II.—*Notes on the Micro-spectroscope and Microscope.*

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IN continuation of my paper on "A New Form of Micro-spectroscope," read before the Royal Microscopical Society on the 4th December, 1872, I would wish to add the following few remarks. On a trial it will be found that the arrangement with the erector placed in its usual position in the draw-tube, as described in the above-mentioned paper, may have a low-powered object-glass substituted for the erector, and that a very useful combination will be thus obtained for viewing the slit, and the object under examination, in the same field. A small ring screw adapter is all that is required to enable the object-glass to be screwed into its place at the end of the draw-tube. This combination, without a slit, can also be used when an erect image is required, as in dissections and arrangement of objects on a slide when placed on the stage of the microscope; and it will be found that, with this arrangement of two objectives, the magnifying power can be diminished or augmented almost at pleasure, without changing either of the object-glasses, by simply altering the relative distances between the object under examination and the first object-glass, and the distance between the first and second objectives, so that almost any degree of magnifying power which is found expedient, can be easily and rapidly obtained without any alteration in the apparatus. The least magnification will be obtained when the two objectives are near each other, and the farther they are separated the more the image will be enlarged. For those persons who have not got an erecting eye-piece, the arrangement herein described will prove a useful and very cheap substitute. It will also be found, if a micrometer of any convenient construction be placed in the position of the slit in this form of micro-spectroscope, and the arrangement just described be used, that a very sharp image of the micrometer and the object on the stage will be obtained; and in some instances this plan will be found more efficient than any of the usual forms which have, from time to time, been adopted. I would also wish to suggest, that when a micrometer with lines ruled on glass is used either in the shape of a stage micrometer or that form which is placed in the eye-piece, that, instead of having the lines ruled in the usual way, they should be made up of concentric circles placed at equal distances from each other; an object would in this way be very readily measured in all its diameters, and facilities for making drawings would also be afforded. Since my paper of the 4th December was read, it has been brought to my notice that the

instrument described by me is similar in principle to the original form of the spectroscope applied to the microscope proposed by Dr. W. Huggins in a paper read by him before the Microscopical Society on the 10th May, 1865, and described and figured in the 'Microscopical Journal' for that month, entitled "Note on the Prismatic Examination of Microscopic Objects." I regret that I did not know of this paper by Dr. Huggins before reading my own, but a reference to it will show that the dispersive power employed was that obtained by the use of two prisms. There can be no doubt that the amount of dispersive power which will be the best for one kind of object, will not be always the most suitable for all other objects, and that therefore sometimes one and sometimes two prisms will give the best results. Much will depend upon the amount of light available, and it would therefore be useful to so arrange matters that either one or both prisms could be used at pleasure, but as there is plenty of light available when the slit is placed sufficiently close to the object-glass, and the collimating lens is of adequate angular aperture, two prisms, under ordinary circumstances, can easily be used without rendering the absorption bands at all undefined or indistinct. Dr. W. Huggins doubtless places his slit at a distance of three or four inches from the object-glass, because it gives a larger image of the object relatively to the slit, and because the angle of divergence is greater the nearer the image or slit is to the object-glass. The maximum of light (irrespective of the size of the object) will be when the angle of the collimator is equal to the angle of divergence. Now, when a very accurate inspection of the minute portions of small objects is required, the position of the slit must accurately correspond to the place where the image of the object on the stage is formed behind the object-glass; and as this position of the image can be made either to approach or to recede from the object-glass, at the will of the operator, by merely altering the distance between the object on the stage and the object-glass, by means of the usual focussing arrangements, almost any position of the slit can be easily made to be in the conjugate focus behind the object-glass; and as the nearer the slit and image are to the object-glass the farther the object-glass must be removed from the object, the motion is in a possible direction; and as the image diminishes as it approaches the object-glass, its brightness rapidly increases, and therefore the closer the slit is to the object-glass, the more the light will be increased which is received within the jaws of the slit; but the closer the image is to the objective the larger will be the angle of divergence, and therefore the diameter of the collimating lens must be increased in proportion, and its focal distance lessened.

Suitable proportions appear to be reached when the slit is placed at a distance of $1\frac{1}{2}$ inch from the objective, and the colli-

mating lens is $1\frac{1}{4}$ inch in diameter with a focal length of 4 inches. The prisms should be of the same width as the collimating lens; and, as Dr. Robinson and others have suggested, they might be made up of any of the forms of compound prisms which were considered most suitable to the object for which this spectroscope was chiefly selected. The magnifying power required is best obtained by changing the objective.