

Hopefield Observatory
Haddenham
(The Post-town is) Thame
6 Sept. 1865

Dear Professor Secchi,

I was greatly pleased to receive your letter of the 24th Ult., & the more so as it relates to a subject in which, as you know, I have taken a special interest. - Moreover, you have anticipated me by only a week or two; for I have long had a letter to you on the same subject in my head; but have been so incessantly engaged with various urgent affairs, that I could not find the requisite time to sit down quietly to accomplish what I should often have greatly preferred to do.

I am not sure whether, when you wrote, you had seen my letter which was published in "The Reader" for Aug. 19th. A letter from yourself, & also one from Mr. E. J. Stone, appeared in the same number.

I well remember the group of spots of which you have sent me photographed pictures. - I wish we could get such directly from the Sun! - They illustrate several of the most interesting points connected with the appearance & constitution of the spots, but necessarily leave those connected with the general photosphere untouched. - As I have stated in my letter to "The Reader," it is the constitution of the general surface that, in my opinion, we should diligently examine in the first place, - as being undisturbed by adventitious causes: & then, with the very different appearances of the spots before us, we should consider by what means & in what way these extraordinary phenomena are caused. - To reverse this process, by examining the spots, & then from the abnormal condition of their constitution to endeavour to account for the normal condition of the undisturbed surface, seems to me to be completely beginning at the wrong end; - or, to use an English proverb, is "putting the Cart before the horse."

Now this is precisely what my old friend Mr. Masmyth has done in his examination of the Sun. With his 8-inch (Eng.) object-glass he found some ^{small} elongated bright bodies on the penumbra, & sometimes insulated on the umbra of a spot, & estimated their length to be ten times their breadth: & then, finding that this was far from being the appearance of the general surface, he has nevertheless concluded that it is in reality composed of distinct objects having precisely and uniformly the same proportions (10 to 1), but interlaced, so that small interstices are in some places seen between them. This, I confess, has always appeared utterly improbable, if not actually absurd, in itself; & also entirely irreconcilable with all the results of my own most careful scrutiny of the solar surface with powerful telescopes for the last 18 years. - You have no doubt seen the pictures in Mr. Masmyth's little pamphlet. The spot which was visible in July 1860, & most carefully observed with my excellent 8 $\frac{1}{4}$ -inch (Eng.) object-glass, which enabled me to measure in distance with a filar micrometer of γ^2 Andromeda, - the two stars being completely separated. I can truly say that the drawing of that spot by Mr. Masmyth is not at all a faithful representation of it, but is in fact "a creature of the imagination", in which Mr. M. excels. - There was no such regularity in the formation of the penumbra, or of the luminous bridges. - And though there were in some places, a few small bright elongated bodies, separated from the rest, yet these were quite exceptional. - And as to the representation of the solar surface given in the lower one of the two pictures (N^o. 2) I can perfectly agree with one of our best observers who possesses one of our best refractors, when he says, that the better the circumstances & the higher the powers he can use, the more unlike is the appearance of the surface to Mr. M.'s picture. - Yet Mr. M. says

of it; "I accompany the drawing with a diagram (N^o 2) which exhibits in a more definite & clear manner the exact form of those remarkable structural details of the solar surface. And again; - "Diagram N^o 2 conveys a pretty clear idea of the manner in which these remarkable details are arranged, in forming, as they do, the entire luminous surface of the sun". I therefore regard this as a fanciful theory which has no foundation in fact.

But is it not extraordinary that, after so clear & decided a statement, Mr. Nasmyth should accept Mr. Stone's 'rice-grains' as being identical with his 'willow-leaves', even on the surface? - objects whose proportion is as 2 to 1, the same as those which are as 10 to 1. This seems to me to give up the willow-leaves on the surface, & to destroy the apurged value of Mr. N.'s first observations.

Then, as to the claim that these objects constitute a new discovery; by Mr. N. - They have been familiar to me as irregularly formed granulations since the year 1830, when I first saw them with my five-foot refractor by Dollond; & I might have thought them something new, if I had not met with Sir Wm. Herschel's description of them as seen with his reflectors: - "There is all over the sun a great unevenness in the surface, which has the appearance of a mixture of small points of unequal light". (Sept. 9, 1792). This was quite enough to convince me that mine was no new discovery in 1830. With my excellent 6 1/3-inch (Engl.) refractor by Metz, & the transparent glass diagonal which Sir John Herschel had suggested in his "Cape Observations" in 1847, I saw these in 1848 far better than before; the larger aperture giving sharper images, & allowing the use of higher powers. But when I had contrived my Solar Eye-piece, I found that the definition with it was rather sharper still, & I always preferred it, unless I required a large field of view. From that time to the present I have diligently availed myself of every good opportunity of scrutinizing the solar surface with excellent object-glasses up to 8 1/4-inch (Engl.) aperture; but I have never found any objects on the surface which could truly be compared to 'willow-leaves' (10 to 1); & rarely any separate objects of such proportions in the penumbra.

I have therefore strongly objected to the term 'willow-leaves' as applied to the photosphere, because there is nothing like them to be found there. - Also ~~willow~~ (but in a much less decided way) to the term 'rice-grains', because they are not at all uniform in size or proportion, & are therefore like no particular kind of grain. Hence my preference for the general term granules, or granulations.

One of our best observers, Mr. Isaac Fletcher, who has a very perfect refractor (by Cooke & Sons, of York) of nearly the same size as your own (9 1/2 Engl. inches), has lately given very careful attention to the solar photosphere, & has thus expressed the results in a letter to myself: - "It is perfectly clear, as you pointed out, that the appearances in question were perfectly familiar to Sir Wm. Herschel; - as is abundantly shown by his paper in the Phil. Trans. for 1801; & his 'corrugations' are your 'granules'; (both good names); & the 'rice-grains' of Mr. Stone (not bad), & the 'willow-leaves' (very bad) of Mr. Nasmyth. - As you have not the Phil. Trans. I send you a very rough tracing of his section of the photosphere, which shews incontestably that the corrugations he depicts are identical with your 'granules', & are elevated portions (as you point out) of the general surface of the photosphere." - I will inclose a tracing of the tracing which Mr. Fletcher has sent me.

As to the existence of these objects being claimed by Mr. Nasmyth as a new discovery, I can only apply to it the maxim of our clever countryman of old time, Bacon, - "The ignorant make many discoveries". - Mr. N. had never before examined the sun with a suitable telescope: & as he was not acquainted with Wm. Herschel's observations or my own, he thought that what he saw had never been seen before; & most unfortunately, Sir John Herschel & Mr. De la Rue, supposing from Mr. N.'s positive assertions, descriptions & drawings, that there really must be such objects on the sun,

too readily gave their adhesion to the notion, - as Herschel now fully confesses. - This circumstance gave it a weight it would never otherwise have had. - But Sir John has no telescope mounted; & Mr De la Rue, having a sight of the granulations (which are not difficult to see in a fine state of the air) adopted Mr. N's explanation of them as interlaced willow-leaves! - Mr. N. unhesitatingly declares that the granulations (of Mr. Stone's 'rice-grains') are indeed the very same as his 'willow-leaves'; & this being so, I perfectly agree with you that "the name is not fit"; - & moreover, it is calculated to mislead. - Your comparison with the microscopic appearance of a drop of stale milk is excellent; ^{except perhaps that the granulations in it are of the same size} but I can hardly agree with the idea that, because they become elongated by the violent forces which set either to or from the centre of a spot, therefore they may be there called by a name which cannot fitly be applied to the same things in their normal condition. This would recognise two different things; while in fact they are only the same things under different circumstances.

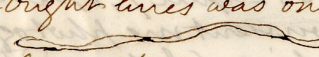
My own idea of the different objects which we meet with on the surface & in the spots, & of the appropriate terms to be applied to them, is as follows. -

1. The granulations are probably slightly elevated above the less luminous interstices. This (immersion) is an imaginary section of the photosphere. - In the immediate vicinity of a regular spot (nearly symmetrical, with penumbra, umbra, & nucleus), these granulations are driven together & heaped up by a force proceeding from the middle of the spot; & thus the individuality of the granulations is lost, & they are heaped up into a faculous ridge, of which a section may be of this kind: -

2. The Penumbra is an inferior stratum of inferior luminosity; but probably more uniform in brightness than the photosphere; - its upper surface perhaps adhering slightly to the under surface of the photosphere. - The brighter lines upon it are portions of the photosphere, elongated by the forces which open out the spot, but not carried away by those forces. Many of these extend without any break at all from the interior edge of the photosphere completely across the penumbra, & even project over its inner edge on to the umbra. Some of these are very coarse & brilliant, & seem to be thicker & more elevated portions of the photosphere, such as, when seen near the eastern or western edge of the sun, appear as small faculae, which often abound near the spots. - When these are numerous & crowded at the interior edge of the penumbra, & project irregularly on the umbra, they constitute what I compared to "a piece of coarse thatching with straw, the edge of which has been left untrimmed." (See my Description of a New Solar Eye-piece, read before the R. A. S. 1852 April 7, & published in the Memoirs, Vol. Xxi, Part 2, page 161) The spots of which you sent me photographic copies were rich in these irregular edges of straw-thatching. (I observed them carefully with my 8-inch Obj. G.) They are seen well at B on the spot of July 30, & at c, d, & all through the spot e in the group of the 31st. The coarser & longer snags, as at A in the spot of July 30th I have sometimes likened to bundles of straw. I will inclose partially traced copies of your pictures, that you may know exactly to what I refer. - The smaller & shorter bright pieces seen on the penumbra, & sometimes sailing off alone over the umbra, I have compared to 'bits of bright thread'; or, when obviously broken off from a longer piece at the edge of the penumbra, to 'bits of straw'; or, when very small, I have called them elongated granules, which in fact they are. I have purposely avoided the use of special names, such as 'willow-leaves' &c; because tho' a few may under these circumstances be found to which the term may not be unsuitable, yet there are so many to which it would be absurd to apply that name, that I have decidedly preferred a more general appellation. The term currents, which you apply to my coarse straws, seems to express the cause of that formation, rather than the thing formed. - The current is the setting in, or out, of ~~some~~ violent stream of force

of some kind, which constrains large masses of the photosphere (perhaps faculose) to assume this elongated shape: much in the same way as a drop of thick linseed oil swimming on water would be drawn out into a long oleaginous thread, if a current in the water were carrying it through a narrow spout or tube. If there were many drops of oil of ^{various} different sizes, the oleaginous threads would be longer or shorter, & thicker or thinner, in some proportion to the original sizes of the drops: & by certain forces, small pieces might be broken off; - but separate drops would not readily ~~and~~ coalesce. This seems to me much like the condition of the bright granulations on the less luminous substance which forms the interstices between them, & on which they seem to float, as it were. (Is this the penumbral stratum?) - They do not readily coalesce; yet some peculiar forces form them in some places into the brighter, more solid & elevated streaks termed faculae.

In speaking of the elongated granulations on the penumbra, or umbra, you say that "the elongation may justify the term of 'willow-leaves', their lengths being at least three times their breadth": - In the margin you add, "their breadth was 0.6, the length 1.30". But whether 3 times or only ^{about} twice their breadth, they must be very different from what Mr. Nasmyth means by willow-leaves, which he describes as uniformly 10 times as long as their breadth. (I will inclose you a specimen out of my own premises). Is it not therefore much better entirely to drop an appellation which is scarcely applicable even under the most favourable circumstances for the production of an abnormal form & proportion?


You observe that "a large current has been seen to be resolved in leaves" - Is not this extremely rare? And may I ask, Have you seen this yourself? And is not such a disjointed bright thread composed in fact of many ^{or several} elongated granulations, which, like very small drops of oil, have not been forced to coalesce into one? - though by the effect of the same force or current they may have been constrained to follow each other in a line? - They are still only elongated granules: while the coarser & longer straws are probably much larger granulations, or moderate sized faculae which usually abound in the vicinity of spots. - But I have on some ~~unfrequent~~ occasions observed a very interesting fact; & I especially noticed it in part of the splendid group of May 1864. - On one part of the penumbra there was a mass of bright lines, which at first sight with a low power (97) looked more like a collection of slender leaves than I had ever remarked in such numbers together. A little waving of the object assisted the idea. But, on raising the power as far as 368 (the highest the state of the air would allow), & waiting for the best views, I found that the disjointing of the bright lines was only apparent, & arose from their being constricted at intervals, thus:  & that there was in fact at that time no break at all! I had often observed the same thing before, but rarely so striking an instance of it & in so many together. (See a Paper by Warren De La Rue, read before the R.A.S. in June 1864, & published in the Memoirs, Vol xxxiii.)

3. We now come to the Umbra. This used formerly to be spoken of & represented as black (e.g. by the Herschels &c) & imagined to be probably the body of the sun, and generally called the nucleus of the spot. But while observing in 1851-2 with my new Solar Eq. piece, I found, by excluding the penumbra of a large spot by the use of a small field, that the umbra was not black, but mottled; that in all spots of considerable size & asymmetrical form, & in some others, there was a perfectly black part near the middle. To this I restricted the name of Nucleus; & termed the large mottled part, the Cloudy Stratum. (See "Description of New Solar Eq. - loc. cit"); - supposing it to be an additional stratum between the penumbral stratum & the body of the sun. The term, Cloudy Stratum Laplace had been used in a different sense, & believe by Herschel I, & I have therefore lately always termed it the Umbra. This is your Veil; - the black portions in your pictures being the Nucleus.

As you have well observed, in very small spots without penumbra, (of which kind

kind there were many in May & June this year) the granulations remain but little disturbed to the very edge of the spot; & though only moderately elongated are seen projecting a little over the edge of the umbra. The eruptive force has been too feeble to drive them away & heap them up round the spot. They therefore continue much more nearly in their normal condition.

I will inclose a tracing of a map of granulations which I found near the centre of the Sun's disk, - my attention having been arrested, while slowly sweeping across the disk, by the unusually large one (a real lump) in the middle. The air was remarkably fine, & I was able to use power 405 with perfect distinctness at times. I seized this excellent opportunity of drawing the portraits of this lump, & of the smaller granulations round it, having inclosed them in a small field of my solar eye-piece, that the eye might be kept steadily on the same objects. It would puzzle anyone to find willow-leaves here, whether interlaced or not. - The lump is like the facular masses commonly seen near the Sun's poles; & I have no doubt that such a map included in a large spot would be drawn out into coarse straws, & perhaps form a bundle of them.

I was present at the Visitation of the Greenwich Observatory on June 3rd, and examined the sun through the large Equatorial (Aperture $12\frac{3}{4}$ Engl. inches; focus $16\frac{1}{2}$ feet) Mr Masmyth was there. - Only the large spot was displayed by the assistant observer, Mr Carpenter; - nor the undisturbed general surface at all. There were plenty of rather 'coarse straws', at one part of the spot, & a few smaller detached pieces in other parts; but nothing answering to Mr N's 10-1 willow-leaves. - It appeared to me that only those who were evidently predisposed to see willow-leaves every where, saw any at all, or thought they did. With these exceptions, I believe, the observers generally doubted the existence of anything of the kind. Mr Carpenter informed me that one of the largest & longest of the straws had been seen to be "regularly split up into willow-leaves"; thus, . But certainly when best seen, I could perceive nothing of the kind, & Mr Carpenter acknowledged there were none then. Moreover, it was confessed that their proportion could not have been anything like 10 to 1.

Now, as there are various kinds of willow-leaves, it is but fair that we should adhere strictly to Masmyth's exact definition of the form which he intended when he claimed his "remarkable discovery"; & not permit this essential particular to be obscured & lost sight of, by applying the name to objects having the ratio of only 2 or 3, or even 4 or 5, to 1. The uniform ratio was one of the special things of which Mr N. claimed the "discovery", & the universal diffusion of these identical forms over the whole surface of the sun was the other. - If then either this exact form or its universal diffusion is given up, the claim of discovery falls to the ground; - for the things themselves were unquestionably discovered & not badly described by Herschel 70 years ago.

Sept 8th - Pray excuse the length of this letter. - I only hope your patience will not be exhausted before you arrive at its conclusion. - I shall await your opinion of its contents with great interest; & I trust you will do me the favour of giving it without reserve, & at any length which your engagements will permit. I have thought it better to go at once into the various parts of the subject, as I had long been intending to do, than to treat of it "bit by bit". - I have certainly no prejudice against the willow-leaf-form, or any other; but I do feel a great anxiety to arrive at the truth.

With great respect

I remain,

Yours faithfully

W R Dawes. 104

Professor Father Secchi
Rome.

P.S. I received, some years ago, through the R. A. S., No 5 of the Numbers of your "Memorie" &c. dated 1859, containing Measures of Double Stars, pages 33 to 40; & I earnestly looked for succeeding numbers, - but none arrived, or at least, were forwarded to me. My excellent old friend, Admiral Smyth tried, about 2 years ago, to get the Volume for me, but without success. - He lives about four miles from me. - The volume was lent me for a few days by a friend who had procured it in Rome, & in looking over the measures of double stars I found that under the Star ϵ Scorpii A+B (erroneously included by Flamsteed in Sibra, & termed by him 51 Sibra & 2 Sibra, - which has caused much confusion), - you have done me the honour of quoting an observation of mine dated 1834.5; but the distance is quoted 1".66 instead of 1".166. This is of some importance - See Memoirs R. A. S. Vol. XIX. p. 199 which you have referred to. - My measurement was made with the same 5-foot refractor by Dollond, with which I first saw the solar granulations. Hence you may judge of its quality. - Also measured with it ϵ Cancri, A+B: - P = 30".8. Dist. 1".09. 1831.30. This star I have observed these two years with my 8-inch refractor -

1864.29 P = 253".18; D = 0".707; on 2 nights
 1865.30 243".42; = 0.631; - 3 -

With great respect

Yours faithfully

W. R. Dawkins

W. R. Dawkins

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Willow Leaves.
from
Stonesfield, Haddenham
Bucks. 106



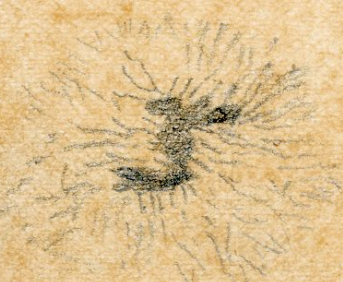
William James
from
Hopfield, Hoboken
N.J.
1881



d

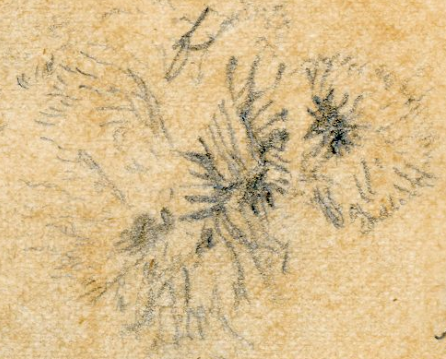
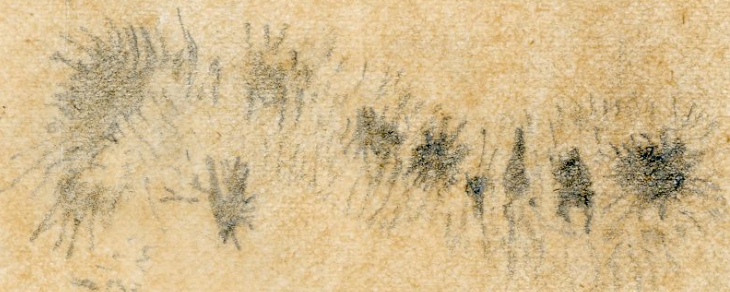


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1892
July 31

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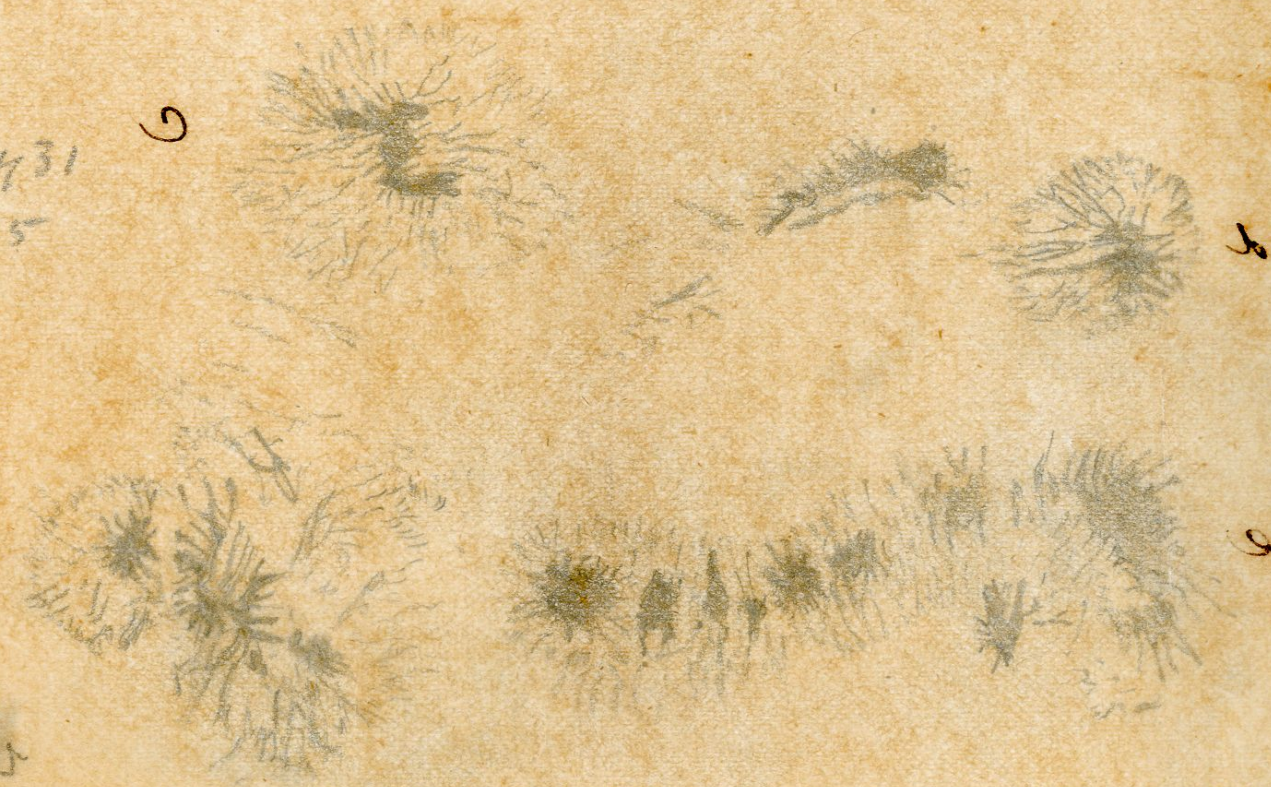
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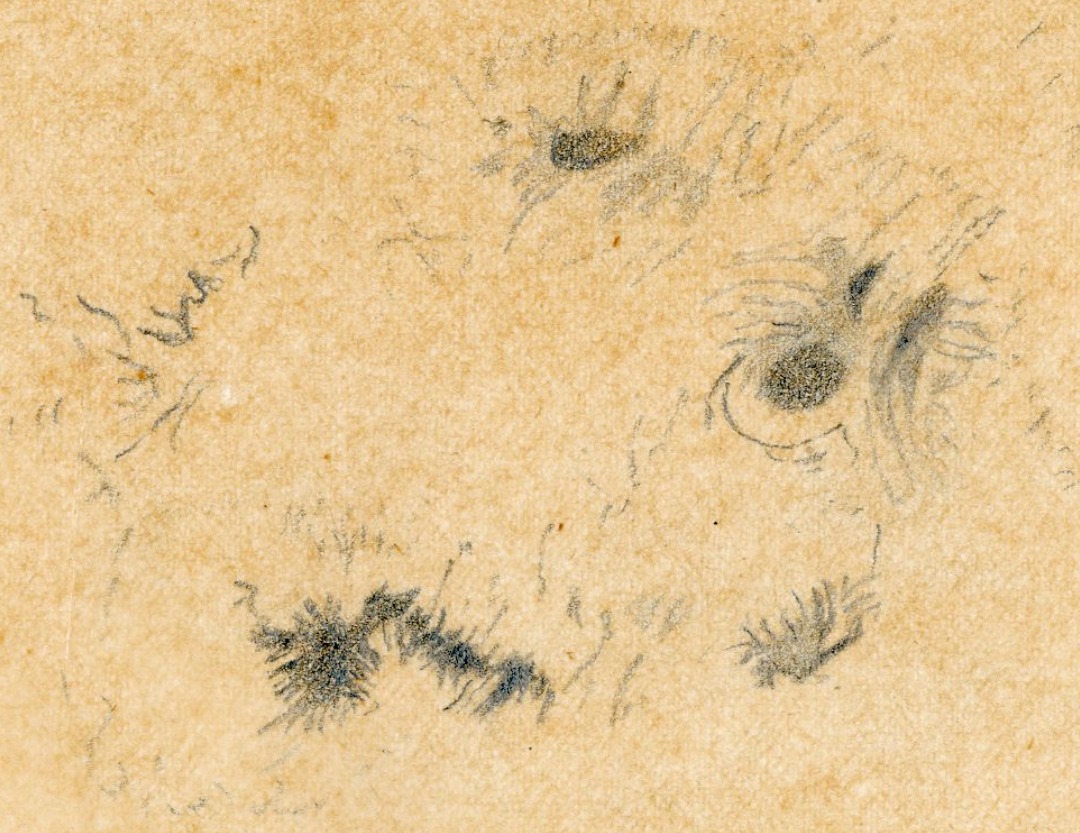
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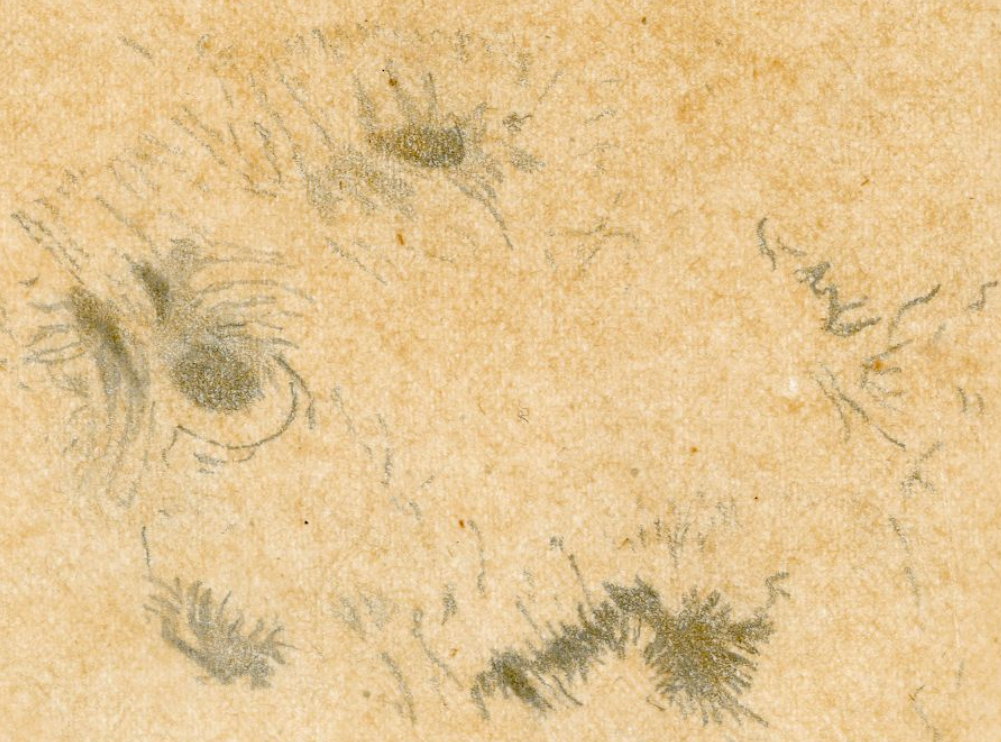
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July 30. 1865

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