52562

The Scientific Shop

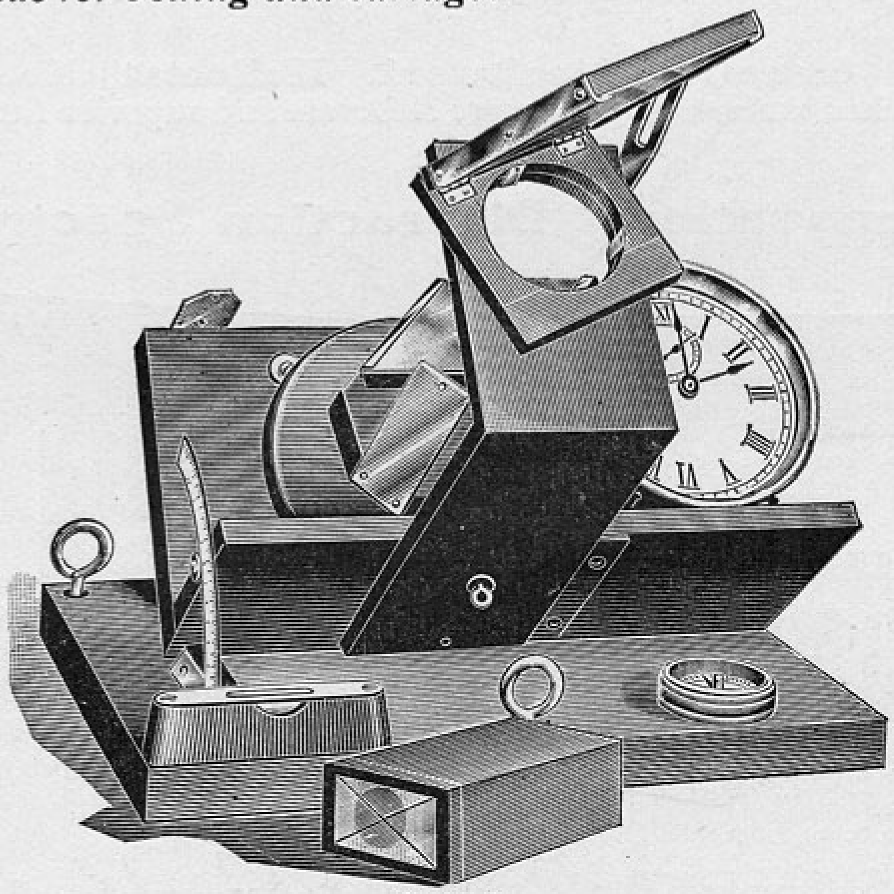
ALBERT B. PORTER

Scientific Instruments 324 Dearborn St., CHICAGO

CIRCULAR 330 MAY 1906

Ives' Simplex Clockwork Heliostat

The prices below are net, f. o. b. cars at Chicago. *No charge is made for boxing and cartage.*



C 307

There are a great many optical experiments requiring a beam of sunlight to projected upon the instrument in order to secure sufficient illumination. Many such experiments would naturally form a part of a students' laboratory course, were it not for the expense and difficulty of providing each student with his own steady beam of sunlight. Various heliostats have been put upon the market, but these have all been too expensive to permit of much duplication, and hence the choice of optical experiments in the students' laboratory has often been governed more by the absence of heliostats than by the teaching value of the experiments chosen.

Mr. Ives has recently designed a new clockwork heliostat which is sold at such a low price that there is no longer reason why each student should not be provided with his own beam of sunlight for experimental purposes. Two or three of these heliostats can be placed in every sunlit window in the laboratory and the steady beams of light thus obtained may be utilized anywhere in the room. Mr. Ives' Simplex Clockwork Heliostat consists of a base with levelling screws, with detachable clock, magnetic compass, and spirit level, combined with a suitably inclined revolving mirror which projects a beam of sunlight parallel to the earth's polar axis, and a second adjustable mirror which reflects this beam of light in any desired direction, upward, downward, or horizontally to either side. Although it is the cheapest clockwork heliostat on the market, it has points of merit altogether peculiar to itself. The clock is a good time-piece, used without any alterations or attachments, except a small brass wheel fitting the key post and serving both as winding key and as a friction drive for the revolving mirror which it turns smoothly at the rate of one revolution in 24 hours. The clock can be instantly detached from the heliostat to wind or set, and as instantly replaced, and it may be used as a time-piece placed on a shelf when the heliostat is not in use. The spirit level and compass are also detachable. All unessential details have been eliminated in order to meet a recognized demand for a serviceable and low priced heliostat, and the finish of the instrument is, for the same reason, made simple and plain. For the use, however, of those who prefer more finely finished instruments, a second pattern is made with polished mahogany wood work and more elaborate and ornamental fittings at an advanced price.

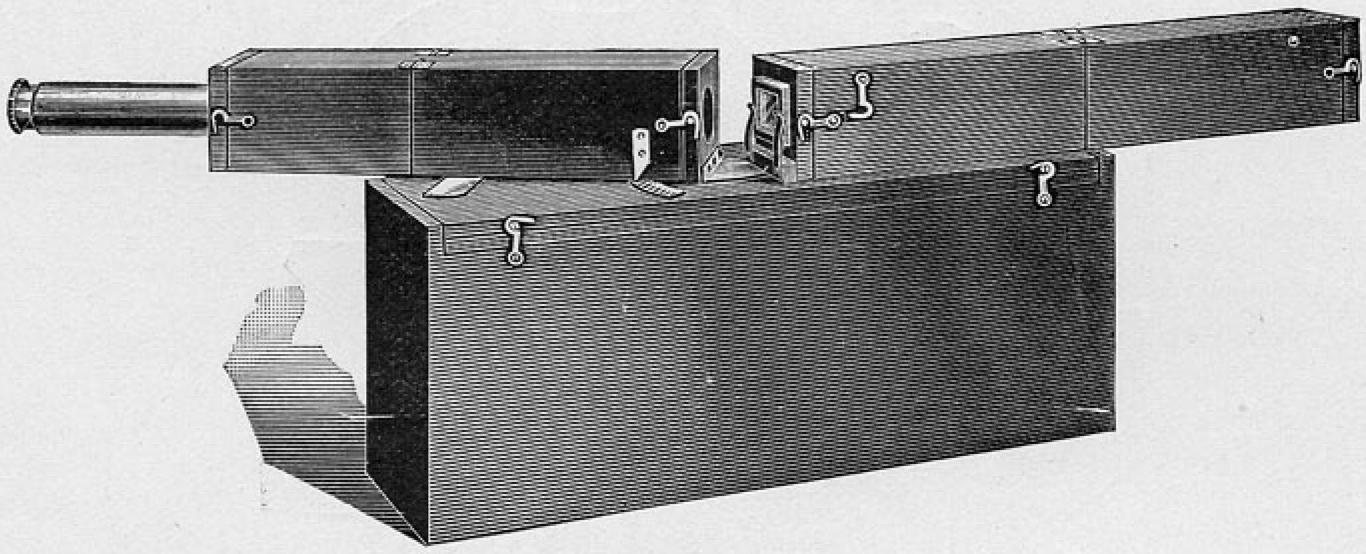
The mirrors used on the Simplex Heliostats are 2x3 inches, giving a two inch circular beam of light.

The small pin-hole camera shown in the foreground of the cut is to aid in centering the beam of light on the upper mirror.

C 307. Ives' Simplex Clockwork Heliostat No. 1, ebonized cherry with simple, plain fittings.................... .... **$15.00**

C 308. Ives' Simplex Clockwork Heliostat No. 2, polished mahogany and more elaborate and superior fittings **25.00**

Ives' "Innovation" Diffraction Spectroscopes



C 137

Mr. Ives' revolutionary improvements in the production of replicas of Rowland Gratings have outstripped the optical capacity of moderate priced spectroscopes to utilize their remarkable resolving power.

A first class spectroscope of 1¼ or 2 in. aperture is a very beautiful and and desirable piece of apparatus, bnt it is very costly combination of "brass and glass" and quite beyond the reach of many who would like to be able to obtain visually the results shown in Mr. Ives' photograph of the E b region of the solar spectrum.

The multiplicity of parts and adjustments, and the display of finely finished brass work, to be found in a spectroscope costing several hundred dollars, are undeniably attractive, and have their uses, but they are not necessary to secure the dispersion, magnification, and definition which are the most important functions of a spectroscope. For nearly every purpose a simple form of high power spectroscope would be far more desirable than a more elaborate instrument with comparatively small optical capacity. Mr. Ives has therefore, in order to meet an expressed demand based upon a recognition of these facts, extended the idea which is the basis of his simplex and duplex spectroscopes to include spectroscopes which at a comparatively small cost will yield substantially the same resolution and definition as could formerly be obtained only with original Rowland gratings used in large laboratory spectroscopes.

Ives' Innovation Spectroscopes are made in two sizes, having 1¼ and 2 in. apertures, and fitted with C 141 and C 146 Ives' gratings, respectively, and with interchangeable photographic gratings of smalldispersion, but without prisms or prism tables.

Used with the photographic gratings these spectroscopes give brilliant spectra showing about the same dispersion and definition that would be obtained with one 60 degree prism, but second and third order spectra are also available with corresponding increase of resolution. Used with the Ives' New Process Grating Replicas, they are guaranteed to readily show with sunlight properly focused on the slit, everything which appears in Mr. Ives' photograph of the E b region of the solar spectrum, i. e., more than two thirds of the lines photographed by Rowland with a 6 inch concave grating worth $350.00 and a spectroscope costing as much more.

These spectroscopes, although of quite novel construction, are extremely simple and convenient. It is necessary to use long tubes in order to obtain the requisite optical capacity, and in order to close the instrument up in a comparatively small space when not in use, but yet to make it rigid and not awkwardly cumbersome when in use, the tubes are jointed in the middle, and the box which holds them when packed is made to serve as stand and base. A six inch circle is provided, divided to half degrees, the telescope turns only to the left, the slit is adjusted by a lever, and the focusing is by a sliding tube; in short, while all necessary adjustments are provided for the purpose for which the spectroscopes are designed, every adjustment which is not necessary is sacrificed in order to secure optical efficiency at low cost. They are sold only with the Ives gratings fitted, and are tested and passed as a whole.

Photographs of limited regions of the spectrum can be made with these spectroscopes by aid of the Simplex Spectrograph No. 2, (C 139) described below. For very high power work in the second order spectrum it is necessary to have everything very rigid, to take sunlight from a heliostat, to focus with great precision (a matter of some difficulty because the light is greatly reduced), and to give long exposures on plates sensitive to the light of the region exposed. Photographs in the first order spectrum, with lower magnification, are much easier to obtain satisfactorily.

C 137. Ives' Innovation Spectroscope, No. 1.................. **$45.00**

Extra eyepieces, each $2.00
Cross line eyepiece.....$6.00

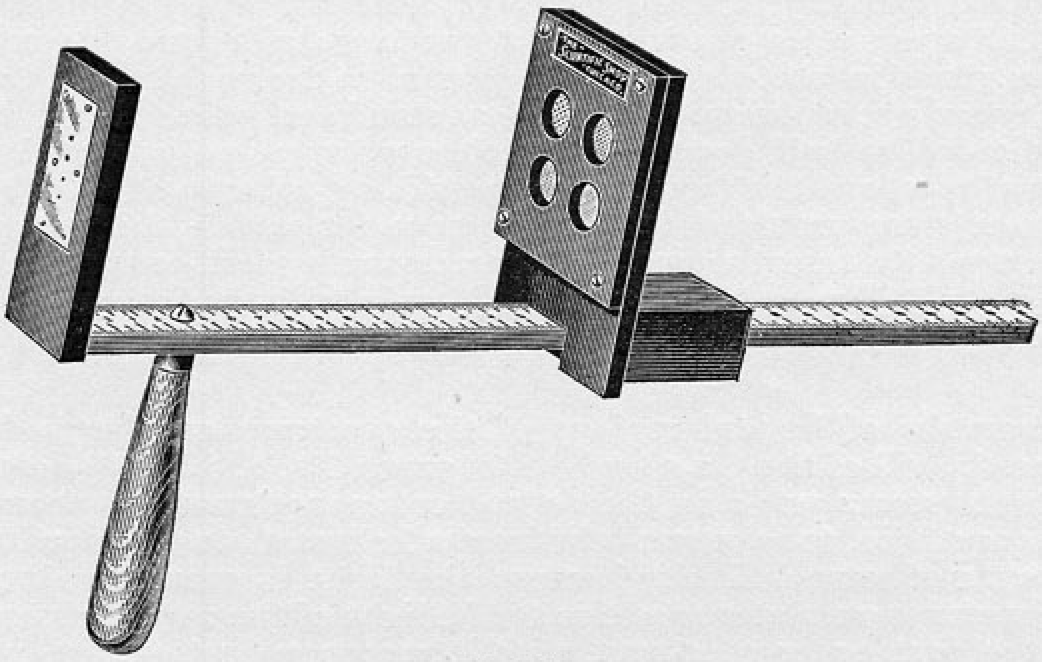
Ives' Simplex Spectrograph No. 2

This is the same as the Simplex Spectrograph No. 1 (C 134), but with the addition of an extra front, adapting it to be brought up to the eyepiece of a large spectroscope for the purpose of making high power photographs of limited portions of the spectrum. The fronts are quickly interchangeable. The extra front has a doubly diaphragmed aperture which is to be brought close to, without touching, the eyepiece of the spectroscope, and a circular screen is provided which slides on the telescope tube (fitting Ives' spectroscopes) and prevents admission of stray light into the camera. The ground glass focusing screen is provided with a transparent circle to permit precise focusing with a focusing glass, and a tripod focusing glass is sent with the camera. The lens of the simplex front can be used by transferring it to the extra front and then, if the spectroscope is focused for normal (far) vision, the image will be in focus on the ground glass. It is, however, well to examine the image and, if the camera lens is not used, refocusing is always necessary.

The magnification depends upon the focal length of spectroscope and eyepiece, and can be altered only by change of eyepiece power. The camera may be supported in any convenient manner, as rigidly as possible, to bring its axis into line with the axis of the telescope. Mr. Ives' photograph of the Eb region of the solar spectrum was made with exactly such an arrangement as this, except that a weak cylindrical lens was introduced and carefully adjusted to smooth out the horizontal lines due to dust on the jaws of the slit.

C 139. Simplex Spectrograph No. 2, with extra front, circular screen, and tripod focusing glass.......................... **$10.50**

Porter's Illustration of Resolving Power



C 915

The relations between the apertures of optical instruments and their resolving powers have been so fully worked out by Helmholtz, Abbe, Rayleigh, and others, and play so important a part in modern theories of optical instruments, that a need has long existed for a simple method of illustrating the connection between resolving power and aperture. The novel apparatus shown in the above cut furnishes at once a simple and striking illustration of this connection, and has the great advantage of being devoid of lenses or other complications requiring adjustment or explanation. The device consists of a bar, graduated in millimetres, on which slides an upright piece bored with four holes, which are covered by pieces of wire gauze of four different degrees of coarseness. To one end of the bar is attached another upright, which carries a thin brass plate pierced by four very small holes of different diameters. A handle is conveniently attached to the under side of the bar.

The observer, facing a window, examines the appearance of the pieces of wire gauze when viewed through the small holes in the brass plate. When the two uprights are about 30 cm. apart, the individual wires are visible in each of the pieces of gauze when observed through the largest aperture; but, as one looks through the smaller holes in succession, one after another of the images blurs out until, when the smallest aperture is reached, the structure of the coarsest gauze only can be seen. By sliding the movable upright along the bar, the effect of distance can be observed; and, by bringing the two uprights closer together than the least distance of distinct vision, the effects of diaphragms in sharpening badly focused images can be studied. The experiments may be made quantitative by measuring the diameters of the holes, and number of wires to the centimetre in the pieces of gauze.

C 915. Porters' Illustration of Resolving Power........... **$3.50**

Abbes' Diffraction Apparatus

This diffraction apparatus, as perfected by Professer Abbe in 1876, serves to demonstrate the effects of diffraction in the formation of images in the microscope. It consists of a diffraction plate and a set of stops, with an arrangement for fitting the stops and rotating them above the objective. The dimensions of the stops are such as to adapt them for Zeiss' objective **"a a."**

The diffraction plate consists of a glass slip with three cover-glasses cemented side by side. The lower surfaces of the latter are silvered and have groups of lines ruled upon them so as to form simple and crossed gratings.

C 891. Abbes' Diffraction Apparatus, from stock............ **$7.60**

C 892. Diffraction Plate, separately, in case. From stock........ **$3.40**

C 893. Iris Diaphragm to place above objective for studying effect of aperture on resolving power, from stock.............. **4.75**

C 894. Zeiss Objective "a a," 26 mm. focal length. From stock.. **10.25**

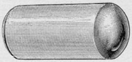
Abbes' Test Plate

This test plate, for testing microscopic objectives with respect to spherical and chromatic aberrations and for estimating that thickness of cover glass which corresponds to the most perfect correction, was designed by Professor Abbe in 1873. Used in conjunction with the Abbe illuminating apparatus, and by establishing the so-called sensitive rays, it gives the greatest prominence to any existing faults of correction.

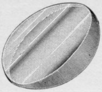
This test plate consists of a glass slip with six cover-glasses of accurately determined thickness (0.09 mm. to 0.24 mm.) cemented side by side. These cover-glasses are silvered on their lower surfaces and engraved with lines, the serrated edges of which form the test object proper.

C 157. Abbe's Test Plate, in case. From stock..................... **$3.80**

Two Odd and Instructive Lenses



C 916



C 917

In the necessarily brief treatment of geometrical optics given in courses on physics, it is customary to limit the discussion to infinitely thin lenses and to omit all mention of the properties of cylindrical surfaces. In practice, thickness must be taken into account in computing lens combinations and there are many uses to which cylindrical lenses are put. Although these matters cannot often be gone into in the limited time allotted to lecture room work, yet the exhibition of one or two striking illustrations of points like these, which can only be briefly touched, may serve to stimulate the students' curiosity and act as an incentive to further study. The two oddities in lenses illustrated above are offered for these purposes. (See the Physical Review, June 1905, pp. 384-385.)

The lens shown in Fig. C 916 is designed to supply an extreme illustration of the effect of thickness on the focal length of a convex lens. The theory of thick lenses shows the focal length of a convex lens to be

$$f = \frac{n}{n-1} \cdot \frac{r^2}{2nr-(n-1)d},$$

where r is the radius of the curved faces, n is the refractive index, and d is the thickness of the lens. The focal length is positive or negative, i. e. the lens is convergent or divergent, according as d is greater or less than $2nr/(n-1)$. If $d=2nr/(n-1)$, the focal length is infinite. Such a lens is neither convergent nor divergent, but gives inverted virtual images without magnification. The thick lens of Fig. C 916 satisfies this condition; although its faces are sharply curved it acts like a piece of flat glass, except that objects seen through it appear inverted. It is an interesting puzzle to a student who has been "brought up "on thin lenses.

The lens shown in Fig. C 917 has cylindrical surfaces, one concave and the other convex, with axes crossed. The curvatures of the two surfaces are so chosen that, when the lens is held at arms' length, one sees through it an undistorted image of distant objects. If the lens, when thus held, is rotated in its own plane, the image also rotates but with an angular velocity twice as great, so that when the lens is turned through 180 degrees the image turns a complete somersault.

The image is peculiar in that it is a purely visual combination of two astigmatic images, one real, the other virtual; one lying behind the lens, the other in front. The image can neither be projected on a screen nor viewed through a telescope; it can be seen by the naked eye merely because of the short focus, and consequent depth of focus, of the eye.

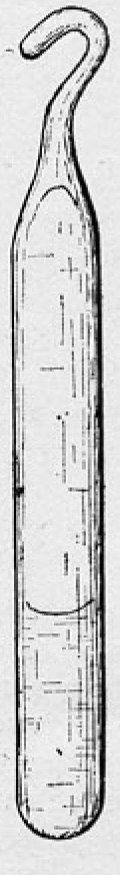
C 916. Porter's Thick Lens **$4.00**

C 917. Porter's Rotating Image Lens **2.00**

The Critical Tube.

This is a simple, satisfactory, and inexpensive apparatus for illustrating the chief phenomena connected with the passage from the liquid to the gaseous state at the critical point. It consists of a stout glass tube, about 9 cm. long and 9 mm. in diameter, closed at both ends and supplied with a hook for convenient suspension. It contains ether and ether vapor, the liquid occupying somewhat less than half the volume of the tube.

Directions for Use.



Hang the tube by its hook and heat very slowly, best using a spirit lamp with a very small flame, removing the lamp as soon as the liquid in the tube has passed into the gaseous state.

The various phenomena connected with the passage of a liquid into a gas at the critical point will be clearly seen—the great expansion of the liquid, the gradual flattening of the meniscus, showing the decreasing surface tension; the changes in refractive index of both gas and liquid, as shown by the change in width of the line of light seen in the tube when illuminated from behind; the sudden disappearance of the meniscus when the critical temperature is reached, and the equal refraction in all parts of the substance; the hazy cloud which forms in the middle of the tube when the lamp is removed; the reappearance of the meniscus; the contraction of the liquid; its increasing refraction, and the increasing curvature of its surface as the tube cools.

By alternately heating the tube above the critical temperature and allowing it to cool, the whole succession of phenomena can be shown several times in a few minutes; and by using a very small flame to heat the tube, so that the temperature changes slowly, ample opportunity is given for close observation.

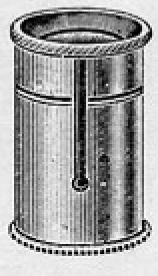
The phenomena can all be clearly projected on the screen by any ordinary optical lantern having an open stage.

CAUTION.

Although every "Critical Tube" is carefully tested, overheating might cause one to burst. To guard against possible harm from this cause, a sheet of glass should be held between the tube and the face of the experimenter, and thick gloves should be worn.

C 279, The "Critical Tube." From stock.................................**$1.25**

The "Studentia" Spinthariscope



C 98

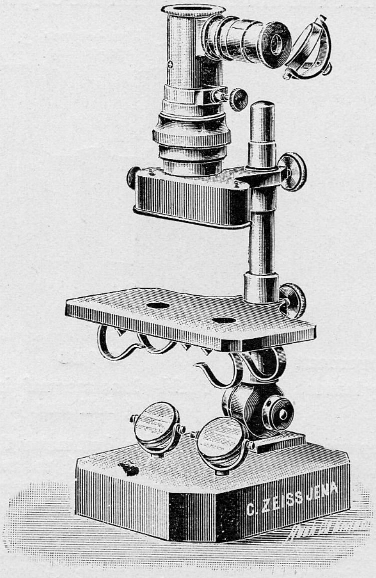
This is a simple modification of Crookes' Spinthariscope which shows the scintillations of Radium in a very effective manner. The instrument contains a small quantity of pure Radium Bromide mixed with Sidot Blende which can be viewed through either of the two attached lenses. The field of view of the high power lens appears like sky full of shooting or scintillating stars, while the field of the low power lens looks like a fluttering luminous cloud.

C 9~~7~~ 8 "Studentia" Spinthariscope, from stock **$1.25**

C 97 Crookes' Spinthariscope, from stock **$8.00**

Comparison Spectroscope for Laboratory Use.

Designed by Prof. H. Quincke.



C 918

This instrument is designed for use in medical and botanical laboratories and also to satisfy the requirements of the physical chemist. It enables the absorption spectra of liquids, coloı screens, etc., to be compared to a degree of precision considerably greater than can be obtained with the ordinary forms of hand-spectroscopes.

The spectroscope proper is the same as that which forms a part of Abbe's microspectroscopic eyepiece. The image is viewed through a slit (Fig. C 918), the lines of the spectrum are sharply focused by turning the collar, the width of the slit is adjusted by means of a screw, and the position of the spectrum is adjusted with respect to the scale of wave-lengths by aid of a milled head.

The spectroscope is mounted on a vertical rod to which it can be clamped at any desired height, and the objects whose spectra are to be compared are placed over the two holes in the stage and illuminated by the mirrors. The stand is hinged so as to permit the examination of liquids in open glass troughs or test tubes, and clips for holding the latter are attached to the lower side of the stage.

The absorption cells supplied with these spectroscopes consist of short glass tubes cemented singly or in pairs to glass plates. These cells are made in thicknesses of 1, 5, 10 and 20 mm. When in use they are closed by flat glass covers. A cell of of adjustable thickness is also supplied. The thickness of the liquid layer in this cell can be varied during observation from 0 to 20 mm, and can be measured to 0.05 mm.

C 918. **Comparison Spectroscope** in case, including a number of lithographed scales for recording observations. Duty free.......... **$80.00**

C 919. **Absorption Cells,** single, 1, 5, 10, or 20 mm. thick. Each, duty free.......... **55**

C 920. **Same,** double, 1, 5, 10, or 20 mm. thick. Each, duty free...... **$1.10**

C 921. **Adjustable Absorption Cell.** Duty free.......... **$9.00**

C 922. **Browning-Zeiss Pocket Spectroscope** without comparison prism. Duty free.......... **$11.00**

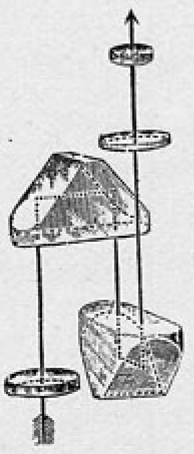
C 923. **Same,** with comparison prism. Duty free.......... **$12.00**

C 924. **Same,** with wave-length scale. Duty free.......... **$21.50**

C 925. **Abbe's Microspectroscopic Eyepiece.** Duty free..... **$53.00**

Zeiss Binocular Field Glasses

with increased distance between the objectives.



Optical arrangement of the Field-glasses.

C 928

Field-glass magnifying 8x.
(⅓ full size.)

These field-glasses are of a compact form, but neverthless the distance between the objectives has been increased to from 1¾ to twice that between the eyes, thus giving a surprising increase of stereoscopic power not found in the prism field-glasses produced by other makers. There are two groups of these instruments; one of them, having a stereoscopic power of 1¾, includes the Universal Binoculars, with magnifications of 4, 6, and 8 diameters; the other group, having a stereoscopic power of 2, includes the Night Marine Glasses with magnifications of 5 and 7½ diameters, two high power Marine Field Glasses magnifying 10 and 12 diameters, and the Combined Day and Night Marine Glass. The latter gives a choice of two magnifications, 5 and 10 diameters, the transition from one to the other being effected by means of revolving plates fitted with two sets of eyepieces; spring catches secure the revolving plates against accidental displacement in either working position.

Descriptive Net Price List,

Linear Magnifications	Specific Stereoscopic Power	Relative Light Transmitting Power	Effective Diameter of Object Glasses	Objective Field: Angular	Objective Field: Linear in yds. per 1000 yds.	Net Weight (Instruments only) oz.	Gross Wght. incl. stiff leather case oz.	In stiff leather case with shoulder sling
C 926 4 x Field-Glass	1¾	12	14 mm.	10.3°	180	13	24	$ 40.00
C 927 6 x "	1¾	9	18 "	6.8°	120	14	26	43.50
C 928 8 x "	1¾	6	20 "	5.1°	90	15	27	47.50
C 929 5 x Night Marine	2	22	24 "	6.8°	120	29	49	63.50
C 930 7½ x "	2	10	24 "	5.4°	95	28	48	63.50
C 931 10 x Day Marine	2	5	24 "	4.0°	70	28	48	67.50
C 932 12 x "	2	4	24 "	3.4°	60	28	47	67.50
C 933 5 & 10 x Combined Day and Night Marine	2	20 and 5	24 "	6.8° 4.0°	120 a. 70	42	70	87.00

Delivery from Stock.