ART. XXXIV.—*Remarks on the nineteen-band Test-plate of Nobert;* by J. J. WOODWARD, Asst. Surgeon, and Brevet Lieutenant-Colonel U. S. Army.

THE January number of this Journal for 1861 contains an interesting article on the thirty-band test-plate of Nobert, by W. S. Sullivant and T. G. Wormley.

In this test-plate the lines of the first band are ruled $\frac{1}{1000}$th, those of the thirtieth band the $\frac{1}{8000}$th of a Paris line apart, measuring from the center of one line to that of the next.

Sullivant and Wormley resolved the first twenty-six of these bands, partly resolved the twenty-seventh, but failed to resolve satisfactorily the last three bands.

Nobert has since prepared a test-plate of nineteen bands, in which the lines of the first are the $\frac{1}{1000}$th, those of the second the $\frac{1}{1500}$th, of the third the $\frac{1}{2000}$th, and so on, those of the nineteenth band being the $\frac{1}{10,000}$th of a Paris line apart.

In this new plate the fifteenth band corresponds precisely with the last band of the thirty-band plate, the lines being the $\frac{1}{8000}$th of a Paris line apart.

On one of these new plates Max Schultze * has succeeded in resolving the fourteenth band, Eulenstein of Stutgard has done the same, and Nobert himself has gone no further,† nor, so far as I know, has any other European microscopist.

Under these circumstances, Mr. Charles Stodder of Boston tells us that he and Mr. Greenleaf "saw the nineteenth band satisfactorily" with a Tolles' $\frac{1}{8}$th immersion of 170° angle, magnifying 550 diameters.

They did not count the lines, an operation which Mr. Stodder thinks is quite impossible.‡

For myself, having also seen lines which I thought real in the nineteenth band, with several objectives, and having satisfied myself both by counting and by having photographs taken of what I saw, that these were spectral or spurious, and not real lines, I am quite convinced that those which Messrs. Stodder and Greenleaf have seen are of the same nature, and hope these gentlemen will attempt to count the lines they see in the nine-

* Archiv für mikroskopische Anatomie. Bonn, 1863, p. 305. His words are: "Bei schiefem Licht bin ich mit den besten systemen bis zur 15ten Gruppe gekommen."

† See quotations from a letter of Eulenstein in the paper of Mr. Charles Stodder hereafter quoted.

‡ Nobert's test-plate and modern microscopes, American Naturalist, vol. ii, p. 97, also Microscopical Journal, July, 1868, p. 131. To the latter article Mr. Stodder appends a note in which he claims that Dr. Barnard also has seen the real lines in the nineteenth band. I am quite sure the lnes Dr. Barnard saw were also spurious ones, and he himself writes me that his opinions in the matter were not fully matured, and that he intends to make further observations.

teenth band by the very simple method I shall append, or to make a photograph of them, either of which will, I think, speedily bring them to my opinion.

I have lately made a careful study of a nineteen-band plate belonging to Rev. Dr. F. A. P. Barnard, which was made for him by Nobert during 1867.

To convince all microscopists interested of the accuracy of my statements, I have had photographs of the different bands made by Dr. E. Curtis, at the Army Medical Museum.

I am satisfied that I have seen, and that Dr. Curtis has photographed the true lines in the fifteenth band, but no further. Dr. Curtis has also photographed two views of the sixteenth, seventeenth, eighteenth and nineteenth bands, in which lines are clearly seen, which, however, I conclude from their number and character to be spurious, although both he and I supposed them to be real before counting them by the method I shall presently mention. For example, the spurious lines in the photograph of the seventeenth band are 30 in number in one photograph; 40 in another; the real number of lines according to Nobert's statement being 51.

I send herewith a full set of these photographs to the editors of this Journal.

In these photographs the lines count as follows in the several bands:

First, 7 lines.	Eighth, 25 lines.	Fifteenth, 45 lines.
Second, 10 "	Ninth, 27 "	Sixteenth, not counted.
Third, 13 "	Tenth, 30 "	Seventeenth," "
Fourth, 15 "	Eleventh, 34 "	Eighteenth " "
Fifth, 17 "	Twelfth, 37 "	Nineteenth, " "
Sixth, 20 "	Thirteenth, 40 "	
Seventh, 23 "	Fourteenth, 43 "	

The photographs were taken with the $\frac{1}{2}\frac{1}{5}$th of Powell and Lealand, and a distance sufficient to magnify 1000 diameters linear. The slide was illuminated by direct sunlight passed through a solution of sulphate of copper in ammonia, and concentrated by an achromatic condenser, with large diaphragm opening, without any central stop, the pencil made oblique by throwing the condenser to the right or left of its true centering. I tried on the slide many object glasses, including an $\frac{1}{8}$th of Ross, a $\frac{1}{1}\frac{1}{0}$th of Tolles, a No. 11 immersion of Hartnack, an $\frac{1}{8}$th, $\frac{1}{1}\frac{1}{5}$th and immersion $\frac{1}{1}\frac{1}{0}$th by Wales, but got the best results with the $\frac{1}{2}\frac{1}{5}$th. The $\frac{1}{5}\frac{1}{0}$th of Powell and Lealand did not do quite so well as the $\frac{1}{2}\frac{1}{5}$th, apparently on account of the thickness of cover.

Dr. Curtis has also made two photographs of the twelfth, thirteenth and fourteenth bands, in which the resolution being

imperfect, spurious lines are shown. The thirteenth band, for example, shows 25 lines in one photograph, and 16 in the other, the real number being 40.

These two photographs agree closely in character with those of the sixteenth, seventeenth, eighteenth and nineteenth bands.

The foregoing results lead me to believe that the lines in the last four bands are really ruled as claimed by Nobert; and that with greater defining power the true lines could be seen. They also compel me to doubt the accuracy of the statements of those who think they have seen the true lines in any band beyond the fifteenth, and especially if the lines seen have not been counted.

I may here mention that the first of this series of photographs represented the last four bands, and was made by Dr. Curtis some months ago. Both he and I supposed at the time that the lines shown on the sixteenth and seventeenth band in this photograph were real. We accounted for their being too few in number (those of the sixteenth counting 37, those of the seventeenth, 40 lines), by supposing that the whole of each band was not to be seen in any one position of the focal adjustment.

Subsequent experience has, however, convinced us that these also are spurious lines. I learn from Dr. Barnard that this photograph was sent by Eulenstein to Nobert, who accounted for the small number of lines by supposing Dr. Curtis had by mistake copied the twelfth, thirteenth, fourteenth and fifteenth bands! We had, however, made no such error, of which I doubt not Nobert will be convinced on receiving the present series of photographs, copies of which I have sent to him.

In conclusion, I may mention briefly two modes of conveniently counting the lines in the highest bands that can be resolved.

If a cobweb micrometer is used, the micrometer eye-piece should be firmly clamped in a stand screwed to the table, so that the eye-piece is close to the end of the microscope tube, but does not touch it, a piece of black velvet being used to complete the connection. The motion of the micrometer screw now communicates no tremor to the microscope, and all difficulty in counting the lines seen (whether real or spurious) disappears. Still better than this is the following method: The microscope being set up in a dark room as though to take a photograph, and the eye-piece being removed, the image of the band to be counted is received on a sheet of plate glass in the plate holder, and viewed with a focussing glass, on the field lens of which a black point is marked. As the focussing glass is moved on the plate from side to side, the black point is moved from line to line. The lines may thus be counted with as much ease and precision as if they were large enough to be touched by the finger.