ILLUSTRATED DESCRIPTION

OF THE

MICRO-SPECTROSCOPE,

AS MANUFACTURED BY

R. & J. BECK.

In giving a description of the forms of Spectroscope as applied to the Microscope, we cannot do better than quote the following introductory explanation, written by H. C. Sorby, F. R. S.:

"Spectrum Analysis as applied to the Microscope must not be confounded with that branch of the subject which has yielded such admirable results in the hands of Bunsen, Kirchhoff, and other physicists. In that method of analysis it is the number and position of the narrow bright lines or bands into which the light of the incandescent body is divided by the Spectroscope that enable the experimenter to identify each different substance. It is, in fact, the analysis of the emitted light; whereas in Spectrum Analysis applied to the Microscope it is the analysis of light which has been modified by transmission through the substance under examination, and it is the absence and not the presence of particular rays which makes the spectra characteristic of different subjects. In this respect it is more analogous to Spectrum Analysis as employed in studying the chemical nature of the atmosphere of the Sun or stars, as illustrated by the researches of Kirchhoff, Müller and Huggins, but the principles involved are materially different. The absorption-bands in such cases are narrow, sharply defined lines, characteristic of absorption by gases; whereas those which play such an important part in researches with the Spectrum Microscope are usually broad, gradually shaded off on each side, and only in a few cases so narrow and sharply defined as to vie with some of the broader dark lines in the Solar spectrum."

The Micro-Spectroscope, No. 66, (figs. 1 and 2) consists of a series of prisms, A, arranged for direct vision, fitted into an Eye-piece, and supplied with various appliances—namely, a slit, B, a supplementary spectrum arrangement, C, consisting of a small right-angle prism, D, a stage, E, for placing an object upon, and a mirror, F, for reflecting the light and all the necessary adjustments.

In the focus of the top lens, G, of an Eye-piece especially constructed is placed what is technically termed a slit, B; this consists of two shutters meeting in the centre of the field, the one sliding up to the centre of the field of view, and the other adjusting by means of a delicate milled head, H. Upon the delicacy of the edge of this slit the value of the Spectroscope largely depends, any irregularity or piece of dust appearing as a dark band at right angles to the spectrum under examination, and greatly interfering with the definition.

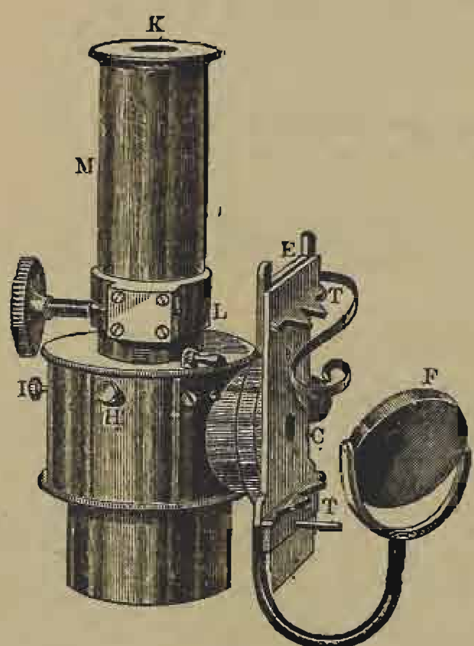
In the same part of the Instrument is inserted a small right-angle prism, D, which can be pushed forward or drawn back out of the field of view by the milled head, I. In the former position it reflects the rays passing through any object placed upon the supplementary stage, E, to the eye placed at the eye-end of the Instrument, K, and enables the observer to compare two spectra with one another, or to measure and record the position of the absorption-bands, as will be described hereafter.

Placed on the flat surface of the Eye-piece are a couple of levers, L, moving two shutters, placed immediately over the slit, for regulating the length of the spectrum under examination.

Above the top lens, G, of the Eye-piece the most important portion of the Instrument slides; this consists of a series of prisms, A, so arranged as to give a direct-vision spectrum, and upon the amount of the dispersion of which prisms, much of the value of the Instrument depends.

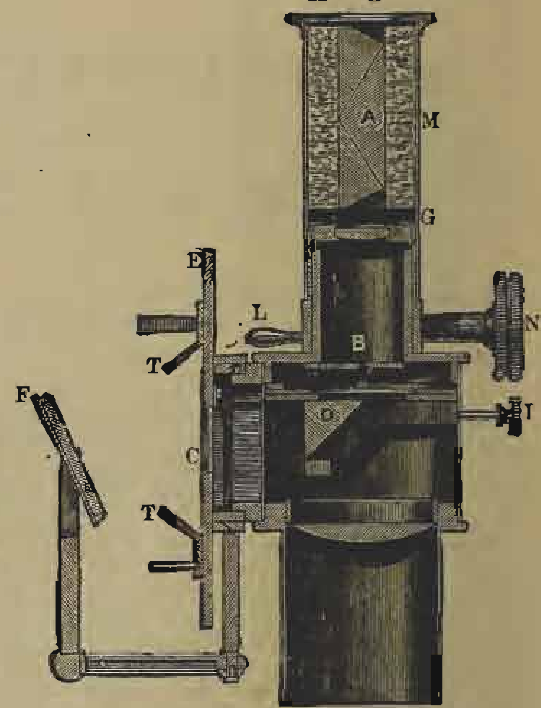
At the side of the main tube is a supplementary stage, E, upon which a standard scale, to be described hereafter, or a second object is placed, supplied with a mirror, F, for reflecting the light through the object, the rays then being totally reflected by the right-angle prism, D, before alluded to, and thrown up the tube to the observer.

Fig. 1.



No. 66.

Fig. 2.



No. 66.

Directions for Using the Micro-Spectroscope.

Remove the ordinary Eye-piece of the Microscope, and slide the Spectroscope Eye-piece (Figs. 1 and 2) into the body in its place. Remove the upper tube, M, containing the series of prisms, and draw back the sliding slit by the milled head, H, so that one-half of the field of view is clear. Focus the microscope to the object to be examined, which is placed upon the stage, pass it up to the edge of the slit, move the side shutters by the levers, L, so as to shut off all side light, save that passing through the object, and push back the sliding side of the slit by the milled head, H. Focus the top lens of the Eye-piece to the slit by means

Fig. 3.

No. 67*.

of the rack-and-pinion, N, place the tube, M, containing the compound prism, A, over the Eye-piece, remove the object from the stage, adjust the slit by means of the adjusting milled head, H, so as to obtain clear vision, if by daylight, so that the Fraunhofer lines are faintly seen, replace the object to be examined upon the stage, and the absorption-bands will be readily seen.

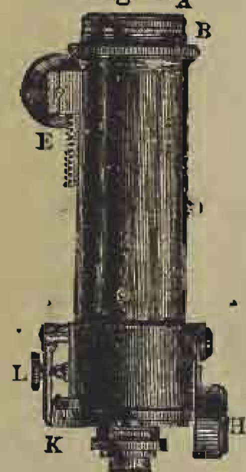
The character of these bands and their position varies in every object; and if any practical use is to be made of the investigation, it is necessary not only to observe, but to record their position. This is done by means of a Standard scale (fig. 3); the precise mode of attaining this result is described in full in the description of the Binocular Spectroscope.

The Standard scale, No. 67*, (fig. 3) used with the Micro-Spectroscope described above consists of two small Nicol's prisms having a plate of quartz .043 inch in thickness between them; it is placed when in use upon the supplementary stage, E, and held in its place by the two clips; the light is thrown in by the mirror, F, and the right-angle prism, D, reflects the image of the quartz-bands up to the eye-end, K.

Description of the Binocular Spectroscope.

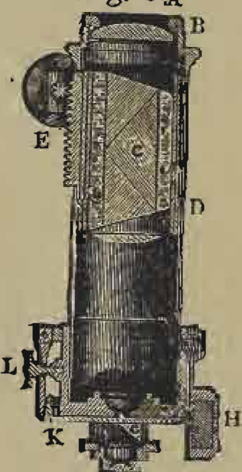
Whilst the Instrument already described is that which is most ordinarily in use, Mr. Sorby has planned another form (Sorby's Binocular Spectroscope, No. 65, figs. 4, 5), which can be used with the Binocular Microscope and which for

Fig. 4.



No. 65.

Fig. 5.



No. 65.

many purposes is superior to that already described and gives a larger dispersion. It consists of the following parts:

1st. An object-glass, A, specially arranged, screwing into the tube of the Microscope by the outside screw, B.

2d. A series of compound dense glass prisms, C, fitting immediately over the Object-glass, A.

3d. A tube, D, moving up and down upon that holding the prisms by means of rack and pinion, E, and carrying the following:

(*a*) A cylindrical lens, F, for lengthening out the spectrum.

(*b*) A small right-angle prism, G, sliding in and out of the field of view, which, when slid in, projects over half the field and throws an image of the dark bands in a piece of quartz polarized by means of two Herapathites or flakes of Iodide of Disulphate of Quinine, and termed (*c*) The Standard Scale, H. This portion of the apparatus is used when the observer desires to record the position of the absorption-bands. The plate of quartz which it contains is cut parallel to the optic axis,* of such a thickness that the line D in the Solar Spectrum comes between the third and fourth band. It is thus described by Mr. Sorby:—"In order to measure the exact position of absorption-bands, etc., seen in spectra, I have contrived a small apparatus which gives an interference-spectrum divided by black bands into 12 parts all of equal optical value. It is composed of two Nicol's prisms, or Herapathites, with an intervening plate of quartz about .043 inch thick, cut parallel to the principal axis of the crystal, the thickness being so adjusted that the sodium or D line is exactly 3½, counting the bands from the red end towards the blue."

*It is a well-known fact that a plate of quartz cut parallel to the optic axis will, under polarized light, give a series of black bands, the distance between such bands being due to the thickness of the plate of quartz.