THE MARKINGS ON VENUS. By A. E. Douglass, A.B

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BY

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(*Communicated by the Secretaries.*)

The reading public has been recently addressed on the subject of the markings on *Venus* in various attempts to show that the discoveries made at this observatory are unworthy of credit. No matter how futile such criticism must prove to be in the long run, some persons will be influenced by it if we do not from time to time make some rejoinder, or give out some statement which will show our continued activity in this line of work, our undiminished confidence in the results obtained, and our answering attitude towards adverse opinion.

In the last six years many thousands of hours have been spent by us at telescopes of 13, 18, and 24 inches aperture and their smaller finders, when the seeing was sufficiently good for profitable work on the finest known planetary detail. Expressed in standard terms, the seeing was practically always such that in a 6-inch aperture the spurious disc of the interference pattern was well defined, and a very large part of the time the rings of the same pattern were unbroken. I consider that any astronomer who cannot say the same for the seeing during his hours of work, and whose hours of work do not reach a commendable number, has no right to criticise our results; for he lacks the experience by which alone he becomes capable of judging.

Under proper conditions of air and aperture the markings on *Venus* are absolutely certain. Under proper conditi ns they are to me about as easy or difficult to see as the irregularities on the terminator of the Moon when it is near the first quarter, viewed by the naked eye. I have on a few occasions seen a large projection perfectly distinct. So it is with *Venus*. At the best seeing the markings are visible at the first glance.

To say that no markings save M. Antoniadi's symmetrical shadings of atmospheric contrast exist, or that the detail seen here is due to pressure on our objective, or to defective densities in the eye-piece, or to our own eyes, or to the imaginings of our brains; or, most ridiculous of all, to our looking all day at some map and then seeing it on the planet, is to offer suggestions too absurd to be taken seriously.

We use the telescope in both positions, normal and reversed: that shows that the markings are not in the lens. We use different eye-pieces and twist them in varying position angles: that shows that the markings are not there. We sit in different positions, so the markings cannot be in our eyes; and different persons in perfect independence find the same detail, so it is not a mental phenomenon.

In order to test our results in a formal manner, I made the following experiments on the afternoon of April 19, when the

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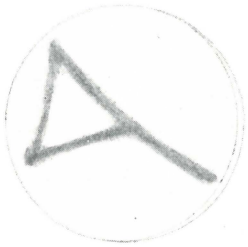

Detail seen in each combination of aperture and focus, save one, 1898 April 19

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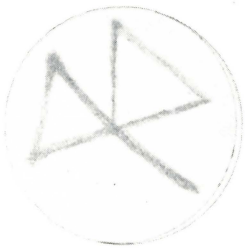

Detail drawn 1898 April 19, $10^h\ 47^m$ G. M. T.

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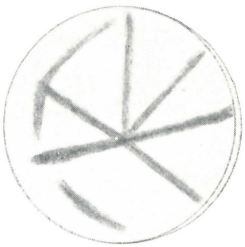

Mr. Drew's drawing of 1898 April 19, $13^h\ 5^m$

VENUS.—Lowell Observatory, Flagstaff, Arizona

seeing was very good. To improve the comparison a power of about 150 was used in every case; the detail visible and unchanged in a single essential throughout is shown in the accompanying drawing (plate 5). It is not symmetrical with respect to its centre, and therefore a reversal of it would have shown at once. In every test a complete observation was made, and in all save the first the detail was seen with absolute certainty.

Aperture. in.	Focal Length. in.	Position of Tube.	Remarks.
24	372	E. of pier	No detail; planet too bright and badly "shattered" by air currents.
3+	372	E. ,,	Detail perfectly evident. This aperture was obtained by a small diaphragm over the eye-piece.
3	372	E. ,,	Detail perfectly evident; diaphragm over objective.
3	372	E. ,,	Twisting eye-piece or changing position angle of eyes makes no difference.
3	372	W. ,,	Detail perfectly evident, and exactly the same.
1·6	372	E. ,,	Detail evident, not quite so well defined. Planet pure white, no diffraction ring.
4	59	E. ,,	Detail evident, seeing not quite so good as in 3-inch aperture.
3	59	E. ,,	Detail exactly the same as in long focus or better, as Sun does not shine on end of tube.
1·6	19·5	E. ,,	Detail the same, but not so well defined, planet yellow, diffraction ring shows.

More than twenty-four hours after making my drawings I saw Mr. Drew's drawings of the same date, and so far as mine went they coincided precisely with his in every detail. I had not seen Mr. Drew's sketches before—in fact those of April 19 were the only ones made by him since the last superior conjunction. On the other hand, I had seen Mr. Drew's drawings of last summer, when *Venus* was on the other side of the Sun, and showed entirely different markings. I had never closely studied Mr. Lowell's map—merely glanced at it casually—and at this time had not seen it in many months; and though I knew it resembled the hub and spokes of a wheel, I did not know what position the centre held with respect to the phase, and in these observations had no idea where the centre ought to be in order to give even a remote resemblance to Mr. Lowell's work.

A final bit of intrinsic evidence is the fact that I saw these lines a little broader and less well defined than Mr. Lowell represents them; that is the difference between us in our drawings of the canals of *Mars*. The difference is, I think, due to our

individual use of the telescope ; for he habitually used on *Mars* a lower power, and on *Venus* a larger aperture, than I did, either one of which would tend to show the lines narrower.

When a man has had a large experience under particularly favourable circumstances, like Mr. Lowell, his report is not lightly to be set aside ; and when he is almost the only one who has experienced these especially favourable conditions, an attempt by another who has never had that experience to prove his results illusions is likely in the end to bring down ridicule on its author.

The first reason why other observers have not seen these markings is bad atmosphere. When I began observing the third satellite of *Jupiter*, for days, even weeks, I drew nothing but hazy indefinite markings or belts, such things as M. Antoniadi describes as appearing to him on *Venus*. But one night after making several drawings of that character the seeing suddenly became superb, the curtain rose as it were, and I saw sharp distinct black lines about which uncertainty was impossible. The very same thing happened on the fourth satellite four days later. I had been drawing the same indefinable shadings, when one night the seeing improved, the curtain again rose, and I perceived sharp definite lines. After once thoroughly understanding the character of the object sought, I could see them and profitably study them under conditions of seeing formerly prohibitory.

The experience on *Venus* has been similar. On the day succeeding my first good view, I spent nearly the whole afternoon without catching a single certain glimpse. Suddenly the seeing improved for an instant, and I saw the same markings unmistakably. If it had not been for that glimpse I would have gone away perfectly ready to believe that no markings existed. I am not surprised that other astronomers doubt them.

The second reason why some other observers have not seen them has been the fault of using too large an aperture. Six years ago I discovered "air waves," and over four years ago I explained theoretically why reducing the aperture is often beneficial. All this has been published in full elsewhere (*Am. Met. Jour.* 1895 and *Pop. Ast.* 1897). I decided long since that in planetary work the greatest efficiency is obtained with the smallest aperture which supplies the required illumination. There is a limit to this, however. An inch and a half lens shows the markings on *Venus* nicely, but they are not so well defined as in a lens of three inches, which in our atmosphere is a very satisfactory size to use. When the seeing is very bad an aperture of less than three inches will become necessary.

A third cause of failure is the effect of heating of the lens and tube by the Sun's rays. For this reason I have found it sometimes advantageous to use the small finder, which is far within the dome and well shaded.

A fourth cause comes from the air within the dome being colder than that without. This is likely to harm the seeing. If

the interior is warmer than the exterior, it will certainly harm the seeing. In fact my latest experiments show that any dome at all is harmful. A sunshade surrounding the tube would be better both night and day.

A fifth cause of failure, and by no means the least important, is the lack of continuity of observations and the lack of a first good view. By the first I mean fair or good observations made many days in succession. For instance if the seeing is only fair it requires the work of several nights in succession, without intervals, to identify with certainty the longitude presented by a satellite of *Jupiter*. By a "first good view" I mean the necessity of one first-class observation before one understands what is sought. After that view the observer can obtain valuable results under conditions in which formerly he failed completely from ignorance of what he was after. It is the same in observing the *Gegenschein*. I have taught many persons to observe it, and I find that teaching consists in getting them to see it well once. After that they can be trusted to pick it out with very small liability to error. This, of course, is most true in atmospheres unclouded by smoke and unlighted by electricity.

No matter how difficult to obtain, a just hearing is our right. No one is entitled to cry out against us until he can show that his atmosphere is approximately as good as the one through which Mr. Lowell discovered these markings. Let our dubious friends, who attempt to show that we as well as they are deluded, devote a portion of their valuable time to work at the telescope under better atmospheric conditions, and no one will misunderstand the silence which will follow.

Lowell Observatory, Flagstaff, Arizona:
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