tions paid, to the Assistant Secretary, Mr. W. Marriott, at 70 Victoria street, S. W.; checks being crost "the Bank of England".

Foreigners are eligible to membership in the society, and it is desired to give the society an international character by adding as many as possible to its list of members. The secretary has deposited a number of blanks for nomination with the Editor of the MONTHLY WEATHER REVIEW, and adds: "We always welcome fellows from any part of the world".

THE CHRISTMAS METEOR OF 1873 AT WASHINGTON, D. C.

By Prof. HENRY A. PECK. Dated Syracuse University, Syracuse, N. Y., November 16, 1907.

At the meeting of the Philosophical Society of Washington, D. C., on the 27th of December, 1873, its attention was called by Dr. Peter Parker to a remarkable meteor which had been seen on Christmas eve. The topic excited considerable interest as several members of the society had witnessed the flight of the meteor, and a committee consisting of Dr. Peter Parker, W. L. Nicholson, and Cleveland Abbe was appointed to collect data. The report of this committee was read April 7, 1877, and was published in the Bulletin of the Philosophical Society of Washington for that year. Some time since the Editor kindly called my attention to the report and suggested that further work on some phases of the subject might be useful. In what follows, the reader is supposed to have access to the report in question, which is readily accessible to interested parties.

THE POINT OF DISAPPEARANCE OF THE METEOR.

At twenty-four stations records were made of the disappearance of the meteor. Many of these records are very crude, and when the directions given by the remainder are plotted on a map, it at once becomes apparent that many of the persons making the observations did not see the meteor at the time of extinguishment, as others situated farther along its track continue to report it. This brings us at once face to face with one of the difficulties that confronts any one having to do with observations made by persons unused to such work. The separation of the wheat from the chaff often calls for more skill and judgment than any other feature in the process of locating the tracks of meteors. Undoubtedly the observers generally see the meteor at the points noted, but interposing trees, buildings, and other obstructions cut off the view, and they do not realize the necessity of noting this fact. An example is found in the Washington observations. Four observers report that the meteor disappeared within a degree or two of due west, and only one mentions any obstruction to vision. On the other hand, Prof. E. S. Holden, at the Naval Observatory, made a careful determination and found the disappearance at south 68° west, with an altitude of less than 5°. This determination is verified by the fact that the meteor was reported at Harpers Ferry and Appomattox to have azimuths differing by almost exactly 180°. After a somewhat careful study of the materials, I have made the determination of the end point depend upon the following observations, the longitude of the observer being noted with reference to the dome of the Capitol at Washington:

Station.	Longitude.	Latitude.	Azimuth.	Weight.
Number.	° ′	° ′	°	
14	E. 0 05	39 35	S. 33 W.	1
28	W. 0 02.5	38 54	S. 68 W.	3
40	W. 1 51	37 20	N. 25 E.	1
45	W. 0 43	39 18	S. 22 W.	1

Station 28 was occupied by Prof. E. S. Holden of the Naval Observatory. I have thought that his superior training in astronomical observation should entitle his record to much greater weight than could be accorded to that of observers who were deficient in this training.

It is evident that if the end point had been accurately observed at each station, the vertical planes corresponding to these azimuths would cut each other in a common line passing thru the zenith of the place where the meteor was extinguished. On account of the great errors with which meteor observations are always affected this will scarcely happen, and therefore we are called upon to determine the most plausible position of this line. A method of solution is given by Bauschinger in his "Bahnbestimmung der Himmelskörper" and this method has been followed, with the result that the geographical coordinates of the point are

Longitude 0° 57.8′ west
Latitude + 38° 42′.

The theoretical probable error of the equations producing these coordinates is very small, and the position satisfies very closely the observation made at Danbury, Conn., as it is recorded on page 144. Professor Holden determined the altitude at disappearance to be 4° 45′ or less. Taking into account the curvature of the surface of the earth, we may easily derive from this that the disappearance took place at 4.8 miles from the surface. That the meteor came comparatively close to the surface is also established by other evidence. To the observer at Newcastle, Del., it was lost in the haze of the horizon. At Milford, Del., it disappeared "where the sun set". At Richmond, Va., it was followed to 9° 30′ altitude, and the observer "did not see the end". At Woodstock, Va., about 25 miles away, the altitude was estimated at 20°–25°, the lower altitude corresponding to 9 miles. In what follows a mean, 7 miles, has been chosen and used.

THE POSITION OF THE RADIANT.

When the end of the flight is known, we may find the position of the radiant from the mutual intersections of the great circles past thru the end point and any other point in the flight. Each station will furnish an equation, and the least-square solution of these equations will give the most plausible position of the radiant, or point from which the meteor would seem to approach an observer situated at the end of the flight. The observations that I have used are as follows:

Station.	Latitude.	Longitude.	Altitude.	Azimuth.
Numbe .	° ′	° ′	°	
1	41 20	3 35 E.	30	S. 46° W.
6	39 38	1 20 E.	60	S.
20	39 9	0 2 E.	50	S.
23	38 54	0 1 E.	45	S. 70° E.
26	38 54	0 0	60	S.
30	38 48	0 3 W.	90	
31	38 53	0 13 W.	75	S.
34	38 40	0 26 W.	90	
40	37 20	1 51 W.	40	N. 55° E.
41	38 59	0 53 W.	70	N. 67½° E.
43	38 50	1 31 W.	45	E.
48	38 56	3 9 W.	45	E.

With regard to Station 1, Danbury, Conn., there is some ambiguity in the record. I have interpreted it to mean that the course of the meteor made an angle of 25° with a vertical circle.

The following table may next be constructed:

Station.	α	δ	α^1	δ^1
Number.	° ′	° ′	° ′	° ′
1	327 8	−25 35	353 4	− 6 50
6	318 24	−18 52	29 41	+ 9 38
20	321 43	−20 2	28 23	− 0 51
23	312 44	− 6 31	71 47	+14 45
26	312 57	− 6 37	28 21	+ 8 54
30	308 57	− 0 33	28 18	+38 48
31	316 42	− 6 57	28 8	+23 53
34	306 20	+13 5	27 55	+38 40
40	164 35	+48 2	95 12	+47 39
41	13 22	−37 50	67 17	+43 46
43	95 44	− 2 56	78 55	+26 19
48	105 19	+ 9 38	77 19	+26 23

Here α and δ are the right ascension and declination of the point of disappearance as seen from the different stations, and α^1 and δ^1 are the right ascensions and declinations computed from the data given above.

From these right ascensions and declinations the longitude of the node, and the inclination of each of the great circles to the equator may be found as follows:

Station.	Longitude of node. N.		Inclination. I.	
Number.	°	′	°	′
1	201	6	139	25
6	185	21	157	37
20	210	33	158	37
23	158	24	165	15
26	164	5	167	27
30	129	37	140	38
31	150	12	152	25
34	109	38	141	2
40	40	27	53	20
41	37	37	62	8
43	274	10	28	0
48	298	16	52	52

The condition that the radiant shall lie on these great circles is exprest by the equation—

$$\sin N \sin I \cos D \cos A - \cos N \sin I \cos D \sin A + \cos I \sin D = 0,$$

where A and D are the equatorial coordinates of the radiant.

Forming these equations and solving them by the least-square method, there results

$$A = \quad 66° \; 55'$$
$$D = +29° \; 51'$$

When these values are substituted in the original equations, the residuals for several of the stations are found to be rather large. As it seemed possible that these might produce a sensible error in the results, the unknown quantities were again determined from equations not open to this objection, with the result

$$A = \quad 63° \; 40'$$
$$D = +31° \; 17'$$

When it is remembered that the observations are in general only estimates, the close agreement in these two results gives confidence in their substantial accuracy.

THE COURSE OF THE METEOR THRU THE ATMOSPHERE.

By the well-known formulas of spherical astronomy, this right ascension and declination of the radiant may be changed into azimuth and altitude. The result shows that, as viewed from the point of disappearance, the bearing and angular height above the horizon of the point from which the meteor appeared to come are

Azimuth S. 86° 55′ E.
Altitude 56° 27′.

It will be noticed that this course differs by nearly 30° from that laid down in the bulletin to which reference has been made. The observers at Washington saw the meteor to the south, and this is also the report from Milford, Del.; while to the observers at Woodstock and Buckhannon it seemed nearly to follow a vertical circle. As usual there is much confusion in the notices, but those that apparently deserve the most confidence seem to bear out the course indicated.

The most difficult results to obtain from the observations have been the data needed in order to compute the velocity thru the atmosphere. If the azimuths recorded by Mr. Inman, of Washington, D. C., and by Mr. Christian, at Appomattox Court-house, are plotted on the map in the bulletin, they will be found to intersect very near the mouth of the Choptank River, on the eastern shore of Chesapeake Bay. This point of intersection lies on the track of the meteor as traced above, and it is here that I am inclined to place its first appearance. As to the height of this point above the ground we have the following data:

	Miles.
Danbury, Conn.	138
Mercersburg, Pa.	112
Newark, Del.	127
Newcastle, Del.	150
Appomattox Court-house, Va.	134
Woodstock, Va.	120
Average	130

While this great elevation is by no means unprecedented, yet it is by no means common. Corresponding to it, the length of the flight may be taken as 154 miles. As usual, the evidence as to the duration of the flight is very weak. The authors of the report estimated it at not less than three nor more than five seconds. If we take the mean of these estimates, the velocity was 38.5 miles per second.

THE ORBIT WITH REGARD TO THE SUN.

The computation of the orbit in space proceeds according to well-established principles of theoretical astronomy. From the data contained in the Nautical Almanac, it is found that the longitude of the apex of the earth's motion was 183° 15′. When the radiant point, as given above, is freed from the effect of the attraction of the earth and from the effect of its motion in space, the position of the true radiant point or position in space from which the meteor actually came is found to be

λ (celestial longitude) 50° 47′
β (celestial latitude) + 6° 26′

and its velocity about fifty miles per second. It was following and overtook the earth, the angle between its path and the direction to the apex being 132°. The elements of the orbit with regard to the sun are

Ω	(longitude of ascending node)	273° 22′
i	(inclination to ecliptic)	9° 28′
π	(longitude of perihelion)	150° 12′
log q	(logarithm of perihelion distance)	9.7937
log e	(logarithm of eccentricity)	0.6329

A PERSISTENT METEOR TRAIN OBSERVED AT ALBANY, N. Y.

By Prof. HENRY A. PECK. Dated Syracuse University, Syracuse, N. Y., October 22, 1907.

During the early twilight of Sunday evening, February 10, 1907, a large meteor was seen in the general direction of the setting sun by residents of Albany, N. Y., and the surrounding territory. Snow squalls had been frequent during the afternoon, and, on this account, in spite of the exertions of Mr. G. T. Todd, the local forecaster of the Weather Bureau, only very meager accounts of the phenomenon were obtained. This is much to be regretted, as the meteor was attended by a train that persisted for fully a quarter of an hour, apparently drifting to the north. Mr. Robert E. Horton, of Albany, resident engineer of the barge canal, was one of the observers, and has kindly furnished the following description:

Sunday evening, February 10, at 5:45 p. m., standard time, I chanced to look from a window facing the south. I was surprised to find the sky overcast with light, yellowish, fleecy clouds of a type which I have seen preceding a midsummer hailstorm. The edge of the cloud canopy was about ten degrees above the horizon when first seen, and underneath was a heavy bank of black clouds reaching about the same altitude. * * * The cloud canopy was lifting and drifting rapidly toward the north. When it had reached an altitude of forty-five degrees, I was surprised to see, about S. 20° W, a zigzag streak of bright gold, the lower end of which was lost in the reddish haze above and back of the cloud bank and at an altitude of about twenty-five degrees. The upper end was visible to the naked eye at an altitude of twenty-five to thirty degrees against a background of clear blue sky. I called my wife to watch while I procured a Lemaire night glass. On my return at 5:50 p. m., it had not changed form but had changed color to a fleecy white. The sun had set and the cloud canopy had lifted nearly to the zenith. The field glass showed it to be apparently a rather dense, clearly demarked band of cloud, which when first seen was illumined by the sun.

A sketch which I made on a scrap of paper, showing its appearance thru the glass, is inclosed. (See Fig. 1.) The glass revealed several