Sciences, in 1853, was "not the least important of the services rendered to science by Mr. Farrar."

In an elementary treatise on mechanics Professor Farrar devotes a considerable section to the barometer. At the end of it, in a series of "Notes," he gives additional information on the history of the instrument. Reference is made to the early belief that humid air was heavier than dry air and hence that the barometer ought to stand higher in rainy weather than in clear, and the fallacy of this belief is pointed out. Of the diurnal variation of the barometer in the Tropics he says: "Neither the wind, nor rain, nor fair weather, nor tempest disturb the perfect regularity of these oscillations."

Mention has already been made of Professor Farrar's personal observations. They were great in variety and astonishing in completeness. We can merely mention the principal points of interest about them here. His barometer was made by W. and S. Jones, London, and was provided with a floating gage and a scale of correction, and was graduated into English inches and hundredths. His temperature observations extended thru the years 1807–1812, 1813, 1816, and 1817. They were abstracted from time to time, together with Professor Webber's for the years 1790–1807, in the American Almanac. During the years 1800–1806 he made hygrometrical observations with a Daniels hygrometer, tabulating the results under "greatest," "mean," and "least," by months. His observations of a great storm which occurred in New England September 23, 1815, are very detailed as to wind direction and velocity, barometer, state of the sky, etc.

With the close of Mr. Farrar's activity as professor of mathematics and natural philosophy, in 1836, the record of the connection of Harvard with meteorology temporarily ceases. Not until thirty-four years later comes the first official mention of meteorology in the university, in the president's report for 1870–71. In that year, with the meteorological lectures of Professor Whitney, began the second and fuller development of the science at Cambridge. An account of this second period, which is seemingly quite independent of the earlier, would deal with the work of Whitney, Pettee, Shaler, Davis, Ward, Rotch, and others, also with the establishment of the Harvard College Observatory and of the Blue Hill Meteorological Observatory; but it would greatly exceed the limits set for this paper.

THE METEOR OF OCTOBER 5, 1907, OVER NEW JERSEY AND PENNSYLVANIA.

By Prof. HENRY A. PECK. Dated Syracuse, N. Y., May 28, 1908.

Saturday evening, October 5, 1907, at 9:55 p. m., eastern time, a very large meteor was seen to pass from a position over the ocean east of the New Jersey coast to the vicinity of Warren, Ohio. It was quite widely noticed in the daily press of the principal cities along its route, including New York, Philadelphia, Baltimore, and Washington. The steamer *Castilian Prince*, plying between Fernandina and New York, observed the phenomenon while coming up the New Jersey coast between Seagirt and Barnegat. Aside from the widely extended press notices, reports have been received from the following, the greater share being in response to a postal-card canvass conducted by the Central Office of the Weather Bureau:

ONTARIO, CANADA.

Deshler Welch, Niagara on the Lake.

NEW YORK.

Fred G. Wyman, Binghamton.	Maurice C. Ashley, Middletown.
Louis Renault, Brooklyn.	William C. Thomas, New York.
Henry A. Morris, Brooklyn.	Charles W. Hall, North Tonawanda.
E. J. McLaughlin, Brooklyn.	E. Russell Davis, Norwich.
William H. Orr, Buffalo.	T. C. Sweet, Phœnix.
Frank W. Cheney, Jamestown.	Paul A. Mackey, Poughkeepsie.
A. J. Lannes, Jamestown.	H. W. Nelson, jr., Poughkeepsie.
Frank J. Nash, Leroy.	Robert Dunk, Scriba.
Frank W. Ball, Leroy.	H. C. Townsend, Wappingers Falls.

NEW JERSEY.

F. C. Pierce, Imlaystown.	Lewis B. Holt, Ocean Grove.
Bert Stiff, Jersey City.	D. W. Smith, Phillipsburg.
William P. Bowne, Lambertville.	P. Hardcastle, Somerville.
Mrs. John H. Brown, Long Branch.	Dr. Franklin Chattin, Trenton.

PENNSYLVANIA.

Arthur B. Cornell, Allegheny.	J. F Blair, Orrstown.
Isaac D. Kreiss, Benjamin.	C. F. Clement, Philadelphia.
R. B. Headlee, Brock.	U. J. Stewart, Pine Bank.
Mrs. C Swenson, Ambridge.	Harry E. Adams, Pittsburg.
A. M. Orr, Greenville.	S. E. Smith, Reading.
George H. Sprenkle, Hanover.	J. G. Apple, Saegerstown.
E. R. Demain, Harrisburg.	Mrs. Alfred McElwain, Scenery Hill.
M. L Heisler, Harrisburg.	Benjamin W. Collins, Swarthmore.
John Larimer, Leetsdale.	George Q. Weaver, Talmage.
T. H. Weagley, M. D., Marion.	George Kralt, jr., Washington.
A. F. See, Meadville.	Dr. I. C. Green, West Chester.
Thomas L. Becker, Newmanstown.	Hannah M. Warrington, West Chester.
M. T Bretz, Newport.	
Clyde Swartz, Nittany.	Mrs. Mabel A. Conrad, Woodhill.

DELAWARE.

H. S. Gray, Clayton.

MARYLAND.

Harry B. Mason, Denton.	Joseph Plummer, Jewell.
Dr. Winfred T. Morrison, Elkton.	James R. Stewart, Princess Anne.
Henry Trail, Frederick.	C. W E. Treadwell, Towson.
E. A. McCulloch, Glencoe.	

DISTRICT OF COLUMBIA.

Thurbert H. Conklin, Washington.	W. W. Saunders, Washington.
Miss Kate S. Curry, Washington.	Herbert C. Hunter, Washington.

VIRGINIA.

H. H. Fox, Ashland.	S. E. Fletcher, Glenallen.
Mrs. E. B. Kneiple, Broadway.	Samuel Brunk, Harrisonburg.
Lizzie M. Heatwole, Dale Enterprise.	Frank Luke, Warrenton.

WEST VIRGINIA.

J. W. Thompson, Elkins.	R. F. Adams, Huntington.

OHIO.

John A. Wentz, Canton.	B. W. Adair, Leesville.
Edwin Vogelgesang, Canton.	H. R. McClintock, Summerfield.
Charles F. Stokey, Canton.	Prof. T. H. Sonnedecker, Tiffin.
S. M. Painter, Fredericktown.	

The accompanying table, in which localities have been arranged by States and in order of longitude from east to west, presents notes as to the physical appearance of the meteor. No attempt has been made to harmonize discrepancies, but as far as possible the impression made upon the observer has been reproduced.

Several observers speak of a peculiar appearance of the sky at the point where the meteor first appeared.

Only two observers mention that the meteor separated into parts. These are both near the end of the flight. The phenomenon does not appear to have been sufficiently marked to attract general attention.

The point of disappearance.—Aside from the numerous hints contained in newspaper references and in inexact descriptions, four observers made records of the point of disappearance that admit of use for the purpose of computation. Thurbert H. Conklin, of Washington, D. C., makes note of the fact that the meteor apparently past behind a house in azimuth N. 50° W. and at an altitude of 5°. I am persuaded by a comparison of this observation with others that he saw the actual disappearance of the meteor. R. F. Adams, of Huntington, W. Va., records that it was last seen by him a little east of northeast. He also records that it first appeared almost directly east of his position. A glance at a map will show that this last statement can not be reconciled with the statement of those situated on the Atlantic coast. If his azimuths are corrected by 18°, both the beginning and the end of the flight are well represented. According to B. W. Adair, of Leesville, Ohio, the meteor disappeared 4° or 5° east of north. J. A. Wentz, of Canton, Ohio, reports that it past from sight at 11° south of east. This seems to be an error, however, as E. L. Vogelgesang, of the same place, reports that it came from a

TABLE 1.—*Observations on the meteor of October 5, 1907, over New York, New Jersey, Pennsylvania, and Ohio.*

Place.	Color of meteor.	Size of meteor.	Intensity of light.	Color of light.	Train.	Noise.	Duration of visibility
Wappingers Falls, N. Y.			Brighter than electric light 200 feet distant.	Light orange.	Lasted 5 seconds.	No noise heard	6–8 seconds.
Poughkeepsie, N. Y.	Dark orange						4 seconds.
Shortsville, N. Y.	Reddish.						
Leroy, N. Y.							2–3 seconds.
Jamestown, N. Y			Bright enough to read by.		Bluish	No noise heard	15–20 seconds.
Long Branch, N. J				Bluish			
Ocean Grove, N. J		One-half size of full moon.		Yellowish			
Trenton, N. J	Red				Long, green		
Philadelphia, Pa					Gradually contracted into a fish-hook shape.		
Benjamin, Pa			Electric lights dwarfed.				
Swarthmore, Pa				Green and yellow.	The part that formed first disappeared last. After 4 minutes it resembled the Milky Way.	No noise heard	
South Scranton, Pa	Reddish					Loud explosion	
West Chester, Pa					Lasted 5 minutes		
Reading, Pa			Equaled 1,000-candlepower street lamp.				
Birdsboro, Pa				Bluish		No noise heard.	
Newmanstown, Pa.				Bluish		Jar or sound 2 minutes after.	
Hanover, Pa	White, with yellow tinge.		Shadows of trees moved		Pale green, faint haze.	Explosion	50 seconds.
Dauphin, Pa.						Roar	
Allegheny, Pa		A blazing ball of fire.					
Ambridge, Pa					Fan shaped		
Leetsdale, Pa	Red hot copper.		Strong as full moon	Yellow.		Quite a noise	
Washington, Pa.			As light as day.		Like a cloud of smoke		
Pine Bank, Pa				Bluish			30 seconds.
Clayton, Del							3 seconds
Elkton, Md							5–10 seconds.
Glencoe, Md.						Loud blasting 1 to 1½ minutes after.	
Jewell, Md				Greenish			
Towson, Md.						Houses trembled	
Washington, D. C.							4 seconds.
Broadway, Va.					Great streak of bright light		
Harrisonburg, Va		One-fourth size of moon.					4–5 seconds.
Glenallen, Va.				Bluish			4–5 seconds.
Huntington, W. Va				White like a gas mantle.			
Canton, Ohio		One-half size of moon.					1–2 seconds.

point on the eastern horizon, a little south of the vertical circle passing thru the point where the belt of Orion rises, and that it past to the north. Using the method of intersecting azimuth planes, the point at which the meteor disappeared is found to be situated vertically over longitude 81° 1′ west, latitude 41° 17′ north. This position is fairly well supported by the other data.

The meteor is somewhat peculiar in that it apparently failed to penetrate the lower levels of the atmosphere. While the evidence is rather scanty, it is quite consistent. The elevation of the point of disappearance as given by the Washington observation is 24 miles; Canton observation 28 miles; North Tonawanda observation 20 miles; and Orrstown observation 17 miles. The average of these places the point of disappearance at an altitude of 22 miles above the surface, near the boundary line between Trumbull and Portage counties, Ohio, and about 10 miles north of west from the city of Warren.

The apparent position of the radiant.—The track of a meteor as seen by an observer is the projection upon the heavens of the essentially straight line it describes in passing thru the atmosphere. The right ascension and declination of two points on one of these projections establish an equation. The solution of the equations representing all the observations is accomplished by the least square method and furnishes the right ascension and declination of the point at which visible flight began as seen from the end of the line. In order to use observations where the position of only one point has been noted, the common method is to calculate the coordinates of the end of the path from data already established and use the result in the place of the observed positions of this point. These computed coordinates may be combined with those of any observed point of the projection to form an equation. In using this method, the observations given in columns 2 and 3 of Table 2 were selected as suitable.

TABLE 2.—*Position of meteor.*

Place.	Azimuth.	Altitude.	α	δ	α'	δ'	Position of track. Γ	Position of track. γ
	°	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Camden, N. J.	0	90	242 17	+14 5	342 47	+39 56	216 41	42 59
West Chester, Pa	0	90	240 26	+16 27	341 44	+39 57	222 30	43 50
Reading, Pa.	S 45 E	68	243 33	+12 59	358 18	+23 29	42 2	147 51
Elmira, N. Y.	S 25 W	6 40	258 48	−5 3	309 7	−36 17	253 4	138 30
Hanover, Pa	N 30 E	45	235 21	+22 44	47 15	+67 23	234 9	87 8
Washington, D. C.	N 40 E	8	225 12	+31 50	100 10	+42 33	71 7	62 7
Orrstown, Pa	S 30 E	17	236 1	+23 11	50 27	+3 30	231 9	78 47
Leroy, N. Y.	S 67.5 E	22 30	257 5	−24 6	38 00	+0 7	217 50	144 44
Canton, Ohio	S 79 E	35	44 22	+68 46	32 27	+14 52	211 6	95 6

If α and δ represent the apparent right ascension and declination of the end of flight as viewed from the various stations and α' and δ' represent the corresponding coordinates computed from the azimuths and altitudes given, we have the values given in columns 4 to 7 of the table.

If γ denote the inclination of the track of the meteor to the equator of the heavens and Γ the longitude of its ascending node, these quantities may now be found from the equations,

$$\tan\gamma\sin(\alpha'-\Gamma)=\tan\delta'$$
$$\tan\gamma\cos(\alpha'-\Gamma)=\frac{\tan\delta-\tan\delta'\cos(\alpha-\alpha')}{\sin(\alpha-\alpha')}$$

with the results given in the last two columns of Table 2.

If A and D denote the right ascension and declination of the apparent radiant, or point from which the meteor appeared to come, the following equation must be satisfied:

$$\sin\Gamma\sin\gamma\cos D\cos A-\cos\Gamma\sin\gamma\cos D\sin A+\cos\gamma\sin D=0.$$

This may be readily put in the form of an equation containing two unknown quantities. From the nine equations thus formed there results, as the most probable value of the coordinates of the radiant,

$$A = 51° 10'$$
$$D = -35° 1'$$

In the present case there are two methods by which this result can be tested. First, it must satisfy the nine observations within reasonable limits; and secondly, when the right ascension and declination are converted into azimuth, the line indicated must pass thru the zenith of the place occupied by the *Castilian Prince*. On substituting in the equations from which the result is produced, very large residuals are found to exist for the last two stations. This is quite natural, considering their distance from the point of the meteor's first appearance. The azimuth derived from this radiant passes near Cape May, which is too far south. If the equations for these last two observations are abandoned, the position of the radiant is

$$A = 57° 17'$$
$$D = -15° 51'$$

and the meteor would have past thru the zenith of all places whose azimuth as seen from the end point was S. 72° 11' E. The probable azimuth of the *Castilian Prince* was S. 73° 18' E. From this agreement we may safely assume the above to represent the coordinates of the apparent radiant point.

The length of the path.—The most unsatisfactory data are those upon which depends our knowledge of the altitude at which the meteor began to glow. There are only two observations that one can use with any thing approaching certainty. These are Hanover, Pa., 61 miles; Orrstown, Pa., 70 miles, the average of which gives 65 miles as the most probable height above the surface. Fortunately the length of the path was so great that a considerable discrepancy in our knowledge of the altitude would have small effect on the resulting velocity. The probable length of the path approximates 385 miles.

The velocity thru the atmosphere.—The duration of visibility, when stated by the observer, is given in the last column of Table 1.

It is always a delicate question to decide which estimates are obvious errors and to which the law of probability can be safely applied. In the present instance, the Hanover observation has been rejected and the average of the remainder taken as the most probable value. Dividing the length of the path by the duration of visibility the velocity thru the atmosphere is 50 miles per second.

The path with regard to the sun.—From the Nautical Almanac it is found that the longitude of the sun was 191.7° and therefore the longitude of the apex of the motion of the earth was 102.6°. The angle between the true path of the meteor and that of the earth was 81.1° and the velocity thru the atmosphere was therefore greater then the velocity in space. The velocity in space before it fell under the attraction of the earth was 43.7 miles per second. The coordinates of the true radiant, or direction in space from which the meteor came, are celestial longitude, 24° 24'; celestial latitude, —40° 24'.

Making use of the known formulas of theoretical astronomy, the elements of the solar orbit [i. e. of the meteor's orbit about the sun] are easily deduced as follows: Longitude of ascending node, 11° 41'; inclination to ecliptic, 104° 14'; longitude of perihelion, 74° 38'; log. of perihelion distance, 9.7495; log. of eccentricity, 0.4790.

NOTE ON SOME METEOROLOGICAL USES OF THE POLARISCOPE.

By DR. LOUIS BELL. Dated January 27, 1908.

[Reprinted from the Proceedings of the American Academy of Arts and Sciences, March, 1908.]

This is merely a preliminary notice of certain facts regarding atmospheric polarization which may prove to have some prognostic value. They were incidental to a proposed study of the character of autumnal haze which the writer undertook last year at Mount Moosilauke, N.H. This peak, 4,811 feet high, has an almost uninterrupted sweep of horizon over a radius of 100 miles or so, and offers an excellent chance for investigating the distribution and nature of the haze that veils the landscape in early autumn. For instruments I took along a Savart polariscope, merely a Savart plate with a bit of tourmaline as analyzer, an extemporized double-image polarimeter of the type outlined in the early and valuable paper of Prof. E. C. Pickering,[1] a couple of carefully calibrated photographic wedges for determining opacities, and a direct vision spectroscope.

A prolonged easterly storm, about the only thing which could have defeated the program, cut short observations upon the summit, but a week of preliminary observations at Breezy Point (elevation 1,650 feet) at the base of the mountain yielded results which seem to be of sufficient interest to put upon record.

These were made mostly with the Savart polariscope, an instrument which, from its very wide field of view and great sensitiveness, showing even one or two per cent of polarization, enables sky conditions to be very readily investigated. The character of the sky polarization, with its general symmetry and maximum in a plane of 90° solar distance, is well known, but the nature and causes of its casual variations have not, perhaps, received the attention that is their due. Nearly everything in the landscape polarizes by reflection to a greater or less extent, the more as the specular component of reflection is the greater. For example, the glossy upper surface of a maple leaf polarizes strongly at fairly large angles of incidence, while the mat lower surface has only a trifling effect —which facts explain the old observation of Spottiswoode that ivy leaves polarize particularly well. Grass, trees, stones, especially if wetted, all produce their effect, which, when sky polarization is cut off by white cloud, is generally a maximum in the vertical plane.

I have several times observed this terrestrial polarization carried up by reflection into low-lying cloud as noted by Pickering (loc. cit.), or even into near-by dense fog otherwise neutral. A completely cloudy sky is otherwise practically free of polarization, but in a partially clear sky white cumuli commonly show some effects with the Savart plate, and light cirri often give bands almost as strongly as the clear sky. This may be due to the usually considerable height of cirri,—quite enough to allow noticeable polarization to have origin below them—or to their letting thru considerable polarized sky light from above—a phenomenon which I observed from the summit station in the case of rather thin layers of cloud in which it was immersed.

One of the most striking features of the sky polarization observed from Breezy Point was the extent to which it appeared while originating over short stretches of air. Mounts Kineo and Cushman, about three miles distant and dark with a heavy growth of conifers, repeatedly showed strong polarization effects from intervening haze, and at times slopes within a mile brought out the bands, altho less conspicuously. On several occasions the polarization on Kineo and Cushman was sensibly as considerable as on peaks at 10 or 15 miles distance. Similarly, in the brief observations on the summit, the Green Mountains, and the almost effaced Adirondacks, showed little if any more polarization than the peaks in the same direction in the middle distance, altho the former were 80 to 100 miles and the latter only 20 to 40 miles. These results follow from the exponential relation between distance and apparent absorption, but show clearly the magnitude of the effects due to comparatively short reaches of air.

At no time was I able to repeat the results obtained by Tyndall in the apparent clearing up of the haze by observation thru a crost Nicol. In this case the mountains remained

[1] Proceedings of the American Academy of Arts and Sciences, Vol 9, p. 1 et seq.