

ART. III.—VENUS IN DAYLIGHT TO EYE AND TO OPERA-GLASS.  
—A. CAMERON, YARMOUTH.

It seems to be commonly supposed that Venus can be seen with the naked eye in daylight on very rare occasions only, and that even then the sight can be enjoyed only by those who have unusually good eyes. It is the chief purpose of this paper to try to show that this is a mistaken notion.

That such a notion should prevail among the general public is not so very strange, for the general public nowadays are not much given to looking heavenwards either by night or by day. But it is not confined to the general public. It may be found expressly stated in some astronomical books and periodicals, and, when not expressly stated, remarks are often made by astronomical writers which seem to imply that they hold this opinion, and which certainly succeed in conveying that impression to their readers. For instance the following appeared a few years ago as an editorial note in an astronomical monthly:—

“Some friend having the initials P. B. S. claims to have seen Venus with the naked eye Jan. 1 and 14 at the hours respectively of half-past one and half-past twelve in the afternoon. This may be possible, but it is also certainly true that our friend has unusual power of vision.”

The man who wrote that is an astronomer. He is, and he was then, the director of an astronomical observatory as well as the editor of an astronomical journal. If the reader of this paper will note the fact that, when P. B. S. made his observation, Venus was  $3\frac{1}{2}$  months out from her nearest conjunction, he will by and by be able to see what an absurd mistake the editor made. It is only fair to add that he afterwards admitted that he had written “inadvertently.”

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This paper is a sequel to one called “The Visibility of Venus to the Naked Eye,” published in last year's Transactions (Ser. 2nd, Vol. I, Art. III). When the earlier paper is referred to here it is usually spoken of as “the Visibility paper.”

The latitude of the writer's station is  $44^{\circ}$  N., longitude  $66^{\circ}$  W., time used  $60^{\circ}$  W.

The numbers given for Venus's brilliancy at different times are percentages of the mean greatest brilliancy.

Of course astronomers have other and more important matters to attend to than such a subject as this; but, when they do write about it, it were well that what they write should not be untrue or misleading.

It is just the kind of subject that a star-gazing hobbyist is apt to get interested in. My own interest in it grew out of the fact that I found my observations inconsistent with the general drift of what I had read about it—which general drift tended to confirm the common but erroneous opinion already mentioned. In fact, so far as I can remember, everything I ever read about it, with one exception, tended that way. The one exception,—and it would have been a very startling announcement to me had not Venus herself prepared me for it,—was a paragraph in *L'Astronomie* for June, 1892. It contains one of the 'conclusions' which M. Trouvelot of the Observatory of Meudon draws from many years' observation of Venus. He says:

“ Par un ciel pur Venus est visible à l'œil nu, en plein jour sur tour les points de son orbite quand sa distance angulaire au Soleil n'est pas inférieure à  $10^{\circ}$ , quand elle est vers ses conjonctions inférieures, et, à  $5^{\circ}$ , quand elle est vers ses conjonctions supérieures.”

I did not see this until two months after I had written the article on the Visibility of Venus, which was published in last year's transactions. That article was intended at first to include the present subject, but I am glad now that it did not. For since it was written, and since M. Trouvelot's paper was published, both an inferior and a superior conjunction have occurred, and I can now set down observations made at these times and compare them with M. Trouvelot's *conclusion*.

It might not be amiss, in passing, to compare his *conclusion* with the statement in the closing sentence of the Visibility article. There it is said—“On every clear day this year so far” (the year was 1892, and the time of writing was April) “Venus could have been seen, even at noon, by any eye of average quality that knew where to look for her; and the same sight may be had by the same kind of eye on every clear day from now till the end of the year, excepting only for a fortnight or

so in July." I happen to know that this was considered a rather astounding statement by some, but previous observations had given me full warrant for making it, and subsequent observations have established the truth of that part of it which refers to the then future. All the same, it is very satisfactory to find that I can claim such an eminent authority as M. Trouvelot as sponsor for the antecedent probability of its truth. All through that year, except from the middle of June until the end of July, the conditions were so very much more favorable than those prescribed by the distinguished French astronomer that it is not worth while making the comparison, except for the excepting clause at the close,—“a fortnight or so in July.” Inferior conjunction occurred on July 9, and this fortnight or so was, of course, the fortnight or so centering at that time. M. Trouvelot fixes  $10^\circ$  of elongation on either side of inferior conjunction as his limit. On the average it takes Venus  $6\frac{1}{2}$  days to move in  $10^\circ$  at this conjunction, and  $6\frac{1}{2}$  more to move out the same distance, and in 1892 she was less than  $10^\circ$  from the sun on the 13 days following July 2. And so the prediction of the Visibility article and the *conclusion* of M. Trouvelot are in very satisfactory agreement on this point. To what extent they agree with observation at that particular conjunction we shall see presently.

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That Venus may be visible to the naked eye in daylight, she must be very brilliant, she must be not too near the horizon, and she must be not too near the sun. In this latitude she mounts once every day, and always in daylight, to an average altitude above the horizon of over  $45^\circ$ . It may be more than  $70^\circ$  and it may be less than  $20^\circ$ . When the other two conditions are favorable it can't be much under  $20^\circ$ . It was a little less than  $20^\circ$  from the 3rd to the 14th of November this year (1893); but, the other conditions being then favorable, it was quite easy to see her in a clear sky on any of those days. For the present then, we may drop the altitude condition and attend only to the other two,—the condition of brilliancy and of angular distance from the sun or 'elongation' as it is called.

The elongation is least at both superior and inferior conjunction, the brilliancy is least at inferior conjunction. And so, if we can determine how close to each conjunction an average eye can see Venus in daylight, it will be quite safe to say that she can be so seen on every clear day between the limits thus determined.

The last inferior conjunction occurred on July 9th, 1892, at 2.30 p. m. Before this, the best observation that the weather had allowed me to get near any of these conjunctions was eight days before the one of April 30th, 1889. The time was a quarter of an hour before sunset, the elongation  $14\frac{1}{2}^{\circ}$ , the brilliancy 23. But I knew that M. Bruguier of Marseilles had done better. He had seen Venus—presumably near noon— $3\frac{1}{2}$  days before this same conjunction, when the elongation was less than  $8^{\circ}$  and the brilliancy less than 7. And  $4\frac{1}{2}$  days before the next inferior conjunction, in December 1890, he had seen her—again presumably near noon—when, though the elongation was nearly  $9^{\circ}$ , the brilliancy was only  $6\frac{1}{2}$ .

I wanted to beat this record, if possible, at the July conjunction in 1892, and to beat it all round,—in brilliancy, in elongation, and in the number of days from conjunction at which the nearest observation was made.

At first it began to look as if I would not lower even my own record, for the last two days of June and the first three days of July were cloudy or foggy. On July 4th the clouds cleared off about an hour before noon, and at 12.30 I made a new record for myself by seeing Venus when only 5 days from inferior conjunction, only  $9^{\circ}$  from the sun, and with a brilliancy of only 10. But M. Bruguier's record was still ahead of mine on all these points. On the 5th my notes say,—“Fine at noon but sun carried a train of light clouds with him, and I didn't get a sight of Venus.” This was very disappointing. But on the 6th,—“12.25 to .35, Venus in eye—easy—cloud-trails attending sun as yesterday, but caught Venus first in a beautifully clear patch of pure blue. Picked her out three or four times for —— and ——, but they couldn't catch her. I held her with eye through the white edges of the cloudy stuff, and even through some of the thinnest of the clouds.” This was three days and

two hours before conjunction, the elongation was just under  $7^\circ$ , the brilliancy 5. I tried my eye again on the 7th but without success,—the sky near the sun was white, instead of blue as on the 6th. The 8th was cloudy. On the 9th—the day of conjunction—Venus was so easy in a field glass, and even in an opera glass, that I felt almost sure that a better eye than mine would have picked her up without help. At 3.30 I thought once I glimpsed her with eye but probably not.”

In the Visibility article I had allowed for the half of “a fortnight or so” before inferior conjunction, during which Venus might not be visible to the naked eye in daylight. And about the same time M. Trouvelot had come to the conclusion that she could be so seen when not less than  $10^\circ$  out from this conjunction. The above observations more than confirm both estimates. That of July 6th, 1892, shows that an eye, which I know to be less keen than many are, can see Venus when only a little over three days, and when less than  $7^\circ$  from inferior conjunction.

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Before inferior conjunction, Venus is on the east side of the sun and following him. I have always found this position the best one for seeing her when near conjunction. My facilities for shutting off the sun are much better when he precedes her than when she precedes him. And the very fact of his preceding her is quite an advantage in itself, for the observer is not then disturbed by the fear that his search may be spoiled by the sun coming into his eyes from round the corner.

This is one of the reasons why I have never seen Venus as close to either conjunction when she was west of the sun as when on the east of him. Another is, that, whenever I have been making observations of this kind, it has happened that the seeing was much better when she was close on the east than when on the other side. But this cannot always happen, and some time or other we may hope to have blue sky and clear air when Venus is preceding the sun at a small angle—as small as or even smaller than the angle that separated them on July 6, 1892.

When I first got my eye on her after that conjunction she was

much farther out than on that day. This was partly the fault of fog, partly of cloud, but mostly of white sky and heat-haze. It was on the 17th at 11.15 a. m., 8 days after conjunction and 11 days after my last eye-observation. My note-book says,—“Venus in eye at last, very easy, sky blue; what a difference between the white sky accompanying the hot weather of last week and the blue one coupled with the cool bracing air of to-day. Can pick her up easily again and again, and hold her with eye even thro' clouds, light ones of course.”

And so it turned out that the prediction of “a fortnight or so” during which Venus might not be visible to the naked eye in daylight in 1892 had not been made too rashly. If the last sentence of the Visibility article were to be re-written now, it would read thus,—“On every clear day in 1892 she could have been seen in this latitude, even at noon, by any eye of average quality that knew where to look for her, excepting only on the ten days between the 6th and the 17th of July.” And this other sentence might be added—“And of these ten days five were cloudy or foggy, either all day or at the best time of day for seeing Venus; while on three of the other five the sky near the sun was white.”

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After Venus passes the limit of visibility on the west side of inferior conjunction, her elongation increases fast and her brilliancy very fast. And therefore it becomes easier and easier for the eye to see her in daylight. About 36 days after inferior conjunction she is at greatest brilliancy (100 for mean conditions), and her elongation is then about  $40^\circ$ . In 36 days more she reaches greatest elongation (about  $46^\circ$ ) and her brilliancy is then 73. Then she begins to swing slowly back towards the sun. It takes her more than three times as long to swing in to superior conjunction as it does to swing out from inferior. Her brilliancy decreases during all this time, but very slowly, and the more slowly the more nearly she approaches conjunction. At inferior conjunction the brilliancy may go down to 0, and usually does go down to very nearly that, but at superior it cannot get much below 24. It ought therefore to be possible to see her at a less

elongation when near superior conjunction than when near inferior, and M. Trouvelot gives  $5^\circ$  as the limit for the former case as against  $10^\circ$  for the latter. But in the latter case the elongation is changing very much faster than in the former, so much so that while the time interval corresponding to  $10^\circ$  near inferior conjunction is only  $6\frac{1}{2}$  days on the average, that corresponding to  $5^\circ$  from superior conjunction is nearly 20. As Venus has been seen with the naked eye in daylight when only 3 days and only  $7^\circ$  from inferior conjunction, it should be possible to see her when less than 20 days and less than  $5^\circ$  from superior conjunction.

Whether she has ever been so seen I don't know. I have tried my eye on her at such times, but have never had the sky and the air in the best seeing condition. Before I knew of M. Trouvelot's  $5^\circ$  limit, the best I had done near superior conjunction was to see her distinctly on March 19, 1890, ten minutes after sunset. This was  $26\frac{1}{2}$  days after conjunction, and the elongation was  $6\frac{1}{2}^\circ$ . I have done nothing better since, and I know of nothing better having been done by any other observer. But of course M. Trouvelot must have made a better observation, or must know of a better one having been made,—unless his  $5^\circ$  limit is an inference from what has been done, under conditions of much lower brilliancy, at the other conjunction. I have a record of one that would have been a little better if it were more trustworthy. The date is May 24th, 1893, when Venus was  $22\frac{1}{2}$  days past her last superior conjunction, and when her elongation was  $6^\circ$ . My note says that from 2 to 17 minutes after the disappearance of the sun I had "several glimpses with eye (?)—not distinct." The "glimpses" and the "not distinct" would not spoil this as an observation, but the (?) does and I don't count it.

There is another objection to counting either it or the previous one here. They were made after sunset. It is true that it was only a few minutes after sunset, and that at the time *il faisait grand jour*; and perhaps a Frenchman might feel justified in saying that it was "en plein jour." I have read in a French astronomical journal of a shooting-star that was seen 34 minutes after sunset, and the heading of the item was "Etoile fileante en

plein jour." I don't know whether M. Trouvelot's "en plein jour" is to be taken in this extended sense or not; but he may use the phrase so, and that is why I have mentioned these sunset observations of mine in connection with his limit.

For myself, I don't recognize either the distinct one of March 1890, or the doubtful one of May 1893, as having been made "in daylight." This phrase in the title of this paper is meant to include only the time while the sun is above the horizon, and especially the two or three hours in the middle of the day.

For this time of day I have not yet mentioned any observation made near superior conjunction, and I have none to mention that I consider good. Once, for a few minutes, I had high hopes of having a splendid one. It was near 1 in the afternoon of May 11, 1893. Venus had been in conjunction only  $9\frac{1}{2}$  days before. She was following the sun's east limb at a distance of only  $2\frac{1}{4}^\circ$ . The seeing was not the best, but it was very good. She was very easy in a field-glass, and quite distinct in an opera-glass (of which more anon), and for a few minutes I hoped to catch her with eye alone, but did not. I am sure that I pointed my eye at the exact spot, I am almost sure that she was fully as easy as on July 6, 1892; but I am not sure that I took proper care to focus my eye for a very distant speck. After the 11th, I have no record of a good sky near noon until the 31st, and then my eye failed again. And again in a fine sky on June 1st. The mid-day weather was bad between the 1st and the 7th. On the 7th — "12.20, Venus very easy in opera-glass, eye no good; 12.57, in eye in a splendid bit of blue sky all washed clean of every particle of cloud, a good long steady look, far more satisfactory than any eye-look in evening so far, wisps of light cloud over her just before and just after observation."

But this was 36 days after conjunction, and the elongation was nearly  $10^\circ$ .

This is the best that the atmospheric conditions have allowed me to do near superior conjunction, but of course it is not at all the best that can be done. When only  $5^\circ$  out at this conjunction Venus is five times as bright as when my eye saw her at  $7^\circ$  elongation near inferior conjunction. This difference in bright-



ness is equal to  $1\frac{3}{4}$  times a star "magnitude," and is exactly the difference between Sirius and Rigel (according to the Harvard Photometry), and more than the difference between the brightest and the faintest of the seven chief stars in Ursa Major. If any observer, who knows exactly where to look, will look for these two pairs of stars in strong twilight, he will get a much more lively sense of what this difference in brightness means than by looking at them at night. And after a few such experiments he will find it easy to believe that, if Rigel could be seen with the naked eye about noon at an angular distance of  $7^\circ$  from the sun, Sirius could be much more easily seen when only  $5^\circ$  distant, if the seeing was equally good. My star-gazing experience assures me of the reasonableness of this conclusion, and, as a corollary, of the reasonableness of the conclusion that, whereas I have seen Venus with the naked eye in daylight when only  $7^\circ$  degrees from the sun at inferior conjunction, it is highly probable that an eye no better than mine can see her when nearer than  $5^\circ$  at superior conjunction.

But I have never yet so seen her, and, in summing up the case in favor of her visibility as a general rule, I shall keep within the limits prescribed by my observations. These more than justify one in saying that Venus can be seen with the naked eye in daylight when not less than  $10^\circ$  from the sun if the sky is clear. At this limit she has proved herself easy to see. When farther out she is easier. She is farther out, on the average, during 246 out of every 292 days. Therefore, on the average, out of every 100 days there are 84 on which any star-gazer with a fairly good eye can see Venus in daylight, if the weather permits and if he knows where to look for her. Near the limit, and especially inside it, both of these "if's" are very emphatic, but they become less and less so as the elongation increases; and during fully one-half of the period of daylight visibility just mentioned, the conditions of brilliancy and elongation are so very favorable that none but those of defective vision need go without their daily look at her, even when the sky is not at its clearest.

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When Venus is near the limit of daylight-eye-visibility, the

importance of knowing exactly where to look for her is a matter of course. There is another important matter, already incidentally mentioned, which may not seem to be so much a matter of course. Its importance has often been impressed on me when searching with the naked eye for any bright planet or star in daylight or in strong twilight. I have of course been careful to know beforehand just what point in the sky I should look towards, and, to make it easier to direct my eye to the very spot, I have so arranged matters that the spot should be very precisely located with respect to some terrestrial object,—a chimney, or a steeple, or a flag-pole, or something of that sort. The nearer to this object the sky-spot is, the more surely you can point your eye straight towards it. But then the eye is very apt to adjust itself for seeing an object just at or a little beyond the chimney or flag-staff which you are using as a point of reference. I have often noticed this in myself and still oftener in others whom I have been trying to get to see some celestial object that was just visible in a daylight or twilight sky. Under these circumstances it is very essential that the observer should make the effort to focus his eye for a very far-off object. As he does so, and as success begins to reward his effort, he will find himself experiencing a curious and pleasing sensation. The star, after being first dimly glimpsed, will seem to be advancing towards him from an infinitely remote distance. It will appear at first as a mere fluttering speck, but will grow more and more distinct and more and more steady as it seems to float nearer, until, when the exact eye-adjustment has been made, it takes up a fixed position as a point of light just where the observer has been steadily gazing all the time. "Swims into his ken" exactly expresses what seems to happen, and I have often wondered if Keats had been picking out stars in a sunset sky just before writing his lines on Chapman's Homer. It is only when the object is at about the extreme limit of visibility that I have noticed this apparent swimming motion. At other times, if there is some delay in getting the object into the eye, the observer is most apt, when he does get it, to be overwhelmed with surprise that he should have missed it before.

I think it is likely that my failure to see Venus on May 31 and June 1, 1893, when the sky was in good condition, was chiefly due to want of proper eye-adjustment. It was certainly not due to Venus being too difficult, or to my not knowing where to look. This I was sure of, and very exactly, for each of those days; but, for several weeks before, my eye had been unpracticed in far-off focussing.

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The star-gazer who has only his naked eye to work with can see Venus in daylight in a clear sky, on at least 84 days out of every 100, on the average. The astronomer with his telescope can see her every day. How near to the astronomer's record may the star-gazer push his if he is provided with a small optical instrument?

If the instrument is like an opera-glass that I often use in making observations, he may hope, under favorable conditions, to make a record of 97 days out of the 100.

This glass—which I call N. when making notes—has a magnifying power which I estimate at  $2\frac{3}{4}$  diameters. Its object-glasses have a clear aperture of  $1\frac{1}{8}$  inch. Its length over all, when focussed, is  $4\frac{7}{8}$  inches. A larger binocular—one of the kind called field-glasses—should, of course, do better than this, but the one I use has no better Venus record than the above, although, at the limit of visibility, it always found and held the planet more easily than the opera-glass did. I call my field-glass A. Its length when focussed is  $7\frac{1}{2}$  inches, the aperture  $2\frac{1}{8}$ , its power 4 diameters. It bears the name of Dufourmantel of St. Cloud, and was bought there for 75 francs. (Bardou, of Paris, offers 6-diameter ones for 55 francs.)

At the inferior conjunction of July, 1892, my eye failed to find Venus on the ten days between the 6th and the 17th. On three of these days neither sun nor Venus could be seen here. Five others were not good days, but my field-glass managed to pick up Venus on each of them. Two were good days, and one of them was the 9th, the day of conjunction. I had not intended to try any observation with these small glasses on this day, taking

for granted that it would be quite useless. But it happened to come about that I did try and with the following result:—

“July 9th, 1892—1.50 to 2 p. m.—Venus in A! First found her while standing on verandah with sun shut off by verandah roof and library L. Venus then among some light clouds, and glass not steady of course [as I was standing up]. Didn't feel at all sceptical, but *did* feel much surprised. To be quite sure, got a chair and straddled it, using its back for a rest for my arms—found Venus again and easily—(first finding was easy too)—at first among thin cloud-stuff, then out into pure blue, and so easy that thought could see her with eye—tried, but didn't. Still, think a good eye could have done it if properly pointed and focussed; got N. but couldn't find V. again with A. This was about 2.20, and sky seemed whiter than before. 2.50 to 3 found V. again several times with A. Seemed so easy that tried eye again, but no good; no good for N. also, but she is ticklish about her focus and I hadn't it fixed. 3.20 to 3.30 picked up again four times with A. Thought once I glimpsed it with eye, but probably not.

3.50 to 4.20, picked up again four times in A.; *got it also in N.* at 4.10, a mere white point there.

4.50 again in A., but clouding up again. See her easily thro' the clouds. 7, tried again with A. but no good; sky not good.”

The hour of conjunction was 2.30 p. m. The elongation during the day was  $4\frac{1}{2}^{\circ}$ , the brilliancy 2.3. At the next inferior conjunction, in February, 1894, the elongation will be nearly twice as much as this, and the naked eye should be able to see Venus. If it does, there will be nothing to prevent its owner from saying—and saying truly—that he could see Venus with his naked eye in daylight on every clear day from the beginning of June, 1893, to the end of October, 1894, a clear run of 17 months.

I have already mentioned my best opera-glass observation near superior conjunction. It was on May 11th, 1893. Venus had been in conjunction  $9\frac{1}{3}$  days before, and she was, at the time of observing,  $2\frac{1}{4}^{\circ}$  east of the sun's limb. I had tried her on the 6th and the 7th with my field-glass (A.), but my notes say “no good.”

I was keeping the glass and my eye in practice with daylight peeps at Sirius, and I find that my latest one was had at 4 in the afternoon of the 8th, when the sun was 7" higher in the sky than Sirius was. I have no note of a try at Venus on the 8th, 9th or 10th, probably because the sky was not clear about noon. On the 11th :—

"12.50 to 1.15 p m.—Venus in A. distinct enough, but not good; looks like a lengthened streak and should not. Tried N. but no good. Again in A, very easy and fine and round. Tried N. again, all right this time. Several distinct glimpses, though unsteady."

From one superior conjunction to the next makes an average period of 584 days. As an opera glass can see Venus  $9\frac{1}{3}$  days after one of these, it should be as easy for it to see her  $9\frac{1}{3}$  days before the next. And as it can see her even on the day of the inferior conjunction that falls between, there are only 19 days of invisibility to be taken out of the 584 days in the whole synodic period. This makes the opera glass record of 97 days out of every 100, which I mentioned above. "Under favorable conditions" I said, because at inferior conjunction Venus is not always as far as  $4\frac{1}{2}^{\circ}$  from the sun, and because at both conjunctions she does not always mount as high above our horizon as at those that happen during the months of May and July.

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The mention of Venus's altitude in the last sentence is the first occurrence of this condition of visibility since I dropped it out of sight near the beginning of the paper. Since it has come up again, perhaps it might be as well to give it a few words of attention before closing. When dropping it, I said that when the other two conditions (brilliancy and elongation) were favorable, the minimum value of Venus's maximum daily altitude could not be much under  $20^{\circ}$  in this latitude, and that at such times it was quite easy to see her with the naked eye in daylight in a clear sky. The mean value of her meridian altitude is  $46^{\circ}$  here, and to see her at that there is no need of very favorable elongation or brilliancy. An opera glass can see her  $10^{\circ}$  lower when these

other conditions are nearly at their worst. This was her altitude when my opera glass (N.) showed her on the afternoon of inferior conjunction in July, 1892.

I have several times tried, both with eye and with glass, how close to the eastern horizon I could catch her, and how close to the western horizon I could hold her in daylight. These observations were made at times when she was too easy at meridian passage to make it at all interesting to observe her in this way then. The best observations of this kind that I have were made near the greatest elongation that preceded the inferior conjunction of 1892, and near the greatest brilliancy that followed it. At the station where I usually do my observing it is not possible to see as close down to the horizon on the east side as on the west. (Of course, by 'horizon' here, I mean the great circle 90° distant from the zenith.) Then there is this other difficulty about making very low observations on the east side,—the object is lowest when first found; whereas, on the west side, you can find it when fairly high, and follow it down until it fades out among the denser strata of atmosphere close to the horizon.

With the eye I have no observation on the east at a lower altitude than 18°. This was at greatest elongation on April 30, 1892. The elongation was  $45\frac{1}{2}^\circ$ , the brilliancy 70; and the observation was of course a very easy one. At the time it was made, 9.30 a. m., the sun's altitude was nearly  $44^\circ$ . On the west I have done better. With the sun at an altitude of  $39^\circ$ , I found it quite easy to pick up Venus when she was  $12\frac{1}{2}^\circ$  high. The date was August 23, 1892. The elongation was  $43^\circ$ , a little less than on April 30; but the brilliancy was greater than then, being 91. The hour was 3.30 p. m., and for nearly half an hour after this there was no difficulty in repeating the observation. I got my last eye-glimpse at 3.55 when Venus was  $8^\circ$  high and the sun  $35\frac{1}{2}^\circ$ .

I have no opera glass observation of this kind, but I may as well set down here the best ones made so far with the field glass described above. It found Venus readily enough when  $7\frac{1}{2}^\circ$  above the east horizon at 8.35 a. m. on March 28, 1892, a month before greatest elongation. The sun's altitude was then

$24\frac{1}{2}^{\circ}$ . Venus was  $43^{\circ}$  distant from the sun, and her brilliancy was 50. On the west, the glass made its best record in this line on the same afternoon, that my eye did,—August 23, 1892. After Venus had faded beyond eye-reach, I put this glass on her at intervals for half an hour longer. My notes say that she was still easy at 4.13 and in sight, but not easy at 4.25. At 4.13 her altitude was  $5^{\circ}$ , and the sun's over  $31^{\circ}$ . At 4.25 the sun was still  $29^{\circ}$  high, and Venus was only  $3^{\circ}$ .