THE HILGER WAVELENGTH SPECTROMETER

(CONSTANT DEVIATION TYPE) & THE NUTTING PHOTOMETER

ADAM HILGER LTD.

THE HILGER WAVELENGTH SPECTROMETER (CONSTANT DEVIATION TYPE) & THE NUTTING PHOTOMETER

For measuring wavelengths and absorptions in the visible spectrum

February 1919

These prices are now increased by ~~10~~ 25 per cent.

ADAM HILGER, Ltd.

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OPTICAL WORKS
75A CAMDEN ROAD · LONDON · N.W. 1
Telegrams SPHERICITY · PHONE · LONDON *Telephone* N1677 & 1678
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INTRODUCTION

INTRODUCED by us in 1904, the Hilger Wavelength Spectrometer has since that time undergone in our workshops a continual process of improvement.

We are therefore able to present in this booklet a well standardised instrument, together with those accessories which experience has shown to be of the most general value for chemical laboratories.

On account of its accuracy and convenience this spectrometer has given an entirely new aspect to the measurement of the wavelengths of emission or absorption spectra.

In combination with the Nutting Photometer it makes an extremely efficient spectro-photometer.

As in all our instruments, the entire work, both optical and mechanical, is carried out at our works under the supervision of managers and foremen who have borne that responsibility for more than twenty years.

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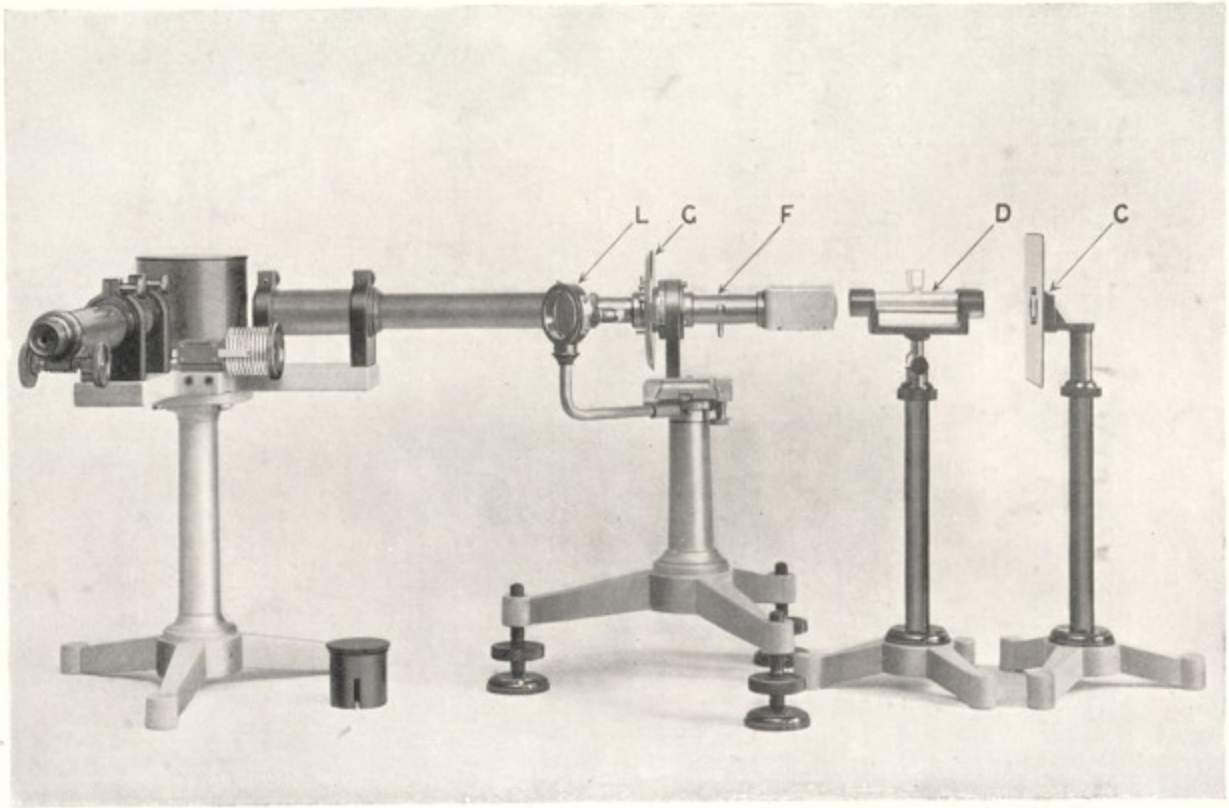

HILGER WAVELENGTH SPECTROMETER AND NUTTING PHOTOMETER

THE HILGER WAVELENGTH SPECTROMETER

(CONSTANT DEVIATION TYPE)

THE design of the Hilger Wavelength Spectrometer, Constant Deviation Type (Fig. 1), is based on the use of the now well-known "constant deviation prism." There are a number of different forms of this prism, of which the one used on the Hilger Wavelength Spectrometer is shown in Fig. 2. Although made of one solid piece of glass it may be considered as built up of two 30° prisms and one right-angled prism from the hypotenuse of which the light is internally reflected as shown. The telescope and collimator are both rigidly fixed, since to pass through the spectrum it is only necessary to rotate the prism; and as a result a construction is arrived at which is at once extremely convenient and mechanically sound.

The table on which the prism stands is rotated by means of a fine steel screw. To the screw is fixed a drum (*see* Fig. 3), on which the wavelength of the line under observation is read off direct as indicated by the index which runs

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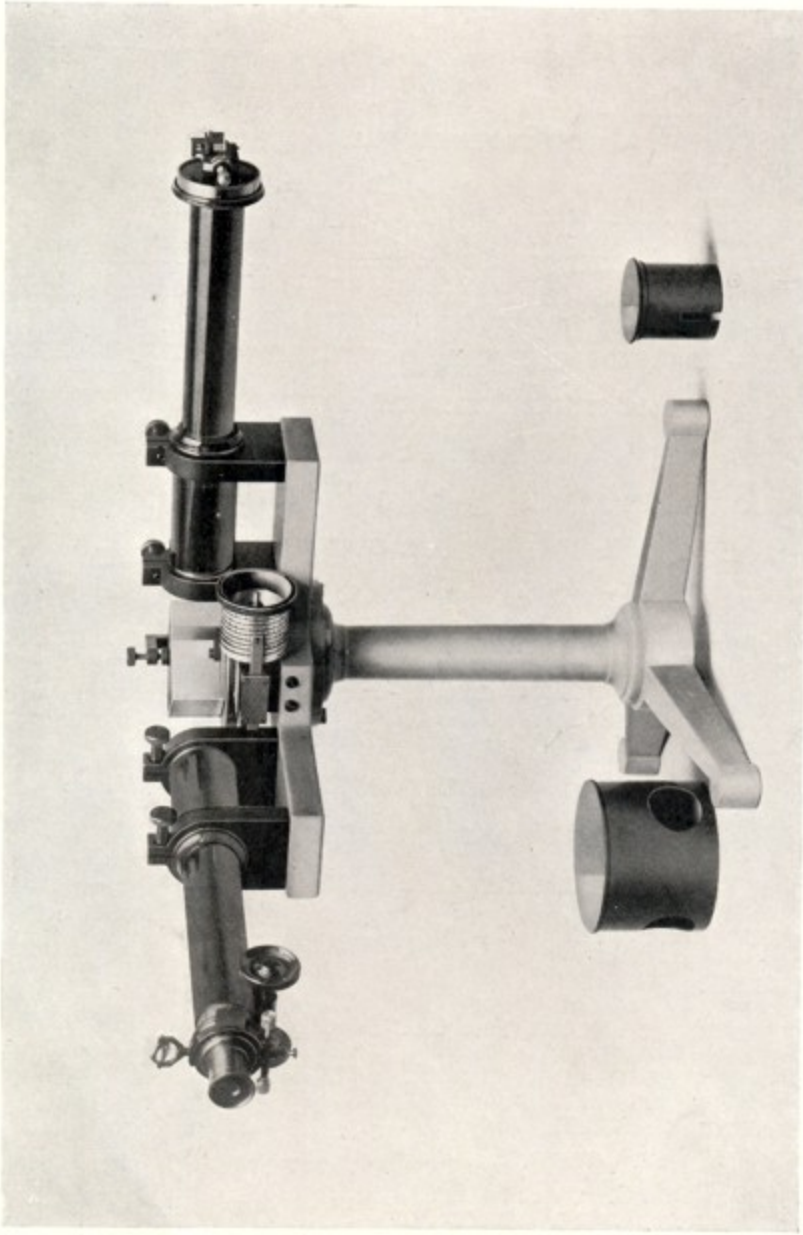

FIG. 1. *Height to the centre, 320 mm. without levelling screws ; with levelling screws, 370 mm.*

in a helical slot. In the most recent instruments this index is on the side of the drum towards the eye; so that the wavelengths of lines can be read off without quitting the eyepiece (*see* Fig. 1). The point of the micrometer screw is of hardened steel, and is permanently fixed before the screw thread is cut, to avoid the risk of periodic errors, the point forming one of the centres whilst the screw thread is being cut. The screws are cut on special screw-cutting lathes of our own design and make—until recently the only screw-cutting lathes made in which the "dead centre" principle was adopted.

The telescope and collimator are both rigidly fixed to the cast-iron base, and the whole is screwed to a strong cast-iron tripod. The object glasses of both telescope and collimator are of 11¼ inches (285 mm.) focal length, and 1¼ inches (31½ mm.) clear aperture. It will be seen that the design is extremely strong and simple; and the accuracy is as great as that obtainable by the

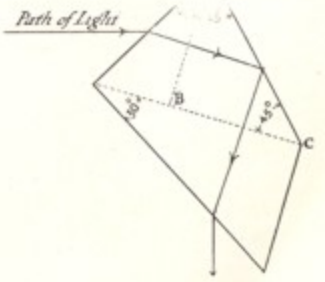

FIG. 2.

use of the very highest class of divided circle spectrometer (unless recourse is had to careful line-to-line measurements with a micrometer eyepiece or some similarly laborious process), whilst in point of ease, speed and convenience the "Wavelength" form is vastly superior.

Fig. 3.

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PRICES

Wavelength spectrometer with dense prism, 1·74 refractive index for D, accurately calibrated in wavelengths **£55 10 0**

Accessories Recommended.

Protective cover to prism table **£1 1 0**

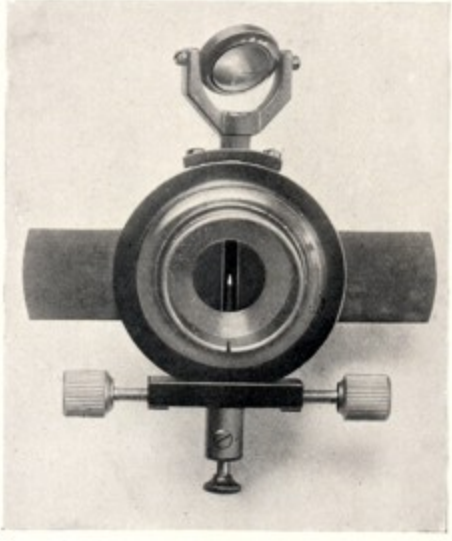

Fig. 4.

Well-made case with lock and key **£3 17 0**

Extra high-power eyepiece, with its own zero adjusting cross-webs **£3 0 0**

Shutter eyepiece with lateral adjustment to bright pointer (*see* Fig. 4, and description below) **£8 0 0**

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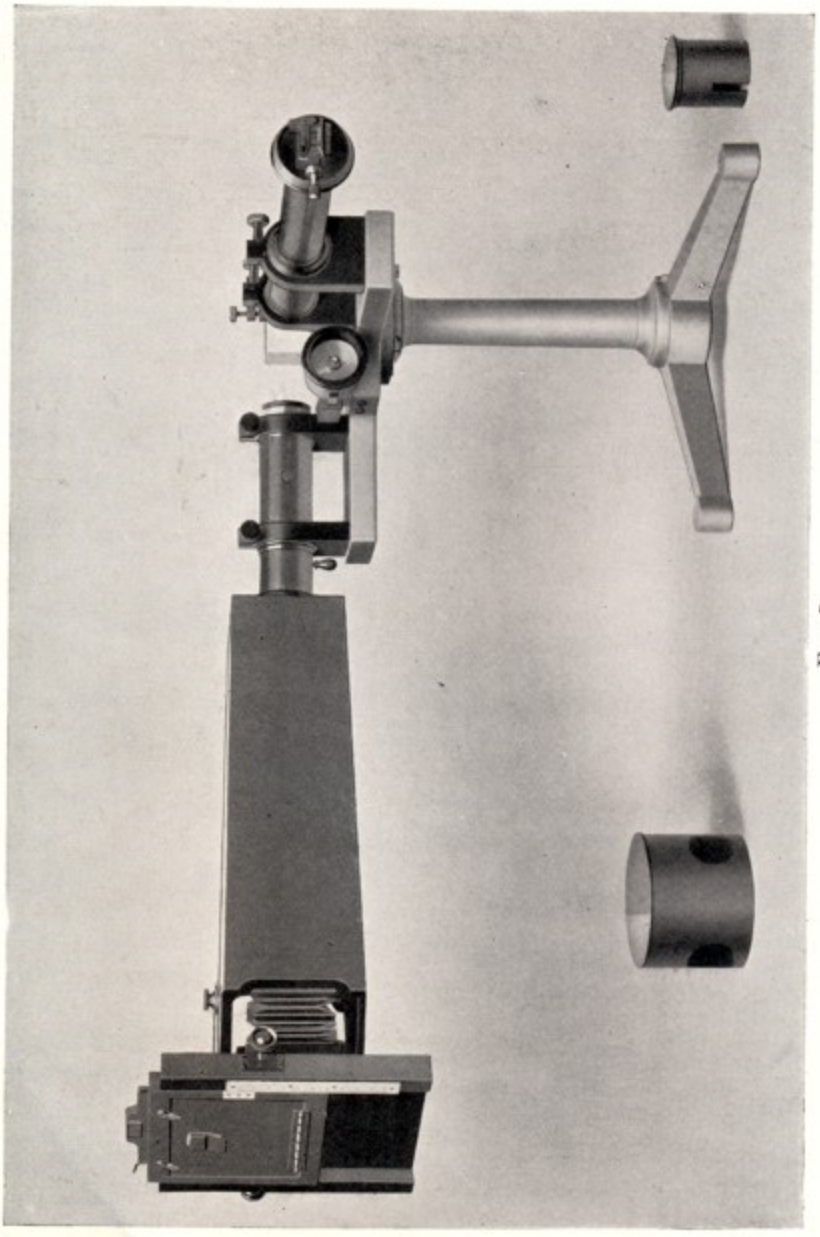

FIG. 5.

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Slide with light filters to the shutter eyepiece for giving the pointer any desired colour, by means of which an increase of accuracy and comfort in reading can be secured, especially in the violet part of the spectrum **£2 10 0**

NOTE.—This eyepiece has two shutters, which can be shifted from either side in the focal plane so as to cover any desired part of the field, thereby obscuring any bright lines which by their proximity prevent the observation of feebler lines. The metal pointer, whose extremity is ground exceedingly fine and polished bright with the greatest care, is illuminated from above by a mirror. This bright pointer is adjustable laterally by the two milled-head screws below, so that one can always return to the standard reading by setting the bright pointer on a reference line.

Camera (shown in position in Fig. 5), with 21-inch focus lens, tilting adjustment for accurately focussing the whole spectrum, vertical adjustment by rack and pinion for taking successive exposures, and shutter for exposure **£13 6 0**

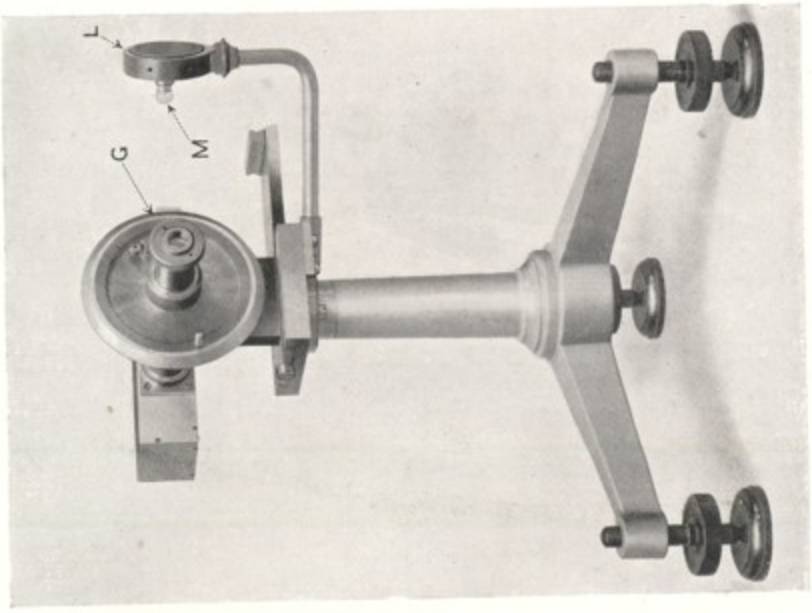

Fig. 7.

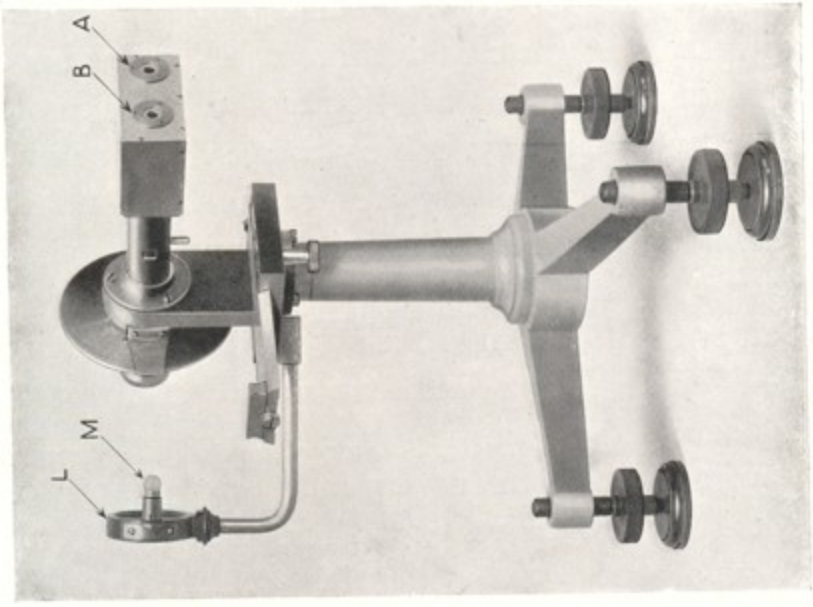

Fig. 6.

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THE NUTTING PHOTOMETER

SPECTROPHOTOMETRY, which for the chemist usually denotes the measurement of the light absorption of a substance for different wavelengths, has till recently not received in the chemical laboratory the attention it deserves. Yet it is only necessary to remember one or two instances of its application in order to remind oneself of the very great importance of this physical measurement. Such investigations as the determination of CO in blood by Vogel, and the separation of Neodymium and Praseodymium by Auer v. Welsbach, may be cited in this connection.

If we look for the reason of this neglect of such a powerful tool, we find it in the difficulty of obtaining accurate results with the older forms of spectrophotometer. It will be found on reference to most of the work on the application of the spectrophotometer to chemical problems that the observer has either assumed his instrument to be correct (an assumption too frequently unjustified) or has been compelled to carry out a laborious preliminary research on the various

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sources of error before commencing the investigation which was his primary object.

The form of Hüfner spectrophotometer made by us since 1904 was designed for research on photographic plates, and for this purpose it has given general satisfaction. While it has also been very serviceable in general chemical work it presents for such purposes several disadvantages. When, therefore, we turned our attention to the development of a spectrophotometer which should be as convenient and accurate as possible for general chemical work, we adopted as the basis of such an instrument—after a careful survey of the main types of photometer available—the form of polarisation photometer described by P. G. Nutting (*see* reprint No. 155, *Bulletin of the Bureau of Standards*), using it in conjunction with our Constant Deviation Wavelength Spectrometer.

Considerable modifications were made in the design of the photometer to fit it for the purpose in view, but the method of dividing the field and other essentials remain ; while every modification has been the subject of careful consideration.

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The features of chief interest to the user are as follow :

(1) One light source is used for both beams of light.

(2) Tubes for liquids or gases of any desired length can be used.

(3) There is ample separation between the two beams (the distance between the centres of the beams being 38 mm.)

(4) The circle is divided both in "densities" and degrees.

(5) The photometer can be used with any ordinary spectroscope, although the Wavelength Spectrometer is to be preferred on account of its convenience, accuracy, and robust design.

An additional point of importance is that great care has been taken to work out thoroughly the correct conditions of illumination, a point of the utmost importance for accurate spectrophotometry.

Our latest model of Nutting Photometer is shown in Figs. 6 and 7, and the combination of Nutting Photometer and Wavelength Spectrometer is shown in the frontispiece.

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Referring to the frontispiece, the two beams of light from the light source are made parallel by the device *C* (whose correct distance from the light source is engraved upon it). In measuring the absorption of a solution the parallel beams pass the one through the tube *D*, containing the liquid, the other through a companion tube containing preferably the liquid used as solvent for the substance under test. The two beams enter the photometer by the apertures *A* and *B* (Fig. 6). Details of the optical construction are given in instructions for use issued with the instrument; it will therefore suffice here to say that the photometer projects upon the slit of the spectrometer a tripartite field, of which the outer two are illuminated by the light which has suffered absorption by the liquid under test, the other being reduced in intensity by rotation of the divided circle *G*. On observation of the resulting spectrum formed by the spectrometer one accordingly sees a spectrum divided into three horizontal strips in close juxtaposition, of which the top and bottom strips are reduced in intensity by the absorption of the liquid, and the middle

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one by the rotation of the divided circle *G*. Attention being directed to a particular wavelength of the spectrum (preferably by isolating it with a shutter eyepiece) the three parts of the spectrum are made to match in intensity, and the reading on the divided circle (divided by the length of the tube of liquid in centimetres) gives the extinction coefficient* of the liquid for the wavelength in question.

The scale of the divided circle, alike with the measuring drum of the wavelength spectrometer, can be conveniently read by the observer without quitting the eyepiece, a lens, *L* (Fig. 7), being attached to the photometer for the purpose.

PRICE

Nutting Photometer as described above, with levelling screws, and including beam parallelising device and small electric lamp (*M* in Fig. 6) for illumination of the divided circle £66 0 0

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* "Extinction coefficient" is the term applied by Bunsen and Roscoe (*Pogg. Ann.* 235—363, 1857) to the quantity, $\frac{1}{d} \log \frac{I}{I_1}$, where I is the light entering the medium, I_1 that transmitted, and d the thickness of medium traversed by the light.

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Raising and lowering stand for holding tubes of absorbing liquids, taking tubes 10 cm. long and upwards **£6 15 0**

10 cm. tubes, accurate to ±0·01 cm., with screwed end caps, and side tube for filling .... Each **£1 10 0**

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