— 50 mm.	6.00
940—110 mm.	8.50
942—110 mm.	10.00
943—110 mm.	10.00
945—185 mm.	15.00
950—250 mm.	22.00
955 Handle	2.25
957 Handle	2.50
960 Back for 940 Knife	1.75
961 Back for 942-943 Knife	1.75
962 Back for 945 Knife	2.00
963 Back for 950 Knife	2.00
965 Chisel Knife	6.00

PAGE 82

964 Holder for Razor Blades....$6.75
970 Yellow Belgian Hone 7.50
971 Yellow Belgian Hone 3.50
972 Yellow Belgian Hone 2.50
975 Blue-green Hone 2.50
978 India Oilstone 1.00
980 Strop 2.00
985 Strop 2.50
990 Strop 3.00
991 Block Strop 3.00
992 Block Strop 3.00

PAGE 83

1000 Slides, Medium, White 1.60
1002 Slides, Medium, Half White 1.50
1005 Slides, Thin, White 1.60
1020 Slides, Medium, White 1.75
1025 Slides 2.00
1030 Slides ..... .90
1032 Slides 1.20
1034 Slides 1.40
1035 Slides ..... .40

Cover Glasses

1055 Squares, No. 1 ..... 1.50

Cover Glasses—Continued

1060 Squares, No. 2 .....$1.20
1065 Squares, No. 3 ..... 1.10
1075 Circles, No. 1 ..... 1.50
1080 Circles, No. 2 ..... 1.20
1085 Circles, No. 3 ..... 1.10

Rectangular Cover Glass

1090 No. 1—22 x 30 mm. 1.50
1095 No. 1—22 x 40 mm. 1.50
1100 No. 1—22 x 50 mm. 1.50
1105 No. 1—22 x 60 mm. 1.60
1107 No. 1—22 x 70 mm. 1.60
1110 No. 1—24 x 30 mm. 1.60
1115 No. 1—24 x 40 mm. 1.60
1120 No. 1—24 x 50 mm. 1.60
1125 No. 1—24 x 60 mm. 1.60
1127 No. 1—24 x 70 mm. 1.60
1130 No. 2—22 x 30 mm. 1.20
1135 No. 2—22 x 40 mm. 1.20
1140 No. 2—22 x 50 mm. 1.20
1145 No. 2—22 x 60 mm. 1.30
1147 No. 2—22 x 70 mm. 1.30
1150 No. 2—24 x 30 mm. 1.30
1155 No. 2—24 x 40 mm. 1.30
1160 No. 2—24 x 50 mm. 1.30
1165 No. 2—24 x 60 mm. 1.30
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PAGE 84

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PAGE 85

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PAGE 86

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