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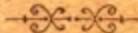
*Optical and Scientific  
Instrument Makers,*

75a CAMDEN ROAD, LONDON, N.W.

Telegraphic Address, "SPHERICITY, LONDON."

Telephone Number, "1687 NORTH."

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## SECTION "B."

ECHELON DIFFRACTION GRATINGS,  
LUMMER-GEHRCKE PARALLEL PLATES,  
and apparatus for use in combination therewith.



33-PLATE ECHELON.

March 1911.

3  
This List cancels all previous ones, and is subject to  
alteration without notice.

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# HENRIQUE MORIZE

## SECTION B.

### ECHELON DIFFRACTION GRATINGS.

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and (2), 5, 2 (1909).

#### SIZES OF ECHELON DIFFRACTION GRATINGS USUALLY SUPPLIED.

Number of Plates		Price. £ s. d.	Number of Plates		Price. £ s. d.
10	...	13 0 0	23	...	42 10 0
11	...	14 10 0	24	...	45 0 0
12	...	16 10 0	25	...	48 0 0
13	...	18 10 0	26	...	51 0 0
14	...	20 10 0	27	...	54 0 0
15	...	23 0 0	28	...	57 10 0
16	...	25 0 0	29	...	61 0 0
17	...	27 5 0	30	...	65 0 0
18	...	29 10 0	31	...	69 0 0
19	...	32 0 0	32	...	73 0 0
20	...	35 0 0	33	...	77 0 0
21	...	37 5 0	35	...	90 0 0
22	...	40 0 0	40	...	120 0 0

The above prices include a suitable mount arranged for the edges of the plates to be vertical.

If the plates are required to be used with the edges horizontal instead of vertical no extra charge is made; if to be used with the edges both horizontal and vertical an extra charge is made, varying from £1, 15s. to £5.

The following proportions have been adopted by us after due consideration, and will be adhered to unless special directions are given to the contrary.

*Height of Plates:* For a 10-plate Echelon about 32 mm.

11	"	"	...	32	"
"	12	"	"	32	"
"	13	"	"	36	"
"	14	"	"	36	"

For a 15-plate and all larger numbers about 40 mm.

PRICES OF HIGHER PLATES IN PROPORTION.

*Thickness of Plates, about 10 mm. (but see below).*

*Width of Step, 1 mm.*

Echelons of 20 plates and upwards are now made also of 15 mm. thick or of 20 mm. thick plates, the prices being 30 per cent. higher than the above scale in the case of the former, and 60 per cent. higher in the case of the latter; this increased price including a suitable alteration of the mount to take the increased length and weight of glass.

**ECHELON DIFFRACTION GRATINGS OF QUARTZ FOR ULTRA-VIOLET WORK.**

12-plate Echelons with plates 10 mm. thick can now be supplied in Crystalline Quartz. The effective aperture of these Echelons is 12 mm. wide by 17 mm. high. Price in suitable mount, arranged for the edges of the plates to be vertical ... ... ... ... £24 0 0

*It is necessary to use polarised light with the above Quartz Echelons owing to the double refraction. The definition is then in every way equal to that of the Glass Echelons.*

**VARIOUS MODES OF ARRANGEMENT OF THE ECHELON APPARATUS.**

In the use of the Echelon Spectroscope an auxiliary analysis of the light is required for the purpose of isolating the particular radiation under observation.

In the case of a spectrum consisting of a few isolated lines, a prism and condensing lens in front of the slit are sufficient, coloured images of the source being thrown on the slit. In the case of spectra where a more powerful analysis is necessary, any of the following three arrangements can be adopted.

**FIRST ARRANGEMENT.**

(*For prices, see pp. B 4 to B 7.*)

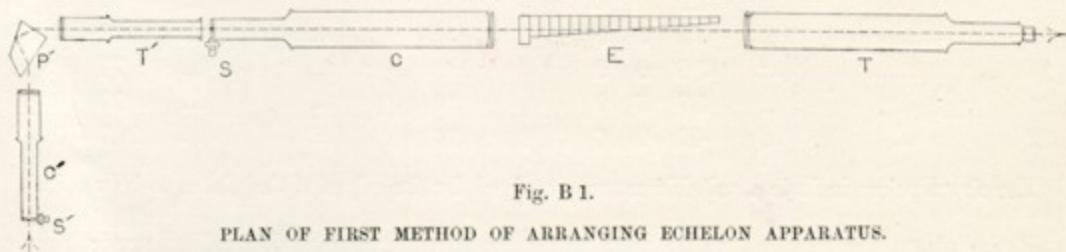


Fig. B 1.

**PLAN OF FIRST METHOD OF ARRANGING ECHELON APPARATUS.**

This is illustrated in diagram in Fig. B 1. It consists of the Echelon Spectroscope with slit S, collimator C, Echelon E, and Telescope T; and an auxiliary Spectroscope, by means of which a

spectrum of the light source under examination is thrown on the slit of the Echelon Spectroscope, any desired line being thus isolated.

Any spectroscope can be used for this preliminary analysis, but the Hilger Wavelength Spectrometer (see p. B 7), as shown in the plan in Fig. B 1, is by far the most suitable, as it affords means of passing gradually through the spectrum without altering the position of the collimator.

Such an arrangement is shown in Figs. B 4 and B 6, in the case of Echelon Spectroscopes 1 and 3 respectively.

**SECOND ARRANGEMENT.**

(*For prices, see pp. B 4 to B 7.*)

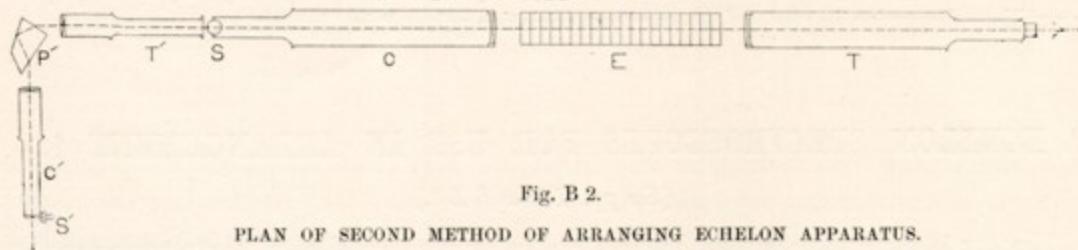


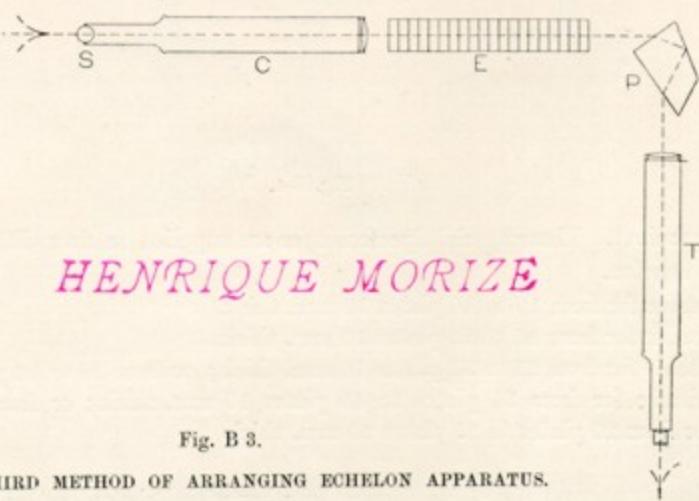
Fig. B 2.

**PLAN OF SECOND METHOD OF ARRANGING ECHELON APPARATUS.**

The only difference between this (Fig. B 2) and the first arrangement is that the slit of the Echelon Spectroscope, and the edges of the plates of the Echelon itself, are both horizontal. Thus instead of only one line a large portion of the spectrum can be examined at once, each line being separately subjected to the analysis of the Echelon. In the Echelon Spectroscopes Nos. 1, 2, 3, and 4 on pp. B 4 to B 7, an equivalent result is obtained by placing in front of the slit of the Echelon Spectroscope a prism of special shape. The edges of the Echelon then remain vertical (its resolution being in a horizontal plane), while the prism spectrum is dispersed in a vertical sense.

**THIRD ARRANGEMENT.**

(*For prices, see pp. B 8 and B 9.*)



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Fig. B 3.

**PLAN OF THIRD METHOD OF ARRANGING ECHELON APPARATUS.**

In this case (Fig. B 3) the auxiliary analysis of the light is obtained by a constant deviation

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prism, large enough to take the whole beam of light from the Echelon, being placed in the position shown in the figure. Thus the light is subjected first to the analysis of the Echelon, and then to that of the constant deviation prism. The edges of the Echelon are horizontal, and the slit of the Echelon Spectroscope has adjustment in two directions at right angles, consisting, in fact, of two slits superposed with the two pairs of jaws as nearly as possible in one plane.

This arrangement has the advantage over the second method (which it resembles in effect), that the light has to pass through only two object glasses, with the result that there is less loss of light.

This arrangement is shown in Fig. B 9, in No. 3 size.

For very complex spectra of sufficient intensity a ruled diffraction grating may be employed for the auxiliary dispersion in place of the constant deviation prism P in Fig. B 3.

## ECHELON SPECTROSCOPES FOR USE IN ARRANGEMENT 1.

(See pp. B 2 and B 3.)

The four following Echelon Spectroscopes can be supplied suitable for No. 2 Arrangement at an extra price of £4, 10s. by placing a prism of special form in front of the slit. The prism spectrum, as seen in the eyepiece, is dispersed in a vertical direction, while the resolution of the Echelon remains in a horizontal direction.

The smaller sizes of Echelon can be adapted to almost any Spectroscope, but owing to the peculiarity of the Echelon, that it is always used at direct vision, special forms of Spectroscopes

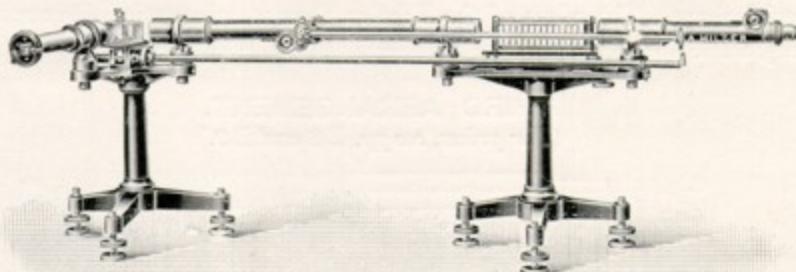


Fig. B 4.

become more convenient. These special Spectroscopes are supplied in four different sizes, suitable for various sizes of Echelon.

No. 1 is suitable for from 10 to 14 plates 10 mm. thick.

No. 2 is suitable for from 15 to 20 plates 10 mm. thick.

No. 3 is suitable for from 21 to 33 plates 10 mm. thick; or from 20 to 22 plates 15 mm. thick.

No. 4 is suitable for from 34 plates to 40 plates 10 mm. thick; or from 23 plates to 33 plates 15 mm. thick; or from 20 plates to 25 plates 20 mm. thick.

**Echelon Spectroscope No. 1** (as shown, together with Echelon and an auxiliary Spectroscope in position, in Fig. B 4), with slit, collimator, and telescope, means of rotating Echelon and rackwork

for the same, and high and low power eyepieces. The slit has non-corrosive jaws, and screw for adjusting width of aperture, with divided drumhead. The object glasses are of  $1\frac{1}{4}$  inch clear aperture, and  $11\frac{1}{4}$  inches focal length. The whole mounted on strong iron tripod. The price does not include the wavelength spectrometer shown, for which see p. B 7.

NOTE.—Since the preparation of Fig. B 1 above, the design of this No. 1 Echelon Spectroscope has been improved, the collimator and telescope being supported by double supports, this arrangement greatly adding to the rigidity. The wavelength spectrometer has also been greatly improved.

**Echelon Spectroscope No. 2** (Fig. B 5), suitable for 15 to 20 plates. The object glasses are 1½ inch clear aperture, and 14½ inches focal length. This stand has means of moving the Echelon out of the field without taking it off the instrument. Two eyepieces are supplied.

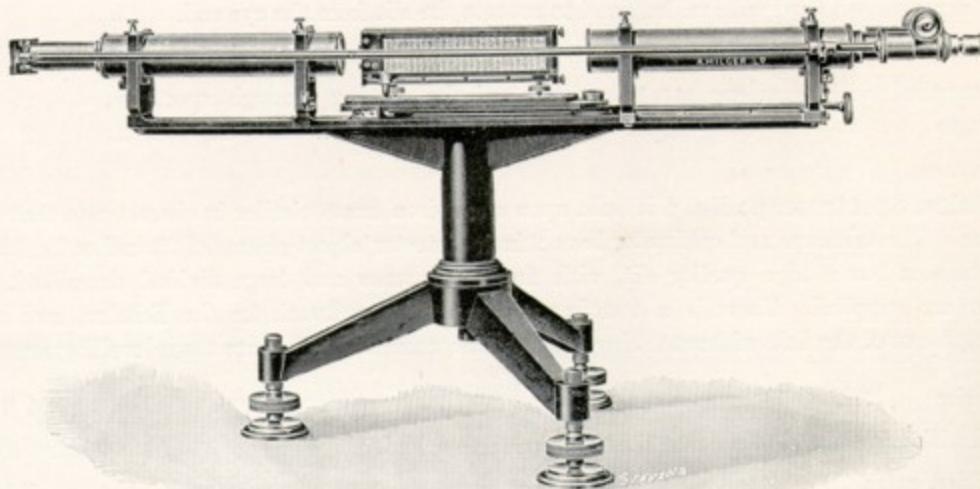


Fig. B 5.

**Echelon Spectroscope No. 3** (as shown, together with Echelon and an auxiliary Spectroscope in position, in Fig. B 6), with 2 inch diameter object glasses, of 22 inches focal length. The collimator has a high quality slit, with fine steel screw and large divided drumhead. Two eyepieces are supplied. There is a rotating movement by rackwork for the Echelon, and means of moving it out of the field.

without taking it off the instrument. On strong tripod stand, with three levelling screws. The price does not include the wavelength spectrometer shown, for which see p. B 7.

NOTE.—Since the preparation of Fig. B 3, the frame of the No. 3 Echelon Spectroscope has been remodelled. The wavelength spectrometer has also been greatly improved.

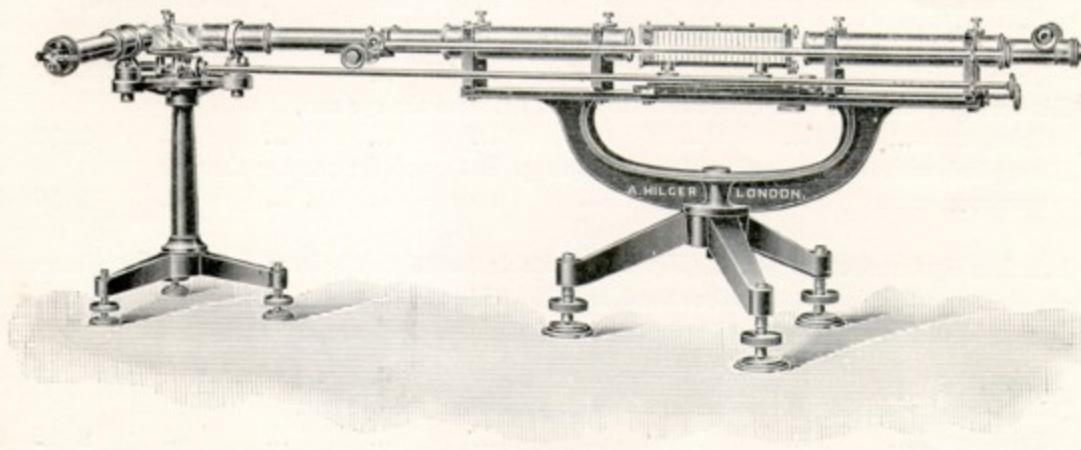


Fig. B 6.

Price	...	...	...	...	...	...	...	...	...	...	...	£53 10 0
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Slit arranged with rod with milled head to actuate the slit from the eye end.

Price, extra	...	...	...	...	...	...	...	...	...	...	...	3 0 0
--------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

If supplied with wavelength spectrometer, rod for passing through spectrum,

extra	...	...	...	...	...	...	...	...	...	...	...	2 0 0
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**Echelon Spectroscope No. 4** is built upon a cast-iron frame similar in character to that of the No. 3 size. The telescope and collimator have 2 inch diameter object glasses of 22 inches focal length. The collimator has a high quality slit, with fine steel screw and large divided drumhead. Two eyepieces are supplied. There is a rotating movement by rackwork for the Echelon, and means of moving it out of the field without taking it off the instrument. There are three levelling screws.

Price	...	...	...	...	...	...	...	...	...	...	...	£64 10 0
-------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Rod with milled head to actuate the slit from the eye end.

Price, extra	...	...	...	...	...	...	...	...	...	...	...	3 0 0
--------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

If supplied with wavelength spectrometer, rod to eye end for passing through

spectrum, extra	...	...	...	...	...	...	...	...	...	...	...	2 5 0
-----------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------

## HILGER WAVELENGTH SPECTROMETER (Constant Deviation Type).

For use as auxiliary Spectroscope with the above Echelon Spectroscopes. Fig. B 7.

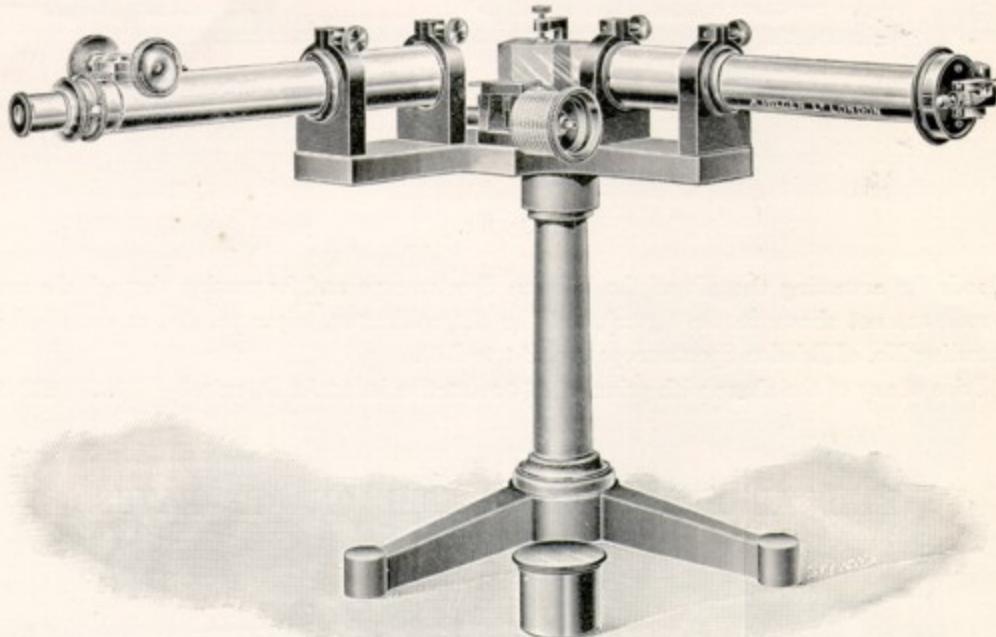


Fig. B 7.

With prism of refractive index 1.65 for D	...	...	...	...	£25	0	0
",	1.74	",	",	",	27	15	0

Both the above instruments are accurately calibrated to read in wavelengths direct throughout the visible spectrum.

For full description, see Section D "Wavelength Spectrometers," p. D 3.

**COMBINATION OF ECHELON AND AUXILIARY SPECTROSCOPE,  
for Arrangement 1 and 2.**

(The prices below are for No. 1 arrangement; for conversion to No. 2 arrangement by special prism, add £4, 10s. See p. B 3.)

We can supply Echelon Spectroscopes Nos. 1 to 4 above mounted in combination with the wavelength spectrometer above on one substantial cast-iron base, at the following prices.

No. 1 size, Price	(not including Echelon)	...	...	£50	0	0
No. 2 size, Price	",	",	",	63	10	0
No. 3 size, as shown in Fig. B 8, Price	",	",	",	94	10	0
No. 4 size, Price	",	",	",	105	10	0

The above prices include the wavelength spectrometer (Fig. B 7), with prism of 1.65 refractive index for D, mounted on the long base which carries the Echelon Spectroscope instead of on the usual



Fig. B 8.

tripod, rods for actuating the slit of the Echelon Spectroscope and for passing through the spectrum (these rods are not shown in the figure), and the slit, collimator, telescope, etc., as described in the corresponding No. of Echelon Spectroscopes (pp. B 4 to B 6).

Price of any of the above with prism of 1.74 refractive index for D, extra ... £2 15 0

**THIRD ARRANGEMENT OF ECHELON APPARATUS.**

(See p. B 3.)

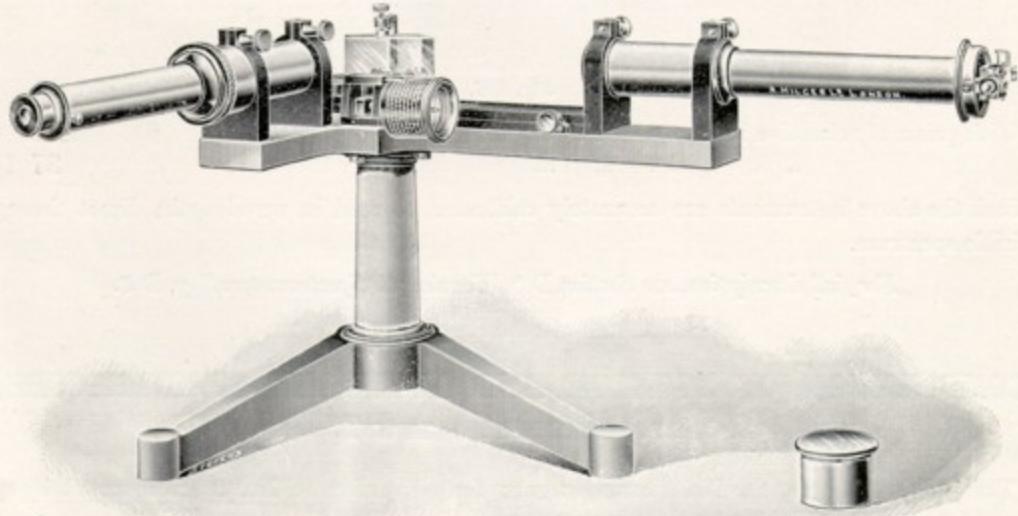


Fig. B 9.

No. 1 suitable for from 10 to 12 plates 10 mm. thick (Fig. B 9).

Price ... £37 10 0

No. 2 suitable for from 13 to 20 plates 10 mm. thick.

Price ... 68 0 0

No. 3 suitable for from 21 to 33 plates 10 mm. thick (Fig. 10); or from 20 to 22 plates 15 mm. thick. The price does not include the micrometer eyepiece shown in the figure.

Price ... ... ... ... ... ... ... ... £147 10 0

No. 4 suitable for from 34 to 40 plates 10 mm. thick; or from 23 to 33 plates 15 mm. thick; or from 20 to 25 plates 20 mm. thick. Similar to No. 3, but suitably modified to take the larger echelons.

Price ... ... ... ... ... ... ... ... 167 0 0

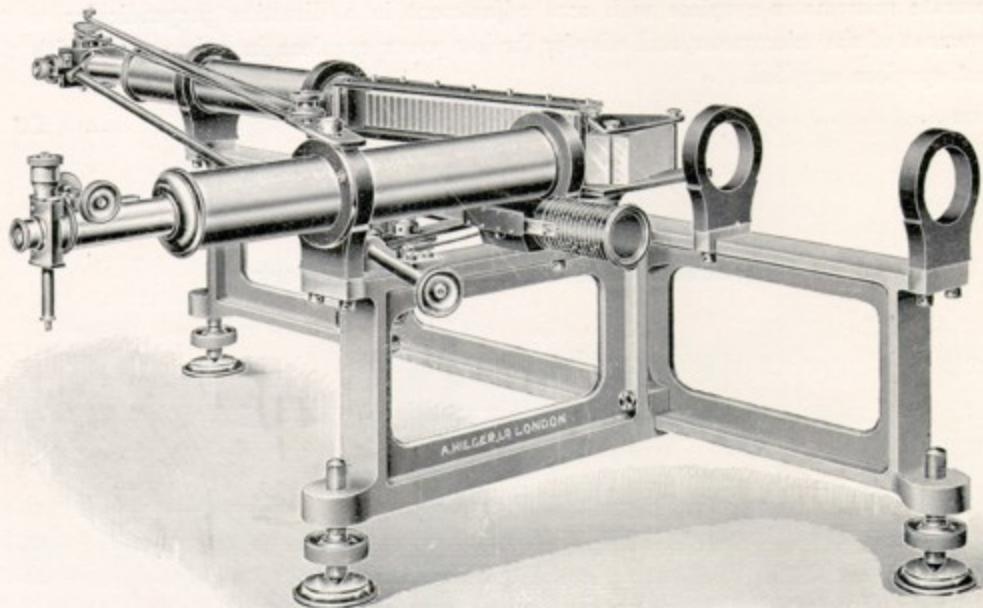


Fig. B 10.

The above prices include the whole arrangement (as shown for No. 1 size in Fig. B 9 and for No. 3 size in Fig. B 10) with constant deviation prism and wavelength calibrations. All adjustments are accessible from the eye end of the apparatus. The prism in size 1 is of 1.74 refractive index for D, and in sizes 2, 3, and 4 of 1.65 refractive index for D. The wavelength calibration in sizes 3 and 4 is accurate to within 1 Ångström unit.

The No. 1 size is also suitable for the Lummer Plate and Fabry and Perot Etalon described in Section O, "Spectroscopic Apparatus for High Resolving Power," it being identical with the modified wavelength spectrometer therein described.

*Note.—In Fig. B 10 the Echelon is shown with its edges vertical, but as described on p. B 3, for the third arrangement the edges of the Echelon are horizontal. It will be noted that the No. 3 and No. 4 sizes can be used as in arrangement No. 1 by removal of the prism, and change of the position of the telescope. The accessibility of the various adjustments is, however, arranged for the Third Arrangement.*

## VARIOUS ACCESSORIES FOR USE WITH ECHELON APPARATUS.

Camera with enlarging lens combination for any of the above Echelon Spectroscopes can be supplied enlarging either twice or three times.

Price, including adaptation ... ... ... ... £3 10 0

Accurate micrometer eyepiece with zero adjustment in a direction perpendicular to that of the movement of the micrometer, and adapter for low-power eyepiece interchangeable with that for the usual eyepiece supplied.

Price ... ... ... ... £6 12 6

## Vacuum Tube for Experimental Work.

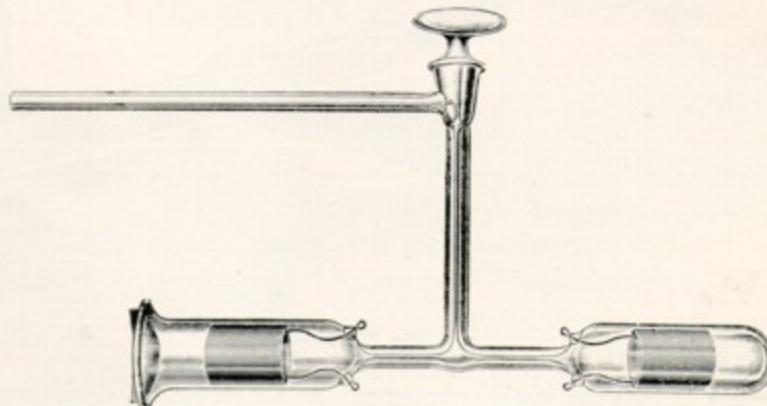


Fig. B 11.

The tube is, as will be seen from the sketch (Fig. B 11), of the end on type. It is supplied with a tap, and the light is concentrated into a line focus by a spherocylindrical condenser, of which the spherical portion fits accurately the cup at the end of the vacuum tube, which is ground and polished to fit it.

Price of tube, with glass condenser ... ... ... ... £2 15 6

Price, with quartz condenser (necessary for ultra-violet work, but not of extra service with the Echelon) ... ... ... ... 4 15 6

## LUMMER-GEHRCKE PARALLEL PLATES.

## BIBLIOGRAPHY—Lummer-Gehrcke Plate.

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 " " 10, 10, 357 (1908).  
 " " 10, 12, 423 (1908).  
 " " 11, 6, 141 (1909).

*Note*.—Unless otherwise specified in ordering, Lummer-Gehrcke Parallel Plates will always be supplied with a prism cemented on, the prism being of the kind indicated in Fig. B 12, whereby the combination becomes a “direct vision” one.

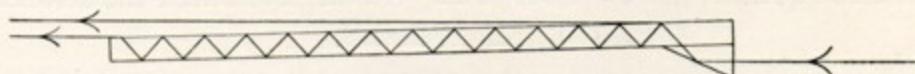


Fig. B 12.

## SIZES OF LUMMER-GEHRCKE PARALLEL PLATES USUALLY SUPPLIED.

Length.	Width.	Thickness.	Approximate Resolving Power.	Price, in suitable mount (see Fig. B 13, for No. 1 size).
(a) 130 mm.	15 mm.	4½ mm.	200,000	£9 10 0

The above size, which can usually be delivered from stock, is strongly recommended, except in the cases where an even higher resolving power is essential. It will be noted that the resolving power of this size (a) is already very great.

	Length.	Width.	Thickness.	Approximate Resolving Power.	Price, in suitable mount (see Fig. B 13, for No. 1 size).
(b)	130 mm.	25 mm.	10 mm.	200,000	£11 0 0
(c)	200 mm.	30 mm.	10 mm.	327,000	24 0 0
(d)	300 mm.	30 mm.	10 mm.	510,000	39 0 0

We can also supply Lummer-Gehrcke Parallel Plates, of size (a), in quartz, for work in the ultra-violet

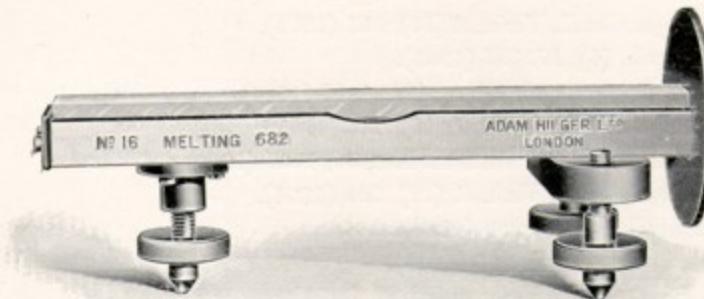


Fig. B 13.

Price in mount (Fig. B 13) ... ... ... ... ... £19 0 0

These can be used in front of a quartz spectrograph on the mount described below (Fig. B 14), which is then supplied with a quartz-rocksalt triple or quartz-fluorspar double achromatic lens at an extra charge of ... ... 5 10 0

*As quartz-fluorspar makes a better achromatic combination than quartz-rocksalt, the former will always be supplied whenever fluorspar of suitable quality is obtainable.*

### SPECTROSCOPES, ETC., FOR USE WITH LUMMER-GEHRCKE PARALLEL PLATES.

For sizes (a), (b), and (c) above, the No. 1 Modified Hilger Wavelength Spectrometer shown in Fig. B 9 and described in Section 9, "Spectroscopic Apparatus for High Resolving Power," is suitable. As so used, the Lummer-Gehrcke Plate lies almost horizontal and thus diffracts the light in a vertical plane.

The ordinary prism spectrum is seen in the eyepiece, the bright lines being readily identified by the wavelength drum; and the Lummer-Gehrcke Plate on being introduced effects the resolution of each ray into its minute structure in a vertical sense.

Price for size (a) and (b) ... ... ... ... ... £35 5 0  
 " " (c) ... ... ... ... ... 37 10 0

This instrument can also be supplied suitable for size (d), Price ... ... 39 10 0 but the necessary extension makes the spectrometer somewhat unwieldy for ordinary spectroscopic work, though without other detriment to its efficiency.

MOUNT TO TAKE THE ABOVE LUMMER-GEHRCKE PARALLEL PLATES IN FRONT OF AN ORDINARY SPECTROSCOPE.

This mount (Fig. B 14) is made to suit the Lummer-Gehrke Parallel Plates described above. The Lummer-Gehrke Parallel Plate (as in Fig. B 14) stands in its mount on a brass plate which

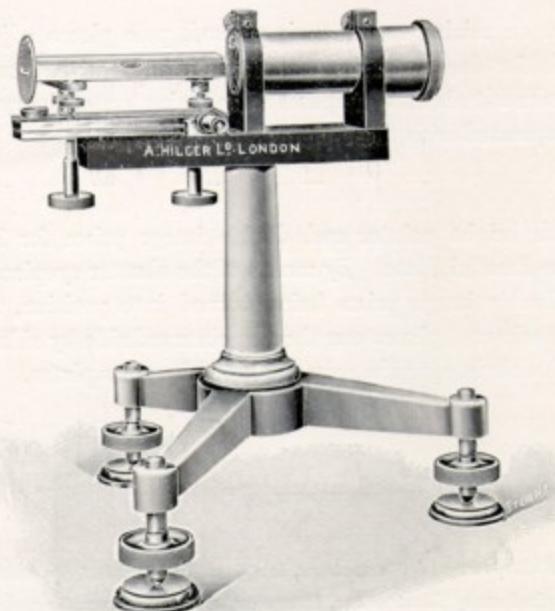


Fig. B 14.

is capable of slight rotation about a vertical axis by means of a milled head screw. This, together with a readily accessible levelling screw, provides the necessary adjustment.

The rays from the source of light should be approximately collimated by a condensing lens. They then traverse the Lummer-Gehrke Parallel Plate, and an image of the resulting diffraction pattern is formed by an achromatic lens. This image consists, of course, of a number of superimposed images produced by the various monochromatic radiations emanating from the source.

The spectroscope to be used in conjunction with this arrangement is then placed in train with the above apparatus so that the diffraction images fall on the slit. The jaws of the slit should be set vertical; and the dispersion of the spectroscope will then give the necessary separation of the overlapping diffraction images.

The apparatus is mounted on a substantial cast-iron tripod, with three levelling screws, and is suitable for use with any ordinary spectroscope.

Price for size (a) or (b)	...	...	...	...	...	...	£11 15 0
Price for size (c)	...	...	...	...	...	...	12 15 0
Price for size (d)	...	...	...	...	...	...	14 10 0

Besides its use with the Lummer-Gehrcke Parallel Plate, this piece of apparatus can also be employed with a Fabry and Perot Etalon. (See Section O, "Spectroscopic Apparatus for High Resolving Power.")

## USEFUL ACCESSORIES FOR THE DEMONSTRATION OF THE ZEEMAN EFFECT BY MEANS OF THE LUMMER-GEHRCKE PARALLEL PLATE

Small electro-magnet on raising and lowering stand, pole pieces adjustable from contact to  $\frac{1}{2}$ " (12 $\frac{1}{2}$  mm.) apart; suitable for demonstrating the Zeeman effect with these Lummer-Gehrcke Parallel Plates. The current required is about 3 amperes when using an ordinary vacuum tube as the source of light. The lines are separated with these plates into triplets, etc.

Price ... ... ... ... ... £5 10 0

Shutter eyepiece with bright pointer and double image prism for Zeeman effect observations with the Lummer-Gehrcke Parallel Plate. By means of the shutter eyepiece the line under observation can be isolated, and the double image prism being turned into position, the components of the rays polarised in vertical and horizontal planes can then be observed side by side simultaneously.

The surfaces of the double image prism are protected by glass plates.

Price ... ... ... ... ... £6 10 0

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*March 1911.*

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**LONDON, N.W.**

Telegraphic Address: "SPHERICITY, LONDON."

Telephone Number: "1687 NORTH."

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