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EDITOR'S PREFACE

This volume is in response to my original call (as reproduced here) for papers. As editor, typist, and publisher I must accept full responsibility for the result. The ideas expressed, however, are the responsibilty of the individual authors. Essentially all papers received have been included. Only three or four papers that did not fulfill certain minimum criteria, such as not having an abstract, being too long, not arriving on time, etc. have not been included. When a volume, such as this, again becomes desirable, I hope that some-one-else will take over the chore of being editor.

The need for this volume should be evident to those of us doing research in space-time physics. The corrupt journal system of communication with its anonymous censors generally permits only sterile "establishment" ideas to be heard. (One example: Lester Guttman, Editor of the Journal of Applied Physics refused to publish a paper of mine last spring (The paper is presented here, page 170) after it had been accepted for publication by his own two secret referees. Guttman, who is obviously completely ignorant of the facts involved, decided that any experimental evidence against Maxwell's electrodynamics must be censored out. Apparently such heresy, like pornography, is not suitable to present to his poor defenseless, gullible, impressionable, immature readers of the J. Appl. Phys. Guttman simply ignored his responsibilty to the author (myself), to his two referees, to the world physics community, to the American Physical Society, to the American Institute of Physics, and finally to the American tax payer who helps pay for his journal with his flagrant disregard of the most elementary ethics. Etc.) This volume has been called into existence to circumvent the journal-system bottleneck with its anonymous censors. This volume makes it possible for space-time specialists to communicate freely with each other. Ideas are freely expressed here whether right or wrong, accepted or unacceptable, believable or unbelievable, serious or ridiculous, supported by government grants or not supported by government grants, or accepted by editors' anonymous referees or rejected by anonymous referees. Only such a free exchange of ideas can lead to the necessary progress in physics that all of us researchers in space-time physics so strongly desire.

Because the papers presented in this volume have not been reviewed, censored, or edited; they may lack the polish that one is accustomed to in the "establishment" journals. The references may not be complete; the equations may have errors; the word order may be wrong; etc. This roughness is what one must unfortuantely accept in order to get really fresh spontaneous creative thought, which is so lacking in the "establishment" literature.

I personally find most of the ideas expressed in this volume unacceptable to me for one reason or another. But ideas, right or wrong, are what we need. What is lacking in the "establishment" literature is ideas. This volume presents a sort of small supermarket of ideas. Most of the ideas, like most of the wares in a supermarket, one may not wish to buy; but now and then there is a bargain well worth the price.

But what is "space-time physics"? Is it simply what one does with a meter stick or a clock in the laboratory? Unfortunately I cannot give a simple definitive definition of "space-time physics". However, it is clear that all of physics is necessarily based upon primitive ideas of "space" and "time". "Space-time physics", thus, is undoubtedly the most basic and fundamental of all areas of physics. To investigate space-time physics one necessarily becomes immediately involved with the behavior of light, basic mechanics, electrodynamics, gravitational theory, quantum theory (Is length quantized? Is time quantized?), the theory of measures, etc. In this volume there is much speculation in many basic areas of physics which are all relevant to space-time physics.

Electrodynamics is considered in many papers here. Because of the highly technical matters considered; the relevancy to space-time physics may not be always immediately apparent. Never-the-less it is probably the most important "touch stone" for space-time physics. Does the "Lorentz covariance" of the Maxwell electrodynamics imply a "Lorentz transformation" of space and time as claimed by the champions of "special relativity"? Or does the original Ampere law for the force between current elements, which now seems to be established experimentally, and which is not "Lorentz covariant", imply some other space-time ?

Unfortunately, in a Preface of a book on space-time physics an editor must mention the poor dying thing called "special relativity".

It came into this world a sick deformed creature that a sensitive midwife should have kindly allowed to die. It now survives only by virtue of an artificial lung, a kidney transplant, a heart pace-maker, a toupee, artificial feeding with tubes through the nose, kindly, anxiously, and attentively assisted by a host of dedicated believers. The absurdities of "special relativity" have now been piled upon the poor dying thing by the hundreds (if not thousands) of volumes; I need not say anything further here.

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You are invited to make a contribution to the volume

PROGRESS IN SPACE-TIME PHYSICS 1987.

This volume is to take the place of an international conference on space-time physics such as the International Conference on Space-Time Absoluteness held in Genoa, Italy in 1982. There are too few people involved in space-time physics; they make only infrequent contributions; and they are too widely scattered over the world to make another international conference practicable at this time. The volume will help us all to keep abreast of the research that is being done in the area.

To save time and to facilitate the publication of the volume your manuscript will be photo-duplicated, if of adequate quality, to be offset printed. You should try to keep your manuscript in the format and style of the enclosed example paper. Since the volume must be sold; it must be kept as small as possible. Your paper should not be over about 20 typewritten pages. It should arrive here not later than the 30th December 1986. The editor, myself, will retype, rewrite, and edit your manuscript if necessary and return it to you for your final approval.

Since papers that are pro "special relativity" or "general relativity" are already adequately represented in standard journals; they are not appropriate for PROGRESS IN SPACE-TIME PHYSICS 1987.

The price of the volume will depend upon its size and costs; but it will not exceed $60 US dollars.

In case I have neglected anyone who should contribute to the volume, it would be appreciated if you would let the person know that the volume is to be published and that his contribution would be welcome.

Sincerely yours

J P Wesley

CONTENTS

Marinov's Toothed-Wheels Measurement of Absolute Velocity of Solar System

J. P. Wesley

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Marinov reports measuring the absolute velocity of the closed laboratory using two toothed wheels mounted on the ends of a rotating shaft. Light incident on the first toothed wheel is chopped. As it arrives at the second toothed wheel later, due to the finite time it takes light to travel down the shaft, it is again chopped by the second toothed wheel. The amount of light that gets through measures the oneway time-of-flight velocity of light in the direction of the shaft. By directly comparing the results for beams travelling in opposite directions the absolute velocity is directly measured, $v = \left[(c + v) - (c - v)\right]/2$. He reports the absolute velocity of the solar system as $v = 360 \pm 40$ km/sec, $\alpha = 12 \pm 1^h$, $\delta = -24 \pm 7°$, in agreement with the results from the 2.7°K cosmic background anisotropy and Marinov's coupled mirrors experiment. The errors he reports are consistent with his experimental setup and procedure.

1. INTRODUCTION

It is of considerable importance to examine Marinov's claim[1]:

I) It contradicts *special relativity*, which assumes the velocity of light is uniquely c fixed relative to the moving observer.

II) It provides an additional independent measurement of the absolute velocity of the solar system.

Considering point I) above there exists considerable dissatisfaction with *special relativity* already[2-7]. It would also seem that the observations of Roemer and Bradley[8,9], the Sagnac experiment[10], the 2.7°K cosmic background anisotropy[11], and the Marinov coupled mirrors experiment[12] give firm evidence that the velocity of energy propagation of light is, in fact, c fixed relative to aboslute space. In addition, assuming absolute space exists, it would appear that a moving observer must see two wave velocities for light, the phase velocity and the velocity of energy propagation, and not merely a single unique wave velocity of light as is usually assumed[13]. These two wave velocities need not have the same magnitude nor direction. It is, thus, very important to know if more independent experimental evidence is now available that can confirm the fact that the velocity of energy propagation of light is c fixed relative to absolute space.

Considering point II) above, presently the only two reliable determinations of the absolute velocity of the solar system are: 1) the anisotropy of the 2.7°K cosmic background radiation[11] and 2) the Marinov coupled mirrors experiment[12]. The 2.7°K background anisotropy provides one place accuracy. The Marinov coupled mirrors experiment provides slightly better accuracy; although with little difficulty it can be readily improved to give two, three, or even four place accuracy[14]. The Marinov toothed wheel experiment provides still a third independent method for determining the absolute velocity of the solar system. He reports one place accuracy; but it would appear that with some minor improvements that two place accuracy might be easily obtained. It is of some interest to know the absolute velocity of the solar system to as great an accuracy as possible; as three place accuracy might provide the chance of detecting dark neighbors to the solar system.

The primary purpose of this paper is to provide a short understandable and readily available description and critique of Marinov's toothed-wheel experiment, Marinov's own account[1] being neither clear nor readily available. It is hoped that this presentation might encourage an independent repetition of this important experiment.

2. MARINOV'S EXPERIMENTAL ARRANGEMENT[1]

Two toothed wheels consisting of 40 round holes of diammeter b = 6 millimeters drilled equi-angular distance from each other at a radial distance R = 12 cm from the center of two circular steel plates were

mounted on a common shaft d = 120 cm from each other as indicated in Fig. 1. The shaft was driven at the center by a variable speed motor N revolutions per second. An Argon laser illuminated the holes on the entrance wheel. A silicon photocell detected the light passing out of the exit wheel. The entire apparatus was enclosed in a vacuum.

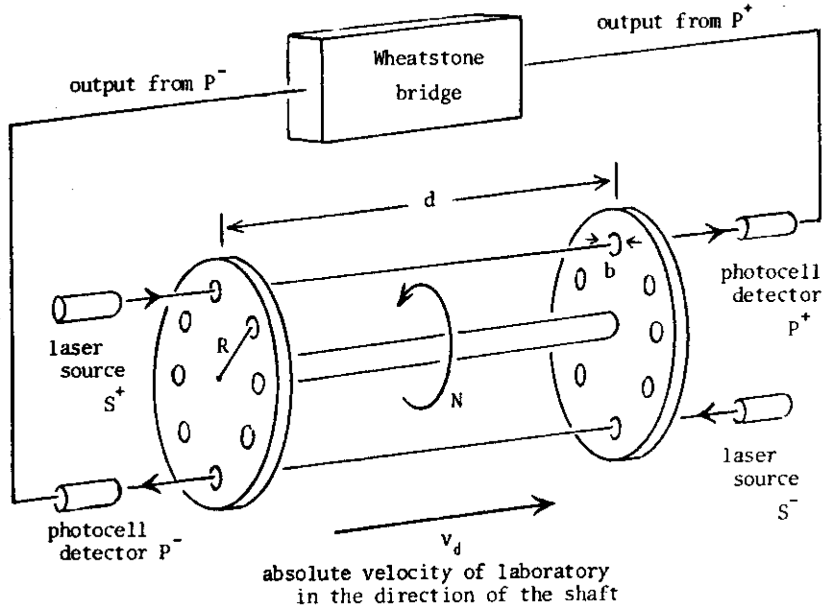

Fig. 1. A diagram of the Marinov toothed-wheel experiment to measure the absolute velocity of the closed laboratory.

3. THEORY FOR ONEWAY TIME-OF-FLIGHT VELOCITY OF LIGHT

Although the present paper is concerned with the direct measurement of the absolute velocity of the closed laboratory; and it is not concerned with the measurement of the oneway time-of-flight velocity of light; in order to develope the theory and to indicate how possible errors may be estimated it is convenient to first present the hypothetical example of how one might measure the oneway time-of-flight velocity of light.

It might be thought that one need merely measure the oneway time-of-flight velocity of light in two opposite directions and by subtracting them obtain the absolute velocity of the laboratory. This is in principle possible; but in practise the experimental errors for the measurement of the oneway time-of-flight velocity in either direction are too large. It is only by balancing the two results directly in a Wheatstone bridge that significance can be obtained; and the absolute velocity of the laboratory can be measured.

The rotating entrance wheel chops the light beam. The rotating exit wheel chops this signal again but at a later time Δt, the time for a pulse of light to travel down the length of the shaft d. If the observed time-of-flight velocity of light in the direction of the shaft is c^*, then

$$\Delta t = d/c^*. \tag{1}$$

If the time-of-flight velocity of light is fixed as c relative to absolute space, then

$$c^* = c - v_d. \tag{2}$$

where v_d is the component of the absolute velocity of the laboratory in the direction of the shaft.

The two wheels, being rigidly mounted to the same shaft, can be optically aligned by simply altering the inclination of the light beam relative to the axis of rotation. If the beam is aligned to achieve a certain intensity I_0 (chosen as one half the maximum possible, $I_0 = I_{max}/2$, to optimize the sensitivity) when $N = 0$, then the intensity must change as N increases and as the alignment of the éntrance and exit holes changes relative to the chopped light pulse. Ideally for square holes of width b that can be perfectly aligned the fractional change in intensity is simply proportional to the fractional mismatch created by the time it takes light to travel between the two toothed wheels; thus,

$$\Delta I/I_0 = 2\Delta b/b, \tag{3}$$

where

$$\Delta b = 2\pi RN\Delta t. \tag{4}$$

It may be readily appreciated that for round holes and including possible effects from diffraction and vibrations $\Delta I/I_0$, will be simply a linear function of $2\Delta b/b$, if $\Delta I/I_0$ is small, as is the case. In general then Eq. (3) may be replaced by

$$\Delta I/I_0 = 2K\Delta b/b, \tag{5}$$

where K is some constant of proportionality. If this constant of proportionality were desired, it could be measured directly or it could be estimated theoretically. Combining Eqs. (1), (4), and (5) then gives the oneway time-of-flight velocity of light as[15]

$$c^* = (KI_0/\Delta I)(4\pi RNd/b). \tag{6}$$

4. THEORY TO FIND THE ABSOLUTE VELOCITY OF THE LABORATORY

Marinov sent simultaneously laser beams in opposite directions through his toothed wheel apparatus which were detected by two independent photocells, as shown in Fig. 1. He measured the difference δI in the intensities registered by the two photocells directly using a Wheatstone bridge for the outputs. Letting the two light velocities involved be

$$c_-^* = c + v_d \qquad \text{and} \qquad c_+^* = c - v_d, \tag{7}$$

Eq. (6) yields the component of the absolute velocity in the direction of the shaft as

$$v_d = (c_-^* - c_+^*)/2 = (\delta I/\Delta I_- \Delta I_+)(4\pi KI_0 RNd/b), \tag{8}$$

where $2\delta I = I_- - I_+ = |\Delta I_-| - |\Delta I_+|$ and ΔI_- and ΔI_+ are the intensity differences registered in the two directions. It may be readily appreciated that to within a negligible second order error of the order of $(\delta I/\Delta I)^2$ or $(v_d/c)^2$ that

$$\Delta I_- \Delta I_+ = (\Delta I)^2, \tag{9}$$

where ΔI may be taken as the intensity when $v_d = 0$ or as $2\Delta I = |\Delta I_-| + |\Delta I_+|$. Combining Eqs. (8), (9) and (6) (for the case $v_d = 0$) then gives the desired result

$$v_d = (\delta I/\Delta I)c. \tag{10}$$

To double his sensitivity and to obviate certain possible errors in alignment of his apparatus Marinov employed the strategem of measuring the change in intensity ΔI when the shaft was rotated in both senses. Because when $N = 0$ the intensity I_0 was chosen as 1/2 the maximum intensity, I_{max}; the change in intensity was positive for one sense of rotation and negative in the opposite sense. The effective intensity change that could be measured was, thus, doubled. The intensity change ΔI was then taken as

$$2\Delta I = |\Delta I(\text{clockwise})| + |\Delta I(\text{counter clockwise})|. \qquad (11)$$

Marinov used the same strategem when measuring δI, averaging the results for the shaft rotating in the two possible senses. If the intensities are broken down into I_0, a part ΔI that depends merely upon the average velocity of light c (where v_d may be regarded as zero), and a part that depends upon the absolute velocity of the laboratory δI, then the four possible situations considered by Marinov experimentally are listed in Table 1. The observed intensity difference was, thus,

Table 1. Four intensities involved in Marinov's toothed-wheel experiment.

case	light direction		sense of rotation	intensity
a	$c + v_d$	⟶	↺	$I_a = I_0 + \Delta I + \delta I$
b	$c + v_d$	⟶	↻	$I_b = I_0 - \Delta I - \delta I$
c	$c - v_d$	⟵	↺	$I_c = I_0 + \Delta I - \delta I$
d	$c - v_d$	⟵	↻	$I_d = I_0 - \Delta I + \delta I$

$$4\delta I = (I_a - I_c) - (I_b - I_d). \qquad (12)$$

It was found to be impossible to align the apparatus so that the two beams in opposite directions were precisely equivalent. Thus, in fact, $(I_0 + \Delta I)_a - (I_0 + \Delta I)_c = I'$ and $(I_0 - \Delta I)_b - (I_0 - \Delta I)_d = I''$ were not precisely zero. A residual constant error $(I' + I'')/2$ remained in the determination of δI. It is clear that this asymmetry could have been easily taken into account if the apparatus had been mounted on a turn table and turned through 180° to repeat the observations. Averaging the two results would have then removed this constant error. Since Marinov's equipment was rigidly fixed to the earth and could not be

be rotated; he resorted to the following strategem:

5. TWELVE HOUR OBSERVATIONS TO DETERMINE THE ABSOLUTE VELOCITY OF THE LABORATORY

Marinov placed his shaft in the north-south direction horizontal to the earth's surface. At the latitude of Graz, Austria, where the experiment was performed, as the earth rotated, the shaft moved on the surface of a cone making an angle of 47° with respect to the axis of the cone, which was parallel to the axis of the earth's rotation. Thus, Marinov had to merely wait 12 hours for the earth to rotate his equipment through 180° as far as the component projected onto the earth's equitorial plane is concerned. It was, therefore, an easy matter to subtract off the constant error $(I' + I'')/2$, mentioned above, by making observations over 12 or more hours without changing any alignments.

6. DETERMINATION OF THE DIRECTION OF THE ABSOLUTE VELOCITY OF THE SOLAR SYSTEM

Because the component of Marinov's shaft projected onto the earth's equitorial plane sampled all possible directions in this plane after 12 hours of observation, and because the component of the shaft projected onto the earth's rotational axis provided the remaining direction to be sampled; straightforward trigonometry provided the direction of the absolute velocity of the earth on the day observations were made.

The absolute velocity of the solar system (i.e., the sun) was then obtained by simply subtracting off the earth's orbital velocity with respect to the sun (which was, in fact, only of the order of the error that he reports for his observations). The tangential velocity of the earth's rotation, which is less than the error Marinov reports, did not enter in due to the north-south orientation of the shaft of his apparatus.

7. DISCUSSION

The final formula (10) for v_d involves only the intensity differences δI and ΔI. Only these two quantities need be examined to determine the random or experimental error. Is the error of 11% reported by Marinov reasonable? This can be best estimated by considering $4\Delta I/I_0$

and $4\delta I/I_0$. The factor 4 arises from the increased sensitivity due to two senses of rotation being used and due to the two directions of light travel being used. From Eq. (6), setting $c^* = c$, the fractional value $4\Delta I/I_0$, according to the numbers provided by Marinov, where he estimated the value of K theoretically for round holes as 9/2, is

$$4\Delta I/I_0 = K16\pi RNd/cb \approx 5 \times 10^{-3}. \quad (13)$$

To obtain ΔI it was necessary to subtract separate readings on a galvanometer. Separate large readings on a galvanometer can be usually made to about 1% accuracy. Thus, the theoretical and the experimental estimate of the fractional error are roughly the same.

The determination of δI was quite different. Here the difference was measured directly on a Wheatstone bridge. Differences of the order of $\delta I \approx 10^{-3}\Delta I \approx 5 \times 10^{-6}$ milliamps could be measured. Since $\delta I/\Delta I$, varying as v_4/c, Eq. (10), is, in fact, about 10^{-3}, as known from the 2.7°K anisotropy[11] and the Marinov coupled mirrors experiment; the fractional errors to determine $4\delta I/I_0$ and $4\Delta I/I_0$ are comparable.

The highest current Marinov recorded for I_0 was 21 milliamp.; and the maximum difference associated with the difference δI was about 6×10^{-5} milliamps. This means a fractional intensity difference of $4\delta I/I_0 \approx 10^{-5}$ was recorded. Others have also reported being able to measure such intensity differences down to a level of 10^{-5} using electronic comparisons. From Eq. (10) the fractional error for v_4/c is the sum of the fractional errors of $4\delta I/I_0$ and $4\Delta I/I_0$. As estimated above each of these fractional errors are of the order of 1%; so Marinov's experimentally determined experimental error of 11% seems quite reasonable.

It has been speculated that mechanical vibrations would make it impossible for Marinov to have obtained a positive result. Although it may be true that instantaneous mechanical distortions produced misalignments resulting in an instantaneous error of the order of 10^{-5} in fractional intensity; observations were not taken instantaneously. Observations were averaged over a time span long in comparison to the period of any mechanical vibrations of interest. Even if vibrations of the order of 10^{-3}cm existed, the fractional error produced by holes of 0.6 cm would be much less than Marinov's reported error. It seems clear that vibrations could not possibly have affected the results. And Marinov reports, consistent with this estimate, no difficulty with vibrations.

It is difficult to imagine systematic errors that might have distorted Marinov's results. Since the apparatus was evacuated, no atmospheric effects could enter in. No temperature effects were involved, as there was no large time lapse between the measurements of δI and ΔI.

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$v = 303 \pm 20$ km/sec, $\alpha = 13.3 \pm 0.3^h$, $\delta = -21 \pm 4°$.

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Silvertooth's Standing-Wave Measurement of Absolute Velocity of Solar System[a,b,c]

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The first order Doppler effect for light propagated with a velocity **c** relative to the ether gives a wavelength $\lambda = cT(1 - \mathbf{v}\cdot\mathbf{c}/c^2)$ for an observer moving with the velocity **v** where T is the period. A standing optical wave pattern established in a closed ring then experiences an additional phase shift when the light path parallel to **v** is decreased by $-\Delta$ and antiparallel by $+\Delta$. This additional phase shift, when π relative to a monitoring signal not sensitive to **v**, gives the velocity of the observer relative to the ether as $v = \lambda c/2\Delta$. The velocity of the solar system relative to the ether is found to be 378 ± 8 km/sec in the direction of right ascension $\alpha = 11 \pm 1^h$ and declination $\delta = -20 \pm 2°$ in reasonable agreement with the 2.7°K background anisotropy and Marinov's coupled mirrors experiment and his toothed wheels experiment.

I. INTRODUCTION

The experiment described here is not the first that has detected absolute space or the ether. The observations of Roemer[1] in 1676 and repeated by Halley[2] and Bradley[3] in 1728 are most easily interpreted in terms of the velocity of light (energy propagation) being c fixed relative to absolute space or the ether. Sagnac's[4] experiment and the Michelson-Gale[5] experiment provide further evidence for the existence of absolute space or the ether.

The observation of the 2.7°K thermal background radiation anisotropy[6] provided for the first time a numerical estimate of the absolute velocity of the solar system through the ether. Marinov's[7,8] coupled mirrors experiment and his toothed-wheels experiment, involving the chopping of a light beam with a rotating cylinder, provided further independent corroborative estimates of the numerical value of the absolute velocity of the solar system through the ether.

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[a]E. W. Silvertooth, Star Route Box 166, Olga Washington 98279, USA.

[b]Silvertooth's experiment was sponsored in part by the Air Force Systems, Rome Development Center, Griffith AFB and Defense Advanced Research Agency.

[c]As Silvertooth declined to submit a manuscript for this volume; this paper has been written from some material he left with the auther, some conversation and some letters from Silvertooth. Hopefully the author has not made any essential mistakes in his description of Silvertooth's brilliant experiment.

The Silvertooth experiment, described here, for the first time measures the absolute velocity of the solar system through the ether without using any moving equipment and is performed in the closed laboratory.

II. EXPERIMENTAL SETUP, THEORY, AND PROCEDURE

Figure 1 displays the essential features of the experimental setup. Light from a HeNe laser L of wavelength 6328 Å is split by the semi-transparent mirror M_1 and the mirror M_2 into two oppositely directed beams which establish a standing optical wave around the ring defined by mirrors M_3, M_4, M_5, and M_6. It is important to note that the light waves involved are never reflected back on themselves; so that only *oneway* light travel is involved. It might be better to characterize the pattern as an interference pattern produced by two independent oppositely directed coherent light beams.

The intensity at a point in the standing optical wave pattern was measured with a very thin detector D[9], a special photomultiplier tube with a thin (about 500Å) semitransparent photoelectric sensitive surface on one window of a two window tube. The intensity in a standing optical wave pattern, the famous Wiener fringes, was first observed in 1890 by Wiener[10] using a photographic film.

It is clear that, when the laser source mounted on a movable platform, as indicated in Fig. 1, is displaced a distance Δ, the standing wave pattern will be shifted around the ring accordingly. Neglecting for the moment the effect of absolute space or the ether, the intensity observed by the detector D as a function of Δ is proportional to

$$\cos^2(2\pi\Delta/\lambda), \qquad (1)$$

where $\lambda = cT$.

When the first order Doppler effect in absolute space or ether is taken into account[11] the phase change parallel to the direction of motion of the laboratory due to a displacement of the movable platform by Δ produces a phase decrease of $-2\pi\Delta/\lambda_1$ and antiparallel produces an increase in phase of $+2\pi\Delta/\lambda_2$ for a net change in the intensity of the standing wave pattern proportional to

$$\cos^2\left\{2\pi\Delta/\lambda + \pi\Delta(1/\lambda_2 - 1/\lambda_1)\right\}, \qquad (2)$$

where

$$1/\lambda_2 - 1/\lambda_1 = 1/T(c-v) - 1/T(c+v) \approx 2v/Tc^2 = 2v/c\lambda, \qquad (3)$$

to first power in v/c, where v is the component of the absolute velocity of the laboratory in the direction of the light between mirrors M_3 and M_4; or $v = \mathbf{v}\cdot\mathbf{c}/c$.

In order to obtain the information for the absolute velocity of the laboratory relative to the ether contained in Eqs. (2) and (3) the intensity varying as Eq. (2) was compared with a monitoring signal varying as Eq. (1). The monitoring signal was generated by placing a mirror on the movable platform to form one branch of a Michelson

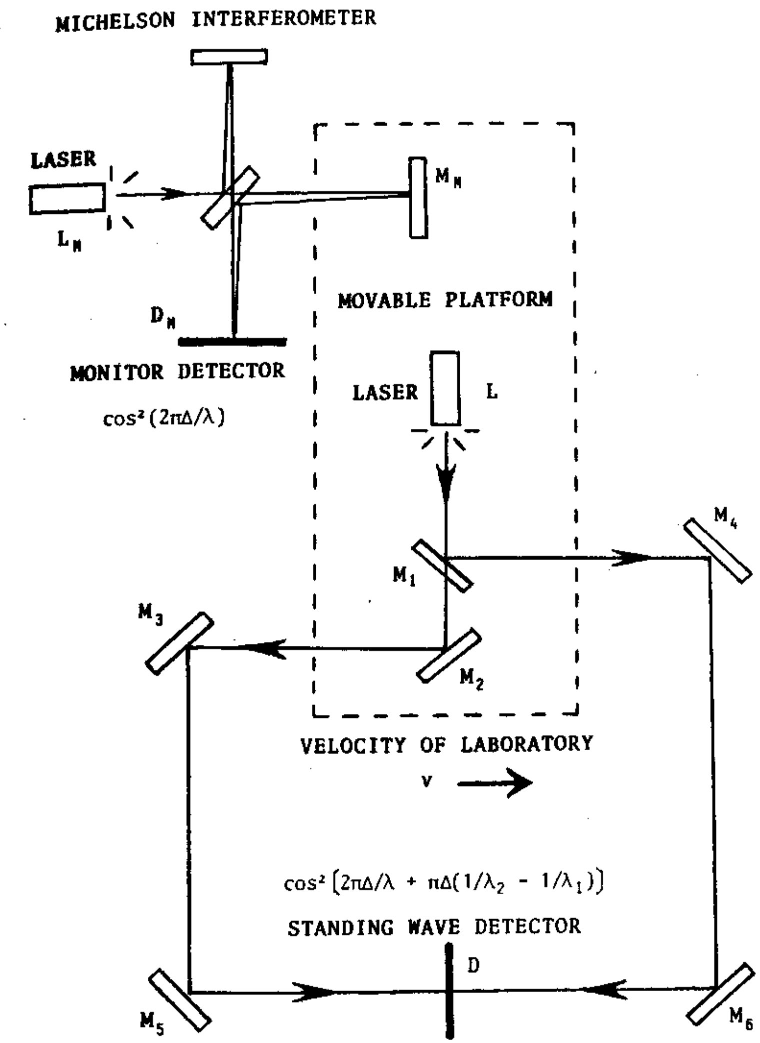

FIG. 1. Experimental setup to generate a standing optical wave in the ring formed by mirrors M_3, M_4, M_5, and M_6 which is shifted in position when the movable platform with the source is shifted a distance Δ. The shift in the position of the standing wave relative to a monitoring signal not sensitive to the velocity of the laboratory yields the absolute velocity of the laboratory through the ether.

interferometer, as shown in Fig. 1, and detecting the resulting intensity. Light, traveling out and back along this branch of the Michelson interferometer, was insensitive to the absolute velocity of the laboratory, as was to be expected from the famous Michelson-Morley null result.

The two outputs as given by Eqs. (2) and (1) were detected by arbitrarily changing Δ sinusoidally with time using a piezoelectric stack and displaying the results on a dual beam oscilloscope. The arbitrarily chosen sinusoidal frequency was used to sweep the display on the oscilloscope. In this way the phase difference between the two outputs, Eqs. (2) and (1), as given by $\pi\Delta(1/\lambda_2 - 1/\lambda_1)$ could be readily observed. When Δ was chosen so that the phase difference was π, Eq. (2) yielded the absolute velocity of the laboratory to first order in v/c as

$$v = c\lambda/2\Delta. \tag{4}$$

The displacement of the movable platform Δ was determined by counting the number of cycles or fringe shifts (a few hundred) registered electronically using the output of the monitor detector D_M in the Michelson interferometer.

III. RESULTS

To obtain a π phase difference between the output Eq. (2) and the monitoring output Eq. (1) the platform, shown in Fig. 1, had to be shifted by about 0.25mm or about 400 wavelengths of light used. The error in the determination of the absolute velocity of the laboratory through the ether, as given by Eq. (4), involved primarily the uncertainty in determining the relative phases of the two outputs as displayed on the dual beam oscilloscope (the π phase difference). Considering the reproducibility of the observations, the fractional error involved was about 2 percent. By allowing the phase difference between Eqs. (1) and (2) to pass through a few hundred cycles (and allowing correspondingly an increase of Δ a few hundred times) the error could be seemingly reduced accordingly.

The error in the determination of Δ did not limit the accuracy of the results, as about 400 wavelengths were counted electronically to obtain Δ and the thickness of the thin detector D was only about 1/10th of a wavelength, which gave a fractional error for Δ of no more than about 0.03 percent.

Since the displayed wave patterns, Eqs. (1) and (2), were the summations or composites of many sweeps; vibrations did not particularly affect the results. The effect of vibrations were simply implicitly included in the 2 percent fractional error of reproducibility of the observations.

The direction of the absolute velocity of the laboratory was determined by noting the orientation of the plane of the surface of the earth at the latitude where the experiment was performed (Olga, Washington, USA) at a particular time of day and choosing a particular direction in this plane by rotating the entire setup as diagrammed in Fig. 1. A few observations during the day were then sufficient to determine the direction of the absolute velocity of the laboratory. The sense of the velocity along this direction was determined by noting in which direction the output Eq. (2) shifted on the oscilloscope with

respect to the monitoring output Eq. (1) as Δ was changed. The absolute motion of the laboratory was found to be away from the constellation Leo. As expected, when the entire setup was rotated to a position 90° relative to the absolute velocity of the laboratory no phase difference between the outputs, Eqs. (1) and (2), could be detected. The tangential velocity of rotation of the earth and the velocity of revolution of the earth about the sun were neglected in the present preliminary experiment; as these velocities are small compared with the absolute velocity of the solar system.

The final result for the absolute velocity of the solar system through the ether obtained by the present method is found to be 378 ± 8 km/sec in the direction of right ascension $\alpha = 11 \pm 1^h$ and declination $\delta = -20 \pm 2°$. This result may be compared with the result of Henry (the best of the measurements of the 2.7°K thermal background anisotropy) of 320 ± 80 km/sec, $\alpha = 10 \pm 4^h$, and $\delta = -30 \pm 25°$, with the result of Marinov's coupled mirrors experiment of 303 ± 20 km/sec, $\alpha = 13.3 \pm 0.3^h$, $\delta = -21 \pm 4°$, and with the result of Marinov's toothed-wheels experiment of 360 ± 40 km/sec, $\alpha = 12 \pm 1^h$, $\delta = -24 \pm 7°$. The agreement among these four completely independent experimental methods for the determination of the absolute velocity of the solar system through the ether is satisfactory considering the experimental errors involved.

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A SIMPLIFIED REPETITION OF SILVERTOOTH'S MEASUREMENT OF THE ABSOLUTE VELOCITY OF THE SOLAR SYSTEM

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I carried out Silvertooth's experiment in a substantially different arrangement which simplifies enormously its execution. I obtained in January 1987 the following figures for the absolute velocity of the Solar System and for the equatorial coordinates of its apex: $v = 386 \pm 38$ km/s, $\delta = -22° \pm 6°$, and $\alpha = 12.5^h \pm 0.5^h$. This result is in agreement with Silvertooth's result, my own results using a rotating axle, the coupled mirrors experiment and the toothed-wheels experiment, and the result of the 2.7°K thermal cosmic background anisotropy.

1. INTRODUCTION

Wiener in 1890 first detected standing light waves by placing a photographic film in the region of light reflected from a mirror. I [2,3] analysed Wiener's experiment for the case when the laboratory is moving through absolute space. The light wavelengths in the direction of absolute motion are contracted and the wavelengths opposite to the absolute motion are dilated. An experiment to detect this difference I call a *quasi - Wiener experiment*. I showed that the quasi-Wiener experiment for standing waves produced by light reflected back on itself cannot yield the absolute velocity of the laboratory.

In a similar manner [2,3] I analysed the experiments of Römer, Bradley, "Doppler", Foucault, and Fizeau in a moving laboratory, calling them, respectively, the quasi-Römer, quasi-Bradley, quasi-Doppler, quasi-Foucault, and quasi-Fizeau experiments. I showed that the quasi-Römer and quasi-Doppler experiments do not provide the opportunity for measuring the absolute velocity of the laboratory; while the quasi-Bradley, quasi-Foucault, and quasi-Fizeau experiments do provide such an opportunity. I myself carried out two variations of the quasi-Foucault experiment, the deviative [4] and the interferometric [5] experiments (the coupled mirrors experiment). I also performed a variation of the quasi-Fizeau experiment [5] (the toothed wheels or coupled shutters experiment).

2. GENERAL THEORY

Silvertooth's arrangement permits the comparison of two independent *oneway* coherent light beams traveling along different paths. The comparison is made by allowing the two independent oneway coherent beams to be incident on a thin detector from opposite directions. This produces a "standing wave" pattern. But it is important to note that no

light is reflected back on itself to create this "standing wave". The two oneway beams following different paths experience different phase changes by virtue of the effect of the absolute velocity of the laboratory on the wavelength of light. The general theory [2,3] follows:

Let a light source and an ideal mirror be placed on the x-axis of a frame K. If this frame is at rest in absolute space (or its absolute velocity is perpendicular to the x-axis), the electric intensities of the light waves incident to and reflected by the mirror will be

$$E_1 = E_{max}\sin(\omega t + kx), \qquad E_2 = E_{max}\sin(\omega t - kx), \qquad (1)$$

where E_{max} is the amplitude of the electric intensity, ω is the angular frequency and k is the angular wave-number. The time t is registered on a clock attached to frame K, and x is the distance from the frame's origin to the point of observation of the electric intensity. The mirror has a larger abscissa than the source.

The incident and reflected light waves will interfere. For the electric intensity of the produced standing waves we obtain

$$E = E_1 + E_2 = 2E_{max}\sin(\omega t)\cos(kx). \qquad (2)$$

Suppose now that frame K is set into motion with a velocity v in the x-direction (or that we rotate the moving frame K, so that its velocity v becomes parallel to the x-axis). Instead of ω and k in equations (1), we now have to write the quantities

$$\omega_{1,2} = \omega, \qquad k_{1,2} = 2\pi/\lambda_{1,2} = (2\pi/\lambda)(1 \pm v/c) = k(1 \pm v/c), \qquad (3)$$

where λ is the light wavelength for the case where K is at rest in absolute space (or the velocity of K is perpendicular to its x-axis) and $\lambda_{1,2}$ is the light wavelength to and fro for the case where K moves with a velocity v in a direction parallel to the positive direction of the x-axis. Formulas (3) are deduced in Ref. 2 and 3, and I show there that they are exact *within an accuracy of any order* in v/c. Now the electric intensity of the standing light wave instead by formula (2) will be given by the following formula

$$E = E_1 + E_2 = 2E_{max}\sin\{\omega(t + vx/c^2)\}\cos(kx). \qquad (4)$$

Hence the distances between the nodes of the standing waves when the Wiener experiment is performed in a frame at rest and in motion with respect to absolute space will be *exactly the same*, and no even second-order differences in the pattern can be registered. The only difference is the following: When the laboratory is at rest in absolute space (or its velocity is perpendicular to the direction of light propagation), E obtains its maximum at all antinodes (i.e., for $x = n\pi/k$, where n is an integer) *at the same moment*, and when the velocity of the laboratory is parallel to the direction of light propagation, E obtains its maximum at the different antinodes *at different moments*. For a given moment t, the electric intensity in (4) obtains its maximum at the antinodes with coordinates near to $x = [(2n+1)\pi/2\omega - t](c^2/v)$, while for this moment t it is zero at the antinodes with coordinates near to $x = (n\pi/\omega - t)(c^2/v)$. This is the unique effect which is offered by the quasi-Wiener experiment and (as I wrote in Ref. 2 and 3) I was sceptical about a possibility for its experimental verification.

It may be pointed out that the null result of the historic Michelson-Morley experiment shows that the quasi-Wiener experiment should not reveal any second-order effect in v/c. Indeed, if the standing waves were to have different lengths (within terms of second order in v/c) in the two cases where the pattern is parallel and where it is perpendicular to the absolute velocity, different numbers of wavelengths would be placed in the Michelson-Morley interferometer between the semi-transparent mirror and the two mirrors placed at equal distances from it in parallel and perpendicular directions to the absolute motion. This *would* lead to a positive effect in the Michelson-Morley experiment which, as we know, has not been observed.

Thus, there are no possibilities for determining the "one-way" light wavelength from the "two-way" light wavelength in a standing wave. Silvertooth[7], however, used a variation of the quasi-Wiener experiment, where a phase shift was determined instead of the wavelength itself, which allows one to then deduce the wavelengths of component waves and consequently the absolute velocity of the laboratory.

3. EXPERIMENTAL SETUP AND PROCEDURE

The setup is shown in Fig. 1. Light coming from a He-Ne laser (λ = 6328 Å) is split by a semi-transparent mirror M_1 into two beams which, after being reflected by mirrors M_2, M_3, M_4, respectively, M_5, M_6, cross the detector D_1 representing a thin semi-tansparent photoelectric

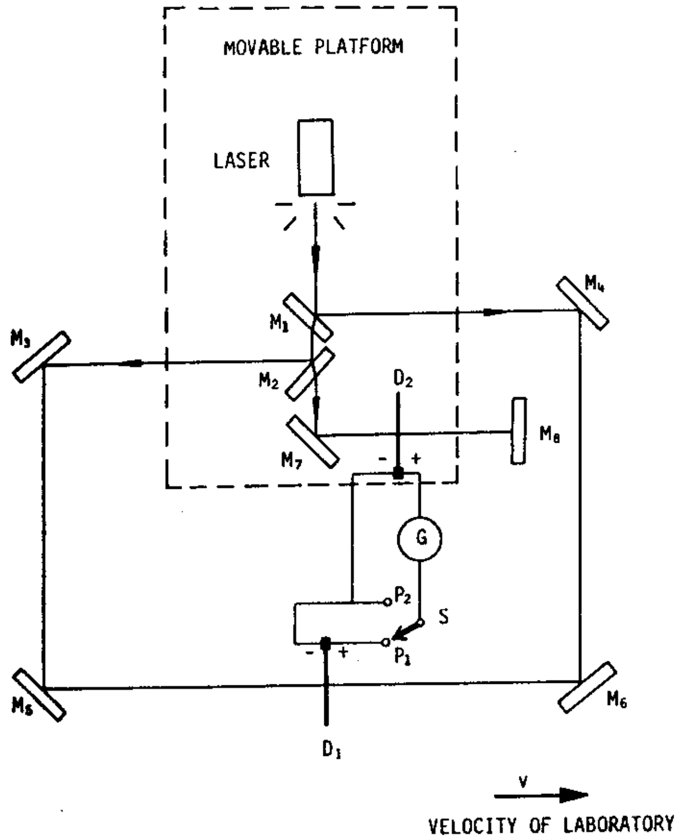

FIG. 1. The experimental setup to repeat Silvertooth's measurement of the absolute velocity of the solar system with substantial improvements and simplifications as explained in the text.

sensitive surface (with a thickness less than λ) deposited on a glass plate. The two oppositely propagating light beams interfere and produce standing waves. When the laser with mirrors M_1 and M_2 is mounted on a platform which is moved over a distance Δ to the right, the standing waves pattern will be shifted around the ring accordingly. I show in Fig. 2a what will occur in absolute space, i.e., when the laboratory absolute velocity is zero. If the point of separation M (mirrors M_1 and M_2 in Fig. 1) is at the initial position and the relation between the light wavelength and the geometry of the ring is as shown in Fig. 2a, there will be an *antinode* at the detector D (D_1 in Fig. 1), thus maximum illumination and consequently maximum photoelectric current. When displacing the point of separation M to the position M' over a distance $\Delta = \lambda/4$, points m' and n' (which correspond to points m and n) will "come" to the detector, and there will be a *node* (minimum illumination). In Fig. 2b I show what will occur when the laboratory moves with a velocity $v = c/2$ to the right. According to my theory[2,3], the velocity of light along and against the motion of the laboratory is given by the formula $c_{1,2} = c/(1 \pm v/c)$, and this formula is exact within an accuracy of any order in v/c, too. Thus we shall have for the laboratory light velocity along and against the direction of motion $c_1 = 2/3c$ and $c_2 = 2c$, and for the respective wavelengths $\lambda_1 = 2/3\lambda$ and $\lambda_2 = 2\lambda$. By displacing now the point of separation M over the same distance $\Delta = \lambda/4$, the points m' and n' (which correspond to points m and n) will "come" to the detector D and there will be an illumination between maximum and minimum. The exact mathematical calculation is to be done as follows: For the case shown in fig. 2a the illumination at the detector is proportional to $\cos^2(2\pi\Delta/\lambda)$. Thus for $\Delta = 0$ (initial position of the platform) there is a maximum illumination and for $\Delta = \lambda/2$ there will be again a maximum illumination, as the period of the function $\cos^2 x$ is $x = \pi$. For the case shown in Fig. 2b the illumination at the detector will be proportional to

$$\cos^2\{2\pi\Delta/\lambda + \pi\lambda(1/\lambda_1 - 1/\lambda_2)\} = \cos^2\{(2\pi\Delta/\lambda)(1 - v/c)\}, \qquad (5)$$

as it follows from Fig. 2b and by using formula (3). Thus now for $\Delta = 0$ (initial position) there is a maximum illumination at the detector and for $\Delta = \lambda$ there will be again a maximum illumination. For $v < c/2$ the illumination at the case 2b will become again maximum at $\lambda/2 < \Delta < \lambda$.

The semi-transparent mirror M_1 reflects 33% of the incident light,

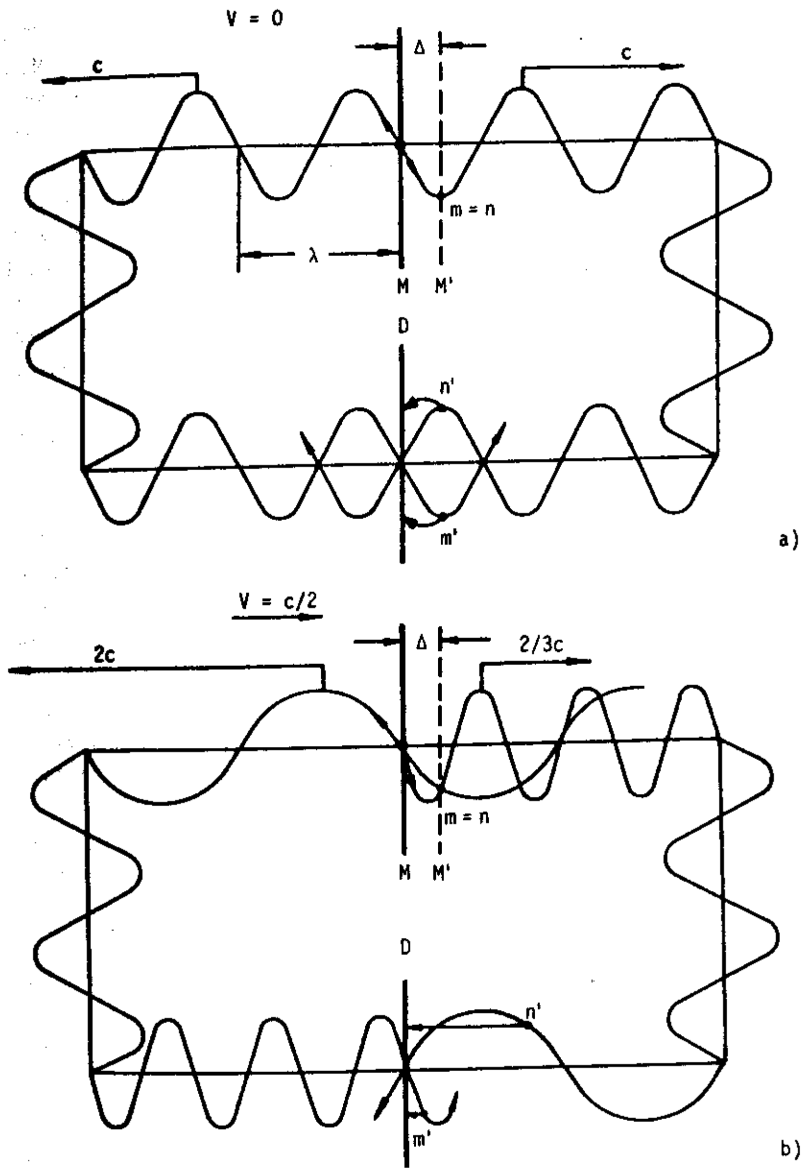

FIG. 2. **A diagram** indicating the phase difference between the two **oppositely directed** coherent light beams as a function of the displacement **of the movable** platform Δ and the absolute velocity of the laboratory **v as explained** in the text.

and mirror M_2, which is also semi-transparent, reflects 50%. Thus 33% of the incident laser light goes from M_1 to M_4, another 33% goes from M_2 to and the remaining 33% goes to mirrors M_7 and M_8, out and back. Between M_7 and M_8 a detector D_2, similar to D_1, is put. When moving the platform the illumination of the standing waves at the second detector changes as in Fig. 2a, as the standing wave pattern formed by a wave doubling back on itself is exactly the same when the laboratory is at rest or moving (See Refs. (2) and (3).). Let us now compare the electric signals produced by the two detectors. If at the initial position of the platform both detectors produce the same currents (say, maximum currents), then after a displacement $\Delta = (c/v)\lambda/4$ they will produce again the same currents, as it follows form (5). For $\Delta < (c/v)\lambda/4$ the produced currents will be different and the difference will be maximum (say, the "Wiener" detector, D_2, produces maximum current, while the "Silvertooth" detector, D_1, produces minimum current) for $\Delta = (c/v)\lambda/4$. For $v = c/1000 = 300$ km/s, we have to displace the moving platform over a distance $\Delta = 250\lambda$ to obtain again the same (maximum) illumination on both detectors. This displacement can be measured *very accurately* by counting how many times will change the illumination on one of the detectors from one maximum to another maximum. Obviously, for the example considered, the illumination on the detectors will pass 500 times through a maximum, as the standing waves represent a "rectified" sinusoid. Of course, if the Wiener detector will exhibit 500 maxima during the shift $\Delta = (c/v)\lambda/4$, the Silvertooth detector will exhibit 499 maxima.

If the absolute velocity of the laboratory v is known from other measurements *with a very high precision* (say from the method described in Ref. 8), then Silvertooth's method permits to verify formula (5) within an accuracy of second order in v/c. Indeed, my theory asserts that formula (5) is true to within an accuracy of second and any higher order in v/c. Thus for $v = 300$ km/s and $\Delta = 250{,}000\lambda = 1.567$ m both detectors will produce maximum currents. Meanwhile, if a concurrent theory will propose instead of (5) a formula of the kind $\cos^2\{(2\pi\Delta/\lambda)(1 - v/c \pm v^2/c^2)\}$, then for $\Delta = 250{,}000\lambda$ the Wiener detector must produce maximum current while the Silvertooth detector must produce minimum current as $(2\pi\Delta/\lambda)(v^2/c^2) = \pi/2$. This shows the *accuracy* of the method

The electric signals from both detectors are sent to the galvanometer G (Fig. 1). If the switch S is at the position P_1, the *difference* of the currents generated by the detectors goes through the galvanometer.

If the switch is at the position P_2, only the current produced by D_2 goes through the galvanometer. The movable platform can be shifted micrometrically. The initial position of the platform is to be chosen when the galvanometer shows zero current (switch at P_1). Then the platform is shifted over such a distance Δ that the galvanometer shows again zero current. The laboratory's absolute velocity (its component along the axis of the apparatus) is to be calculated from the formula $v = c\lambda/4\Delta$, which follows from (5).

The changes that I introduced into Silvertooth's original experiment were the following:

1) A single laser source was used as shown in Fig. 1 instead of the two used by Silvertooth. This obviated any possible error due to the difference in performance of Silvertooth's two lasers.
2) Silvertooth's thin detector D_1 was a two window photomultiplier tube that was difficult to manufacture. I replaced detectors D_1 and D_2 by vacuum photocells with transparent photosensitive cathodes and small holes in the anodes to allow the contradirected beams to pass. An important simplification involved only opaque photodiodes[16].
3) The position of the movable platform was not oscillated sinusoidally with an arbitrary frequency. The outputs of the detector D_1 and the monitoring detector D_2 did not have to be displayed on a dual gun oscilloscope.
4) The monitoring output, which was insensitive to the absolute velocity of the laboratory was not taken as the output of a Michelson interferometer. It was obtained by establishing a standing wave where the light was reflected back on itself by the mirror M_8 as shown in Fig. 1 and using a thin detector D_2. A very important simplification involved an opaque photodiode[16].
5) The comparison between the outputs of D_1 and D_2 were obtained by simply using a galvanometer, noting the difference in the currents from D_1 and D_2 and noting the current in D_2 by itself. Silvertooth's complicated arrangement of an oscillating platform and a dual gun oscilloscope was, thus, obviated.
6) The equipment was not mounted on a turntable as used by Silvertooth. The equipment was simply mounted rigidly to the surface of the earth with its axis in the north-south direction. This arrangement is much simpler and it reduces the effect of vibrations. The rotation of the earth itself provided the necessary information for

deducing the magnitude and direction of the absolute velocity of the solar system, as explained in detail below.

7) The number of 1/4th wavelengths $N = \Delta/(\lambda/4)$ as a function of Δ was determined manually. This procedure, while much simpler than Silvertooth's electronic method, introduced a fractional human error in N of about 10%.

I plotted the shifts Δ as a function of the time of day, making a measurement every half hour (Fig. 3). The diagram also gives the numbers $N = \Delta/(\lambda/4)$ of quarter wavelengths over the distance Δ and the respective *components* of the absolute velocity along the axis of the setup $v = c/N = c\lambda/4\Delta$ The axis of the apparatus pointed "north-south".

I made measurements only for shifts of the platform that did not exceed 1.5mm. The graph (Fig. 3) has two maxima. On the 2nd and 3rd January 1987 I determined the plot by measuring Δ as given by the micrometer moving the platform. On the 4th of January I made precise measurements of the shifts Δ during the hour when the shift was a minimum by counting how many times the galvanometer (at position P_2) showed a maximum current during the shift Δ. The counting of the number N could not be done very precisely (especially for the larger shifts Δ), as the micrometer could not be rotated smoothly enough and some maximum readings could have escaped my attention. The counting of the number of these maximum current readings required over 10 minutes, especially for the larger values of Δ. I estimate that in counting 10 maximum current readings I made no more than one error. Thus, I estimate the error in measuring the number N as 10%. If one were to use an electronic counter (as Silvertooth did) the error in counting N would become zero.

The only remaining experimental error involved is the uncertainty in the determination of the annihilation of the currents produced by D_1 and D_2, the Silvertooth and Wiener detectors (switch at position P_1). I estimate this imprecision to be not larger than 2 or 3 percent. As a matter of fact, in principle, this is the *only error* in Silvertooth's experiment. Thus if one were to make shifts Δ corresponding to the 10th, 20th, and so on, annihilation of the currents produced by D_1 and D_2, the measuring error could, in principle, be reduced to 0.1% or even 0.01%. This means that with the help of Silvertooth's method one should be able to measure the Earth's absolute velocity to within an accuracy of 3 or even 0.3 km/s. My preliminary observations reported here are, of course, still very crude.

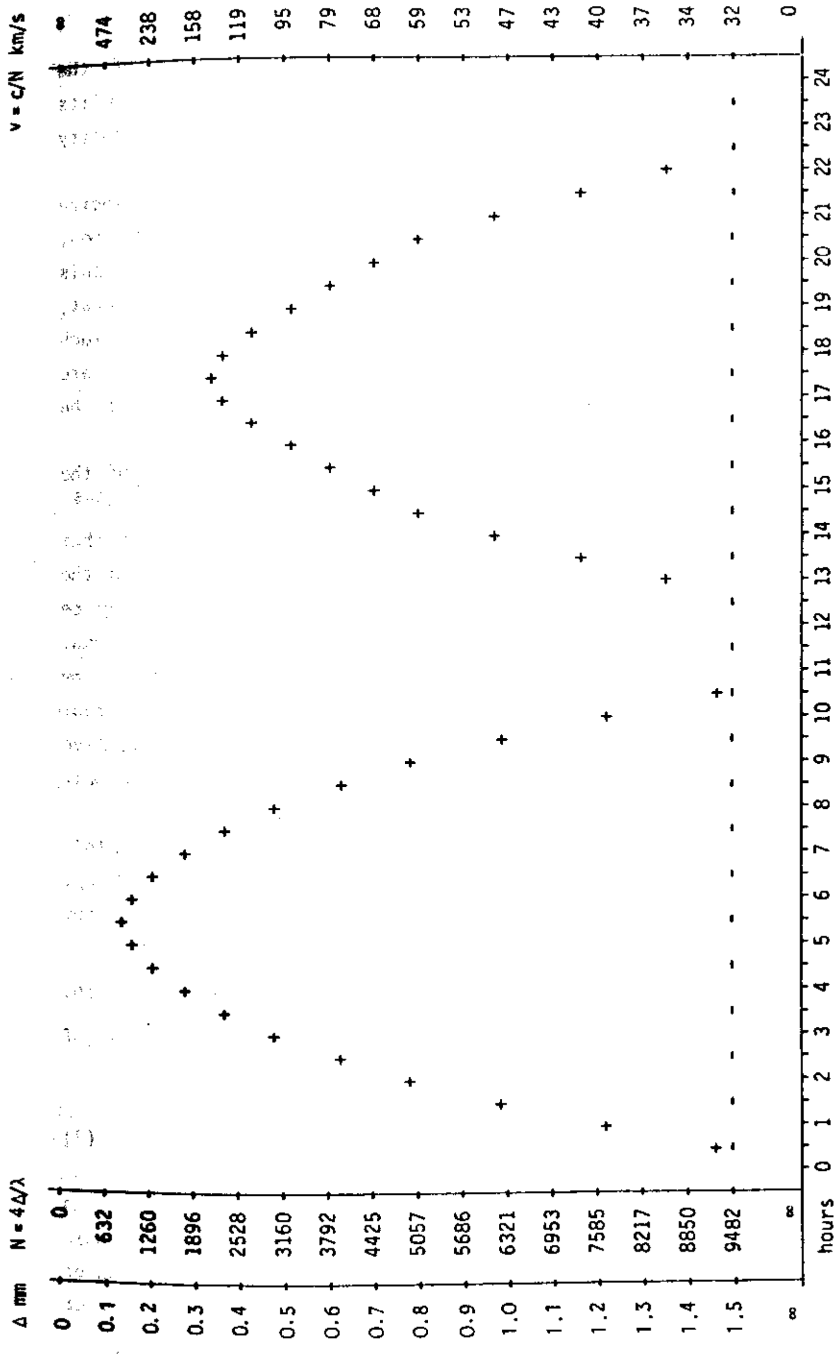

FIG. 3. Displacements Δ of the movable platform to achieve the first simultaneous maximum output of both D_1 and the monitor D_2 at different hours of the day as explained in the text.

Now I shall explain how I established the magnitude of the laboratory's absolute velocity and the equatorial coordinates of its apex. This method was already used to determine the absolute velocity of the solar system using the toothed wheels experiment[5,6].

In Fig. 4 I show the Earth at the moment when its absolute velocity is parallel to the local meridian of the laboratory (the Graz meridian), disregarding the daily rotation of the Earth about its axis. At this moment the component of v along the axis of my setup (which, I repeat, pointed "north-south") was a maximum. In 24 hours there are two such positions occurring 12 hours apart. The components pointing north are taken *positive* and those pointing to the south *negative*. I lable the component whose *algebraic* value is smaller v_a.

Silvertooth's method does *not* establish the algebraic sign of the velocity components (as can be done in my rotating axle experiments[4-6]). The only conclusion that can be drawn from the graph, Fig. 3, is that there are *two* extrema; and consequently one must be positive and the other negative. If both components have the same sign, then, as may be easily concluded by analysing Fig. 4, the graph must have *four* extrema. By comparing the results of this experiment with the results of my "coupled shutters" (or toothed wheels) experiment carried out in February 1984, I concluded that the component registered at $5^h\,30^m$ was negative and the component registered at $17^h\,30^m$ was positive. Having only the Silvertooth experiment, one could also take the *opposite* option.

As it can be seen from Fig. 4, the two components of the Earth's absolute velocity in the horizontal plane of the laboratory, v_a and v_b, are connected with the magnitude of the absolute velocity by the following relations

$$v_a = v \sin(\delta - \varphi), \qquad v_b = v \sin(\delta + \varphi), \qquad (6)$$

where φ is the latitude of the laboratory and δ is the declination of the velocity's apex. From these one obtains

$$v = \frac{\left(v_a^2 + v_b^2 - 2v_a v_b(\cos^2\varphi - \sin^2\varphi)\right)^{1/2}}{2\sin\varphi\cos\varphi}, \qquad \tan\delta = \frac{v_b + v_a}{v_b - v_a}\tan\varphi. \qquad (7)$$

Obviously the apex of v points to the meridian of v_a. The graph in Fig. 3 shows that the time of observation of the maximum component could be determined within an accuracy of $\pm 0.5^h$. (If an electronic counter were to be used to determine the number N, the time of registration of

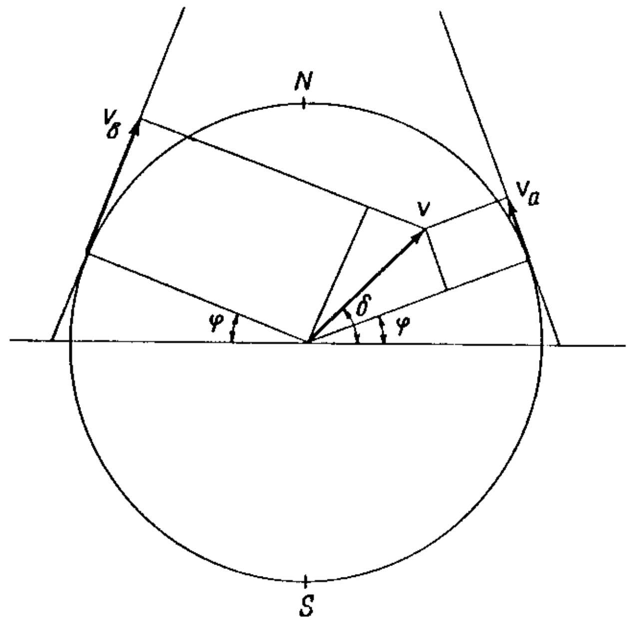

FIG. 4. A diagram indicating the geometry needed to deduce the absolute **velocity** of the laboratory when the apparatus is rigidly fixed to the **surface** of the rotating earth in the north-south direction as explained **in the text.**

the maximum number N could be determined to a precision of 1 minute.)

The right ascension α of the apex equaled the local sidereal time of registration of v_a. Hence it was enough to calculate (within an accuracy not larger than ± 5 minutes) the sidereal time t_{si} for the meridian where the local time is the same as the standard time t_{st} of registration, taking into account that the sidereal time at a middle midnight is as follows:

22 September - 0^h	23 March - 12^h
22 October - 2^h	23 April - 14^h
22 November - 4^h	23 May - 16^h
22 December - 6^h	22 June - 18^h
21 January - 8^h	23 July - 20^h
21 February - 10^h	22 August - 22^h

On the 4th of January 1987 I registered in Graz ($\varphi = 47^\circ$, $\lambda = 15^\circ 26'$) the following numbers N_a and N_b, i.e., the following velocity components v_a and v_b, at the following times:

$$N_a = 865 \pm 87, \quad v_a = -347 \pm 35 \text{ km/s}, \quad (t_{st})_a = 5.5^h \pm 0.5^h,$$
$$N_b = 2069 \pm 207, \quad v_b = +145 \pm 15 \text{ km/s}, \quad (t_{st})_b = 17.5^h \pm 0.5^h, \qquad (8)$$

and formulas (7) give

$$v = 386 \pm 38 \text{ km/s}, \quad \delta = -22^\circ \pm 6^\circ, \quad \alpha = (t_{si})_a = 12.5^h \pm 0.5^h, \qquad (9)$$

where the errors are calculated supposing $\varphi = 45^\circ$.

The local sidereal time for the observations of v_a (i.e., the right ascension α of the absolute velocity's apex) was calculated in the following manner: As for any day the sidereal time increases by 4^m (with respect to the solar time), so the sidereal time at midnight on the 4th of January (which follows 13 days after midnight on the 22nd of December) was $6^h + 52^m = 6^h 52^m$. At $5^h 30^m$ middle European (i.e., Graz) time on the 4th of January the local sidereal time on the 15th meridean was $6^h 52^m + 5^h 30^m = 12^h 22^m$. On the Graz meridian the local sidereal time was $12^h 22^m + 2^m = 12^h 24^m \simeq 12.5^h$.

Let me note that my coupled shutters (or toothed wheels) experiment[6] gave on the 11th of February 1984

$$v = 363 \pm 40 \text{ km/s}, \quad \delta = -24^\circ \pm 7^\circ, \quad \alpha = 12.5^h \pm 1^h,$$

and my interferometric "coupled mirrors" experiment[5] gave on the 11th of January 1976

$$v = 327 \pm 20 \text{ km/s}, \quad \delta = -21^\circ \pm 4^\circ, \quad \alpha = 13^h 17^m \pm 20^m.$$

4. DISCUSSION AND CONCLUSIONS

The original Silvertooth[7] experiment and the confirmation (with substantial simplifications and improvements) by an independent researcher, myself, as reported above, provides conclusive proof of the existence of absolute space. The two experiments provide a good firm estimate of the magnitude and direction of the absolute velocity of the solar system through absolute space or the ether.

The existence of absolute space was, of course, already established by the experiments of Roemer[10], Bradley[11], Sagnac[12], Michelson-Gale[13], Conklin[14], and Marinov[4-6]. Conklin[14] was the first to estimate the absolute velocity of the solar system from the 2.7°K cosmic thermal background anisotropy. I then measured the absolute velocity of the solar system three different ways[4-6] using a rotating shaft (or axle) to chop a light beam entering at one end of the shaft and to again chop the light beam after it traveled down the length of the shaft as it exited at the other end. The change in intensity as a function of the chopping rate, or rotation rate of the shaft, and the length of the shaft provided a method to measure the oneway time-of-flight velocity of light. Balancing the results for beams traveling in opposite directions down the shaft then provided a direct measure of the absolute velocity of the solar system.

The unique feature of the Silvertooth experiment (especially with my simplifications and improvements) is *no moving equipment* is required. Thus, this method for measuring the absolute velocity of the solar system is extremely easy to perform. Its simplicity also provides ample opportunity to increase the accuracy. An increase of a few orders of magnitude in accuracy with a search for a secular change over the years might provide evidence for the existence of a dark companion to the solar system. The Silvertooth experiment succeeds where the Michelso-Morley experiment, which also involves no moving equipment, fails.

Although the Silvertooth experiment has now been confirmed by an independent investigator, myself (as reported above); my rotating shaft experiments[4-6] have still to be repeated by some-one-else. These experiments require very little effort to perform. The theoretical consequences of these experiments (such as the final coup de grace to "special relativity") are extremely great. Considering the success of the confirmed Silvertooth result, it would seem that anyone should *now* recognize that, if he were to repeat one of my experiments, he would be guaranteed positive results.

Not only has the "physics community" failed to repeat my important experiments; it has also made it virtually impossible for me to even report my experimental results in the scientific journals (See my *Thorny Way of Truth I & II* (East-West, Graz, Austria, 1982 & 1984)). The present Volume, in contrast, provides a welcome opportunity for the specialists in the area of space-time physics to present their ideas and experimental results unencumbered by the prejudices of the "established physics community". The "establishment" seems to have decreed that THOU SHALT NOT BELIEVE IN ABSOLUTE SPACE OR ETHER. Any hint of such a belief must be shunned and eradicated. The zeal with which the "establishment" carries out this witch hunt is truly amazing. It is as though the "establishment" has been caught up into a blind hysterical religious type fanaticism that yields to no scientific evidence what-so ever.

The significant conclusions of Silvertooth's experiment and my simplified repitition of it (as well as the other experiments establishing absolute space) are:

1) Absolute space or the ether exists and our solar system moves through it.

2) The measurement of the absolute velocity of the closed laboratory means that "special relativity" must be finally abandoned (It never was a viable scientific theory in the first place[15].).

3) The Maxwell theory of electromagnetism yields no preferred frame of reference for the velocity of electromagnetic waves, in contradiction to the experimental facts discussed above. The Maxwell theory does not specify the frame of reference to measure charge velocities or currents. The Maxwell theory is, therefore, clearly not an adeqaute universal theory.

4) An adequate fundamental mechanics should include the effects of absolute space. In fact, all basic physics theories should take cognizance of absolute space or the ether.

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16 A very important simplification of the experiment was achieved by introducing simple opaque solid-state photodiodes in lieu of the two-window transparent vacuum photocells D_1 and D_2. In particular, Mirror M_6 was replaced by a semitransparent mirror having the same inclination as M_4. The solid-state photodiode, acting as D_1, was then placed under M_6. Similarly, mirror M_7 was replaced by a semitransparent mirror and a horizontal mirror M_9 was placed under it to reflect light from above back upwards. An opaque solid-state photodiode, which played the role of D_2, was placed to the left of M_7. The mirrors M_7 and M_8, thus, formed one arm of a Michelson interferometer, and M_7 and M_9 formed the other arm. In this arrangement Silvertooth's experiment might be viewed as a variation of the Michelson-Morley experiment which allows first order in v/c effects to be observed, rather than a variation of the quasi-Wiener experiment. One might call it a "quasi-Michelson-Morley experiment". Had this idea occurred to Michelson 100 years ago, subsequent history would have been substantially different.

The Anistropy of Light Velocity

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It is shown that the claim of Byl et al to having experimentally demonstrated the isotropy of the velocity of light in agreement with "special relativity" is not warranted. Their arrangement simply allows two anisotropic effects to cancel each other out. A general discussion concerning the first order in V/c effects in the propagation of light is presented. The difficulty in communicating space-time physics through scientific journals is also discussed.

I. CONCERNING THE BYL ET AL[1] EXPERIMENT

Recently Byl et al[1] report an interferometric experiment which they claim would reveal any anistropy in the velocity of light to first order in V/c, where V is the absolute velocity of the laboratory, if such an anistropy existed. They claim that their setup was capable of detecting an anistropy even for laboratory velocities of the order of only 10 m/sec (The velocity of the solar system is of the order of 300 km/s.). Obtaining a null result, they claim to have verfied the "special relativity" dogma that the velocity of light is isotropic.

Their claim is clearly in error, as I have measured over the last 10 years the first order anistropy of the velocity of light three different ways[2,3,4]. Byl et al have come to a false conclusion because their theory and analysis is wrong. Using correct theory, where the anistropic effects are included, one obtains a null result for the Byl et al set up.

Let us consider a medium with a refractive index n (for vacuum or air n = 1) in which light propagates with a velocity c/n. According to my theory[5], for the three different possible cases of motion of the medium and or else the observer along the direction of light propagation, the observer will measure the following three different light velocities (The formulas are written to within an accuracy of first oder in V/c.):

1. Observer at rest in absolute space, medium moving with a velocity V

$$c^* = c/n + V(1 - 1/n^2). \qquad (1)$$

2. Medium at rest in absolute space, observer moving with a velocity V

$$c^\circ = c/n - V. \qquad (2)$$

3. Observer and medium moving both with a velocity V

$$c' = c/n - V/n^2. \qquad (3)$$

The first effect was observed for the first time by Fizeau[6], and I call it the *Fizeau effect*. The second effect was observed for the first time by Dufour and Prunier[7], and I call it the *Dufour effect*. The third effect was observed for the first time by Harress[8] for $n \neq 1$ and by Sagnac[9] for n = 1 and for rotational motion. For rotational motion I call it the *Sagnac effect*; and for inertial motion as observed by Marinov[2,3,4] I call it the *Marinov effect*.

Byl et al intended to measure the Marinov effect, but with their setup the Marinov effect cannot be measured. In particular, according to formula (3), the velocity of light in the air of the laboratory is $c'_{air} = c - V$, while in the medium it is $c'_{med} = c/n - V/n^2$. Thus, the difference between the time intervals in which light covers a distance L in the medium and in the air is

$$\Delta t = L/c'_{med} - L/c'_{air} = Ln/(c - V/n) - L/(c - V) = L(n - 1)/c; \qquad (4)$$

and within an accuracy of first order in V/c the result does not depend upon V.

Writing c' to second order accuracy[5] in V/c

$$c' = c/n - V/n^2 + V^2/cn^3, \qquad (5)$$

we find, by calculating similarly as in (4) that the Byl experiment must also yield a null result to second order in V/c.

I carried out a Byl type of experiment using rotational motion on a disc in Sofia[10,11] and also obtained a null result.

II. SOME GENERAL DISCUSSION AND COMMENTS

Recently the question as to whether the theory of "special relativity" or certain of its predictions might be wrong was discussed in a paper by Maciel and Tiomno[12]. Maddox[13], the editor of Nature, has commented on this paper. I wish to introduce some clarity into the discussion.

For a dozen years my physics papers have been almost always rejected arbitrarily (see the abundant documentation in my book Thorny Way of Truth[14] and the review of this book in Nature[15]). Apparently there is the mistaken impression that I work with absolute Newtonian space-time concepts and that I predict a positive effect for "rotating axle" experiments - which is wrong. The space-time concepts to be used must be relative (Einsteinian), and the effect in these experiments must be null. However, I have observed positive effects in three different variations of the "rotating axle" experiment, namely the deviated "coupled mirrors" experiment[2], the interferometric "coupled mirrors" experiment[3] and the "coupled shutters" experiment[4].

Maciel and Tiomno suggested that "rotating axle" experiments may give positive effects. If this be the case, then, according to Maciel and Tiomno, "special relaitivity" must be judged wrong. This conclusion, of course, is right and logical. However, Maddox, after having read the description of my "coupled shutters" experiment in my paper "New Measurement of the Earth's Absolute Velocity with the Help of the 'Coupled Shutters' Experiment" which was submitted to him for publication in Nature and which was rejected[16], writes:

> Marinov claims that his results, most recently obtained with home-made equipment at Graz, demonstrate that the velocity of light is not the same in all directions. He even claims to have been able to detect the velocity and direction of the Earth's movement through absolute space (and time???). None of this proves that there is anything wrong with special relativity. It is merely a pointer to the kinds of tests that would be necessary to demonstrate a particular (and "weak") violation thereof.

Thus, I pose the question: Is the positive effect in my "coupled shutters" experiment a "weak", a "strong", or a "devastating" violation of "special relativity"?

A similar question was posed in a "Note added in proof" to a paper of mine[3], where I wrote:

> I must note that many scientists are doubtful of whether I, indeed, have registered the effects reported in this paper and of the different high-velocity light experiments reported in the monograph[10], So, for example, Prof. P. Bergmann wrote me a year ago: "I affirm that your 'coupled mirrors' experiment must give a null result, and the effects registered by you are due to side causes." In my answer to him I wrote: "If you shall publish this opinion in the press, I shall immediately send you $500." I heard no more from Bergmann. (See the reaction of the editor of Gen. Rel. Grav. to my generous offer[17].)

I think it is time that a prominent "relativist" appears in the press and says clearly: "Is the positive effect in my 'coupled shutters' experiment in conformity with 'special relativity' or not?" Maybe for a dozen years my papers have been rejected by people who do not understand properly Einstein's theory (According to Eddington, only three persons understood this theory properly; but it is not clear who was the third person and whether this man might be still alive.)

In a recent phone call to Dr. Maddox (during which he informed me about the appearance of the paper of Maciel and Tiomno) I said to him: The problem is no more the anisotropy of light velocity. Only people who have not read my books can claim that light propagation in a moving frame is isotropic. This problem is closed for me, and I do not wish to waste any more of my time discussing it. Now the problem is that electromagnetic interactions depend not on the relative velocities of the particles but on their absolute velocities. These conclusions of my theory, together with the mathematical form of the full Newton's third law (introduced by me[5]) and the local (point-to-point) character of the induction phenomena (observed first by Müller[4]) lead to violation of the conservation laws and to a possibility for constructing a perpetuum mobile. I have observed the violation of energy conservation (as described in the papers "On the Action and Interaction of Stationary Currents" and "Coup de Grace to Relativity and to Something Else", rejected by Nature[16] and now published in Ref. 4) not on "home-made equipment" but on "kitchen made gadgets". Swallow as soon as possible the bitter pill of my experimental refutations of the principles of "relativity" and "equivalence" (My experimental demonstration of the invalidity of Einstein's principle of "equivalence", the base of "general relativity", is described in Refs. 5 and 10 in the accelerated "coupled mirrors" experiment). And be prepared to swallow a much more bitter (or sweet?) pill: the violation of the energy conservation law.

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