INTRODUCTION

We are listing in this catalog a line of high grade measuring and optical instruments on which we have been specializing for over twenty-seven years and which now are found in use in all parts of the civilized world. Having the constant advice of many prominent scientists, we have been able to meet the increasing demand for instruments of higher precision, greater convenience and durability, and believe that our products will come up to all demands of the modern laboratory and research engineer. Being now located in a new plant specially built for our requirements and excellently equipped with modern facilities indispensable for precise and economical manufacture, and having the assistance of a carefully trained staff of able scientists, skilled instrument makers and opticians, we feel safe in assuring our patrons that the reputed high standard of Wm. Gaertner & Co. will be maintained, and that any orders entrusted to us will be carefully executed. Before an instrument leaves our works, it is subjected to a rigid practical test in our laboratory, and if so desired, a certificate is furnished as to performance and accuracy.

In the **Measuring Instruments** (listed in the first part of the catalog) such as Micrometer Microscopes, Micrometer Slides, Comparators, Dividing Machines, etc., one of the most important part is the micrometer screw. Our customers may feel assured that in respect to accuracy we are able to supply precision screws of the highest order, positively not obtainable elsewhere. Mr. Gaertner's work in this line has been recognized by leading scientists throughout the world, and his methods used for cutting, correcting and testing such screws are described in several scientific and technical papers.

Official recognition was accorded Mr. Gaertner only recently for his life work, when he was awarded the Howard N. Potts gold medal by the Franklin Institute of Pennsylvania, at Philadelphia; a singular honor bestowed on a maker of scientific instruments. While the award was made mostly in recognition of Mr. Gaertner's successful achievements in connection with the cutting and correcting of precision screws, the minutes of the Franklin Institute's Committee of Science and Arts read that the award be made to Mr. Gaertner:

> "*In consideration of his notable achievements as a designer and maker of scientific instruments, materially contributing to the success of the research in physical science.*"

Our present facilities permit us to produce screws up to 1.2 meters in length, of either metric or English pitch and of any degree of accuracy as may be specified. Equal attention is paid to other essential features required in a precision instrument, such as the selection of the proper materials, the designing of each part in such dimensions as to assure long life and constant accuracy of the various instruments, the designing of the optical systems of microscopes and telescopes to be in best proportion with the other parts of the instrument, so as to assure the greatest comfort to the observer and to allow accurate settings, without unduly restricting the field of vision.

The **Optical Instruments** (listed in the second part of the catalog) such as Spectrometers, Spectroscopes, Spectrographs, Photometers, Interferometers, etc., are all of our own design and manufacture. Many new instruments have been developed in the last few years and considerable changes and improvements have been made on the older models. Such instruments listed in former catalogs, for which there is only an occasional demand, have been omitted, but as patterns and drawings are kept on hand, they can be furnished to order and inquiries will have prompt attention.

Special attention is called to the graduations on our Spectrometers L110 and L120 which are on white celluloid. The celluloid is inlaid in the metal by a special process which has proved to be entirely satisfactory and permanent in the course of fifteen years of constant use. The black lines and figures on the white surface are much easier to read than a silver scale, especially when the latter is tarnished, a fault from which the celluloid is entirely free.

In concluding, we consider it our pleasant duty to thank our many old friends and patrons for their gratifying support in the past, and we take this occasion to assure them of our earnest desire to merit their continued patronage in the future.

THE GAERTNER SCIENTIFIC CORPORATION
Successor to Wm. Gaertner & Company

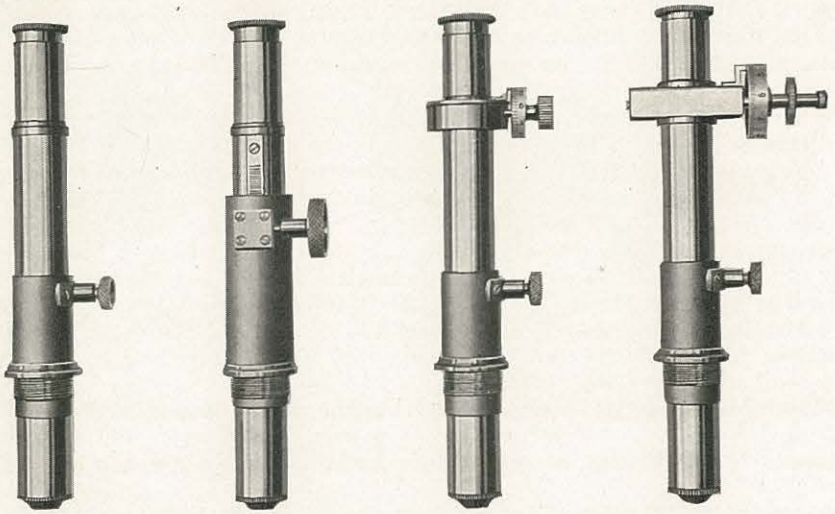
I. INSTRUMENTS OF PRECISION

Table of Contents

MEASURING MICROSCOPES AND ACCESSORIES

These microscopes are intended for physical and mechanical measurements in which instruments of considerable rigidity and moderate magnifying power are required. For most purposes a microscope of fixed tube length is recommended, as it avoids unnecessary joints and assures greater rigidity. This is particularly desirable in a micrometer microscope, giving assurance that the value of the micrometer readings will remain fixed. The rack and pinion motion is not essential for low power microscopes, but it is very convenient for focusing. Each microscope is fitted with a support sleeve, the thread on which is standard, fitting any of the various supports, micrometer slides, etc. The objective end of the microscope is threaded with the standard society microscope thread.

Our standard microscopes are furnished with an optical system, which gives a magnification of about 32 diameters and a working distance (objective to object) of 50 mm, this having proved to be most useful for general work. The objective is a single achromat of the best optical quality. The eyepiece is of the Ramsden type, giving a large flat field free of color. The adapter to which it is fitted is of standard size, the same as furnished with our telescopes, being interchangeable with the eyepiece micrometers, slits, etc. The cross hairs (spider threads) are placed at an angle of 60° which allows a very accurate bisecting of a single line and which has been found most convenient. However, different arrangements of cross hairs can be furnished if specified by the customer.



M101 M101a M102 M103

PLAIN MICROSCOPES

M101. Microscope. A microscope of fixed tube length, fitted with cross hairs and support sleeve with clamp. The tube is made of special hard nickel silver. Outside diameter of tube 22.2 mm, magnifying power about 32 diameters, tube length 160 mm, aperture of objective 10 mm, working distance 50 mm, field of vision about 3.3 mm ..... **$ 16.50**

M101a. Microscope. The same as M101, but fitted with rack and pinion motion for convenience in focusing ..... **$ 25.00**

M101b. Microscope. Consisting of M101, fitted with draw tube for eye end to adjust magnifying power. The draw tube can be clamped after the tube length is adjusted. Range of magnifying power with standard eyepiece and objective, 25 to 35 diameters..... $ 24.00

M101c. Microscope. The same as M101a, but **with millimeter scale on the draw tube** and vernier reading to 0.1 mm on the sleeve. Convenient for use in determining the index of refraction, etc. ..... $ 32.00

MICROMETER MICROSCOPES

The micrometers used with these microscopes are of two kinds; the **Filar Micrometers** which are generally preferred on account of the high accuracy of setting and precision of the measurements obtainable, and the **Glass Scale Micrometers,** which are useful for reading deflections and for quick measurements where great accuracy is not required. These micrometers may be used on microscopes or telescopes. Attention is called to the fact that in either case *measurements are made on the image of the object* produced by the objective. This image may be larger or it may be smaller than the object, the relative sizes of image and object being proportional to their distances from the objective lens, that is, as applied to the microscopes, the size of the image is to the size of the object in the same proportion as the tube length is to the working distance. To measure an object with the micrometer, the reading must be multiplied by a factor corresponding to the above ratio. It will be seen that by adjusting the magnification, this proportion may be given some value which may be of particular convenience, for instance with a magnification of 2.46, 0.004 inch on the object is exactly 0.25 mm on the image so that a millimeter screw or scale can be used conveniently to measure inches. As no two objectives are exactly alike, microscopes made of standard tube length, fitted with objectives from the same lot, will not have the same magnifying power, and each instrument must be calibrated, as illustrated by the following example:

Focusing one of our micrometer microscopes (M103) on an accurately divided millimeter scale, it is found that 31.29 turns of the micrometer head are required to move the cross hairs over 2.5 mm (on the scale). Each turn of the micrometer head then represents 2.5/31.29 mm, or .0799 mm, and each division on the head represents .000799 mm on any object which is in sharp focus.

A suitable scale for calibrating micrometer microscopes is listed under catalog No. M210.

The adjustable tube length of micrometer microscopes M102b, M103b, M104b and M105b permits adjustment of the magnification between 2.4 and 3.5 diameters, so that the micrometer divisions can be made to represent convenient decimal fractions of either millimeter or inch.

For mechanical and shop measurements it is desirable to have a microscope of fixed tube length which also reads in convenient decimals. Any of our Micrometer Microscopes of fixed tube lengths, Nos. M102, M102a, M103, M103a, M104, M104a, M105, M105a, can be furnished with the tube accurately cut to length so as to read direct in millimeters or inches.

Microscopes M102, M102a can be furnished of special tube length, the value of one micrometer head division being 0.002 mm.

Microscopes M103, M103a, of special tube length, value of one micrometer head division being 0.001 mm.

Microscopes M104, M104a, of special tube length, smallest division on scale equalling 0.10 mm.

Microscopes M105, M105a, of special tube length, smallest division on scale equalling 0.04 mm.

To obtain convenient **readings in inches** with micrometer microscopes, the head of the microscopes is divided in 40 parts. Microscopes M102, M102a, M103, and M103a of special tube length, smallest division on micrometer head equal to 0.001 mm.

Extra cost of any of the microscopes of Special Tube Length ..... $ 5.00

M102. Microscope. M101 fitted with Filar Micrometer M201. Measurable distance about 1.8 mm ..... $ 38.00

M102a. Microscope. M101a with rack and pinion fitted with Filar Micrometer M201. Measurable distance about 1.8 mm ..... $ 46.50

M102b. Microscope. M101b with adjustable draw tube, fitted with Filar Micrometer M201. Measurable distance about 1.7 to 2.4 mm ..... $ 45.50

M103. Microscope. M101 fitted with Filar Micrometer M202. Measurable distance about 3.1 mm ..... $ 51.50

M103a. Microscope. M101a with rack and pinion fitted with Filar Micrometer M202. Measurable distance 3.1 mm ..... $ 60.00

M103b. Microscope. M101b with adjustable draw tube, fitted with Filar Micrometer M202. Measurable distance about 2.8 to 4.0 mm ..... $ 59.00

M104. Microscope. M101 fitted with Glass Scale Micrometer, 10 mm long divided to 0.25 mm (M203). This is especially recommended for reading the deflection of gold leaf electroscopes. Measurable distance about 3.1 mm ..... $ 25.00

M104a. Microscope. The same as M104 but with rack and pinion. Measurable distance about 3.1 mm ..... $ 32.00

M104b. Microscope. The same as M104 but with adjustable draw tube, for reading deflection of gold leaf electroscopes. Measurable distance about 2.8 to 4.0 mm .... $ 31.50

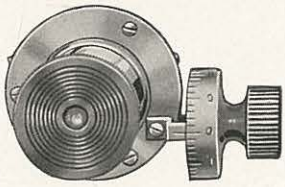
M105. Microscope. M101 fitted with Glass Scale Micrometer, 10 mm long divided to 0.1 mm (M204). Measurable distance about 3.1 mm ..... $ 26.00

M105a. Microscope. The same as M105 but with rack and pinion. Measurable distance about 3.1 mm ..... $ 34.50

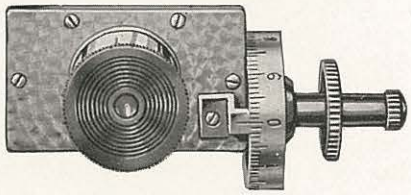
M105b. Microscope. The same as M105 but with adjustable draw tube. Measurable distance about 2.8 to 4.0 mm ..... $ 33.50

EYEPIECE MICROMETERS FOR MICROSCOPES OR TELESCOPES

These micrometers are furnished complete with standard eyepiece (M242) and adapter to fit any of our microscopes or telescopes (except telescope M511). The Repsold design of micrometer is recognized the best and has been adopted by us, it assures accurate motion of the carriage and great durability.



M201



M202

M201. Filar Micrometer, Range 6 mm. Fitted with only two wires, one stationary and one movable. The screw has a pitch of 0.25 mm, the micrometer head is divided in 50 parts. This micrometer is suitable for measurements of the highest accuracy where a large range is not required ..... $ 24.00

M202. Filar Micrometer, Range 10 mm. An instrument of the highest order of workmanship and accuracy. Two of the wires are fixed at right angles, passing through the center of the field of vision. The two movable wires are 0.05 mm apart. A comb in the field of the eyepiece registers full revolutions of the screw. Number of divisions on micrometer head 100; pitch of screw 0.25 mm, range of screw about 10 mm ..... $ 37.50

M203. Glass Scale Micrometer. Consists of eyepiece, and standard adapter having a glass scale in place of the fixed cross hairs. Scale divided to 0.25 mm, length of scale 10 mm ..... $ 10.00

M204. Glass Scale Micrometer. Scale divided to 0.10 mm, otherwise the same as M203 ..... $ 12.00

M210. Glass Scale, for Calibrating Micrometer Microscopes. Scale divided on strip 25 mm x 75 mm, 10 mm long, subdivided in 0.1 mm ..... $ 3.50

MICROSCOPE OBJECTIVES

Different magnifications from those usually provided are desirable for certain grades of work. Where higher accuracy of measurement is desired, a higher magnification will be necessary, and when it is desirable to increase the working distance, a lower power objective is needed. Objective M222 is our standard, and it is usually furnished.

M220. Objective. Equivalent focus 32 mm, working distance 33 mm, magnification 48.5, field of vision 2.1 mm ..... **$ 6.50**

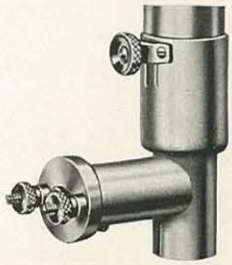
M222. Objective. Equivalent focus 38 mm, working distance 50 mm, magnification 32, field of vision 3.3 mm ..... **$ 6.00**

M224. Objective. Equivalent focus 48 mm, working distance 68 mm, magnification 23.5, field of vision 4.4 mm ..... **$ 6.00**

M226. Objective. Equivalent focus 80 mm, working distance 160 mm, magnification 10; field of vision 10.5 mm ..... **$ 7.50**

M536. Adapter. For holding any of the Microscope Objectives M220-M226 in Telescopes M512, M512a, M522, M522a. This converts the telescope into a microscope of great tube length and correspondingly high power ..... **$ 2.50**

Note: The working distance, magnification and field of vision are figured for the standard tube length of 160 mm, but the magnification depends also on the power of the eyepiece and is given for standard eyepiece M242.



M230

ILLUMINATING ATTACHMENTS FOR MICROSCOPES

M230. Illuminating Attachment for Microscope. For illuminating opaque objects. Consisting of a thin plane glass reflector and a miniature 4 volt electric incandescent lamp, mounted together in a tube which attaches to the body tube of the microscope in front of the objective ..... **$ 10.00**

M232. Illuminating Attachment. Similar in every respect to M230, but without the electric lamp ..... **$ 5.00**

M234. Illuminating Attachment. This attachment is similar in construction to M230, but intended for use between objective and eyepiece. It is used in connection with high power objectives, where the short working distance does not permit the use of M230. With 4-volt electric lamp ..... **$ 10.00**

M236. Illuminating Attachment. Similar to M234, but without the electric lamp ..... **$ 5.00**

EYEPIECES FOR MICROSCOPES AND TELESCOPES

These eyepieces are of the Ramsden type, consisting of two plano-convex lenses. The M242, 25 mm eyepiece is ordinarily furnished with microscopes as listed, and also with the standard laboratory telescopes.

M240. Eyepiece of 18 mm equivalent focal length. Magnifying power 14 diameters ..... **$ 4.00**

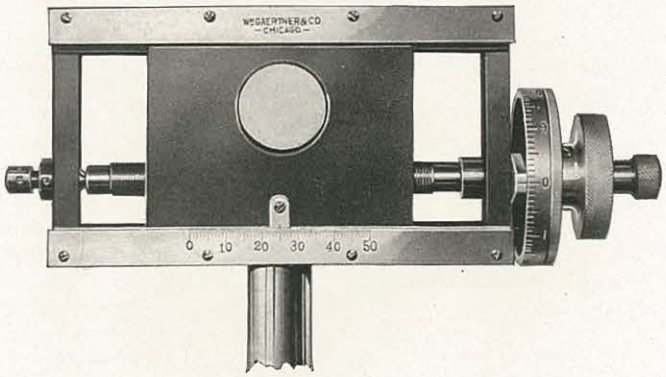
M242. Eyepiece of 25 mm equivalent focal length. This is our standard eyepiece. Magnifying power 10 diameters ..... **$ 3.50**

M244. Eyepiece of 50 mm equivalent focal length. Magnifying power 5 diameters ..... **$ 4.00**

MICROMETER SLIDES AND ATTACHMENTS

These instruments are intended for measurements of larger ranges, which do not come within the scope of the micrometer microscopes; they are made in two sizes having ranges of 50 mm and 100 mm, but are also furnished with inch threads of 2 inch or 4 inch range. They will hold any of the measuring microscopes as listed before. These slides are suitable for a great many purposes and in connection with the various attachments furnish one of the most useful instruments for the educational or industrial laboratory. They may be held horizontally, forming a very convenient comparator, or may be used on the optical bench, with the microscope horizontal, for measuring fringes, etc. When supported vertically, they form a cathetometer of short range, and may be used for measuring small vertical distances or motions, such as stretch of wire, expansion of a liquid in a capillary tube, etc. A large number of these micrometer slides have been furnished to institutions in all parts of the world and they have given good service for many years. One of our patrons, a recognized authority, connected with one of the largest Polytechnic Institutes in the United States, who had used a Gaertner comparator in his department for many years, sent us the following unsolicited testimonial:

"*The instrument which you supplied us nearly twenty years ago has been in many thousand measurements and has been wonderfully satisfactory, and even after these years of use its accuracy is really remarkable.*"



M301

M301. Micrometer Slide of 50 mm Range. The slide is threaded for the sleeve of our standard microscope, and the instrument is fitted with a supporting shank 19 mm x 15 cm. The micrometer head is of magnalium, bedplate and carriage are of hard brass, the guides are accurately scraped straight, and the carriage is carefully fitted. The screw is of the highest accuracy. Pitch of micrometer screw 1 mm, diameter of screw 10 mm, number of divisions on micrometer head 100, diameter of micrometer head 50 mm..... **$ 60.00**

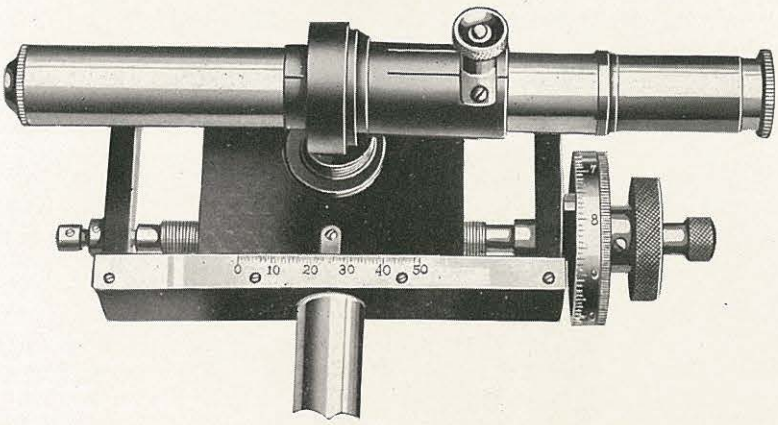
Note: This slide has formerly been furnished with a screw of 0.5 mm pitch, which we could produce at that time of a greater accuracy than a screw of 1 mm pitch. Our present facilities, however, permit us to obtain screws of 1 mm pitch of equal accuracy, and as many of our customers prefer readings to 0.01 mm, we have decided to make this change.

The old style slide with 0.5 mm screw can still be supplied at the same price.

M301a. Micrometer Slide, English screw thread. In every respect the same as M301, except that the screw has a pitch of 0.02 inch and the micrometer head is 65 mm in diameter, divided into 200 parts, each division being equal to 0.0001 inch..... **$ 75.00**

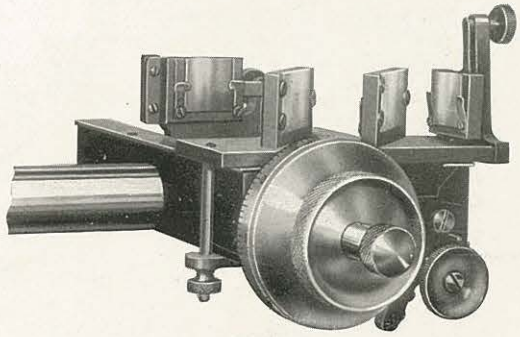
M303. Micrometer Slide of 100 mm Range. This instrument is the same as M301 except in range ..... **$ 90.00**

M303a. Micrometer Slide, English screw thread of 4 inch range. This instrument is the same as M301a except in range **$100.00**



M301, M304, M101

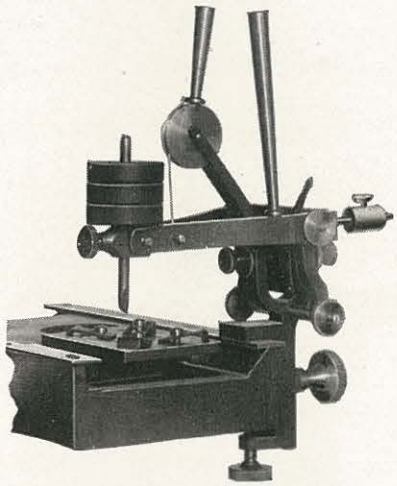
M304. Adapter. Attached to the carriage, it will hold the microscope parallel to the screw, thus providing means of delicate focusing. It is useful in many experiments such, for example, as the determination of the index of refraction of glass, etc..... **$ 5.00**



M305

M305. Interferometer Attachment to Micrometer Slide. This attachment converts any of our micrometer slides into an inexpensive interferometer of the Michelson type. One mirror is attached to the carriage of the micrometer slide, which also carries the microscope. The other parts, as the parallel plates, fixed mirror and its adjustable frame, as well as the delicate motion head, are all mounted on a brass plate which is clamped to the bed plate of the instrument. Simultaneous measurements may be made with the screw and microscope, and by counting the fringes. The plates are 15x22 mm, the mirrors 15x15.. **$ 75.00**

M306. Dividing Attachment. This dividing attachment will fit on any of the micrometer slides and will be found very convenient for dividing small scales on glass or metal, such, for example, as are used for measuring magnifying powers of microscopes and telescopes. It can also be used in connection with interferometer attachment M305, thus permitting graduations in wavelengths of light, and it can be furnished to attach to our larger comparators or dividing machines. The scale to be divided is fastened to a small stage which is held on the carriage. The ruling head is provided with a simple stop for quickly changing the lengths of the lines. Longest line that can be ruled is 10 mm..... **$ 50.00**



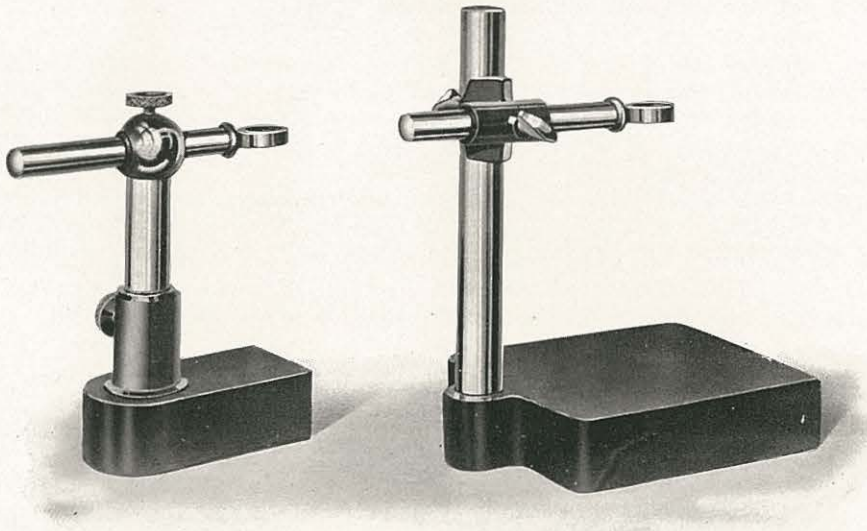
M306

MICROSCOPE SUPPORTS

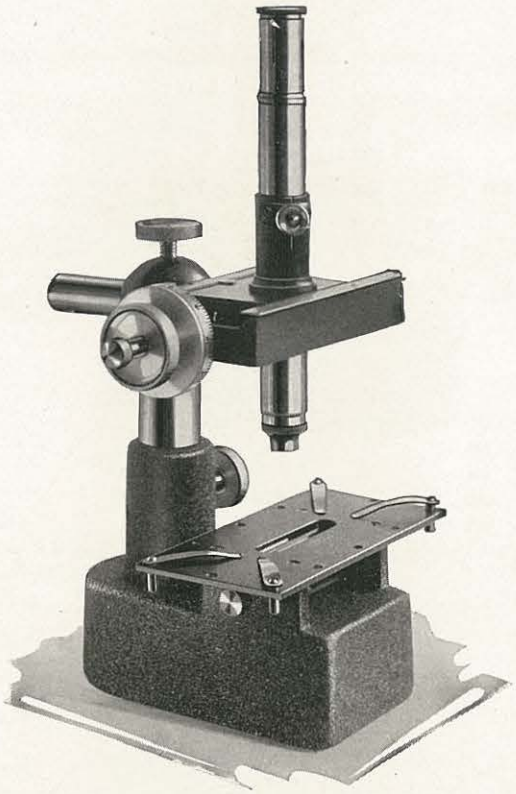
M310. Microscope Support. A heavy adjustable support for holding measuring microscopes or micrometer slides. The microscopes may be rigidly held in any position, as all joints can be firmly clamped. The base has sufficient weight to insure the steadiness required in a microscope used for accurate measurement and has the top surface planed. The opening in the horizontal arm is of standard size, threaded for the sleeves of our microscopes ..... **$ 20.00**

M315. Microscope Support with Stage. This support is the same as used in Comparator M1200, illustrated on the next page. It is fitted with a stage 150 mm long, 75 mm wide with slot 60 mm long. It is provided with four clips for holding objects and an adjustable mirror for illumination from below..... **$ 28.50**

M320. Microscope Support. A heavy base machined on the top surface, with vertical rod 30 mm x 25, cm clamp and horizontal arm. This support will be found convenient in many cases in which a tripod support cannot be used. ..... **$ 15.00**



M310 M320



M1200

M1200. Comparator, 50 mm Range. Consisting of Micrometer Slide M301 with Microscope M101 mounted on Support M315 ..... **$105.00**

M1200a. Comparator, 50 mm Range. Similar to M1200 with exception of the microscope which is fitted with rack and pinion motion **$113.50**

SPHEROMETERS

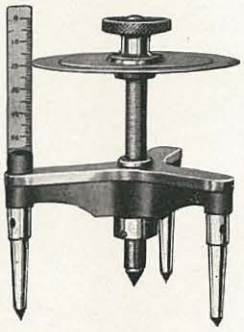
These instruments are of the best workmanship and are especially intended for laboratory work. We can furnish to order spherometers for high precision work fitted with **lever contact,** or **ring spherometers** with micrometer microscope, and shall be glad to quote on such instruments.

The formula for obtaining the radius of curvature is given below:

$$R = \frac{r^2 - d^2}{2d}$$

r = Radius of spherometer base circle.
d = Reading of spherometer screw.

M401. Spherometer. The base circle is 50 mm in diameter; the screw has a range of 20 mm, a diameter of 6 mm and a pitch of 0.5 mm; the head is 50 mm in diameter and is divided into 100 parts. ..... **$ 30.00**



M402

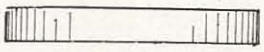
M402. Spherometer. The base circle is 100 mm in diameter; the screw has a range of 50 mm, a diameter of 10 mm, and a pitch of 0.5 mm; the head has a diameter of 90 mm, and is divided into 250 parts. ..... **$ 50.00**

TEST PLANES

FOR USE WITH SPHEROMETERS

These planes are necessary to obtain and check the zero reading of the spherometers, especially when the latter are used for highly accurate work, as in measuring the curves of high grade lenses. They are of glass, and being polished on both sides, they can be used also to test optical surfaces by the interference method. They are circular, one side being figured to high accuracy for use as a test surface.

The **a** and **b** numbers are sufficiently accurate for spherometer work.



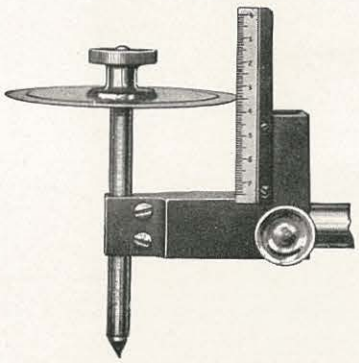
M405—M406b

M405. Test Plane.	65 mm diameter, flat to 1/16 wavelength (.000036mm)	**$ 30.00**
M405a. Test Plane.	65 mm diameter, flat to 1/8 wavelength (.000072mm)	**20.00**
M405b. Test Plane.	65 mm diameter, flat to 1/4 wavelength (.000144mm)	**15.00**
M406. Test Plane.	130 mm diameter, flat to 1/16 wavelength (.000036mm)	**70.00**
M406a. Test Plane.	130 mm diameter, flat to 1/8 wavelength (.000072mm)	**40.00**
M406b. Test Plane.	130 mm diameter, flat to 1/4 wavelength (.000144mm)	**30.00**

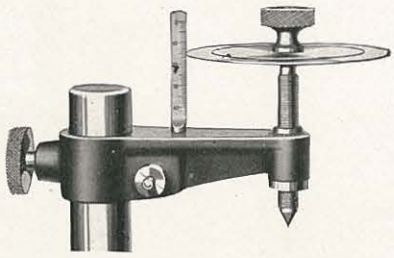
MICROMETER SCREWS

In setting up special apparatus it is frequently necessary to use micrometer screws. The screws listed below are especially convenient for use in connection with our laboratory supports listed in catalog S-T-O. The mounting permits the use in a variety of positions for many different purposes, such as measuring expansion, bending and stretching of rods, testing levels, etc.

M411. Micrometer Screw. Range of screw 25 mm, diameter 5 mm, pitch 0.5 mm. The head is 45 mm in diameter, divided into 100 parts. The mounting has a 13 mm reamed hole parallel, and another at right angles, to the screw. ..... **$ 20.00**



M412



M416

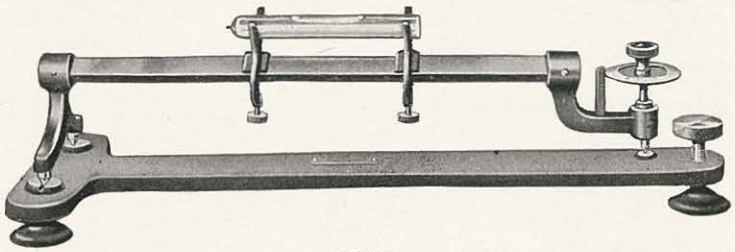
M412. Micrometer Screw. Range of screw 70 mm, diameter 10 mm, pitch 0.5 mm. The head is 90 mm in diameter and divided into 250 parts. The holes in the mounting are reamed for 19 mm rods. ..... **$ 40.00**

M416. Micrometer Screw with Electric Contact. The screw has a range of 40 mm, is 10 mm in diameter and of 0.05 mm pitch. The head is 90 mm in diameter and divided into 250 parts. The screw is mounted in the supporting arm by an insulating bushing. Two binding posts are attached, one of which is grounded to the arms, the other connected to the screw. The hole in the arm is 30 mm. ..... **$ 40.00**

Note: Any of the screws listed above can be furnished with inch thread at slightly higher cost.

LEVELS AND LEVEL TESTER

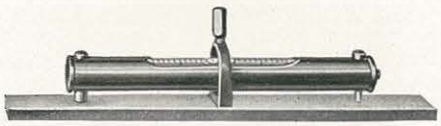
For many kinds of measurements, the spirit level can often be used to very great advantage. For measuring small angles, a properly mounted level is often preferable to sensitive optical methods, whereas for testing straightness and parallelism of guides, nothing serves better than the level. All level vials used in our instruments are ground to accurate curves; they are graduated, each division being equal to 2.5 mm, and their sensitiveness is tested. By sensitiveness of a level, it is meant that the bubble will move 2.5 mm (one scale division) if the level is inclined as many seconds as its stated sensitiveness.



M470

LEVEL TESTER

M470. Level Tester. An instrument used for the calibration and testing of levels. The screw has a diameter of 6 mm and a pitch of 0.5 mm; the divided head has 100 parts, one division corresponding to 3 seconds. The instrument is furnished with an iron base fitted with leveling screw. Three small base plates for supporting the base are furnished .. **$ 50.00**



M481

LABORATORY LEVELS

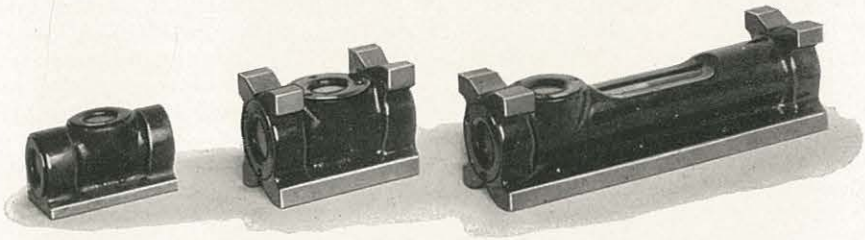
M481. Laboratory Level. A level vial of about 60″ sensitiveness is mounted in a brass tube and attached adjustably to a steel base. The base is 150 mm long, 25 mm wide, and accurately flat ..... **$ 12.50**

M483. Laboratory Level. Similar in every respect to M481, but the level has a sensitiveness of about 40″ and the base is 200 mm long ..... **$ 18.00**

UNIVERSAL LEVELS

This new type of Level, on which U. S. patent rights have been granted, is made in various sizes and grades of sensitiveness and will meet most of the requirements in the laboratory or shop. The level glasses are mounted in fixed position in the cast iron body, and remain in permanent adjustment. The body is durably finished in black enamel. A special feature of some of these levels is a combination of one cylindrical and two circular levels, mounted together in the same body. The base of the body is provided with a V-groove, serving as support on cylindrical objects either in horizontal or vertical position.

The levels listed hereafter have been tested extensively in practical use, and have proved extremely reliable and satisfactory.



M494 M496 M497-M497a

M494. Universal Level, Pocket Size, with two circular levels, for horizontal and vertical use, with flat base, suitable only for use on plane surfaces. Size 60x38x38 mm. With nice, substantial case ..... **$ 5.50**

M495. Universal Level, Pocket Size, with two circular levels, like M494, but with V-groove base. Size 60x45x45 mm. With nice, substantial case ..... **$ 7.50**

M496. Universal Level, Pocket Size, with two circular levels and with V-groove base, suitable for both plane and cylindrical surfaces. Size 65x40x45 mm. With nice, substantial case ..... **$ 9.50**

M497. Universal Level, with one sensitive cylindrical level in addition to the two circular levels. Recommended for horizontal and vertical measurements where great accuracy is essential. The base has a V-groove, and all the surfaces, as well as the edges, are scraped accurately. Size 150x37x44 mm. With nice, substantial case ..... **$ 14.50**

M497a. Universal Level. In every respect like M497, but of size 200x38x45 mm. With nice, substantial case ..... **$ 17.50**

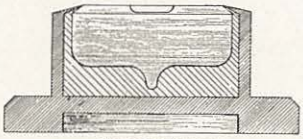
UNMOUNTED LEVEL VIALS

These level vials are carefully ground, graduated, and tested. The accurate value in seconds of arc is marked on each vial.

M490a.	**Level.**	Length 55 mm, diameter 11 mm, sensitiveness 45″ - 60″....	**$ 3.00**
M490d.	**Level.**	Length 75 mm, diameter 13 mm, sensitiveness 45″ - 60″....	**3.50**
M490g.	**Level.**	Length 100 mm, diameter 14 mm, sensitiveness 45″ - 60″...	**4.00**
M490h.	**Level.**	Length 100 mm, diameter 14 mm, sensitiveness 20″ - 30″...	**5.00**

CIRCULAR LEVELS

These levels are very convenient for the quick leveling of apparatus or for permanent attachment. The glass body is made in one piece and fused up so that evaporation of the fluid is impossible.



M492-M493

M492.	**Circular Level, Brass.**	Outside diameter of glass body 13 mm.....	**$ 2.50**
M493.	**Circular Level, Brass.**	Outside diameter of glass body 25 mm.....	**3.50**

LABORATORY TELESCOPES

These telescopes are designed for reading and observing purposes. They are unmounted, thus permitting of any desired mounting or use, a feature which will be appreciated by those wishing a good telescope, available for all kinds of work. The optical parts are guaranteed to be of the best quality. The objectives are all achromatic. The eyepieces of all the telescopes are interchangeable, being the same as used for our microscopes. They are of the Ramsden type, giving a large and flat field, the one ordinarily used having a magnifying power of 10. The cross hairs in the eyepiece adapters are placed at an angle of 60 degrees, unless otherwise specified. The body tube of the telescope is finished in durable bright black enamel, the draw tube is of nickel-silver and the eye end of the adapter is yellow lacquered. The magnifying power of each telescope is given for its shortest working distance; it is the one ordinarily defined for telescopes, that is, linear size of object as seen through the instrument, divided by the linear size as seen by the naked eye, eye and object remaining at the same distance apart.

Attention is called to the fact that a change of eyepiece changes the magnification, at the same time changing the apparent intensity of the illumination of the field of vision, by the greater spreading of the light with higher magnification.

All laboratory telescopes listed give an inverted image. In some cases, such as when intended for reading thermometers it may be desirable to have the image erect, and to provide for this we furnish the usual erecting eyepiece as used in surveying instruments. Any of our telescopes with the exception of M510 and M511 can be supplied with **erecting eyepiece at an extra cost of $10.00.**

M512-M513a

M522-M523a

M510. Telescope. A simple achromatic telescope of 18 mm aperture and about 125 mm focal length with single eye lens and cross hairs. Will focus from infinity to 40 cm ..... $ 7.50

M511. Telescope. A plain telescope, with achromatic objective of 20 mm aperture and about 130 mm focal length. Shortest focus of telescope, (objective to object) 31cm, field at 31 cm about 16 mm, magnification at 31 cm about 14 diameters ..... $ 12.00

M512. Telescope. A plain telescope with objective of 25 mm aperture and about 200 mm focal length. Shortest focus of telescope, (objective to object) 80 cm; magnification at 80 cm about 13 diameters ..... $ 16.50

M512a. Telescope. M512 fitted with high power eyepiece. Magnification at 80 cm about 18 diameters ..... $ 17.00

M513. Telescope. A plain telescope, with objective of 30 mm aperture and about 250 mm focal length. Shortest focus of telescope (objective to object) 125 cm, magnification at 125 cm about 15 diameters ..... $ 22.00

M513a. Telescope. M513 fitted with high-power eyepiece. Magnification at 125 cm about 21 diameters ..... $ 22.50

M522. Telescope. M512 fitted with rack and pinion 22.50

M522a. Telescope. M512a fitted with rack and pinion 23.00

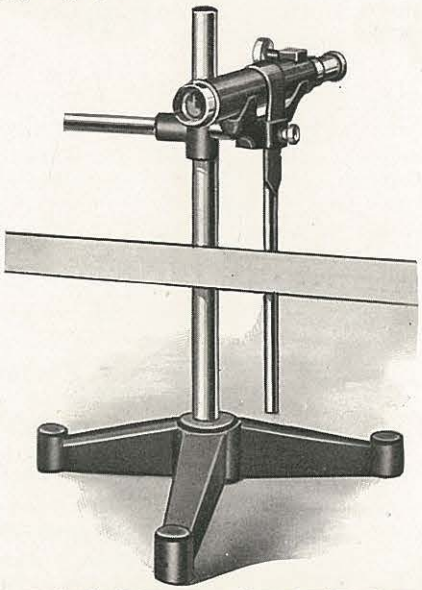
M523. Telescope. M513 fitted with rack and pinion 27.50

M523a. Telescope. M513a fitted with rack and pinion 28.00

M524. Telescope of High Power. Fitted with rack and pinion for convenient focusing, and with extra draw tube for the objective, for focusing at short distance. Aperture of objective, 40 mm, focal length about 300 mm, shortest focus of telescope, (objective to object) 75 cm, field at 75 cm about 16 mm, magnification at 75 cm about 34 diameters $ 42.00

M530. Telescope of Short Focus and Low Power. Fitted with rack and pinion for convenient focusing, and with extra draw tube for the objective. Aperture of objective 25 mm, focal length about 80 mm, focus of telescope (objective to object) 13 to 33 cm; field from 6 to 30 mm, magnification from 22 to 5 diameters ..... $ 27.50

M536. Adapter. For holding any of the Microscope Objectives M220-M226 in Telescopes M512, M512a, M522, M522a. This converts the telescope into a microscope of great tube length and correspondingly high power ..... $ 2.50



S1670-S1672

TELESCOPE SUPPORTS

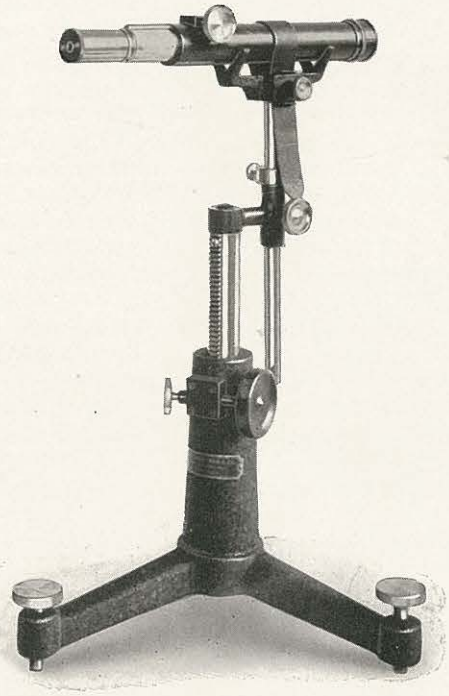
S1670. Reading Telescope Support. This support will hold any of the telescopes listed, it has height adjustment up to 300 mm, rotation in horizontal and vertical planes and is fitted with paper scale 50 cm long ..... $ 7.95

S1672. Reading Telescope Support. In every respect the same as S1670 but constructed entirely of non-magnetic materials ..... $ 15.00

S1673

S1673. Reading Telescope Support. Similar to S1670, but fitted with substantial hinge allowing an accurate tilt of the telescope. Very convenient, permitting of quick adjustment of both telescope and scale ..... **$ 8.70**

S1673a. Reading Telescope Support. Like S1673, but fitted with three leveling screws ..... **$ 14.00**

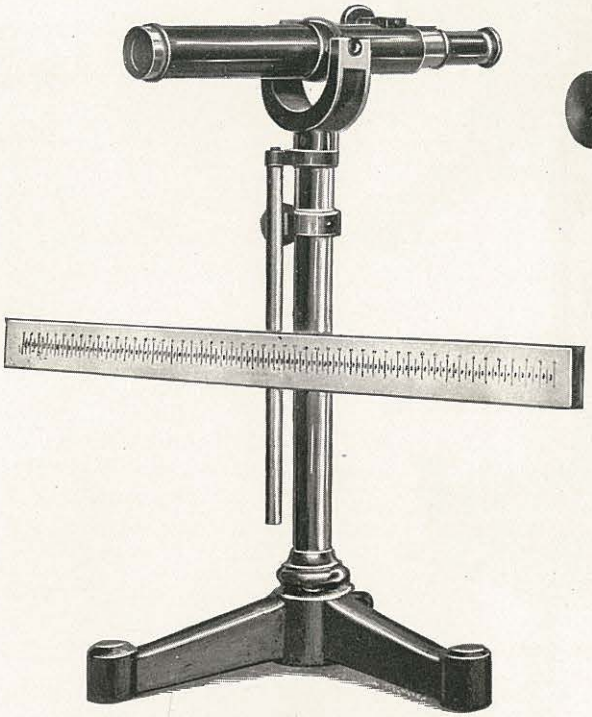


S1680

S1680. Reading Telescope Support. This support will hold any of our laboratory telescopes and permits of raising and lowering by means of rack and pinion motion. The heavy tripod base is fitted with leveling screws. The telescope is mounted on a rod which permits rough vertical adjustment and rotation in the horizontal plane. Range of rack motion 10 cm, lowest position of telescope 27 cm, highest position 60 cm over table. Convenient for reading thermometers, etc..... **$ 37.50**

MOUNTED READING TELESCOPES

These telescopes are suitable for permanent work where interchangeability of telescope and support is not desired. They have the advantage over the built-up supports in that they will keep in better adjustment, are neater in appearance and always ready for use.



M620-M621-M622

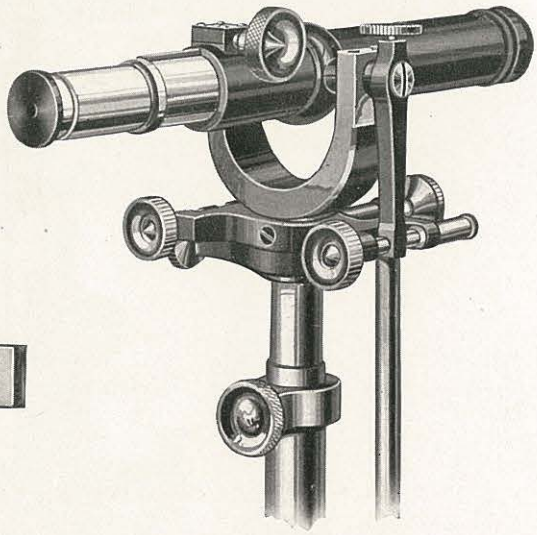


Illustration shows the delicate adjustments as used with M626-M628a

M620. Reading Telescope. This instrument is constructed of non-magnetic material and consists of tripod with support tube of 200 mm height, carrying telescope M522 on top of the sliding tube. The scale is 50 cm long, divided on celluloid, 0 in the center; it can be shifted and turned in any position from below to above the telescope. Highest position of telescope is 45 cm ..... $ 50.00

M620a. Reading Telescope. The same as M620, but tripod fitted with leveling screws ..... $ 56.00

M621. Reading Telescope. Similar to M620, but fitted with Telescope M523 55.00

M621a. Reading Telescope. The same as M621, but tripod fitted with leveling screws ..... $ 61.00

M622. Reading Telescope. Similar to M620, but fitted with Telescope M524, and having larger tripod and heavier mounting ..... $ 80.00

M622a. Reading Telescope. The same as M622, but tripod fitted with leveling screws ..... $ 87.50

M626. Reading Telescope, with delicate adjustments. This instrument is the same as M620, but provided with delicate adjustment for vertical and horizontal motions. $ 85.00

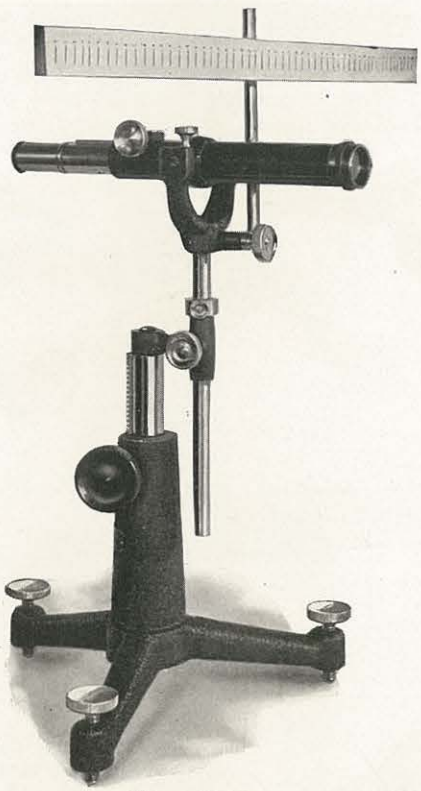
M626a. Reading Telescope. The same as M626, but tripod fitted with leveling screws ..... $ 91.00

M627. Reading Telescope. Similar to M626, but fitted with Telescope M523 90.00

M627a. Reading Telescope. The same as M627, but tripod fitted with leveling screws ..... $ 96.00

M628. Reading Telescope. Similar to M622, but provided with delicate adjustments $110.00

M628a. Reading Telescope. The same as M628, but tripod fitted with leveling screws $117.50



M632-M634

M632. Reading Telescope. Latest model, for reading galvanometer deflections, mounted on substantial tripod fitted with leveling screws and rack and pinion for delicate vertical adjustment. Range of adjustment on rack 10 cm, on sliding rod 15 cm. Telescope 25 mm aperture and 20 cm focal length, with rack and pinion, magnification about 10 diameters. Celluloid scale 50 cm long with zero in the middle. The scale may be adjusted to different heights either above or below the telescope ..... **$ 65.00**

M633. Reading Telescope. Similar to M632 but with objective of 30 mm aperture and 25 cm focal length. Magnification about 12 diameters..... **$ 70.00**

M634. Reading Telescope. Similar to M632, but with objective of 40 mm aperture and 30 cm focal length. Magnification about 15 diameters..... **$ 90.00**

M635. Reading Telescope. Similar to M632, but with delicate adjustments for telescope in horizontal and vertical planes ..... **$ 95.00**

M636. Reading Telescope. Similar to M633, but with delicate adjustments as above **$100.00**

M637. Reading Telescope. Similar to M634, but with delicate adjustments as above **$120.00**

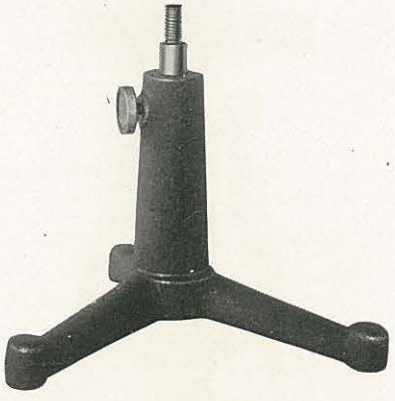
Note: Reading Telescopes M627 to M637 are partly constructed of iron and steel, but they can be furnished **of non-magnetic material throughout,** at an additional cost of $10.00.

ELEVATING STANDS

ELEVATING TRIPOD STANDS

With tripod base of iron, low in design, reamed for standard support rods. Convenient to hold table tops or may be used in connection with telescope holder, lens holder, etc.

S740. Elevating Stand. Tripod legs 10 cm long, height 18 cm. Hole reamed for 13 mm rod, not including rod shown in illustration..... **$ 2.25**

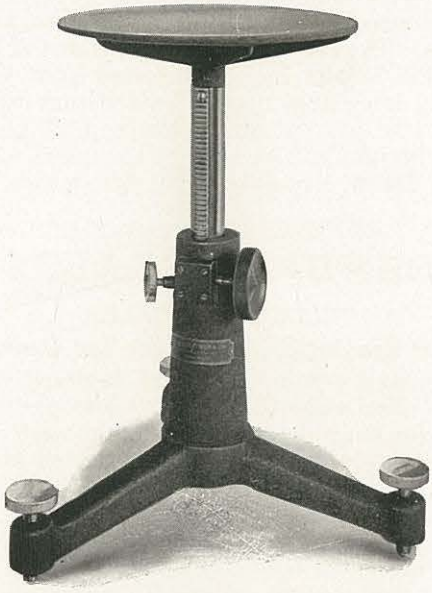


S740-S742

S742. Elevating Stand. Tripod legs 15 cm long, height 18 cm. Hole reamed for 19 mm rod, not including rod shown in illustration ..... $ 4.00

S746. Elevating Stand, like S740, but with three T-handle nickelplated leveling screws. ..... $ 3.50

S748. Elevating Stand, like S742, but with three T-handle nickelplated leveling screws ..... $ 6.00



S750a

ELEVATING TRIPOD STANDS WITH DELICATE MOTION

S750a. Elevating Stand. Tripod legs 15 cm long, fitted with knurled head nickeled leveling screws, the rack and pinion motion for delicate vertical adjustment has a range of 10 cm, the lowest position being 18 cm in height. The sliding rod, 22 mm in diameter, is threaded 3/8-16, for use in connection with standard laboratory support pieces. With table top 15 cm diameter as shown in cut ..... $ 25.00

S751a. Elevating Stand, the same as S750 but with table top of 20 cm diameter. 26.00

S760

ELEVATING WOOD STANDS

Made of seasoned maple wood, well finished in shellac. The top and center pieces are three-ply to prevent warping. The clamp screw and nut are of brass. The top is 35 cm in diameter and 5 cm thick. The height may be adjusted from 67 to 100 cm. These stands are convenient for supporting laboratory apparatus and they have the added advantage of being non-magnetic.

S760. Elevating Wood Stand. ..... **$ 30.00**

S762. Elevating Wood Stand, like above, but fitted with delicate motion for elevating ..... **$ 40.00**

READING SCALES

CELLULOID SCALES

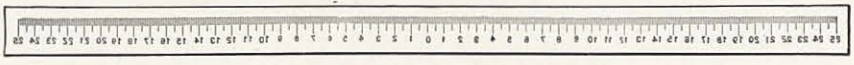
For Telescopes, Lamp Reading, Lecture Room and General Laboratory Use.

These scales are made of well seasoned material, engine divided and furnished in three different kinds of celluloid, either **white opaque** for telescopes, **transparent** for Wheatstone bridges, etc., or **translucent** for lamp reading, permitting observation from both sides.

The white opaque scales are mounted on strips of well seasoned hard-wood, and are furnished in millimeter graduations, either 50 or 100 cm in length, with zero at the end or in the center. In the latter form the figures come in black on one half of the scale and in red on the other. On the opaque scales the figures are engraved inverted unless otherwise specified.

The transparent scales are ruled on strips about 1 mm thick and 40 mm wide, with upright figures, graduated to millimeters, every cm figured.

The translucent scales are intended for lecture room use and have heavy lines 1 cm apart and large upright figures. The width is 75 mm.



M640

M640. Reading Telescope Scale, 50 cm long. A white opaque celluloid scale is mounted on a hardwood strip, with holder for 10 mm rod, 3 cm wide, inverted figures, zero in center ..... **$ 3.50**

M642. Reading Telescope Scale, 100 cm long, mounted on light boxwood strip, with celluloid cover on both sides to prevent warping, inverted figures, zero in the middle. To order only ..... $ 15.00

M645. Transparent Scale, 50 cm long. Unmounted, 4 cm wide, zero at the left end ..... $ 3.00

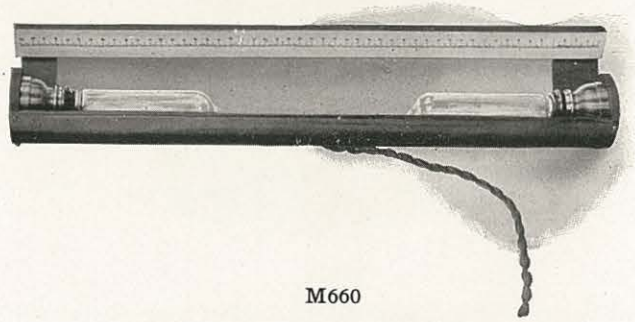
M646. Transparent Scale, 100 cm long. Otherwise like M645 ..... 6.00

M650. Translucent Scale, 50 cm long, unmounted, 7.5 cm wide 2.50

M651. Translucent Scale, 100 cm long. Otherwise like M650 ..... 6.00

Scales, Linear or Circular

We have facilities for making accurate scales of any design, ruled or etched on glass or metal, and shall be glad to quote on special requirements.



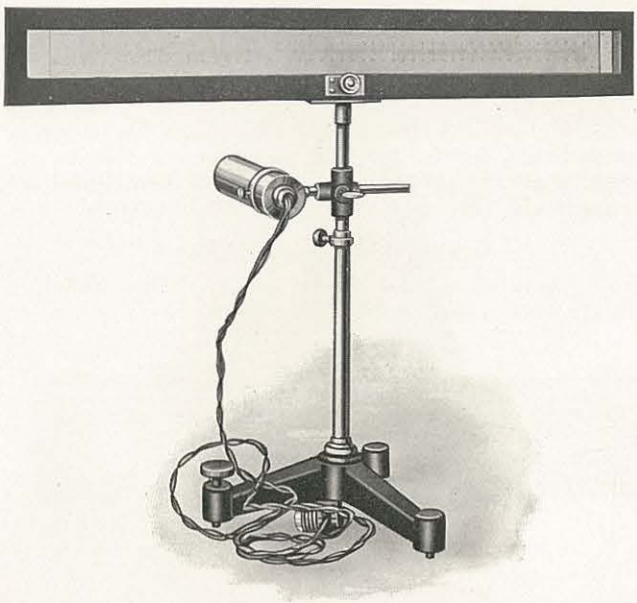
M660

M660. Illuminated Telescope Scale, 50 cm long. Consists of white opaque celluloid scale M640 (zero in the middle), fitted with a metal hood which serves as reflector for two bunghole incandescent lamps, with swivel clamp for 13 mm rods, which permits of its use in any position from horizontal to vertical ..... $ 16.00

M670. Mounted Curved Transparent Scale, 50 cm long. Scale M645 is fitted to holder which has a device for bending the scale to any desired radius; mounted on tripod and rod 40 cm high ..... $ 10.00

M670-M675

M675. Reading Lamp. A bunghole lamp is mounted in a light-tight hood on adjustable stand ..... $ 7.50



M678

M678. Lamp and Scale. This apparatus consists of a small electric incandescent lamp, mounted in adjustable brass tube with condensing lens and index mounted in front. The index consists of a fine wire with arrow point on one end which assists in locating the position of the image of the wire on the scale. The scale is etched on a ground glass plate 50 cm long, divided to millimeters and carries two rows of figures, one row having zero in the center, while the other has zero on the end. The scale is in a hard-wood frame and is provided with rack and pinion adjustment to facilitate setting on zero. The height is adjustable and one leveling screw in the tripod permits adjustment of the scale for horizontal position. Complete with 5 feet of flexible cord and Edison plug ..... **$ 30.00**

SCALES ON BRISTOL BOARD

M680. Scale, 50 cm long, mounted on hardwood strip, with holder for 10 mm support rod. The scale is printed on bristol board, and divided in millimeters, having inverted figures with zero in the center. Convenient for galvanometer reading, etc ..... **$ 1.00**

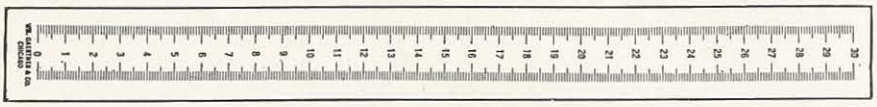
M681. Scale, like M680, but without holder ..... .50

M682. Scale, 50 cm long, unmounted, otherwise the same as for M680, each $0.15. Per dozen ..... **$ 1.50**

M682a. Scale, 50 cm long, like M682, but with zero at end. Each $0.15. Per dozen ..... **$ 1.50**

M682b. Scale, 50 cm long, like M682, but with upright figures. Each $0.15. Per dozen ..... **$ 1.50**

M682c. Scale, 50 cm long, unmounted, with upright figures and zero at one end. Suitable for Wheatstone bridges, potentiometers, etc. Each $0.15. Per dozen ..... **$ 1.50**



M684

M684. Scale, 50 cm long, on bristol board, unmounted, with vertical figures, making the scale suitable for manometers. Each $0.15. Per dozen ..... **$ 1.50**

M685. Scale, 30 cm long, otherwise like M684. Each $0.12. Per dozen 1.25

M686. Scale, 10 cm long, like M684, but with zero in the middle. Each $0.10. Per dozen ..... **$ 1.00**

OPTICAL LEVER

This instrument is used in connection with reading telescopes and is convenient for measuring small vertical deflections due to bending, expansion, contraction, etc. The two legs in line with the mirror are set on a fixed support, the single leg rests on the piece on which measurements are to be made. The mirror is of selected plate glass.

M801

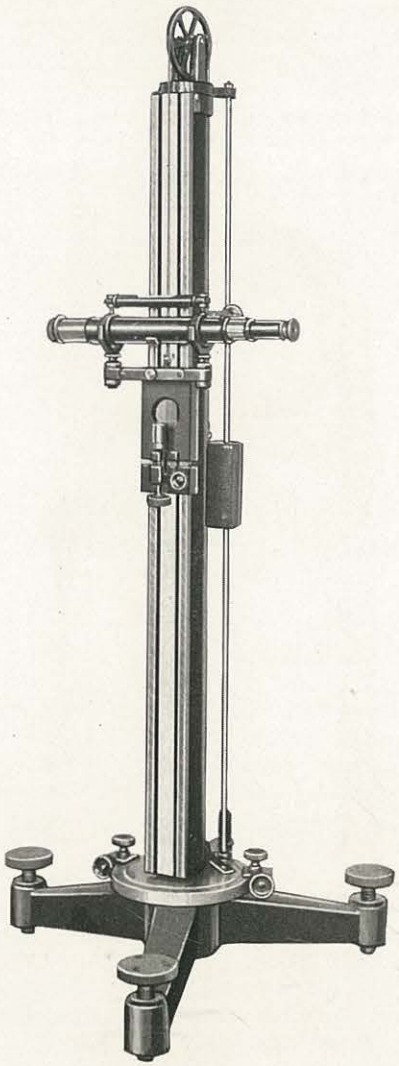
M801. Optical Lever. Size of mirror 35 mm, length of lever 75 mm..... **$ 6.00**

CATHETOMETERS

These instruments are convenient and often indispensable whenever accurate measurements of vertical distance are to be made. To facilitate accurate setting on a horizontal surface, for example, the top of a mercury column, the telescope cross hairs are placed at right angles through the center of the field of vision. The cathetometers listed herein are provided with scales in metric divisions but they can be furnished with graduations in inches, subdivided to twentieths, with vernier reading to 0.005 inch.

M900. Cathetometer, Range 65 cm. This instrument is designed to meet the demand for a cathetometer of great accuracy, possessing all the adjustments and conveniences necessary and being easily portable.

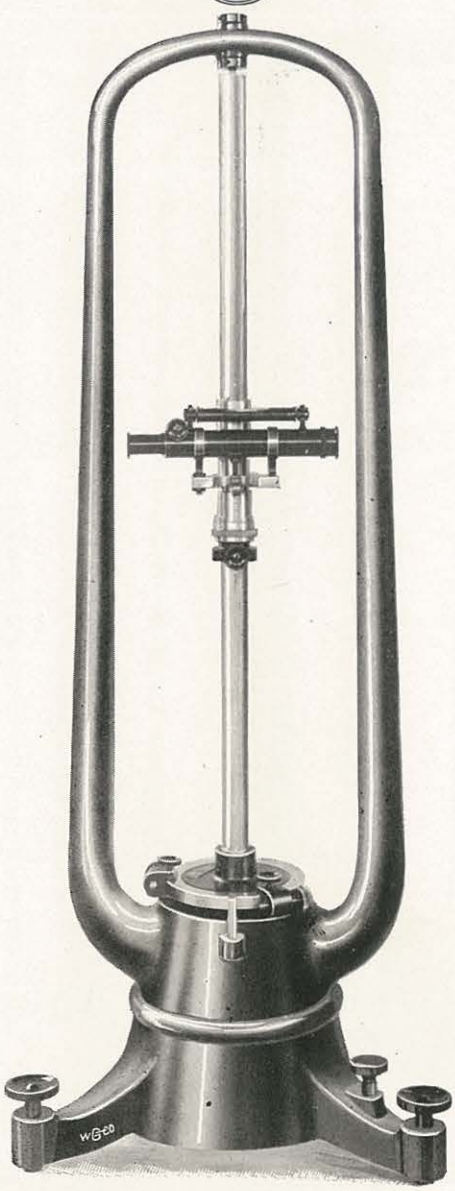
The vertical guide consists of a hollow iron casting which rotates on a heavy axis having the full length of the instrument. The guides are very carefully straightened, and adjustment is provided on the lower end to make them accurately parallel to the axis of rotation. The telescope slide is of ample length, carefully fitted to the guide, and has clamp and delicate adjusting screw. The scale is divided on an inlaid strip of nickel-silver, graduated to millimeters, and every centimeter is figured. The vernier reads to 0.05 mm. A counterweight is provided to balance the telescope slide assuring uniform motion up and down. The tripod has ample size and weight and is fitted with accurate steel leveling screws. Foot plates for the leveling screws are furnished. A plate attached to the top of the tripod carries adjustable stops for limiting the motion around the vertical axis. A handle is attached for conveniently rotating the vertical column. The telescope has an aperture of 25 mm; it is fitted with rack and pinion adjustment on the eye end and has an extra draw tube for the objective which permits focusing to about 55 cm. The telescope is fitted with a sensitive level and is easily reversible in the Y's. All necessary adjustments for level and telescope are provided **$300.00**



M900-M901

M901. Cathetometer, Range 90 cm. This instrument is in every respect the same as M900 excepting as to range **$375.00**

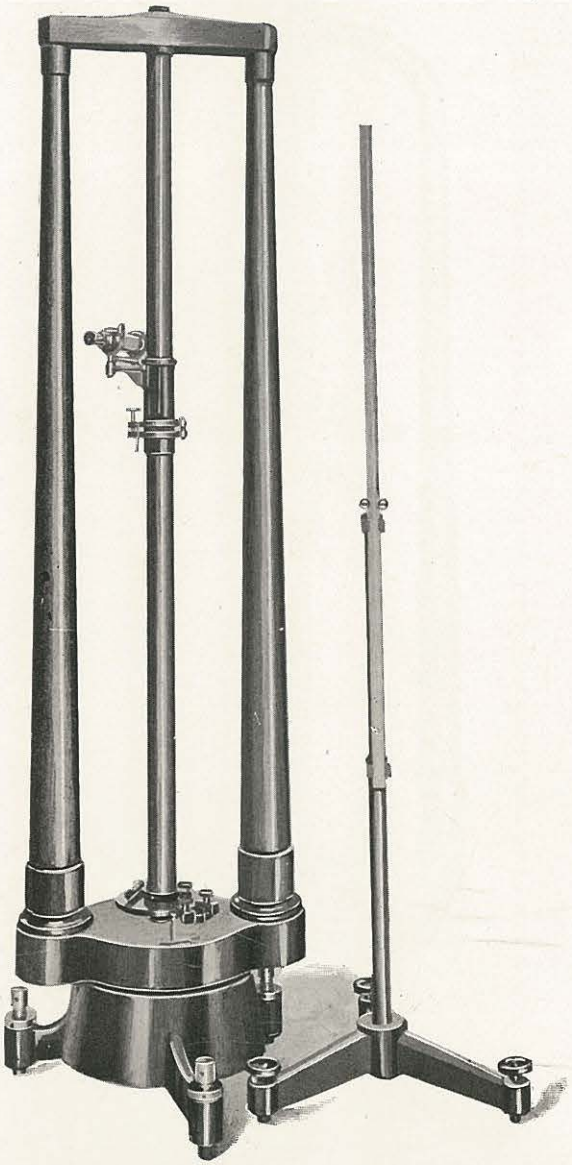
M902. Cathetometer, Range 65 cm. This instrument is of great stability, designed for the most accurate work, easily adjustable and very convenient in use. The support for the vertical guide consists of a heavy iron casting which can be easily rotated and clamped in any position on the tripod base. The vertical guide is made of cast iron and of the same cross section as the guide on Cathetometer M900. It rotates on ball centers and carries a plate on the lower end with adjustable stops which limit the rotating motion. Adjustment is provided on the top bearing to make the axis of rotation of the vertical column parallel to the guide. The scale is divided on an inlaid strip of nickel silver, graduated to millimeters, every centimeter figured. The vernier reads to 0.05 mm. The construction of the telescope slide is the same as that of Cathetometer M900. The telescope has an aperture of 25 mm; it is fitted with rack and pinion and extra draw tube for the objective and will focus as close as 55 cm. All the necessary adjustments for the telescope and level are provided. A counterpoise to balance the weight of the telescope slide is provided in the hollow column **$500.00**



M902-M902a

M902a. Cathetometer, Range 90 cm. This instrument is in every respect similar to M900, excepting range **$600.00**

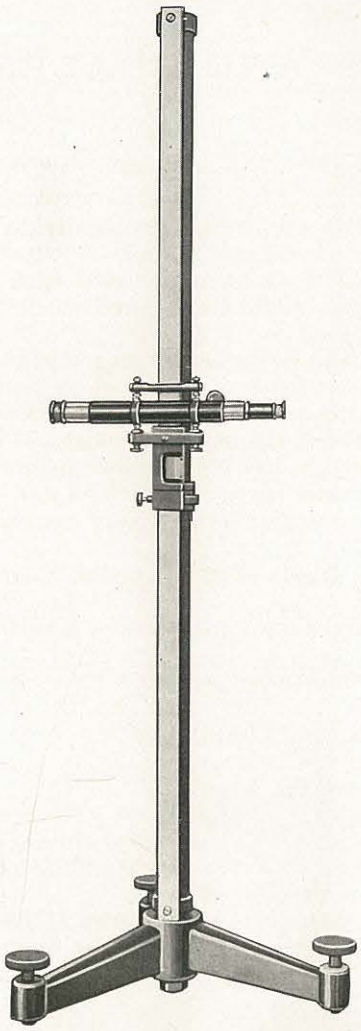
M903. Cathetometer, Range 100 cm. This instrument is very heavy and substantially constructed and it is intended for measurements of the highest accuracy. The supporting frame for the vertical column consists of two cast-iron pillars mounted on a substantial base which is mounted on a heavy tripod of 25 cm length of legs. The vertical guide consists of a hollow iron casting very carefully straightened. Adjustment is provided on the top of the column to make its axis of rotation parallel to the guide. A plate with adjustable stops for limiting the amount of rotation is attached to the lower end of the column. The scale is on a strip of inlaid nickel-silver, divided to millimeters. The vernier reads to 0.05 mm and a magnifying glass for reading the vernier is attached. The telescope has an aperture of 25 mm; it is fitted with rack and pinion and extra objective draw tube. It will focus as near as 55 cm, at which distance it gives a magnification of 18 diameters and a field of 20 mm. The telescope is reversible in the Y's and all necessary adjustments for level and telescope are provided. A counterpoise for telescope and slide is provided in the hollow column **$900.00**



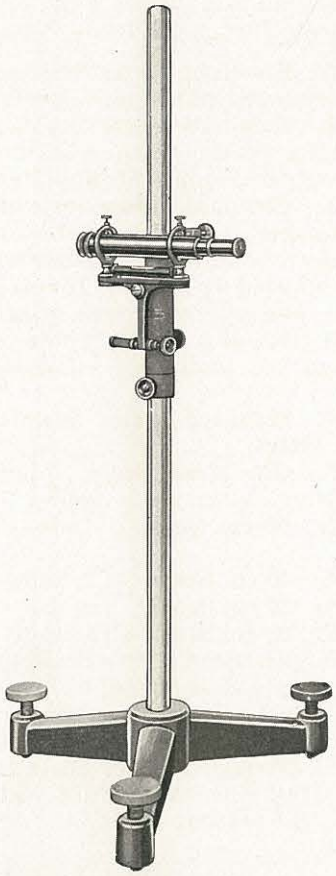
M903 M1001—M1101

M904. Cathetometer, Range 100 cm, with Two Telescopes. This instrument is similar in every respect to M903 but it is fitted with two telescopes having all adjustments, which can be placed at a maximum distance of 1 meter; minimum distance 20 cm..... **$1000.00**

M907. Cathetometer, Range 100 cm. This cathetometer is designed to meet the demand for a less expensive instrument of large range and sufficient accuracy for general laboratory work. The instrument is similar in construction to our M900 cathetometer and the tripod base and telescope are the same. The guide consists of a straight steel bar of 25x13 mm cross section, divided to millimeters for a distance of one meter. The vernier reads to 0.05 mm. The telescope carriage is provided with delicate adjustment and a motion for tilting the telescope and keeping the level in adjustment, should it be affected by any slight irregularities in the guide. The telescope has an aperture of 25 mm, fitted with rack and pinion and extra objective draw tube for short focus. The whole instrument rotates on a strong vertical support rod and can be clamped in position **$175.00**



M907



M910

M908. Cathetometer, Range 100 cm. This instrument is in every respect the same as M907, but **the guide bar is made of brass,** cross section 32 mm x 13 mm. For chemical laboratories, when the instrument is exposed to acid fumes, this instrument is especially recommended **$200.00**

M910. Cathetometer, Range 100 cm. This instrument is intended for measurements where the greatest accuracy is not required. The support and guide for the telescope sleeve consists of a straight white-plated steel rod of 30 mm diameter, 120 cm long, mounted on a heavy tripod, fitted with steel leveling screws. **The rod is graduated to millimeters,** and the slide is fitted with vernier reading to 0.1 mm. The sleeve on which the telescope is mounted is of considerable length and well fitted to the rod. The adjustment in height is made by hand by sliding the collar on which the telescope sleeve rotates. The support for the telescope is provided with a spirit level and delicate horizontal tilting adjustment. The telescope furnished with the instrument has 25 mm aperture, is fitted with rack and pinion; it has draw tube for short focus to about 55 cm and a power of about 18 diameters **$100.00**

STANDARD METERS AND SCALES

We have excellent facilities for the manufacture of accurate scales of every description of any length up to 3 meters with metric or inch graduations. We can furnish these scales with certificate from the Bureau of Standards if so desired.

M1000. Standard Meter Scale, made of hard brass 19 mm square, divided into millimeters, every tenth millimeter figured. In box ..... $ 40.00

M1001. Standard Meter Scale, made of hard brass 19 mm square, with inlaid strip of nickel-silver divided into millimeters, every tenth millimeter figured; the first and last millimeter subdivided into fifth-millimeters. In box ..... $ 75.00

M1002. Standard Meter Scale of H-Form. The H-Form was suggested by the "Bureau International des Poids et Mésures" and it is in general use for very accurate scales. It was adopted because the graduation is on a surface in the neutral axis of the section and will not be affected by flexion. It also offers the greatest rigidity in comparison to the weight of the scale, and a large surface, which is of advantage to obtain temperature equilibrium. The scale is made of brass 25x25 mm outside, with inlaid silver strip divided into millimeters; the first and last millimeter subdivided into tenth-millimeters. Every centimeter is figured. $120.00

M1004. Standard Meter Scale of H-Form. Made of **Invar** metal, graduations the same as on M1002. ..... $300.00

M1010. One Meter Scale. Made of steel, 25x12 mm cross section, divided into millimeters. Every centimeter is figured. ..... $ 28.00

M1012. 50 cm Scale. Made of steel, 25x6 mm cross section. Every centimeter is figured. ..... $ 15.00

M1014. 40 cm Scale. The same as M1012 except in length. 12.00

M1016. 30 cm Scale. The same as M1012 except in length. 9.00

M1018. 20 cm Scale. The same as M1012 except in length. 6.00

M1030. Standard Meter Scale on Glass, divided into millimeters. The scale is etched on a strip of plate glass 50 mm wide, about 7 mm thick. The lines are about one-tenth millimeter in width so that accurate settings can be made. Every tenth millimeter is figured, the figures are in line with the graduations for horizontal use of scale. ..... $ 50.00

M1031. Standard Meter Scale on Glass. This scale is the same as M1030 in respect to divisions, but it is intended for vertical use, with figures at right angles to the lines, and with zero at the bottom. ..... $ 50.00

SUPPORTS FOR STANDARD METER SCALES

These supports are intended to hold the scale in accurate vertical position when used in connection with the cathetometer. The scale can be clamped at different heights so that the bottom of scale will come from 10 cm to 60 cm over the table top. A delicate vertical adjustment is provided with accurate plumb-bob attached to give a check on the vertical adjustment.

M1101. Scale Support, for holding Standard Meter M1001. ..... $ 70.00

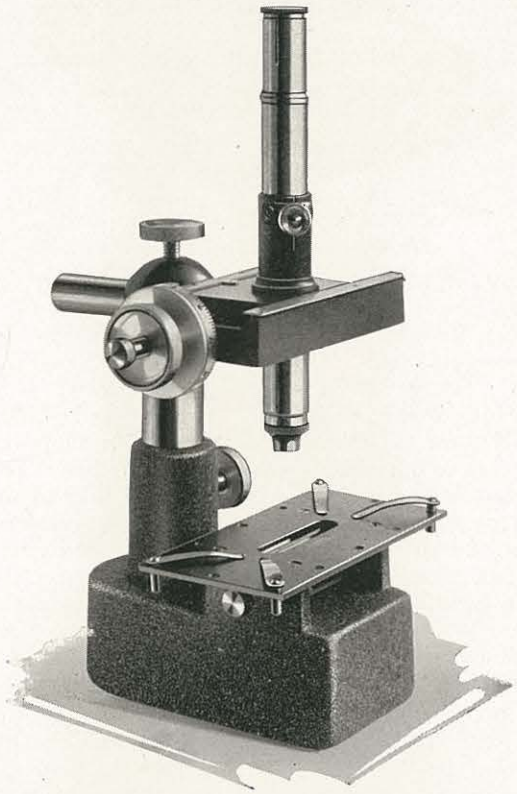
M1102. Scale Support, for holding Standard Meter M1002 or M1004..... 70.00

COMPARATORS

The Construction of Comparators has been one of our principal specialities for over a quarter century. We list here only standard types and sizes which either are kept on hand or which can be furnished on short notice. To meet individual requirements we are prepared to construct Comparators of special design, as may be required.

Our Comparators have a world wide reputation for their accuracy. The Micrometer Screw is free from periodic and progressive errors (errors of run). A painstaking process of cutting, recutting, lapping, and interference testing is used. (For description of the methods used by us see "Machinery", June 1917). For the most part no attempt is made during the correcting process to hold the screw thread to standard metric or inch gauge, so that slight variations in the total length may be expected. For scientific purposes the standard character of the measurements is usually unimportant. For commercial work, we are able, owing to our new facilities, to construct Comparators reading inches, which are accurate not only as regards freedom from periodic and progressive errors but as regards the standard character of the measurements ("total length").

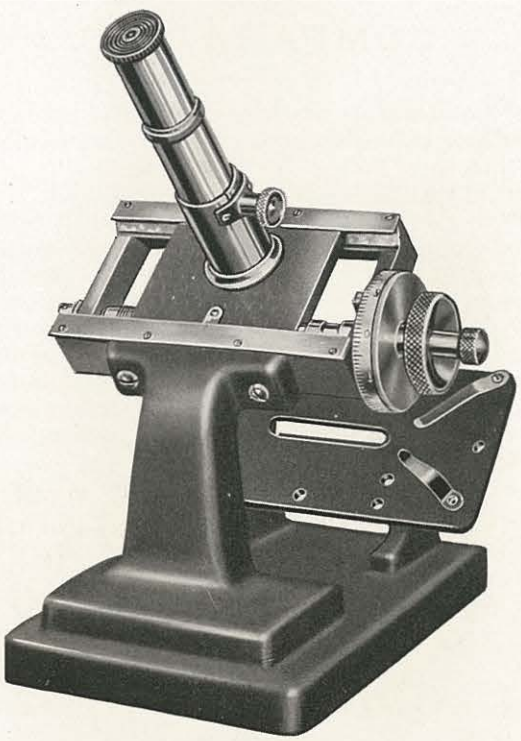
Inquiries in regard to modified or special Comparators will receive prompt attention.



M1200

M1200. Comparator, Range 50 mm. Consisting of Micrometer Slide M301, with Micrometer M101, mounted on Support M315. ..... **$105.00**

M1200a. Comparator, Range 50 mm. Similar to M1200 with exception of the microscope, which is fitted with rack and pinion motion. **$113.50**



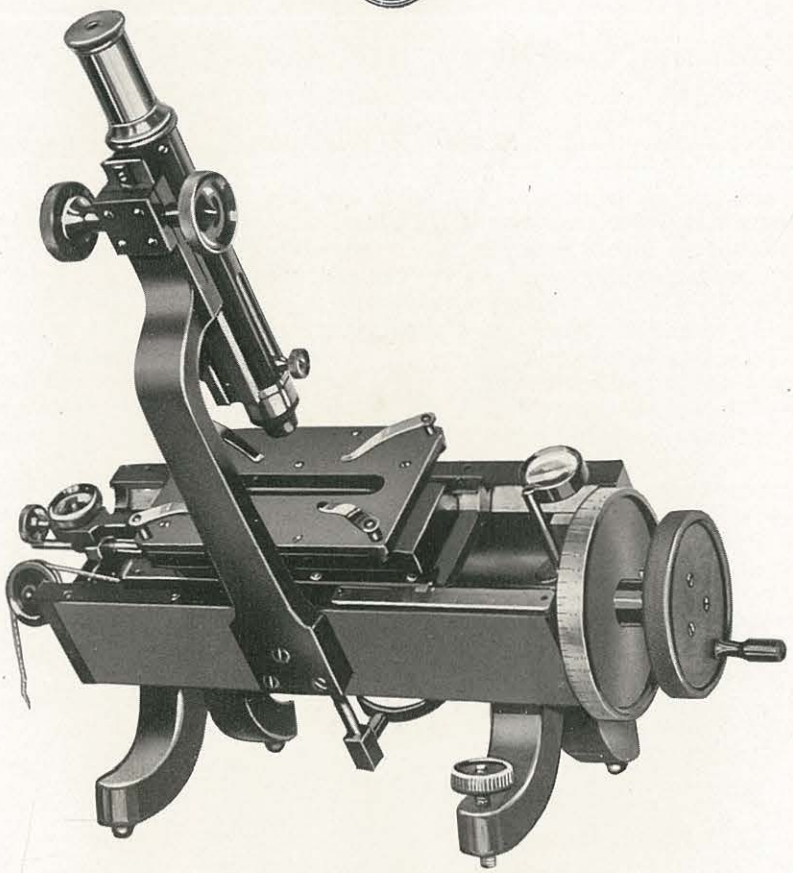
M1200b

M1200b. Comparator, Range 50 mm. This comparator is similar to M1200, but the micrometer slide and stage are mounted at an angle convenient for the observer. . **$100.00**

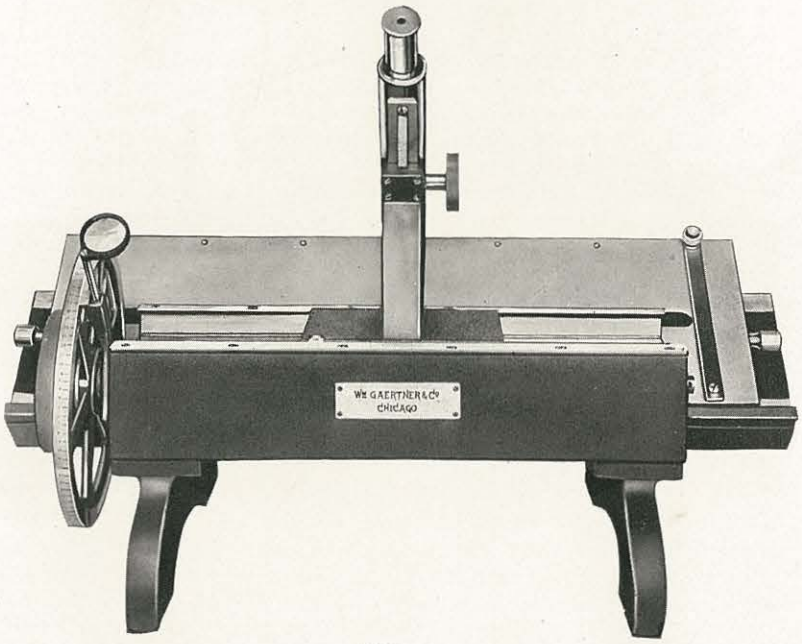
M1200c. Comparator, Range 50 mm. Similar to M1200b, but having rack and pinion motion fitted to the microscope. **$108.50**

M1201. Comparator, Range 80 mm. This instrument is intended for measuring spectra photographs, gratings, scales, or such objects that can be held on the stage and focused by the microscope; it will allow rapid measurements of the highest possible accuracy. The micrometer screw has a pitch of 0.5 mm and diameter of 15 mm. The index head has a diameter of 80 mm and is fitted with a solid silver rim which is graduated into 500 parts. The full revolutions are read by means of a scale in front of the instrument. The bed plate is heavy, made of cast iron and the guides are carefully scraped true within 0.001 mm. The carriage has a movement of 80 mm; it is made of gun metal and fitted exactly to the guide, and it is provided with a second top carriage with 40 mm motion. The extra carriage can be moved by hand and set accurately by means of a micrometer screw. The microscope is fitted with extra draw tube for variable magnifying power and is focused by rack and pinion. Illumination for transparent objects is given from below by means of a plane mirror. The instrument is mounted on heavy supports, set at an angle convenient for the observer, and finished in first-class manner. **$520.00**

M1205. Comparator, Range 200 mm. This comparator is fitted with a screw of 1 mm pitch and has a micrometer head of about 180 mm diameter divided into 1000 parts, with graduations on solid silver. The head and handle are placed on the left side of the comparator so as to leave the right hand free for taking notes. The microscope is of standard type, fitted with an arrangement for varying the magnifying power from 10 to 25 diameters, mounted on the movable carriage. The carriage, which holds the spectrum plate, will accommodate any size plate up to 24 inches long and any width up to 2½ inches. This carriage is mounted on a guide parallel to the slide which carries the microscope, and it can be shifted and clamped securely so that any part of the spectrum plate may be quickly brought under the microscope. The screw is of the highest accuracy and very carefully corrected **$800.00**



M1201



M1205

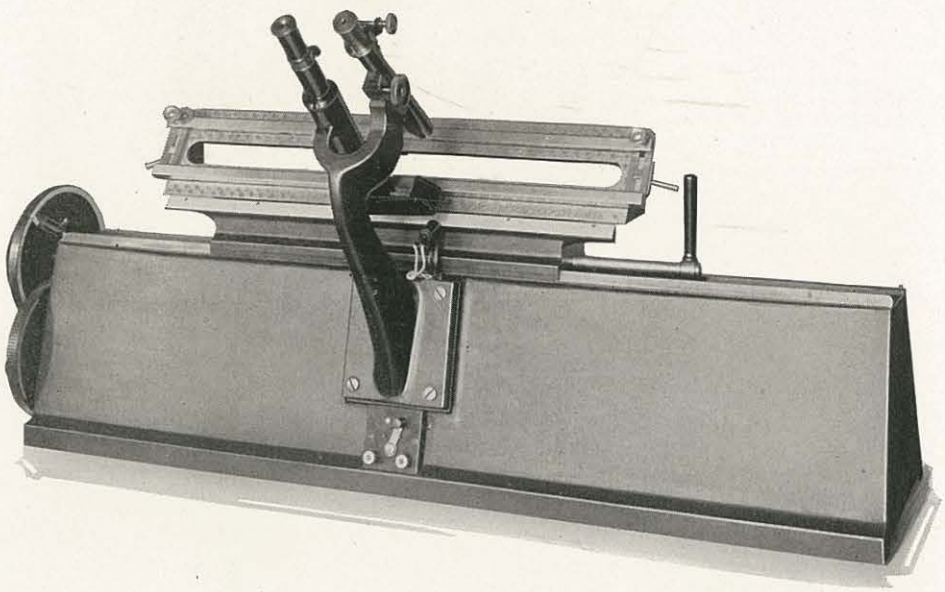
M1206. Comparator, Range 250 mm. This instrument is similar in every respect to M1205, except in range. **$1000.00**

M1207. Comparator, Range 350 mm. This instrument is similar in design to M1205, except in respect to the plate holding and plate aligning arrangement. The plate is held between grooved steel strips in such a manner that the film side will always come in the same plane regardless of the thickness of the plate. Plates from one to two inches in width and up to twenty-four inches long can be accommodated. The alignment of the plate is facilitated by disengaging the carriage from the nut, thus permitting it to be pushed back and forth by hand. The nut remains permanently adjusted to the screw, and is connected to the carriage by means of a hardened steel coupling which can be easily engaged or released by manipulating a handle on the right end of the carriage. To disengage the carriage, the handle is thrown upward and serves as a hold to slide the carriage back and forth. In order to engage the coupling, the carriage is pushed to the extreme left, the handle thrown backward and the carriage moved slowly to the right until a spring feeler piece touches the nut; in this position the handle is turned forward engaging the coupling.

The microscope and illuminating mirror are the same as in the smaller comparators.

The screw is of one millimeter pitch and of large diameter, to insure continuous accuracy. The divided circle is of about 180 mm diameter, divided to 1000 parts. A fast gear motion is provided, which increases the speed of the screw four times and as a rawhide idler is placed between the gears the motion is in the same direction and noiseless.. **$1650.00**

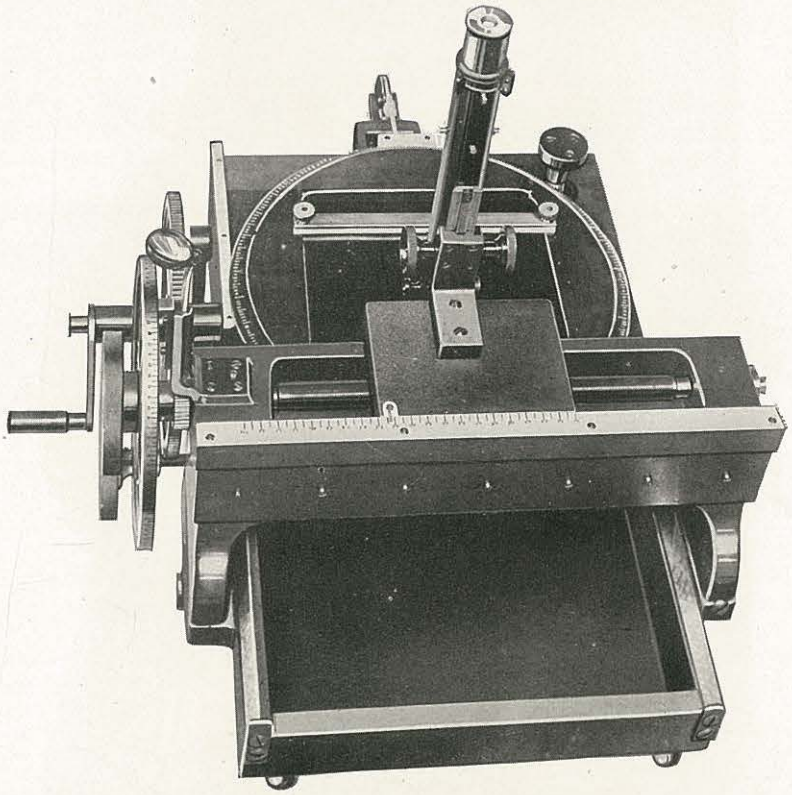
M1210. Comparator, Range 50 cm. This instrument is similar in every respect to M1207, except to range. **$2200.00**



M1212

M1212. Comparator, Range 50 cm. In this instrument, which is otherwise of the same size and construction as M1210, the readings on the index wheel and linear scale are made in an eyepiece, placed near the microscope, so that the observer can conveniently make settings with the microscope and readings on the scales without moving the head. Both circular and linear scales are divided on white celluloid, inlaid in metal, and are illuminated by small electric lamps **$2550.00**

Note: This comparator is in use at the Bureau of Standards, giving good satisfaction.



M1230

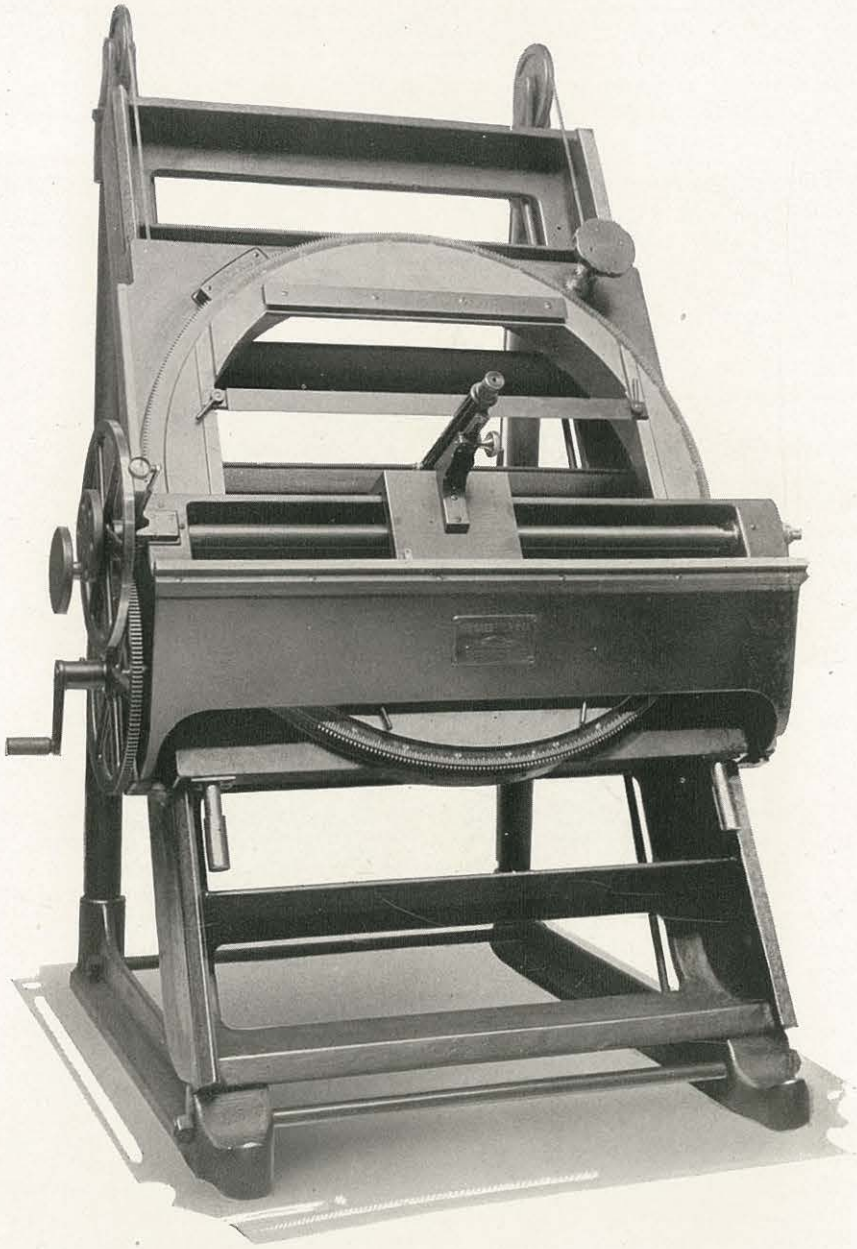
M1230. Comparator for Star Photographs, Plates 5 in x 7 in. Plate carriage is mounted on a heavy bed plate which may be inclined at any convenient angle 35° to 45°. The motion of the carriage is by rack and pinion with handle provided on each side. The range of the carriage is 180 mm, and a scale divided into millimeters is attached on the left side.

The carriage is fitted with a circle 275 mm in diameter, graduated to single degrees, reading by a vernier to 6 minutes. The rotation of the circle is given by gear and pinion. The circle has an opening 170 mm x 170 mm, and carries the photographic plate, with film side up. Smaller size plates down to 2 inches width can be accommodated.

The microscope carriage is moved by a micrometer screw having a range of 200 mm, a diameter of 18 mm, and a pitch of 1 mm. The micrometer head is placed on the left side; it is about 180 mm in diameter, and is divided into 1000 parts. The divisions are on silver. A set of change gears, for quick motion of the carriage, is provided. Adjustments are provided to bring the horizontal guide accurately at right angles to the lower one.

The microscope tube length can be varied and can be adjusted to give powers from about 5 to 35 diameters by using two different eyepieces.

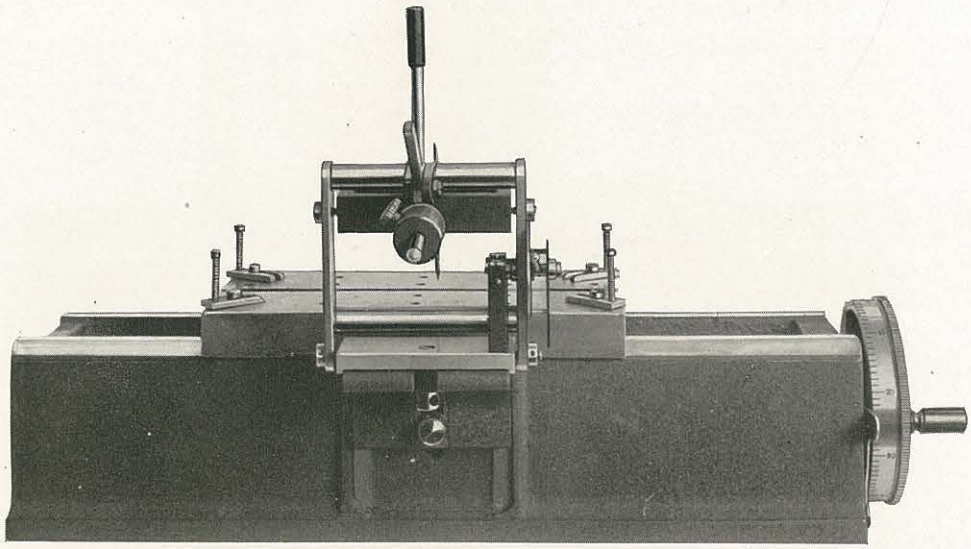
Price on application.



LARGE COMPARATOR FOR STAR PHOTOGRAPHS

Plates 23 in x 19 in. Range of micrometer screw 22 in. Constructed to order for Yale University Observatory, New Haven, Connecticut, according to suggestions by Professor Dr. Frank Schlesinger.

DIVIDING MACHINES



M1301

M1301. Linear and Circular Dividing Machine. This machine is especially designed for use in the laboratory and particular attention has been paid to convenience, durability and accuracy. It can be changed from a linear to a circular dividing machine within a few minutes and its range of work is such as to cover about 90 per cent of all the dividing which is required in a laboratory. The small machine is in many cases more advantageous to use than the more expensive semi-automatic machines, as the adjustments are of the simplest kind, easily understood and quickly made.

The linear range of the machine is 20 cm and it will work with equal rapidity and accuracy in either direction, backwards or forwards. The carriage is 21 cm long; it is provided with a groove for the convenient holding of round rods, glass tubes, etc. An automatic stop for dividing full millimeters is provided. The screw has a pitch of 1 mm, and is carefully corrected. The divided head has 100 parts.

The construction of the tracing mechanism is such as to enable with equal convenience the ruling of fine lines with a diamond, or of heavy lines, such as are used on a steel scale, with a steel cutter. The length of line can be changed as may be desired for every second, third, fourth or any other mark, by simply turning a small lever which is within convenient reach. By turning the lever either upward or downward the long lines can be made to extend (forward or backward) on either side of the scale. This arrangement saves much time in the first adjustment of the machine.

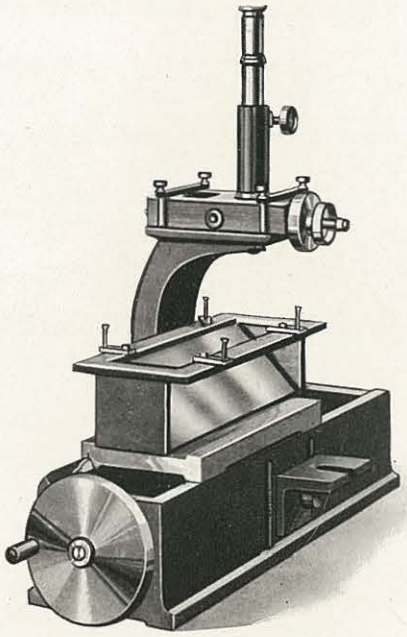
The circular dividing arrangement consists of a bronze worm wheel with 360 teeth in which engages a worm screw having a divided head with 60 parts. An automatic stop is provided for the rapid dividing of full degrees. The range of this attachment is such as to enable the ruling of a circular scale of from 4 cm to 25 cm diameter. The machine can be easily arranged as a comparator, by fitting a microscope in place of the circular dividing attachment.

Complete with circular attachment, diamond point, steel cutter, weights and full instructions **$475.00**

M1301a. Linear Dividing Machine. M1301 without circular attachment 360.00

M1301b. Glass Case for Dividing Machine M1301 or M1301a 25.00

M1301c. Microscope Support for use with M1301 or M1301a Dividing Machine. This support will fit in place of the ruling mechanism and consists of iron pillar with adjustable arm to hold any of our measuring microscopes ..... $ 10.00



M1301d

M1301d. Comparator Attachment to fit Dividing Machine M1301, consisting of vertical bracket with Micrometer Slide M301 and Microscope M101a. A stage with glass top and reflector is fitted to the carriage of the machine. This arrangement forms a very convenient comparator for measuring any object which comes within the ranges of the machine and micrometer slide $145.00

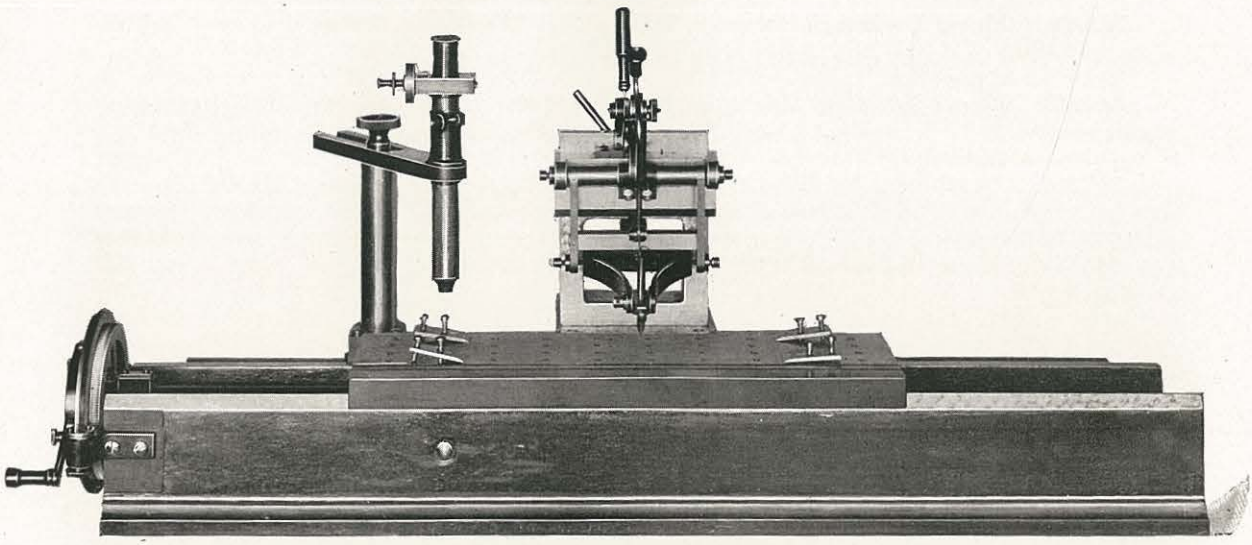
M1302. Linear Dividing Machine, Range 35 cm, for laboratory use. The total length of the machine is 80 cm. The screw has millimeter pitch and is carefully corrected. The nut is of ample length, and is carefully fitted to the screw. It is guided on a bar which may be inclined for length correction. The indexing arrangement is automatic and permits of spacings from 2 mm to 0.005 mm. The tracing mechanism may be fastened on any part of the bed, it is very solidly constructed and is easily adjustable in every direction. Provision is made for the automatic changing of the length of line. A counterbalance is fitted to the arm holding the dividing tool, so as to permit the tracing of very light lines. The carriage has a length of 41 cm and is fitted on top with a V-groove for holding round rods, glass tubes, etc. The machine is carefully constructed and well and durably finished $550.00

M1302a. Glass Case for Dividing Machine M1302 ..... 45.00

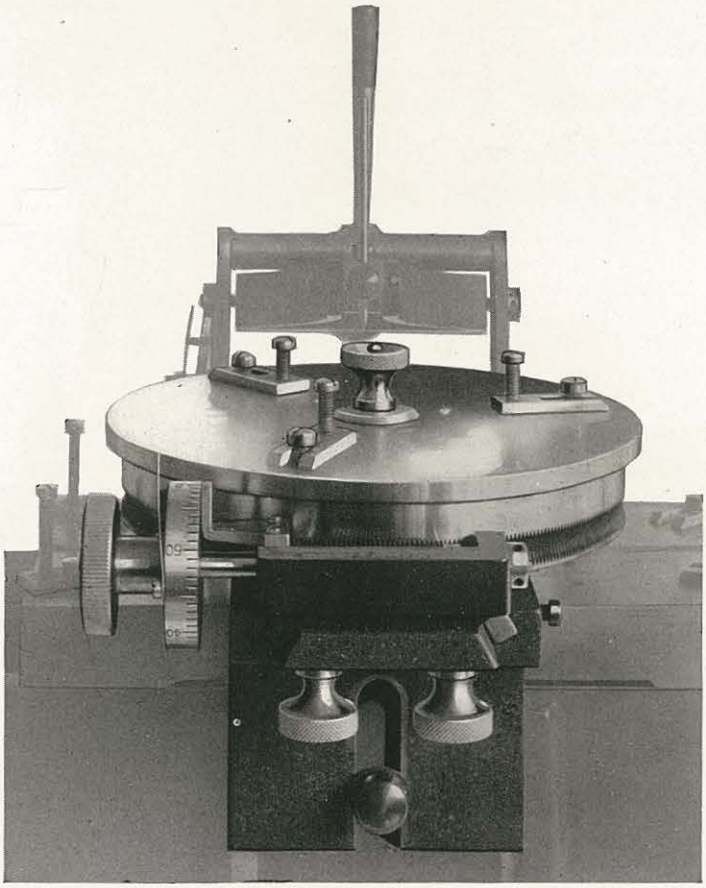
M1302b. Dividing Machine. M1302 including Microscope Support with Microscope M103, as shown in illustration $620.00

M1303. Linear Dividing Machine, Range 55 cm. The same as M1302 except in range $820.00

M1303a. Glass Case for Dividing Machine M1303 ..... 60.00



M1302b



M1311

M1304. Linear Dividing Machine. The same as M1303 but arranged to work entirely automatically. A 1-8 H. P. Motor will be required.

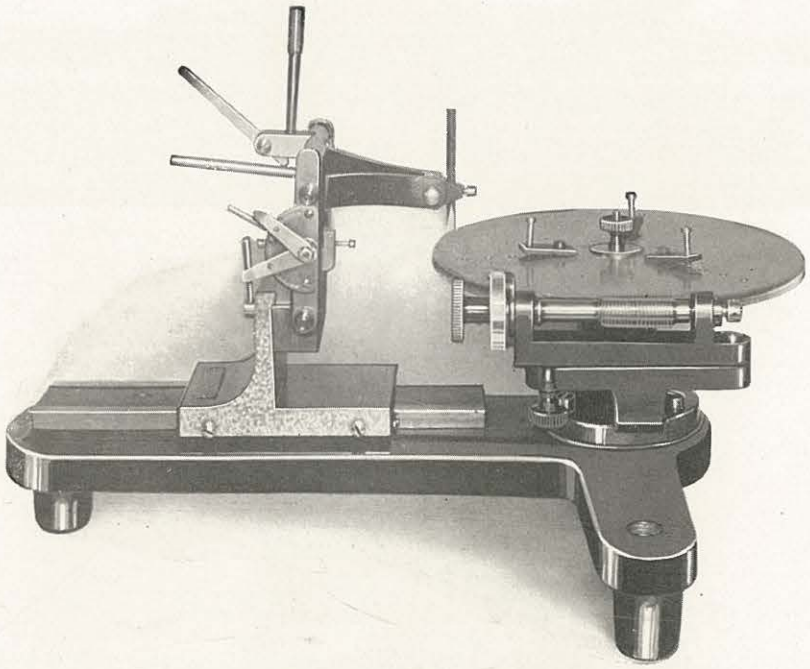
Price on application.

M1306. Linear Dividing Machine, Range 1 Meter. The same as M1304 except to range.

Price on application.

M1311. Attachment for Dividing Circles. To fit machine M1302 or M1303. Largest circle that may be divided 20 cm; worm wheel 360 teeth; index head on worm screw 60 parts, accuracy 30 seconds **$130.00**

M1312. Mounted Diamond Point. For ruling mechanism **5.00**



M1350

M1350. Dividing Machine for Circles. The worm wheel of this machine has a diameter of 20 cm, and has 360 teeth. The machine will divide circles up to 40 cm in diameter. The worm screw carries an index head divided into 60 parts, which is fitted with a stop for the quick setting of full revolutions. The simple tracing mechanism is so arranged that the long lines may be drawn to extend either inward or outward from the center and the change from one arrangement to the other can be made very quickly. Provision is made for attaching a microscope to the machine **$360.00**

M1352. Dividing Machine for Circles. M1350 fitted with automatic tracing mechanism, such as used on Dividing Machine M1302 ..... **$420.00**

M1354. Dividing Machine for Circles. M1350 fitted with automatic tracing mechanism, such as used on dividing machine M1302, and with an automatic attachment to the worm screw, to make spacings automatically. Three different ratchet wheels are furnished with this attachment, having 120, 100 and 90 teeth respectively, allowing a great many different spacings to be made **$525.00**

M1355. Microscope Support for M1350, M1352 or M1354 ..... **8.00**

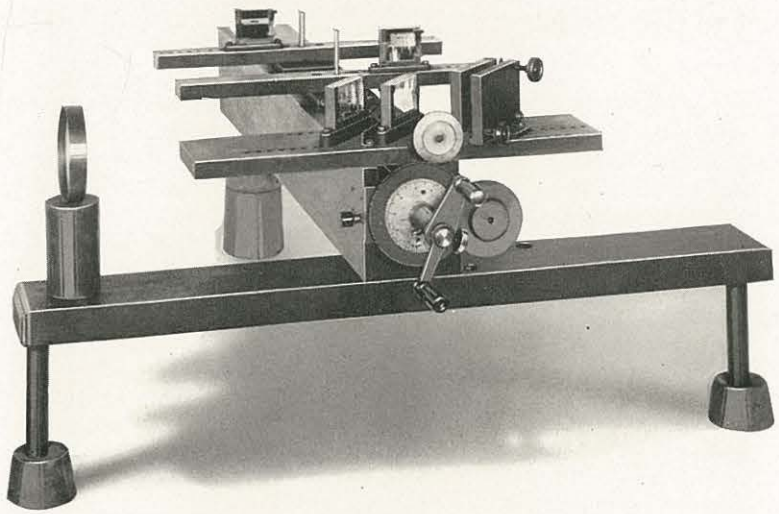
Note: We are in a position to furnish **Engraving Machines** and Appliances for marking linear and circular scales. Prices on application.

MODERN SHOP MEASUREMENTS

Optical measuring instruments can often be used to advantage for shop measurements, in place of micrometer calipers and similar shop instruments. The eye replaces the sense of touch giving greater accuracy and convenience. Mechanical parts may be replaced by beams of light, as for example, the optical lever, which instantly rotates a beam of light of any desired length, multiplying in corresponding ratio the motion imparted to it, without having to overcome the inertia and avoiding the weight and wear of mechanical lever systems. The parts to be measured are not put under any strain nor even touched so that no damage is done to them; expansion from the heat of the hand is avoided, and no errors are introduced into the measurement because of mechanical distortion. Parts which are hard to measure by usual means because of their form or inaccessibility, can often be measured easily by the optical method. It is only necessary that they can be seen.

The simplicity, rugged construction, speed and ease in use of our optical measuring instruments make them especially desirable for industrial purposes. They make possible the utmost precision where this is desired, because of the high accuracy of our micrometer screws.

We are always glad to consult with any one in need of help in selecting instruments, and can often be of assistance to those having new and unusual needs, as well as to those who wish to improve upon present methods of measurements. In unusual cases where the highest precision known to science is desired, the use of a light wave interference method such for example, as used by us for testing our micrometer screws is recommended. As we have been in this field ever since the introduction of interference methods for practical measurements, we can give advice in any particular case, and we are glad to help any one who wishes to take measurements of the very greatest accuracy.



INTERFEROMETER FOR SCREW TESTING

The two mirrors are mounted on separate carriages transported by separate nuts placed at two points of the screw under test. As the screw is rotated errors of run and periodic errors appear as progressive and periodic displacements respectively of the white light fringes.

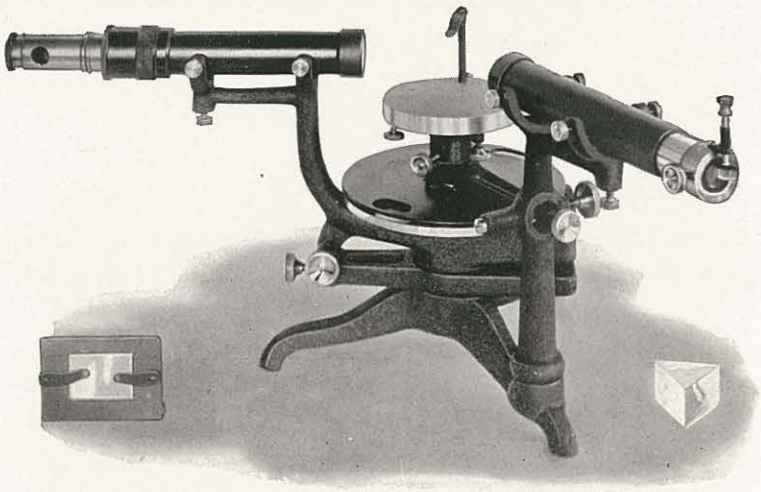
II. OPTICAL INSTRUMENTS

Table of Contents

Appendix

TIME RECORDING INSTRUMENTS

SPECTROMETERS AND ACCESSORIES



L101b L101 with L101a and L101c L712

L101. Spectrometer, reading to one minute of arc, diameter of circle 125 mm, aperture of objectives 25 mm. For college and general use when no considerable degree of accuracy is required. The instrument is substantially constructed throughout and durably and neatly finished, presenting a pleasing appearance; it may safely be placed in the hands of inexperienced students. The height of the instrument is 200 mm. Telescope and prism table are each supplied with clamp and tangent screws. Telescope and collimator tubes are firmly mounted in double cradles and provided with adjustments in the vertical and horizontal planes. The prism table, of magnalium, 80 mm in diameter, has an adjustable spring prism clamp, which holds objects of various size without strain; it has, in addition, height and tilting adjustments. Telescope and collimator have adjustable draw tubes. The circle, also of magnalium, 125 mm in diameter, reads by means of verniers to one minute of arc. Circle and verniers are covered by a dustproof protecting plate with glass windows over the verniers. The objectives are achromats of 25 mm aperture and about 160 mm focal length. The slit, 10 mm long, has a fine adjusting screw and closes by spring pressure. The observing telescope carries a Gauss eyepiece. Without prism ..... **$ 90.00**

L712. 60° Prism of Flint, index about 1.65, 22.5 mm high, 45 mm side, with two polished faces ..... **$ 18.00**

L712a. 60° Prism of Flint, index and dimensions same as L712, but with three polished faces ..... **$ 22.00**

L790b. Diffraction Grating, replica, (transmission grating) for direct observation of spectra, 3940 lines per cm, ruling 25x20 mm. ..... **$ 4.50**

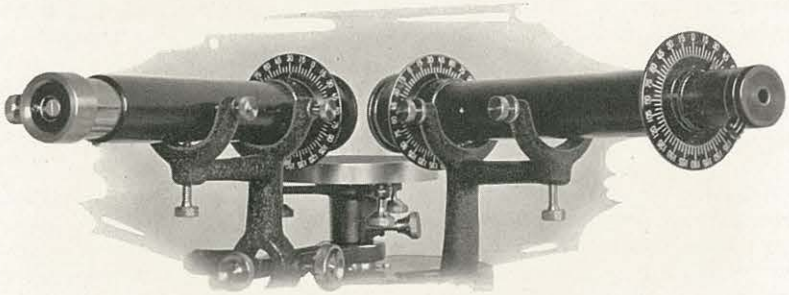
L791. Diffraction Grating, replica of highest quality, 5,900 lines per cm, ruling 25x21 mm ..... **$ 7.50**

L791b. Diffraction Grating, replica for direct observation of spectra. The same as L791, except in quality. ..... **$ 4.50**

L101a. Comparison Prism, fitted to slit. (Should be ordered with the instrument; if wanted later, slit must be returned) ..... **$ 7.50**

L101b. Grating Holder, to attach to prism table, for gratings or Fresnel bi-prisms up to 25x35 mm. ..... **$ 3.50**

L101c. Delicate Focusing Adjustment for either telescope or collimator. (Should be ordered with the instrument; if wanted later, telescope or collimator respectively must be returned) ..... **$ 8.00**

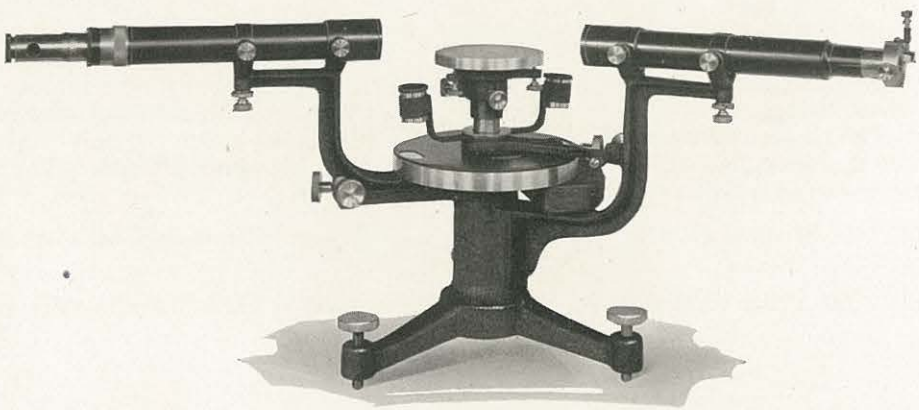


L101d

L101d. Polarizing Attachments for L101, Spectrometer, for studying Fresnel's laws of refraction, elliptical polarization by reflection, and by transmission through crystals, etc. Two circles carrying rotable 10 mm nicols fit over the telescope and collimator objectives. A third circle at the eye end fits in the place of the usual adapter with cross hairs and carries a special Ramsden eyepiece with a nicol between the lenses. The circles are divided to 5 degrees and permit estimating to single degrees. The nicols may be rotated independently of the circle for adjustment of zero. ..... **$ 60.00**

Note: For accessories to Polarizing Attachments see page 46.

L101e. Camera Attachment for L101 Spectrometer, will fit in place of the observing telescope, has objective of 300 mm focal length and takes a standard plate 4½ in. x 3¼ in. The plate holder can be shifted to take a number of exposures on the same plate. A ground glass screen for focusing is included. ..... **$ 75.00**



L110

L110. Laboratory Spectrometer, with Graduations on Celluloid, diameter of circle 150 mm, aperture of objectives 30 mm. This instrument is intended as a high quality spectrometer for use in college and technical laboratories, for work in which high accuracy is required. The instrument is of substantial construction, durably and neatly finished; the tripod is fitted with leveling screws. A feature of the Laboratory Spectrometer worth mentioning is the graduation in black on white celluloid, the celluloid graduations being much easier to read and of greater permanency than the usual silver graduations. The permanency of the celluloid circle will be appreciated as this material is not affected by fumes and will not tarnish like silver. By our special process the celluloid ring is attached firmly to the strong magnalium circle, thus forming a permanent unit, absolutely precluding any shrinkage of the celluloid. By the same process the celluloid is attached to the verniers. We have been furnishing this spectrometer with graduations on celluloid for the past fifteen years to many institutions throughout the world and it has given very satisfactory service even under adverse climatic conditions such as in the tropics. The two opposite verniers read to 20 seconds of arc and are fitted with magnifying glasses. The circle is 150 mm in diameter, divided to 20 minutes of arc; it is covered with a protecting plate having glass windows over the verniers and rotates with the telescope on a cone bearing. The prism table is 90 mm in diameter; it has adjustments in height, a rotation independent of the verniers without disturbing adjustments of height, particularly useful for setting the prism to minimum deviation, as well as a rotation together with the verniers. The usual clamp and tangent screw for both the telescope and the prism table are provided and so constructed that the clamping exerts no strain on the bearing, thus avoiding disturbances of the center. The axes of telescope and prism table are of steel made in one piece; they are turned and ground on dead centers at one operation, giving more accurate alignment. The weight of the telescope is counterbalanced by a weight attached to the circle and the whole weight of the rotating parts is to a great extent relieved from the center by means of a strong spiral spring thus assuring free rotation.

Telescope and collimator are firmly mounted in double cradles, between screws allowing lateral adjustment. Vertical adjustment screws permit adjustment to a horizontal plane without lateral shift. The objectives are achromats of 30 mm aperture and about 250 mm focal length. The telescope has a delicate focusing adjustment, operated by a knurled ring. The tube at the eye end is of standard size, so as to take our eyepiece micrometers or auto collimating eyepieces. A Gauss eyepiece of 25 mm focus is furnished with the instrument. The slit is 10 mm long; it opens by a fine screw and closes by a spring, thus preventing the jamming of the jaws in closing. The jaws are of nickel silver, polished with the greatest care. A comparison prism at the slit is provided **$230.00**

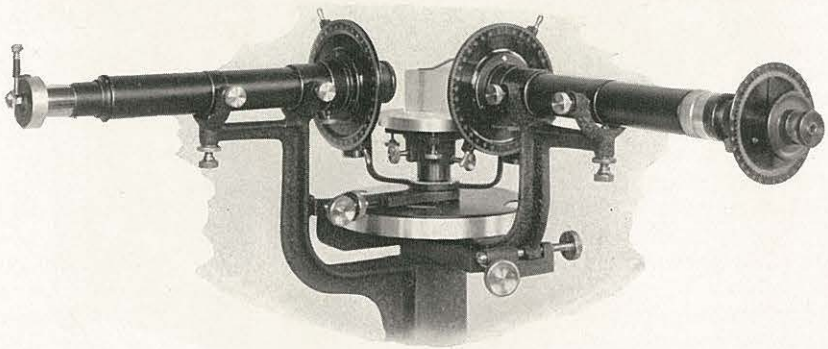
L713. 60° Prism of Flint, of index 1.65, for use with Laboratory Spectrometer L110; Faces 54x27 mm ..... **$ 25.00**

L713a. 60° Prism of Heavy Flint, with three faces polished; Faces 54x27 mm .. **$ 32.00**

Note: For gratings see page 90.

L110c. Delicate Focusing Adjustment for collimator ..... **$ 8.00**

L110d. Grating Holder, to attach to prism table, for gratings or Fresnel bi-prisms up to 40x50 mm ..... **$ 4.00**



L130

L130. Polarizing Attachments for L110. Similar in general design to L101d but with carefully selected nicols of 14 mm aperture for the objectives, and circles divided to one degree **$150.00**

L132. Wollaston Prism of 20 mm aperture mounted to fit Polarizing Attachments L101d and L130 in place of one nicol prism for the objectives ..... **$ 32.00**

L133

L133. Babinet Compensator, for analyzing elliptically polarized light. Consists of two quartz wedges of small and equal angles, with faces optically plane and with their axes at right angles. The longer wedge is fastened at its thick end to the carriage which is moved by a micrometer screw of .25 mm pitch. The range is 8 mm. The screw head is divided in one hundred parts and the full turns are read on a scale. The compensator fits in the draw tube of the telescope in place of the eye end adapter. An eyepiece containing a nicol is placed in an adapter which screws into the compensator. Complete with analyzing eyepiece ..... **$ 95.00**

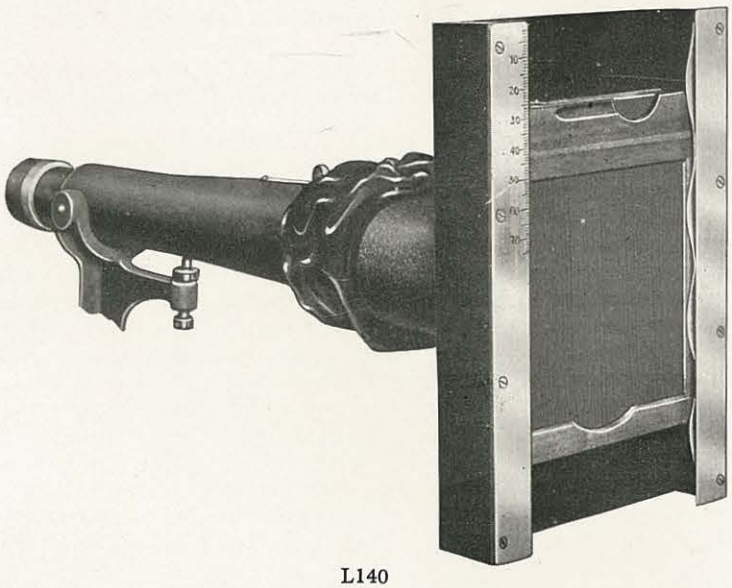
Note: If eyepiece containing nicol is not desired, the same being identical with the third attachment furnished with L101d and L130, an allowance of $12.00 on the above price will be made.

L134. Quarter Wave Plate with Holder, for Polarizing Attachments L101d and L130. The holder consists of a metal plate with clip for holding the quarter wave plate and is mounted on a collar which fits in place of one nicol prism for the objectives ..... **$ 12.50**

L136. Plane Metallic Surfaces, 20x20 mm, of Gold, Silver, or Nickel, sputtered on glass, for determining the constants of metallic reflection. Each ..... **$ 7.50**

L136a. Plane Steel Surface, 20x20 mm, of solid polished nickel steel **6.00**

Note: Description and prices of other polarizing accessories on request; correspondence solicited.



L140

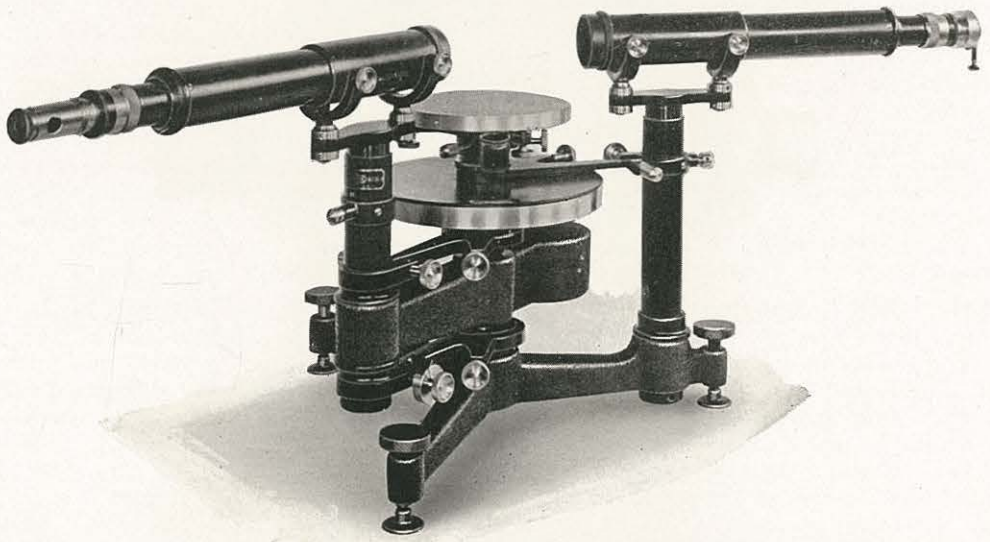
L140. Camera Attachment for L110, fitting in place of the observing telescope; it has an objective of 25 mm aperture and about 300 mm focal length mounted in a draw tube. Provision is made for photographing comparison spectra; a shutter which slips over the slit has three apertures allowing one to cover either the center or the outer parts of the slit.

The plate holder which takes any 3¼ in x 4¼ in plate, slides vertically allowing ten or more exposures to be taken on one plate. A scale is provided for setting the plate holder for different exposures and a swivel with adjusting screws permits setting the plate at an angle to photograph the extreme violet. A ground glass screen for focusing is included ..... **$ 90.00**

L140a. Eyepiece, for focusing camera attachments. Our standard 25 mm eyepiece is fitted into a holder provided with diaphragm and cross hairs, which bears against the plate holder slide, bringing the focus of the eyepiece in the plane occupied by the sensitive film of the plate. The eyepiece slides over the whole length of the spectrum and permits sharper focusing than obtainable with the ground glass ..... **$ 8.00**

L140b. Extra Plate Holder, for camera attachment **3.00**

L140c. Spectrum Plates, 1 dozen, 3¼ in x 4¼ in for camera attachment ..... **.75**



L120

L120. Precision Spectrometer, reading to twenty seconds of arc, diameter of circle 200 mm, aperture of objectives 40 mm. This instrument is designed to combine accuracy with compactness and convenience, and is substantially and carefully constructed throughout. The essential features of mechanical construction are as described in L110.

The circle has a diameter of 200 mm and is designed for repeating measurements. The telescope may be clamped to different parts of the circle, and can also be rotated independently of the circle, which permits the use of any part of the graduation for one measurement and the elimination of any errors due to the inaccuracies of graduation or eccentricities. The tangent screw of the telescope has a head divided in 60 parts; one turn of the screw is made to correspond to 10 minutes of arc, the divisions corresponding to 10 seconds of arc.

Telescope and collimator are each provided with a delicate focusing adjustment operating by means of a knurled ring. The objectives are of 40 mm aperture and 350 mm focal length. The brackets holding telescope and collimator are mounted to slide in hollow pillars which allows for rotational and vertical adjustment; this gives a greater adaptability to the

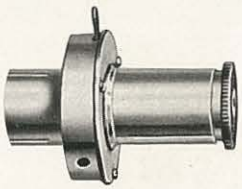
instrument; the rotation permits the use of a prism train or of concave mirrors for collimating and focusing where glass lenses are to be avoided. The vertical adjustment is sufficient for the accommodation of a large prism, or grating, or of a goniometer head. The prism table is of 110 mm diameter and has all usual adjustments $600.00

L714. 60° Prism, of Flint, for L120, index 1.65, of faces 36x72 mm 45.00

L110d. Grating Holder, same as for use with L110 ..... 4.00

L121. Camera Attachment to L120; essentially the same as L140; objective 40 mm aperture, 400 mm focal length $110.00

L125. Precision Spectrometer, with Reading Microscopes, diameter of circle 350 mm, aperture of objectives 65 mm. The instrument rests on a heavy cast iron base with leveling screws, to which the collimator is rigidly attached. The weight of the telescope is counterbalanced by a roller with spring tension moving on the base. The prism table in its adjustments is similar to L120. The circle, 350 mm in diameter, is designed for repeating measurements. (See L120.) The graduations are on an inlaid strip of nickel silver to two minutes of arc. The two opposite micrometer microscopes move with the telescope, and their eye ends are within convenient reach of the observer's eye. The readings on the micrometers are to one second of arc. Illumination of the scale is by means of small electric lamps. The objectives are triple apochromats of 65 mm aperture and about 450 mm focal length. Both telescope and collimator have delicate focusing adjustments. This instrument will permit determinations of indices of refraction exact to 5 places $1800.00

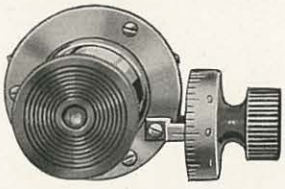


L372

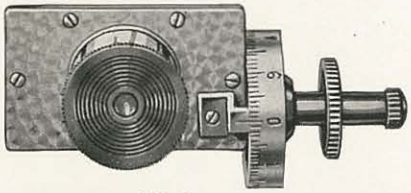
L374

L372. Auto Collimating Eyepiece (Lamont and Abbe). For use with any of the spectrometers listed herein. This form of eyepiece gives a stronger illumination to the cross hairs than the Gauss eyepiece, and it is free from internal reflections. A small total reflecting prism, illuminated from the side, illuminates a single vertical fibre, the reflected image of the vertical fibre appearing between a pair of 60° cross hairs. The prism can be thrown out of the field by means of a small lever ..... $ 30.00

L374. Gauss Eyepiece. Intended for the same purpose as L372. A thin glass plate, mounted at 45° between the eyepiece lenses, serves as reflector. The eyepiece is of 25 mm focus ..... $ 10.00



M201



M202

M201. Micrometer Eyepiece, Range 6 mm, with two wires, one stationary and one movable. The screw has a pitch of ¼ mm and the micrometer head is divided in 50 parts. For use with any of the above Spectrometers ..... $ 24.00

M202. Micrometer Eyepiece, Range 10 mm. An instrument of the highest order of workmanship and accuracy. Two of the wires are fixed at right angles, passing through the center of the field of vision. The two movable wires are 0.05 mm apart. A comb in the field of the eyepiece registers full revolutions of the screw. Number of divisions on micrometer head 100; pitch of screw 0.25 mm; range of screw about 10 mm. For use with any of the above Spectrometers ..... $ 37.50

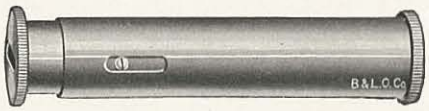
SPECTROSCOPES AND ACCESSORIES

DIRECT VISION SPECTROSCOPES

The three models of direct vision spectroscopes described here are designed for use in industrial laboratories, as well as in schools for determining the bright lines of metals and gasses and for locating absorption bands. They are compact in construction with special attention given to enclosure of all parts to prevent corrosion and the entrance of dust and stray light.

The optical system is alike in all of them comprising a three piece Amici prism of 6°15′ dispersion between the C and F lines of the hydrogen spectrum, and an achromatic collimating lens of 32 mm focal length.

The instruments are finished in dull black and supplied with leather cases.



L200

L200a

L200b

L200. Direct Vision Spectroscope, 16 mm diameter, 80 mm long, the slit has the fixed width 0.1 mm; it is ruled on a silvered glass disc and protected by a cover glass.
This spectroscope easily shows the more prominent Fraunhofer lines..... **$ 18.00**

L200a. Direct Vision Spectroscope, 16 mm diameter, 95 mm long. Adjustable slit with jaws of stellite, a hard and non-corrosive tungsten-steel alloy..... **$ 22.50**

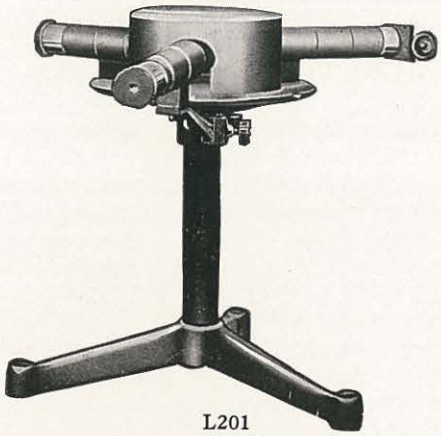
L200b. Direct Vision Spectroscope. Same as L291 but provided with comparison prism ..... **$ 25.00**

SPECTROSCOPES OF BUNSEN-KIRCHHOFF TYPE

L201. Student's Spectroscope. A small spectroscope giving a brilliant spectrum of ample length enabling the student to study and chart the spectra of the elements.

The instrument rests on a cast iron tripod carrying a disc to which collimator and scale tubes are rigidly screwed; the telescope is rotable by hand about the axis of the instrument and may be clamped to it by a screw.

Telescope and scale tube have simple draw-tube focusing adjustments;the slit is fixed in focus by us. The slit is of adjustable width, 10 mm long; the jaws are nicely finished and close by spring tension, eliminating any danger of jamming.

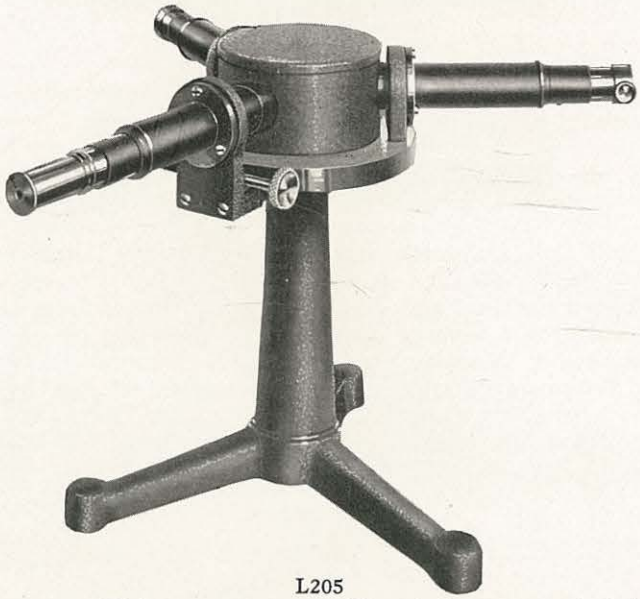


L201

The prism table has three leveling screws which we adjust for the prism provided, it is covered by a housing with three openings for the tubes. The objectives of telescope and collimator are achromats of 20 mm aperture and 130 mm focal length; the prism is a 60° flint prism. The scale is a photographic negative having 17 figured divisions each divided to tenths; on it the hydrogen lines C and F (6563 and 4861 A. U.) appear about 4 divisions apart, the whole range of the spectrum covering about 9 divisions. The two sodium lines in this spectroscope are just resolved.

The height of the instrument from table to eye end is 230 mm..... **$ 44.00**

L201a. Comparison Prism for Slit. A small total reflecting prism covering one-half of the slit when in position. It is adjusted by means of a knurled head and can be rotated or moved vertically to cover any part of the slit or to clear it entirely..... **$ 7.50**



L205

L205. Spectroscope. This spectroscope while on the same principles as L201, is built larger and more substantially throughout. The three tubes carry flanges which are screwed to cast iron brackets. The telescope is rotated about the axis of the instrument by means of a tangent screw, which covers a sufficient range to permit ready observation of the entire spectrum. The eyepiece carries a single vertical wire.

The prism table has leveling adjustments. The slit is of adjustable width; the jaws are nicely finished and close by spring tension. The scale has 17 figured divisions each divided to tenths. The objectives of collimator and telescope are achromats of 25 mm aperture and about 200 mm focal length. The prism is of flint glass, d = about 1.65. The spectrum

(400-800 Mu Mu) is about 23 mm long in the focal plane or 6°. The eyepiece has a magnification of 10 ..... $ 80.00

L210. Spectroscope. Like L205 but with 30 mm objectives of 250 mm focal length and a prism of corresponding size. The spectrum (400-800 Mu Mu) is about 29 mm long in the focal plane or 6°. The eyepiece has a magnification of 10 ..... $100.00

L220. Spectroscope with Two Prisms. This spectroscope is constructed essentially like L210. As a dispersive system it has two 60° flint prisms giving a spectrum nearly twice as long (about 45 mm or 10°) as that obtained with a single prism, and a correspondingly greater resolving power.

The objectives are achromats of 30 mm aperture and 250 mm focal length.

The instrument is suitable for work requiring a large dispersion and at the same time greater intensity than that obtained with a grating $160.00

ACCESSORIES TO SPECTROSCOPES L205, L210, L220

L240. Comparison Prism for Slit. A small total reflecting prism covering one-half of the slit when in position. It is adjusted by means of a knurled head and can be rotated or moved vertically to cover any part of the slit, or to clear it entirely ..... $ 7.50

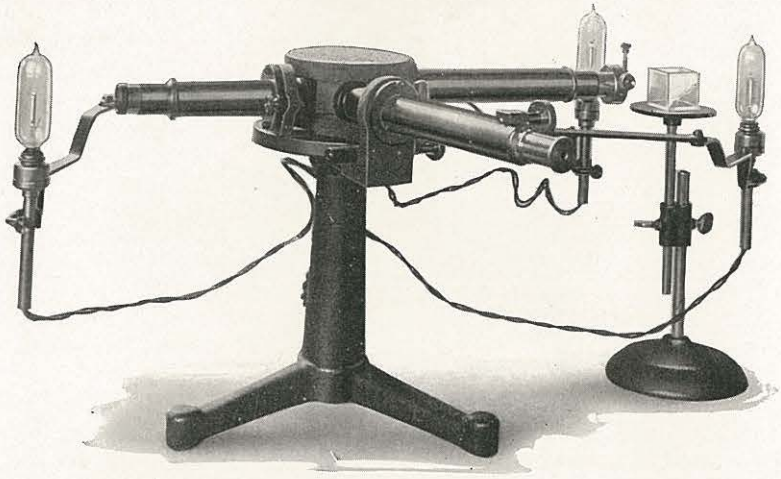
L241. Delicate Focusing Adjustment for Telescope. A knurled ring, threaded inside, engages threads in the movable tube, allowing a very fine adjustment ..... $ 8.00

L242. Fine Angular Adjustment for Scale Tube. A capstan head screw at one side of the collar, gives a rotation sufficient for adjusting the position of the scale in relation to the spectrum ..... $ 7.50

L243. Illuminating Burner for Scale. A gas burner is mounted adjustably on the instrument, providing convenient illumination either for the scale or the slit ..... $ 4.50

L244. Electric Lamp for Scale. A 15 watt, 110 volt tungsten lamp is held by an adjustable support fastened to the instrument. The bulb has a candelabra base and is fitted in a hood to shield the eyes of the observer. Plug for standard socket and connecting cord 5 feet long are provided. Shown in illustration below ..... $ 8.00

L248. Camera Attachment for Spectroscopes L205, L210, L220. This is similar in every respect to L140 except that it is made to attach to our spectroscopes. A collar with three screws similar to that of the telescope of the instrument, is used to hold the camera attachment in place. A fourth screw bears against the frame of the instrument, providing a small tilting adjustment at the lower part of the collar. The objective is of 30 cm focal length ..... $ 80.00



SIMPLE ABSORPTION SPECTROPHOTOMETER

Consisting of Two-Prism Spectroscope L220, Comparison Prism for Slit L240, three Electric Lamps L244,—one for illuminating scale, one for absorbed, and one for comparison beam,—also Absorption Cell on Support L774.

With Camera Attachment L248, and varying exposing time this may be used in the ultra violet down to about 3500Å for quantitative measurements of absorption.

WAVELENGTH SPECTROSCOPES AND ACCESSORIES

The essential characteristics of a Wavelength Spectroscope are:

1. The telescope and collimator are fixed. This preserves all optical alignments and makes observation more rapid and more convenient.

2. The spectrum is moved by the rotation of the prism and its table by means of a micrometer screw. The screw carries a helical drum graduated directly in wavelengths so that time-consuming calibration and reference to calibration curves is dispensed with.

Our Wavelength Spectroscopes have won recognition on the part of discriminating scientists and industrial engineers who are particular in the selection of their instruments. This is due to the outstanding qualities of the Wavelength Spectroscopes of our make, which are convenience, combined with greatest accuracy and pleasing appearance. In practical test, in the educational laboratory as well as in the industrial, our Wavelength Spectroscopes have met the most exacting requirements, which accounts for the ever growing demand for Gaertner instruments.

L226

L225. Auto-Collimating Wavelength Spectroscope. In this instrument collimator and telescope are in one. Light from the side is condensed by a lens attached to the instrument and thrown, by means of a total reflecting prism through one half of the slit, is collimated by the objective, and then enters the 30° prism; the ray which traverses the prism at minimum deviation strikes the back silvered surface at right angles traversing its path again and forming an image on the other half of the slit which has an enlarged opening with cross-hairs.

The telescope has adjustments for tilting it about a vertical and a horizontal axis; also a delicate adjustment operated by a knurled ring. The objective is an achromat of 25 mm aperture and 200 mm focal length.

The entire prism table and micrometer mechanism are enclosed in a dust-tight metal case. The prism is of index 1.72 and is equivalent to a 60° prism in the usual type of instrument.

The height of the instrument is adjustable. Its compactness and convenience make this instrument an extremely useful one for analytic work **$250.00**

L226. Auto-Collimating Wavelength Spectroscope. Same as L225 but with objective of 30 mm aperture and 250 mm focus **$280.00**

L230—L231

L230. Wavelength Spectroscope. Prism index N_D 1.65. This instrument and the instrument L230a or L231, listed below, embody in addition to those features mentioned above that of wide adaptability. An Exit Slit L230g converts it into a Monochromatic Illuminator; with the Camera Attachment L230a it forms a substantial and accurate Spectrograph. The addition of the Polarizing Photometer L482 converts it into a Spectrophotometer which is exceedingly rapid and convenient to work with. With the Attachment for Interference Accessories L232o it can be used in train with an Echelon, Etalon, or Lummer-Gehrcke plate to provide a preliminary resolution. A new feature also is that the prism, drum and telescopes may be removed and replaced by suitable parts to convert the instrument into a Monochromatic Illuminator for the Ultra-Violet.

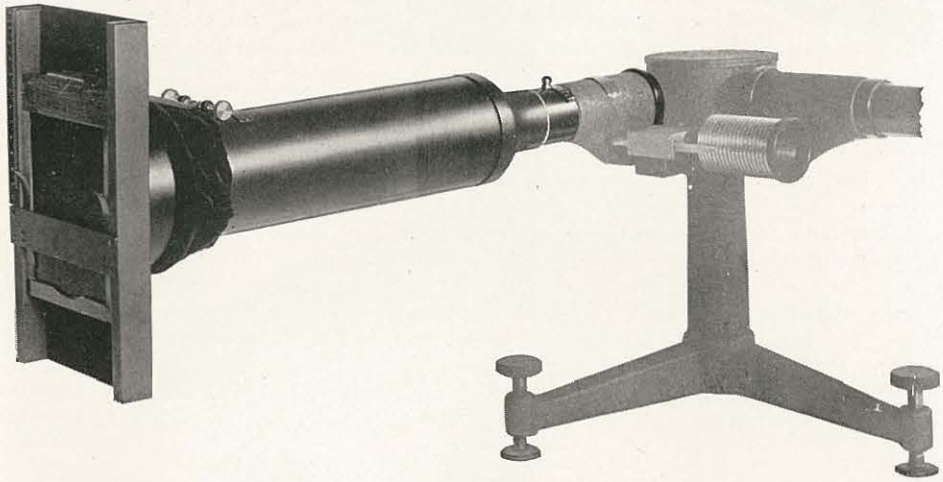
The prism table, prism and micrometer mechanism are wholly enclosed. The micrometer screw is of large diameter and is cut and corrected according to the method developed by us in the manufacture of precision comparator screws. The screw carries a helical drum of 75 mm (3 in) diameter calibrated individually for each instrument and graduated at intervals of ten Angstroms throughout the visible spectrum, (390-800 Mu Mu), a sliding index indicating the wavelength directly.

The prism is of the Pellin and Broca type in which, owing to an internal reflection, the ray emergent at right angles to the incident ray is always in the position of minimum deviation.

Telescope and collimator have an aperture of 31 mm and a focal length of 300 mm. The telescope is focused by turning a milled ring which slides the objective. The slit is a symmetrical one of the Wadsworth type, has a length of 10 mm and carries a slide having steps to reduce the slit length. The eyepiece has a focal length of 18 mm and carries adjustable cross hairs. The entire height of the instrument is about 30 cm. Leveling screws and attached foot plates are provided **$420.00**

L231. Wavelength Spectroscope, Prism index N_D 1.73. Similar in every respect to L230 save the density of the flint glass; the dense prism has one and one third times the dispersion and resolving power of the lighter one and correspondingly higher accuracy of setting but it reduces the intensity by absorption, particularly in the violet **$450.00**

L230uv. Accessories for Converting L230 or L231 into Monochromatic Illuminator for the Ultra Violet. Comprising Plate carrying Cornu prism (faces 30x45 mm) and plane reflector of sputtered silicon to fit on prism table in place of glass constant deviation prism; also collimator and telescope tubes with quartz lenses, symmetrical micrometer slits of the Wadsworth type (18 mm length of slit), the exit slit having its beveled face outward to avoid reflections from the jaws. A calibrated drum of 3 inch diameter to cover the range 200-700 Mu Mu is furnished. If these accessories are not ordered at the same time as the Wavelength Spectrometer L230 or L231, the return of the instrument will be required in order to make the necessary calibration of the drum **$480.00**



L230a

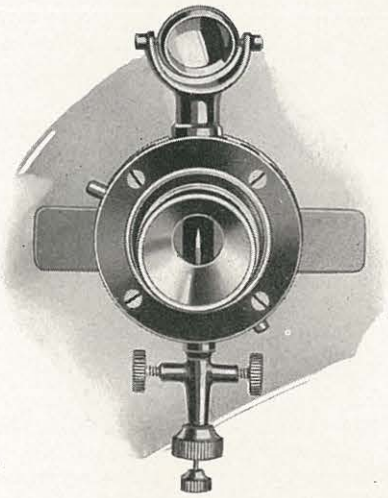
L230a. Camera Attachment to L230-L232. This attachment fits in place of the observing telescope. The objective is of 31 mm aperture and about 500 mm focal length, mounted in a draw tube. A slide with three apertures in front of the slit is provided for photographing comparison spectra. Size of plates 3¼x4¼ inch. The plate holder slides vertically permitting a number of exposures on one plate. The guides have a scale for setting the plate holder to different exposures; a swivel with adjusting screws permits setting the plate at any angle for proper focusing. A ground screen for focusing and one plate holder are included **$100.00**

L230b. Photographic Plates. Wratten and Wainwright Panchromatic Plates 3¼x4¼ inch for L230a. Per dozen..... **$ 1.00**

L230c. Plate Holder with Index **4.00**

L230d. Shutter Eyepiece with Light Filters. This eyepiece is interchangeable with the regular eyepiece and carries in place of the cross hairs a fine bright polished steel pointer which is adjustable, in height and laterally, by delicate adjusting screws. The pointer is illuminated from above by means of an adjustable mirror. The two shutter slides in front of the pointer are independently adjustable and permit the easier observation of faint spectrum lines by cutting out the brighter lines in close proximity. Five small light filters of different colors are mounted on a ring surrounding the eyepiece body, an extra aperture being provided for white light. The ring can be rotated so as to bring the different colors between mirror and pointer. The illumination of the pointer by the same color when working in any particular part of the spectrum assures greater comfort and accuracy of setting by making the pointer easily visible without introducing parallax. An eyepiece of 25 mm focal length is included ..... **$ 80.00**

L230f. Symmetrical Eye Slit with Eyepiece. For L230, particularly useful in photometric work. It is mounted on a separate plate in order to permit lateral adjustment. The shutter jaws open symmetrically and are operated by turning a lever arm. A wedge for



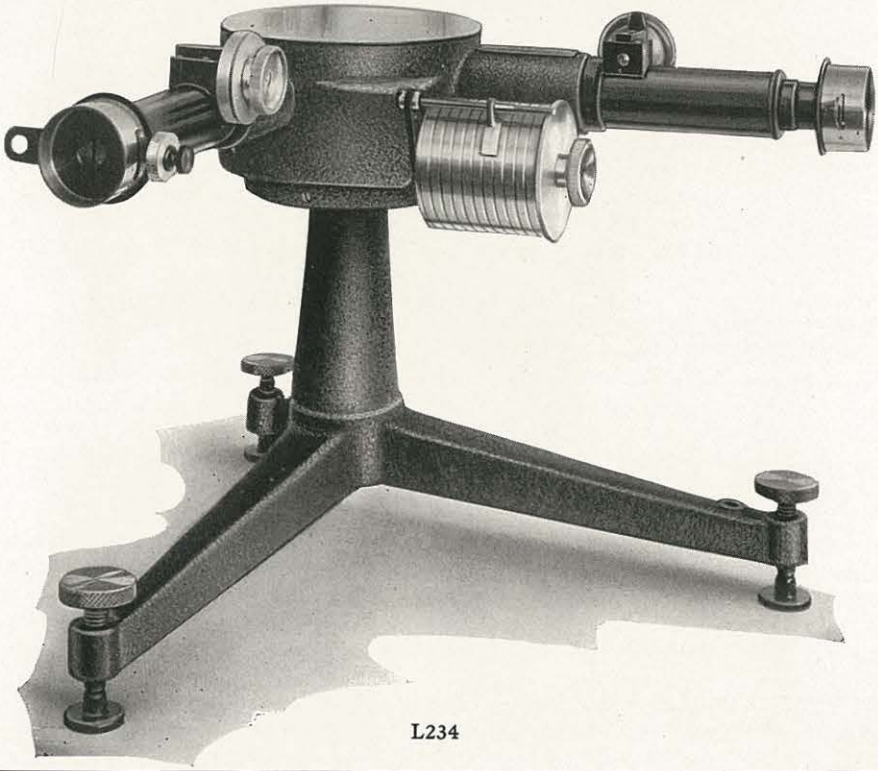
L230d

limiting the vertical aperture is also provided. The eyepiece with its adapter can be quickly removed if desired, so as to bring the eye close to the shutter (a desideratum in certain types of spectrophotometric apparatus) and can just as quickly be returned to position ..... $ 40.00

L230f

L230g. Exit Slit, Bilateral. This slit has a tube to fit into the eye-end of the telescope tube in place of the adapter and cross hairs. It is a symmetric slit of the Wadsworth type and carries a micrometer screw and head. Length of jaws 10 mm ..... $ 45.00

L230h. Micrometer Eyepiece for L230-L232. A single wire is fixed in the center of the field at right angles to the direction of travel. The wire system on the carriage consists of a 60° cross in the middle of the field, and two single wires, one on each side, parallel to the fixed wire 2.5 mm off the center. The latter arrangement is especially convenient with the Fabry and Perot Etalon, as it reduces the amount of travel. A comb in the field of the eyepiece indicates full revolutions of the screw. The number of divisions on the micrometer head is 100; the pitch of screw is 0.25 mm, focal length about 25 mm, travel 10 mm... $ 50.00

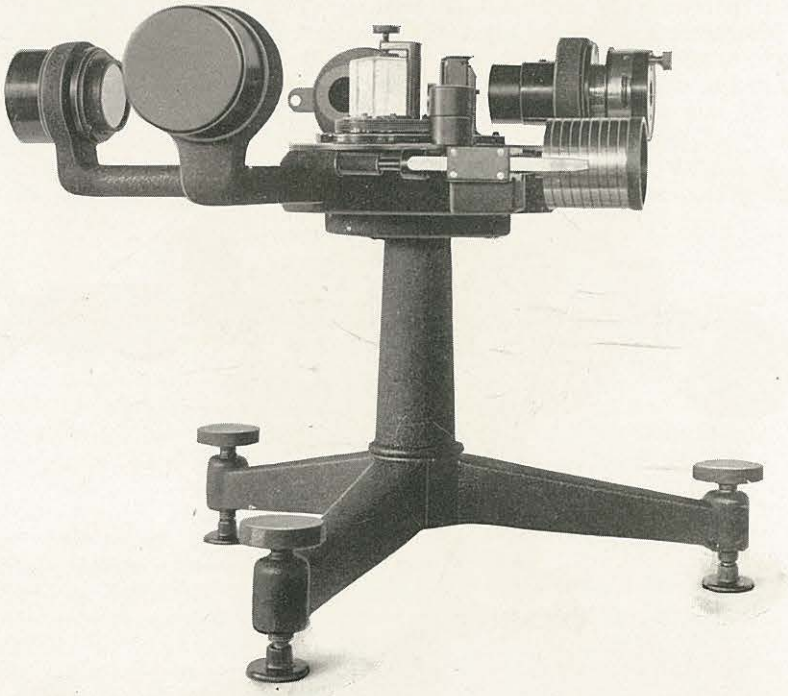


L234

L234. Ultra Violet Monochromatic Illuminator, with Wavelength Drum reading from 200 Mu Mu to 700 Mu Mu. This instrument is similar in construction to our L230 Wavelength Spectroscope, having the same dimensions and height. The quartz objectives are of 30 mm aperture and about 225 mm focal length for wavelength of 589 Mu Mu. The Wadsworth prism-mirror train is used to secure a constant angle of minimum deviation. The Cornu prism has a height of 30 mm, base 45 mm, and is kept together in optical contact thereby avoiding troublesome internal reflections. Both are mounted carefully on a table which is rotated by means of the micrometer screw with wavelength drum. The slits are bilateral and are fitted with micrometer screws for indicating the width, and with shutters to adjust the length of slits. The exit slit has its beveled face outward to avoid oblique reflections from the jaws. The slits remain stationary, the objectives focusing by means of rack and pinion. To facilitate the focusing the pinion carries a large head which is provided with wavelength graduations.

The body of this instrument is precisely like Wavelength Spectrometer L230 and L231, so that with the addition of glass optical parts and calibrated drum it can be used as a Wavelength Spectroscope **$700.00**

L234v. Accessories for Converting L234 Ultra Violet Monochromatic Illuminator into Wavelength Spectroscope L230. Comprising Plate carrying constant deviation prism of index 1.65 in place of Cornu prism; also collimator and telescope tubes with achromatic lenses of 30 cm focal length and 31 mm aperture, Ramsden eyepiece and adjustable cross hairs. A calibrated drum to cover the range 3850-8200 Angstroms is included. If the accessories are ordered later than the original instrument, the return of the latter will be required for the necessary calibration **$200.00**

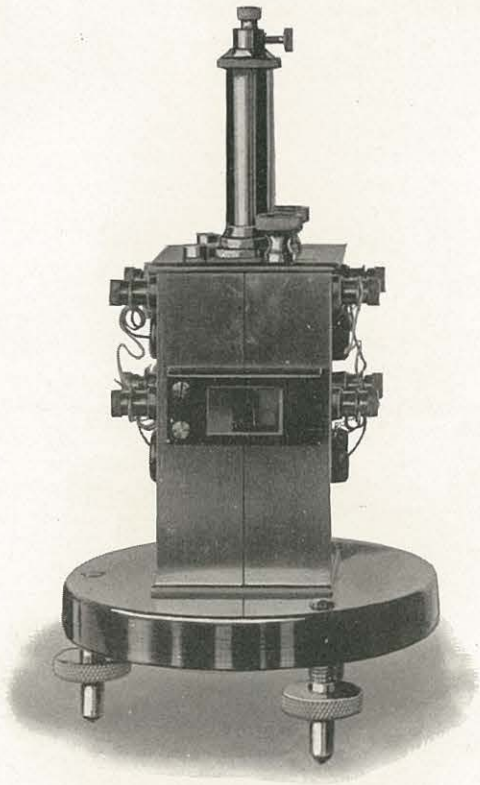


L235

L235. Infra Red Spectrometer and Monochromator. This is a constant deviation spectroscope of the Wadsworth type. Constant deviation is secured by mounting the prism together with a plane mirror on a rotating table, the telescope and collimator being fixed in position. The prism is of rocksalt with faces 35x45 mm, and the mirror a cathodic deposit of gold on glass. The collimator and telescope have concave mirrors of 300 mm focus and 40 mm aperture, also of gold on glass, and are provided with symmetrical micrometer slits. The exit slit has its beveled face outward to avoid reflections from the jaws and is provided with a Coblentz thermopile which has found great favor owing to its sensitivity and freedom

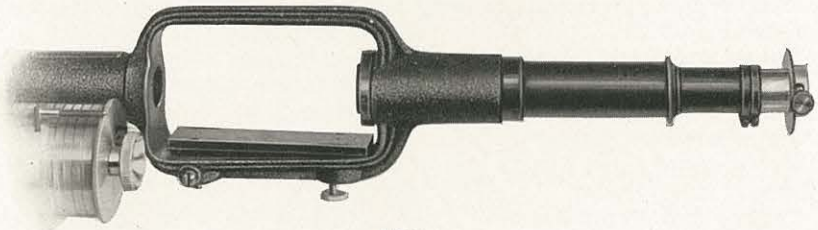
from drift. The thermopile is mounted on a hinged plate so as to be easily turned to receive the radiations or allow them to pass unobstructed. The prism table is rotated by a micrometer screw which carries a helical drum graduated directly in wavelengths from 700 to 12000 Mu Mu. Each instrument is individually calibrated with the highest accuracy permitted by the published data on rock salt. For use with this instrument we recommend the Coblentz Galvanometer listed below. **In these instruments the concave mirrors are freed from astigmatism by parabolizing about an axis which lies outside the mirrors** . **$750.00**

L235a. Cover for L235. Infra Red Spectrometer of black enameled sheet metal, to protect all optical parts and shield off the stray light, leaving only entrance and exit slit and wavelength drum exposed ..... **$ 50.00**



L235g

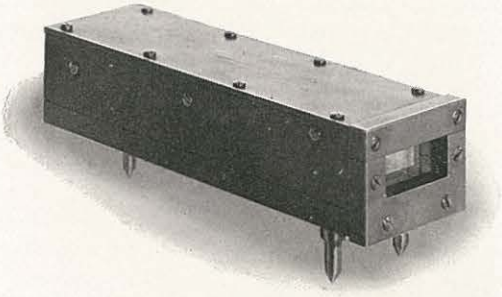
L235g. Coblentz Galvanometer. An ironclad galvanometer of high sensitivity, particularly suitable for use with the preceding thermopile. (See Scientific Paper No. 229, U. S. Bureau of Standards) **$260.00**



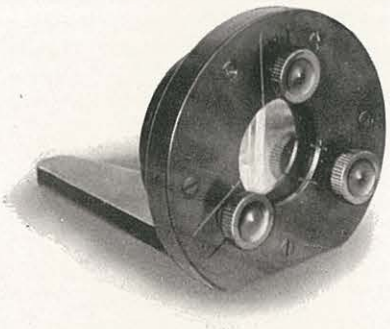
L232o

L232o. Attachment for Holding Interference Accessories. This attachment fits into the sleeve of Wavelength Spectroscopes L230, L231, in place of the collimator; it carries a sleeve to hold the collimator, and an adjustable table for the interference accessories which come between collimator and prism **$100.00**

L232d. Detachable Slit. This slips over the slit of L230, L231 and occupies a position in nearly the same plane and at right angles to the others reducing the slit to a point source. With this arrangement an echelon in train with L230 and L232o gives a spectrum dispersed horizontally by the prism and vertically by the echelon ..... **$ 35.00**

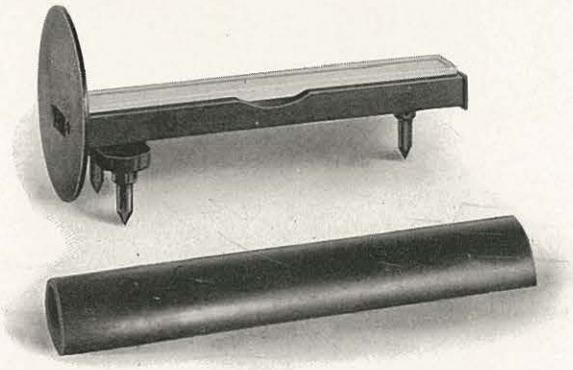


L232a.



L232c.

L232a. Michelson Echelon. This Echelon is composed of 12 plates, each 10 mm thick, and has an aperture of 29x12 mm. The width of step is 1 mm. The Echelon is carefully mounted in a brass case to be used with the edges placed horizontally **$225.00**



L232b.

L232b. Lummer-Gehrcke Interferometer. This Interferometer consists of a very accurate plane parallel plate 130x15 mm in size and 4½ mm thick to be used in the horizontal position. A small reflecting prism is cemented to the plate to diminish the loss of light on entering the plate **$175.00**

L232c. Fabry and Perot Etalon. This Etalon consists of two plane plates of crown glass, the faces of each forming an angle of 1 minute, to avoid interference between the outer and inner surfaces. The inner surfaces are semi-silvered by "sputtering". Parallelism of these surfaces is secured by having the plates kept in contact by means of finely adjustable levers with three plugs of fused quartz mounted in a brass ring serving as separators. Free aperture of plates 27 mm. Distance of plates apart 10 mm **$125.00**

L232cq. Fabry and Perot Etalon. Same as above but with quartz plates for ultraviolet work **$155.00**

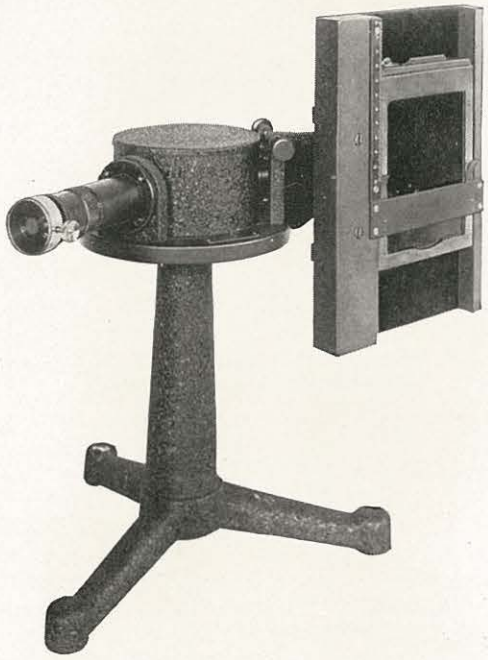
L230e. Shutter Eyepiece with Wollaston Prism. For use with above accessories when observing the polarized components in the Zeeman effect. With the prism removed the eyepiece is exactly like the Shutter Eyepiece L230d, described on page 54 ..... **$100.00**

SPECTROGRAPHS

In this catalog we are listing only Quartz Spectographs, but we are prepared to construct practically any other type of Spectograph, using as optical parts flint glass prism, uvial prism and lenses, or gratings, should the latter be obtainable. We are also in a position to furnish Vacuum and X-Ray Spectographs or any other special type according to specifications.

See also Camera Attachments on pages 44, 47, 52, 54.

Note: Photographs of the spectrum taken with any of our Spectrographs, will be sent on request.



L250

L250. Small Quartz Spectrograph. This instrument is suitable for photographing emission and absorption spectra in the visible and ultra violet regions. The whole spectrum from 185 to 800 Mu Mu is taken on a standard size 3¼ in x 4¼ in dry plate, the length of spectrum being about 70 mm. The plate holder slides vertically in a guide with vertical scale.

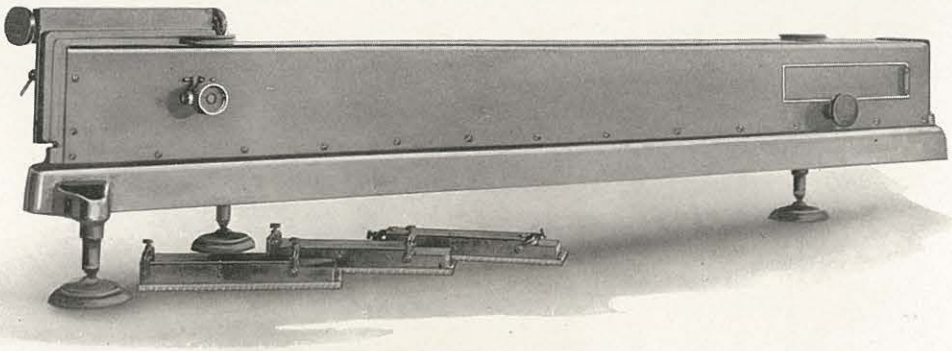
The optical train consists of two quartz lenses of 25 mm aperture and of a 60° quartz Cornu prism with faces 20x30 mm. The slit is delicately adjustable in width, has a micrometer head and carries a slide with three apertures for photographing comparison spectra. **$250.00**

L250a. Wavelength Scale for L250. This scale is accurately divided and figured on glass. It may be inlaid on the spectrogram and the wavelengths read off directly . . . **$ 40.00**

L251. Quartz Spectrograph. This instrument is constructed of metal throughout, the entire body being mounted in a substantial iron casting. The spectrum from 210 Mu Mu to 790 Mu Mu is photographed on one plate 10 in x 2 2/3 in. The plate holder and slide are of metal and may be set to successive exposures by means of a rack and pinion.

Collimator and camera lenses are of 40 mm aperture and 625 mm focus. The Cornu prism is 40 mm high with faces 65 mm long. The micrometer slit has jaws 18 mm long with a slide for photographing comparison spectra **$1000.00**

L251a. Quartz Spectrograph. This Spectrograph is the same in every respect as L251, except that a wavelength scale is provided from which contact prints can be made, adjacent to the spectrum, by turning a lever **$1250.00**



L253

QUARTZ SPECTROGRAPH LITTROW AUTO-COLLIMATING TYPE

This Spectrograph gives a spectrum from 210 Mu Mu to 790 Mu Mu about 600 mm long. The light enters by the slit, a small quartz prism reflects it along the camera tube where it is collimated by the quartz lens; it then enters a 30° quartz prism whose back surface is covered with tinfoil amalgam; such rays as traverse the prism at minimum deviation strike the back surface at right angles and are reflected to retrace their own path, the lens forming an image on the photographic plate. This arrangement is equivalent in every important respect to a two-lens Spectrograph with a 60° Cornu prism of the same length of face.

The quartz prism has a face approximately 98x57 mm; the lens has an aperture 70 mm and focal length 1700 mm. Prism and lens are mounted on a slide which can be shifted to focus by rack and pinion motion. The prism table can be rotated to photograph different parts of the spectrum. Both the shift and the rotation are made entirely automatically by turning a lever on the outside of the instrument. The instrument is so designed that three different positions of the prism will photograph the entire range from 210 Mu Mu to 790 Mu Mu in three exposures. Each of these is taken in an individual plateholder with a focal curve carefully worked out against which the plate is pressed by means of clamps. The size of plates is 2 2/3 in x 10 in (one-third of the regular 8 in x 10 in plates). The plate may be set to successive exposures by means of a rack and pinion adjustment.

All that is required for taking photographs will be:

(a). Setting the slide carrying lens and prism to one of the three positions as indicated by a scale on the outside of the instrument and turning the lever to adjust both position of slide and rotation of prism automatically.

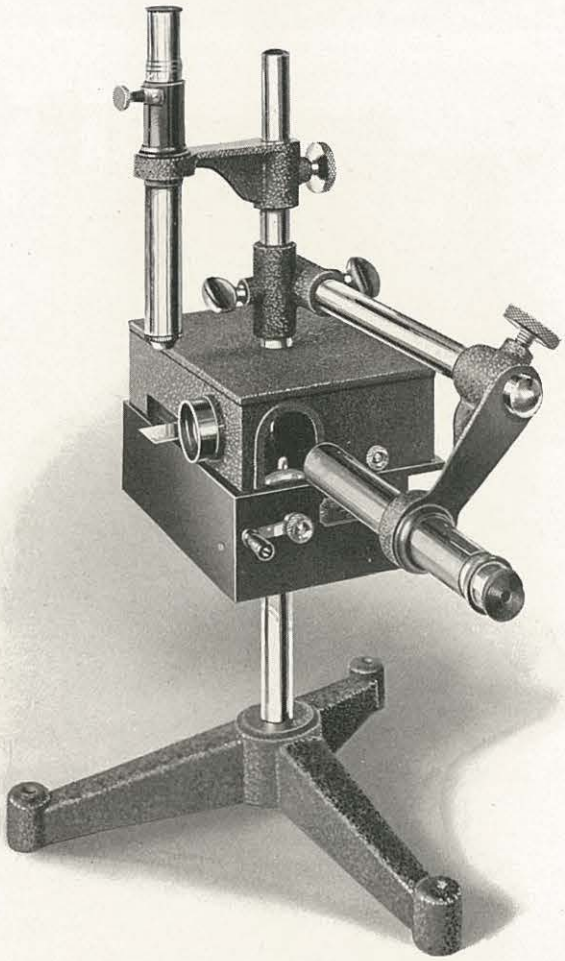
(b). Choosing the plate holder corresponding to this position.

(c). Making the exposure.

The slit jaws of nickel silver 18 mm long, close by spring pressure and are provided with a micrometer adjustment head. It carries a slide with three apertures for photographing comparison spectra.

The instrument is constructed entirely of metal, mounted on a heavy iron base and covered with a steel hood having convenient openings for adjusting the optical parts. Total length of Spectrograph 2 meters **$2400.00**

INTERFERENCE APPARATUS AND ACCESSORIES



I 1001 Research Interferometer, Michelson Type, with I 1040 Bracket, I 1042 Microscope, I 1060 Telescope, I 1070 Support for Telescope

In this catalog we are listing our standard Interferometers and accessories together with the newer instruments of high resolving power, designated by Prof. R. W. Wood as **Interference Spectroscopes.** The instruments listed herein comprise only a fraction of those which are constructed by us. Special purposes require special instruments, and we are prepared to construct these when required, as we have done in the past.

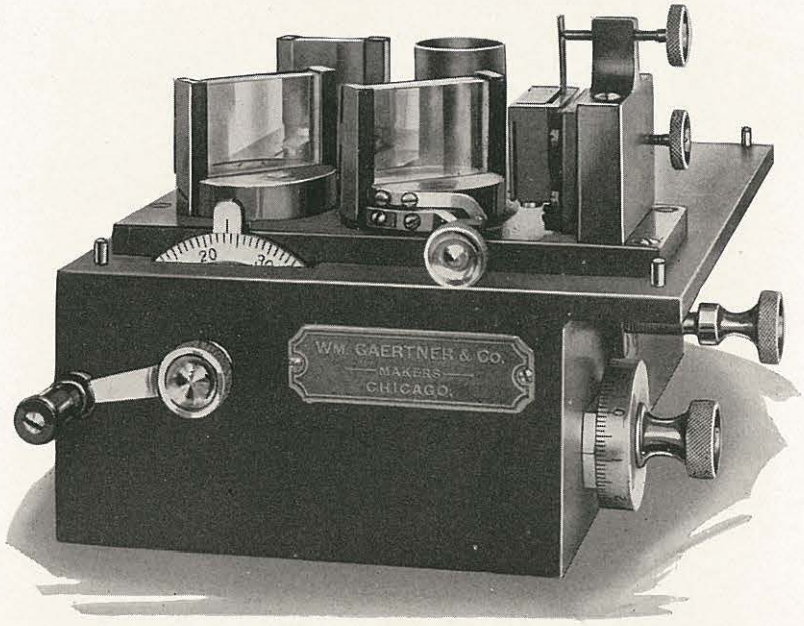
The field of application of the Interferometer is very wide. Its application to problems of the modern industrial laboratory, machine shop, and optical shop has only begun. In our own shop we have used for several years a special form of instrument, shown on page 41, for the routine testing of periodic errors and errors of run in precision micrometer screws. We solicit correspondence relative to such problems, as well as those of the physical laboratory.

The micrometer screws used in our interferometers are made of specially selected steel accurately cut and carefully corrected so as to assure uniform motion.

The cast iron used for the bodies of the instrument is well seasoned before the guides are straightened.

The plates are made of optical crown glass and are accurately parallel and plane to at least 1/10 wavelength of sodium light. The mirrors are made of stainless steel which has proven more satisfactory than the silvered glass because of its greater permanency. The dividing plate is unsilvered, this giving just as good fringes as the semi-silver ones. Thus the trouble of re-silvering plates or mirrors is entirely done away with.

Printed instructions for adjustment and care of the interferometer are given with each instrument.



I 1001

I 1001. Research Interferometer, Michelson Type. Mirrors 20x20 mm, plates 20x30 mm, range of carriage 65 mm, micrometer screw diameter 10 mm, pitch 1 mm. The screw is fitted with an index head of 100 divisions and with a worm wheel of 100 teeth in which engages a worm with index head of 100 divisions; thus a rotation of the worm by one division on the head corresponds to 0.0001 mm motion of the mirror (that is to a fraction of a wavelength). The loosening of a screw at the head of the micrometer screw disengages the worm, allowing to move the carriage rapidly by means of a crank. A scale divided in millimeters is attached to the carriage guide and an index on the carriage shows the position of the latter. Two clips on the carriage serve to hold a micrometer scale or other objects to be observed under the microscope. The mirror on the carriage is provided with three adjusting screws intended for rough adjustment only.

Two fine micrometer screws permit the tilting of the fixed mirror around a horizontal and vertical axis and give the delicate adjustment. This adjustment is easily and conveniently made, and is not affected by rough handling or vibration.

The compensator plate is rotated by means of a screw which allows an angular motion of about 15°. A second fine micrometer screw is provided to give a delicate turning of the compensator plate. One turn of this screw gives a shifting of approximately one fringe.

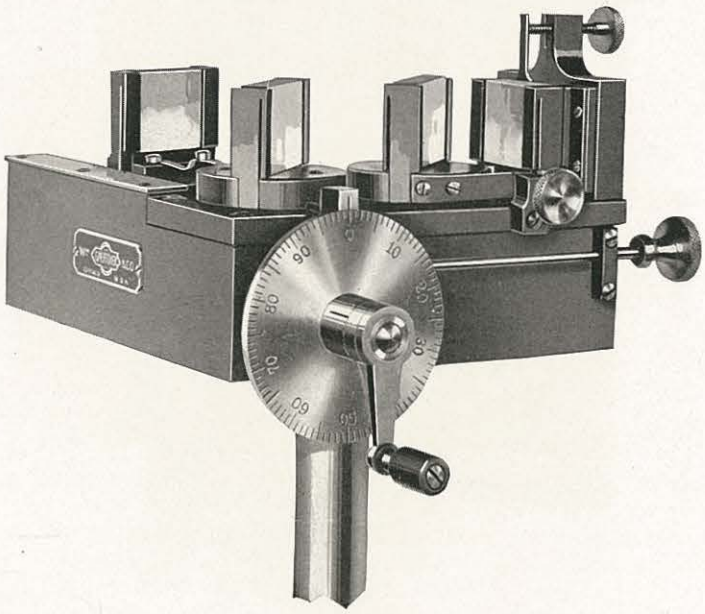
The box-shaped body of the instrument incloses all the delicate parts such as the micrometer screw with nut, the worm and the worm wheel and the adjusting screw for the compensator plate. The dimensions of the box are 20 cm x 13 cm x 6 cm.

A cover is furnished to protect the optical parts of the instrument. Two openings covered with glass are provided for illumination and observation. Another opening on the side of the box permits a micrometer scale placed on the carriage to extend outside of the box. The head of the screw for delicate adjustment of the compensator plate is also accessible from outside.

The cover is convenient to shield off the stray light, protects the instrument from dust and injury and prevents any accidental disturbance to the adjustments.

The instrument is clamped to our standard 19 mm support rod, which can be adjusted to any convenient height. Clamps for holding the observing telescope and microscope can be attached to the support rod as shown in the illustration on page 61 ..... **$450.00**

I 1005. Research Interferometer, Michelson's Larger Type. In construction same as I 1001, mirrors 25x25 mm, plates 25x40 mm, range of carriage 120 mm, micrometer screw diameter 15 mm, pitch 1 mm, mounted on three support legs, height from table to center of mirror 27 cm **$550.00**



I 1010

I 1010. Students' Interferometer, Michelson Type. Mirrors 20x20 mm, plates 20x30 mm, range of carriage 30 mm, micrometer screw diameter 10 mm, pitch 0.5 mm. The screw is fitted with a head divided into 100 parts and a worm wheel with 100 teeth. The worm does not have a divided index head. Compensator plate with delicate adjustment only.

The instrument is similar in design and size to I1001 having all necessary adjustments for performing the principal interference experiment **$250.00**

I 1040. Bracket with threaded collar to hold any of our standard measuring microscopes on Interferometer ..... **$ 6.00**

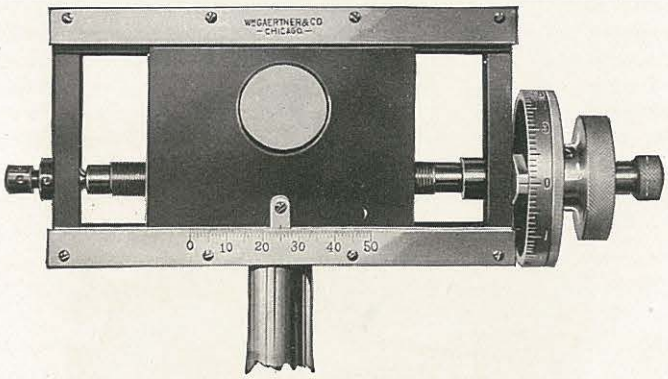
I 1042. Measuring Microscope. A microscope of fixed tube length with cross hairs and support sleeve. The magnifying power is about 32 diameters, working distance 50 mm, and field view 3.3 mm ..... **$ 16.50**

I 1050. Micrometer Scale on Glass. Ruling 10 mm long in 1-10 mm for experiments in direct measurements of wavelengths ..... **$ 4.00**

I 1060. Telescope of low Power for observing fringes **16.00**

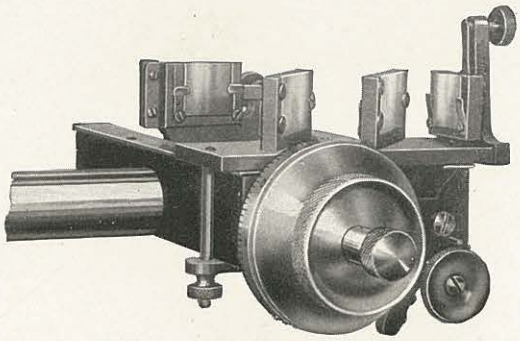
I 1070. Support for Telescope, consisting of bracket right angle clamp and rod **8.00**

M301. Micrometer Slide, 50 mm Range. The slide is threaded for the sleeve of our standard microscope, and the instrument is fitted with a supporting shank 19 mm x 15 cm. The micrometer head is of magnalium, bed plate and carriage are of hard brass, the guides are accurately scraped straight, and the carriage is carefully fitted. The screw is of the highest accuracy. Pitch of micrometer screw 1 mm; diameter of screw 10 mm; number of divisions on micrometer head 100; diameter of micrometer head 50 mm ..... **$ 60.00**



M301

M303. Micrometer Slide, 100 mm Range. This instrument is the same as M301 except in range ..... $ 90.00



M305

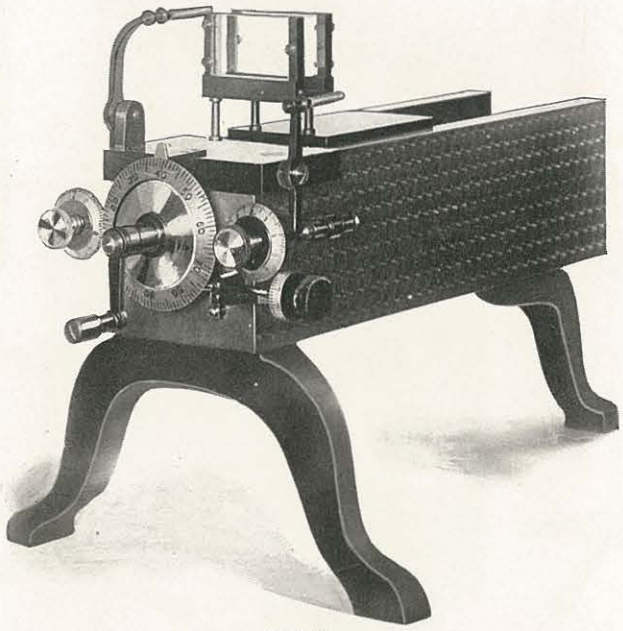
M305. Interferometer Attachment to Micrometer Slide. This attachment converts any of our micrometer slides into an inexpensive interferometer of the Michelson type. One mirror is attached to the carriage of the micrometer slide, which also carries the microscope. The other parts as the parallel plates, fixed mirror and its adjustable frame, as well as the delicate motion head, are all mounted on a brass plate which is clamped to the bed plate of the instrument. Simultaneous measurements may be made with the screw and microscope, and by counting the fringes. The plates are 15x22 mm, the mirrors 15x15 mm ..... $ 75.00

FABRY-PEROT INTERFEROMETER

I 1150. Fabry-Perot Interferometer. Plates 25x40 mm; range of carriage 120 mm; micrometer screw: diameter 15 mm, pitch 10 mm. For slow motion device of micrometer screw see I1001. The plates are semi-silvered on one side by sputtering; they are slightly wedge shaped to avoid reflections from the outer surfaces.

The body of the instrument is made of cast iron. The carriage on which the movable mirror is mounted is of bronze, carefully fitted in the guides, and of considerable weight to assure good contact. The movable mirror is roughly adjustable by means of three screws; the stationary front mirror is provided with delicate screws permitting an adjustment for parallelism with great precision; these screws are fitted with divided circles having 100 divisions. The mirror is rigidly mounted on a strong steel post so that once adjusted, it will remain so.

The instrument stands on three support legs; height from the table to center of mirrors 27 cm. $600.00



I 1150

INSTRUMENTS FOR HIGH RESOLVING POWER

The following instruments are used where a powerful resolution of the spectrum is desired, that is, for the study or demonstration of the fine structure of the spectrum lines, the Zeeman and Stark effect, the influence of the gas pressure on the spectrum, etc.

They may be used with any ordinary spectroscope but more conveniently in connection with an attachment specially designed for this purpose, L230o.

Note: For illustrations showing L232a, L232b, L232c refer to page 58, and for illustration showing L232o, to page 57 of this catalog.

L232a. Michelson Echelon. This Echelon is composed of 12 plates, each 10 mm thick. The width of step is 1 mm, the aperture 29x12 mm.

The Echelon is carefully mounted in a brass case, with the instrument. The exact thickness of the plates is given in each case.

For description and theory see Michelson "The Echelon Spectroscope" Astrophysical Journal 8, p. 36,1898. ..... **$225.00**

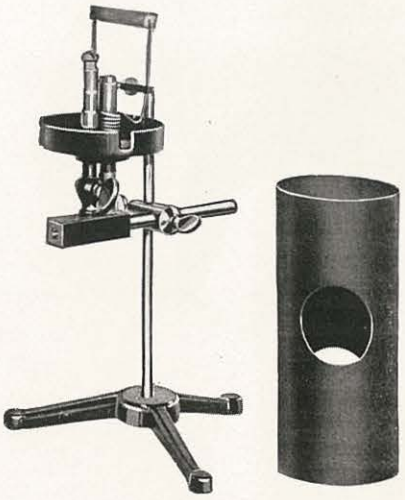
L232b. Lummer-Gercke Interferometer. The interferometer consists of a very accurate plane parallel plate of length 120 mm, width 15 mm, thickness 4.5 mm. A small reflecting prism is cemented to the plate to diminish the loss of light when entering the plate. For description and theory see: Annalen der Physik, 10, p. 457, 1903 ..... **$175.00**

L232c. Fabry-Perot Etalon. The Etalon consists of two plane plates in fixed parallel position; the parallelism is secured by a spring keeping the plates in contact with 3 small plugs of fused quartz inserted in a brass ring. (We have found this arrangement more satisfactory than an entire ring of quartz because it avoids the errors introduced by the air film and by small particles of dust between the ring and the plates.) The inner surfaces of the plates are semi-silvered by sputtering. The faces of each plate form a small angle (about 1′) to avoid interferences from reflection at the outer surfaces.

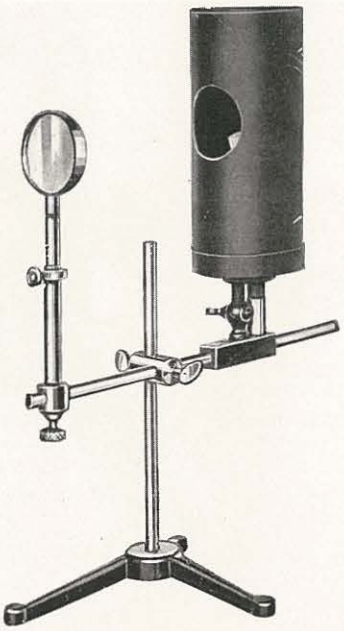
Distance of plates about 2.5 mm; the exact distance will be given with each individual instrument.

Free aperture 32 mm. **$125.00**

L232o. Attachment for Holding Interference Accessories. This attachment fits into the sleeve of Wavelength Spectroscopes L230, L231, in place of the collimator; it carries a sleeve to hold the collimator and an adjustable table for the interference accessories which come between collimator and prism **$100.00**



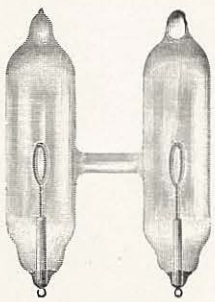
L560



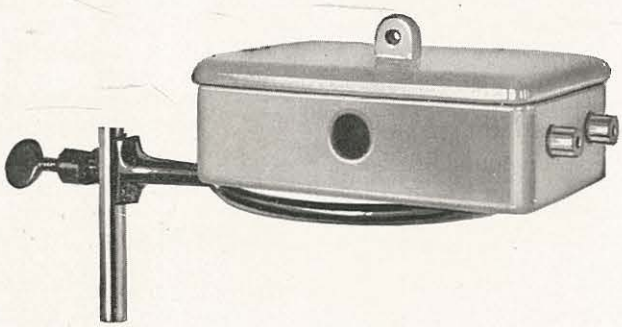
L562

L560. Monochromatic and White Light Burner. An ordinary gas burner mounted in front of a Bunsen Burner with monochromatic flame attachment. The latter consists of an asbestos block which can be soaked in an appropriate salt solution to give the corresponding flame spectrum. The white light burner has a separate stopcock for turning either on or off ..... **$ 15.00**

L562. Monochromatic and White Light Burner with Lens Attached. Except for the lens like L560. This burner has been particularly designed for use with the Michelson Interferometer. The lens can be focused within a wide range ..... **$ 18.00**



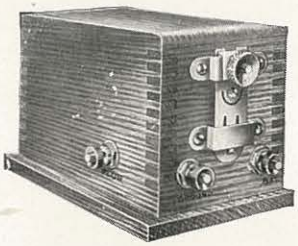
L508



L510

L508. Spectrum Tubes H-Form. The light comes from the end of the glowing column of vapor giving an intense illumination free from the lens-effect of the capillary. To vaporize the metal, Heating Box L510 is required. The tubes may be operated on a half-inch Spark Coil, as E1813, listed below. They should not be operated until the metal is vaporized. They are listed on page 95 of this catalog.

L510. Heating Box for L508. The tube is held in the box so as to permit easy attachment of the electrical connections which pass through lava bushings. A round hole in the side permits viewing the column end-on. The box can be set on a ring stand and heated from below by a burner flame ..... **$ 6.50**



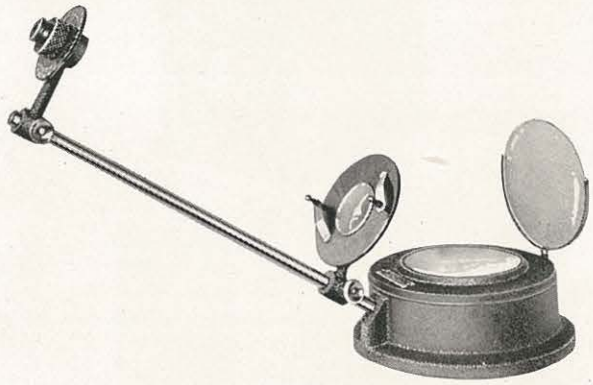
E1813

E1813. Spark Coil, ½ in Spark, equipped with pole changing switch. The circuit breaker is a mechanical breaker with platinum points which can be readily replaced. The adjustment is so designed that vibration will not disturb it. The coil may be operated on three or four dry cells or a small bell ringing transformer ..... **$ 6.00**

L512

L512. Cooper Hewitt Labarc. This is a powerful Quartz mercury arc which can be operated on 110 volts, either alternating or direct current. The illuminated area of the tube is ¼ in wide by ¾ in high and is of the same intrinsic brilliancy as the larger arcs. An adjustable slit to limit this area is provided. The lamp is adjustable in height. This arc is the most convenient and practical source of monochromatic light at present available. A removable mica window absorbs the ultra-violet light. Clips on the mounting are provided for holding light filters **$150.00**

POLARISCOPES AND ACCESSORIES



L260

L260. Students' Polariscope. This Polariscope while not attempting to be adaptable to such a wide variety of uses as the larger Polariscope L270 below, will with the accessories demonstrate the phenomena of polarized light sufficiently complete for elementary courses. The polarizer consists of a black glass mirror mounted in a metal cap, which fits over the base of the instrument. The latter is hollow and felt lined to contain the necessary accessories. Illumination may be provided by an ordinary electric lamp before the ground glass or by daylight. A nicol prism analyzer and stage are mounted on a rod which is screwed into the base and sets at the polarizing angle. The nicol prism rotates inside a circle graduated to 5 degrees making estimation to 1 degree possible. The position of analyzer and rotable stage may be adjusted.

The instrument is substantially constructed in every detail and is well finished . **$ 30.00**

L265. Set of Seven Accessories, comprising items listed below:

L277. Glass Plate for Clamp.
L278. Pressure Clamp for showing double refraction in glass under strain.
L279. Rhombohedron of Iceland Spar.
L286. Tourmaline Tongs.
L292. Spar Plate cut perpendicular to axis, showing colored rings and cross when viewed in Polariscope or between Tourmaline Tongs.
L295. Sheet of Clear Mica.
L296a. Design in Selenite, plain.

Complete, special price ..... **$ 20.00**

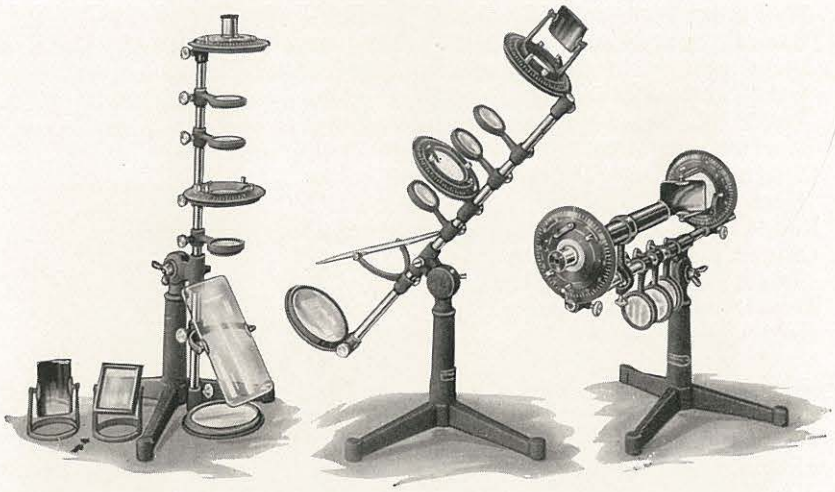
L270. Polariscope. A new design embodying all that was desirable in the old Norremberg types together with some distinctly novel features. The optical parts are mounted on a single rod which can be tilted and clamped at any angle to suit the position of the light source and the convenience of the observer. Any of the optical parts can be swung out of position when not in use or removed entirely from the rod.

The polarizer is a sheet of plane glass which can be rotated either to reflect light into the analyzer or to the mirror at the bottom of the rod.

The analyzer is held in a rotating collar, the position of which is read on a circle divided to 5 degrees. Three analyzers are supplied, a nicol prism, a black glass mirror, and a pile of glass plates, the last two having tilting adjustments.

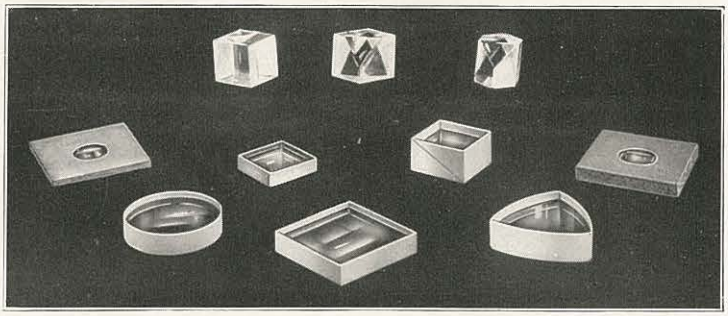
The stage is provided with a glass plate and clips; it can be rotated and is provided with a divided circle for reading the angle of rotation. The stage also serves as mount for the black glass mirror or pile of glass plates when it is desired to use one of these as the polarizer. For examining objects in convergent light, three lenses are furnished.

The instrument is suitable for the examination of crystals, polarizing prisms, quartz, spar and mica plates, for the testing of optical glass, and with the Accessory Tube L298 and Holder L299, listed on page 70, for studying the rotation of the plane of polarization by optically active liquids **$100.00**



L270 Shown in Three Different Positions

L271. Polariscope. Same as L270 but with circles graduated to 1 degree 110.00
L275. Nicol Prism, mounted to fit stage of Polariscope L270, aperture 10 mm . 25.00
L277. Glass Plate for Clamp 1.30
L278. Pressure Clamp, for showing double reflection in glass under strain 1.50



L293 L281 L291 L297 L282 L297-A L284 L290 L297-B L296

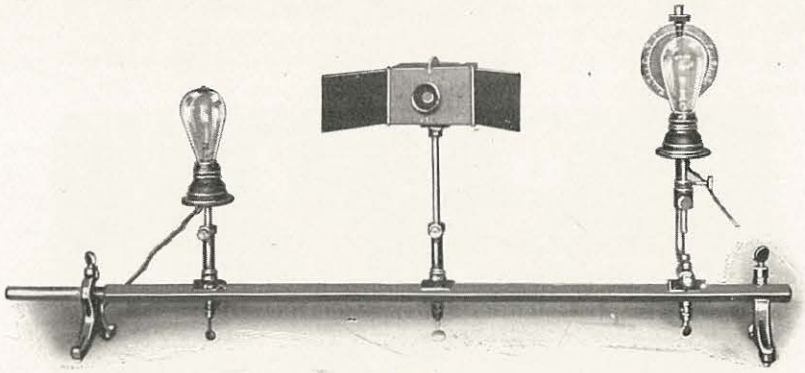
L279. Rhombohedron of Iceland Spar 1.00
L280. Rhombohedron of Iceland Spar, with six polished cleavage planes, 12 mm edge. For showing the double refraction of spar ..... $ 10.00
L281. Rhombohedron of Iceland Spar, like above, but with 15 mm edge 14.00
L282. Rhombohedron of Iceland Spar, with six polished cleavage planes and two faces perpendicular to axis, 15 mm edge ..... $ 18.00
L284. Rhombohedron of Iceland Spar, with six polished cleavage planes, two polished faces parallel and two polished faces perpendicular to optic axis, 20 mm edge. This single crystal will show practically all the varied phenomena in uniaxial crystals and is, accordingly, an extremely valuable accessory to the Polariscope ..... $ 30.00
L286. Tourmaline Tongs, the simplest polarization apparatus 3.50
L290. Wollaston Prism, quartz, aperture 20 mm square 20.00
L291. Quartz Plate, cut perpendicular to axis, 20 mm aperture 10.00
L291a. Biquartz Plate, of R. and L. Quartz, 10 mm 14.00
L292. Spar Plate, cut perpendicular to axis, 10 mm aperture, 1 mm thick 7.50
L293. Quarter Wave Plate, mica for sodium light 3.75

L293a. Half Wave Plate, mica, for sodium light 3.75
L294a. Set of Three Plates, 1/4, 3/4 and 9/4 wave retardations, which can be combined to give 13 different retardations. Adjusted for white light ..... $ 15.00
L294b. Set of Three Plates, but adjusted for sodium light 16.50
L294c. Von Mohl's Set of eight Selenite-Mica films 14.00
L295. Sheet of Clear Mica, 40x40 mm, about 0.5 mm thick 1.00
L296. Design in Selenite (Butterfly) in many colors 20.00
L296a. Design in Selenite (Plain) 8.00
L297. Round Unannealed Glass, showing strains under Polariscope 3.50
L297a. Square Unannealed Glass 3.50
L297b. Triangular Unannealed Glass 3.50
L298. Tube for Solutions, standard form, 20 cm long 6.00
L299. Holder for Tube L298 ..... 2.50

PHOTOMETERS AND ACCESSORIES

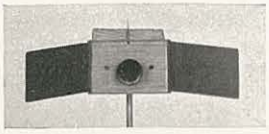
BUNSEN PHOTOMETERS

L450. Simple Bunsen Photometer, Complete. This instrument comprises the Bunsen Photometer Box L478 described hereafter, mounted on our Standard Single Rod Optical Bench of 220 cm length, two Edison sockets with cord and plug, mounted on sliding support pieces, a certified standard 110 V. 16 c. p. tungsten incandescent lamp, and one 110 V. Mazda lamp. Spring for clamps included ..... $ 46.25



L452

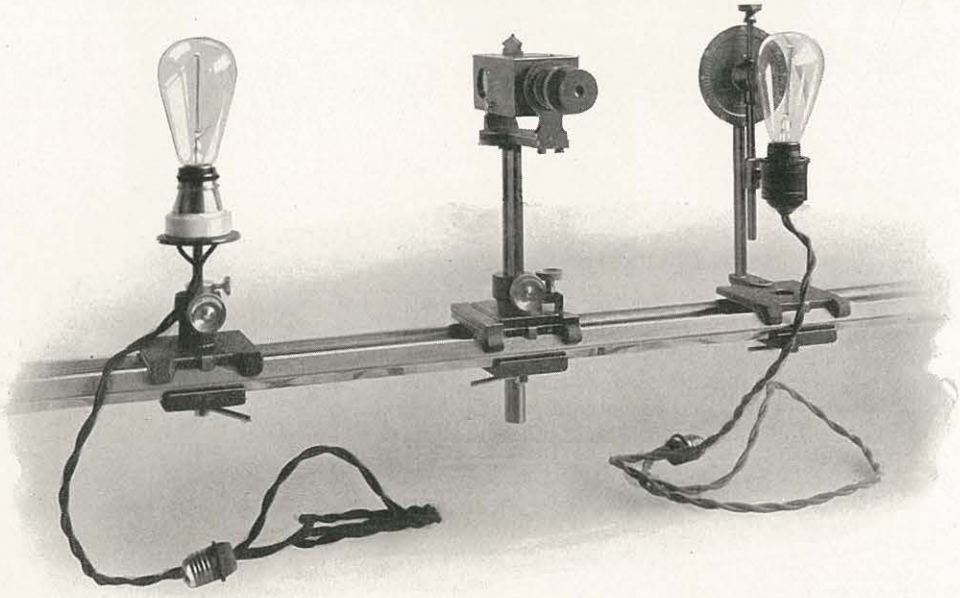
L452. Bunsen Photometer, for measuring light distribution. This Photometer is precisely like L450, except that one lamp socket is rotable about a horizontal axis as well as about the axis of the lamp. Divided circles permit both angles of rotation to be measured ..... $ 77.25
L453. Bunsen Photometer, on Double Rod Bench, 220 cm long (as shown in illustration of L455), permitting an easier motion of the parts; otherwise the same equipment as with L452 ..... $104.00
L454. Bunsen Photometer, on Double Rod Bench, 320 cm long. This Photometer is in every other respect like L453 ..... $ 119.00



L478

L478. Bunsen Photometer Box with Photometric Surface, according to Dibdin. In place of the grease spot, three pieces of thin white paper are mounted together, the middle one having a hole cut in the center to transmit the light. Mirrors on each side of the screen permit simultaneous observation of both sides ..... $ 8.00

L470. Electric Lamp Base, Rotable. This base is the same as that shown in the illustration, of L455. The lamp can be rotated about a horizontal axis transverse to the bench, as well as about the axis of the lamp, and graduated circles permit reading both angles. The light distribution about the lamp may in this way be completely determined. The lamp may be adjusted along its axis for properly locating the center of rotation ..... $ 35.00



L455

LUMMER-BRODHUN PHOTOMETERS

L455. Lummer-Brodhun Photometer, for measuring light distribution. The Lummer-Brodhun Photometer Box L480 is mounted on our standard double rod optical bench of 220 cm length. Three carriages slide along the bench and serve as supports for the photometer box, the standard lamp, and the lamp under test. The socket for the latter is mounted on an adjustable holder permitting rotation about a horizontal axis, and about the axis of the lamp. Circles are provided for reading the two rotations. A certified standard tungsten 110 V. 16 c. p. incandescent lamp and one 110 V. 25 watt Mazda lamp are supplied **$181.00**

L460. Lummer-Brodhun Photometer, with Bench 320 cm long. In every other respect like L455 ..... **$196.00**

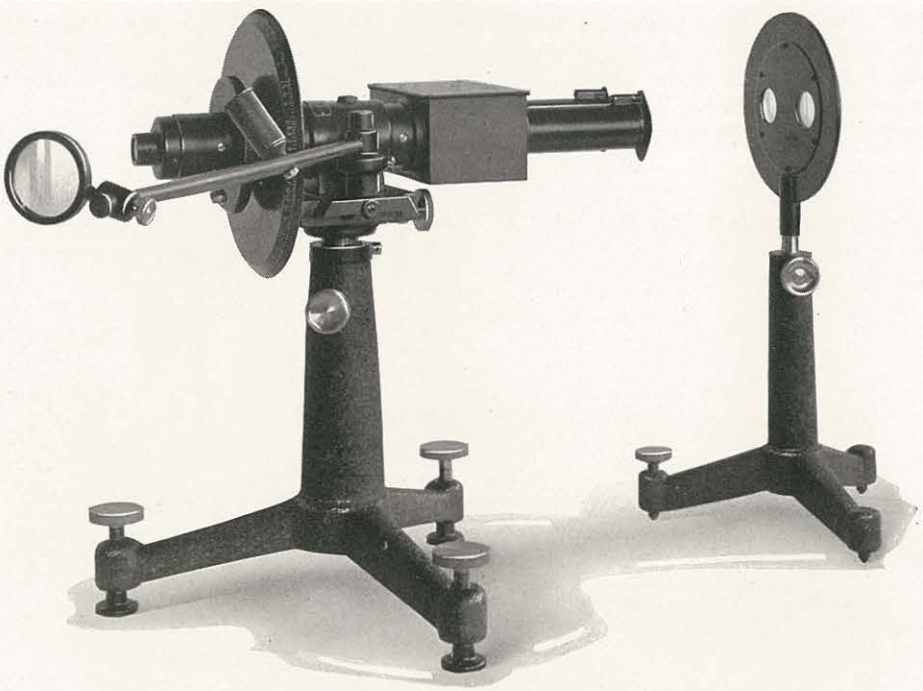
L480. Lummer-Brodhun Photometer Box. Of the well known Lummer-Brodhun type with total reflecting prisms in place of silvered surfaces. The photometer may be rotated about the line of sight for taking reversed readings. The box and mounting are substantially constructed of metal ..... $ 85.00

L480a. Lummer-Brodhun Contrast Photometer Box. This photometer is exactly like L480 with the addition of two small glass plates which may be swung into position so that the instrument can be used as a contrast photometer if desired. With the glass plates out of position the instrument functions like L480, as a Lummer-Brodhun Photometer of the usual type, settings being made for equality of brightness ..... $ 85.00

POLARIZING PHOTOMETER

L482. Polarizing Photometer. This is an accessory to any ordinary spectroscope converting it into a spectrophotometer for the measurement of absorption of light by solutions or other media. It can be readily adapted to a multitude of other uses such as the measurement of relative intensity of light sources or of the spectral distribution of light reflected from paints and pigments, etc.

Light from a suitable source is divided into two parallel collimated beams by a twin collimator. The two beams then pass through the absorbing substance and standard, respectively. After polarization they are brought together in a special form of Lummer-Brodhun



L482 with Twin Collimator

cube having a tri-partite field. The two outer parts are from one path and the middle part from the other. An image of this tri-partite field is projected through a rotable nicol onto the spectroscope slit. The spectrum is thus seen as divided into three horizontal strips, the two outer strips appearing as of like intensity, but the middle part of a different intensity. The three strips are brought to the same intensity by rotation of the rotable nicol. This is near the spectroscope slit and within convenient reach.

L485

The rotable nicol carries a large, easily legible, circle which permits estimation of the angle of setting to tenths of a degree. Two quadrants are divided in degrees, and two quadrants in extinction-coefficients (the logarithm of the relative intensities of the two beams).

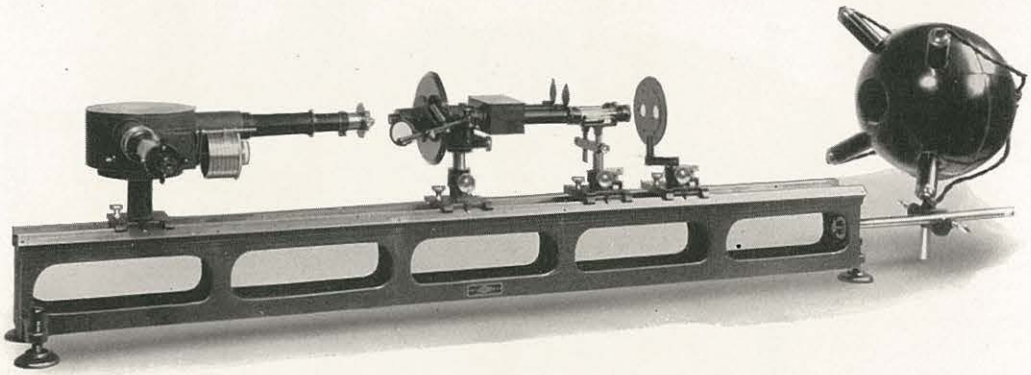
An electric lamp bulb and adjustable arm with reading glass facilitate reading the circle from the eye end of the spectroscope. The instrument is of a modified Nutting type and is furnished with twin collimator **$575.00**

L483. Support for Holding Two Absorption Tubes. With height adjustments for each tube separately ..... $ 40.00

L484. Absorption Tube. 10 cm long, aperture 15 mm, with screw end caps containing removable windows. Each ..... $ 16.00

L485. Illuminating Sphere, 12 inches in diameter containing four 150 watt Mazda lamps and giving a bright uniform illumination. A ventilating device prevents overheating ..... $ 75.00

L230f. Symmetrical Eye Slit with Eyepieces, to fit Standard Spectroscope, with adjustable symmetrical jaws and a set of jaws at right angles to vary the length of slit
For ill. see page 55 ..... $ 40.00



POLARIZING SPECTRO-PHOTOMETER OUTFIT

Consisting of Polarizing Photometer L482 and Twin Collimator, Adjustable Support for Absorption Tubes L483, two Absorption Tubes L484, Illuminating Sphere L485, Wavelength Spectroscope L230, fitted with Symmetrical Eyeslit L230f, mounted on cast iron bench $1350.00

Note: All necessary tripod supports for setting up any of the instruments on table are included.

FLICKER PHOTOMETERS

The Flicker Photometer is furnished in two forms, either with rotating sector discs or with rotating flicker body; the latter form is provided with a graduated device for tilting in order to make possible the taking of measurements in different directions. Both forms are fitted with hinged centering discs, for properly aligning the instrument with the light sources. The rotation of the flicker device can be effected by hand or with the aid of a small motor.

L490. Flicker Photometer Head, with sector discs ..... $ 55.00

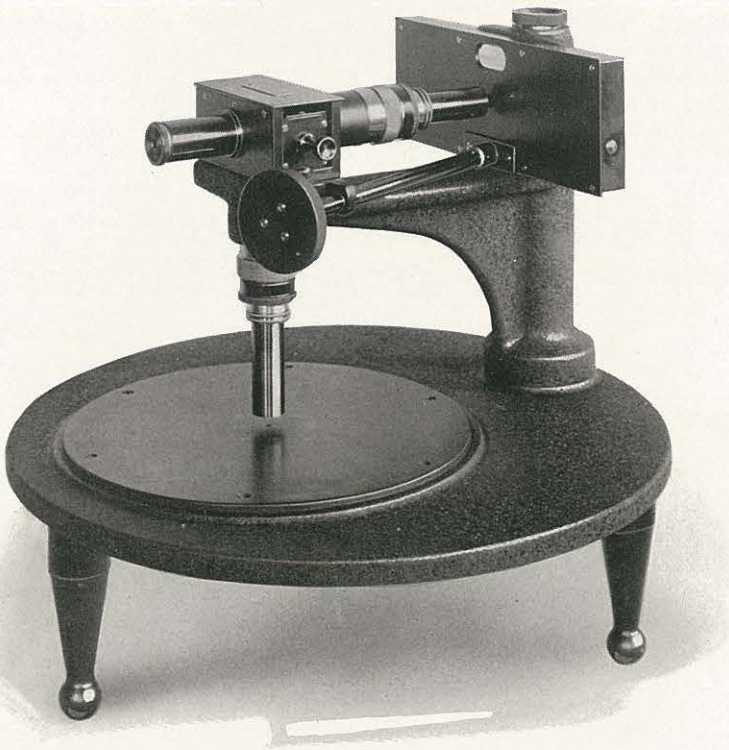
L491. Flicker Photometer Head, with flicker body, tilting device and graduations for taking measurements in different directions ..... $ 75.00

L493. Universal Motor, for use with the above Flicker Photometer Heads 12.50

HARTMANN MICROPHOTOMETER

L495. Hartmann Microphotometer. This is of the form described by Hartmann (Zeitschrift fur Instrumentenkunde 1899, Vol. 19 pp. 77-103) and is particularly suitable for the measurement of photographic densities, star magnitudes, intensities of spectrum lines, etc.

The table on which the plate to be measured is placed is 22 cm in diameter. An image of the plate is seen in the 1 mm diameter center circle of a Lummer-Brodhun cube; the outer part of the field is occupied by an image of a photographic wedge. The latter has a travel of 75 mm, and is read with scale and index. The cube is mounted on a slide with an auxiliary



L495

cube containing a ruled cross in place of the bipartite field, for use in adjusting the plate to be measured.

Both wedge and plate are illuminated from the same source by a divided beam from a milk-glass plate $650.00

PHOTOMETRIC LIGHT SOURCES

L485. Illuminating Sphere, 12 inches in diameter containing four 150 watt Mazda lamps and giving a bright uniform illumination. A ventilating device prevents overheating. (For illustration see page 72) ..... $ 75.00

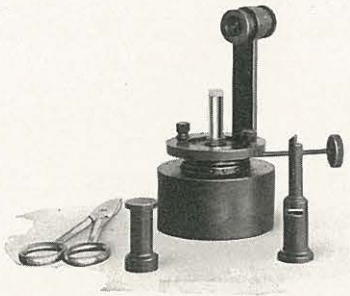
S2163. Candle Holder, of brass on rod 10 mm diameter, 10 cm long ..... .80

L464. Gas Burner on rod 10 mm diameter, 10 cm long 1.25

L466. Welsbach Lamp with mantle and chimney on rod 10 mm diameter, 10 cm long ..... $ 3.00

L468. Socket for Standard Incandescent Lamps, mounted with fibre disc on 10 mm diameter rod, 10 cm long, with 5 feet of cord and standard plug ..... $ 4.00

L472. Standard Candles. These candles are made of sperm, 7/8 inch in diameter and burn 120 grains per hour. They are 9½ inches long and will burn nine hours or more. Each ..... $ .35

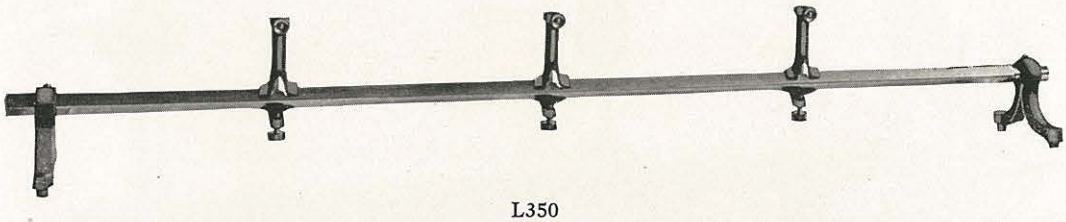


L474

L474. Hefner Standard Lamp. This is of the Reichsanstalt form, burning amylacetate. It is furnished with wick and gauge for accurate adjustment of the height of flame . . . **$ 25.00**

L476. Standard Incandescent Lamp. Tungsten 110 Volt, 15 c. p. This lamp has been standardized and certified for use as photometric standard. The lamp is intended to be stationary and viewed in a direction which is indicated on the lamp certificate. A graph showing variation of candle power with voltage accompanies the lamp . . . . . **$ 6.00**

OPTICAL BENCHES, SUPPORTS AND ACCESSORIES



L350

SINGLE ROD OPTICAL BENCHES, GRADUATED

L350. Single Rod Optical Bench, 1 Meter Range, Graduated. The bench comprises a 19 mm square rod mounted in end brackets. The rod is graduated over a range of 100 cm, the actual usable length being 10 cm longer than the range of graduation. Three Support Pieces (L410a) are furnished. These have a 10 mm hole and set screw for holding objects mounted on 10 mm round rods and carry an index for reading the positions. The Support Pieces can be fitted with phosphor bronze springs (S1220) between clamp screw and rod, so that the pieces can be moved smoothly along the rod, when the screw is released.

With three Support Pieces (L410a) . . . . . **$ 20.00**

L352. Single Rod Optical Bench, 2 Meters Range, Graduated. With three Support Pieces (L410a) . . . . . **$ 28.00**

L354. Single Rod Optical Bench, 3 Meters Range, Graduated. With three Support Pieces (L410a) . . . . . **$ 38.00**

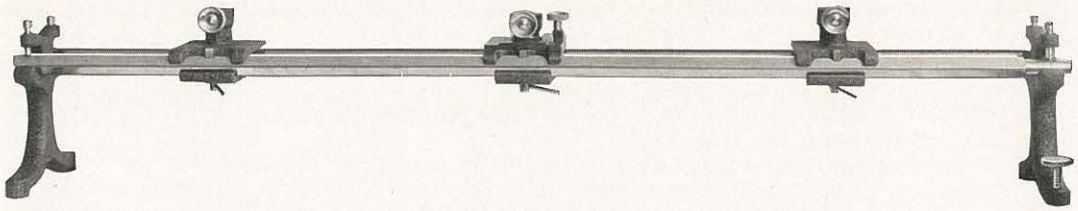
SINGLE ROD OPTICAL BENCHES, UNGRADUATED

L351. Single Rod Optical Bench, 1 Meter Range, Ungraduated. Otherwise like L350 above.

With three Support Pieces (L410) . . . . . **$ 15.00**

L353. Single Rod Optical Bench, 2 Meters Range, Ungraduated. With three Support Pieces (L410) . . . . . **$ 19.00**

L355. Single Rod Optical Bench, 3 Meters Range, Ungraduated. With three Support Pieces (L410) . . . . . **$ 33.00**



L360

DOUBLE ROD OPTICAL BENCHES, GRADUATED

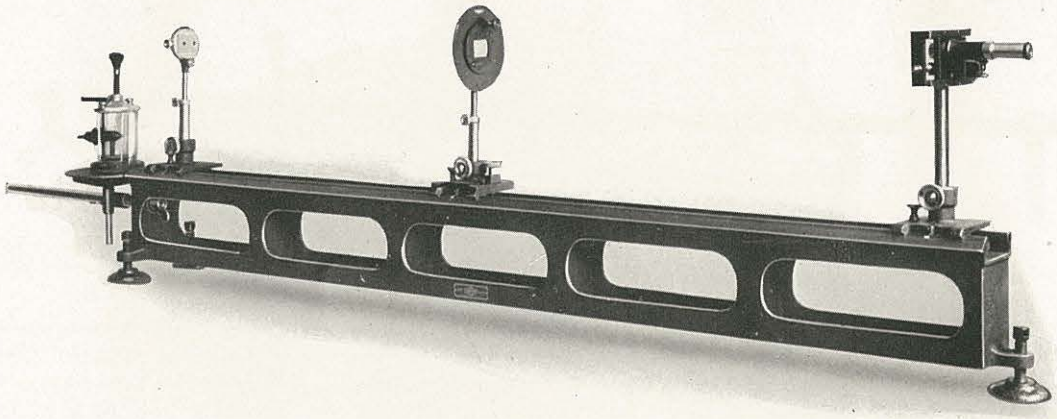
L360. Double Rod Optical Bench Graduated, 1 Meter Range. Two 19 mm Rods, one square and one round, are held horizontally by end supports with their center lines 7.5 cm apart. Three carriages with indices to read the graduations carry the optical parts and

slide along the rod. One of the carriages has a lateral motion by rack and pinion over a range of 30 mm. Each clamps by a quarter turn of a lever underneath. The carriages have a hole and set screw for holding 19 mm Round Rods; 10 mm and 13 mm sizes can also be used with the Adapters S1236, S1238. The Square Rod is graduated in millimeters and is 20 cm longer than the graduation.

With three carriages ..... $ 45.00

L361. Double Rod Optical Bench, Graduated, 2 Meters Range. With three carriages ..... $ 55.00

L362. Double Rod Optical Bench, Graduated, 3 Meters Range. With three carriages ..... $ 65.00



PRECISION OPTICAL BENCH

Set up for interference experiments, with 19 mm extension rod supporting L568 Colored Flame Burner. On the carriages are supported M720 Slit, L363 Object Holder with L366 Fresnel Biprism, and L390 Micrometer Slide.

L360a. Precision Optical Bench, 1½ Meter Range. The bed is made of cast iron and of large cross-section to assure rigidity. The guides are carefully straightened and the carriages are well fitted and slide accurately, being kept in contact by springs. The bed is drilled on each end for 19 mm Rods, useful for supporting accessories such as condensing lenses, source of light, observing telescopes, etc. The clamp screws are in convenient reach on top of the carriages which are otherwise similar in dimensions to those as used on the Double Rod Benches L360, L361, and L362. The scale is divided on a strip of steel and has a length of 150 cm. Three carriages are provided, one of which with lateral motion of 30 mm range. The holes in the carriages are 19 mm in diameter $150.00

Note: This bench is especially recommended for work in interference where accuracy of motion is required or for supporting heavier pieces of optical apparatus which have to be carefully aligned.

The smaller carriages L422-L426, as used on the double rod Optical Benches can also be fitted to this bench at an extra cost each of ..... $ 1.00

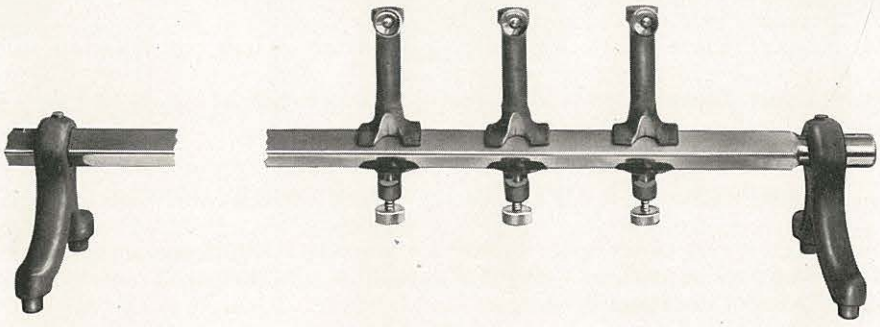
Note: All benches listed above will serve as Photometer Benches. For Photometer Boxes and other parts, see page 70.

For extra support pieces and carriages see below and pages following.

SUPPORT PIECES FOR OPTICAL BENCHES

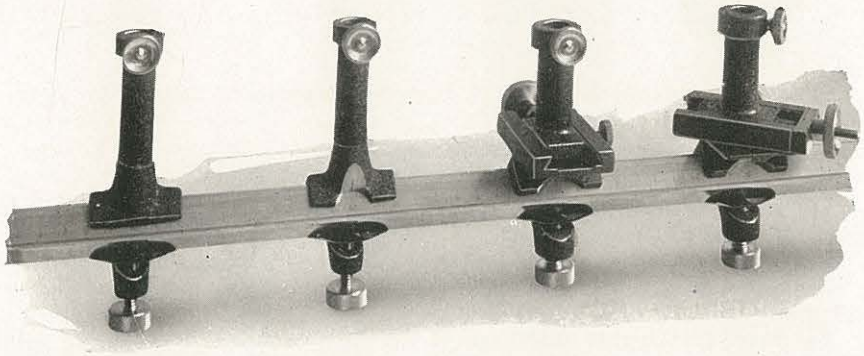
These are primarily intended as extra supports for the Single Rod Benches L350 and L351, but may also be used for holding objects in a fixed position on the Double Rod Benches by clamping in a tilted position to the round rod. They have a V shaped opening to fit the 19 mm round or square rod and have a hole and set screw for holding objects mounted on round rods. The clamp screws can be fitted with phosphor bronze springs so that the piece

may be moved smoothly along the rod when the clamp screw is released. The clamp screws on all support pieces, used on Optical Benches, are made of brass, and have round knurled heads, the latter being very convenient for that purpose.



Single Rod Optical Bench, Showing L410a Support Pieces, Fitted with Spring

L410. Support Piece, to hold 10 mm Round Rods ..... $ 1.60
L411. Support Piece, to hold 13 mm Round Rods 2.00
L412. Support Piece, to hold 19 mm Round Rods 2.75
L410a. Support Piece, with index for graduated bench; to hold 10 mm Round Rods ..... $ 2.15
L411a. Support Piece, with index for graduated bench; to hold 13 mm Round Rods ..... $ 2.55
L412a. Support Piece, with index for graduated bench; to hold 19 mm Round Rods ..... $ 3.50



L410 L410a L416a L418a

SUPPORT PIECES FOR OPTICAL BENCH WITH SIDE ADJUSTMENT

For Single Rod Optical Benches. The piece which carries the round rod is mounted on a slide with screw adjustment for giving a delicate transverse motion to the object. The range of motion is 25 mm.

L415. Support Piece, to hold 10 mm Round Rods ..... $ 7.50
L416. Support Piece, to hold 13 mm Round Rods 7.50
L415a. Support Piece, with index for graduated bench; to hold 10 mm Round Rods ..... $ 8.50
L416a. Support Piece, with index for graduated bench; to hold 13 mm Round Rods ..... $ 8.50

SUPPORT PIECES FOR OPTICAL BENCH WITH SIDE ADJUSTMENT AND SWIVEL

Besides the screw adjustment these clamps carry a swivel so that the motion can take place parallel to the rod or transversely.

L417. Support Piece, to hold 10 mm Round Rods ..... $ 10.00

L418. Support Piece, to hold 13 mm Round Rods 10.00

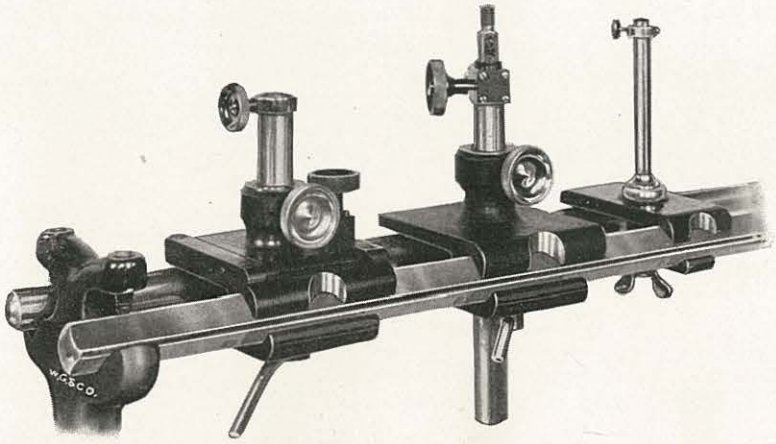
L417a. Support Piece, with index for graduated bench; to hold 10 mm Round Rods ..... $ 11.00

L418a. Support Piece, with index for graduated bench; to hold 13 mm Round Rods ..... $ 11.00

SPRING FOR OPTICAL BENCH SUPPORT PIECES

A shoe shaped spring of phosphor bronze for use with support pieces on round or square rods between clamp screw and rod. Especially useful to give a smooth motion along the rod.

S1220. Spring of Phosphor Bronze ..... .25



L420 with S1236 L421 with S1719 L424

CARRIAGES FOR OPTICAL BENCHES

L420. Carriage, for Double Rod Optical Bench, 9 cm wide, with index for reading graduations, 19 mm hole and clamp screw ..... $ 7.00

L421. Carriage, with Lateral Motion for Double Rod Optical Bench. The piece which carries the 19 mm Rod is mounted on a slide which moves by rack and pinion giving a delicate motion of 30 mm transverse to the bench ..... $ 13.50

L422. Carriage, for Double Rod Optical Bench, 5 cm wide for holding small objects. It is tapped to hold a 10 mm Stand Tube, or a 10 mm Round Rod ..... $ 3.50

L423. Carriage, tapped for 13 mm Rod or Stand Tube 3.50

L424. Carriage, with Stand Tube, 10 cm long, 10 mm inner diameter 5.00

L425. Carriage, with Stand Tube, 10 cm long, 13 mm inner diameter 5.25

L426. Carriage, with Stand Tube, having a 13 mm Rod threaded at the top and adjustable by rack and pinion, between 10 and 20 cm height ..... $ 20.00

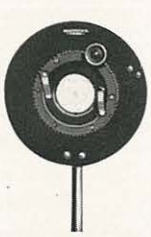
ADAPTERS

Consisting of a steel bushing to fit the 19 mm hole of the carriage and having a hole and set screw for holding smaller sized rods, nickel plated.

S1236. Adapter, to hold 10 mm Rods ..... $ 1.45

S1238. Adapter, to hold 13 mm Rods 1.45

S1719. Adapter with Rack and Pinion. Fits 19 mm hole of the carriage and carries a 13 mm Rod threaded at the top and adjustable in height by rack and pinion ..... $ 17.00

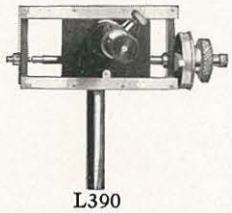

L363


L364


L367


S2157


L380


L390

ACCESSORIES FOR OPTICAL BENCHES

These accessories may be used on any of our benches. In lecture demonstrations they may be set up on the table if used with our Universal Laboratory Supports. For complete list of these see Catalog S-T-O.

L363. Rotable Object Holder. The part holding the object rotates by a gear and pinion. The opening is 45 mm in diameter, and the diameter of the body 130 mm, the body serving as a screen. The support shank is 13 mm in diameter. This holder is particularly suitable for diaphragms, slits, gratings, cylindrical lenses and Fresnel biprisms.... **$ 20.00**

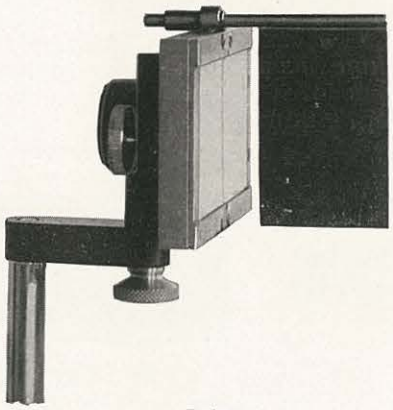
L364. Grating Holder, to fit L363, suitable for holding grating replicas..... **$ 4.00**

L365. Cylindrical Lens, 35 mm square, 20 cm Focal Length, with mounting to fit L363 ..... **$ 6.00**

L366. Fresnel Biprism, 35x22 mm to fit L363..... **18.00**

L367. Table Support, consisting of iron table top, 8 cm in diameter, on 10 mm support rod, for supporting prisms, etc. ..... **$ 1.05**

S2157. Screen with Diaphragm. Consists of a rectangular screen which has a round opening of 25 mm and carries a rotable diaphragm. This diaphragm has round openings of 6, 12, 20, and 25 mm and a slit 1 mm wide, any of which can be brought into position by rotation of the diaphragm..... **$ 7.50**


L370

L370. Fresnel Mirror. The mirrors are of optically flat black glass 35x30 mm. One mirror is fixed, the other is provided with screws for aligning it properly and a screw and hinge for varying the angle of the mirrors..... **$ 50.00**

L380. Micrometer Eyepiece, range 6 mm with two wires, one stationary and one movable. The screw has a pitch of ¼ mm and the micrometer head is divided in 50 parts. Including a holder with 10 mm rod for mounting on the optical bench..... **$ 26.00**

L390. Micrometer Slide, range 50 mm, 1 mm pitch, 100 divisions on head, mounted on a 19 mm shank, fitted with adapter and eyepiece, for use in measuring fringes, images, etc. ..... **$ 66.00**

Note: Other Micrometer Eyepieces and Micrometer Slides are listed on pages 7 and 9. For Adapters and Slits see pages 8, 10, 80, 81.

L400. Set of Object Pieces and Diaphragm, for use in obtaining the resolving power of the telescope. Four object pieces, three consisting of wire gauze of different mesh, and one of perforated metal, mounted in circular metal frame of 35 mm outside diameter and

25 mm inside diameter. The gauze is of bronze wire, of uniform square mesh, one of wire of 0.15 mm diameter and 0.35 mm spacing, the second of wire of 0.17 mm diameter and 0.60 mm spacing, the third of wire of 0.30 mm diameter and 0.75 mm spacing. The perforated metal has holes of 1.25 mm diameter, spaced square at 2.25 mm. The diaphragm is of blackened metal, 35 mm in diameter with a 3 mm aperture. The object piece, brightly illuminated from behind, is viewed through the telescope with the diaphragm in front of the objective. The object piece is then moved away until the images of the meshes or holes become blurred into a uniform field..... **$ 3.50**

L402. Set of Perforated Discs, for experiments in diffraction and interference. Five blackened metal diaphragms of 25 mm outside diameter, with 1 mm holes. Two have one hole in the center, one has two holes 3 mm apart, one has three holes 3 mm apart, and one has four holes at the corners of a 3.5 mm square. In use, a disc having one hole is viewed through a telescope at a distance of about two meters. The hole is brightly illuminated by sunlight or by placing an electric lamp so that a portion of the filament can be seen through it in the telescope. The diffraction and interference patterns are obtained by placing the other diaphragms in front of the telescope objective..... **$ 3.00**

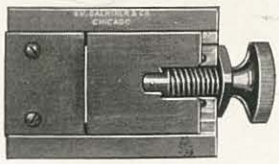
L404. Set of Slotted Discs, similar to L402, for experiments in diffraction and interference. There are four discs, having slits 7.5 mm long and 1.25 mm wide. Two have a single slit, one has two slits 2.5 mm apart, and one has three slits 2.5 mm apart. They are used in the way described for L402, using a single slit as the source and holding the other slits in front of the objective, parallel to this one..... **$ 3.00**

L406. Pair of Diaphragms, for spherical aberration. One has a hole 19 mm in diameter, the other has a central part 16 mm in diameter and an opening 37.5 mm in diameter, the central part being held by four radial arms 1.5 mm wide. Both diaphragms are of blackened metal, and are of 50 mm outside diameter..... **$ 3.00**

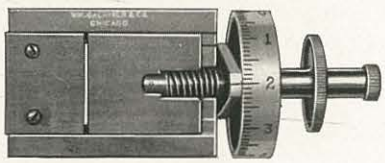
EYEPIECES

Our eyepieces as well as our eyepiece adapters are made of standard size; the diameter of the eyepiece body is 19.4 mm while the adapter is made to fit into tubing of 20.32 mm internal diameter.

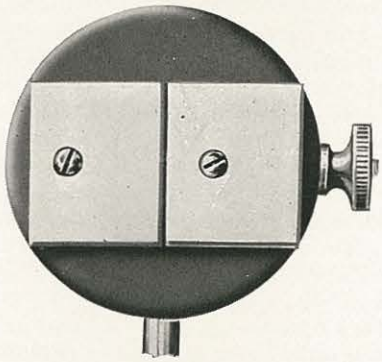
M240. Ramsden Eyepiece, of 18 mm focal length, magnifying power 14 dia.. **$ 4.00**
M242. Ramsden Eyepiece, of 25 mm focal length, magnifying power 10 dia.. **3.50**
M244. Ramsden Eyepiece, of 50 mm focal length, magnifying power 5 dia... **4.00**
M250. Eyepiece Adapter. Made to fit into tubing of 20.32 mm internal diameter, and to carry the above eyepiece. A diaphragm with crosshairs is included..... **$ 3.50**



M701



M710



M720

SLITS AND HOLDER

M701. Slit. Jaws 20 mm long, of nickel silver. Closing by spring pressure, opening by a screw. The screw is of ¼ mm pitch with Holder M722 ..... $ 16.00

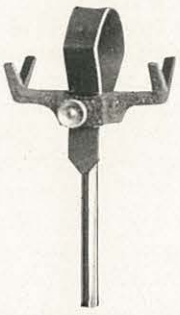
M710. Slit, Micrometer. Jaws 20 mm long, screw of ¼ mm pitch fitted with micrometer head having 100 divisions. With Holder M722 ..... $ 28.00

M720. Slit. Jaws 30 mm long, opening to 4 mm. Supported on a rod 10 mm in diameter, 15 cm long, on which it may be adjusted to any angle from vertical to horizontal $ 16.00

M722. Holder, for Slits, Eyepiece Adapters, Micrometer Eyepieces. A split collar of 20.3 mm diameter mounted on a rod of 10 mm diameter, 15 cm long..... $ 2.00

M728. Comparison Prism for Slits. This is a small total reflecting prism which may be fitted to any of the above slits. It is mounted in such a way that it can be placed over any part of the slit, and can be rotated to clear the slit..... $ 7.50

Note: If comparison prism and slit are not ordered at the same time the slit will have to be returned to us to fit the prism to it.



S1601

S1901

S1906a

S2152

TELESCOPE HOLDERS

Convenient for telescopes or other round or square objects liable to be injured by too great pressure. A leather strap holds the object securely. The bottom of the holder is also tapped for the support rod, and, in addition, for a 10 mm rod, which may carry a scale. All parts with the exception of the rod are of brass. The holder, in connection with a telescope and tripod support, form a convenient reading telescope.

S1601. Telescope Holder. For objects up to 5 cm in diameter. With Rod 13 mm in diameter, 15 cm long ..... $ 3.75

S1602. Telescope Holder. Like S1601, but with Y-supports, which may be clamped from 5 cm to 10 cm apart, so as to accommodate shorter or longer objects. The ends are tapped for 13 mm Rods..... $ 4.50

S1604. Telescope Holder. Like S1602, but with large Y-supports and correspondingly longer strap, to hold objects up to 12 cm in diameter. With Rod, 13 mm in diameter, 15 cm long ..... $ 5.50

TRIPODS WITH STAND TUBE

For mounting lens and mirror holders on the lecture or laboratory table.

S1700t. Tripod with Stand Tube, 10 cm high, to fit 10 mm Rod, tripod legs 9 cm..... $ 2.00

S1721t. Tripod with Stand Tube, 10 cm high, to fit 13 mm Rod, tripod legs 9 cm..... $ 2.25

S1701t. Tripod with Stand Tube, 20 cm high, to fit 13 mm Rod, tripod legs 13.5 cm ..... $ 3.50

S1702t. Tripod with Stand Tube, 30 cm high, to fit 13 mm Rod, tripod legs 13.5 cm ..... $ 4.00

Note: For a complete line of Laboratory Supports we refer to catalog S-T-O: 1923.

LENS HOLDERS

S1901. Adjustable Lens Holder. The lens is held in a V-groove by a springy arm which can be raised or lowered to accommodate any size of lens within the specified limits, or moved forward and back to adjust the tilt. The edge of the lens is at all times accessible for measurement. For lenses from 25 to 50 mm in diameter, with 10 mm Rod, 15 cm long ..... $ 1.75

S1902. Lens Holder, for lenses from 50 to 100 mm in diameter, with 10 mm Rod, 15 cm long. Otherwise like S1901 ..... $ 2.25

S1906. Spring Lens Holder. For lenses from 10 to 50 mm in diameter. This holder can be set on the table for simple experiments. Tapped for 10 mm Rod. Without Rod ..... $ 0.80

S1906a. Lens Holder, same as S1906 but with 10 mm Support Rod, 15 cm long 1.10

S1925. Lens Holder. Will hold single or achromatic lenses of the specified diameter firmly in position, particularly recommended for permanent optical set-ups, provided with Support Rod 10 mm in diameter and 15 cm long, for lenses 25 mm in diameter.... $ 1.00

S1950. Lens Holder 50 mm in diameter..... 1.50

S1975. Lens Holder 75 mm in diameter..... 2.50

S1910. Lens Holder 110 mm in diameter..... 3.50

MIRRORS IN ADJUSTABLE HOLDER

These are adjustable about both a vertical and horizontal axis and are provided with Support Rods as specified.

S2151. Mirror with Holder. Plane Mirror 38 mm in diameter, mounted on 10 mm Rod, 10 cm long..... $ 3.00

S2152. Mirror with Holder. Plane Mirror 60 mm in diameter, mounted on 10 mm Rod, 10 cm long..... $ 5.00

S2153. Mirror with Holder. Plane Mirror, 100 mm in diameter, mounted on 13 mm Rod, 10 cm long..... $ 6.50

S2151a. Mirror with Holder. Concave Mirror 35 mm in diameter, 12.5 cm focal length, on 10 mm Rod..... $ 4.00

S2151b. Mirror with Holder. Concave Mirror, 35 mm in diameter, 20 cm focal length, on 10 mm Rod..... $ 4.00

S2151c. Mirror with Holder. Concave Mirror, 35 mm in diameter, 100 cm focal length, on 13 mm Rod..... $ 4.00

S2152a. Mirror with Holder. Concave Mirror, 60 mm in diameter, 30 cm focal length, on 10 mm Rod..... $ 6.50

S2153a. Mirror with Holder. Concave Mirror, 100 mm in diameter, 30 cm focal length, on 13 mm Rod..... $ 8.00

LAMP AND BURNER FOR OPTICAL BENCHES

S2196. Electric Lamp with Shade. An incandescent lamp of the Bunghole type, mounted on Edison receptacle with fiber disc and 10 mm support rod, fitted with 5 feet of cord and Edison plug. The shade is made of steel, white enameled inside..... $ 5.25

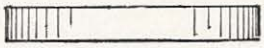
L565a. Monochromatic Flame Burner. Consisting of a Bunsen burner mounted on a support piece with index for single rod optical bench, and fitted with wire support for asbestos block. The latter serves to hold the salt solution giving the desired color to the flame..... $ 6.00

Note: For other Lamps and Burners see pages 96-99.

S2196

L565a

OPTICAL PARTS



M405—M406b

GLASS TEST PLANES

These planes are circular. They are polished on two sides, one side being figured to the accuracy specified below up to within about one-fourth inch of the edge. Test planes of other than the sizes listed, and planes of fused or crystal quartz will be made to order.

M405.	**Test Plane.** 65 mm diameter, flat to 1/16 wavelength (.000036 mm)	**$ 30.00**
M405a.	**Test Plane.** 65 mm diameter, flat to 1/8 wavelength (.000072 mm)	**20.00**
M405b.	**Test Plane.** 65 mm diameter, flat to ¼ wavelength (.000144 mm)	**15.00**
M406.	**Test Plane.** 130 mm diameter, flat to 1/16 wavelength (.000036 mm)	**70.00**
M406a.	**Test Plane.** 130 mm diameter, flat to 1/8 wavelength (.000072 mm)	**40.00**
M406b.	**Test Plane.** 130 mm diameter, flat to ¼ wavelength (.000144 mm)	**30.00**

SPHERICAL TEST GLASSES

For testing curved surfaces by the Newton's Rings method. These are made to order according to specifications furnished by the purchaser in regard to size and radius of curvature. They are made in pairs, one convex and one concave which have the same curvature to one-fourth wavelength. Prices on receipt of specifications.

PLANE MIRRORS

These are figured on the front side to an accuracy of one-eighth wavelength of sodium light, except at the extreme edges. The thickness is one-sixth to one-seventh the diameter of the disc. The silver coating is on the front. Other sizes than those listed will be made to order. Mirrors of 75 mm diameter or under can be furnished, coated with gold or nickel.

L620.	**Plane Mirror,** 25 mm diameter, cathodically silvered	**$ 8.00**
L621.	**Plane Mirror,** 37 mm diameter, cathodically silvered	**12.00**

L622.	**Plane Mirror,** 50 mm diameter, cathodically silvered	15.00
L623.	**Plane Mirror,** 60 mm diameter, cathodically silvered	20.00
L624.	**Plane Mirror,** 75 mm diameter, cathodically silvered	30.00
L625.	**Plane Mirror,** 100 mm diameter, chemically silvered	40.00
L626.	**Plane Mirror,** 125 mm diameter, chemically silvered	60.00
L627.	**Plane Mirror,** 150 mm diameter, chemically silvered	75.00
L628.	**Plane Mirror,** 200 mm diameter, chemically silvered	140.00
L629.	**Plane Mirror,** 250 mm diameter, chemically silvered	250.00

BLACK GLASS MIRRORS

L635 **Black Glass Mirror,** 12x6 cm for polarizer ..... $ 5.00

L636. **Black Glass Mirror,** 4x3 cm, with optical plane surface, suitable for Fresnel mirror, Lloyd's mirror and other experiments requiring reflection from a glass surface $ 4.00

SPHERICAL CONCAVE MIRRORS

These mirrors are circular and ground flat on the back. **The front surface is figured truly spherical and is silvered.** As it is difficult in figuring to maintain the radius exactly, the focal lengths below are only approximate. Parabolic mirrors can be supplied at 100% additional.

L640.	**Spherical Concave Mirror,** 50 mm diameter, 30 cm focal length	$ 15.00
L641.	**Spherical Concave Mirror,** 70 mm diameter, 50 cm focal length	25.00
L642.	**Spherical Concave Mirror,** 100 mm diameter, 60 cm focal length	32.00
L643.	**Spherical Concave Mirror,** 125 mm diameter, 75 cm focal length	50.00
L644.	**Spherical Concave Mirror,** 150 mm diameter, 100 cm focal length	75.00
L645.	**Spherical Concave Mirror,** 200 mm diameter, 120 cm focal length	125.00

CONCAVE MIRRORS

These mirrors are **silvered on the back,** and are suitable for most laboratory experiments where perfection of image is not required.

L650.	**Concave Mirror,** 37.5 mm diameter, 7.5 cm focal length	$ 1.30
L651.	**Concave Mirror,** 37.5 mm diameter, 12.5 cm focal length	1.30
L652.	**Concave Mirror,** 37.5 mm diameter, 20 cm focal length	1.30
L653.	**Concave Mirror,** 37.5 mm diameter, 100 cm focal length	1.30
L658.	**Concave Mirror,** 100 mm diameter, 75 cm focal length	5.00
L659.	**Concave Mirror,** 150 mm diameter, 75 cm focal length	10.00

For mirrors in mountings see page 82.

L660—L662

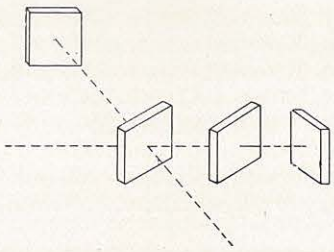
NEWTON'S RINGS PLATES

A pair of plates polished on both sides. One side of one plate is a true plane, and one side of the second plate is convex by 20 fringes. These plates are worked with care, and the rings obtained with them are truly circular so that reliable measurements can be made.

L660.	**Newton's Rings Plates,** 1 inch in diameter	$ 15.00
L661.	**Newton's Rings Plates,** 1½ inch in diameter	18.00
L662.	**Newton's Rings Plates,** 2 inches in diameter	20.00

INTERFEROMETER PLATES

As used in Michelson Interferometers. Each set consists of two stainless steel mirrors worked true to one-tenth wavelength and two rectangular matched plates plane and parallel to one-tenth wave length. Silvered glass mirrors can be supplied in place of those of stainless steel if desired.



L670—L673

L670. Set of Interferometer Plates. Consisting of two plane-parallel plates 15x23 mm and two stainless steel mirrors 15x15 mm ..... **$ 24.00**

L671. Set of Interferometer Plates. With two plane-parallel plates 20x30 mm, and two stainless steel mirrors 20x20 mm ..... **$ 35.00**

L672. Set of Interferometer Plates. With two plane-parallel plates 25x40 mm and two stainless steel mirrors 25x25 mm ..... **$ 48.00**

L672p. Set of Interferometer Plates, for projection, with two parallel plates 40x60 mm and two round stainless steel mirrors 40 mm in diameter..... **$ 90.00**

STAINLESS STEEL MIRRORS

These mirrors are well annealed and are worked true to an accuracy of one-eighth wavelength. The surfaces are unaffected by age and by fumes present in the ordinary laboratory.

L673-19. Stainless Steel Mirror 16x19 mm ..... **$ 4.00**
L673-20. Stainless Steel Mirror 20x20 mm **5.50**
L673-25. Stainless Steel Mirror 25x25 mm **7.50**
L673-40. Stainless Steel Mirror 25x40 mm **12.00**

PLANE-PARALLELS

Owing to special facilities installed in our optical shop, we are now prepared to make plane-parallels of any diameter up to 30 cm of thickness, not less than 1/30 of the diameter plane and parallel to 1/20 wavelength of sodium light. As such plane-parallels are only made to order, prices are not listed, but will be furnished on receipt of specifications as to size, thickness, and accuracy required.

FABRY AND PEROT PLATES

L674. Fabry and Perot Plates. The two faces make an angle of one minute to avoid interference. The plates are 38 mm in diameter. The inner faces are truly plane to 1/10 wavelength, the outer faces to ½ wavelength. The inner faces are indicated by an arrow on the edge ..... **$ 50.00**

The plates can be supplied with a fresh cathodic deposit of silver at $8.00 extra. Unless otherwise specified, the coat will be sufficiently heavy to give fifteen or more reflections of a lamp filament.

For complete etalons see page 58.

ACHROMATIC OBJECTIVES

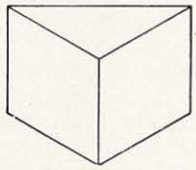
Suitable for telescopes, collimators, etc., mounted in brass cell for visual work. The objectives up to 50 mm are cemented.

L680. Achromatic Objective, 20 mm aperture, 80 mm focal length ..... **$ 6.00**
L681. Achromatic Objective, 25 mm aperture, 160 mm focal length **7.50**
L682. Achromatic Objective, 25 mm aperture, 200 mm focal length **7.50**

L683.	**Achromatic Objective,** 30 mm aperture, 250 mm focal length	12.50
L684.	**Achromatic Objective,** 30 mm aperture, 300 mm focal length	12.50
L685.	**Achromatic Objective,** 40 mm aperture, 300 mm focal length	20.00
L686.	**Achromatic Objective,** 40 mm aperture, 350 mm focal length	20.00
L687.	**Achromatic Objective,** 50 mm aperture, 650 mm focal length	25.00
L688.	**Achromatic Objective,** 60 mm aperture, 900 mm focal length	40.00
L689.	**Achromatic Objective,** 80 mm aperture, 1250 mm focal length	90.00
L690.	**Achromatic Objectve,** 100 mm aperture, 1500 mm focal length	135.00

RIGHT ANGLE REFLECTING PRISMS

Of best quality optical glass with angles of 45°, 45° 90°. The faces enclosing the right angle are square. All faces are accurately flat.



L700—L706a

Reflecting Prisms Made of Crown Glass

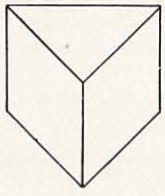
L700.	**Reflecting Prism,** 5 mm square faces	$ 4.00
L701.	**Reflecting Prism,** 10 mm square faces	6.00
L702.	**Reflecting Prism,** 15 mm square faces	7.00
L703.	**Reflecting Prism,** 20 mm square faces	10.00
L704.	**Reflecting Prism,** 25 mm square faces	14.00
L705.	**Reflecting Prism,** 30 mm square faces	18.00
L706.	**Reflecting Prism,** 40 mm square faces	30.00

Reflecting Prisms Made of Light Flint Glass

L704a.	**Reflecting Prism,** 25 mm square faces	$ 15.00
L705a.	**Reflecting Prism,** 30 mm square faces	20.00
L706a.	**Reflecting Prism,** 40 mm square faces	33.00

60° DISPERSING PRISMS FOR SPECTROSCOPES AND SPECTROMETERS

These prisms have faces proportioned to make full use of the horizontal aperture on which the resolving power depends, and nine-tenths of the vertical aperture when in the position of minimum deviation for the visual spectrum.



L710—L714c-a

60° Prisms of Flint Glass ($N_D = 1.65$) with Two Polished Faces

L710.	**60° Prism** for 15 mm objectives; height 13.5 mm, length of face 27 mm	$ 6.00
L711.	**60° Prism** for 20 mm objectives; height 18 mm, length of face 36 mm	10.00

L712.	60° Prism for 25 mm objectives; height 22.5 mm, length of face 45 mm . .	18.00
L713.	60° Prism for 30 mm objectives; height 27 mm, length of face 54 mm . . .	25.00
L714.	60° Prism for 40 mm objectives; height 36 mm, length of face 72 mm . . .	45.00

60° Prisms of Flint Glass ($N_D = 1.65$) with Three Polished faces

L710a.	60° Prism for 15 mm objectives; height 13.5 mm, length of face 27 mm	$ 10.00
L711a.	60° Prism for 20 mm objectives; height 18 mm, length of face 36 mm . .	13.50
L712a.	60° Prism for 25 mm objectives; height 22.5 mm, length of face 45 mm .	22.00
L713a.	60° Prism for 30 mm objectives; height 27 mm, length of face 54 mm . .	32.00
L714a.	60° Prism for 40 mm objectives; height 36 mm, length of face 72 mm . .	55.00

60° Prisms of Crown Glass with Two Polished Faces

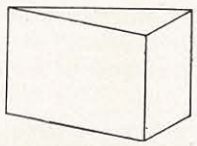
L710c.	60° Prism for 15 mm objectives; height 13.5 mm, length of face 27 mm .	$ 5.50
L711c.	60° Prism for 20 mm objectives; height 18 mm, length of face 36 mm . .	9.00
L712c.	60° Prism for 25 mm objectives; height 22.5 mm, length of face 45 mm .	16.50
L713c.	60° Prism for 30 mm objectives; height 27 mm, length of face 54 mm . .	23.00
L714c.	60° Prism for 40 mm objectives; height 36 mm, length of face 72 mm . .	40.00

60° Prism of Crown Glass with Three Polished Faces

L710c-a.	60° Prism for 15 mm objectives; height 13.5 mm, length of face 27 mm	$ 9.00
L711c-a.	60° Prism for 20 mm objectives; height 18 mm, length of face 36 mm	12.00
L712c-a.	60° Prism for 25 mm objectives; height 22.5 mm, length of face 45 mm	18.00
L713c-a.	60° Prism for 30 mm objectives; height 27 mm, length of face 54 mm	37.00
L714c-a.	60° Prism for 40 mm objectives; height 36 mm, length of face 72 mm	47.50

30 DEGREE DISPERSING PRISMS ($N_D = 1.65$)

The prisms have angles 30°, 60°, 90°, with the two long faces polished. They are used with autocollimating spectrometers, one side being silvered and are equivalent to a 60° prism of the same length of face.



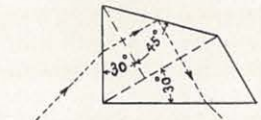
L710h—L714h

L710h.	30° Prism for 15 mm objectives; height 13.5 mm, length of face 27 mm	$ 5.00
L711h.	30° Prism for 20 mm objectives; height 18 mm, length of face 36 mm	7.00
L712h.	30° Prism for 25 mm objectives; height 22.5 mm, length of face 45 mm	14.00
L713h.	30° Prism for 30 mm objectives; height 27 mm, length of face 54 mm	20.00
L714h.	30° Prism for 40 mm objectives; height 36 mm, length of face 72 mm	36.00

CONSTANT DEVIATION PRISMS

(Pellin and Broca Type)

These prisms although made of a single piece of glass, are equivalent to two 30° prisms and one 90° reflecting prism. The ray which is at ninety degrees to the incident ray makes equal angles of incidence and emergence and thus corresponds to the ray at minimum deviation in the usual type of prism. With these prisms the telescope and collimator may remain fixed, the spectrum being displaced by rotation of the prism. The size of face is that of an equivalent 60° prism.

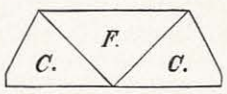


L720—L722

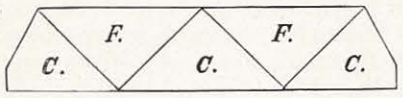
L720. Constant Deviation Prism for 30 mm objectives; face 30x42 mm. Index 1.65 ..... $ 55.00

L722. Constant Deviation Prism for 30 mm objectives; face 30x42 mm. Index 1.72 ..... $ 62.00

L723. Constant Deviation Prism for 40 mm objectives; face 40x61 mm. Index 1.65 ..... $150.00



L726—L727



L728—L729

DIRECT VISION PRISMS

L726. Direct Vision Triple Prism, 15 mm side ..... $ 20.00
L727. Direct Vision Triple Prism, 20 mm side 30.00
L728. Direct Vision Quintuple Prism, 20 mm side 50.00
L729. Direct Vision Quintuple Prism, 30 mm side 80.00

WEDGE PRISMS OF OPTICAL CROWN GLASS

For deviating a beam through a small angle. They have 35 mm square faces.

L730. Wedge Prism; Angle 2°; deviation 1° ..... $ 2.00
L731. Wedge Prism; Angle 4°; deviation 2° 2.50
L732. Wedge Prism; Angle 6°; deviation 3° 2.50
L733. Wedge Prism; Angle 8°; deviation 4° 3.00
L734. Wedge Prism; Angle 10°; deviation 5° 3.00
L735. Wedge Prism; Angle 12°; deviation 6° 3.00

FRESNEL BIPRISM

L745. Fresnel Biprism, 35x22 mm. Will give sodium bands of 18 minutes width, or .0052 f when f is the focal length of the telescope objective ..... $ 12.00

60° HOLLOW PRISMS

Made of selected plate glass, cemented to metal frame with a cement which is not acted on by carbon bisulphide.

L750. Hollow Prism; aperture 20x45 mm ..... $ 9.00
L751. Hollow Prism; aperture 30x57 mm 12.00
L752. Hollow Prism; aperture 60x70 mm 15.00
L753. Hollow Prism; aperture 100x120 mm 30.00

L756. Hollow Prism with 20 mm hole. The prism is made of a single block of glass bored and optically faced. The cover plates are plane-parallel and are attached by a sliding motion after the faces have been thoroughly cleaned and dried. The cover plates are detached by quickly heating them ..... $ 35.00

L757. Hollow Prism with 25 mm hole. Otherwise like L756 ..... 45.00
L756q. Hollow Prism with quartz cover plates. Otherwise like L756 ..... 42.00
L757q. Hollow Prism with quartz cover plates. Otherwise like L757 ..... 55.00

ACHROMATIC PRISM

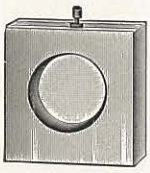
L758. Achromatic Prism. This prism consists of a crown glass prism together with a flint glass prism, the combination giving an achromatic image which is, however, deviated from the original direction. For 30 mm objectives..... $ 16.00

ABSORPTION CELLS

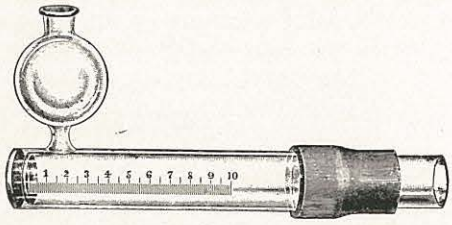
These cells have their sides accurately parallel and the thickness as specified. The sides are of good quality crystal plate glass. The cement is proof against water and alcohol.

L760. Absorption Cell, of U-shaped aperture. The cavity is 30 mm high, 20 mm wide, and 10 mm thick..... $ 6.00

L761. Absorption Cell, of U-shaped aperture. The cavity is 20 mm high, 7 mm wide, and 5 mm thick..... $ 7.50



L762—L764



L770—L770q

L762. Absorption Cell, of circular aperture, with glass stopper. The cavity is 20 mm diameter, 10 mm thick..... $ 7.00

L764. Absorption Cell, of circular aperture, with glass stopper. The cavity is 50 mm diameter, 10 mm thick..... $ 9.00

L766. Absorption Cell, square, with open top. A glass plate cemented to the bottom serves as base. Aperture 10x10 cm. Thickness about 1 cm..... $ 5.00

L767. Absorption Cell, cubical, 10x10x10 cm..... 10.00

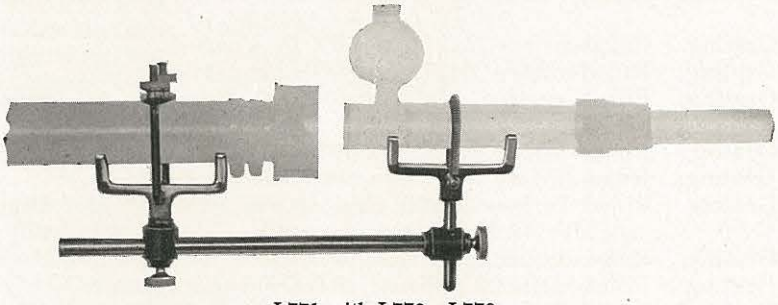
L768. Absorption Cell, cubical, 10x10x10 cm, with diagonal glass partition.. 11.50

L760q. Absorption Cell, with quartz end plates, of U-shaped aperture, 20 mm high and 20 mm wide. The cavity is 10 mm thick..... $ 32.00

L769. Hollow Lens. Double convex, 10 cm diameter..... 7.00

L770. Baly's Absorption Cell of adjustable thickness. The tube is of 15 mm clear aperture. The inner tube fits snugly within the outer tube, the latter being graduated in millimeters over a range of 10 cm. The end plates are optically worked..... $ 10.00

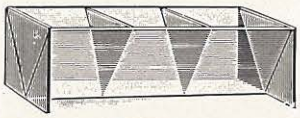
L770q. Baly's Absorption Cell with quartz end plates..... 25.00



L771 with L770—L770q

L771. Attachment for Holding Baly's Absorption Cell L770 or L770q to the collimator of a spectroscope or spectrograph..... $ 20.00

L772. Support for Baly's Absorption Cell L770 or L770q, consisting of holder for cell, similar as illustrated on page 89, mounted on vertical rod adjustable for height $ 3.80
L774. Support for Absorption Cells, adjustable in height, as illustrated on page 51 2.75



L780

TROUGH PRISM

L780. Trough Prism. Made of pieces of clear plate glass fused together with an insoluble cement. This prism may be filled with various liquids to show refraction and dispersion on a screen, using a lantern or sun light and a horizontal slit. There are three compartments, each 50 mm long and 50 mm on the side..... $ 15.00

DIFFRACTION GRATINGS

L784. Ruled Glass Grating. 500 lines per cm for direct observation of spectra. The various orders may be observed and their separation measured if a radium or lithium flame is viewed with the grating before the eye. The grating has a ruled surface 6x7 mm, the lines being 6 mm long..... $ 4.50
L786. Ruled Glass Grating, 1000 lines per cm..... 5.00

REPLICA GRATINGS

Made from high quality Rowland and Michelson gratings. The highest quality gratings are carefully selected, and excepting L790 will show the lines 5226, 707-5227, 043-5227, 362 in the solar spectrum clearly resolved in the second order. Gratings of quality **a** are guaranteed to resolve the double 5262, 419-5261, 876 in the solar spectrum.

The gratings of quality **b** are intended for projection purposes and are not suitable for use in the Spectroscope.

L790. Grating. Ruled surface, 25x21 mm, 3940 lines per cm. Highest quality..... $ 7.50
L790a. Grating. Ruled surface, 25x21 mm, 3940 lines per cm..... 6.00
L790b. Grating. Ruled surface, 25x21 mm, 3940 lines per cm..... 4.50
L791. Grating. Ruled surface 25x21 mm, 5900 lines per cm. Highest quality..... 7.50
L791a. Grating. Ruled surface 25x21 mm, 5900 lines per cm..... 6.00
L791b. Grating. Ruled surface 25x21 mm, 5900 lines per cm..... 4.50
L792. Grating. Ruled surface 47x35 mm, 5900 lines per cm. Highest quality..... 12.00
L792a. Grating. Ruled surface 47x35 mm, 5900 lines per cm..... 10.50
L792b. Grating. Ruled surface 47x35 mm, 5900 lines per cm..... 7.50
L793. Grating. Ruled surface 25x30 mm, 10,000 lines per cm. Highest quality..... 9.00
L793a. Grating. Ruled surface 25x30 mm, 10,000 lines per cm..... 7.50
L793b. Grating. Ruled surface 25x30 mm, 10,000 lines per cm..... 6.00
L794. Grating. Ruled surface 50x30 mm, 10,000 lines per cm. Highest quality..... 15.00
L794a. Grating. Ruled surface 50x30 mm, 10,000 lines per cm..... 12.00
L794b. Grating. Ruled surface 50x30 mm, 10,000 lines per cm..... 9.00

DOUBLE CONVEX LENSES

Of crown glass with edges ground. These lenses give clear images.

L800.	Double Convex Lens.	38 mm diameter, 5 cm focal length	$ .80
L801.	Double Convex Lens.	38 mm diameter, 10 cm focal length	.75
L802.	Double Convex Lens.	38 mm diameter, 15 cm focal length	.60
L803.	Double Convex Lens.	38 mm diameter, 20 cm focal length	.50
L804.	Double Convex Lens.	38 mm diameter, 30 cm focal length	.50
L805.	Double Convex Lens.	38 mm diameter, 40 cm focal length	.50
L806.	Double Convex Lens.	38 mm diameter, 70 cm focal length	.50
L806a.	Double Convex Lens.	38 mm diameter, 100 cm focal length	.50
I 807.	Double Convex Lens.	38 mm diameter, 200 cm focal length	.50
L808.	Double Convex Lens.	38 mm diameter, 400 cm focal length	.50
I 810.	Double Convex Lens.	50 mm diameter, 12.5 cm focal length	.80
I 811.	Double Convex Lens.	50 mm diameter, 25 cm focal length	.80
L812.	Double Convex Lens.	50 mm diameter, 35 cm focal length	.80
L815.	Double Convex Lens.	75 mm diameter, 15 cm focal length	1.50
L816.	Double Convex Lens.	75 mm diameter, 30 cm focal length	1.50
L818.	Double Convex Lens.	100 mm diameter, 25 cm focal length	2.50
I 819.	Double Convex Lens.	100 mm diameter, 50 cm focal length	2.50
L820.	Double Convex Lens.	100 mm diameter, 150 cm focal length	2.50
L821.	Double Convex Lens.	150 mm diameter, 150 cm focal length	5.50

PLANO CONVEX LENSES

L822.	Plano Convex Lens.	5 mm diameter, 7.5 mm focal length	$ 3.00
L823.	Plano Convex Lens.	8 mm diameter, 10 mm focal length	2.50
L824.	Plano Convex Lens.	11 mm diameter, 16 mm focal length	2.00
L825.	Plano Convex Lens.	11 mm diameter, 20 mm focal length	2.00
L826.	Plano Convex Lens.	8 mm diameter, 30 mm focal length	1.50
L827.	Plano Convex Lens.	13 mm diameter, 30 mm focal length	1.50
L828.	Plano Convex Lens.	13 mm diameter, 40 mm focal length	1.00
L831.	Plano Convex Lens.	16 mm diameter, 40 mm focal length	1.00
L832.	Plano Convex Lens.	13 mm diameter, 75 mm focal length	1.00
L833.	Plano Convex Lens.	16 mm diameter, 75 mm focal length	1.00
L834.	Plano Convex Lens.	27 mm diameter, 48 mm focal length	2.00
L835.	Plano Convex Lens.	27 mm diameter, 60 mm focal length	2.00

PLANO CONVEX CONDENSING LENSES

These lenses are sufficiently good for condensing light, but not for forming clear images. They are of 114 mm diameter.

L840.	Condensing Lens.	16.5 cm focal length	$ 1.50
L841.	Condensing Lens.	19 cm focal length	1.50
L842.	Condensing Lens.	25.4 cm focal length	1.50

DOUBLE CONCAVE LENSES

Of optical crown glass with edges ground.

L850.	Double Concave Lens.	38 mm diameter, 10 cm focal length	$ .60
L851.	Double Concave Lens.	38 mm diameter, 15 cm focal length	.60
L852.	Double Concave Lens.	38 mm diameter, 20 cm focal length	.60
L853.	Double Concave Lens.	38 mm diameter, 30 cm focal length	.60

Note: Concave lenses of other focal length or different diameters can be furnished promptly.

CYLINDRICAL LENSES

These are 42 mm square and are ordinarily supplied with unground edges.

L862. **Cylindrical Lens.** Plano convex, 140 mm focal length..... $ 2.00
L863. **Cylindrical Lens.** Plano convex, 250 mm focal length..... 1.50
L864. **Cylindrical Lens.** Plano convex, 400 mm focal length..... 1.50
L865. **Cylindrical Lens.** Plano convex, 500 mm focal length..... 1.50
L866. **Cylindrical Lens.** Plano convex, 1000 mm focal length..... 1.50

DEMONSTRATION LENSES

L870. **Set of Six Lenses,** each of 38 mm diameter and 150 mm focal length. Comprising one bi-convex, one plano-convex, one concave-convex, one convexo-concave, one plano-concave, and one double concave lens..... $ 2.00

L871. **Set of Six Lenses,** like L870, but with lenses of 50 mm diameter..... 3.25

L872. **Set of Ten Lenses,** each of 38 mm diameter. Comprising one double convex, one double concave, one plano-convex, one plano-concave, one meniscus convex, one meniscus concave, one cylindrical convex, one cylindrical concave, one sphero-cylindrical, and one prismatic lens..... $ 6.00

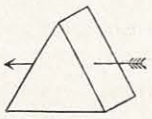
L875. **Achromatic Lens.** Consisting of a double convex crown and plano-concave flint component, uncemented, for demonstrating the construction of an achromatic lens. The components are of the best optical glass and the surfaces carefully worked. They are 54 mm in diameter and of about 18 cm focal length..... $ 6.00

QUARTZ OPTICAL PARTS

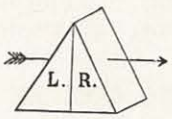
THIRTY DEGREE QUARTZ PRISMS

With two polished faces, the shorter one being at right angles to the optic axis. These can be used in quartz spectrographs of the Littrow type if coated on the back with a reflecting film and give under these conditions no doubling of the lines.

L890-16. **30° Quartz Prism.** Height 16 mm, length of face 25 mm..... $ 15.00
L890-20. **30° Quartz Prism.** Height 20 mm, length of face 30 mm..... 30.00
L890-30. **30° Quartz Prism.** Height 30 mm, length of face 45 mm..... 60.00
L890-40. **30° Quartz Prism.** Height 40 mm, length of face 65 mm..... 100.00



L900



L908

SIXTY DEGREE QUARTZ PRISM

L900. **60° Quartz Prism.** With refracting edge perpendicular to the optic axis. Height 14 mm, length of face 25 mm. This prism gives a doubling of the lines, which must be allowed for in use..... $ 15.00

CORNU DOUBLE QUARTZ PRISMS

Consisting of two thirty degree prisms, one of left and one of right turning quartz, accurately cut with respect to the crystallographic axis. These give at minimum deviation a spectrum free of doubling. The inner faces are held together by cohesion, avoiding false images due to successive reflections.

L908-16. **Cornu Prism.** Height 16 mm, length of face 25 mm..... $ 36.00
L908-20. **Cornu Prism.** Height 20 mm, length of face 30 mm..... 70.00

L908-30. **Cornu Prism.** Height 30 mm, length of face 45 mm..... 140.00
L908-40. **Cornu Prism.** Height 40 mm, length of face 65 mm..... 235.00

TOTAL REFLECTING QUARTZ PRISM

L914. **Total Reflecting Quartz Prism,** 45° angle with faces 10 mm square. The axis is parallel to the polished faces..... $ 9.00

WOLLASTON PRISM

L290. **Wollaston Prism** of Quartz face, 20 mm square. Separation of images about 42 minutes..... $ 20.00

QUARTZ WINDOWS

Suitable for absorption cells, vacuum tubes, etc.
L920-10. **Quartz Window,** 10 mm diameter..... $ 6.00
L920-20. **Quartz Window,** 20 mm diameter..... 12.00
L920-30. **Quartz Window,** 30 mm diameter..... 20.00
L920-40. **Quartz Window,** 40 mm diameter..... 30.00

PLANE-PARALLEL QUARTZ PLATE

L927. **Plane-Parallel Quartz Plate.** 42x54 mm, 5 mm thick. Commonly used with tinfoil amalgam backing as a reflector in monochromators, etc..... $ 75.00

BICONVEX QUARTZ LENSES

Cut perpendicular to the optic axis.
L930-25. **Biconvex Quartz Lens.** Diameter 25 mm, focal length 200 mm.. $ 15.00
L930-25a. **Biconvex Quartz Lens.** Diameter 25 mm, focal length 100 mm.. 18.00
L930-30. **Biconvex Quartz Lens.** Diameter 30 mm, focal length 250 mm.. 24.00
L930-40. **Biconvex Quartz Lens.** Diameter 40 mm, focal length 300 mm.. 36.00
L930-50. **Biconvex Quartz Lens.** Diameter 50 mm, focal length 400 mm.. 50.00

SPHERO-CYLINDRICAL QUARTZ CONDENSING LENS

L935. **Sphero-Cylindrical Quartz Condensing Lens.** For throwing a line image of a point source on a slit. 25 mm diameter. Will cover a slit 25 mm long..... $ 16.00

ABSORPTION CELL WITH QUARTZ END PLATES

L938. **Absorption Cell with Quartz End Plates.** Consists of a tube 4 cm long with screw end caps which carry quartz plates of 15 mm aperture..... $ 26.00

NICOL PRISMS

Nicol Polarizing Prisms, Rhomboidal Section

With oblique end faces. Angular extent of the polarized field about 22°. The sizes given below are measured across the sides of the prisms.
L940a. **Nicol Prism,** 6 mm aperture..... $ 6.00
L940b. **Nicol Prism,** 8 mm aperture..... 9.00
L940c. **Nicol Prism,** 10 mm aperture..... 13.00
L940d. **Nicol Prism,** 15 mm aperture..... 33.00

Nicol Polarizing Prisms, Rectangular Section

With oblique end faces. Angular extent of the polarized field about 23°.

L942a. Rectangular Nicol Prism, 8 mm aperture ..... $ 12.00
L942b. Rectangular Nicol Prism, 10 mm aperture 18.00
L942c. Rectangular Nicol Prism, 15 mm aperture 55.00

THOMPSON POLARIZING PRISMS

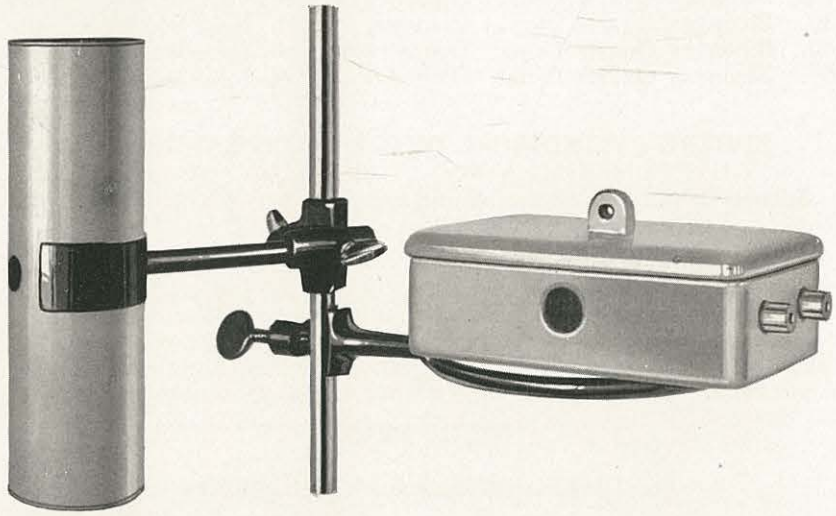
Of square section with square ends. Angular extent of the polarized field about 30°. The length of the prism is three times the width of the side.

L944a. Thompson Polarizing Prism, 5 mm aperture ..... $ 10.00
L944b. Thompson Polarizing Prism, 7 mm aperture 21.00
L944c. Thompson Polarizing Prism, 8 mm aperture 33.00

LIGHT SOURCES, SPECTRUM TUBES AND ACCESSORIES

SPECTRUM TUBES, STRAIGHT FORM

L500. Spectrum Tube, unfilled. With two stop-cocks and sealed-in straight electrodes ..... $ 5.00
L504H. Spectrum Tube, containing Hydrogen 4.00
L504N. Spectrum Tube, containing Nitrogen 4.00
L504He. Spectrum Tube, containing Helium 8.00
L504Na. Spectrum Tube, containing Sodium. Must be heated to vaporization 4.00
L504Tl. Spectrum Tube, containing Thallium. Must be heated to vaporization 4.00
L504Cd. Spectrum Tube, containing Cadmium. Must be heated to vaporization ..... $ 4.00
L504Hg. Spectrum Tube, containing Mercury. Must be heated to vaporization ..... $ 4.00

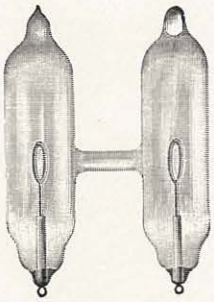


L506 L510

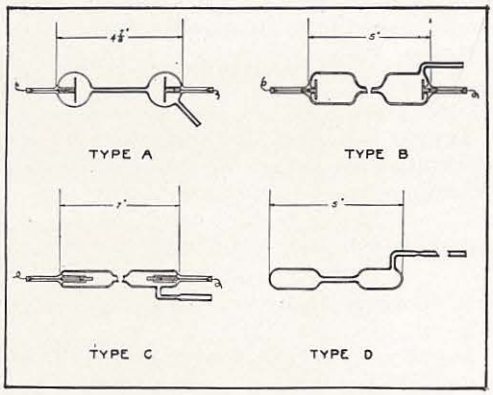
L506. Heating Box for L504, consisting of an enameled cylinder inside which the spectrum tube is suspended, a hole being provided for viewing the capillary portion. A burner flame playing against the side of the cylinder heats the contained metal to vaporization ..... $ 3.50

SPECTRUM TUBES, H-FORM

The light comes from the end of the glowing column of vapor giving an intense illumination free from the lens-effect of the capillary.



L508



L515a—L515d

L508He. Spectrum Tube, H-Form, containing Helium ..... $ 12.00
L508Ne. Spectrum Tube, H-Form, containing Neon 12.00
L508A. Spectrum Tube, H-Form, containing Argon 12.00
L508N. Spectrum Tube, H-Form, containing Nitrogen 5.50
L508H. Spectrum Tube, H-Form, containing Hydrogen 5.50
L508Na. Spectrum Tube, H-Form, containing Sodium. Must be heated to vaporization ..... $ 5.50
L508Tl. Spectrum Tube, H-Form, containing Thallium. Must be heated to vaporization ..... $ 5.50
L508Cd. Spectrum Tube, H-Form, containing Cadmium. Must be heated to vaporization ..... $ 5.50
L508Hg. Spectrum Tube, H-Form, containing Mercury. Must be heated to vaporization ..... $ 5.50

L510. Heating Box for L508. The tube is held in the box so as to permit easy attachment of the electrical connections which pass through lava bushings. A round hole in the side permits viewing the column end-on. The box can be set on a ring stand and heated from below by a burner flame ..... $ 6.50

VITREOSIL (FUSED PURE QUARTZ) SPECTRUM TUBES

Designed along lines approved by the Bureau of Standards for use with high electrical input and for investigations with ultra-violet light.

The connections of the electrodes with lead-in wires is accomplished by a patented lead seal which constitutes an absolutely vacuum tight electrical inlet and one in which the possibility of breakage resulting from thermal expansion of a metallic element, is eliminated.

L515a. Vitreosil Spectrum Tube, with Platinum Electrode for use with the more active gases. Price on application.
L515b. Vitreosil Spectrum Tube, with Aluminum Disc Electrode ..... $ 30.00
L515c. Vitreosil Spectrum Tube, with Aluminum Rod Electrode 27.00
L515d. Vitreosil Spectrum Tube, Electrodeless 10.00

ELECTRICAL ACCESSORIES FOR SPECTRUM TUBES

E1813. Spark Coil, ½ in Spark, equipped with pole changing switch. The circuit breaker is a mechanical breaker with platinum points which can be readily replaced. The adjustment is so designed that vibration will not disturb it. The coil may be operated on three or four dry cells or a small bell ringing transformer ..... $ 6.00

E1814. Ruhmkorff Induction Coil, 1-in Spark. With automatic breaker, and of durable make, on highly polished mahogany base; giving a heavy spark ..... $ 18.00

E1815. Ruhmkorff Induction Coil, 2-in Spark. Otherwise like E1814 ..... 32.00

E1816. Ruhmkorff Induction Coil, 3-in Spark. A special hammer vibrator circuit breaking mechanism gives uniform operation and high efficiency. Operates on 4 to 6 volts, and requires about 5 amperes current ..... $ 50.00

E1818. Ruhmkorff Induction Coil, 6-in Spark. Operates on 4 to 6 volts, and requires about 6 amperes current. Otherwise similar to E1816 ..... $ 85.00

E550. Edison Storage Battery. For operating spark and induction coils, consisting of 5 cells in wood tray, 6½ volts, 40 ampere hours capacity; total weight 27¾ lbs. Dimensions: 9-5/8 in x 6-1/8 in x 10¾ in ..... $ 43.25

E855. Tungar Rectifier. For charging batteries on A. C. 105 to 125 volts, 60 cycle, 6 amperes, 15 volts at full load. Operates satisfactorily on reduced load, making it especially suitable for charging batteries of different sizes ..... $ 28.00

SUPPORTS FOR SPECTRUM TUBES AND SPARK TERMINALS

L520. Support for Spectrum Tubes, to accommodate tubes of the long form (Plucker tubes) up to 25 cm, in length ..... $ 8.00

L522. Support for Spark Terminals. The clips for holding the metal electrodes are readily adjusted and are well insulated. Illustration on p. 100 ..... $ 15.00

L523. Support for Spectrum Tubes and Spark Terminals, combined, mounted on a substantial tripod support on which it can be rotated ..... $ 45.00

SPARKING TUBE

L524. Sparking Tube for Solutions ..... $ 3.00

SPECTRUM CHARTS

L532a. Spectrum Chart, 100x67 cm, mounted on linen with rollers, in color print, according to drawings of Prof. Kirchhoff and Bunsen, containing the spectrum of the sun and of Ka, Rb, Cs, Tl, Na, Li, Ca, Sr, Ba ..... $ 6.00

L532b. Spectrum Chart, in every respect like L532a, but containing the spectrum of Jn, C, Bo, Mn, Pb, Cu, Co, Ni, Fe ..... $ 6.00

COLORED GLASS

L540. Red Glass, 5x5 cm ..... $ .50
L542. Blue Glass, 5x5 cm ..... .50
L544. Green Glass, 5x5 cm ..... .50

LAMPS AND BURNERS

S2163. Candle Holder, of brass on rod 10 mm diameter, 10 cm long ..... $ .80

S2196. Electric Lamp with Shade. An incandescent lamp of the Bunghole type, mounted on Edison receptacle with fiber disc and 10 mm support rod, fitted with 5 feet of cord and Edison plug. The shade is made of steel, white enameled inside. For illustration see page 83 ..... $ 5.25

L464. Gas Burner on rod 10 mm diameter, 10 cm long ..... .80

L466. Welsbach Lamp with mantle and chimney on rod 10 mm diameter, 10 cm long ..... $ 3.00

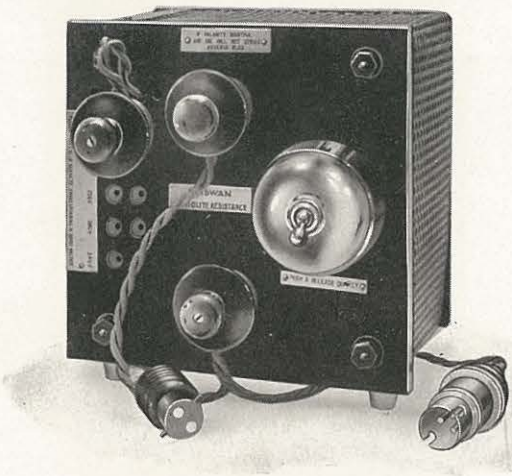
L468. Socket for Standard Incandescent Lamps, mounted with fibre disc on 10 mm diameter rod, 10 cm long, with 5 feet of cord and standard plug ..... $ 4.00

L472. Standard Candles. These candles are made of sperm, 7/8 inch in diameter and burn 120 grains per hour. They are 9½ inches long and will burn nine hours or more. Each ..... $ .35

L512. Cooper Hewitt Labarc. This is a powerful quartz mercury arc which can be operated on 110 volts, either alternating or direct current. The illuminated area of the tube is ¼ in. wide by ¾ in. high and is of the same intrinsic brilliancy as the larger arcs. An ad-

justable slit to limit this area is provided. The lamp is adjustable in height. This arc is the most convenient and practical source of monochromatic light at present available. A removable mica window absorbs the ultra-violet light. Clips on the mounting are provided for holding light filters. For illustration see page 67 ..... **$150.00**

L546



L548

L546. "Pointolite" Incandescent Lamp. This is an ideal lamp for projection work; it is also excellent for use in conjunction with microscopes, galvanometers and oscillographs; for color matching, stage illumination, photographic work, gauge testing, the study of microstructure of metals, and for many other purposes, when an intensely brilliant, white light from a very small source is required.

This lamp is a Direct Current Arc Incandescent Lamp, consisting of a special starting device known as the "Ionizer", and of two fused tungsten electrodes, the whole being enclosed in a glass bulb filled with an inert gas at a low pressure. The light source is of a point nature, far superior in intense concentration and uniformity to anything previously obtainable in incandescent lamps.

100 c. p., 2½ inch bulb, 1.35 amp., 2 Electrode, consumption 0.65 watt c. p., ionizing current 7.0 amps ..... **$ 13.50**

L547. "Pointolite" Incandescent Lamp, similar to the above but of 3 inch bulb **13.50**

L548. Standard Universal Resistance, adaptable to all circuits with Plug, Switch, Holder, Adapter, and Flexible, for 100 C. P. lamps ..... **$ 40.00**

L549. Nernst Lamp, single glower. This lamp, on account of the intensity and whiteness of its light, is very desirable for spectroscope and polariscope work. The single glower type is also very suitable for demonstration work with mirror galvanometers. The operating mechanism contains the "ballast" and heater cutout, and will fit any Edison socket. This part must be in a vertical position, when the lamp is started. Size 66 watt, for 110 volts; gives about 60 mean hemispherical candle power. Oxidized copper finish, with 3 inches clear glass ball and Edison screw socket. Complete ..... **$ 7.00**

L549a. Glower only for above **4.25**

L549b. Ballast only for above **4.25**

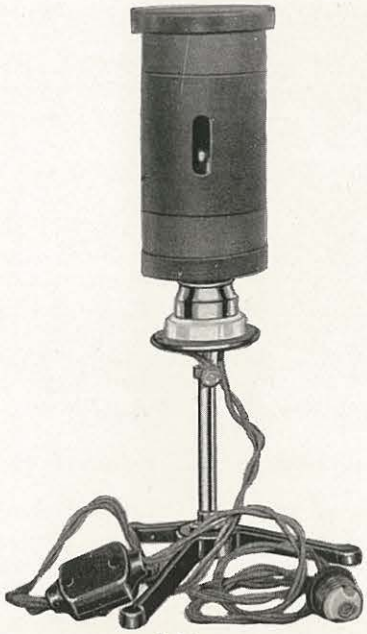
L549c. Burner, with heater mounted **2.50**

L550. Electric Lamp. A 110 volt incandescent lamp with diffusing surface mounted in an Edison socket which is carried on a 10 mm support rod on a tripod with height adjustment. The lamp is enclosed in a black metal hood with a circular aperture of 5 cm diameter. Complete with 8 feet of connecting cord, standard screw plug and snap switch ..... **$ 14.00**

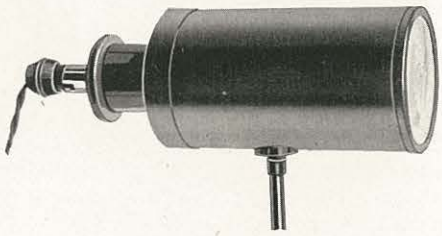
L550a. Electric Lamp. Like L550 but without the tripod support **12.00**

L551. Electric Lamp with Single Straight Filament. Useful in demonstrating diffraction and interference phenomena where it can replace the slit; useful also for projection galvanometer. Bulb only ..... **$ 3.50**

L553. Light Source for Optical Demonstration. A concentrated filament lamp placed at the focus of a short focus lens giving an intense beam of parallel light. In a moderately dark room the path of the rays can be clearly seen, making the lamp very useful for demonstration of the laws of reflection, refraction, etc. The filament can be focused with a slit before the lens, this makes an excellent source for projection galvanometers, etc. To operate on 6 to 8 volts A. C. or D. C. A cord 7 feet long is provided ..... **$ 13.50**

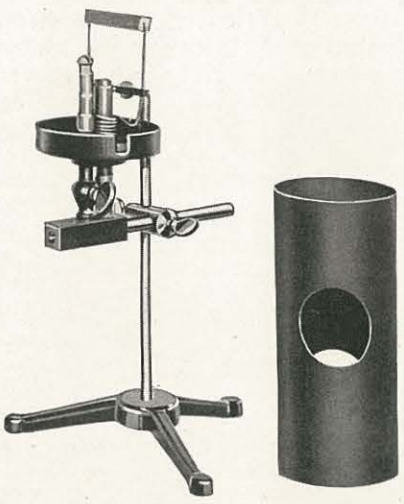


L550

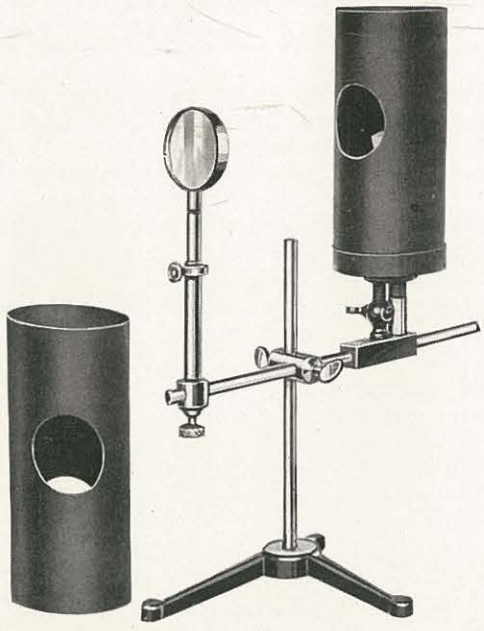


L553

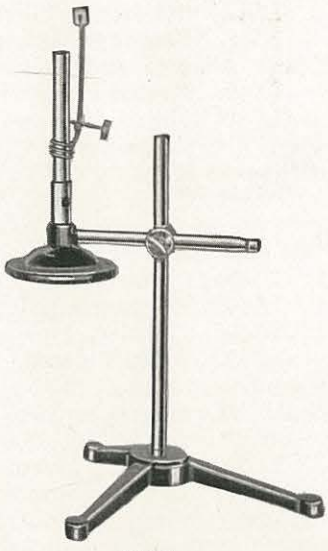
L554. Transformer, Step-down, 110 to 8 volts, 60 cycles, for use with L553 ... **1.25**
L555. Resistance for use with L553 on direct current 110 volt..... **5.00**



L560



L562



L565

L560. Monochromatic and White Light Burner. An ordinary gas burner mounted in front of a Bunsen Burner with monochromatic flame attachment. The latter consists of an asbestos block which can be soaked in an appropriate salt solution to give the corresponding flame spectrum. The white light burner has a separate stopcock for turning either on or off ..... $ 15.00

L562. Monochromatic and White Light Burner with Lens Attached. Except for the lens, like L560. This burner has been particularly designed for use with the Michelson Interferometer. The lens can be focused within a wide range ..... $ 18.00

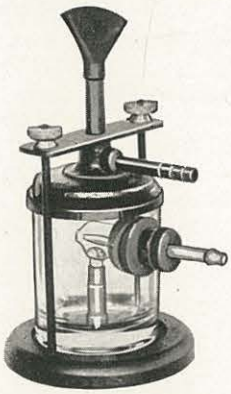
L563. Monochromatic Burner. Like L560, but without the white light burner ..... $ 12.50

L564. Monochromatic Flame Attachment. This attachment will fit any standard 7/16 in Bunsen burner tube. A block of asbestos is carried by a wire support which slips over the burner tube, being provided with a screw for moving the asbestos in or out of the flame. The asbestos can be readily detached and soaked in a salt solution giving the desired color to the flame. The use of separate blocks for various solutions is recommended (see L567) ..... $ 2.50

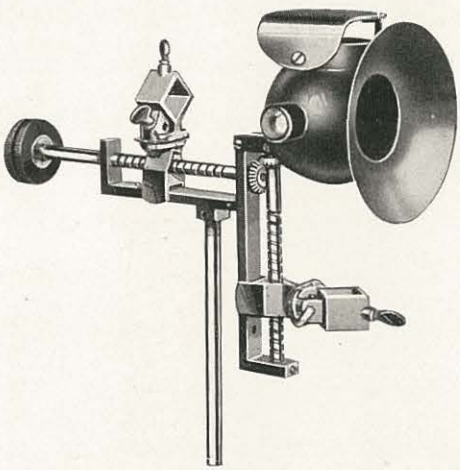
L565. Monochromatic Flame Burner. A Bunsen burner with Monochromatic Flame Attachment, mounted by means of a V-groove right angle clamp on a 10 mm rod, supported by tripod stand with legs of 9 cm length ..... $ 5.50

L565a. Monochromatic Flame Burner. Consisting of a Bunsen burner mounted on a support piece with index for single rod optical bench, and fitted with wire support for asbestos block. The latter serves to hold salt solution giving the desired color to the flame. See illustration on page 83 ..... $ 6.00

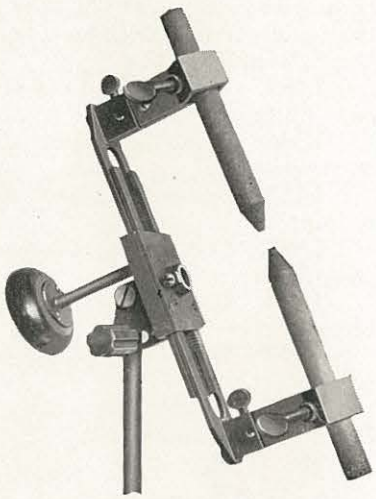
L567. Extra Asbestos Block, for Monochromatic Flame Attachment L564 and for Monochromatic Burners L560, L562, L563, L565, L565a ..... $ .25



L568



L574



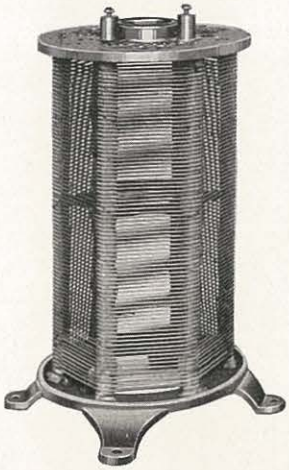
L575

L568. Colored Flame Burner. A Bunsen burner, a vessel for solution and an atomizer are mounted together. The atomizer when attached to an air supply blows a fine spray of the solution in with the gas, giving a bright, broad flame with the color characteristic of the salt used. With a slit the flame is viewed edgewise giving a considerable intensity $ 8.50

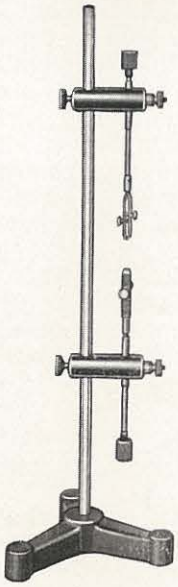
L574. Arc Lamp. With Carbons at right angles to each other and separately adjustable ..... $ 14.50

L575. Arc Lamp. With Carbons in line with each other. The distance is adjustable by a rack and pinion motion which displaces both Carbons symmetrically ..... $ 14.50

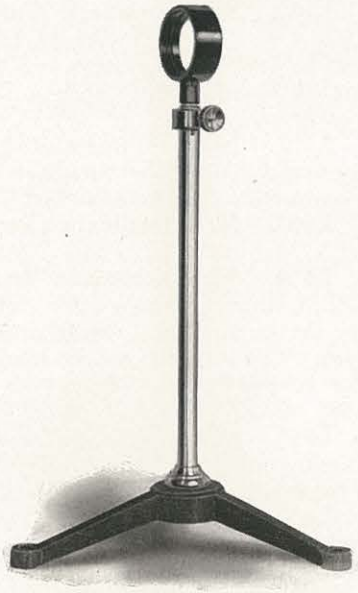
L576. Rheostat, for use as ballast with Arc Lamps L574, L575. A stove-pipe rheostat of fixed resistance for 110 volts. Carrying capacity 15 amperes ..... $ 13.50



L576



L522



L585—L598

CONDENSING LENSES ON ADJUSTABLE SUPPORTS

These condensing lenses are supplied in either glass or quartz, plano convex, biconvex or spherocylindrical. They are useful for giving uniform illumination to the slit of any spectroscopic apparatus. The spherocylindrical lenses give uniform illumination over the whole length of the slit.

L585. Condensing Lens of Glass, Plano Convex, diameter 38 mm, focal length 100 mm, on support ..... **$ 20.00**

L586. Condensing Lens of Glass, Plano Convex, diameter 38 mm, focal length 150 mm, on support ..... **$ 20.00**

L587. Condensing Lens of Glass, Plano Convex, diameter 38 mm, focal length 200 mm, on support ..... **$ 20.00**

L588. Condensing Lens of Glass, Biconvex, diameter 38 mm, focal length 100 mm, on support ..... **$ 20.00**

L589. Condensing Lens of Glass, Biconvex, diameter 38 mm, focal length 150 mm, on support ..... **$ 20.00**

L590. Condensing Lens of Glass, Biconvex, diameter 38 mm, focal length 200 mm, on support ..... **$ 20.00**

L591. Condensing Lens of Glass, Sphero Cylindrical, diameter 38 mm, focal length 200 mm, on support ..... **$ 25.00**

CONDENSING LENSES OF QUARTZ

L592. Condensing Lens of Quartz, Plano Convex, diameter 38 mm, focal length 100 mm, on support ..... **$ 40.00**

L593. Condensing Lens of Quartz, Plano Convex, diameter 38 mm, focal length 150 mm, on support ..... **$ 40.00**

L594. Condensing Lens of Quartz, Plano Convex, diameter 38 mm, focal length 200 mm, on support ..... **$ 40.00**

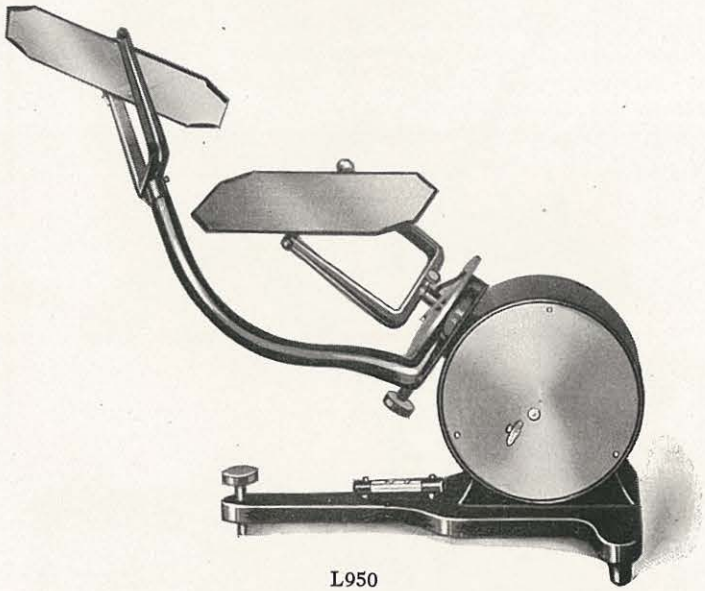
L595. Condensing Lens of Quartz, Biconvex, diameter 38 mm, focal length 100 mm, on support ..... **$ 40.00**

L596. Condensing Lens of Quartz, Biconvex, diameter 38 mm, focal length 150 mm, on support ..... **$ 40.00**

L597. Condensing Lens of Quartz, Biconvex, diameter 38 mm, focal length 200 mm, on support ..... **$ 40.00**

L598. Condensing Lens of Quartz, Sphero Cylindrical, diameter 38 mm, focal length 200 mm on support ..... **$ 45.00**

HELIOSTATS

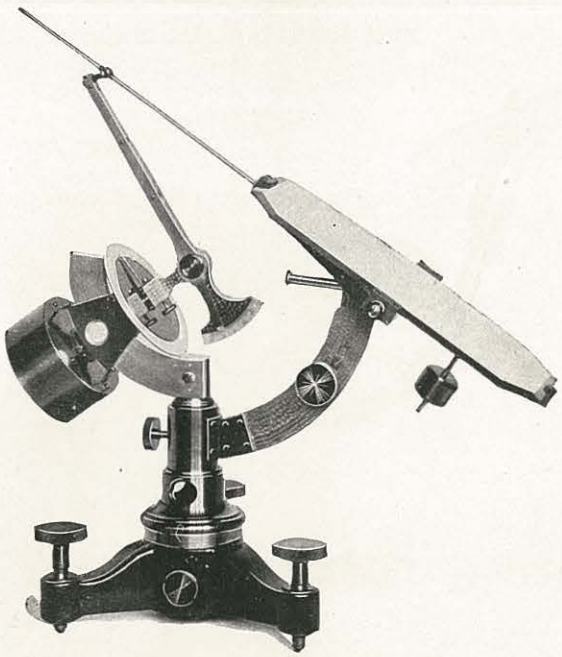


L950

L950. Two-Mirror Heliostat. The moving mirror reflects the sunlight directly along the polar axis to the stationary mirror, which may be adjusted to give the beam a convenient direction. The mirrors are of crystal plate, 10x20 cm. The clock work is strong and is fully incased. The polar axis carries an hour circle reading to 4 minutes. Latitude adjustment is provided, this adjustment, being made by us for each instrument for the latitude specified ..... **$ 90.00**

L952

L952. Two-Mirror Heliostat. This instrument is similar to L950, but is simpler in construction. The moving mirror is 6.5x12.5 cm, the stationary one is 9.4 cm in diameter. The latitude adjustment is made by us for a level table top, no level being provided on the instrument. The instrument should consequently be set on a surface which should be level..... **$ 55.00**

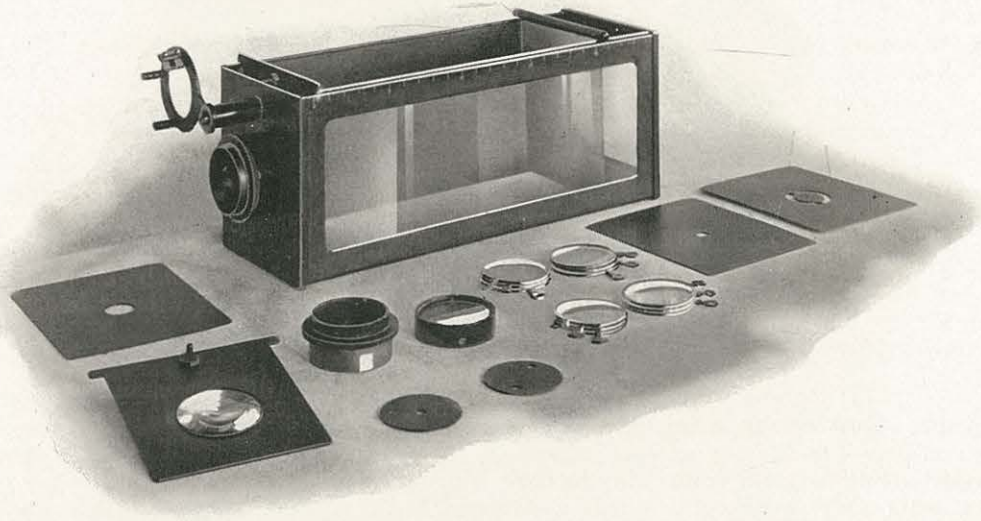


L953

L953. Foucault Heliostat. The instrument is mounted on a heavy base fitted with leveling screws, a circular level being set in the center of the column. The Heliostat is adjustable for different latitudes and fitted with divided latitude arc, with hour circle and declination arc. The whole instrument can be rotated on the tripod for azimuth adjustment. The clock work is very strong and will keep good time. The mirror is 25 by 12.5 cm and is made of select French crystal plate. The beam of light is easily adjustable in every direction. The instrument is substantially constructed and nicely finished..... **$325.00**

Note: We have designs for larger Heliostats of the Foucault type and Coelostats with optically plane mirrors and shall be glad to submit details and prices.

KUEHNE EYE MODEL

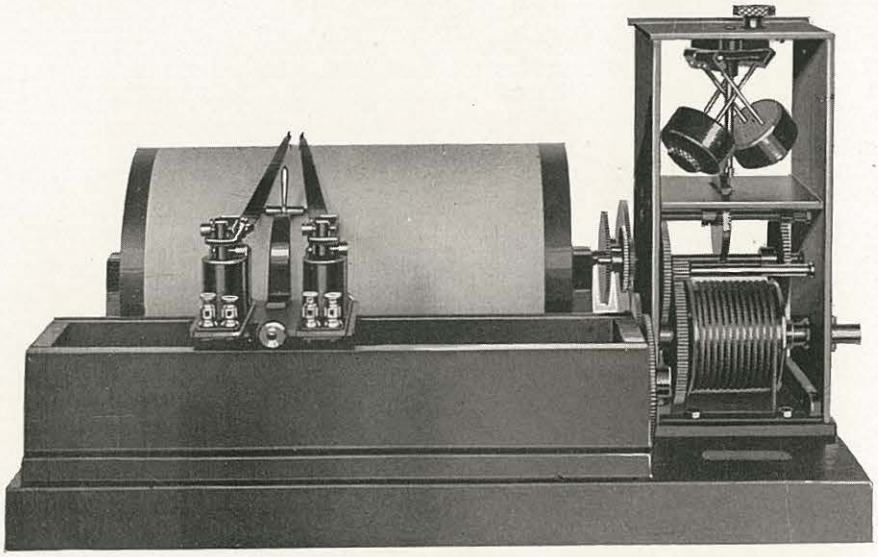


L960

L960. Kuehne Eye Model. With this instrument the optical construction of the eye, its normal and abnormal condition and the necessary corrections can be demonstrated and studied. The model consists of a tank with glass sides and back, and a cornea at the front, with extra parts as follows: one cylindrical lens for throwing astigmatism into the eye, two eye lenses representing the accommodation for near and far objects, six spherical and six cylindrical correcting lenses, set of diaphragms for demonstrating spherical aberration, Scheiner's experiment, etc. Complete with fluorescent dye for making the path of the rays visible, and full instructions ..... **$ 55.00**

APPENDIX

TIME RECORDING INSTRUMENTS



A352

CHRONOGRAPHS

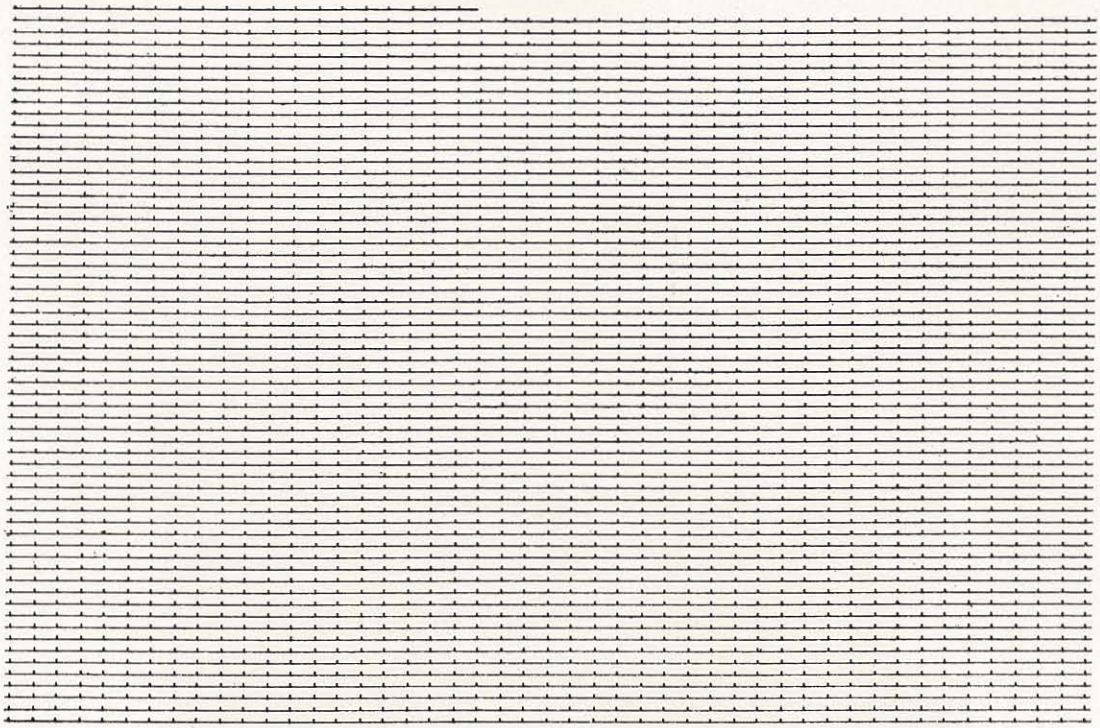
A350. Drum Chronograph with One Recording Pen. The clock, the most important part of the chronograph, is fitted with a friction governor of our own design and allows such perfect regulation that the second records come out in a beautiful straight line along the cylinder, not showing a variation of 0.05 of a second in a full hour's run. The clock is dust-proof enclosed and the whole instrument is protected by a glass case when not in use. The drum is 152 mm in diameter and 250 mm long and is geared for two speeds 60 and 30 seconds per revolution. Using the slow speed (60 sec. per rev.) the drum will run for a full hour and the space between two seconds is exactly 8 mm. The carriage for the pens travels on a substantial bed plate and is moved by a screw from which it can be easily disengaged. The pens are provided with every necessary adjustment and are operated by electro-magnets on either closed or open circuit. The records are traced on a special paraffine coated paper, the tracing points being of hardened steel. 100 sheets of special record paper are included **$420.00**

A352. Chronograph with Two Pens, glass case, 100 sheets of paper **450.00**

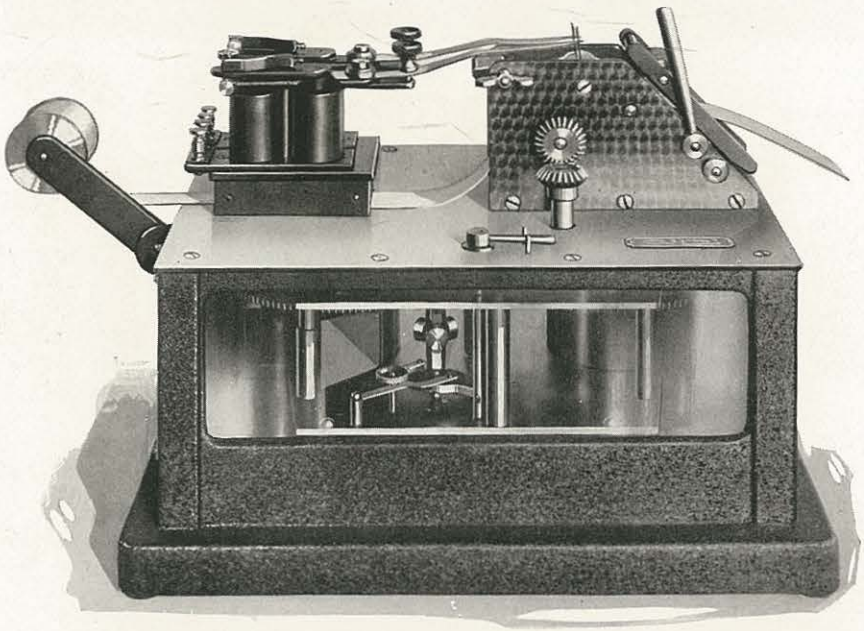
A354. Chronograph with Three Pens, Drum 35 cm long, glass case, 100 sheets of paper **$500.00**

A360. Reading Scale for Chronograph Sheets, 60 seconds long divided to 0.1 seconds ..... **$ 10.00**

A362. Record Paper, per 100 sheets **5.00**



Etching made direct from one of our chronograph sheets (reduced about 8:3) showing the accuracy of the clock work



A365

A365. Chronograph with Two Pens. The record is made on a moving tape of coated paper, operated by a strong spring driven clock movement, regulated by friction governor. The tape travels at a speed of 10 mm per second and at this rate the clock will run about one hour at uniform speed. Slower or higher speeds can be obtained by adjusting the governor.

This form of chronograph is very convenient to use and easily portable..... **$350.00**

A365a. Chronograph with Three Pens **380.00**

A366. Roll of Paper for use with Chronographs A365, A365a, 28 mm wide about 50 meters long ..... **$ 2.00**

A380. Printing Chronograph. This chronograph was designed by us and furnished to the U. S. Naval Observatory, the Washburn Observatory of the University of Wisconsin and the U. S. Army. The instrument will save the difference in its cost in a short time if observations are made regularly. The minutes, seconds and hundredths of seconds are printed in figures on a narrow strip of paper and several thousand observations can be recorded before the paper has to be removed. The space required for two records is about 1 cm. An astronomical regulator clock is used in connection with the instrument, it controls the speed of the driving clock of the chronograph which is similar to the one used with our drum chronographs. This control assures an absolute accuracy of 0.01 seconds. The instrument is mounted on an iron pillar which gives room for the clock weights and may also hold the necessary batteries. Price on application.

Note: Details of this instrument, with diagrams, etc. will be sent to interested parties.

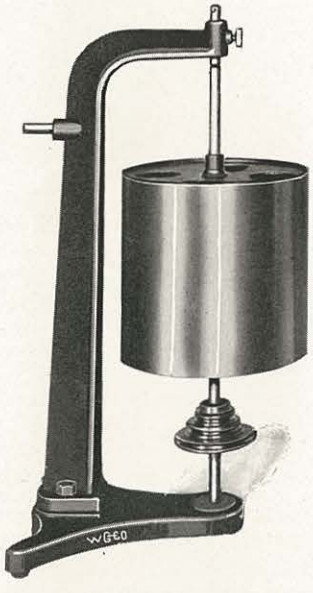
CHRONOGRAPHS FOR SPECIAL PURPOSES

We have on hand designs of Chronographs for various special purposes, to record very small time intervals of less than one thousandth of a second, such as required to record all kinds of high velocities. Correspondence solicited.

RECORDING DRUMS (KYMOGRAPHS)

L5003

L5005

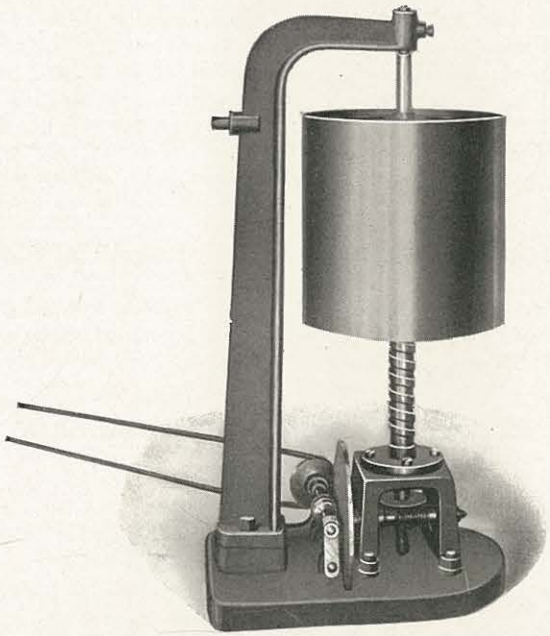


L5007

L5003. Recording Drum. The drum is driven by a spring clock movement, running twenty-four hours, and it may be used vertically or horizontally. Speeds of six hours, twelve hours and twenty-four hours per revolution, can be obtained by means of change gears. The drum has a diameter of 15 cm, a length of 15 cm, and can be shifted and clamped on any part of the shaft..... $ 60.00

L5005. Recording Drum. Convenient for recording tuning fork vibrations, etc., similar to the preceding one but driven by spring motor, and giving speeds ranging from one revolution in about three seconds to one revolution in two minutes..... $100.00

L5007. Recording Drum. A drum of the same size as L5003, is mounted on a shaft, on which it can be shifted. A cone pulley on the shaft transmits the power..... $ 30.00

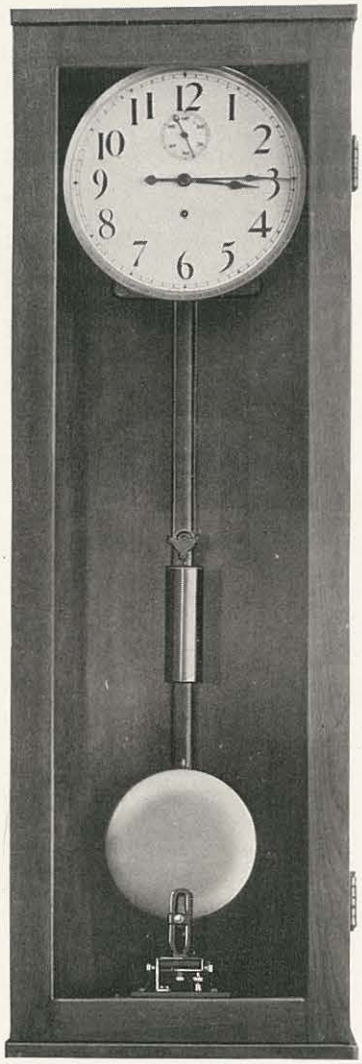


L5009

L5009. Recording Drum. Belt driven. The drum is of the same size as the foregoing, but is shifting while revolving so that tracings up to 6 meters in length can be obtained. Power is transmitted by means of a friction disc and worm wheel and great variations in speed can be obtained. The friction disc can be released and the drum stopped instantly. The drum may be used in any position..... $ 90.00

CLOCKS

L1012. Laboratory Clock. This is an eight day clock fitted with a high grade movement, weight driven, beats seconds, Graham dead-beat escapement with sapphire jewels, cut steel pinions and hardened pivots. The pendulum bar is of well seasoned wood with heavy pendulum bob. The dial is 12 in in diameter. The clock is mounted in a substantial well finished hardwood case with mercury contact at the bottom..... $140.00



L1012

L1013

L1013. Regulator Clock. The clock case is made of walnut, beautifully finished and is about 76 in high and 27 in wide. The dial is 12 in in diameter, and is silver plated. The movement is of the highest quality. The pendulum rod is compensated for temperature. The clock keeps excellent time. It has a **sweep second hand.** Fitted with mercury contact **$190.00**

L1014. Astronomical Regulator Clock. A clock of the highest quality and finest workmanship furnished with a dial for standard or sidereal time. With electrical contact wheel in the clock movement.

Price on application.

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