

42D CONGRESS, }
2d Session. }

HOUSE OF REPRESENTATIVES.

{ Ex. Doc.
No. 121.

REPORT OF THE SUPERINTENDENT

OF THE

UNITED STATES COAST SURVEY,

SHOWING

THE PROGRESS OF THE SURVEY

DURING

THE YEAR 1871.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1874

APPENDIX No. 14.

REPORT OF OBSERVATION OF THE ECLIPSE OF THE SUN OF DECEMBER 22, 1870, BY DR. C. H. F. PETERS, DIRECTOR OF THE LITCHFIELD OBSERVATORY OF HAMILTON COLLEGE.

DEAR SIR: I have the honor to report upon my participation in the observations of the solar eclipse of 22d December, 1870. When, on being appointed a member of the United States Eclipse Expedition to the Mediterranean, I received the gratifying order to accompany the party that, under your personal leadership, was to be stationed in Sicily, I beheld that, besides contributing my share in the astronomical observations, the particular duty came necessarily to me to bring to bear what knowledge of the country, acquired there by a longer sojourn in former years, might be furthering the purpose of the expedition. It is consoling to me that while, in the former, the scientific investigation, by a freak of the weather only a very partial success fell to my lot, for the rest, my company at least indirectly has been, as I hope, of some usefulness. This, however, for a great part, is owing to the characteristic hospitality and readiness to assist of the citizens of Catania. The names of some of the gentlemen who thus have been of special help to us I shall take the pleasure to mention below.

In the preliminary preparations at home I directed my attention to fit my apparatus with the purpose to permit ease and effectiveness for investigating the solar appendages by direct vision. The eclipse of August, 1869, as observed by myself and the members of my party at Des Moines, Iowa, had intimated so clearly a certain structural arrangement, both in protuberances and in corona, that a closer scrutiny of these phenomena seemed to me particularly desirable. I had at my position an excellent telescope of Steinheil, of four inches aperture, five feet focal length, the gift of Mr. Litchfield on occasion of the preceding eclipse. Its object-glass is of exquisite perfection; it has powers ranging from 40 to 300, and is equatorially mounted, with setting-circles and tangent-screw for right-ascensional motion. I had now made, in addition, (by Mr. Chubbuck, of Utica,) a slide, which holds simultaneously three of the eye-pieces, so that, by the touch a spring, the power may be changed from the lowest to the highest almost without loss of time and without fear of deranging the position of the telescope. Thus, when all the three eye-pieces are adjusted to focus, and an object is seen near the center of field through the lowest power, in less than a second the highest magnifying-power may be brought to bear upon it. The consideration that nebulae and gaseous bodies like comets usually reveal their various features only when viewed and examined under varied proportions between light and power, led me to expect much of the described arrangement in scrutinizing the luminous appendages of the sun.

Moreover, near to and at the side of the ordinary small seeker carried by the tube, (magnifying about nine times,) I had attached one of those beautiful little instruments called "hand comet-seekers" by Steinheil. The one in my possession, only six inches long, magnifying two and a half times, with an aperture of one inch, has a field rather more than 17° , which enables the observer to take in at one glance the whole of the eclipse-phenomena, even to the remotest rays of the corona.

These together, therefore, may be said to represent, upon one and the same equatorial stand, five separate telescopes, differing in power and extension of field. The small seeker alone had a sun-glass; a wedge of neutral tint could be applied to either of the three eye-pieces of the large tube for graduating the light according to circumstances.

The instruments were packed in four boxes, and went, with the other instruments of the expedition, from Liverpool by sea directly to Messina. As it was your wish that I might be early in Sicily to reconnoiter for the observing-stations, I left Clinton on October 29, and arrived at Liverpool on November 14. Then, after a few days' sojourn in London, where we conferred with

Mr. Lockyer and some of the other English observers, by the way of Southampton, Gibraltar, and Malta, I reached Catania on December 7. Here I had the pleasure of meeting Mr. Charles A. Schott, already arrived two days before; also the Italian observers were already on the spot, centered at Angosta, and Professor Cacciatore, director of the observatory of Palermo, and vice-president of the Italian commission, directed a greeting dispatch of welcome to the Americans on Sicilian soil, which was duly responded to in Mr. Schott's and my name.

The following days were spent in looking at localities in the neighborhood of Catania, where the instruments of the various observers might be established, and I extended my reconnoitering trips over the slope of Mount Etna, and as far as Lentini and Carlentini. The zone of totality (as indicated also on the accompanying sketch) covered the whole southeast corner of the island of Sicily, including Cape Passaro, its northern limit intersecting the east shore of the island a few miles north of Taormina. It would have been of some interest if observers could have been stationed along the whole coast from Cape Passaro to Taormina, forming a line nearly at right angle to the path of the moon's shadow, and extending nearly across the whole width of it. Various circumstances, however, combined to prevent this scheme. Transportation, especially in the southern part of the island, is still very difficult, no carriage-road leading to Cape Passaro or its surroundings. Already, for this reason, the more ponderous instruments were necessarily restricted to the neighborhood of the larger towns. Moreover, the photographic and spectroscopic apparatus, besides needing a longer accurate preparation and adjustment in a firm position, were to be stationed not too far from the central line of totality, in order not to have too much curtailed the duration of two minutes in maximum. Fortunately, there were the three towns of Angosta, situated very near the central line, and Syracuse and Catania, about half way from it to the southern and northern limits respectively. The Italian astronomers had established themselves at Angosta; at Syracuse was the party of the United States Naval Observatory; for our photographers, and as headquarters for time and latitude observations, the best opportunity was presented at Catania.

There remained the distribution of the portable telescopes for direct eye-observation, which, supplementing the spectroscopic investigation in this eclipse, it was hoped would essentially contribute to solve the enigma of the nature of the corona. Between English and Americans now united, there were on hand, prepared for this purpose, observers sufficient in number to attack the corona from stations situated more or less eccentrically across the whole zone of totality. A still more promising arrangement, however, seemed to be offered spontaneously by Mount Etna. Usually, this mountain becomes snow-covered, and ceases to be accessible beyond the "regione nemorosa" in the latter half of October. This year the mountain was quite exceptionally free of snow. I saw distinctly the Casa Inglese entirely free only two days before the eclipse. It seemed as if thus the mountain itself invited the observers. The idea of having a series of stations with lesser and lesser densities of atmosphere (at the Casa Inglese the barometric pressure is only 540^{mm}, or two-thirds of that on the level of the sea) was too tempting; it would put decisively at rest the question whether the corona is simply an effect of our atmosphere. Consequently, number of forces were dispatched for the slope of Mount Etna, arranged, so to say, upon the third co-ordinate—that of altitude. The highest point was reached by General Abbot, United States Engineers.

I have tried to represent in one view upon the accompanying sketch the final disposition of all the stations in Sicily as they were occupied by parties of the various nations co-operating. There may be placed on record yet, as near as I could ascertain, the names of the observers of each station.

I. ITALIANS:

Angosta.—Cacciatore, Secchi, Donati, Blaserna, Agnello, De Lisa, Photographer Tagliarini.
Terra Nuova.—P. Tacchini, Lorenzoni, Legnazzi, Nobile, A. Tacchini, Diamilla Müller, Serra.
Slope of Mount Etna, (in about 8,000 feet elevation.)—Count Schio.

II. AMERICANS:

Catania, (Garden of the Benedictines.)—Schott, Laue, Photographers Fitz, Chapman, Burgess.

Catania, (casino di St. Giuliano, elevation about 500 feet.)—B. Peirce, Superintendent, Charles Peirce, with Mrs. C. Peirce and Mrs. Parsons.

Carlentini.—Watson.

Monte Rossi, (elevation 3,200 feet.)—Peters, Eimbeck.

Slope of Mount Etna, (elevation 8,000 feet.)—General Abbot.

Syracuse.—The party of the United States Naval Observatory, Harkness, Hall, Eastman, and Mrs. Eastman.

III. ENGLISH:

Catania, (Garden of the Benedictines.)—N. Lockyer and Mrs. Lockyer, Seabroke, Cumming, Thorpe, Pedlar.

Angosta.—Adams, Burton, Clifford.

Near Villasmunda.—Ranyard, Samuelson, Brett.

Syracuse.—Brothers, Fryer, Griffiths.

Slope of Mount Etna, (Casa Terentina del Bosco, elevation 5,500 feet.)—Roscoe, Bowen, Harris, Darwin, Photographer Dr. Vogel, and Professor Silvestri of Catania.

I come now to report on my part taken in observing the eclipse. With your consent I located my station on the western top of the Monte Rossi di Nicolosi, on the identical spot that had formed a point in the triangulation of Mount Etna made years ago by Baron Sartorius von Waltershausen and myself. The immortal Gauss himself, for his own pleasure, in a leisure hour, had submitted our triangles to his theory of compensation, and derived the most probable values for the signal on Monte Rossi:

— 12776^m.051 north;
+ 6090^m.214 west;

counted from center of dome of the monastery of S. Nicola de' PP. Benedettini at Catania.

The geographical position of the latter place was ascertained by myself at the time, and has been redetermined by Mr. Schott on this occasion. The co-ordinates stated, when reduced into arc by means of Bessel's constants for the dimensions of the earth, will be—

6' 54".45 north, and

4' 8".18=16°.545 west of Catania;

and the elevation above the level of the sea we had determined trigonometrically at 948^m.7.

You allowed me the assistance of Mr. Eimbeck. We started from Catania early on December 21, and completed the last preparations at Nicolosi that same afternoon; in which was of much use to us the young Doctor Bonanno, a native of the place, who also gave us his company upon the mountain the following day. Nicolosi is the 14th village on the southern slope of Mount Etna, 707^m above the sea, whence to the top of Monte Rossi is about an hour's walk.

Mr. Eimbeck was provided with one of the Munich portable spy-glasses, (12 lines aperture, magnifying from five to six times,) and I used the telescope described above. Mr. Schott had given us one of the Coast Survey chronometers, (Sid. Chron. Hutton, No. 208,) which was compared at Catania immediately before and after the journey. Besides, in order to be independent of any change of rate the chronometer might suffer by transportation, it had been concerted between Mr. Schott and myself to exchange signals by flashes of light, as a sort of heliotropes, using a couple of common mirrors that were brought to reflect the sun's rays in the direction of our stations. The moments when the light was withdrawn by a sudden turn of the mirror were noted with our respective chronometers. The signals were given before the beginning of the eclipse. Though but few of them, as was found afterward, could be made use of, either on account of indistinctness or from uncertainty of identifying them or from want of correspondency, still, the precaution of a check proved of some value, as the rate of the chronometer of Monte Rossi really appears to have changed considerably.

The weather on the day of December 21 was fair, and promised a good success. In the afternoon, however, I was forewarned by my old friend, the venerable Dr. Giuseppe Gemellaro, the "guardian" of Mount Etna at Nicolosi, that the barometer was going down; and, indeed, toward evening clouds arose, the sky became overcast, and later it began to rain, storming during the night pretty heavily. The rain lasted still at 7 o'clock in the morning of the momentous day; but then it ceased, the clouds broke, the veil lifted itself, and Mount Etna stood there in glorious and

beautiful clearness—snow-clad now, as if it had exchanged its dark hue of yesterday for a white holiday dress to honor the occasion. Quickly the mules, that had been kept in readiness with their pack-saddles, were loaded with the instruments, and gay-hearted we ascended to the top of Monte Rossi; for the weather seemed to have exhausted its wrath, and everything went on promising beyond all expectations. Signals for time were exchanged with Mr. Schott, the sun shining bright through the purest sky. By the village-carpenter, whom I had hired to assist, the parallaxic top-piece of the telescope was mounted on a wooden base. The axis I adjusted approximately to the meridian, pointing it by the eye a little east of the Montagnuola, (an eruption-crater of 1763,) where from Waltershausen's chart I judged the meridian of Monte Rossi to pass.

The beginning of the eclipse was noted at—

18^h 40^m 50^s chronometer-time;
= 18 39 53.9 sidereal time;
= 0 36 36.4 mean time.

I am not sure, however, but that this was too late by some seconds; for the strong undulations which agitated the sun's limb may have concealed the real indentation of the moon upon the disk several seconds before I became aware of it. Besides, though the instrument was placed on the side sheltered by the top, it was not quite exempt from being shaken by currents of wind, to which that rather isolated peak is freely exposed. Mr. Eimbeck, with his smaller glass, observed the first contact at—

18^h 40^m 52^s.5 chronometer-time;
= 18 39 56.4 sidereal time;
= 0 36 38.9 mean time;

and estimates that the true contact may have occurred about two or three seconds earlier.

During the partial eclipse, while smaller and smaller was growing the solar crescent, the moon's edge was always very steady and sharply defined. A great many people by and by had gathered around us—one might almost say the whole male population of Nicolosi had climbed the mountain. They were most orderly and respectful, however, and remained modestly at the distance, beyond the limits marked off by two American flags; so that there was hardly need of the guard of three gendarmes, whom the *intendente* of the province of Catania kindly had had the foresight to order to accompany us.

Meanwhile a very suspicious-looking cloud came creeping around the northwest corner along the slope of Mount Etna, drawing alarmingly nearer and nearer in proportion as the sun's sickle became narrower. It was a quarter of an hour yet until totality; already I saw our companions at the Terentina enveloped in dense mist; five minutes later, and with a gush of wind, down came upon us rain-drops with hail and sleet, so that for protecting the object-glass I had to put the cap on. This hail-storm had the effect of driving the crowd of people precipitously down-hill toward home. The minute for the commencement of total eclipse was fast approaching; those were moments of great anxiety. There is hope yet! I see the end of the cloud; there is clear sky below it, on the horizon in the northwest. How slow the cloud moves! but the clear spot is widening. "Time is up!" But, perhaps, there is an error in the computation, for the darkness is no greater yet than any thick dense cloud alone would produce; we can read the chronometer all the time with the greatest ease. Throwing our eyes again upon that clear opening in the northwest, we behold it considerably enlarged, but shining now with a peculiar sombre, greenish-gray tint, that casts over the whole landscape a certain awe. It is the tinge produced by the shadow. There can be no doubt the total eclipse has begun. The cloudy veil is rapidly gliding away; its following edge is approaching the place where the star of the day must stand. We are ready with our telescopes. Now, on the cloudy rim, it brightens. "Venus!" my assistant called out. Alas! it was not Venus, but a small crescent of the re-appearing sun; my more powerful magnifying-glass at the same instant revealed it too clearly. Totality was passed. With a disappointment, made only more painful by the thought that three minutes earlier would have sufficed for witnessing the entire phenomenon in a cloudless sky, I resigned myself to dismount the instrument. Mr. Eimbeck noted yet the end of the eclipse at—

21^h 24^m 4^s.0 chronometer-time;
= 21 23 7.5 sidereal time;
= 3 19 23.2 mean time.

The correction and rate of chronometer have been adopted as computed by Mr. Schott.

At Nicolosi we joined our companions from the higher stations on Mount Etna, who, equally unfortunate, moreover had had to sustain a greater degree of inclemency of the weather. Late in the evening we reached Catania.

It may not seem amiss here to touch shortly upon the hypothesis advanced by some at the time, that the cloud interfering with our observations in Sicily just at the critical moment, coming and passing by almost as rapidly as the obscuration of the sun, possibly might have been produced by the eclipse itself. The moon, it was argued, interposing herself before the sun, hence shutting off the solar heat, effected a cooling of the particles of air, and condensed the vapors in the line of the shadow. Indeed, if we incline to adopt the explanation advanced by a distinguished physicist of the origin of the solar spots, and in particular of the formation of the nuclei of the same, we might here find an analogon. But if such was the case, if an eclipse was capable of producing its own cloud, why is it that a total eclipse has ever been seen at all? In the present instance, the data are at hand for subverting that hypothesis. The various series of meteorological observations since published show unmistakably that the atmospheric pressure over almost the entire basin of the Mediterranean began to diminish already on the day before the eclipse, the barometer thereupon continuing to fall steadily. The cloudy and stormy weather experienced, therefore, was preparing long before the eclipse began, and we can see nothing extraordinary in their coincidence. The same may be said likewise in regard to the variation of the magnetic needle observed by the Italian party at Terra Nuova.

In concluding this report I think it my duty to record the names of the gentlemen who, with so much kindness and disinterestedness, furthered our undertaking in Sicily, and who therefore have a just claim upon science for gratitude. In the first place, among these I must mention the Marquis di San Giuliano, who, besides endeavoring in many ways to make the sojourn at Catania personally pleasant to the members of the expedition, offered liberally, if desired as observing-stations, the comfort of his villas at Viagrande, at Villasmunda, and at the Carcarazzi above Catania. Of these, the last one now has a place in science through the observations made there by the Superintendent's party. The aid of Mr. A. Peratoner, consular agent of the United States at Catania, was frequently called into requisition, too often perhaps in quite trivial matters. He gave his assistance assiduously; for this and for his other acts of kindness, a grateful memory remains with every one of us. Prof. O. Silvestri, whose zeal and interest in the good success of the observations may be inferred from his participating in the hardships of one of the Etna parties, gave important assistance to our photographers by the use of his chemical laboratory. To my tried friend, Prof. G. Zurria, I owe much valuable information about localities; he contributed to Professor Watson's good success by procuring a letter of introduction to the hospitable Messrs. Modica, at Carlentini. Many other gentlemen aided us in various ways, to name all of whom singly would be impossible. Our thanks are due for a standing invitation to visit the rooms of the Casino and of the Gabinetto letterario Gioeni. The *cindario* of the city of Catania, Signor Marchese di Casalotto, to whose authority the abolished convent S. Nicola of the Benedictines now is subject, was always anxious with prompt orders to satisfy our wishes. From the Sicilian custom-house officers we experienced the greatest politeness. The Italian government, as is known to you, had given direction for the undisturbed entry of our instrument-boxes. The same liberal spirit pervaded the *intendente* of the province in providing that we might do our work unmolested. And, in thanking you, dear sir, for having offered me the occasion of seeing again a country that I had once seen sobbing under political absolutism, I may not omit to mention—if it does not seem improper in this place to speak of one's sentiments—how, in looking down from the top of Monte Rossi over the plains, I could not help feeling with joy that we, from the land of freedom, had come to a country not only blessed by nature in every respect, but, now, free too!

Yours, very respectfully and truly,

C. H. F. PETERS.

Prof. BENJAMIN PEIRCE,
Superintendent U. S. Coast Survey, Chief of U. S. Eclipse Expedition.

THIS PAGE LEFT BLANK INTENTIONALLY