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Harvard College Observatory.

Notes on the Astronomical Engravings from the Observatory.

Also Spanish weather record, etc.; see table of contents within; lists of apparatus, etc.

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Weather record
by
R. Davies
Jerez de la Frontera
Spain.
Presented to Prof. J. Winlock for
Harvard College Observatory
in December 1870,
on the occasion of his visit to Spain
to observe the solar eclipse of 1870.

Pages 2 to 7 inclusive.

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December. 1864.

Dec.		Ther.	
7.	8 o'clock A M.	56.	
	12. M.	60	Fine.
	3. PM.	61.	
	8	57.	
8th	8 AM.	57.	Rained during afternoon
	12. M.	59.	& Night
	3. PM.	59.	
	8. "	57.	
9.	8 AM.	56.	Rain.
	12. M.	60	
	3 PM.	59.	
	8 PM.	57.	
10	8 AM.	57.	
	12. M.	60	Rain
	3. PM.	60.	
	8 PM.	58.	
11.	8 AM.	57.	Rain - Fine in afternoon
	12. M.	59	
	3 PM.	60	
	8 PM.	58.	
12th	8 AM.	56	Rain.
	12. M.	60	
	3. PM.	59.	
	8 PM.	57.	
13.	8 AM.	57.	Rain. Wind Thunder.
	12. M.	59.	
	3. PM.	59.	
	8. PM.	57.	
14.	8 AM.	54.	Rain. Fine during
	12 M.	59.	afternoon.
	3. PM	58	
	8 PM	56.	

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Dec.			Ther.	
15.	8.	A M.	54.	Fine Cloudy Very Cold.
	12	M.	57.	
	3	P M.	57.	
	8	—	55.	
16.	8.	A M.	54.	Fine. Rain Lightning
	12	M	56.	Hail & Wind during
	3.	P M	57.	the night.
	8	"	58.	
17.	8.	A M	54	Rain.
	12	M	56.	
	3.	P M	56	
	8	"	55	
18.	8	A M.	54.	Fine.
	12.	M.	56.	
	3	P M	56.	
	8.	"	54.	
19.	8	A M.	53.	
	12.	M.	56.	
	3	P M	56.	
	8	"	54.	
20th	8	A M.	52.	Fine.
	12	M.	56.	
	3	P M	56	
	8	"	54.	
21.	8	A M.	49.	Fine.
	12	M.	55.	
	3	P M	56.	
	8	"	52.	
22.	8	A M.	49.	Fine
	12	M.	55.	
	3	P M	56	
	8	"	52.	

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			Ther.	
Dec.	23d	8 AM	60.	Time Rained during
		12 M.	56.	the Night.
		3. PM	57.	
		8. "	53.	
	24th	8. AM	52.	Rain.
		12 M.	56.	
		3 PM	56	
		8 " "	54.	
	25.	8. AM.	52.	
		12. M.	56.	
		3 PM.	56.	
		8 " "	54.	
	26.	8. AM	48.	Time very cold Frost.
		12 M.	55.	
		3 PM.	56.	
		8 " "	54.	
	27.	8 AM.	48.	Time Frost.
		12. M.	52.	
		3 PM.	53.	
		8 " "	50.	
	28.	8 AM.	48	Time Frost.
		12 M	52	
		3 PM	53.	
		8. " "	49.	
	29	8 AM	48	Time. Frost.
		12 M	52	
		3 PM.	51	
		8 " "	49.	
	30.	8 AM	48	Time Frost.
		12. M.	52	Rained during the
		3 PM.	51	night.
		8 " "	49.	

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Dec. 31. 8 A M Ther 50
12 M 54. Fine Review
8 P M 54. during the morning
8 P M. 50.

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December. 1865.

Dec.		Ther	
1.	8 A.M.	58	A Splendid day.
	12 M.	62.	
	3 P.M.	63.	
	8	61.	
2.	8 A.M.	59	Cloudy morning but
	12. M	62.	fine afternoon. cold.
	3 P.M	63.	
	8 P.M.	60.	
3.	8 A.M	56	Very cold.
	12 M.	59	very gloomy & cold day
	3 P.M	60	It poured during the
	8 P.M.	59.	morning.
4.	8 A.M.	57.	
	12. M.	59.	Cold.
	3 P.M	60	Very cloudy all day It rained
	8 P.M.	59.	very hard during the day.
5.	8 A.M.	59.	
	12. M.	61.	Cloudy morning but fine
	3. P.M	63.	afternoon. Mild.
	8 P.M.	61.	
6th.	8 A.M.	59	A splendid day.
	12 M.	64	
	3 P.M	64	
	8 P.M.	63.	
7th	8 A.M	61	very cloudy all day It
	12 M.	63	poured all morning
	3. P.M.	63.	
	8 P.M.	61.	
8th	8 A.M	60	
	12. M.	63.	

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Dec. 8. 3. P.M. — — Ther. 63.

8. P.M. 61. Very f

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Fragments of Reports
by Professor Winlock.
Pages 9 to 13 inclusive.

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First Report. Jan. 13 1866 to Oct. 19 1866

The Report which I have the honor to lay before the Visiting Committee of the Board of Overseers today relates to the proceedings of the Observatory from the 13th of February 1866, the date at which I assumed the to the 19th of October 1866, and to its Condition at the last-mentioned date.

Grounds remain in substantially the same Condition as at the last visit of the Committee. In regard to the occupation of a portion of them by the Beds of the Botanic Garden, - there seems to be no encroachment or claim of privilege on the part of the Botanic Garden that calls for the slightest remark.

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The Report which I have the honor to submit before the visiting Committee of the Board of Overseers to day, relates to the proceedings of the Observatory from the 13th of February 1866, the date at which I assumed the responsibility of the direction to the 19th of October 1866, and to its condition at the last mentioned date.

The Grounds remain in substantially the same condition as at the last visit of the Committee. In regard to the occupation of a portion of them by the trees of the Botanic Garden, there seems to be no encroachment or claim of privilege on the part of the Botanic Garden that calls for the slightest remark.

Great improvement has been made in the means of lighting and warming the Buildings by the introduction of gas. And by the addition of two furnaces, one in the Observers House and the other in the basement of the East Room of the Observatory. The East Room which contains the clock and Chronograph and the desks of the assistants has been more effectually secured from changes of temperature by adding to the partition which separates it from the East Transit Room a substantial brick wall in the basement and a covering of lath and plaster above.

The Shutters of the East Transit Room has been as before represented, sometimes troublesome. They are now, however, in a satisfactory condition and it is hoped that new Shutters will not be needed.

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The machinery for moving the ~~Shutters of the~~ East Dome, which at first appeared to be insecure and inadequate has been put in order at a slight expense and now gives entire satisfaction.

The Shutters and the appliances for working them, after occasional repairs, are at present in substantially as good condition, no doubt, as they have been at any time. The lower sections, if frequently used easily get obstructed, and give trouble.

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Notes on the
Astronomical Engravings from the Observatory
of Harvard College
by L. Trouvelot and A. Searle

Pages 15 to 49 inclusive.

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Copie des notes originales prises durant les observations
nécessaires pour le croquis des objets célestes dessinés par Le Trouvelet

1872 — Planète A —

Fig. 1 — 28 février — entre 8h.00 et 9h.30m Vue assez bonne, oculaire N° 2. Bande équatoriale est plus portée au sud qu'au nord, elle n'est pas centrale. Pole sud nuageux avec deux taches très lumineuses en forme de virgule. Bande équatoriale teinté de rouge carmine est bien visible.

Fig. 2 — 12 fev. Entre 7h.00 et 9h.00. Vue bonne. Oculaire N°.3. Beaucoup de changements dans la couche nuageuse de la planète depuis le 4 février. Les bandes sombres sont plus nombreuses au sud et au nord, au sud ouest les bandes disparaissent presque entièrement dans ce qui ressemble à une brume épaisse; en réalité toutes les parties qui avoisinent le limbe de l'astre semblent un peu couvertes de ces brumes, excepté cependant la partie nord est. Mais on observe des changements rapides ~~dans~~ et la brume qui au commencement de l'observation couvrait un tiers de la planète est beaucoup amoindrie une heure après. Les intervalls entre les bandes sombres au sud de la bande équatoriale sont marquées de nombreuses taches blanchatres semblables à des cumulus. La tache sombre allongée qui est représentée sur la bande sombre au nord ouest de la planète n'avait pas été apperçue au commencement de l'observation. La bande équatoriale rosée occupe aujourd'hui la région centrale de l'astre, ce qui n'avait pas lieu la semaine dernière —

Fig. 3

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1872 ——— Planche 2 ——— (This plate was rejected after having been distributed, and a new plate was prepared.) See page 34.

Fig. 1 – 28 Mars entre 8h. 00 et 9h. 30m. – La vue n'est pas bien bonne. Oculaire N° 2 – La bande équatoriale semble être moins large que d'habitude, la partie occupée par les taches blanchâtres de sa surface semble être dépourvue de rosée. La zone polaire Sud semble être légèrement colorée d'olivâtre, la zone nord au contraire me semble de couleur ardoisée. Mon observation terminée, une aurore assez belle se montra quelques minutes après

Fig. 2 – 1er avril entre 8h. 00 et 9h. 00. au commencement de l'observation la vue était mauvaise, mais une demie heure après elle était passable, et même très bonne par courts instants. Je n'ai pu tracer la rosée de la bande équatoriale jusqu'aux bords de l'astre, pas plus que les taches blanchâtres qui parsement cette bande. La bande équatoriale semble aujourd'hui moins rosée que d'habitude, à la dernière observation la même remarque avait déjà été faite. Vers le commencement de l'observation près de la moitié de l'hemisphère sud était brumeuse dans sa partie ouest, vers la fin cette partie était éclaircie et distincte, tandis que le coté opposé du même hemisphère, c'est-à-dire la partie sud est était devenue brumeuse. Oculaire N°. 3

Fig. 3 – 2 avril entre 8h. 00 et 9h. 30m, oculaire N° 3. Vue excellente, La Bande blanchatre extrême au nord me paraît de couleur ardoisée. Faible lueur aurorale dans la soirée.

Fig. 4 – 3 avril entre 9h. 10m et 10h. 30m. Oculaire N°. 3 ✻ – La vue est passable, mais bientôt elle devient mauvaise, une aurore avec quelques rayons est visible durant cette observation. Le Prof. Winlock pense avoir vu une couleur rosée sur la bande ~~sombre~~ sinueuse sombre au ~~Sud~~ de la planète. J'avais d'abord cru voir cette couleur entre cette bande et la bande équatoriale, mais après un plus long examen je n'ai pu en constater l'existance. Cette lueur avait-elle été seulement temporaire? La bande sombre au nord me semble toujours ardoisée. Les taches blanchatres sur la bande équatoriale semblent être tout-à-fait à la même place que celles observées hier – Mésurés les diametres équatorial et polaire de la planète, la moyenne de trois observations donne pour l'applatissement 1/16.9me – Le 4 avril j'ai constaté le déplacement des taches lumineuses de la bande équatoriale, soit par la rotation de l'astre, soit pour toute autre cause. Ce déplacement se fait de l'est à l'ouest, ou de gauche à droite, sur l'image renversée

---

——— Plate 3 (Rejected after distribution, like Plate 2, and a new plate prepared. See page 34.)

Fig. 1 – 2 février – Taches dessinées à 11h. 50m ciel pur, vue excellente, facules remarquables par leur bonne définition, au spectroscope elles apparaissent comme de brillantes protubérances nuageuses en dehors du limbe solaire

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Fig. 2 — 16 fév – Vue magnifique, bonne définition. Les proéminences qui ont été dessinées entre 12.45 et 1h. 40m sont bien définies et leur structure particulière a été représentée avec soin. La plus haute d'entre elles atteignait environ 62,900 miles de hauteur. Ces flammes étaient la continuation de facules comme j'ai pu le reconnaître par le raisinage des taches

---

Planche 4

Fig. 1 — Torricelli – 14 Mars entre 7h et 9h. 30m, Vue assez bonne, Oculaire N° 2, terminateur coupant l'hémisphère vers le milieu. Ce cratère est situé par 4°.30' sud et 27° 30' longitude Wolfert. La lumière du soleil qui traversait la pointe allongée et ouverte de ce cratère pyriforme lui donnait à cette époque un caractère remarquable. Revu ce cratère le 12 Mai

Fig. 2 — Agrippa, Gadin et les environs, observés le 16 Mars entre 7h. 00 et 8h. 00, Vue bonne, oculaire N° 2. L'intérieur du cratère Gadin montre sur son côté éclairé une apparence d'éboulement prononcé, il semblerait que cette immense masse ait glissée tout d'une pièce dans les parties basses du cratère – Il y a aux environs de ces cratères plusieurs fissures remarquables. J'ai revu plusieurs fois ces cratères : ils sont situés dans le quartier nord ouest entre 2° et 5° de lat. sud et 10° de long. ouest

Fig 3 — Eratosthene et les environs, Dessiné le 16 avril entre 8h et 10h 00 du soir, bonne vue, oculaire N° 3 – La partie située au sud de ce grand cratère semble être parsemée de débris et de lignes sinueuses divergeant du cratère vers le plaines du sud. Au nord on voit très peu de cette apparence de couloir, cependant il y en a à un endroit, et c'est justement où le mur du cratère semble avoir été disloqué. À l'extrême gauche est le mont Wolf et à l'extrême droite vers le haut sont de nombreux petits cratères appartenant à Stadius

---

Planche 5 (Rejected after distribution, like Plates 2 and 3. A new plate prepared from sketches of 1873. The dates of the sketches are given on the plate.)

Fig. 1 — 28 Mars – Tache solaire se trouvant un peu au nord de l'équateur et à environ 1/4 du rayon solaire sur le côté "suivant" cette tache est marquée f sur le dessin des taches solaires de ce jour. Une grande facule lumineuse s'avance au dessus de la tache et la divise en deux, cette facule se ramifie vers le côté sud et ressemble un peu aux racines d'un arbre, ces ramifications ont une texture ressemblant parfaitement à certaines protubérances. Elle a été dessinée à 12h. 20m

Fig. 2 — Même tache solaire f que celle du 28 mars – Elle a été dessinée le 30 Mars vers 1h. 30m. Bonne vue. La grosse facule qui s'avance au dessus du noyeau envoie des filets déliés sur la pénombre. Cette tache changeait de forme à vue d'œil, vers la gauche elle envoya les ramifications faculaires représentées pendant le temps de l'observation. Cette tache est presque sur le milieu du soleil

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Fig. 3 — La même tache f dessinée le 1er avril vers 11h. 00. La grosse facule d'hier s'est divisée à son extrémité ou elle forme de longs filaments récurbés. Vaste vide dans l'intérieur du noyeau Une très basse

Fig. 4 — Même tache f le 2 avril à 9h. 40m —. Vue médiocre, Tache se referme, Les filaments faculaires sont moins nombreux et éloignés du centre. Deux langues vides dans le noyeau

Fig. 5 — La même tache f le 3 avril à 9h. 45m. Elle approche du limbe, des facules brillantes et ramifiées l'entourent. Un vide vaste traverse l'intérieur

Fig. 6 — La même tache f le 4 avril vers 10h. 00m, Nombreuses facules très brillantes et ramifiées La perspective rétrécit la tache car elle s'approche du limbe solaire et disparaîtra le 6 dans la journée

See foot of page 38.

Planche 6

~~Fig. 1 is nearly right in position; North point uppermost.~~ The ~~other~~ figures are so as the preceding point should be lower.

Les figures 1, 2, 3 et 4 representent le soleil et les taches de sa photosphère photographié avec une lentille corrigée ayant 35 pieds de distance focale

~~and the north points are above but on the right.~~ ~~Fig. 6 is misdated; should be Oct. 10.~~

~~Plate 6 represents photographs looked at with the collodion towards the spectator;~~ from the indication of position being wrong in Fig 1.

~~Plate 7 " " " " " "~~

"Planche" 7

See foot of page 38.

Les figures 1 et 2 représentent le soleil avec ses taches photographié avec une lentille ordinaire ayant une distance focale de 40 pieds

Fig. 1. July 4, 1870, 10½ A.M. The arrowhead is wrong on the original as well as on the engraving. The upper side is north, the left preceding.

2. Aug. 26, 1870, 12h 7m 5s P.M. The arrowhead is right, and the lower side is north, the left following.

Planche 8

Protubérances solaires

Fig 1 — Protubérance en forme de flamme recourbée. La hauteur de cette flamme avait 2 15/20 revolutions de la vis qui meut la fente du spectroscope — D'après une évaluation faite par le Prof. Winlock chaque pas de vis égale à 47.02 secondes d'arc. Suivant Schellen une seconde d'arc d'un objet à la surface du soleil équivaut à 445 miles — Cette protubérance observée le 21 février à 10h. 25m. était sur le côté précédent du soleil dans le voisinage des deux taches d qui étaient près de disparaître

Fig. 2 — Protubérance observée le 15 février à 12h. 25m. sa plus grande extremité atteignait 3 15/20 rev. elle était sur le côté précédent du soleil apparemment au dessus du grand groupe H. p Du 13 fév et disparu dans la journée du 14 fév.

Fig. 3 — Protubérance observée le 7 Mai à 9h. 20m. Elle était sur le côté précédent du soleil au dessus du groupe b qui était près de disparaître, sa hauteur était de 2 16/20 revolutions.

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cette protubérance semblait tordue comme un cable en plusieurs endroits.

Fig. 4 — Protubérance observée le 7 Mai (9h 43m) sur le coté "précédent" à environ 120° à sa base, les deux pilliers qui l'unissent au soleil sont tordus, le haut ressemble à des nuages très divisés, comme un amas de cumulus. Cette protubérance n'est pas très brillante et est remplie de circonvolutions. Sa plus grande hauteur égalait $3\frac{5}{20}$ révolutions.

Fig. 5 — Protubérance arborescente. La base semble formée de nombreux jets parallèles — la tête dont quelques parties sont très brillantes et découpées en massifs semble s'avancer vers l'observateur; c'est-à-dire que les massifs lumineux du milieu semblent être plus proches de l'observateur que la base — Sa hauteur était seulement de $1\frac{5}{20}$ révolutions. Sa position était à 100°. sur le coté "précédent". elle fut dessinée à 9h. 15m (May 28.)

Fig. 6 — Grande protubérance filamenteuse, 16 février, sur le coté "précédent" et dans le voisinage du groupe de taches 5 qui est près de disparaître. Cette protubérance changeait rapidement de forme, elle était très brillante. Sa hauteur était de $3\frac{6}{20}$ révolutions

Fig. 7 — Protubérance observée le 30 Mai à 9h. 25m. sur le coté "précédent", elle était dans le voisinage de la tache 5 dont les facules se prolongeait sur le bord solaire ou cette protubérance s'élevait, sa hauteur était de 2 revolutions, brillante à la base

Fig. 8 — ~~16 février, 1h. 40~~ Mr. Trouvelot was not able to identify this figure, & thinks, in August, 1875, that it was from some early sketch which has been lost.

Fig. 9 — 16 février, dessinée à 1h. 40m sur le coté "Suivant", position 270°. hauteur $1\frac{10}{20}$ révolutions assez brillante, deux prolongements découpés en lanières.

Fig. 10 — Protubérances vues le 15 février à 11h. 45m. formes arborescentes, troncs ou bases cannelés position environ 270° coté "suivant", hauteur 3 révolutions.

(The figures of Plate 8 were drawn on the stone as on the sketches, and are consequently reversed in printing.)

Planche 9

Fig. 1 Protubérances en jets très brillants, elle changeait avec rapidité et il était difficile de saisir sa véritable forme, car quelques secondes suffisaient pour tout changer. A droite la partie recourbée semblait retomber avec rapidité vers l'astre, en forme de grosses larmes qui se condensaient et devenaient plus brillantes à mesure qu'elles se rapprochaient du soleil. Ces flammes gigantesques dont la hauteur atteignait $4\frac{15}{20}$ révolutions s'élevaient au dessus du groupe de taches d qui était près de disparaître sur le coté "précédent". Elle furent dessinée le 29 avril à 10h. 05m —

(This figure was probably reversed in printing, like the figures of Plate 8.)

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Fig. 2 Protubérance nuageuse observée le 15 avril à 10h. 00m. à environ 225° ! coté suivant" elle était rattachée aux facules du groupe de taches S qui était près de la bordure. sa hauteur est de $3\frac{15}{20}$ revolutions (This figure was reversed in printing, like the figures of Plate 8).

~~(The figures of Plate 10 were not reversed in printing, with the probable exception of Figure 2.)~~

Planche 10

Fig. 1 — observée le 1er avril à 12h. 35m. Il y a une protubérance qui semble détachée, cependant il se peut qu'elle soit rattachée à la langue de feu qui se trouve presque dessus elle par de la matière non lumineuse. La flamme détachée avait $2\frac{5}{20}$ rév. dans sa plus grande hauteur. Cette protubérance est sur le coté "précédent" du soleil à environ 80°

Fig. 2 — observée le 29 avril à 9..40 sur le coté "précédent" juste au dessus de la tache d près de disparaître, sa hauteur est de $4\frac{5}{20}$ révolutions. Cette protubérance est la même que celle qui est représentée à la fig. 1 de la planche 9, seulement elle a été dessinée 25m plutôt

Fig. 3 — observée le 5 avril à 10h. 10m, elle est sur le "précédent" au dessus ou dans le voisinage de la tache p qui va bientôt disparaître. Sa hauteur n'est que de $1\frac{11}{20}$ revolutions. Elle est remarquable par sa transparence, non seulement on apperçoit à travers sa substance qui est comme un léger voile de gaze, la bordure de la chromosphère avec ses ondulations, mais encore on apperçoit deux petites protubérances brillantes qui s'élevent au dessus de la chromosphère et paraissent à travers le voile de cette flamme transparente

Fig. 4 — observée le 13 juillet à 9h. 00 sur le "précédent" à environ 85°. hauteur 2 révolutions Les jets recourbés à droite son peu illumines. à 10h. 45m. on n'apperçoit plus aucune trace des jets de droite, l'arche seule reste, cependant sa forme est altérée, son sommet étant aplati

Fig. 5 — observée cette protubérance en jets le 8 juillet à 9h. 10m. sur le coté "suivant" dans le voisinage du groupe de taches y. Ces filets étaient très brillants et acérés, en plusieurs endroits ils empiétaient sur le bord de la flamme tournée vers le centre du soleil et lui faisait une échancrure brillante. Hauteur extrême $2\frac{10}{20}$ révolutions

Fig. 6 — observée le 17 avril à 9h. 25m. Dans le voisinage de la tache d qui venait d'apparaître sur le coté "suivant" du soleil, on voit une masse nuageuse, allongée a sa partie inférieure qui semble détachée du soleil, au dessus des filets minces semblent se diriger vers elle, à gauche deux protubérances recourbées remarquables en ce que l'une vient de l'hemisphère opposé du soleil et se termine vers l'observateur, tandis que l'autre qui est sur l'hemisphère visible dirige son extremité vers l'hemisphère invisible, ou s'éloigne de l'observateur. Hauteur 2 revolutions

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Fig 7 — observée le 27 avril à 3h. 40m au dessus de la tache Z qui venait d'apparaître sur le coté "Suivant" du soleil. Sa hauteur résultant de 6 mesures, était à cet instant de $4\frac{13}{20}$ revolutions. Cette protubérance changeait rapidement, à 4h. 00m elle ne tient plus le filet qui attachait la flamme supérieure à la flamme inférieure, elle semble isolée, son éclat est diminué, la protubérance inférieure est entièrement changée de forme

Fig. 8 — Même protubérance que celle de la fig. 7 dessinée à 4h. 00m, ou seulement 20m. plus tard, à cet instant la hauteur de la flamme détachée est de 5 rév., à ~~4h~~ 4h. 10m elle atteint $5\frac{14}{20}$ révolutions, à 4h. 20m sa hauteur est de $6\frac{9}{10}$ rév. mais elle devient de moins en moins visible et s'éloigne vers la droite, à 4h. 25m la flamme inférieure s'efface rapidement et elle est plus d'à moitié disparue — La plus grande hauteur atteinte était de 5' 5" d'arc = 127 083 ⅓ miles [Plate 3 gives the height about 140,000 miles, which agrees with the 6,9 revolutions mentioned a few lines above, on the scale given on page 18, in the account of Plate 8, Fig. 1. But Plate 10 gives the height only about 122,000 miles.]

Fig. 9 — observée le 30 avril à 9h. 25m au dessus de la tache d qui a disparu il y a quelques heures, sa hauteur extrême est de $4\frac{15}{20}$ révolutions

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Planche 11

Fig. 1 Spectroscope, Vue de coté

F. 2 " Vue de dessus

Fig. 3 Spectroscope, vue de coté

Planche 12

Eclipse de soleil du 7 août 1869 (Kentucky)

Planche 13

Eclipse du 22 déc 1870 (Espagne)

Planche 14

Fig 1 — Dessinée le 20 avril à 10h. 00m. - Taches n. 2. alors proches du centre du soleil voiles roses au fonde r

Fig. 2 — Tache d a environ 1/4 du diamètre solaire sur le "précédant". Dessinée à 11h. 00m voiles roses au fond des noyaux ou ombre, observée le 25 avril

Fig. 3 — Même tache d que celle du 25 avril, voiles roses au fond de l'ombre des taches, grands changements, rayons de la pénombre recouverts en plusieurs endroits

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Fig. 4 — 5 juillet, tache k ~~sur l'hemisphere nord du soleil~~ au nord de l'equateur solaire dessinée à $9^h 30^m$, longs filaments recourbés qui semblent s'enfoncer dans l'ombre des taches, nombreuses facules sur la pénombre

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Planche 15

Fig. 1. Agathocrides dessiné le 12 sept. entre 8^h et 11^h, bonne vue, terminateur passant par Hainzel au sud et Dionysius au nord, volcan crateriforme indiquant une forte cavité au nord, le talus qui descend du cratère en cet endroit semble avoir une inclinaison peu rapide et cet endroit est moins accidenté que les autres parties. ce talus est sillonné de nombreuses rigoles qui semblent avoir été tracées par une matière liquefiée. Ce cratère est situé a environ 60° de long. est et 36° de latitude Sud, oculaire n° 3

Fig. 2 — Hypatie et ses environs situé à environ 7° de latitude Sud et 45° de longitude ouest, dessiné 11 juin entre 9^h et 11^h du soir, vue assez bonne, oculaire n° 2 terminateur passe par Fermat au sud et le petit volcan a gauche d'Aristote au nord

Fig. 3 — Guttenberg, dessiné le 9 juillet entre 6 et 10 heures du soir, Lune à 3 jours terminateur passe au sud par Méander, au nord par Hercule, il est situé a environ 18° de lat. Sud et 83° de longitude ouest. au ~~nord~~ sud de ce cratère est Magellan et au ~~nord~~ sud ouest est Galenius, vue bonne, oculaire n° 3

Fig. 4 — Jules César dessiné le 15 Mars entre 6 et 9 heures du soir, terminateur passe par Abulfeda au sud et Endoxe au nord, situé a environ 18° de lat. nord et 30° de longitude ouest, vue assez bonne, oculaire n° 1. Cette vue est dessinée sur une échelle plus petite que celles sur laquelle les autres de la lune ont été dessinées, elle représente beaucoup d'autres cratères, au sud ouest, au vers la base, a gauche est le Cratère Ménélas, au dessus de Jules cesar à gauche est le petit cratere Soisigenes, au dessus est Arago, puis Ritter, Aridaeus et Dionisius

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Planche 16

Planete Saturne — La figure représentée est le resultat d'une étude assez longue que je commençai le 28 juillet et que je terminai le 20 octobre. La planète n'est point représentée telle que je l'ai vue en aucune occasion, mais je me suis attaché à reproduire sur cette figure tous les points remarquables qui se sont présentés durant les diverses observations

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faites pendant près de trois mois. Je me suis attaché surtout a ne donner aucune exagération à ce que j'ai vu, et j'ai autant que possible tâché de représenter la planète telle qu'elle apparaît dans le grand équatorial quand la vue est particulièrement bonne et l'atmosphère tranquille; tout ce qui n'a pas été parfaitement vu plusieurs fois, je me suis gardé de le représenter préférant omettre quelques points qui pouvaient n'être dus qu'a une illusion — Je me suis servi, suivant que la vue était plus ou moins bonne des oculaires N°s 1. 2. 3. 4. 5. 6 et 7, mais je considère qu'il n'y a aucun avantage à dépasser le N° 3. Cependant, pour juger de la couleur de la planète comparée avec celles des anneaux, il est avantageux de se servir d'un plus fort grossissement, car alors la diminution de la lumière occasionnée par le grossissement devient favorable à cette Comparaison — Le 28 juillet je remarquai que la bordure sud de l'anneau extérieur était diffuse, tandis que la même bordure nord était nette et bien définie, je trouve que la planète diffère de couleur avec les anneaux, sa teinte contient un une minime partie de rouge, ou de jaune chaud, ce qui fait qu'il y a contraste entre la planète et les anneaux qui ont une teinte froide — Je crois voir une teinte légèrement rosée sur l'équateur, ce qui la fait ressembler à Jupiter, mais le rose est beaucoup plus faible — L'anneau médian est beaucoup plus lumineux que les autres et il me semble renflé ou plus épais dans sa partie la plus lumineuse, ou tout près de la ligne noire principale.

4 Août observé Saturne pendant une brillante aurore polaire, apperçu la ligne noire que l'on nomme, division de l'anneau extérieur, j'ai pu voir cette ligne seulement avec beaucoup de peine et seulement sur les anses, dans mes observations ultérieures je n'ai jamais parvenu a en saisir la moindre trace plus au delà de ce que j'ai représenté — La ligne noire principale a été parfaitement et aisement observée sur toute la circonférance des anneaux. Bande équatoriale bien marquée, un peu nuageuse et certainement un peu teintée de rougeâtre. Planète d'un ton plus chaud que les anneaux, coté droit de la planète très ombré. La partie de l'anneau nord qui passe derrière la planète et qui semble effleurer son sommet paraît déformée, et au lieu de suivre une courbe parfaite elle semble rentrer en dedans. Déjà aux autres observations j'avais eu cette impression. Impossible de trouver aucune ligne noire comme plusieurs vues de Saturne la représentent, sur l'anneau sombre intérieur je me suis servi pour cela des oculaires 1, 2, 3 et 5, à

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l'extremité des anses, et au sommet du grand axe de la ligne noire principale qui divise l'anneau médium de l'anneau extérieur, il me semble voir deux points ombrés irréguliers se prolongeant plus loin sur l'anneau extérieur que la division noire, le point qui était le plus bas était le plus marqué, cette apparence est à droite de la planète

18 août — La planète montre aujourd'hui deux bandes, l'équatoriale d'abord qui est plus ombrée vers le sud ou le haut que vers le bas, elle me paraît toujours rosée — La deuxième bande est sur le coté nord de la planète mais elle ne traverse pas l'hemisphère tout entier et dépasse à peine le milieu de la planète. Les deux points ombrés déjà apperçus sur l'anse droite me paraissent toujours exister.

24 août — une mauvaise, brumes, mais cependant par rares et courts instants il y a une très bonne définition — La bande rosée de la planète ~~équatoriale~~ est certainement rosée très pâle. au dessus de la bande équatoriale, au sud, entre elle et l'anneau intérieur qui traverse la planète, il y a une apparence nuageuse bien marquée et trois taches lumineuses semblables à celles de Jupiter, mais cependant plus pâles. aujourd'hui il me semble voir l'ombre de la planète projetée sur les anneaux, et déviée en passant de l'anneau médian sur l'anneau extérieur; L'ombre de la planète est moins noire que le fond du ciel dans les anses. Je vois certainement les deux points ombrés à droite de l'anneau médian, le supérieur me semble aujourd'hui plus noir que l'inférieur — L'anneau médian le plus illuminé me paraît beaucoup plus étroit qu'on ne le représente généralement, et l'anneau sombre intérieur plus large et plus rapproché de la planète. avec un fort grossissement N°. 6 la différence de couleur entre les anneaux et la planète est frappante. Ouverte pendant l'observation —

30 août — bonne vue. Bande équatoriale certainement ~~teintée~~ de rose très pâle et de plus elle est accidentée par une apparence nuageuse: le reste de la planète présente aussi cet aspect mentionné de Jupiter; avec beaucoup plus de vague cependant. Aujourd'hui j'ai vu clairement le limbe de la planète à travers la bande obscure intérieure qui la traverse. Les ombres sur l'anse droite existent toujours, mais encore je crois voir à peu près les mêmes ombres sur l'anse gauche. Sur les anses des anneaux médian et extérieur on apperçoit une apparence floconée ou nuageuse. Tache plus lumineuse près du limbe de la planète au nord à droite. L'anneau extérieur paraît plus large sur la ligne du petit axe au sud qu'au nord.

31 août / 31 août — L'ombre de la planète sur l'anneau extérieur s'étend à gauche un peu au delà de

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pôle sud de la planète. Sur chacune des anses de l'anneau médian je vois certainement deux taches en forme de nuages, plus lumineuses que le reste de l'anneau. Sous la bande rose équatoriale il y a une bande blanchâtre qui semble divisée par des ombres en trois régions distinctes plus lumineuses, ressemblant à celles de Jupiter, mais seulement plus vaporeuses, il faut une grande attention pour saisir ces détails. En dessous de cette zone il y a une autre bande légèrement ombrée. L'anneau sombre intérieur n'est pas ombré uniformément sur sa partie qui traverse la planète, il y a des endroits plus sombres; cet anneau sombre n'a pas non plus une ligne nette et définie ni vers le haut, ni vers le bas, mais sa définition est vague et il est impossible de la saisir

1er Sept. — Bonne vue, malgré cette belle vue je ne suis pas certain d'avoir apperçu la ligne noire qui divise l'anneau extérieur, même sur les anses — Les deux ombres sur chacune des anses m'ont paru toujours exister — L'anneau médian, c'est à dire la partie qui est comprise entre l'anneau extérieur et l'anneau sombre intérieur me semble être divisée en deux parties distinctes, dont l'une, la plus étroite et aussi la plus brillante est ~~est~~ extérieure, la bande intérieure est moins brillante, il ne semble pas cependant qu'il existe une division entre ces deux bandes car on ne voit aucune ligne plus noire et même la séparation de l'une avec l'autre n'est pas nette et tranchée, mais graduelle, l'ombre de la bande intérieure se fond avec la lumière de la bande extérieure. Cette bande intérieure médiane devient de plus en plus sombre à mesure qu'elle s'approche de l'anneau sombre intérieur.

L'anneau nébuleux intérieur (Bond's ring) me paraît colorié en violet sombre, et m'a toujours semblé avoir cette couleur, comme je l'ai déjà remarqué, la partie de cet anneau nébuleux qui traverse la planète montre encore aujourd'hui des taches plus sombres semblables à des petits nuages noirâtres — Entre l'anneau nébuleux intérieur et l'anneau médian, je ne puis saisir aucune ligne de division, aucune ligne noire tranchée, seulement il y a une différence dans la lumière, l'anneau nébuleux étant un peu plus foncé que la bande interne de l'anneau médian, mais comme pour celui-ci, il n'y a pas de séparation nette et définie entre les deux anneaux, à leur point de jonction ils se fondent doucement l'un dans l'autre. L'anneau nébuleux intérieur semble aussi divisé en deux bandes, mais cette apparence est difficile à observer et je ne l'ai vue que sur les anses. La bande la plus extérieure, celle qui touche à l'anneau médian, est moins sombre que la bande intérieure, et sa bordure intérieure, celle qui est en contact avec la bande la plus sombre, est tout

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à fort diffuse et mal définie, les deux systèmes se fondent ensemble. On voit nettement les bords de la planète à travers les brumes de l'anneau intérieur, mais on ne peut les tracer dans toute la largeur de cet anneau, on ne les voit certainement pas dans sa partie extérieure, celle qui touche à l'anneau médian. Ce limbe visible à travers les brumes ne s'arrête pas brusquement comme tous les figures de cette planète dessinées jusqu'ici le représentent, au contraire, le limbe d'abord bien visible quand il entre dans les brumes le devient de moins en moins jusqu'à ce qu'il s'efface graduellement et devienne tout à fait invisible. Ce qui semble prouver que la matière qui compose cet anneau ~~[illegible]~~ en possède une plus grande épaisseur, ou bien est moins diffuse. Quelque chose de singulier, c'est que l'anneau nébuleux qui apparaît dans les anses semble ne pas être concentrique aux autres anneaux, car il semble être courbé parallèlement à la planète; c'est-à-dire qu'il semble être ~~une [illegible]~~ arc de cercle, tandis que les autres anneaux qui sont vus en perspective ont la figure elliptique. Cette apparence singulière n'existe pas pour toute la largeur de l'anneau, mais seulement pour sa partie interne qui semble décrire un petit arc de cercle et s'arrêter vers le haut et vers le bas à la limite de la bande extérieure de l'anneau nébuleux, où il semble qu'elle forme avec lui un angle un peu ouvert, cependant il est très difficile de voir le sommet de cet angle et je ne suis pas certain de l'avoir bien vu

4 sept. Bonne vue. L'anneau médian a été revu et me paraît encore tel que je l'ai vu le 1er sept. L'ombre projetée par la planète sur les anneaux a été attentivement examinée et dessinée, elle est devenue quand elle passe de l'anneau médian sur l'anneau extérieur, et se recourbe un peu en crochet sur la bordure extrême de l'anneau médian et de l'anneau extérieur. La bande équatoriale est toujours rosée et nuageuse, la légère bande nord est perçue, mais elle est très vague. De chaque côté de la bande équatoriale, au nord et au sud il y a comme deux bandes lumineuses très diffuses, ces bandes ont l'apparence floconnée ou nuageuse particulière à Jupiter, mais bien moins accusée, revu sur les anses l'apparence nuageuse déjà observée à différentes reprises.

6 sept. Vu Saturne à l'aide de l'équatorial de l'obs. de Washington, maintenant en construction chez les Mrs. Clark de Cambridge. J'ai vu pleinement l'ombre projetée par la planète comme je l'ai toujours vu ici, sa déviation et sa courbe en crochet. L'anneau nébuleux intérieur qui m'avait paru anguleux dans les anses m'a paru au contraire se recourber et rejoindre la planète comme les autres anneaux, seulement il est moins visible

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que dans les anses, et plus difficile à saisir, mais je suis satisfait qu'il se recourbe et que je n'avais pas bien vu dans les observations précédentes

8 sept. Bonne nuit, essayé de prendre les mesures micrométriques de la planète et des anneaux, la moyenne de cinq mesures donne les résultats suivants : Les nombres sont donnés en révolutions et en centièmes de révolutions de la vis micrométrique

Diamètre équatorial de la planète, ~~etc~~ de B à C = ——— 2. 55

Diamètre du grand axe de l'anneau extérieur, ~~etc~~ de A à D = ——— 5. 60 2/5

Distance du bord de la planète à l'anneau intérieur du côté opposé, ou de C à E = —— 2. 76

" " " " " " ou de B à F = —— 2. 75 3/5

Distance de l'anneau ext. au bord de la planète, sur le grand axe, ou de A à B = ——— 1. 64 1/5

" " " " " " côté opposé, ou de C à D = —— 1. 73 5/6

Largeur de l'anneau ext. à l'anneau int. sur le grand axe, ou de A à E = ——— 1. 52 4/5

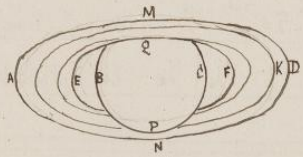
De la planète à la séparation de l'anneau médian et ext. ou de C à K = ——— 1. 18 1/5

Diamètre du petit axe, ou de M à N = ——— 2. 74 4/5

Diamètre de ce qui est visible de la planète sur le petit axe, ou de P à Q = 1. 91 2/5

Distance entre l'anneau int. et le bord de la planète évaluée à l'œil, ou de E à B et de C à F 0. 25

~~Largeur des anneaux~~ sur le petit axe, ou de Q à M ~~évalué~~ à l'œil = 0. 52



30 oct. Vue assez bonne ; l'anneau nébuleux est divisé en deux bandes, dont une un peu moins sombre et contiguë à l'anneau médian, la séparation des deux bandes est vague et sous l'aspect de tranché - La planète n'est pas visible à travers la seconde bande et elles disparaît graduellement comme dans une couche plus épaisse de vapeurs. Sur la planète on remarque de chaque côté de la bande rose équatoriale une bande blanchâtre parsemée de points brillants semblables à la crête de vastes cumuli ; cependant ces nuages sont beaucoup moins visibles qu'ils ne le sont sur Jupiter. Encore revu aujourd'hui les ombres si souvent observées sur les anses près de la principale ligne noire. La ligne noire qui semble séparer l'anneau médian de l'anneau extérieur, n'est certainement pas aussi noire que ne l'est le ciel à travers les anses, sa teinte est un peu grisâtre.

~~L'anneau intérieur~~ La bordure interne de l'anneau nébuleux intérieur n'est plus visible quand

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il se projette sur la planète, la matière qui le compose est tellement rare qu'il disparaît une fois plongé dans la lumière de la planète ; et c'est probablement cette ~~disparition~~ invisibilité d'une portion notable de la largeur de cet anneau qui fait que cet anneau sombre est moins large quand il passe sur la planète qu'il ne devrait être suivant les lois de la perspective, aussi celle devient visible sur chaque côté de la planète on on voit que l'ombre fait une courbe étroite pour rejoindre le bord interne de cet anneau sombre qui apparaît dans les anses, et il semble probable que cette matière de l'anneau nébuleux devient visible sur les bords, comme je viens de l'indiquer par la diminution de la lumière de la planète sur ses bords, causée sans doute par une absorption de son atmosphère.

Planche 17

Fig. 1 — Le soleil avec ses taches le 20 avril à 8h. 35m. Le groupe de taches représenté à la fig. 1 de la planche 14 est la même que le groupe marqué n sur cette figure

Fig. 2 — Le soleil le 25 avril à 8h. 40m Le groupe marqué d est celui qui est représenté sur la fig. 2 de la planche 14

Fig. 3 Le soleil le 26 avril à 4h. 50m Le groupe d est représenté à la fig. 3 de la planche 14. ce groupe d est le même que celui du 25 avril et montre les changements importants survenus dans une journée

Fig. 4 Le soleil le 5 juillet à 8h. 50m Le groupe marqué K est le même qui est représenté en grand sur la fig. 4 de la planche 14

Planche 18

Fig. 1 — Le cratère Cassini dessiné le 9 oct. entre 6 et 8 h. du soir. Ce cratère est situé dans le Palus nebularum par 40° de latitude nord et 8° de longitude ouest, ~~le cratère au N. O de cassini est Theaetetus~~

Fig. 2. — Le terminateur passe au nord par Archimède, au sud par Saussure. Le cratère situé au nord ouest de Cassini est Theaetetus, les deux qui sont au sud ouest sont marqués C. E sur la carte de Beer et Mädler

Fig. 2. Plinius dessiné le 4 janv. Terminateur passe par Tacite au sud et Aristote au nord Ce cratère est situé à l'extrémité du promontoire Archemedia et entre les mers tranquille et sereine. Le cratère Ross est représenté en partie au nord est, celui qui est au sud ouest est marqué A sur Beer et Mädler - Le cratère représenté au N. N. E de plinie est à peine indiqué sur la carte de Beer et Mädler — Fissure remarquable au nord et Coulée de lave au nord — Le fond du cratère cassini semble être moins profond que le niveau des terrains au bas des talus de ce cratère

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1873 Pline. coté nord du cratère semble indiquer une coulée de lave qui dans quelques cas descend jusqu'au bas du talus situé a une assez grande distance au nord du cratère, au Sud et Sud est il y a encore des traces de coulée – La fissure au nord que traverse une étendue double de celle du cratère semble s'être faite après que les coulées de laves eurent lieu car elles separe suivent les rigalles et les coupe en deux. Cependant en trois endroits différents il y a eu une action après que la fissure fut faite car elle est obstruée soit par des éboulements des parois de la fissure elle même soit par des roches descendues du talus du cratère

Fig. 3 – Cratères Guericke, Parry, Bonpland et Fra Mauro dessinés le 7 janv. entre 5 et 8 heures du soir. Terminateur passe au Sud par Theaetetus, au nord par Fontenelle Ces cratères sont situés au nord de la mer des Nuages entre 10° et 25 degrés de latitude nord et environ 30° de longitude est. Plusieurs fissures remarquables traversent Fra Mauro et Bonpland

Fig. 4 – Arzachel, Alphons et Alpetragius dessinés le 6 janvier entre 5 et 10 heures, et revus le 5 février par une vue exceptionnellement bonne, alors je vis un grand nombre de très petits cratères que je n'avais pu apperçevoir avant et qui parconséquent n'ont pu être representés sur la planche, il y en a douze dans le cratère Alphons. Ces cratères sont à l'ouest de la mer des nuages entre 0 et 10° degrés de longitude est, et entre 22 et 43° de latitude Sud, dans une partie très montagneuse et accidentée

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Planche 19

views of the star spectroscope

Fig. 1 Top view, with the mounting for the prisms

Fig. 2 Side view, the prisms omitted

Planche 20

Mouvements Craters

Fig. 1 Linné et ses environs. Le 5 Mars par une vue excellente le cratère était très visible au milieu de la tache blanche qui l'entoure. Cette tache avait fort peu d'éclat ce jour. Non seulement on apperçevait l'ombre projetée par les murs du cratère dans son intérieur, mais encore ces murs portaient leur ombre sur les contreforts extérieurs, preuve que ce cratère est plus élevé que la surface environnante – Le terminateur passait par

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Mouchins et Cuvier au moment que j'en pris le croquis, il était alors 7 heures du soir
Les 3 petits cratères au sud ouest de Linné sont rarement visibles et sont plus petits que
Linné. ils ne sont pas indiqués sur la carte Selenographique de Beer et Maedler, pas
plus que le petit cratère au sud de Linné. — Ce cratère est situé à l'est de Mare Serenitatis
à environ 24° de latitude Sud et a environ 23° de longitude ouest, oculaire 2 et 3

Fig. 2. représente le cratère Gassendi dessiné le 9 Mars entre 5 et 9 heures du soir et revu le 10
Ce cratère est situé au nord de la Mare Hymorum par 18° de latitude sud et 40° de
longitude orientale. Ce cratère peu profond est remarquable par des fissures profondes, droites
et courbées, et aussi par deux petits cratères très brillants. Au sud ouest du mur du cratère
se trouve un plateau, au sud ouest une longue eminence; entre ce plateau et cette chaîne
le mur du volcan est ouvert dans cette vallée qui semble être au même niveau que l'intérieur
du cratère. La partie centrale du cratère semble plus élevée que la partie ouest et sud qui
avoisine les murs. ~~Au~~ Au nord se trouve un cratère plus récent que Gassendi car il s'est
ouvert dans son mur et les débris qui se remarquent au sud, sur le fond de Gassendi semblent
avoir été repoussés là par l'action du volcan quand il était en eruption, oculaire 2 et 3

Fig. 3 Platon dessiné le 7 Mars entre 7 et 10 heures du soir, - La vue est excellente. Le terminateur
passe par Eratosthène et Tycho — Revu Platon le 10 Mars. L'intérieur du cratère est
d'une teinte beaucoup plus foncé que ne l'est la plaine environnante. Les
taches blanchâtres ainsi que les rayons ont été apperçus plusieurs fois et surtout quand
tout le fond du cratère était illuminé, ce cratère est situé au Nord de Mare Imbrium
et au sud de Mare Frigoris par 52° de latitude nord et 19° de longitude
orientale —, oculaire 3

Fig. 4 - Aristarque et Herodote dessiné le 4 juin. entre 4 et 6 heures du soir, la vue n'était
pas très bonne, Oculaire n° 1. Revu ces cratères le 10 Mars. Le contrefort
du talus du cratère Aristarque, celui qui est tourné vers l'ouest est d'un éclat éblouissant
le talus intérieur est orné d'une lumière intense et 3 points dans ce talus intérieur
~~ont~~ un éclat éblouissant, l'espace rond compris entre Aristarque et Herodote est orné
d'un grand éclat ainsi que les deux petits cratères qui sont sur le plateau au
nord des deux cratères - La ligne sinueuse au nord d'Herodote est sans doute causée
par une fissure profonde car elle est formée d'une ombre très noire avec une ligne lumineuse
sur le coté illuminé par le soleil - Le terminateur ce jour là était un peu a l'est d'Herodote
- Herodote est peu profond et le fond en est sombre. Les environs d'Aristarque qui sont

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d'un éclat intense sont bordés d'une teinte violacée très visible. Ces deux cratères sont situés dans le Oceanus Procellarum, par 23° de latitude nord et 94° de longitude orientale

Notes added in August, 1875, by A. Searle, with regard to the remaining plates.

Plate 21.

This is a reduced copy of Beer & Mädler's map of the moon, intended merely to serve as a guide in finding the craters shown in previous plates.

Plate 22.

Four views of Mars, the dates and times of which are given on the plate.

Plate 23.

Solar prominences, the dates and times of which have been derived from an examination of the original sketches of the sun in 1873 by M. Trouvelot, who confirms the correctness of the identifications.

	Date.	Pos. from N. through left.	Height in revolutions.
Fig. 1,	1873 Nov. 10, 2½ P.M.	90°	3½
" 2,	1873 June 10, 9 A.M.	240°	3¼
" 3,	1873 Aug. 24, 12 M.	320°	3
" 4,	1873 Dec. 14, 10½ A.M.	315°	3½
" 5,	1873 Oct. 1, 9½ A.M.	274°	4
" 6,	1873 Oct. 17, 9½ A.M.	312° to 327°	3
" 7,	1873 Sept. 21, 11 A.M.	323°	2

Heights in arc: Fig. 1, 164".57; 2, 152".82; 3, 141".06; 4, 164".57; 5, 188".08; 6, 141".06; 7, 94".04.

Plate 24.

This is a Woodbury type from a crayon

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drawing by Mr. Trouvelot, the drawing being compiled from various sketches of the Orion nebula, made about the beginning of 1874.

Plate 25.

Lithograph by Mr. Trouvelot of two clusters in Hercules, after his sketches made in 1874. Probably the ruled plate used for the Andromeda nebula was used to determine the relative positions of the stars in these clusters also.

Plate 26. (Donati's Comet.)

The original steel plate used for Vol. III of the Annals of the Observatory.

Plate 27 (Orion nebula).

Original steel plate used for Vol. V. of the Annals.

Plates 28 & 29. (Donati's Comet).

Original steel plates used in Vol. III of the Annals.

Plate 30.

Lithographs by Mr. Trouvelot. Coggia's Comet, June 10 and July 9, 1874.

Plate 31.

Lithograph by Mr. Trouvelot. Coggia's Comet, July 13, 1874.

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Plate 32

Trifid nebula, lithographed from sketches by Mr. Trouvelot in 1874. There is also a plate without a number, showing the relative places of the stars of this nebula on a ruled plate, for account of which see Plate 33. The preceding point of Plate 32 should be to the left, like the others, according to Mr. Trouvelot.

Plate 33.

Nebula in Andromeda, lithographed from sketches by Mr. Trouvelot, in 1874. There is also a plate without a number, showing the relative position of the stars of this nebula on a ruled glass plate. ~~The~~ The observations made by Mr. R. W. Pilson must be wrong; see pages 398, 440. for value of the squares on this plate ~~the mean value of a side of one of the large squares is 9"77; of one of the small squares 0"172.~~ Each large square contains two hundred and twenty-five (225) small squares. (The plate of the Trifid nebula is on a larger scale, and shows little more than one of the large squares.) The two plates showing the lines are to be held so that their titles are uppermost; the preceding points are then to the left. But it appears (Sept. 2) that the title of the plate showing the stars in the Andromeda nebula should stand as it does in Plate 33, and not at the side of the plate.

Plate 34.

Ring nebula in Lyra, lithographed from sketches by Mr. Trouvelot in 1874. (Prof. Winlock was not quite satisfied with this plate, but left no definite instructions for its alteration).

Plate 35.

Dumb-bell nebula, lithographed from sketches by Mr. Trouvelot in 1874.

Two plates without numbers, already noticed under Plates 32 and 33.

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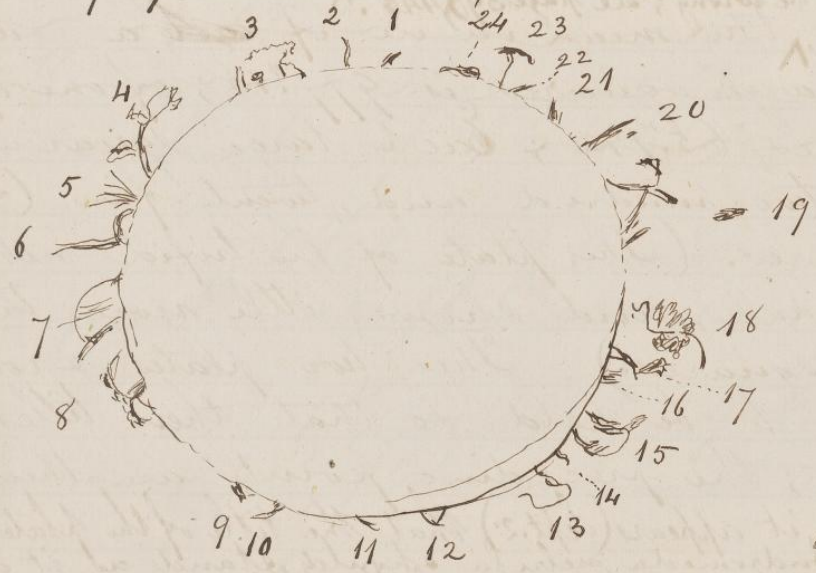
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Plate 2 (new plate issued to replace the original Plate 2).

Four views of Jupiter in 1873 (dates and times given on the plate). It was noticed by Prof. Winlock at the time when the observations were made that the equatorial belt no longer showed the red color of the previous year.

Plate 3A (new plate issued to replace the original Plate 3, ~~and described simply as Plate 3 in the text prepared to accompany the engravings.~~)

This plate represents specimens of different kinds of prominences, observed at different dates.



No dates are given for these prominences, and the following notes are compiled from the plates of separate prominences and from the original sketches.

Of these prominences, the following appear on Plate 8, but inverted (see notes on Plate 8).

Plate 8, Fig. 3, is Plate 3, No. 18 of the above sketch.
" 8, Fig. 5, " " 3, No. 8 " " " "
" 8, "

The following appear on Plate 10.

Plate 10, Fig. 8, is Plate 3, No. 19 of above sketch.
" 10, " 9, " " 3, " 6 " " "
" 10, " 5, " " 3, " 5 " " "

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Plate 23, Fig. 7, is apparently Plate 3, No. 3 of above sketch.

Prominences being seldom seen near the sun's poles, it is likely that Plate 3 was drawn with the general intention of representing the sun's axis as lying in the line from the top to the bottom of the plate. But the prominence Plate 23, Fig. 7, is stated in the notes to the drawing, Sept. 21, 1873, to have been situated at 323°, the reckoning beginning from a point 90° from the preceding point towards the north, and continuing through the following, south, and preceding points. On the sketch of the disk, Sept. 21, 1873, the preceding point is set down as differing 22° from the left-hand point, so that the prominence is placed 301° from the top, reckoning through the right-hand point. Its position on Plate 3, however, is higher, and correct only if the preceding and left-hand points are supposed identical.

No definite record of positions remains for the prominences of Plates 8, 9, 10, either in the original drawings or elsewhere, so far as is known. Plate 3, therefore, is merely a popular picture, and gives no scientific information except that relating to the form and height of some remarkable prominences.

Sketch No. 494 also back of same sketch, Nov. 19, 1872, apparently represents No. 20 of opposite page. It seems to have been south of the following spot.

Sketch No. 345, May 26, 1872, may represent No. 10 of opposite page. It was 225° foll. (But see also sketch No. 635, June 4, 1873, 11 7/12 A.M.) [See also page 38.]

Sketch No. 565, March 7, 1873, 9½ A.M., apparently exhibits the spots represented in Plate 3A, but the large group was apparently not closely copied from the sketch when the plate was drawn. The preceding spot, March 7, 1873, was nearly opposite

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the small group to the left (in Plate 3A) above the large group. See remarks (on page 35) on prominence No. 3 of figure on page 34.

Prominence No. 18 of figure on page 34 is from sketch No. 573, March 16, 1873, 10h 27m A.M. Its position was on the following side 252° (from south point through preceding point, apparently).

There is another large prominence on the same sketch on the preceding side, 297° (from north point through following point, apparently).

Prominences Nos. 7, 13, 14, of figure on page 34 are from sketch No. 596, April 20, 1873, 8 5/6 A.M.; all being on the preceding side, No. 7 being about 120° from north point through preceding point, Nos. 13 & 14 about 70° to 80° from north point towards preceding point.

Prominence No. 9 of figure on page 34 may be from sketch No. 607, May 1, 1873, 9 1/4 A.M., (or from back of sketch 606). It was apparently 228° from south point through preceding point.

Prominence 246° p. (apparently 246° from north point through following point) on back of sketch 606, may be the original of No. 12 of figure on page 34. (But see also sketch No. 649, June 19, 1873, 9 1/4 A.M.)

[See page 38 for position & date of Nos. 9 & 12].

Prominence No. 4 of figure on page 34 is from sketch No. 620, May 19, 1873, 10 1/4 A.M. (or from back of sketch No. 619.) Its base was apparently 290° from north point through following point.

Prominence No. 23 of figure on page 34 is from sketch No. 627, May 27, 1873, 9 1/2 A.M., (or from back of sketch No. 626). It was apparently 203° from south point through preceding point.

Prominence No. 2 of figure on page 34 is perhaps from sketch No. 691, Aug. 26, 1873, 10 3/4 A.M., apparently about 330° from north point through following point.

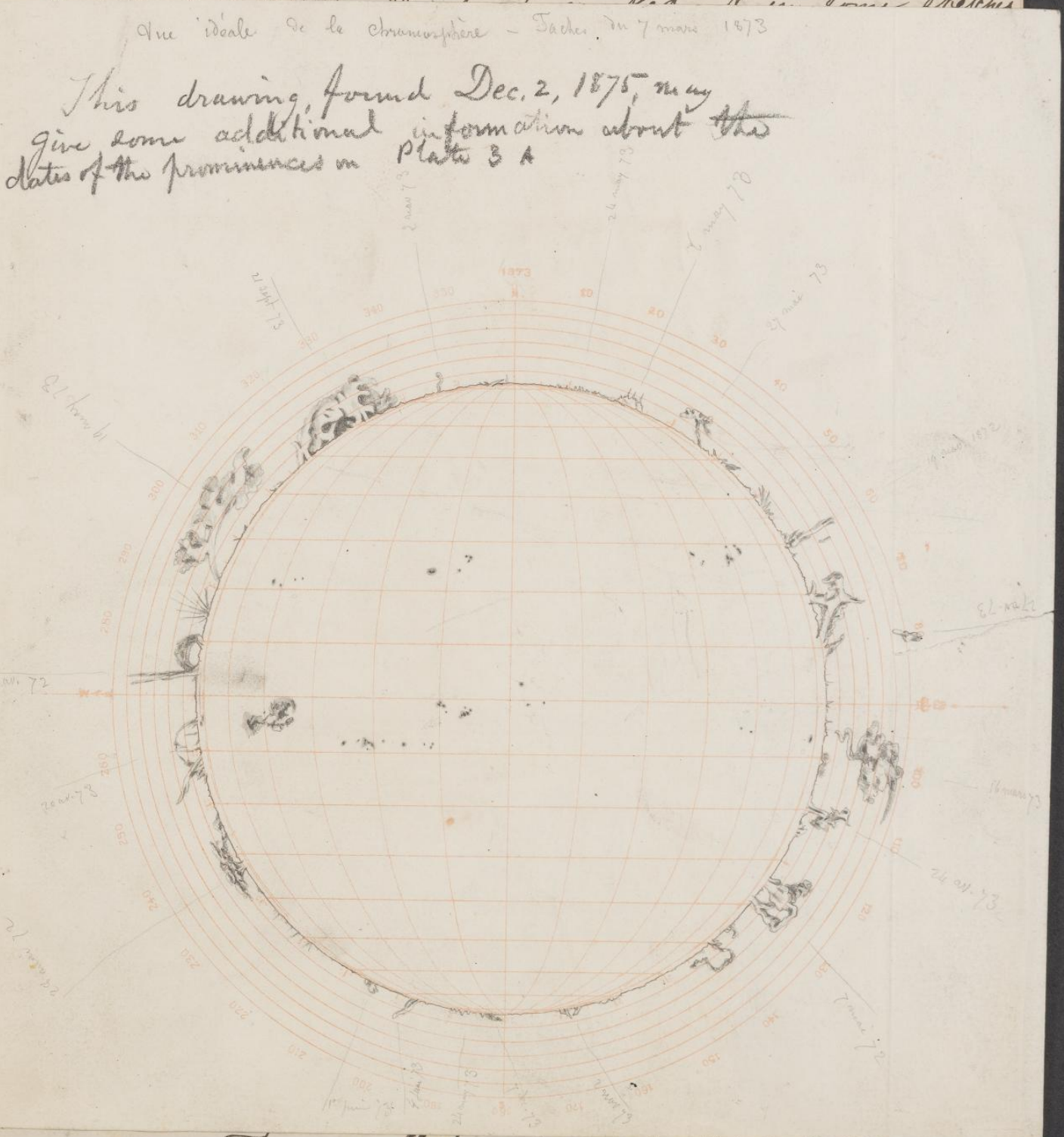
[See page 38 for information about No. 2.]

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Prominence No. 17 of figure on page 34 has not been found among sketches of 1872 or 1873. It is not represented in either the large sketch-book or either of the three little sketch-books. On a second examination of the detached sketches of the sun, especially made to search for this prominence, I conclude that its original is shown on sketch No. 600, April 24, 1873, 10 A.M. 276° from the north through the preceding point. The preceding & following points seem to have been set down as if they were inverted on this sketch, but the subsequent sketches seem to show that they are not.

It seems from the sketches that previous to sketch



This drawing found Dec. 2, 1875, may give some additional information about the dates of the prominences on Plate 3 A

The small prominences Nos. 1, 17, 21, 22, 23, can

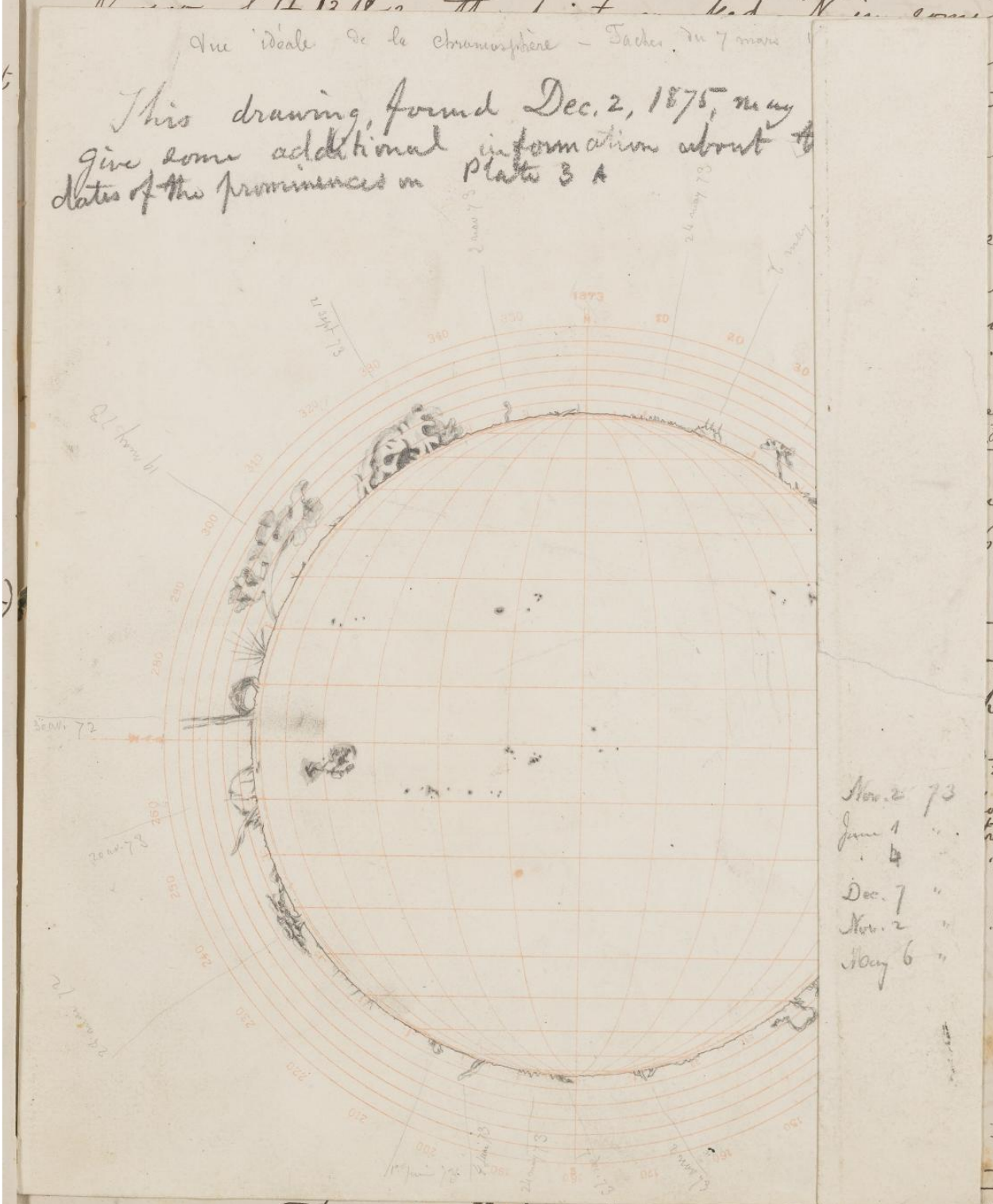
* See page 38 for additional information.

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Prominence No. 17 of figure on page 34 has not been found among sketches of 1872 or 1873. It is not represented in either the large sketch-book or either of the three little sketch-books. On a second examination of the detached sketches of the sun, especially made to search for this prominence, I conclude that its original is shown on sketch No. 600, April 24, 1873, 10 A.M., 276° from the north through the preceding point. The preceding & following points seem to have been set down as if they were inverted on this sketch, but the subsequent sketches seem to show that they are not.

It seems from the sketches that previous to sketch



This drawing found Dec. 2, 1875, may give some additional information about the Notes of the prominences on plate 3 A

The small prominences Nos. 1, 11, 21, 22, 23, can

* See page 38 for additional information.

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Prominence No. 17 of figure on page 34 has not been found among sketches of 1872 or 1873. It is not represented in either the large sketch-book or either of the three little sketch-books. On a second examination of the detached sketches of the sun, especially made to search for this prominence, I conclude that its original is shown on sketch No. 600, April 24, 1873, 10 A.M., 276° from the north through the preceding point. The preceding & following points seem to have been set down as if they were inverted on this sketch, but the subsequent sketches seem to show that they are not.

It seems from the sketches that previous to sketch No. 705, Sept. 13, 1873, the point marked N. in some sketches is 90° from the preceding point; and that the principal indications of position refer to the diurnal motion; the secondary lines seen on some sketches referring to the ecliptic (see especially sketch No. 690, Aug. 25, 1873). But after sketch No. 704, the principal lines seem to refer to the ecliptic; the preceding point is usually marked with an arrow. There seems to be no attempt to indicate heliographic positions on any of the sketches. [In drawing Plate 3*, the prominences seem sometimes to have been placed about as they stood on the sketches after sketch No. 704, noted above; on the whole, the left-hand point of the plate may be taken for the preceding point, without reference to the change of zero points.]

Remarkable prominences are shown in sketches No. 499 (back) Nov. 27, 1872, and No. 609, May 5, 1873.

The summary of the information attainable with regard to Plate (numbering the prominences as in the figure on ~~Plate~~ page 34) as follows:

The spots represented are those of March 7, 1873, 9½ A.M.

Prominence No.	is from sketch No.:	dated:	position:	zero point:
1	unknown			
* 2	691 (?)	Aug. 26, 1873, 10¾ A.M.	330°	from north through following
* 3	711 and 710 (back);	Sept. 21, 1873, 10½ "	323 " " " "	
4	620 - 619 (");	May 19, 1873, 10¾ "	290 " " " "	
5	not shown on 382	July 8, 1872, 9½ "	following side:	
6	321	April 30, 1872, 9⅝ "	about 250 " " " "	
7	596	April 20, 1873, 8½ "	240 " " " "	
8	341	May 28, 1872, 9¼ "	about 300 " " " "	
* 9	607 (?) and 606 (back);	May 1, 1873, 9¼ "	88 " " " "	
* 10	345 or 635	May 26, 1872, or June 4, 1873		
* 11	unknown			
* 12	606 (back) or 649	May 1 or June 19, 1873		
13	596	April 20, 1873, 8⅝ A.M.	287 " " " "	
14	596	" " " "	282 " " " "	
15	328	May 7, 1872, 9⅓ "	preceding side: 280 " " " "	
16	600	April 25, 1873, 10 "	90 " " " "	
17	600	" " " "	84 " " " "	
18	573	March 16, 1873, 10 27 "	72 " " " "	
19	318	April 27, 1872, 4 50 P.M.	following side: 45 " " " "	
20	494	Nov. 19, 1872, 10 A.M.	south of foll. point: 80 " " " "	
21	unknown			
22	"			
23	627 and 626 (back):	May 27, 1873, 9½ A.M.:	23 " " " "	
24	unknown			

The small prominences Nos. 1, 11, 21, 22, 23, can

* See page 38 for additional information.

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scarcely be identified in the absence of memoranda concerning them, so that it is probably useless to make a minute search for them among the sketches.

Nos. 10 and 12, also, are not well identified, and it is needless to attempt to give their times and positions.

It is plain that no attempt has been made to set down positions accurately in Plate 3, either with regard to the diurnal motion, or to the axis and equator of the Sun.

Additional information obtained by the aid of the drawing, found after the previous notes were made, and pasted on page 37.

Prominence No.	is from sketch No.	dated	position and zero point
2	748	Nov. 2, 1873, $9\frac{2}{3}$ A.M.;	5° from north towards following
9	632	June 1, 1873, $8\frac{5}{6}$ A.M.;	199° from north through following
10	635	June 4, 1873, $11\frac{7}{60}$ A.M.;	190° " " " "
11	771	Dec. 7, 1873, $11\frac{18}{60}$ A.M.;	189 " " " "
12	748	Nov. 2, 1873, $9\frac{2}{3}$ A.M.;	189° from north through following
24	610	May 6, 1873, $9\frac{1}{2}$ A.M.;	5° from N. to foll. point.
Between Nos. 10 & 11	624	May 24, 1873, $9\frac{2}{3}$ A.M.;	176° from north through following.
Between Nos. 24 & 1	624	May 24, 1873, $9\frac{2}{3}$ A.M.;	about the north point.

P1

Plate 4 (new issue).

Same objects represented in old Plate 4.
Dates given on the plate.

Plate 5 (new issue).

Solar spots, dates given on the plate. Wholly different objects from those represented in the old Plate 5. Fig. 1 seems to represent spot d on the projection of March 5, 1873. The other figures represent spot y on the projections of March 12, 14, 18. Spot d (in Fig. 1) seems to be represented preceding and uppermost. Figs. 2 and 4 seem to be following and uppermost, Fig. 3 preceding and uppermost.

Plate 6.

July 13, 1876. It is evident after a close examination of the original photographs copied in this plate that the copies have been made roughly speaking to set the axis of the sun upright, north pole uppermost. The indications of position in the originals are defective and the arrowhead is wholly wrong in the photograph of Oct. 9, 1871; but the known circumstances under which the photographs were made, and their recorded times, enable the facts to be tolerably well made out. Hence the preceding points are some 20° lower than the arrow-heads of the four figures of Plate 6.

Plate 7.

Three photographs were taken July 4, 1870; the indications of position on the first two are the reverse of those on the third, which seems to be right from the photograph of July 6. Plate 7, Fig. 1, was taken from the first photograph and reproduces its erroneous position. This first photograph has the actual north edge marked N by a scratch on the collodion, and the south side S. Perhaps, however, Garnett did not know which was which.

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Observations to determine value of ~~a~~ intervals between lines on ruled plate used by L. Trouvelot in drawing nebulae. (Plates 32, 33, etc.)

Sept. 9, 1875. Observer Arthur Searle; recorder Walter Hoxie. Chronometer used, Bond 236, 1 second slow of South Clock at $21^h\ 4^m$ sidereal time, 2 seconds slow next morning at $7^h\ 15^m$ " " "; South Clock gaining $0^s.62$ a day; hence B. 236 losing about $0^s.73$ in 10 hours, or only $0^s.0001$ in 6 seconds, the equatorial interval to be determined.

Instrument East Equatorial with ~~large micrometer~~ one of the eye-pieces used by Mr. Trouvelot. (this was ~~No. 1~~ used for observations of comets (Nos. 1 of my list), ~~power said to be 103~~) Plate used by Mr. Trouvelot set in focus of eye lens; this plate is ruled in squares marked with Indian ink, so that the lines are visible without artificial illumination; 225 squares about fill the field of the eye-piece. (Squares shown in two plates without numbers belonging to the Astronomical Engravings, as described above, page 33). The plate, of course, could not certainly be set exactly as it was when Mr. Trouvelot made his observations, but it cannot be far from its position at that time.

Transits of β Cassiopeae across north side of central and preceding squares (these squares are two of the nine squares, each containing 25 small squares, as shown in plates above referred to).

Transits over sides of small squares	Differences from middle	Resulting width of small squares, without reduction	Differences of 1st from 6th, 2d from 7th, etc.	
$19^h\ 59^m\ 55^s.0$	$59^s.8$	$11^s.96$		$59^s.8$
6.5	47.7	11.92		59.7
19.5	34.7	11.57		59.7
30.2	24.0	12.00		59.8
42.5	11.7	11.70		60.5
54.2	0.6			61.9
20 0 6.2	12.0	12.00		
19.2	25.0	12.50		361.4
30.0	35.8	11.93		Divide by 6×5 or 30
43.0	48.8	12.20		
56.1	61.9	12.38		
		120.16		12.047

Continued on next page.

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Observations Continued.

Reversed lines, by turning sliding tube (into which the eye-piece was screwed) 180°.

Transits of β Cassiopeae over same lines and same parts of lines as before, in reversed order.

Transits

		Differences from middle	Resulting width of small squares, without reduction		Differences of 1st line from 6th, 2d from 7th, etc.	
20h 13m	38.5	63.5	12.70			63.5
	54.5	47.5	11.88			60.0
14	7.0	35.0	11.67			59.5
	18.2	23.8	11.90			60.0
	31.0	11.0	11.00			59.2
	42.0	0.0				60.0
	54.5	12.5	12.50			362.2
15	6.5	24.5	12.25			
	18.2	36.2	12.07		Dividing by 6×5 or 30	
	30.2	48.2	12.05			
	42.0	60.0	12.00			
			120.02			
			Mean 12.002			Mean 12.073

Taking the mean of the four means obtained above, we have 12s.035 for the time of transit of β Cassiopeae across one of the small squares. This measure must be repeated in different parts of the plate, and with the lines turned 90° as well as 180°, if accuracy is required.

Logarithm of	12.035	is	1.08045
"	cos 58° 28' (decl. of star)	"	9.71850
∴ "	6.291	"	0.79895
"	15	"	1.17609
∴ "	94.415	"	1.97504

Hence the value of the width of one of the small squares is 94".415; by Willson's observations (see above, page 33) it was only 65".142, owing apparently to some error, since the result just obtained agrees with the observations of the Andromeda nebula below.

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Observations of Andromeda nebula, Sept. 9, 1875 (observers and instrument as stated on page 39, above)

From the southern nebula to a neighboring star the difference of declination is $3\frac{2}{3}$ of the small squares.

Diff. of decl. from this star to a second $5\frac{1}{2}$ of the " "

" " " " second star to chief nebula 7 " " " "

∴ " " " of two nebulae 16.17 " " " "

" " " of chief nebula & a third star 9.8 " " " "

" " " " third star & southern nebula 5.5 " " " "

∴ " " " two nebulae 15.3 " " " "

(Measures repeated).

" " " " southern nebula & 1st " star 3.5 " " " "

" " " " 1st " star & 2d " " 5.5 " " " "

" " " " 2d " " & chief nebula 6.5 " " " "

∴ " " " " two nebulae 15.5 " " " "

" " " " chief nebula & 3d " star 10.25 " " " "

" " " " 3d " star & southern nebula 5.50 " " " "

∴ " " " " two nebulae 15.75 " " " "

Mean of four results makes the two nebulae differ in declination 15.68 of the small squares.

$15.68 \times 94.415 = 1480.44$

Hence the nebulae, by this observation, differ in declination $24'\ 40''.44$

By J. F. W. Herschel's Catalogue of 1830 the difference is $24'\ 27''$

" D'Arrest's " " 1861 " " " $24'.65 = 24'\ 39''$

Hence the measure appears to be sufficient to confirm the correctness of the preceding determination of the value of the width of the squares, and to show that the eye-piece used by Mr. Trouvelot on the Andromeda nebula is that used this evening.

The engraved plate in the series of Astronomical

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Engravings (described on page 33, above,) makes the two nebulae differ in declination about $15\frac{1}{3}$ of the small squares, which agrees fairly with the result just obtained. But while Herschel and D'Arrest make the difference ~~[illegible]~~ of declination between the chief nebula and the northern nebula about the same as the difference between the chief nebula and the southern nebula, the plate just ~~[illegible]~~ mentioned makes it $19\frac{1}{2}$ of the small squares. This point should be examined at the first opportunity. The seeing was not good enough to continue the observations on Sept 9, and the observer's eyes had become fatigued.

Observations of Andromeda nebula

Sept. 10, 1875, about $8^h\frac{1}{2}$ mean time.

Observer Arthur Searle. Recorder W. C. Winlock.

Instrument as on Sept. 9; see page 39, above.

The eye-piece had been removed and replaced since the last observations, but had been handled carefully, so as probably not to disturb the sliding piece between the lenses which carries the ruled plate.

Rough measure of difference of position between chief nebula and north preceding nebula, as follows:

Star	3 squares	following	}	2 squares	north	of northern nebula
Another star	$0\frac{1}{2}$ "	"	}	$5\frac{1}{2}$ "	south	" first star.
" "	3 "	"	}	8 "	south	" second " .
" "	5 "	"	}	1 "	north	" third " .
Chief nebula	5 "	"	}	5 "	south	" fourth " .

Hence chief nebula $16\frac{1}{2}$ squares following } $15\frac{1}{2}$ squares south of northern nebula.

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Log. 15.5	1.19033	3.16537		1463.4	24′ 23″.4
" 94.415	1.97504	3.19252			
" 16.5	1.21748				
" sec 40° 46′		0.12069			
Ar. co. " 15		8.82391			
		2.13712		137.1	2ᵐ 17ˢ.1

By this measure, the two nebulae differ in α 2ᵐ 17ˢ & in δ 24′ 23″
" D'Arrest's catalogue, 1861, —— " —— 2 20 —" — 24′ 30″
" Herschel's " ,1830, —— " —— 2 18 —" — 24′ 55″

Apparently there is no error in the identification of the nebulae or in the measure of the value of the squares. The plate ~~&~~ mentioned above, pages 41, 42, must be wrong and needs revision. By the plate the difference of α is 18 squares, of δ 19½.

Sept. 15, 1875. Mr. Trouvelot took the ~~set of~~ ruled glass plate used in the observations above, and in his observations, as he wished to use it in Washington, where he is going for a time. Further observations with it will therefore not be made here for the present.

Oct. 2, 1875. Observations for relative magnitude of image formed by East Equatorial with large Comet-seeking negative eye-piece (No. 7 of my list of small apparatus — see page 39 above for use of this eye-piece) and with ring micrometer positive eye-piece No. 1 (No. 8 of my list just named). Observer Arthur Searle. Sidereal time about 23ʰ. A square of thin metal bars (one side marked by a lump of wax) placed successively in the foci of these eye-pieces, and transits of α Lyrae taken across the same part of the square with

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each eye-piece.

With negative eye-piece (No.7) the transit occupies 74 seconds by chronometer B.236. ~~Four~~ Four transits taken to confirm the observation. Fractions of seconds not readily observable, as the appearance and disappearance of the star is gradual.

With positive eye-piece (No.8) the transit occupies 51 seconds by same chronometer. Three transits taken.

~~Focal leng~~ Image formed by negative eye-piece (No.7) $2\frac{1}{2}$ inches nearer object-glass than without an eye-piece (or with the positive eye-piece No.8). Diameter of image with negative eye-piece, by above observations, $\frac{51}{74}$ of diameter of image with positive eye-piece.

Value of width of one of small squares used in Mr. Trouvelot's drawings, with negative eye-piece (No.7), as found Sept. 9 (see page 40 above), 94".4.

$$74 : 51 = 94.4 : 65.1$$

Hence, with positive eye-piece (No.8) the value of the width would be 65".1.

By Mr. Willson's observations last winter, the value was 65".142; hence it is obvious that he used the positive eye-piece (No.8), while Mr. Trouvelot used the negative eye-piece (No.7) in drawing the nebula in Andromeda.

What eye-piece Mr. Trouvelot used in drawing the trifid nebula is at present unknown. The two ruled plates representing the positions of stars in the nebula in Andromeda and the trifid nebula must be withdrawn from the series of Astronomical Engravings. That of the stars

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in the nebula in Andromeda is not accurate enough (see page 43 above) to appear as an Observatory publication. That representing the stars in the trifid nebula is probably right, but needs examination when time can be found for the purpose. It may be worth reproducing in the Annals of the Observatory.

The plates representing the nebulæ in Andromeda and the trifid nebula (Plates 33 and 32 of the Astronomical Engravings) are inaccurate in positions to the same extent with the ruled plates just mentioned; but as Plates 32 and 33 make no pretence to statements of position, and are good pictures, they may properly be retained in the series of Astronomical Engravings.

1876 July 14.

Compared some points in Rowelot's chart of the trifid nebula with J. F. W. Herschel's figure and catalogue (Cape Observations, pp. 10, 11, and Plate II, Fig. 2; for explanation of methods employed in forming the catalogue, see also pp. 8, 9). Herschel's positions, by his account of them, are so rough that they should be inferior to Rowelot's.

It appears from the positions given by Herschel that the eye-piece used by Mr. Rowelot was the positive one, No. 8 (see p. 44 opposite), so that the value of each small space is 65."1 or thereabouts.

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Herschel's stars α and β are too near each other, as appears from the table in Oeltzen's Catalogue, to be relatively changed by precession since 1830.

1830. Herschel makes them differ in α $8^s.8$ & in δ 444"
1874. Ironwelot " " " " " $8^s.6$ " " " 456"

β is north of α and follows it.

Observation is required to decide the value of Ironwelot's chart.

July 15, 1876. Observer A. Searle. Recorder A.B. Gibbs.
Instrument, East Equatorial with eye-piece No. 8, named on previous page, and the set of squares used by Mr. Ironwelot in making his drawings. Chronometer Frodsham 3451.
Trifid, nebula, α $17^h 55^m$ δ $-23° 2'$.

Diff. of α between Herschel's stars α & β (see above) by ten transits over various lines of the set of squares, adjusted for position. Time noted from chronometer by the recorder.

^{s}
8.5
9.0
9.0
8.5
9.0
9.0
9.0
8.5
8.5
9.0

} Mean $8^s.8$, agreeing with Herschel; and sufficiently with Ironwelot.

The diff. of α is at least as much as 7.8 of the small squares. $(1.8 \times 65".1 \sec 23° = 127".4 = 8^s.5)$.

Diff. of δ is 7 of the small squares, and rather more than less; $(7 \times 65".1 = 455".7)$; agreeing with Ironwelot.

The side of each small square in Ironwelot's chart is 12 millimetres.

Herschel makes the difference between his stars α & ω, on the scale of Ironwelot's chart, in α 18 millimetres, in δ 54 millimetres

Ironwelot has a star 20 millimetres following & 51 millimetres south of Herschel's α, which seems to be Herschel's ω.

This star was not seen July 15, 1876; stars were seen as follows: one 4 squares following and 4 squares

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south of α, and one about 2 squares following and not more than 3½ squares south of α. ~~Between~~ This last ~~and α the diff~~ follows α 7.s0, according to one transit. If the transit was taken correctly, the estimate of 2 squares is too large. The star and the lines were seen with difficulty. Two other small stars were seen near this one, which is probably the star on Chowelot's chart 17 millimetres following and 89 millimetres south of α.

The star 4 squares following and 4 squares south of α appears to be on Chowelot's chart.

As Chowelot agrees with Herschel about the place of the star ω, it will be well to look again for it.

A star was seen following ~~β~~ Herschel's β two squares, and estimated 2.7 squares north of β. There is a star on Chowelot's chart not far from this place. The star which should have been observed is Herschel's 9, but the recorder made some mistake in stating the approximate place of the star.

A star was seen 2 squares preceding and 3½ north of Herschel's α (this is probably Herschel's ε, and appears on Chowelot's chart).

A star was seen 1.9 squares north and 2.7 following α (this is probably Herschel's η, and appears on Chowelot's chart.)

The last three observations are not close enough to decide differences between Herschel and Chowelot.

1876, July 16. Adopted value of sides of small squares, with eye-piece No. 8, verified by 3 transits of γ Sagittarii, over 15 squares, in 75.s5; corresponding value for 1 square 65."1.

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1876 July 17. Observations on trifid nebula Continued.

Herschel's star ω seen in the place assigned it by Trouvelot. It is much fainter than the star 4 squares following and 4 squares south of α.

The three stars north of ω on Trouvelot's chart were also seen. The following star of the three is extremely faint; the middle, or northern, one is about as bright as ω.

A star taken for Herschel's star φ by observation seems to be 3½ squares following and 4.9 squares north of β. This agrees sufficiently with Trouvelot's chart, by which the figures are 3.4 and 4.8. The star following φ on Trouvelot's chart was also seen. There is another near it, south following.

Herschel makes φ follow β 14ˢ.0, ~~and~~ north of it 4'.5. Trouvelot's chart and the present observations agree in making φ follow β as much as 16ˢ.0, north of β as much as 5'.2. But there is another star on Trouvelot's chart ~~Herschel's star ζ by the~~ 13ˢ.4 following β, north of it 4'.0. This is more likely to be Herschel's φ. It was seen, but its place was not taken. In Herschel's figure φ is just on the edge of the nebula. In Trouvelot's chart one of the stars discussed above is outside, and the other inside the nebula.

Herschel's star ε, according to him, precedes α 8ˢ.0, north of it 3'.5; according to Trouvelot's chart, the figures are 7ˢ.5 and 3'.5; according to observation today, 7ˢ.5 to 8ˢ.0 (by transits) and 3'.6; difference of right ascension estimated 1.8 squares, which makes it 8ˢ.5; the estimate is doubtless too large.

Herschel's star ζ, according to him, follows α 7ˢ.6, north of it 4'.0; hence precedes β 1ˢ.2, south of it 3'.4.

Trouvelot's chart and observation today agree in making ζ precede β very little, if at all; (Trouvelot's chart makes the

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difference about $0^s.3$); and in making ζ south of β 3'.6.

Herschel makes ζ follow ε $15^s.6$, north of it 0'.5.
Trouvelot " ζ " ε $15^s.3$, " " " 0',45.
Observation today " ζ " ε $16^s.5$, " " " 0',5.
The observation ~~of~~ was merely an estimate, $3\frac{1}{2}$ squares & $0\frac{1}{2}$ squares.

Herschel makes η follow α $11^s.9$, north of it 1'.8
Trouvelot " η " α $11^s.4$, " " " 2'.1
Observation today " η " α $12^s.7$, " " " 2'.2
Observation by estimate, 2.7 squares and 2 squares.

Herschel makes η follow ζ $4^s.3$, south of it 2'.2
Trouvelot " η " ζ $3^s.7$, " " " 1'.9
Observation today " η " ζ $3^s.8$, " " " 2'.2
Observation by estimate, 0.8 squares and 2 squares.

On the whole, Trouvelot's chart seems to be at least as correct as Herschel's, and may properly be published in the Annals. The discrepancies might be set down to differences of proper motion, if both observers were assumed to be correct; but in fact the observations are too rough to make it worth while to treat them as evidence of proper motion.

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{Tempel's nebula, figured in Plate II of No. 5 of the Pubblicazioni del Reale Osservatorio di Brera in Milano.} 75

Observations on Tempel's nebula in the Pleiades.

Oct. 25, 1875, $9\frac{1}{2}$ to 10^h mean time. Observers A. Searle & W. Hoxie. Instruments, East Equatorial and its finder.

With the lowest power of the finder, and also with the lowest ring micrometer eye-piece of the large telescope, A. S. saw a distinct boundary between comparatively dark & light portions of the sky along the line of the two small stars bounding the nebula on the following side in Tempel's chart. Other shadings of the sky were suspected, in general agreement with Tempel's figure, but not satisfactorily determined.

W. H. saw the boundary above mentioned, and also a somewhat bright spot on the north preceding side of the nebula as Tempel draws it, about $\frac{2}{3}$ of the way from Merope to the next (faint) star along that side of the nebula in Tempel's chart.

Nov. 21, 1875. A. Searle, observer. East Equatorial, lowest ring micrometer eye-piece, (No. 8 of the list of apparatus.)

9^h mean time. Plenty of nebula, or at least of whitish light, visible near Merope, but at least as much in other parts of the group. In particular, Alcyone is surrounded by light, which stretches towards the next star south of Alcyone in Tempel's drawing. The nebula near Merope lies more to the preceding side than in his drawing, so that the two small stars which bound the nebula on the following side according to Tempel now have a distinct dark space between them and the nebula, while on the preceding side the star which Tempel puts on the boundary of the nebula now lies well within it.

2^d. Observations, $10\frac{1}{2}$ mean times. Less appearance

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of nebula about Alcyone. Nebula near Merope as in following sketch; the three little stars preceding Merope in a comparatively dark space; Electra and Celeno in a very dark part of the sky.



Nov. 22, 1875, 10h mean time. Same general appearance as yesterday; boundary indefinite at top of above sketch.

Dec. 6, 1875, 10h mean time. Observer and instrument as on Nov. 21. Nebula visible notwithstanding moonlight; Alcyone did not appear nebulous. Observation of Nov. 21 confirmed, except that after passing the two small stars between Merope and Electra, the boundary of the nebula seemed to turn towards Electra and approach it closely, but not to include it. The three small stars preceding Merope still appeared to be in a comparatively dark space; and the following boundary of the nebula appeared distinctly as on Nov. 21.

Dec. 10, 1875, 15h mean time. The moon was to pass a little south of Merope and Atlas before sunrise, occulting some of the small stars in that region; but as the western sky where the moon was, was covered with extensive though thin clouds, it appeared useless to attempt observing an occultation of any but a bright star.

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of nebula about Alcyone. Nebula near Merope as in following sketch; the three little stars preceding Merope in a comparatively dark space; Electra and Celeno in a very dark part of the sky.



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Occultation of Saturn, Aug. 6, 1876.

Observer, A. Searle. Instruments, East Equatorial with power No. 3 (so-called) [redacted see list page 103]; power 316; spring governor No. 1; East Clock, compared with South Clock on the chronograph sheet before and after observations. East Clock fast of South Clock $1^m\ 24^s.4$

Immersion.

	E. Clock	S. Clock (fast $11^s.2$)	Cambridge sidereal time
First contact of ball with Moon's bright limb	$20^h\ 13^m\ 53^s.8$	$20^h\ 12^m\ 29^s.4$	$20^h\ 12^m\ 18^s.2$
Last contact of ball with Moon's bright limb	15 32.6	14 8.2	13 57.0
Mean of these		13 18.8	13 7.6

Contacts of ring with Moon's limb nearly coincident with those of ball; observer did not attempt to note them, apprehending that the attempt might make the observation of the contacts of the ball less secure.

The second contact is thought to have been recorded too late rather than too early.

Emersion

(on dark limb, but close to [redacted] terminator)

	E. Clock	S. Clock (fast $11^s.2$)	Cambridge sidereal time.
First appearance of exterior edge of ring A	$20^h\ 44^m\ 32^s.4$	$20^h\ 43^m\ 8^s.0$	$20^h\ 42^m\ 56^s.8$
Inner edge of ring B	45 24.4	44 0.0	43 48.8
First contact of ball	45 50.8	44 26.4	44 15.2
Ball bisected	46 44.9	45 20.5	45 9.3
Last contact of ball	47 42.7	46 18.3	46 7.1
Inner edge of ring B	47 54.0	46 29.6	46 18.4
Last contact of ring A	48 43.5	47 19.1	47 7.9

Of these seven observations, the first is of course somewhat late, but not known to be very late. The second and third were considered decidedly late, two seconds at least. The fourth was thought to be late rather than early. The sixth was thought much too early, ten seconds very likely. The fifth and seventh were thought pretty good.

The seeing was excellent. The division

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South Clock 1st minute after on sheet 19h 14m
last " " " " 21 5
East Clock last " " " " 21 7

1876 Aug. 6. Occultation of Saturn.

East Equatorial. East Clock. 19h 14m S. Clock

14.31 becomes to hundredths 0.02
52.84
39.46
38 47.89 34.50 26.36
39 39.75 26.36 18.26
40 6.08
41 0.03
41 57.67
42 8.94
42 58.30

watch comparison

1st contact at this last " " " "
both of the ball

watch comparison

accidental break

1st contact at emersion
24 33.5
4 5 46

watch comparison

21h 7m East Clock

21h 5m S. Clock

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ling between rings A and B was seen at immersion when the planet was close to the moon. At emersion the images were less steady, but still good. The observer's eye was considerably fatigued by the brightness of the moon.

The angles of position might have been taken after immersion and emersion, but were neglected. The emersion took place a little beyond (reckoning from the north point) a large walled plain, wholly within the terminator, which I take to be Endymion.

Error of South Clock Aug. 6, 1876, at $18\frac{h}{2}$ sidereal time, -11.09
" " " " Aug. 7, 1876, (morning) at $5\frac{h}{4}$ " " , -12.82
Clock gaining $0^s.05$ an hour.
Error at immersion, $20\frac{h}{4}$ sidereal time, -11.18
" " emersion, $20\frac{h}{4}$ " " , -11.20

Cambridge mean times of contacts on last page.

Immersion.

1.	11^h ~~8^m 0.9~~	8^m	$14^s.31$ ~~seconds to hundredths 0.92~~	
2.	11 ~~9 39.5~~	9	52.84	~~39.46~~

Emersion.

1.	11^h ~~38^m $34^s.5$~~	38^m	$47^s.89$	~~34.60 26.36~~
2.	11 ~~39 26.4~~	39	39.75	~~26.36 52.69~~
3.	11 ~~39 52.7~~	40	6.08	~~52.69~~
4.	11 ~~40 46.6~~	~~40~~ 41	0.03	~~46.64~~
5.	11 ~~41 44.3~~	41	57.67	~~44.28~~
6.	11 ~~41 55.5~~	42	8.94	~~55.55~~
7.	11 ~~42 44.9~~	42	58.30	~~44.91~~

South Clock 1st minute e
East Clock last "
" " last "

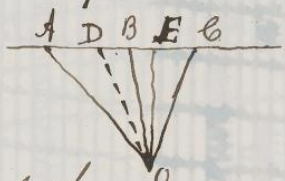
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Table of values of OCE, when E lies between B & C, and AOC = 40°

Argument $\frac{BC}{AB}$

.766	90°.00		.920	76°.53	42
.770	89.65	35 × 5/4 = 44	.925	76.11	42
.775	89.20	45	.930	75.69	42
.780	88.76	44	.935	75.27	41
.785	88.31	45	.940	74.86	42
.790	87.87	44	.945	74.44	41
.795	87.42	45	.950	74.03	41
.800	86.98	44	.955	73.62	41
.805	86.53	45	.960	73.21	41
.810	86.09	44	.965	72.80	41
.815	85.64	45	.970	72.39	40
.820	85.20	44	.975	71.99	40
.825	84.76	44	.980	71.59	40
.830	84.32	44	.985	71.19	40
.835	83.88	44	.990	70.79	40
.840	83.44	44	.995	70.39	39
.845	83.00	44	1.000	70°.00	
.850	82.56	44			
.855	82.12	44			
.860	81.68	44			
.865	81.24	44			
.870	80.82	44			
.875	80.38	44			
.880	79.94	43			
.885	79.51	42			
.890	79.09	43			
.895	78.66	43			
.900	78.23	43			
.905	77.80	43			
.910	77.37	42			
.915	76.95	42			



In this case

$AB = BD + DA$

$BC = CD - BD$

$\cot OCE = \frac{BC}{AB} \operatorname{cosec} AOC - \cot AOC$

$DE = CD - CE = CD - AC \sin OAE \cos CCE \operatorname{cosec} AOC$

$OE = AC \sin OAE \sin OCE \operatorname{cosec} AOC$

Another method not requiring a chronograph, would be to make AB = BC, each quantity being an exact number of seconds. The ratio $\frac{\sin AOB}{\sin BOC}$ is then equal to $\frac{OC}{OA}$ and may be used in the manner in which the ratio $\frac{BC}{AB}$ is used above. In this case, however, it would be impracticable or inconvenient to construct tables for the reductions.

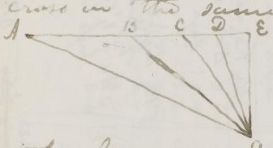
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Determination of differences of α and δ by position circle and chronograph, without determination of position angle.

Take transits in three settings of position circle, arranged as may seem most advantageous but always at equal intervals, so that the angle between the first and second position is equal to that between the second and third.

There are three cases: the three settings should be all on one side of a parallel of declination (so that a given point on the thread used for the transits is always in the northern or southern half of the field); but they may all be in one quadrant, two in one and the third in the other, or one in each, with the second position of the thread on the meridian. These variations, however, make no difference in the computation; but if the order in which the stars cross the thread changes, the sign of the δ interval between the transits must change.

Taking the case in which the positions are in one quadrant, and in which the stars always cross in the same order, let AE be on a parallel of declination and OE on an hour circle; let one star is at O let the other be at D; let OA, OB, OC, be the successive positions of the thread, taken so that $AOB = BOC$.



The observations give these angles, and the differences $AD - BD (= AB)$ and $BD - CD (= BC)$.

The measured ~~arcs~~ arcs being small, so that their chords may be substituted for them, we have $OA : OC = AB : BC$, or $\sin OCA : \sin OAC = AB : BC$, or $\sin OCE : \sin OAE = AB : BC$, or $\cos COE : \cos AOE = AB : BC$.

Hence $\cos AOE = \frac{BC}{AB} \cos COE$; and as $AOE = AOC + COE$,

$$\cos AOC \cos COE - \sin AOC \sin COE = \frac{BC}{AB} \cos COE.$$

Hence $\tan COE = \cot OCE = \frac{\cos AOC - \frac{BC}{AB}}{\sin AOC} = \cot AOC - \frac{BC}{AB} \operatorname{cosec} AOC$.

From this equation the values of the angle OCE for various values of AOC may very easily be tabulated, the argument being the ratio $\frac{BC}{AB}$ in hundredths from 0 to 1; a smaller range is practically enough.

Knowing OCE, we have $OAE = OCE - AOC$, and, reducing OAC to seconds of arc in a great circle, we have $\Delta\alpha = AC \sin OAE \sin OCE \operatorname{cosec} AOC$; without the reduction, $\Delta\alpha = AC \sin OAE \cos OCE \operatorname{cosec} AOC - CD$.

Table of values of the angle OCE for the value 20° of the angle AOC. Argument $\frac{BC}{AB}$

.00	20°.0	.36	30°.5	.72	57°.3
.01	20°.1	.37	31.0	.73	58.6
.02	20.4	.38	31.4	.74	59.8
.03	20.6	.39	31.9	.75	61.0
.04	20.8	.40	32.4	.76	62.3
.05	21.0	.41	32.9	.77	63.6
.06	21.2	.42	33.4	.78	65.0
.07	21.5	.43	33.9	.79	66.4
.08	21.7	.44	34.4	.80	67.8
.09	21.9	.45	34.9	.81	69.3
.10	22.2	.46	35.5	.82	70.7
.11	22.4	.47	36.1	.83	72.3
.12	22.6	.48	36.7	.84	73.8
.13	22.9	.49	37.3	.85	75.3
.14	23.2	.50	37.9	.86	76.9
.15	23.4	.51	38.5	.87	78.5
.16	23.7	.52	39.2	.88	80.1
.17	24.0	.53	39.9	.89	81.8
.18	24.2	.54	40.6	.90	83.4
.19	24.5	.55	41.3	.91	85.1
.20	24.8	.56	42.0	.92	86.7
.21	25.1	.57	42.8	.93	88.5
.22	25.4	.58	43.6	.94	90.1
.23	25.7	.59	44.4	.95	91.8
.24	26.1	.60	45.2	.96	93.4
.25	26.4	.61	46.0	.97	95.1
.26	26.7	.62	46.9	.98	96.8
.27	27.1	.63	47.9	.99	98.4
.28	27.4	.64	48.8	1.00	100.0
.29	27.8	.65	49.7		
.30	28.1	.66	50.7		
.31	28.5	.67	51.8		
.32	28.9	.68	52.8		
.33	29.3	.69	53.9		
.34	29.7	.70	55.0		
.35	30.1	.71	56.2		

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1876 Aug. 5. Transits for trial of methods of observation.

α 1876½ 17h 36m 18s δ 1876½ +2° 5′

East Equatorial, eye-piece No 2 ring micrometer, thread 17′, with notched and plain bar, crossing at an angle of 45° with each other

Stars 2 M. +2° 3386 and a small star 3 p. (identification hasty, but this plain must be given nearly to work with.) α 1883.0 17 35 25.7 δ 1883 +2° 52.4

1876

Notched strip on a parallel of declination when position circle reads 0°.

5 transits over plain strip circle reading 0°. S. p. star crosses first.

5 transits over notched strip circle reading 90°. S. p. star crosses first.

n. f. star crosses first

6 transits over plain strip circle reading 55°.

5 over plain strip reading 65°.

5 over plain strip circle reading 75°.

5 transits circle reading 0° (plain strip): 4.2, 4.2, 3.9, 3.7, 3.4, 3.4 — Mean 4.00

6 transits circle reading 90° (notched strip): 1.7, 2.10, 1.7, 1.5, 1.8 — Mean 1.82 = Δα

With this Δα the angle between the bars of the strips and the parallels of declination, measured as shown on the circle, was 90°.0 and the angle between the strips 41°.8

With Δα = 1.72 and the measured angle between the bars of the stars & the parallels of declination, measured as before, 41° 55′, the Δδ is 27′.6, and the angle between the strips (= to 5 transits circle reading 0°) 38°.9

1918.

1932

6 over plain strip circle reading 75°.

10 over plain strip circle reading 65°.

6 over plain strip circle reading 55°.

Readings of position circle, notched strip parallel to stars.

48° 20′, 47 35, 47 45, 47 37, 46 50 — Mean 47 16/34

93 53, 46 56 — Mean 47 34

45 31, 45 58, 47 10, 45 31, 46 26 — Mean 46 9/19

Position gage examined again after observations and found apparently as correct as it could be made.

Transits over plain strip

Circle reading	55°	65°	75°	75°	65°	55°	55°	65°	75°
Transit 1	5.8	3.6	1.8	1.4	3.6	9.5	9.15	3.60	1.60
2	6.8	3.6	1.8	1.4	3.4	9.4	9.10	3.50	1.60
3	4.8	3.5	2.0	1.7	3.3	9.0	8.90	3.40	1.85
4	9.6	3.6	1.5	1.4	3.5	9.49	9.50	3.55	1.45
5	8.7	3.5	1.4	1.8	3.9	8.8	8.75	3.70	1.60
6	9.8			1.5	3.9	8.8			
7					3.4				
8									
9									
10									

1.62

Means of first four transits

Differences

5.55	2.00	2.775
5.60	1.90	2.947
5.50	1.55	3.548
5.95	2.10	2.833
5.05	2.10	2.405
2.65	1.45	
5.530	1.930	

Reciprocals

4	3	0.360
2	9	0.339
3	3	0.282
4	5	0.353
		0.416
	15	1.1

Angles

30°.5
29.7
21.5
30.2
33.2

Mean 30.22

By the method of transits only
Δα = 1.72 Δδ = 29′.3
Angle between the strips 75° − 30°.22 = 44°.8

By direct measurement of Δα and of position angle:
Δα = 1.82 Δδ = 29′.2
Angle between the strips = 41°.8

Δδ = 7.5 × 15 = 112″.5 in 22s.2 = 20″ = 29″.3

30.22 − 20 = 10.22

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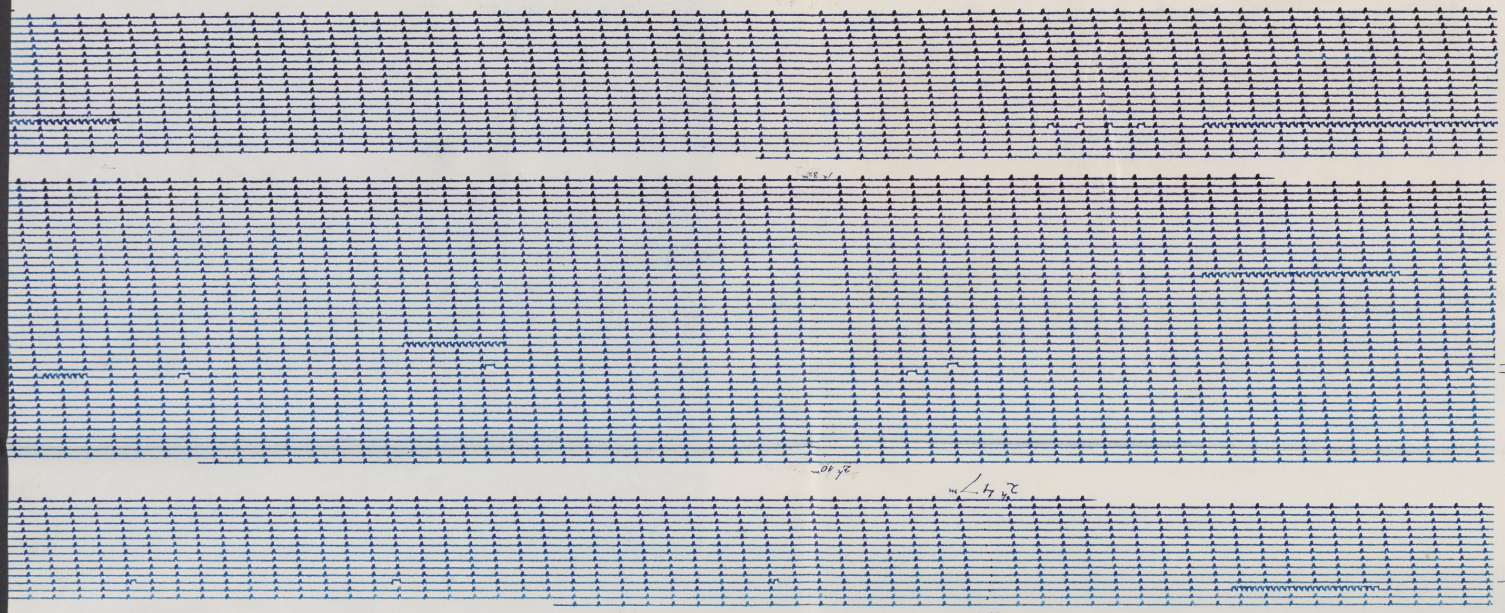
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8.03

Occultation of Saturn
Sept. 2, 1876.

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Occultation of Saturn, Sept. 2, 1876. East Equatorial, power Nels(401); Smith Clock. Observer A. Searle.



Mean times corresponding to sidereal times at right side of sheet.

$15^h\ 0^m\ 25^s.94$		
5 44.69		
6 5.03	}	Immersion.
6 27.47		
6 56.79		
16 6. 29.81		
6 45.07	}	Emersion.
6 55.84		

Error of South Clock Aug. 31, 1876 (morning) at $7^h\ 38^m$ sid. time, -19.42

~~Add for~~ Increased ~~correction~~ value of m, by observation of last Sept. 2 $+.13$

-19.55

Error of South Clock Sept. 2, 1876, at 20^h sid. time -19.17 (38)

" " " Sept. 3, 1876 (morning) at $7\frac{1}{2}$ sid. time -18.41 (63)

~~Add for~~ Increased value of m as above $+.13$

-18.54

Rate during night of Sept. 2 assumed 0.02 per hour, losing

Error at immersion -19.05

" " emersion -19.03 } -19.0

Clock time of Immersion

40.3 { 35.8 {	$1^h\ 55^m$	54.8
	57	13.6
	58	34.0
	58	54.5
	59	25.9

Sid. Clock about 22^s fast?

Immersion about $1^h\ 57^m\ 12^s$

Emersion " $2\ 57\ 47$

Cambridge Sidereal time

$1^h\ 56^m$	$35^s.8$
	54.6
57	15.0
58	37.6
	47.9

Emersion

$2^h\ 58^m\ 8^s$	$2^h\ 57^m\ 49^s.7$
24.0	$58\ \ 5.0$
34.8	58.8

Immersion on dark limb, but close to termination. Seen hard. Emersion on bright limb at the expected place; first image of planet so faint and tremulous (moon near horizon) that it could not be distinctly recognized until the ball had partly come into view.

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Occultation of Saturn
Sept. 2, 1876.

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1876 Dec. 13. Observed Saturn 8^h to 9^h mean time, to detect the white spot seen recently by Prof. Hall; but the sky was so hazy that no details could be made out with any power.

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Inspection of sun, Oct. 2 & 3, 1876, at request of M. Le Verrier received through Smithsonian Institution, for possible transito of planets within Mercury.

L. Waldo examined image formed by Comet-seeker every 20 minutes from sunrise to 10 A.M. Oct. 2, (22^h mean time Oct. 1, astronomical).

A. Searle examined image formed by photographic lens as follows: the image was distinct, showing the distinction between the umbrae and penumbrae of the three largest of the group of four spots shown by the sun on this date. The time is from chronometer B. 236* (sidereal) $1^h 35^s$ fast of South Clock at 10 A.M. Oct. 2; at 2 P.M. $1^h 34\frac{5}{2}$ fast of South Clock.

Observations from 10 A.M. to 2 P.M.

Image examined

	$11^h\ 57^m$	to	$12^h\ 0^m$	
	12 2	"	12 3	
	9	"	10	
	17	"	18	
	22	"	23	
	$27\frac{1}{2}$	"	28	
	31	"	32	
	40	"	41	
	52	"	53	
	13 7	"	13 8	
	20	"	21	
	33	"	34	
	46	"	$46\frac{1}{2}$	
	$57\frac{1}{2}$	"	58	
	14 $2\frac{1}{2}$	"	14 3	
	$15\frac{1}{2}$	"	16	
	$21\frac{1}{2}$	"	22	
	32	"	33	
	47	"	48	
	57	"	58	
	15 $6\frac{1}{2}$	"	15 7	
	17	"	$17\frac{1}{2}$	
	26	"	27	
	34	"	35	
	43	"	$43\frac{1}{2}$	
	54	"	55	

{Chron. F. 34 51 / S. Clock 24s slow}

Afterwards cloudy till near sunset.

Watch kept by L. Waldo, 2 to 4 P.M. & also near sunset.

In order to be prepared for hasty observations, if occasion arose, a sheet of paper was ruled with two perpendicular pairs of close parallel lines and placed on the frame which supports the photographic plate-holder (about in the visual focus of the photographic lens) so that it could be turned into any convenient position for taking transits by Carrington's method described in the Introduction to his Observations of the Spots on the Sun. With this apparatus, a few transits of the preceding spot of the group in view Oct. 2, were taken for practice. The result given below appears to show that the work was not likely to be seriously damaged by unsteadiness of the paper or yielding of the cords by which the mirror is kept in place; but the mirror is shaken so much by even a light wind as to make the observations rough compared with those taken with a sheltered and clamped telescope, as Carrington's were. Nos. 5 & 6 of the following observations were taken with the paper turned about a quadrant from the positions in which Nos. 1, 2, 3, & 4 were taken. In No. 5 the mirror shook more than usual. The result indicates no noticeable want of perpendicularity in the lines used, compared with the other sources of error.

No.	Result for position, sun's motion in δ neglected.	Result for distance from sun's centre, in terms of sun's radius.	Residuals: Position	Residuals: Distance
1	275°.30	0.3732	+1.12	−.0134
2	274.94	0.3860	+0.76	−.0006
3	275.10	0.3868	+0.92	+.0002
4	273.87	0.3852	−0.31	−.0014
5	272.01	0.3960	−2.17	+.0094
6	273.84	0.3926	−0.34	+.0060
Mean	274.18	0.3866.	0.82	0.0052

Probable error of one observation

* Chronometer B. 236 was either $1^h\ 35^s$ fast of S. Clock between 10 A.M. & 2 P.M., when the observations with it were made Oct. 2, or else it was 35^s fast and the hour was incorrectly read, which is perhaps more likely, as the chronometer is inconveniently made, the hour dial being small and difficult to read.

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Inspection of sun (continued).

1876 Oct. 3. Watch kept by Lt. Waldo till 10 A.M.

Sun observed as follows with Bowditch comet-seeker; negative (plain) eye-piece No. 4 (No. 29 of list of small apparatus). This eye-piece, on the comet-seeker, just takes in the sun, but in order to examine it carefully the telescope has to be moved, which occasions some difficulty, as the motion in altitude is very uneven. Time by watch $11\frac{3}{4}$ minutes slow of North Clock, or $11\frac{1}{2}$ minutes slow of Cambridge mean time, the North Clock being kept 16 seconds fast. {Time by watch at 2 P.M. 11 1/2 minutes slow of North Clock; at 4 P.M. 11 1/2 min. slow; at 5 1/2 P.M. 11 1/3 min. slow.}

Image examined by direct inspection through comet-seeker:

$10^h\ 6^m$ A.M.	to $10^h\ 7^m$ A.M.
21	" 22
27	" 28
39	" 41

Image formed in photographic shed examined:

52	" 56

Image examined by direct inspection through comet-seeker:

$11^h\ 0^m$ A.M.	to $11^h\ 3^m$ A.M.
11	" 12
24	" 25
34	" 35
$45\frac{1}{4}$	" $47\frac{1}{4}$
59	" 60

Eyes too much fatigued to continue observations with comet-seeker.

Image formed in photographic shed examined:

$12^h\ 10^m$ P.M.	to $12^h\ 11^m$ P.M.
20	" 21 "
37	" 38
46	" 47
58	" 59
1 8	" 1 9
$21\frac{1}{2}$	" 23
33	" 34
$40\frac{1}{2}$	" $41\frac{1}{2}$
46	" 47

Sun viewed through comet-seeker:

3 31	" 3 32.
52	" $52\frac{1}{2}$
4 7	" 4 $8\frac{1}{2}$
14	" $15\frac{1}{2}$
$22\frac{1}{2}$	" $24\frac{1}{2}$
$31\frac{1}{2}$	" $34\frac{1}{2}$
47	" 51
58	" 5 1
5 9	" $15\frac{1}{2}$

Sun half set (behind roof) at $5^h\ 13\frac{1}{2}$; wholly set at $5\ 15\frac{1}{2}$.

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Inspection of sun in compliance with a newspaper paragraph purporting to convey a request from Le Verrier transmitted through Prof. Watson, for observations on Oct. 9 & 10, 1876.

1876 Oct. 9, civil time. A. Searle and L. Waldo examined the sun occasionally. The following are the times of the observations made by A. Searle. No spots of any kind seen. Day clear.

Image formed by photographic lens examined: time by watch, slow of Boston clock
$11\frac{1}{8}$ minutes at 8 A.M.
$10\frac{3}{4}$ " " 1 P.M.
$10\frac{3}{4}$ " " 2 P.M.

10	2m	A.M. to 10	5m A.M.
10	56	" " 11	58 "
11	25	" " 11	27 "
12	22	P.M. " 12	23 P.M.
	$42\frac{1}{2}$	" "	43 "
1	$49\frac{1}{2}$	" " 1	59 "
	9	" " 1	11 "
	27	" "	$28\frac{1}{2}$ "
	$43\frac{1}{2}$	" "	$44\frac{1}{2}$ "
	53	" "	$53\frac{1}{2}$ "
4	1	" " 4	2m $\frac{1}{2}$ "

Sun viewed through Comet-seeker; time by watch, slow of Boston clock
$10\frac{5}{4}$ minutes at $4\frac{3}{4}$ P.M.

4	18m	" " 4	19m "
	$32\frac{1}{2}$	" "	35 "
	$48\frac{1}{2}$	" "	$49\frac{1}{2}$ "
5	3	" 5	8 "

sun setting behind trees.

1876, Oct. 10, civil time. Sun occasionally examined. Following observations by A. Searle. No spots of any kind seen. Clouds not too thick to allow sun to be seen pretty well.

Sun viewed through comet-seeker; time by watch, slow of Boston clock
$10\frac{3}{4}$ minutes at 8 A.M.
$10\frac{5}{4}$ " " 10 "
$10\frac{5}{8}$ " " $11\frac{1}{4}$ "
$10\frac{3}{8}$ " " 1 P.M.
$10\frac{1}{4}$ " " 2 "
$10\frac{1}{8}$ " " 4 "

8	57m	A.M. to 8	57m A.M.
9	41	" " 9	42 "
10	4	" " 10	5 "
10	59	" " 11	1 "
11	45	" " 11	46 "
12	21	P.M. " 12	25 P.M.
	$58\frac{1}{2}$	P. "	56 "
1	26	" " 1	27 "
1	51	" " 1	$52\frac{1}{2}$ "
3	$10\frac{1}{2}$	" " 3	$12\frac{1}{2}$ "
3	40	" " 3	41 "
4	11	" " 4	13 "
4	27	" " 4	29 "
4	$48\frac{1}{2}$	" " 4	53 "

Sun getting into thick clouds.

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1877, Feb. 9 (astronomical date). Comet (reported by telegraph through Smithsonian Institution) observed by A. Searle with finder of East Equatorial. (The filar micrometer was attached to the principal telescope and left there at request of Mr. Waldo. The lamp belonging to the filar micrometer could not be found, and perhaps the comet was too faint for observation with any illumination, even of the threads only).

The finder has four coarse lines arranged thus ‖‖. The interval between the lines of each pair is about 35' near the equator; say 8' 45". One pair was adjusted to the apparent movement of the stars, and transits taken across the others, by eye & ear, with sidereal chronometer B. 236, slow of South Clock 18^s at 15^h 22^m sid. time; about 18^{s}½ two hours later.

Comparison stars a, b, c., as follows: a is DM. +2° 3302, b is DM. +2° 3295, c is DM. +2° 3298. a identified by observed difference of α (4^m 34^s) from DM. +2° 3318, which follows it on the same parallel, and belongs to a well-marked group; also by position of DM. +2° 3296.

At 14^h 22^{m}½, chronometer time, comet follows a 24^s.
Comet north of a 1⅛ times interval of wires, say 9' 45".*

At 14^h 37^{m}½, chronometer time, comet follows a 25^s.
Comet north of a 1⅓ times interval of wires, say 11' 40".*

At 14^h 52^{m}½, chronometer time, comet follows a 27^s.5

At 14^h 55^{m}½ " " , comet slightly north of b.

At 15^h 0^{m}½ " " , comet differs equally in δ with b and c.

At 15^h 2^{m}½ " " , comet follows a 30^s.

At 15^h 10^m " " , comet follows a 30^s (a better determination than the last)

At 15^h 13^m " " , comet on same parallel with c, and 2¼ squares north of a, say 19' 41"; but

* a & c differ in DM. by 14' 30" only, and no doubt the estimated distance of the wires given above is too great. The measurements should perhaps be 7' 19", 8' 45", and 14' 30", instead of 9' 45", 11' 40", and 19' 41".

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Using the amended values, the comet appears from the observations to move $8\frac{1}{2}$ in hour northwards, or 3° 24′ a day.

It appears to gain in right ascension 6ˢ in about 48 minutes, or $7\frac{1}{2}$ an hour, equivalent to 3 minutes a day.

The place of the comet at the last observation, corrected for precession of comparison stars since 1855, is $17^h\ 16^m\ 41^s$, + 2° 41′.8.

The place when discovered was, according to the telegram, $17^h\ 13^m$, − 1° 37′. The discovery was presumably made some 30 hours (allowing for difference of longitude), before the above observations. On this supposition, the movement in right ascension for 1 day is 3 minutes, that in declination 3° 27′, agreeing with the above measures. (The daily movements derived from the first observations, and given in the telegram, were 1 minute 44 seconds, and 3° 7′.)

The Comet presented a rather diffused nebulosity, about 6′ wide, condensed with a distinct outline on the north preceding side, but without any very distinct nucleus even in the principal telescope. The part which seemed brightest was that observed for position, and this was probably somewhat north preceding the centre of the nebulosity.

The original notes of the observations are pasted on the opposite side of this leaf.

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Original record of comet observations; see two preceding pages.

(B)

At 14h 22½m
☌ foll. * 24s
☌ n.f. * 9′ 45″

At 14h 37½m
☌ foll. * 25s
☌ n. of * 11′ 30″

At 14h 52m 30s
☌ foll. * 27½s

At 14h 55m 30s
☌ slightly north of * b

At 15h 0m 30s
☌ differs 9′ 45″
equally in declination from b and c

At 15h 2m 30s
☌ follows * 30s

19	37.0
15	3.2
4	33.8
12	27.7
2	35.5

2°	43.3
	1.5
2°	41.8
1	37
4	19

15	3.2
1	7.5
16	10.7
	30
16	40.7
13	
3	40.7

50.5) 431 (8.5

5) 220.7 / 44.1

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Original record of comet observations, see two preceding pages.

Comet a rather diffused nebulosity, 6' wide condensed on the north preceding side, but without any very distinct nucleus even in the principal telescope

R.A. 15h 16m
Dec. + 30s
both determinations
than last
R.A. 15h 13m
Dec. on a parallel with c
2½ square north of c
a about 19' 30"

70
78
30
11
19h 30m 43.3
28.8
14.5

Comet, 18s about
J. Clark at

15h 22m

8.75
8.175
2.119
19.69
6.0
4.140

22½
13
35½
11.67
2.07
8.75

1
8

3 50
1 52 5
8 45

9.7
4.44
7.31
186

1 37
2 45

4 22
2 40
24) 262
11'

Duplicate observations
made by different observers
a as by the chart 17h 15m, 2½ No. 3302 Argelander
b " " 17 12½, 2¾ No. 3295
c " " 17 13½, 2¾ No. 3298

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Copy by A.B. Gibbs of a list made out in 1875 by A. Searle.

Catalogue of Small Apparatus found in the Dome, September, 1875.

A sliding tail-piece, provided with a clamp and fine tangent screw, fits into the small end of the tube of the East Equatorial, and is a permanent part of that instrument. Into this tail-piece may be screwed either of the following pieces:

1— The old filar micrometer. (Heavy instrument with two inclined tubes for wire illumination. It has a wooden stand to carry it when not in use)

2— Adapter for micrometer eye-pieces (Small brown and black instrument with two rack and pinion movements)

3— The new position circle. (Heavy graduated circle with two opposite clamps) Clamp at outer end to bind sliding tubes.

4— The adapting piece for sliding tubes (Large slit tube with screw to fit tail-piece, and screw clamp to bind any sliding tube) Marked with one notch on inner end of tube and one on shaft of clamp screw.

5— Focus adjuster for sight-seeing (Plain tube, screw thread inside outer end, movable by rack and pinion in larger tube with screw to fit tail piece, and clamp to bind inner tube when desirable) The clamp when loosened, is

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removable, The shaft of its screw is marked with two notches, close together. Same mark put on inner edge of inner (movable) tube.

6— Adapting piece for plain eye-pieces (Flat saucer-shaped piece* with screw to fit tail piece on inner end and screw thread inside outer end) Marked with three notches close together on inner edge of inner end.

7— Large eye-piece, four inches long to junction of eye lens; field lens over two and one half (2½) inches across, cracked, but serviceable. Power not known. Field about 25', as appears from measures for value of micrometer divisions, Sept. 9-1875. The adapting piece with screw to fit tail-piece, is not readily separable from the eye-piece. There is a small sliding piece in tube between lenses to carry a micrometer of any kind

8— Ring micrometer eye-piece. No. 1; power said to be 103 (no ring at present); the adapting piece is separable, and marked with notches v vvv v on the outer end. In this adapting piece slides a tube marked v vvvv v on the inside end; the eye-piece screws into the outer end of this tube.

9— Ring micrometer eye-piece No. 2; power said to be 172 (glass plate now in adapting piece with a coarse ring and some fine lines) Construction like (8); adapting piece marked vv vvv vv on outer end; sliding piece not readily separable and left unmarked.

*10— Ring micrometer eye-piece No. 4; power

* See also No. 71, page 113.

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said to be 373; the (separable) adapting piece has a ring of the ordinary kind, which will serve to distinguish it.

Into (1) and (2) may be screwed any of the micrometer eye-pieces, as follows;

11 — Power No 1. (so-called) power said to be 141, field 12'. Separable adapting piece, screwing into micrometers, marked VV VV on outer end; separable sliding tube within this, marked VV VVV on inner end; the eye-piece screws into its outer end.

12 — Power No. 2 (so-called); power said to be 206, field 9'. Separable adapting piece, screwing into micrometers, marked VV V VV on outer end; separable sliding tube within this marked VV V VVV on inner end; the eye-piece screws into its outer end.

13 — Power No. 3 (so-called); power said to be 316, field 7'. Construction as in (11) and (12); marks of adapting pieces VV VV VV, of sliding piece VV VV VVV

14 — Power No. 4 (so-called; power said to be 401, field 7'. Construction as in (11) and (12); mark of adapting piece VVV VVV, sliding piece not marked.

15 — Power No. 5 (so called); power said to be 688 field 3'
16 — " " 6 " " " " " 861 " 2'
17 — " " 7 " " " " " 1243 " 2'
18 — " " 8 " " " " " 1561 " 1'
19 — " " 9 " " " " " 2004 " 1'

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Note: (15) (16) (17) (18) (19) have separable adapting pieces like (11) (12) (13) (14) but so small as not to be readily marked with notches. They were marked with ink some time ago, sufficiently to distinguish them.

Into (3) and (4) may be slid either of the following pieces:

20— Solid tube 6 inches long, screw thread on outside of outer end. Marked V VV on inner end.

21— Tube like (20), but about 2½ inches long; marked VV V on inner end.

22— Diagonal finder. Large reflecting prism moovable by rack and pinion along a lateral tube perpendicular to the main tube. Mark unnecessary.

Into (5) may be screwed either of the following pieces:

23— Tube 4 inches long; screw thread near outer end. Marked V VVV on inner end.

24— Tube 3½ inches long; screw thread close to outer end. Marked VVV V on inner end.

25— Tube 2½ inches long, with two parallel slits connected by a third; screw thread close to outer end. Marked VVV VV on inner end.

Into (6) may be screwed either

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of the following pieces:

26 — Adapting piece for small eye-pieces. Shaped somewhat like (6), but very small. Marked v vv v on inner edge of inner end.

27 — Eye-piece with cross wires between lenses. Probably that called plain eye-piece No. 2; power said to be 333

28 — Eye-piece with diaphragm between lenses; no cross wires. Probably that called plain eye-piece No. 3; power said to be 505.

Into (26) may be screwed either of the following pieces;

29 — Eye-piece about 1 inch long, apparently that called plain eye-piece No. 4; power said to be 767.

30 — Eye-piece about 0½ inches long, apparently that called plain eye-piece No. 5. power said to be 1118. ~~(Plain eye-piece No. 5, power said to be 1118, was not found unless it was one of the two preceding in which case one of the lower powers is lost.~~ Eye-piece found in the West dome, ~~(West)~~ Sept. 15, 1875, seems to be No. 1. of this set ~~; each of those above is probably of higher power than at first supposed~~;

To (20) or (21) may be attached either or both at once of the following pieces;

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31— Box 3 inches across, 1½ inches deep, 4 holes in cylindrical surface for throwing in illumination; screw thread inside inner end to fit (20) or (21), screw thread inside outer end same as inside tail-piece of telescope.

32— Tube with 3 slits, 2½ inches long, sliding into (20) or (21), with coarse screw thread inside outer end. Marked v vv vvv on inner end.

To (22) may be attached the following pieces:

33— Spectroscope with box for prisms curved on one side, straight on the other sides. Screw thread on inner end to fit outer end of (22)

34— Spectroscope with cylindrical box for prisms. Screw thread on inner end to fit outer end of (22). ~~11 to 19 inclusive. These eye-pieces fit the lateral tube of (22)~~ 11 to 19 inclusive. These eye-pieces fit the lateral tube of (22).

To (24) may be attached:

35— Tube 4 inches long, with screw thread same as that of (32) inside outer end. Marked v vvv vv on inner end, which slides into (24). ~~53, 78, 79, 81, see pages 110, 114.~~ 53, 78, 79, 81. See pages 110, 114.

To (25) may be attached:

36— Tube about 2½ inches long, with screw thread same as that of (6) inside

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outer end. Marked vvvv on inner end, which slides into (25)

To (31) may be attached:

2 & 6 to 10 inclusive. [(1) and (3) are so heavy as to be best attached directly to the tail-piece; (4) would probably be used to put on (31); if (3) were used to put on (31) (4) might be attached to it; (5) projects too far beyond screw thread to be put on (31).]

To (32) or (35) may be attached:

37—— Adapting piece for micrometer eye-pieces. Coarse thread on outside of inner end; fine thread on inside of outer end. Marked v vv vv on inside edge of inner end.

38—— Adapting piece for small eye-pieces of brass telescope now mounted as finder of Equatorial. Coarse threads outside of inner end and inside of outer end. Marked v vvv vvv on inside edge of inner end.

39—— Third adapting piece. Tube about 3 inches long, with coarse thread outside near outer end. Marked v v vv on inner end.

40—— Terrestrial eye-piece of brass-telescope (finder of Equatorial) About 18 inches long.

41—— Large eye-piece of brass telescope, about 5 inches long.

42—— Micrometer frame of brass telescope (Small rectangular micrometer frame.)

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To (36) may be attached:
26 to 28 inclusive.

To (37) may be attached:
11 to 19 inclusive.

To (39) may be attached:
43 ___ Tube about 3 inches long, with thread same as (38) on inside of outer end. Slides into outer end of (39) Marked VV V V on inner end.
44 ___ Tube about 2½ inches long, sliding into outer end of (39), with milled head on outer end. No screw thread. Marked VV VV V on inner end.
45 ___ Duplicate of (48). Marked VVV V V.
For triplicate of (43) & (45) see page 113.

To (38), (43), or (45) may be attached:
46 ___ Eye-piece about 3½ inches long. Field-lens projects beyond tube. There is a tube about 4 inches long apparently intended as a case for this eye-piece when not in use, into which it can be screwed. This case is marked V V VVV at end farthest from the screw threads.
47 ___ Eye-piece a little over 1 inch long; figure (6) scratched upon it
48 ___ Eye-piece 1 inch long; figures 113

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(probably the power when used with the brass telescope) engraved and (3) scratched upon it

49— Eye-piece under 1 inch long; figures 200 (probably the power when used with the brass telescope) engraved, and (2) scratched upon it

50— Eye-piece 1 inch long; figures 150 scratched upon it. It does not fit well in the threads of (38), (43), or (45) but seems to belong to the same set of eye-pieces with (46), (47), (48), and (49).

See also (73), (74) & (75), page 113.

To (42) may be attached;

51— Eye-piece about 1½ inches long, with cross wires beyond field-lens.

~~Five foot brass telescope (at present, finder of East Equatorial)~~

Five foot brass telescope (at present, finder of East Equatorial).

The tail-piece of this telescope is moved forward and back by a rack and pinion. Into this tail-piece may be screwed:

52— Adapting piece for sliding tubes. Tube about 2½ inches long, with fine screw thread on inner end, so much worn that it cannot be screwed up snug. Clamp at outer end to bind sliding tubes; this clamp comes off when its screw is loosened. Outer end of tube, and shaft of clamp screw, marked VV VVV V.

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To (52) may be attached:

53 —— Tube 8½ inches long, with screw thread inside outer end same as in (32) or (35) Marked VVV V VV on inner end.

(35) [(32) is too thick]

(78), (79), (81); see page 114.

To (53) may be attached:

37 to 42 inclusive.

Bowditch Comet-Seeker:

This instrument has no movable tail-piece. It has a clamp to bind either of the sliding tubes;

54 —— Length 5¼ inches; narrow rectangular opening near outer end; strengthened inside with rings. Marked VVV VV V on inner end.

55 —— Length 5¼ inches; marked VVV VV VV on inner end

Into either (54) or (53) may be screwed:

56 —— Large eye-piece, about 4 inches long, with projecting field-lens. It fits (54) better than (55)

57 —— Eye-piece about 3 inches long.

58 —— Adapting piece shaped like (6). Marked VVV V VVV on outer edge of Leaden plate attached to its inner end.

83. —See page 114.

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~~(58). See page 114~~

To (58) may be attached:
26 to 28 inclusive.

Three foot wooden telescope (bought of G.M. Searle) Into the small end of the tube may be slid:

59 ____ Tube about 7 inches long; screw thread inside outer end. Marked VVV VV VVV on inner end.

Into (59) may be screwed:

60 ____ Eye-piece about 4¼ inches long, with two opposite screws projecting into field between lenses.

61 ____ Adapting piece. Tube about 2½ inches long, with screw thread outside at outer end. Marked VVV VVV V on inside end.

Into (61) may be slid

62 ____ Tube about 2½ inches long, with screw thread inside outer end. Marked VVV VVV VV on inner end.

63 ____ Tube about 7 inches long, with diaphragm near outer end, and screw thread inside outer end. Marked VVV VVV VVV on inner end. This tube does not fit tight into (61), but its screw thread seems to be like that of (62) (It was af-

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wards found to belong to Quincy Comet-Seeker: see page 114

Into (62) or (63) may be screwed:

64 —— Eye-piece about 0½ inches long.

65 —— Eye-piece about 1 inch long; field-lens missing. This eye-piece fits (63) better than (62). It evidently belongs to the Quincy Comet-Seeker; see page 114.

Additional pieces found in Rome September, 1875 and marked, the use of which was not ascertained.

66 —— Adapting piece like (6) and (38). Its outer end will take (26) to (28), as (6) and (38) will but its inner end fits some instrument smaller than the East Equatorial or the Bowditch Comet-Seeker but larger than the brass telescope (finder of Equatorial) Marked v vvvv on inside edge of inner end. [This was found in 1876 to belong to the old finder of the East Equatorial, now kept by Prof. Lovering.]

67 —— Piece like (37) with same sized coarse thread on inner end; but micrometer eye-pieces do not fit outer end well. Marked vv vvvv on inside edge of inner end.

68 —— Piece like (67); thread of outer end not quite like either (37) or (67). Marked vvv vvvv on inside edge of inner end.

69 —— Adapting piece for sliding tubes;

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about 2¼ inches long; screw thread at outer end. Marked VVVV V on inside end.

70 —— Adapting piece for sliding tubes; about 1¼ inches long; screw thread near inner end. Marked VVVV VV on inside end.

Found in West Dome, Sept. 15, 1875, an eye-piece which seems to be ring micrometer eye-piece No. 3.; should come between (9) & (10) of this list.

71 —— Construction like (9); no ring; power said to be 229; marked VV VVV VVV on outer end of adapting piece

~~Other apparatus~~ ~~Besides eye-pieces~~ found in West Dome, Sept. 15, 1875:

72 —— Triplicate of (43) & (45); marked V VVVV VV on inside end

73 —— Eye-piece fitting (38), (43), (45), or (72), 166 engraved & (1) scratched on it.

74 —— Eye-piece fitting (38), (43), (45), or (72), 295 engraved and (2) scratched on it.

75 —— Eye-piece fitting (38), (43), (45), or (72) 3 scratched on it.

76 —— Eye-piece without field lens, 2 inches long: apparently that called plain eye-piece No. 1, power said to be 222.

77 —— Slit-tube about 4¼ inches long; screw thread on outside of outer end; may be attached to the tail-piece of the East Equatorial but not to (31); marked VVVV VVV on inner end; will receive (33), but not (32).

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78 ___ Tube 9 inches long, same size as (35) or (53), same sized screw thread inside outer end as (32), (35); or (53). Marked vvvv vvvv on inner end.

79 ___ Tube about 11 inches long, same size as (35), (53) or (78); screw thread outside outer end. Marked v vvvv vvv on inner end

80 ___ Black cylindrical box containing reflecting prism. Screws over (79) and will receive eye-pieces (46) to (50), (73), (74), (75), but does not hold well; the threads being almost gone.

81 ___ Tube about 7 inches long, size of (35), (53), (78), or (79). Contains transparent reflector for observation of sun. Lateral tube will receive eye-pieces (46) to (50), (73) (74), (75). Marked v vvvv vvvv on inner end.

82 ___ Adapting piece for ring micrometer eye-pieces, Inner end screws into (32), (35), (53), (78). Sufficiently marked by two opposite notches ∨ ∨ in inner end.

Found in Dome, Sept. 16, 1875.

83 ___ Conical leather-covered diagonal eye-piece fitting (54) or (55).

The Quincy Comet-Seeker has a good object-glass, of about 2½ inches aperture and about 26 inches focal length. It has an old battered wooden tube about two feet long, and a brass tail-piece, meant to be fastened to the tube

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by short screws). The tube (63) fits this tail-piece. The eye-piece (65), without field-lens, seems to be the only one now here belonging to the Quincy Comet-Seeker. Eye-piece (64), which is a negative one, does not come to a focus when (63) is pushed into the tail-piece as far as it can go.

(See next page)

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List of Marks.

Mark	Number in preceding list of apparatus	Mark	Number in preceding list of apparatus	Mark	Number in preceding list of apparatus
V	4	V VVV V	8	VVV VVV V	61
VV	5	V VVV VV	35	VVV VVV VV	62
VVV	6	V VVV VVV	38	VVV VVV VVV	63
VVVV	36				
V VV	20	V VVVV V	8		
V VVV	23	V VVVV VV	72		
V VVVV	66	V VVVV VVV	79		
		V VVVV VVVV	81.		
VV V	21				
VV VV VV VVV	11	VV V V	43		
		VV V VV VV V VVV	12		
VV VVVV	67				
VVV V	24	VV VV V	44		
VVV VV	25	VV VV VV VV VV VVV	13		
VVV VVV	14				
VVV VVVV	68				
		VV VVV V	52		
VVVV V	69	VV VVV VV	9		
VVVV VV	70	VV VVV VVV	71		
VVVV VVV	77				
VVVV VVVV	78	VVV V V	45		
~~V V~~		VVV V VV	53		
V V VV	39	VVV V VVV	58		
V V VVV	46				
		VVV VV V	54		
V VV V	26	VVV VV VV	55		
V VV VV	37	VVV VV VVV	59		
V VV VVV	82.				

(See next page)

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To put micrometer eye-pieces on East Equatorial use either of the following connections:

(1) ; (2) ; (3) or (4) , (20) or (21) , (32) , (37) ; (3), (20) , (31) , (2) ; (3) , (24) , (35) , (37) ; (77), (35) , (37) ; (77), (78) , (37).

To put plain eye-pieces on East Equatorial, either (6) ; (3) or (4) , (20) , (31) , (6) ; (5) , (25) , (36) ; for high powers (26) must be inserted after (6) or (36).

To put ring micrometer eye-pieces on East Equatorial either nothing or (4) , (20) , (31) ; (3), (20), (31), may be used except with (7). Also (77) , (35) , (82) ; (77) (78), (32) etc.

To put eye-pieces of finder on East Equatorial, either (3) or (4) , (20) or (21), (32) ; (5) , (24) (35) ; for high powers (38) or (39) with (43) or (45) must be inserted after (32) or (35).

To put micrometer eye-pieces on finder:
(52), (53), (37) ; (52), (35), (37).
To put ring ~~micrometer~~ eye-pieces on finder:
(52), (53) or (35) or (78) , (82).

To put plain eye-pieces on Bowditch Comet-Seeker:
(54) or (55), (58).

To put ring micrometer, micrometer, or finder

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eye-pieces on West Equatorial:

(77) will slide into the tail-piece*, when the spectroscope is removed or turned aside; (35) or (78) or (81) will slide into (77). Ring micrometer eye-pieces may be put on to (35) or (78) by (82); micrometer eye-pieces by (87); finder eye-pieces by (28) or by (39), (43); or (77), (81).

* The tube here called the tail-piece is connected with the bar to which the spectroscope is attached. When this bar is taken off, the tube must be detached with it, and the outer tube (in which it is fixed by ~~screws~~ a ring screwed upon it at its further end) is of course too large for (77).

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List of some pieces of Furniture belonging to Harvard College Observatory June, 1876.

1. Cot bed, mattrass, and comforters, in East Wing (dwelling-house); bought in 1875.

2. Two large cases, with cupboards right and left, drawers between, and pigeon-holes above. [One in the entry of the Pearce Tower, one in the south room in the upper story of the West Wing.] At the Observatory before 1866.

3. Three large chests of drawers, with shelves above. [Two on the south side of the East Transit Room; one of these has some pigeon-holes above the drawers, the other has a cupboard on the right, drawers on the left. The third is in the north room on the first floor of the West Wing.] At the Observatory before 1866.

4. Two chests of drawers, with a few pigeon-holes above. [One in the East Wing (dwelling-house), up stairs, the other in the northwest corner of the East Transit Room, supporting a set of pamphlet shelves.] At the Observatory before 1866.

5. Large oval table in south room of lower floor of West Wing. At the Observatory before 1866.

6. Large oblong table in Clock Room, bought 1874, Jan. 8.

7. Large extending table bought 1872 July 12, for prime vertical room; now in kitchen of East Wing.

8. Large table in south room of upper story of West Wing. [The top of this is part of ~~an~~ a desk belonging to Professor Winlock, which was repaired at the expense of the Observatory, the top being taken in exchange for part of the cost of repairs (see the letter-press, p. 134), and mounted on trestles at the expense of the Observatory.

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9. Small oblong table in Clock Room, bought for "optical room" Feb. 19, 1873.

10. Round table in South room in upper story of West Wing, bought Oct. 9, 1873, for spectrometer.

11. Small cheap oblong table supporting relay and sounders in East Transit Room, bought Sept. 25, 1869.

12. Unpainted table in upper entry of West Wing, supporting letter-press, made about 1872.

13. Stand for large micrometer in south room in upper story of West Wing, bought ~~Dec. 24~~ Jan. 5, 1870, (called a ~~stand~~ press stand). A cover for the micrometer, made at that time, is now missing.

14. Large standing desk, with drawers, in the Clock Room, bought Oct. 21, 1874, (see Professor Winlock's account with the Observatory.)

15. Small desk, with drawers and pigeon-holes, in the Clock Room; this perhaps belonged to the Observatory before 1866.

16. Book-case, with desk, pigeon-holes, and drawers, in the Clock Room; bought Sept. 28, 1869, of G. M. Searle.

17. Soapstone stove in Clock Room, bought Aug. 27, 1874, of A. Searle.

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18. Large chest of drawers in lower south room of West Wing; bought June 6, 1870; this supports a small chest of drawers for library catalogue, bought Sept. 12, 1874.

19. Large stand with slate top in lower south room of West Wing; for use with the "occultator" which stands on it. The slate came with the occultator, probably.

20. Rough table in cellar of West Wing; work-bench there also.

21. Stand with marble top used in recording observations with the meridian circle; is this the "writing stand" bought Dec. 20, 1871?

22. Large painted steps, with rollers, in large dome, used in equatorial observations; probably there before 1866.

23. Two step-ladders, bought in 1874.

24. Two pair "chest steps", (short) used in dome, etc.

25. Book-shelves Nos. 1 to 84 in lower south room of West Wing.

26. Book-shelves Nos. 201 to 235 in upper entry of West Wing.

27. Book-shelves Nos. 501 to 546 in the Prime Vertical Room.

28. Pamphlet shelves Nos. 801 to 854 in the East Transit Room.

29. Pamphlet cases Nos. 1001 to 1029 in the East Transit Room, and a few others without numbers there and in the Prime Vertical Room.

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30. Letter press in upper entry of West Wing. Brought to the Observatory by Professor Winlock; left there in consideration of payment by the Observatory for repairs and alterations of Professor Winlock's large desk.

31. Book-shelves, not numbered, in entry of Sears Tower; others in cellar of West Wing.

32. Celestial globe in large dome, in use before 1866.

33. Blank globe now in upper south room of West Wing, bought Nov. 27, 1868.

34. Stuffed library chairs; one with arms and eleven without.

35. Three cane-seat chairs with arms (in dome clock room & south upper room of West Wing)

36. One easy-chair, with separate leg rest; all of rattan; bought July 31, 1874; (see Professor Winlock's account with the Observatory).

37. Settee in rotunda below large dome of Sears Tower.

38. Wooden chair with arms; one or two stools.

39. Shelves (fixed to the walls, and hence perhaps not to be included in this list) in closet on upper floor of West Wing (containing pier of West Equatorial), and eight boxes with handles for holding stock of copies of Annals of the Observatory.

There are 5 other shelves fixed in the cellar of the West Wing.

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40. Five long boxes, (formerly used in chronometric expeditions?).

41. Two camp-stools in dome.

42. Short steps in West Dome.

43. Observing couch formerly used with East Transit Circle.

44. Stand with three legs, now in East Transit Room; a ~~two~~ desk sometimes placed upon this stand may or may not belong to the Observatory.

45. Small lathe, (in room over entry of Sears Tower?)

There are metal plates for numbering the library shelves which may hereafter be put up, with the following numbers: 85 to 100, 236 to 250, 546 to 550, 855 to 900: also a few separate metallic numbers.

In above list, for bedstead, see No. 1.
" cupboards, " Nos. 2, 3.
" drawers, " " 2, 3, 4, 14, 15, 16, 18.
" pigeon-holes, " " 2, 3, 4, 15, 16.
" tables & stands, " " 5, 6, 7, 8, 9, 10, 11, 12, 13, 19, 20, 21, 44.
" shelves, " " 3, 4, 16, 25, 26, 27, 28, 31, 39.
" desks, " " 14, 15, 16, 44.
" steps, " " 22, 23, 24, 42.
" chairs, " " 34, 35, 36, 37, 38, 41, 43.
" boxes, " " 39, 40.
" globes, " " 32, 33.
" {stove, pamphlet cases, letter-press} " 17, 29, 30.
" work-bench, lathe, " " 20, 45.

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The statutes of the Observatory (see p. lx of the first volume of the Annals) require a list to be kept at the Observatory of the instruments and books purchased from the Phillips Fund.

No such lists are known to exist at present, June, 1876.

As there are no accounts at the Observatory of the expenditure from the Phillips Fund before 1866, it will be necessary, if the list contemplated by the statutes is ever formed, to examine the old accounts which are probably to be found at the office of the College Treasurer.

For the period subsequent to the beginning of Professor Winlock's term of office, an account of the expenditure from the Phillips Fund exists at the Observatory (except that the surplus income of the fund for the years between 1865 and 1868 was to some extent reserved and spent upon instruments without any record except that at the office of the College Treasurer). It is known that one of the three lenses used in the Meridian Circle and its collimators was bought at a cost of $1120 from the surplus of the Phillips Fund reserved in 1867, and that about $600 more came from the same source for spectroscopic apparatus. These two items are probably the only ones of importance not recorded at the Observatory since 1865. Similar items may have been omitted after 1868, but probably no large ones.

On the following pages will be found extracts from the Observatory account of the Phillips Fund, showing its expenditure for books and instruments. The full titles of the books may be referred to in the library catalogue and book of entries.

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Expenditure from Books

1866 July 8.	Berlin Jahrbuch for 1868	$3.58	
	Silliman's Journal	1.00	
	5 vols. Todhunter's Works	20.93	
	Tait & Steele's Dynamics	4.75	
	Todhunter	2.03	
	Weale's Series 4 vols.	1.80	
	Fonctions Elliptiques	2.50	
	Nichols, Cyclopaedia	10.50	
	2 vols. Todhunter's Works	4.25	$51.34
Sept. 13.	Fitzroy's Weather Book	$7.50	
	Puckle's Conic Sections	3.50	11.00
1867 Jan. 11.	Rankine's Rules	$4.25	
	Ferguson's Electricity	2.25	
	Proctor's Handbook of the Stars	2.75	
	British Nautical Almanac 1869	1.75	11.00
Jan. 29	Silliman's Journal 1866		6.00
May 26	Math. & Astr. Memoirs from the Phil. Trans. 1828 to 1857; and Berlin Academy Star Charts,		10.40
June	Duhamel, Cours de Méc.	$6.50	
	Jamin, Cours de Physique	5.00	
	Duhamel, Cours d'Analyse	4.50	
	Berlin Jahrbuch 1867	5.00	
	Poggendorf, Handwörterbuch	24.25	
	Phipson, Meteors,	2.50	
	Herschel's Lectures	2.25	
	Chambers, Astronomy	9.50	59.50
	Carried up		$249.24

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Phillips Fund on Instruments.

1866 June 23.	2 lamps	$30.00
July 8. (approved)	Repairing clocks and chronograph	110.00
June 16	" telescope	24.50
Aug. 15.	Electrical materials	13.94
March 5 to Aug. 17.	Repairing micrometer, etc.	42.00
1867 Jan. 11	Rain gauge	8.84
Jan. 11	Gas cock, Equatorial, $3.80 Galvanic connections 2.00 Hooks for transit circle 1.00	6.80
Jan. 11	Two lamps for telescope $12.00 Repairs & supplies of clocks and chronograph 24.58	36.58
June 20	Rumkorff Coil	286.86
Jan. to June	Repairs and supplies of clocks and chronograph	32.17
	Star, Spectrum apparatus & thermometers £29 10/6 about	200.00
Aug. 19	Frodsham Clock	843.32
	Carried up	$1635.01

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Expenditures from Books

		Brought up	$249.24
1867, Feb. to July.	Wild, Selbstreg. Met. Instr. in Bern		
	Astr. Nachr. Index vols. 41–60		45.82.
	Schrön, Logarithmen		
	Egrl, Repertorium, 3 vols.		
Sept. 27.	Same bill as above, repeated with one addition:		
	Rillen auf dem Monde		1.96
1868 March 2.	Silliman's Journal, 1867		6.00
1867 Sept. 14.	Argelander, Astr. Beobachtungen		6.36
June to 1868 Jan.	British Naut. Almanac	$1.50	
	Whitworth's Geometry	1.50	
	Mayn's Astronomy	6.30	
	Cambridge Philosophy	12.00	
	Berlin Jahrbuch 1870	5.00	32.30
1868 Jan. 4.	Astr. Nachr. Vols 69, 70,		11.66
June 29.	Watson's Theoretical Astronomy, 2 copies,		15.00
July 24.	Simms on Rain		1.00
Aug. 26	Brande's Dictionary, 3 vols.		28.75
	Amount carried up		$397.59

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Phillips Fund on Instruments

		Brought up	$1635.01
1867	Aug. 27.	Pier for clock	156.38
	June to Dec.	Electrical supplies	33.15
	Aug.	Repairs of barometer & thermometer	17.00
		Spectroscopic apparatus (see page 141)	600.00
		Eight-inch lens (see page 141)	1120.00
1868	April 21.	Chronometer Frodsham 3424	171.67
		Repairs	37.12
	May 26.	Repairs and materials for chronograph	36.00
	June 29.	Repairs of barometer $ 33.00 Soapstone trough 12.00	45.00
	July 2.	Case for sidereal clock	58.60
	Aug. 26.	Specimens of metals, thermometer, anemometer,	82.71
	Aug. 27.	Repairs and alterations (Equatorial)	112.00
	Aug. 28.	Battery supplies, etc.	35.50
	Aug. 29.	Gas pipes, etc.	13.60
		Amount carried up	$4153.74

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Expenditure from Books

		Amount brought up.	$397.59
1868 Dec. 29.	Johnson's Family Atlas		17.50
1869 Jan. 4.	Herschel's Outlines of Astronomy	$2.25	
	Price's Calculus, 4 vols.	28.35	
	Loomis' Astronomy	1.75	
	Godfray's Astronomy	13.25	
	Merrifield's Nautical Astronomy		45.60
Jan. 14.	Argelander, Astr. Beobacht. Vol. 7		
	Dumoiseau, Tables des Sat. de Jupiter		
	Hansen, Auseinandersetzung, Part 3,		
	Bauernfeind, Vermessungskunde,		
	Brasack, Luftspectrum		
	Account of Principal Triangulation, 2 vols.		39.02
Feb. 27.	Silliman's Journal, 1868,	$6.00	
	Astronomische Nachrichten, Vols. 71, 72, 73,	18.83	24.83
April 28.	Farmer's Almanac	$0.25	
	Parkinson's Optics	4.75	
	Frome's Surveying	6.00	
	Guillemin's Heavens	9.45	
	Webb's Cel. Objects for Com. Telescopes	3.37	23.82
June 26.	American Year Book, 1869,		4.00
	Amount Carried up		$552.36

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1870phae.proj..360T

Phillips Fund on Instruments

Amount brought up $1153.74

1868 Nov. 27.	Direct vision spectroscope	47.25
1869 Jan. 14	Chronograph supplies & repairs	9.50
Jan. 21	3-inch refracting telescope	70.00
Feb. 8	2 hypsometers, with registers & note-books; 1 solar thermometer; Specimens of metals; Aneroid barometer	112.69
Feb. 8 (From reserved fund)	Travellers' Transit Theodolite	137.95
Feb. 8 (From reserved fund)	Chronometer Frodsham 3451 £54 9/ o/c about	375.00
Feb. 9.	Electrical apparatus	68.25
March 29.	Electical apparatus	21.75
April 28.	Measuring glass	1.50
May 22.	Electrical apparatus	75.60
June 26.	Specimens of metals	3.71
	Amount carried up	$5076.94

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Expenditure from Books

Amount brought up $552.36

1869 June 26. Frome's Surveying, duplicate;
Huggins on Star Spectra
" " Chemical "
" " Nebulous "
" " " "
" " Neb. of Orion
" " Star in Corona Bor.;
Fischer, Geodäsie;
Phil. Transactions,
1860 — 1868;
Proceedings R. Society
Vols. 11 — 16; 353.77
Kirchhoff, Untersuchungen,
Part 2;
Crelle, Rechentafeln;
Kirchhoff & Bunsen, Charts;
Berlin Astr. Jahrbuch;
Stars, in Six Maps;
Carlini's Solar Tables;
Hoppe-Seyler, Spectr. Analysis;
Mathem. Annalen, 1869;
Roscoe, Spectr. Analysis
" , Translation of Part 2
of Kirchhoff's Untersuchungen;
Angström's Researches on the Spectrum

July 3. Berlin Astr. Jahrbuch, 1871, duplicate, 5.25

Amount carried up $911.38

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Phillips Fund on Instruments

		Amount brought up	$5076.94
1869 July 13.	Chronograph supplies & repairs	$11.25	
	Fitting up a pendulum	30.00	
	Altering Spectroscope	15.00	56.25
Aug. 30.	1 Timing Watch		30.00
Aug. 30.	Repairs of telescope		40.00
Aug. 30.	Alterations of telescope, micrometer, and spectroscope,		109.50
Oct. 27.	Portable Transit Instrument (from reserved surplus)		727.20
Oct. 29.	Indium		5.80
Nov. 24.	Five spectroscope prisms (from reserved surplus)		136.40
Dec. 28.	Repairs of telescope & spectroscope (including photographic lens)		112.50
1870 Jan. 4.	West Equatorial (from reserved surplus)		4135.00
Jan. 5.	Work on telescope & spectroscope		14.00
	Amount carried up		$6743.59

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Expenditures from Books

Amount brought up $911.38

1869 Aug. 30. Comptes Rendus (Paris) 1835–1863, Tomes 1–57; Lielegg, Gas Spectra; Helmholtz, Conservation of Force; 118.25

Sept. 27. Carl's Repertorium 10.08

1870 April 8. Richardson's Dictionary, 2 vols., 30.00

April 14. Grandeau, Analyse Spectrale;
Hansen, Berechnung der Störungen, etc., Part 2, 1862;
Annales Scient. de l'École Normale, IV;
Carl's Repertorium, Vol. V;
Comptes Rendus (Paris) Vols. 57–69;
Stars in six Maps, duplicate;
Chacornac, Atlas Eclipt., liv. 2, 3, 4;
Klinkerfues, (translation from Huggins);
Gauss's Works, Vols. II, III, V;
Mathem. Annalen, Vol. 2;
Comptes Rendus (Paris), 1870;
Verhandlungen der Leop. Car. Akad., Vols. 28, 29;
Beschreibung der Sonnenfinsternis 1715;
R. Society's Catalogue of Scient. Papers, Vols. I, II, III;
Berlin Astron. Jahrbuch, 1872;
Trans. R. Phil. Society, 1869, vol. I;
Memoirs Lit. & Phil. Soc. Manchester, 3d Ser. vol. 3;
Schellen, Spectral Analyse;
Carl's Repertorium, Vol. 6;
Lond., Edinb., & Dublin, Philos. Mag. 1870;
Winklt, Beiträge (Sinnestäuschungen);
Böhmer, Sinneswahrnehmungen;
Aubert, Physiol. der Netzhaut;
Schultze, Anat. der Retina;
Panum, Sehen mit 2 Augen;
Mädler, Reden und Abhandlungen;
Oppolzer, Lehrbuch zur Bahnbestimmung etc.;
256.53

Amount carried up $1126.24

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1870phae.proj..360T

Phillips Fund on Instruments

Amount brought up $6743.59

1870 Jan. 25.	Clock repairs		2.50
Jan. 28.	Timing watch	$30.00	
	Chronometer repairs	30.00	
	Battery supplies	6.00	66.00
April 1.	Battery		20.30
April 2.	Telegraph keys & sounders		33.00
April 11.	Work on electrical apparatus and spectroscope		9.26
April 26.	Solar spectroscope (from reserved surplus)		130.84
Aug. 30.	Repairs of telescope and electrical apparates		14.95
Sept. 28.	Battery & wire		9.80
Oct. 26.	Setting up Mer. Circle	$80.00	
	Two 8-inch lenses & collimator tubes	1304.00	
	Work on Dew cap, Mer. Circle	12.00	
	Repairs of spectroscope, (From reserved surplus)	42.00	1438.00

Amount carried up $8468.24

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1870phae.proj..360r

Expenditure from Books

Amount brought up $1126.24

1870 June 15. Astronom. Nachr., 1869; 10.65

Aug. 2. B. A. Catalogue;
Lond., Edinb., Dublin, Philos. Mag. 1860–1869;
Karsten's Encyclop. der Physik, Parts 1–20;
Classen, Schlussverfahren des Schadtes;
Kepler's Works, Vol. 8, Part 1;
Carnezer, Willensbewegung;
Delboeuf, Illusions d'Optique;
Phil. Transactions, Vol. 159, Part 2;
Secchi, Sugli Spettri Prismatici dei Corpi Celesti; 209.34

Aug. 30. Penrose on Occultations $6.00
Shortrede's Navig. Tables 3.00
Chauvenet's Spherical Astronomy 7.00
Loomis' Meteorology 1.75
Tait's Quaternions 5.00
Shortrede's Log. Tables 12.00
26 nos. "Nature" 3.12
Rankine's Civil Engineering 5.50 43.37

1871 Sept. 30. 31 nos. "Nature" $3.72
17 " " 2.04
Lockyer's Astronomy 1.50 7.26

Sept. 30. Am. Journal of Science, 1870, 6.00

Amount carried up $1402.86

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1870phae.proj..3601

Phillips Fund on Instruments

Amount brought up $8468.24

1870 Oct. 29.	Putting up vane and anemometer	$107.09	
	Part cost putting up Mer. Circle or Portable Transit	16.62	
	Chronograph supplies & repairs	57.50	
	Reflector for photography	25.00	
	Rain gauge funnel	4.00	
	Repairs to micrometer, spectroscope, etc.	15.00	225.21
1871 Sept. 30.	Tin tubes & reflectors for Meridian Circle		9.00
March 13.	Case for Portable Transit (from reserved surplus)		80.00
Oct. 4.	Gas fitting for Mer. Circle		40.69
Oct. 4.	Tin work for Mer. Circle		11.96
Oct. 5.	Brass work, etc., for Mer. Circle		103.77
Oct. 5.	Brass work, etc., for other instruments		17.97
Oct. 16.	Repairs and supplies of clocks and chronographs		93.00

Amount carried up $9049.84

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Expenditure from Books

Amount brought up $1402.86

1872 May 4. Delboeuf, 1re Note sur cert. Illusions d'Optique;
Guirandet, Notions d'Astronomie;
Thomae Theorie d. complex. Functionen;
Meyer, Vorlesungen über naut. Astronomie;
Berlin Star list (Scheinbare Oerter von 529 Sternen);
Bretel, Die Sternwarten;
Müller, Die Keplerschen Gesetze;
König, Theorie der Modular Gleichungen;
Nellmayer, Ein Project;
Oppolzer, Bahnbestimmung;
Oppolzer, Venusdurchgang;
Clausen, Werke, Vol. I;
Annalen d. Mathematik, Vol. III;
Philosph. Transactions, 1870;
Berlin Astr. Jahrbuch, 1873;
R. Society, Catal. Scient. Papers, Vol. IV;
Carl's Repertorium, Vol. VII;
Annalen d. Mathematik, Vol. IV;
Gaebich, Sonnenfinsterniss, 1868;
Weiss, Beobachtungen 18. Aug.;
Vierordt, Anwendung d. Spectralapparates;
Stuzmer, Argumententafel;
Leitzow, Zusammenkünfte der Planeten;
Schiaparelli, Theorie der Sternschnuppen;
Engelmann, Jupitersatelliten;
Secchi, Le Soleil;
Oppolzer, Bahn des Planeten Erato;
Zeffroid, Massenabs. d. Himmelskörper;
Thalén, Spectre d'Absorption;
Peters, Astronom. Tafeln;
Berlin Star List (Mittlere Oerter von 539 Sternen);
Moldenhauer, Axendrehung;
Secchi, Die Sonne, 2 vols.; 87.46

N.B. (Whole bill $89.46; charges for postage, etc., about $2, deducted here);

Amount carried up $1490.32

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Phillips Fund on
Instruments

Amount brought up $9049.84

1873 Jan. 25. Repairs of telescope,
spectroscope, etc. 17.79

Jan. 28. Reversing Mer. Circle
& setting piers for collimators $31.62
Electrical apparatus 78.00 109.62

Amount carried up $9237.25

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Expenditure from Books

Amount brought up $1490.32

1872 Oct. 23. Berlin Astr. Jahrbuch, 1874;
Zoellner, Natur der Kometen;
Goebel, Kepler's Anschauungen;
Respighi, Protuberanze Solari;
Mathem. Annalen, 1872;
Carl's Repertorium, Vol. VIII; 27.13

1873 Jan. 29. Spons' Dict. Engineering, $25.00
Heis' Atlas Caelestis 10.00, 35.00

Feb. 13. Vierteljahrsschrift der Astr. Gesellschaft, II Jahrg. I. Heft.;
Secchi & Schellen, Die Sonne, Vol. III;
Vogel, Bothkamp Observations, Vol. I;
R. Society's Catalogue of Scient. Papers, Vol. V;
Zenker on Comets;
Berlin Star List, 1872, (Mittlere Oerter von 539 St.);
Vierordt, Anwendung des Spectralapparates;
Memorie della Società degli Spettroscopisti Italiani, 1872, No. 8;
Klinck-Klukczyi on Comets;
Hoffman, Uebergang der Venus; 21.11

Feb. 14. Webster's Dictionary $9.50
84 nos. "Nature" 10.08
Klinkerfues, Theoretische Astron. 3.25
Proctor, Astronomical Essays, 4.50
Schellen's Spectrum Analysis 12.00, 39.83

(This bill contains a charge of $7.25 for treatises with unrecorded titles which may be regarded as paid from the Contingent Fund, since probably the Whipple income was overdrawn, and the balance charged to the Contingent Fund in the Treasurer's accounts.)

Amount carried up $1612.89

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1870phae.proj..3607

Phillips Fund for
Instruments

	Amount brought up		$9237.25
1873 July 7.	Alterations of Meridian Circle	$ 49.00	
" "	Spectroscopes		
	equatorial	131.00	180.00

Amount carried up $9417.25

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Expenditure from Books

Amount brought up $1612.89

1873 April 5. Astronom. Nachrichten, Vols. 76, 77, 78, 79, 80, 81, } 26.12

Sept. 26. Atlas of Cambridge $12.00
Spons' Dict. Engineering, Vol. 6, 5.00 17.00

Sept. 26. Budde, Kosmologie;
Mathem. Annalen, Vol. VI;
R. Society, Catalogue Scient. Papers, Vol. VI;
Hirn, Saturn's rings;
Nautical Almanac, 1870–75; 45.97
Berlin Astr. Jahrbuch, 1875;
Carl's Repertorium, 1873;
Lamont, Erdmagnetismus;
Walker, Terrestr. & Cosm. Magnetism;
Airy, Magnetism;

1874 Jan. 8. Maxwell, Electricity, $12.00
Popular Science Review, 0.50
"Nature", 1873 & 1874, 10.00 22.50

Feb. 16. Cordier, Insuccès en Photographie;
Schorr, Vorübergang der Venus;
Schranke, Wärmespectrum;
Kettler, Undulationstheorie;
Carrington, Observations of Spots on Sun; 31.70
Vogel, Bothkamp Observations, Vol. II;
Berlin Star List (Mittlere Oerter von 539 St.), 1873;
Thalén, Spectral Analysis;
Gauss, Werke, Vol. IV;

Amount carried up $1756.18

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1870phae.proj..3601

Phillips Fund for Instruments

Amount brought up $947.25

1873 Oct. 3. Repairs, East Clock, $160.00
Repairs & supplies for clocks & chronographs 88.25 248.25

Oct. 18. Covered wire 80.12

Nov. 1. Electrical apparatus 121.75

Nov. 14. Electrical apparatus $229.11
Chronograph wire 12.11
Part cost of chronograph No. 1, bought of W. A. Rogers, 119.90 361.12
(From reserved surplus)

1874 Jan. 8. Break circuit for time signals $50.00
Repairs & supplies for clocks and chronographs 14.48 64.48

Jan. 8. Repairs of telescope 36.70

Amount carried up $10329.67

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160

Expenditure from Phillips Books

Amount brought up $1756.18

1874 May 26. American Cyclopaedia (Appleton's) Vols. I, II, III, IV, 28.00

June 29. Proctor's Moon $5.00
Schwerd, Beobachtungen, 3.75
Proceedings R. Society, Vol. 17 to 21; } 52.64
Philosoph. Mag., Nos. 264 to 311; }
Comptes Rendus (Paris) Vols. 71-77; 39.70, 101.09

June 29. American Cyclopaedia (Appleton's) 2 volumes 14.00

July 11. Spons' Dict. Engineering, Parts 7 & 8, 10.00

Aug. 4. Mathem. Annalen, 1874;
Gauss, Werke, Vol. VII;
Dubois, Passages de Venus;
Carl's Repertorium, 1874;
Philosoph. Transactions, Vol. 161, part 2, Vol. 162 parts 1 & 2, } 55.14
Vol. 163, part 1;

Aug. 4. American Cyclopaedia (Appleton's) Vol. VII, 7.00

~~Sept. 12~~ Oct. 1. Church, Descriptive Geometry, } 6.00
Kohlrausch, Physical Measurements, }

Amount carried up $1977.41

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Fund on

Instruments

		Amount brought up,	$1032.9.67
1874 April 13.	Position circle for micrometric measures	$143.00	
	Adapting piece for spectroscope,	38.50	
	Repairs of micrometer & telescope,	53.25	234.75
July 11.	Merid. Circle lanterns	$24.63	
	Repairs, telescope & clock case	10.75	35.38
July 11.	Repairs, clocks & chronographs,		58.50
Aug. 29.	Part cost Meridian Circle, and eye-pieces,		231.58
Dec. 10.	Part cost chronograph No 1		100.00

Amount carried up $1089.88

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Expenditure from Books

Amount brought up $1977.41

1875 Jan. 5. Journal Franklin Institute $0.50
Boston Almanac 1.00
"Nature", 1875 6.00
American Cyclopaedia
(Appleton's), Vol. VIII, 7.00 14.50

Feb. 15. Astronom. Nachrichten,
Vols. 84, 85, $8.40
Am. Journal of Scien., 1874, 6.00 14.40

Feb. 27. Berlin Astr. Jahrbuch, 1876;
Lecoq de Boisbaudran, Spectres;
Berlin Star List (Mittl. Oerter v. 539 St.), 1874;
Behrmann, Atlas of Southern sky;
Mathem. Annalen, Vol. VIII;
Vogel, Spectra der Planeten;
André, Observatories, Parts 1, 2; 30.73

April 21. American Cyclopaedia
(Appleton's) Vols. IX, X, XI, 21.00

April 21. Jenkinson, Electricity $1.50
Thomson & Tait, Physics, 3.50
Pickering, Phys. Manipulation, 3.00
Thomson, Magnetism, 9.00
Telegraphic Engineering, 6.00 23.00

May 17. Philosophical Transactions, 1870, 1871;
Nasmyth and Carpenter, Moon; 38.34

Amount carried up $2119.38

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Phillips Fund on
Instruments

		Amount brought up	$10989.88
1875 Jan. 5.	Alterations in reversing Carriage of Meridian Circle		19.08
Jan. 7.	Part cost Chronograph No. 1		100.00
Jan. 14.	Repairs and supplies of clocks & chronographs		108.25
April 29.	Payment to complete purchase of Chronograph No. 1,		126.00
May 17.	Brass for repairs of telescope		2.18

Amount Carried up $11,345.39

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Expenditure from Books,

Amount brought up $2119.38

1875 June 12. Dien's Atlas Céleste 12.75

July 8. Brinkley's Astronomy $3.00
Rambosson's " 6.00
Encyclopaedia Britannica, 9th edition, Vol. I., 11.00
" " " " II., 11.00
Mätzner's English Grammar 8.00
Morris' " Primer 0.50 39.50

July 16. Stürmer, Sonnentafeln;
Berlin Stav Last, 1875, (Mitth. Centr. v. 539 St.);
Schorr, Venusmond;
Gauss, Werke, Vol. VI.;
Guillemin, Les Comètes;
Carl's Repertorium, 1875; 30.13

Aug. 13. Am. Journal of Science, 1875, $6.00
Back nos. of do. 1.50 7.50

Oct. 11. American Cyclopaedia
(Appleton's) Vols. XII, XIII, 14.00

1876 Jan. 1. "Nature", 1876, 6.00

Feb. 11. Berlin Astr. Jahrbuch, 1877;
Mathem. Annalen, Vol. IX;
Barnard, Metric Weights & Measures;
"Engineer", 1874, 1875; 40.66

Amount carried up $2269.92

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Phillips Fund on

Instruments

Amount brought up $11,345.39

1875 Aug. 11.	Repairing Chronometer Bond 236	$50.00	
	Regulator for North Clock	7.00	
	Chronograph pens and fittings	1.15	58.15

Amount carried up $11,403.54

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Expenditure from Books,

Amount brought up $2269.92

1876 March 10.	Argelander, Astronom. Observations at Abo, 2 vols.; 2 copies Gauss's Fünfstellige Logarithmische Tafeln;		9.12
March 17.	3 copies Tabulae Refractionum in usum Speculae Pulcovensis Congestae		3.00
April 3.	Encyclopaedia Britannica, 9th. editeim, Vol. 3,		11.00
April 17.	Watts, Index of Spectra		3.00
April 28.	Astronom. Nachrichten, Vol. 86, & duplicates of Vols. 80, 81, 82, 83, 84,		24.81

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Phillips Fund on Instruments

		Amount brought up	$11,403.54
1876 March 28.	Repairs of filar micrometer		150.00
April 28.	Nadir eye-piece, Meridian Circle, $7.04		
	Alteration of filar micrometer 3.50		10.54
June 5.	Two sets of spider lines		6.25

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