Introduction to the Airy Experiment

The debate over the large-scale structure of the earth notwithstanding, heliocentrism (specifically in respect of its subsumed translational motion of the earth) was experimentally refuted by George Biddell Airy in 1871.[1]

Those who benefit from the false but popular narrative of heliocentrism have culturally propagandized the experiment as a failed attempt to detect the aether, dubbing it as Airy's Failure. It therefore behooves this writer to establish from the outset, the essential facts of the case, as it were.

George Biddell Airy did not set out to discover either a stationary or moving aether. Nor did he set out to prove that the earth itself was either stationary or moving. A simple reading of his paper confirms those facts. Airy's experiment was motivated exclusively by what he describes as a discussion in Continental publications (to which he refers in the opening paragraph of his paper) concerning light undergoing a relative increase in refraction upon traversing a refracting medium that has a translational velocity. The hypothesis of refractional increase with refracting medium motion was proposed by Fresnel[2,3] in 1818 and experimentally confirmed by Fizeau[4] in 1851. That confirmation has been repeated and stands today despite the unpopularity of Fresnel's theoretical explanation of partial aether entrainment being responsible for the phenomenon.

In any case, the phenomenon characterized by Fresnel and Fizeau is exclusively optical in nature. In and of itself, it really has nothing to do with the translational movement of the earth or lack thereof. As heliocentrism had taken over nineteenth century education (see our Homepage section titled, PREFATORY under the subsection titled, The Particular Problem of Heliocentrism and Its (Allegedly Spheroidal) Earth), there is no reason not to believe that all of the mainstream scientists (including Airy) investigating this phenomenon took the earth's (alleged) translational (i.e., orbital) motion around the sun for granted, and as such, the (allegedly moving) earth would have been seen as the perfect experimental platform and starlight the perfect subject.

Hence, whereas Klinkerfues[5] (considerd to be an authority), using starlight, a fluid-filled telescope, and the (alleged) translational motion of the earth, measured an alleged increase in stellar aberration, Airy realized that a result of such importance necessitated further investigation.

The Airy Experiment

In his paper, Airy initially describes the conceptual basis for determining the translational motion of a refracting medium (in this case, the water of a water-filled telescope) by means of light aberration[6,7] as follows:

> [1st paragrah] A discussion has taken place on the Continent, conducted partly in the 'Astronomische Nachrichten,' partly in independent pamphlets, on the change of direction which a ray of light will receive (as inferred from the Undulatory Theory of Light) when it traverses a refracting medium which has a motion of translation. The subject to which attention is particularly called is the effect that will be produced on the apparent amount of that angular displacement of a star or planet which is caused by the Earth's motion of translation,[8] and is known as the Aberration of Light. It has been conceived that there may be a difference in the amounts of this displacement, as seen with different telescopes, depending on the difference in the thicknesses of their object-glasses. The most important of the papers containing this discussion are:—that of Professor Klinkerfues, contained in a pamphlet published at Leipzig in 1867, August; and those of M. Hoek, one published 1867, October, in No. 1669 of the 'Astronomische Nachrichten,' and the other published in 1869 in a communication to the Netherlands Royal Academy of Sciences. Professor Klinkerfues maintained that, as a necessary result of the Undulatory Theory, the amount of Aberration would be increased, in accordance with a formula which he has given; and he supported it by the following experiment:—[9]

The key concept here is the change in direction of light rays passing through a refracting medium that is moving as opposed to a stationary refracting medium. Obviously, there is existing light aberration because of relative translational motion between the earth and the stars; whether that relative translational motion results from either the stars moving or the earth moving is the (perhaps unintentional) essence of Airy's experiment given that Airy was only trying to confirm what Klinkerfues had apparently observed—a measurable increase in aberration (presumably resulting from the refracting medium moving with a presumably moving earth).

Airy describes Klinkerfues' experimental arragement in the 2nd paragraph, summarizing the results toward the end of that paragraph:

> [...] Professor Klinkerfues had computed that the effect of the 8-inch column of water and of a prism in the interior of the telescope would be to increase the coefficient of Aberration by eight seconds of arc. The observation appeared to show that the Aberration was really increased by 7".1 [i.e., 7.1"]. It does not appear that this observation was repeated.[10]

That Klinkerfues' observation was (apparently) not repeated, whereas Airy carried out two sets of observations (each set spanning a month or more) six months apart (see Table 1 below), and at specific times of the year where aberrational effects (if they did exist) were predicted to be maximally opposite, imparts significant credibility to Airy's results.

Airy decribes his own experimental arrangement in the 3rd paragraph, part of which is excerpted as follows:

> [...] Having carefully considered the astronomical means which would be most accurately employed for the experiment, I decided on adopting a vertical telescope, the subject of observation being the meridional zenith distance of γ Draconis, the same star by which the existence and laws of Aberration were first established. The position of this star is at present somewhat more favourable than it was in the time of Bradley, its mean zenith-distance[11] north of the Royal Observatory being about 100" and still slowly diminishing. With the sanction of the Government, therefore, I planned an instrument, of which the essential part is, that the whole tube, from the lower surface of the object-glass to a plane glass closing the lower end of the tube, is filled with water, the length of the column of water being 35.3 inches.[12] [...]

To achieve the greatest possible change in aberration from his experimental arrangement, Airy chose observation periods around the equinoxes, stating toward the end of the 5th paragraph:

[...] The seasons at which the meridional zenith-distance of γ Draconis is most affected by aberration in opposite directions are the Eqinoxes.[13]

The remainder of p. 37 provides an explanation of Airy's tabulated results and is excerpted here as follows:

> For understanding the following Table, it is to be remarked that an apparent value of the Geographical Latitude of the Instrument [designated as column (B) - (A) in the (adapted and annotated) Table 1 below] is formed from every observation, by subtracting the Observed Instrumental Zenith-distance North of the Star [designated as column (A) in the (adapted and annotated) Table 1 below] from the Tabular Declination[14] of the star given in the 'Nautical Almanac' [designated as column (B) in the (adapted and annotated) Table 1 below]. The observed zenith-distance [i.e., column (A)] is affected with the True Aberration as seen in the instrument, the tabular declination [i.e., column (B)] is affected with the Received Aberration used in the computation of the 'Nautical Almanac,' and the apparent value of the geographical latitude [i.e., (B) - (A)] is therefore affected by the difference between the True Aberration as seen in the instrument and the Received Aberration. If, therefore, under all circumstances, and especially in the comparison of days when the sign of aberration has changed, the apparent value of the geographical latitude [i.e., column (B) - (A)] is sensibly constant, it proves that the True Aberration is the same as the Received Aberration, or at least that one is not a multiple of the other. [emphasis added]
>
> The last column [i.e., column (C)] is given only to show to how large an extent Aberration enters into the star's Apparent Declination.
>
> Every result for Observed Zenith-distance [i.e., column (A)] in the Table is the mean of observations in reversed positions of the instrument.

Observation Number[15]	Day of Observation (1871)	Star's Observed Zenith-distance North (A)	Star's Declination from 'Nautical Almanac' (B)	Difference for Geographical Latitude of Instrument (B - A)	Correction for Aberration Adopted in 'Nautical Almanac' (C)
1	February 28	85.30"	51° 29' **59.3"**	51° 28' **34.0"**	-18.71"
2	March 1	85.71"	51° 29' **59.1"**	51° 28' **33.4"**	-18.82"
3	March 3	84.19"	51° 29' **58.9"**	51° 28' **34.7"**	-19.02"
4	March 4	82.18"	51° 29' **58.8"**	51° 28' **36.6"**	-19.11"
5	March 16	83.63"	51° 29' **58.0"**	51° 28' **34.4"**	-19.73"
6	March 17	84.58"	51° 29' **58.0"**	51° 28' **33.4"**	-19.74"
7	March 21	83.87"	51° 29' **57.9"**	51° 28' **34.0"**	-19.73"
8	March 23	82.73"	51° 29' **57.9"**	51° 28' **35.2"**	-19.69"
9	March 24	84.18"	51° 29' **58.0"**	51° 28' **33.8"**	-19.66"
10	March 26	84.04"	51° 29' **58.1"**	51° 28' **34.1"**	-19.59"
11	March 27	83.48"	51° 29' **58.2"**	51° 28' **34.7"**	-19.54"
Mean Latitude of Instrument from Spring Observations				**51° 28' 34.4"**	
1	August 29	122.10"	51° 30' **34.4"**	51° 28' **32.3"**	+18.25"
2	Sept. 5	121.84"	51° 30' **35.0"**	51° 28' **33.2"**	+19.01"
3	Sept. 7	121.62"	51° 30' **35.1"**	51° 28' **33.5"**	+19.18"
4	Sept. 9	120.27"	51° 30' **35.2"**	51° 28' **34.9"**	+19.33"
5	Sept. 11	122.98"	51° 30' **35.3"**	51° 28' **32.3"**	+19.45"
6	Sept. 15	122.20"	51° 30' **35.4"**	51° 28' **33.2"**	+19.64"
7	Sept. 17	121.53"	51° 30' **35.5"**	51° 28' **34.0"**	+19.70"
8	Sept. 22	121.38"	51° 30' **35.5"**	51° 28' **34.1"**	+19.74"
9	Sept. 24	120.01"	51° 30' **35.4"**	51° 28' **35.4"**	+19.72"
10	October 1	120.62"	51° 30' **35.1"**	51° 28' **34.8"**	+19.46"
11	October 2	120.29"	51° 30' **35.1"**	51° 28' **34.8"**	+19.40"
12	October 3	121.31"	51° 30' **35.0"**	51° 28' **33.7"**	+19.33"
13	October 4	124.41"	51° 30' **34.9"**	51° 28' **30.5"**	+19.26"
14	October 6	120.60"	51° 30' **34.8"**	51° 28' **34.2"**	+19.10"
Mean Latitude of Instrument from Autumn Observations				**51° 28' 33.6"**	

Table 1. Airy's Table (adapted and annotated for this website) listing spring and autumn observations of γγ Draconis. (Note: Mobile device users can scroll this table horizontally.)

Upon carrying out the experiment and tabulating the results, Airy's conclusion on the matter is definitive:

Remarking that the mean results for Geographical Latitude of the Instrument (determined from observations made when the Aberration of the star had respectively its largest + value and its largest − value) agree within a fraction of a second, I think myself justified in concluding that the hypothesis of Professor Klinkerfues is untenable. Had it been retained, the Aberrations to be employed in the corrections would have been increased by +15" and −15" respectively, and the two mean results would have disagreed by 30".[16]

The Meaning of the Airy Experiment's Results

As stated above, Airy concluded that "... the hypothesis of Professor Klinkerfues is untenable." But what was Professor Klinkerfues' hypothesis? Actually, there were two hypotheses, the second hypothesis being partially dependent upon the first: As described in the first paragraph of Airy's paper, the first hypothesis concerned the underlying optical phenomenon in general, being "... on the change of direction which a ray of light will receive (as inferred from the Undalatory Theory of Light) when it traverses a refracting medium having a motion of translation." The second hypothesis related to a particular astronomical manisfestation of that optical phenomenon, being "... the effect that will be produced on the supposed amount of that angular displacement of a star or planet which is caused by the Earth's motion of translation, and is known as the Aberration of Light."

Clearly, Airy did not (nor could not) find the first hypothesis of Professor Klinkerfues untenable for the simple reason that its confirmation was essentially legacy, having been proposed by Fresnel in 1818 and experimentally confirmed by Fizeau in 1851.
That brings us to the second hypothesis. If the first hypothesis (concerning the underlying optical principle) had been previously confirmed elsewhere, then it follows that the issue was with the astronomical application of that principle. There is no reason not to believe that Airy's experimental methodology was up to the standards of that time. In other words, if the refracting medium (i.e., the water in the water-filled telescope) had been in fact undergoing sufficient translational velocity to have measurably increased refraction and hence, stellar aberration, then Airy would have recorded such increases accordingly.

The only possible explanation is that the second hypothesis involved an implicit but otherwise untenable assumption, viz. that the earth orbits the sun, therefore implying the attribute of translational motion to everything on the earth including the water of a water-filled telescope. Airy did not measure the theoretically predicted increase in stellar aberration for the simple reason that the earth does not orbit the sun but is stationary. But because Airy would have been a heliocentrist, he concluded that the overall hypothesis of Klinkerfues (involving the application of what was really a proven optical principle to astronomical measurements) was untenable. But Airy's consistent measurement of no aberrational increases over periods of the year when such increases presumably would have been maximally opposite, proved that the earth is stationary, thereby refuting heliocentrism. No other conclusion can be drawn from Airy's results.

Denouement

Whereas geocentrism was experimentally confirmed by George Biddell Airy as far back as 1871, it should not surprise readers that modern systems, e.g., commercial aviation, dependent upon the earth being stationary, re-confirm geocentrism on a daily basis. See Heliocentrism Refuted: Experimental Proof of a Stationary Earth.

— FINIS —

Sources

1. George Biddell Airy, “On a supposed alteration in the amount of Astronomical Aberration of Light, produced by the passage of the Light through a considerable thickness of Refracting Medium.” *Proceedings of the Royal Society of London*, Volume XX (1871-1872), No. 130, November 23, 1871 (Art. IV), pp. 35-39.
2. Augustin Fresnel, « Lettre de M. Fresnel à M. Arago sur l’influence du mouvement terrestre dans quelques phénomènes d’optique », *Annales de chimie et de physique*, t. 9, 1818, p. 57-66.
3. Augustin Fresnel, « Note additionnelle à la lettre de M. Fresnel à M. Arago », *Annales de chimie et de physique*, t. 9, 1818, p. 286-287.
4. Hippolyte Fizeau, « Sur les hypothèses relatives à l’éther lumineux », *Comptes Rendus*. 33: 349–355.
5. Wilhelm Klinkerfues, *Die Aberration der Fixsterne nach der Wellentheorie* (Leipzig: Verlag von Quandt & Händel, 1867).
6. **Aberration** is defined by the Nautical Almanac Office (United States Naval Observatory) and H.M. Nautical Almanac Office (Rutherford Appleton Laboratory), in their publication titled, *The Astronomical Almanac for the Year 2007* (Washington: U.S Government Printing Office · London: The Stationery Office, 2005), GLOSSARY, p. M1. See “**aberration:** the relativistic apparent angular displacement of the observed position of a celestial object from its **geometric position**, caused by the motion of the observer in the reference system in which the trajectories of the observed object and the observer are described. [...]” See also “**aberration, stellar:** the apparent angular displacement of the observed position of a celestial body resulting from the motion of the observer. Stellar aberration is divided into the diurnal, annual, and secular components. [...]” See also “**aberration, annual:** “the component of stellar **aberration** resulting from the [alleged] motion of the Earth about the Sun. [...]” **Geometric position** is defined on p. M6 as follows: “**geometric position:** the position of an object defined by a straight line (vector) between the center of the Earth (or the observer) and the object at a given time, without any corrections for **light-time**, **aberration**, etc.
7. In the experiments of Klinkerfues and Airy, it is specifically (stellar) **annual aberration** (as defined above) that is under investigation.
8. In other words, the earth’s (alleged) orbit around the sun.
9. George Biddell Airy, *op. cit.*, pp. 35-36.
10. *Ibid.*, p. 36.
11. Nautical Almanac Office, *op. cit.*, GLOSSARY, p. M14. See “**zenith distance:** angular distance on the **celestial sphere** measured along the great circle from the **zenith** to the celestial object. Zenith distance is 90° minus **altitude**.” See also (p. M3) “**celestial sphere:** an imaginary sphere of arbitrary radius upon which celestial bodies may be considered to be located. As circumstances require, the celestial sphere may be centered at the observer, at the Earth’s center, or at any other location.” See also (p. M14) “**zenith:** in general, the point directly overhead on the **celestial sphere**”. See also (p. M1) “**altitude:** the angular distance of a celestial body above or below the horizon, measured along the great circle passing throught the body and the **zenith**. **Altitude** is 90° minus **zenith distance**.”
12. George Biddell Airy, *op. cit.*, p. 36.
13. *Ibid.*, p. 37.
14. Nautical Almanac Office, *op. cit.*, GLOSSARY, p. M3. See “**declination:** angular distance on the **celestial sphere** north or south of the **celestial equator**. It is measured along the **hour circle** passing through the celestial object. Declination is usually given in combination with **right ascension** or **hour angle**.” See also (p. M2) “**celestial equator:** [...] Colloquially, the projection onto the **celestial sphere** of the Earth’s **equator**. [...]” See also (p. M6) “**hour angle:** angular distance on the **celestial sphere** measured westward along the **celestial equator** from the **meridian** to the **hour circle** that passes through a celestial object.” See also (p. M6) “**hour circle:** a great circle on the **celestial sphere** that passes throught the **celestial poles** and is therefore perpendicular to the **celestial equator**.” See also (p. M12) “**right ascension:** angular distance on the **celestial sphere** measured eastward along the **celestial equator** from the **equinox** to the **hour circle** passing throught the celestial object. Right ascension is usually given in combination with **declination**.”
15. Sequential observation numbers have been annotated to Airy’s table for clarity.
16. *Ibid.*, p. 38.