Concerning the Aether

by E. Gehrcke

from "Über den Äther" (1918) in Verhandlungen der Deutschen Physikalischen Gesellschaft, 20, 165-169.
(originally submitted 5 September 1918)

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Translator’s Preface

Ernst Gehrcke (1878-1960) played a significant part in the criticism of relativity in the early 1920s. He and Einstein both lived in Berlin at that time, so their paths crossed — notably at the protest meeting at the Philharmonic in August 1920, (see "PS(ii)" below). Scientifically, Gehrcke is probably best remembered today for the Lummer-Gehrcke optical interference plate.

Also see Einstein’s brief reply in German (1918, ibid. p261) to this present Gehrcke paper, or the translation of it on this website: Comment on E. Gehrcke’s Note: Über den Äther. By now, there is also presumably an official translation in Einstein’s collected papers (volume 7), but I do not have ready access to it.

Brief background information: http://www.wikipda.de/infos/ai/an/antirelativismus.html which lists Gehrcke, Lenard, and some others of like mind at that period. (Text in German).

Very extensive source: www.ekkehard-friebe.de/kap0.pdf to www.ekkehard-friebe.de/kap8.pdf (a 1159-page online book by G.O.Mueller) — best accessed by trying to call-up the non-existent chapter www.ekkehard-friebe.de/kap9.pdf which then results in a menu of those chapters which do exist. Although the main text is mostly in German, there is still much here for non-German readers interested in relativity criticism, including (i) a large number of references to publications and sources, many in English, (together with their descriptive-titles if you look in the right place, e.g. at the end of each subsection in chapter 2, in Arial font); (ii) multiple lists and chronologies, sorted various ways; (iii) occasional important quotations in English. [File sizes are as follows: kap0=223KB; kap1=147KB; kap2=752KB; kap3=775KB; kap4=2274KB; kap5=166KB; kap6=561KB; kap7=520KB; kap8=220KB. —— "kap"="Kapitel"=Chapter.]

In the present text, my own comments are shown in three ways, often in combination: •violet colour, •by square brackets "[. . .]" and/or •as footnotes marked by letters (A,B,C, ...). Gehrcke’s original footnotes are marked by (1),(2),(3),...).

In the interest of clarity, I have subdivided some excessively lengthy passages. Gehrcke’s original seven paragraphs are here labelled "[1] to [7]."

[1] For some time, it has been said that the aether is dead. However it is rising again to new life as is shown, for example, in a recent account by Lenard (1). In support of this scientific trend, which once again recognizes the aether and respects it as an indispensible aid to theory, I would like to contribute the following note.

Footnote (1): P. Lenard (1918), Jahrbuch der Radioaktivität und Elektronik 15, 117.

[2] At present it is a rather widely-held assumption, that the finding of the famous Michelson mirror-research into the
detection of an aether-drag with the moving Earth is inconsistent with the fact of the aberration of [light from the] fixed stars; and that the aberration could only be understood in terms of a [universally]-resting aether, not-dragged by the Earth. However this view is wrong. Already Stokes has shown that, if one pictures the Earth as carrying the [local] aether with it, then aberration follows naturally, qualitatively and quantitatively. Then also the negative finding of Michelson's investigation is immediately clear. —

There is, e.g., a brief account referring to Stokes' theory in the 3rd edition (2) of Drude's Optik; and a fuller reference by H.A.Lorentz (3), who, although he is the chief advocate for the rival notion of an absolutely resting, immobile aether, has put the case for Stokes' theory with commendable objectivity. In these circumstances it is surprising that Stokes' theory has not generally been accepted as a serious and original attempt at solving the problem of aberration.

Footnote (2): Pages 470 ff. [3rd Ed, German version of Drude. There seems to be no such reference to Stokes in the 1959 English edition, presumably translated from the 2nd edition of 1902.]


Footnote A: G.G.Stokes (1845 Jul) "On the aberration of light" Philosophical Magazine (3), 27, 9-; or from his Mathematical and Physical Papers, 1, 135-140. (1966) — [also cited by Lorentz, (1916, p169)]

Footnote B: G.G.Stokes (1846 Feb) "On Fresnel's theory of the aberration of light" Philosophical Magazine (3), 28, 76-; — or from his Mathematical and Physical Papers, 1, 141-147. (1966)

[3] However at first sight it now seems that, for the concept of the Earth-accompanying aether, there is a certain difficulty: that there are known to be several laboratory-experiments which hardly allow any other interpretation than that the light-carrier, the aether, would not be dragged along by moving matter.

This is what we find e.g. in Fizeau's interference experiment, C that a light-ray, which propagates in the direction of the streaming water by which it is in no way carried along: the light-carrying aether in the streaming water remains lying motionless. In other experiments one observes the same: here the observers declare themselves uneasy about the assumption that the aether would remain stationary and not be dragged by moving bodies.

Footnote C: [presumably A-H-L Fizeau's "On the Effect of the Motion of a Body upon the Velocity with which it is traversed by Light" — (Dec.1859) Annales de Chimie et de Physique — of which the English version is: (Apr. 1860) Philosophical Magazine (4th series), 19(127), 245-260].

[4] But now we need to notice that the optical and electro-magnetic experiments on small moving masses would entail trivial velocities. Then in opposition to this, the Michelson mirror-experiment and the aberration of the fixed-stars have to do with the huge Earth as the moving body, which travels at 30 Km/sec around the Sun. In these circumstances the simplest resolution seems to me to be this:

The aether is so constituted that it would not be dragged by trivial masses of trivial velocity, but rather by large and rapidly moving masses such as the Earth. Now every difficulty disappears, and it would thus achieve a reconciliation of the opposing viewpoints: the absolutely resting motionless aether of Fresnel and the moveable rotation-free aether of Stokes would be one-and-the-same, though under various extra conditions.

The notion that the equations of this aether are unknown to us, would not upset the nature-researcher who know that nature does not shrink from mathematical difficulties. Here one separates the mathematical form of the aether equations altogether, and it has much more to do with the question of existence, whether it is true — that there is an aether and what its properties are.

Footnote A: G.G.Stokes (1845 Jul) "On the aberration of light" Philosophical Magazine (3), 27, 9-; or from his Mathematical and Physical Papers, 1, 135-140. (1966) — [also cited by Lorentz, (1916, p169)]

Footnote B: G.G.Stokes (1846 Feb) "On Fresnel's theory of the aberration of light" Philosophical Magazine (3), 28, 76-; — or from his Mathematical and Physical Papers, 1, 141-147. (1966)

[5] A beautiful experiment by Sagnac (4) shows most directly that the aether remains with the slow motions of earthly bodies: A mirror-configuration for achieving interference fringes, an analogue of the Michelson mirror-experiment, is set up on a rotating disc. The whole apparatus, including the light-source, rotates with constant angular velocity. If the aether were caught up in this rotation, there would be no displacement of the interference fringes. However Sagnac finds a displacement proportional to the angular velocity and eliminates the actual [rectilinear?] magnitude and direction, so that his apparatus rotates "in the aether-wind". This finding, which is positive, in opposition
to the negative attempt by Michelson, thus supports the earlier experiments of Fizeau etc. in the sense of a Fresnel aether, not [wholly] dragged.


[6] The Sagnac experiment allows yet further prospects. Apart from the above, one could use Sagnac's arrangement to investigate whether the aether also stays at rest if the rotating body is a compact mass of lead which surrounds the investigated light-ray thickly on all sides. —  
This question cannot be answered without experiment, though that would be worth the effort. —  
Apart from posing this and similar experimental questions, one can also extract an interesting fundamental aspect of the problem from the the Sagnac experiment. His result suggests the impression: that absolute rotation is optically provable. Here the "absolute" rotation would be understood as being relative to the aether.D

Footnote D: The phrase "relative to the aether" potentially lands us in a philosophical minefield! Of course there is no problem if we are working with a uniform undragged aether. Otherwise we need some formula for integrating or summing the effects of different parts of the overall aether, suitably weighted according to proximity or whatever, and with proper attention to any delayed effects and all that entails. — [RRT]

According to our previous understanding, the absolute rotation could only be determined mechanically, namely through the centrifugal force of rotating masses; but now Sagnac's optical research is a welcome supplement to the mechanics. If one has proposed "absolute" motion as being "relative to the aether", then the question arises secondarily, whether this motion results in bent-or-straight lines, uniform-or-heterogeneous lines. The proof of straight, uniform motion can be technically difficult or quite impossible, however there must exist an absolute, straightline and uniform motion even so, just as the absolute rotation exists, or else an absolute motion.

Now the Sagnac experiment suggests that we think out an arrangement which also makes the absolute straightline-uniform optical translation. One need only set up the Michelson mirror-experiment on some sort of rapidly moving vehicle such as a car or aircraft, instead of using the Earth as base. Then, to judge by Sagnac's experiment, one must find the shift in the interference-fringes vainly saught-after by Michelson; for these technical apparatuses will not [significantly] drag along the local aether in the way that the Earth would. 

So simple is this experiment to set up in thought, but so difficult does it turn out in its real-life execution, especially since the second power of the velocity-ratio is negligible. E However it means despairing of the advance of science if one holds that whatever is difficult today, will forever be unattainable — and it would be somewhat audacious on that account to hold that no proof of absolute translation was possible, simply because until now no-one has succeeded.

Footnote E: "velocity-ratio" is my more-readable abbreviation for: "the translational velocity relative to the velocity of light" ——— [RRT]

[7] To close this exposition one might be permitted a short word on the work of Gerber on the gravitation, brought to light by me. Herr von Seeliger[5] has contested the correctness of this theory and taken pains to show up a "mistake" in Gerber's derivation. Herr von Seeliger has however firstly not stressed that Gerber's formula for the Mercury-[orbit] perturbation is independent of the paths chosen by Gerber. However one need only change the constants of Weber's electrodynamic potential:

\[ V = (\mu/r) \left[ 1 - \left(1/c^2\right) (dr/dt)^2 \right] \]

and substitute \((3/c^2)\) instead of \((1/c^2)\), in order to immediately achieve Gerber's force-law in the usual way:

\[ K = -{(\mu r^2)} \left[ 1 - \left(3/c^2\right) (dr/dt)^2 + \left(6r/c^2\right)(d^2r/dt^2) \right] \]

and hence achieve the correct value for the Mercury perturbation using fundamentals of \(c\), the velocity of light. It thus
remains true throughout, that one can also attain the Gerber formula (reached by Einstein through relativity considerations) in a simpler way, in principle.

Footnote F: Paul Gerber (1917 May) "Die Fortpflanzungsgeschwindigkeit der Gravitation", Annalen der Physik (4), 52(4), 415-444. [ie. "The propagation-velocity of gravitation". This paper originated in 1898 as a summary in Zeitschrift für Mathematik und Physik 43, 93-104 — next printed in full in a 1902 inhouse journal — and was then reprinted posthumously as noted by this May-1917 reference, with Gehrcke's support and introductory footnote].


Footnote G: This almost certainly refers to Wilhelm Eduard Weber (1804-1891), though I have not yet found the exact reference. Suggestions?

Footnote H: As in other German texts, "K" is here used for force (Kraft). Also the last term of this equation in Gehrcke's original text is given as "(d²r/dt²)" instead of (d²r/dt²).

Secondly Herr von Seeliger ignores the fact that the connection between potential and force throughout, need not be general as he assumes. He presupposes that only mechanical energies (potential and kinetic) are available. If, for example, gravity is to be bound to an absorption of gravitational energy, then a further energy-total would be added — and the potential would not be adequate for the required work, which Herr von Seeliger expects of it.

So my contribution here is to point out that henceforth Gerber's honour remains intact in claiming to have derived the constants of the aether, the velocity of light, from a gravitational phenomenon.

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**Consolidated References in Chronological Order**

Gehrcke's own details are in dark blue.
The translator's additions are coloured violet.


Stokes, G.G. (1845 Jul) "On the aberration of light" Philosophical Magazine (3), 27, 9-; or from his Mathematical and Physical Papers, 1, 135-140. (1966) — [cited explicitly by Lorentz, (1916, p169)]


Fizeau, A-H-L (1851) "Sur les hypothèses relatives à l'éther lumineux, et sur une expérience qui paraît démontrer que le mouvement des corps change la vitesse avec laquelle la lumière se propage dans leur intérieur", Comptes rendus, 33, 349- — [cited by Lorentz, (1916, p.190)]

Fizeau, A-H-L (1859 Dec.) "On the Effect of the Motion of a Body upon the Velocity with which it is traversed by Light". Annales de Chimie et de Physique — of which the English version is: (1860 Apr) Philosophical Magazine (4th series), 19(127), 245-260. [Footnote C]


Drude, Paul (3rd German Ed., 1912). Optik. [Cited informally by Einstein (1918 Nov). Also cited again by Gehrcke (1919 Feb, p.68), where he quotes a paragraph from Drude's p.472ff. The 1959 English edition (Dover: NY) seems to lack the passage in question. The previous German editions were 1900 and 1902.]

Gerber, Paul (1917 May) "Die Fortpflanzungsgeschwindigkeit der Gravitation", Annalen der Physik (4), 52(4), 415-444. [ie. "The propagation-velocity of gravitation". This paper originated in 1898 as a summary in Zeitschrift für Mathematik und Physik 43, 93-104 — next printed in full in a 1902 inhouse journal — and was then reprinted posthumously as noted by this May-1917 reference, with Gehrcke's support and introductory footnote].

Seeliger, H, v. (1917 Oct) "Bemerkung zu P.Gerbers Aufsatz: 'Die Fortpflanzungsgeschwindigkeit der Gravitation' " Annalen der Physik (4). 53(9), 31-32. [Seeliger cites Gehrke (1916 Sep); and also Gerber (1917 May), the paper reprinted from 1898 and 1902 with Gehrcke's support].

Lenard, P. (1918), Jahrbuch der Radioaktivität und Elektronik 15, 117.

Gehrcke, E. (1918) —— This Paper ———

