WHY DOES NEWTONIAN MECHANICS FORBID INERTIAL PROPULSION DEVICES WHEN THEY EVIDENTLY DO EXIST?

DENNIS P. ALLEN, JR.

Third Edition

ISBN:1508744661
ISBN-13:978-1508744665

DEDICATION

This book is respectively dedicated to the Holy Spirit of God, Source of all Wisdom and Knowledge and the Spirit of Truth, together with His Most Chaste Spouse, the Blessed Virgin Mary, without Whom this book could have neither been conceived nor written.

However, any and all mistakes are, of course, solely the author's responsibility.

CONTENTS

DENNIS P. ALLEN, JR.

ACKNOWLEDGEMENTS

The author would like once again to thank his physics mentor, Thomas E. Phipps Jr., PhD (Harvard, 1951), for patiently explaining to him (at length) that lower order physics must be made right before higher order physics can be made right. Also, thanks to Greg Volk for his help, encouragement, and assistance. And the author owes a vote of thanks to Harvey Fiala and his explanation of his HMT working gyroscopic inertial propulsion device during our many phone conversations. And many thanks to Nick Percival for his suggestions as to how to make our work clearer and more correct. Finally, the author would like to thank Gottfried Gutsche for his free copies of his inertial propulsion books that then succeeded in convincing him that there definitely *are* difficulties with Newton's third law of motion … and that proper use of energy methods *may* be a key to avoiding these problems.

INTRODUCTION

Inertial propulsion is the ability to move linearly and indefinitely a device either in three dimensional space or on a two dimensional surface using no propellers, exhaust gasses, or traction against a surface (say the device is held by gravity to the surface), but only using the internal dynamics of this device. And it is considered by classical mechanical experts as not existing … since it manifestly violates the separate conservation of angular and linear momentum. However, there are numerous working devices invented by such people as Harvey Fiala (an honorably retired Space Shuttle scientist), Gottfried Gutsche (a semi-retired German engineer and author), and Veljko Milkovic (a Serbian inventor and author) that may be viewed in operation on the Internet (see his excellent web site) or in videos of talks given at conferences. [See on the web site “ResearchGate” under the author’s name a lengthy computer simulation of the Milkovic oblique pendulum driven cart; but actually, for this to qualify as a bona fide inertial propulsion device, one has to continue on and imitate Christiaan Huygens who studied simple pendulums’ dynamics and who invented the simple pendulum clock by adding an escapement to it to give it a ”boost” at the end of each cycle so that the bob would not quickly run down.]

Gottfried Gutsche has published a series of books (available from Amazon.com) on inertial propulsion the latest of which is [1]. In them, he describes some patented inventions using classical mechanical formulas from the very well-known Kurt Gieck Engineering Formulas 7th Edition-section L1-L10. One of these inventions is an inertial propulsion device called the MARK II Inertial Propulsion Device, a working model of which he demonstrates on the Internet, and which is *not* a gravity machine (and so should then also work in free fall) as are Fiala's HMT and Milkovic's oblique pendulum driven cart. He also has invented other devices which illustrate the superiority of energy methods to (ordinary) momentum methods (where the force is generally the time derivative of the momentum).

Additionally, Harvey Fiala has a HMT gyroscopic inertial propulsion device (a gravity machine) that he discusses and demonstrates in operation in his 2012 TeslaTech talk, a video of which may be purchased from them [3].

The author's purpose in this little book will be to delve into Newtonian mechanics to see why its "proof" that angular and linear momentum are separately conserved fails. And he will begin by considering Gutsche's assertion [1] that Newton's third law (action and reaction are equal but opposite) only holds generally for one dimensional motion.

Actually, Dr. Jeremy Dunning-Davies and the author have written a book [2] that allows the analysis of

Fiala's HMT (as he calls it) and gyroscopic devices in general from the point of view of changing inertial mass [see the web site "ResearchGate" under the author's name for a two part computer simulation of this amazing invention of Fiala's], but our work showed that rotor mass only changes appreciably in the case of high rotation; and so since the Milkovic cart (mentioned above) has only a relatively slowly swinging pendulum (in an oblique plane), our changing inertial mass notions would *not* allow an analysis of this cart that was appreciably different than a classical mechanical one. Thus we realized that even in the case of Newtonian mechanics holding, there are other problems than just changing inertial mass ones.

But Gutsche's brilliant work, which lays mechanical difficulties at the door of Newton's third law, gave the author the idea that he needed in order to carefully examine this law of motion for difficulties, and so we begin there. And we might now call to mind the famous saying of Ernst Mach [5] to the effect that, to him, there is neither rotational nor translational motion, but only just "motion". How prophetic!

See also our new Appendix 4 concerning long time Boeing engineering supervisor Michael Gamble's recent COFE7 talk chronicling Boeing's long history of using "Control Moment Gyros" [that is, inertial propulsion of the forced precession type] to alter their satellites' orbits without the burning of *very* expensive propellant.

And we have now additionally added an introduction to Gottfried Gutche's mechanical writings found in his various inertial propulsion device books as our Appendix 5 … in as much as his thinking so far has proven to be quite opaque both to mechanical engineers and physicists interested in classical mechanics.

We would like to thank Prof. James Casey (of the Univ. of California at Berkeley's Mechanical Engineering Dept.) for sending a proof of the conservation of linear momentum from H. Lamb's *Dynamics* [10]. But we believe that the role of inertial forces is not properly understood in making such arguments. And so we have added a paragraph at the end of our Chapter 1 which briefly explains how inertial forces contribute to the dynamics of a horizontally precessing gyroscope using a second law of motion analysis from A.P. French's [5] of such a horizontally precessing gyroscope to obtain our elementary example.

Finally, we note that our argument that inertial mass in Newtonian mechanics is variable even at non-relativistic velocities (included in the earlier versions of this book) has been found to be incorrect by Prof. Dr. Chris Provatidis, and due to an erroneous implicit approximation involving a moment of inertia. The author thanks him for pointing this out to him.

1. A CRITICAL ANALYSIS OF NEWTON'S THIRD LAW OF MOTION

We begin by noting that Gottfried Gutsche's Gieck handbook formulas (mentioned in our introduction) *all* seem to boil down to classical mechanical ones, but his working inventions designed using these classical equations show (as he carefully points out in [1]) that Newton's third law as used to show separate conservation of angular and linear momentum … without *any* regard for *any* information as to just what is actually going on in a system of particles that make up a hypothetical device … both are a consequence of applying the third law (in three space, not one dimensional space) assuring that if $\mathbf{F}_{i\,j}$ is the force on the j^{th} particle due to only the i^{th} particle, then $\mathbf{F}_{i\,j} = -\mathbf{F}_{j\,i}$. That's all these two conservation results use, and there is no hypothesis adopted as to what is actually going on in the rigid body …

whatsoever! The two proofs are very brief, and both simply use the force equality just mentioned … and not much else.

However, they certainly do not strike the author as examples of humility, but rather as examples of arrogance. How do the experts know whether some inventor may, one fine day, walk into one of their offices with a Rube Goldberg style device that turns out to defy either or both conservation results???

But, of course, we do know that this does happen from time to time, but then (typically) the man is asked to leave the premises or security will be called; that is the modern way of the physics elite nowadays, as we know all too well.

Now, let us begin in earnest. There are, according to Newton, basically two types of force, namely, the usual (active) contact, gravitational, centripetal (but not centrifugal), electric, magnetic, and so on, and the second is the (passive) inertial force … according to I. Bernard Cohen in "The Cambridge

Companion to Newton" [4], on page 62. (Friction also is a passive force.) The inertial force is mass's resistance to change of motion, and is covered in his first two laws. (The third law when applied to an active force on a particle yields an inertial force on it that is equal but opposite, and conversely.) This inertial force is unlike other types of force in that it is an effect type force, not a cause type force. Thus if one pushes an object across a frictionless table, then by the third law the object pushes back with an equal but opposite force; however, the object moves none the less. But in the case of another person pushing the object also, but in the opposite direction and with equal (pushing) force, the object fails to move.

It occurs to the author that this dichotomy may be helpfully viewed in the light of Chapter 9 of [2], "Causality in Physics" (which we include as Appendix 2 and a numerical example of its word description as Appendix 3). There the author makes the point that since in experimental physics, there is only a finite precision in measurement, then the continuum may be considered to be discrete (or equivalently time may be considered to be quantized) which then leads to, in the case of A. P. French's section on nutation in [5], the nutation due to gravity being the cause and the precession being the (later on) effect simply because using Euler's method of integrating systems of ordinary differential equations (by far and away the most natural and simplest method). We see that when we Euler integrate French's system of two ordinary differential equations with time as the independent variable, the nutation is always one tempo (a term borrowed from the game of chess [8]) ahead of the precession.

But reconsider a much more elementary example: a man pushing an object across a frictionless table. As we have said, in this situation, the force of inertia – although equal and opposite to the primary force – fails to stop the object from moving under the influence of the primary force so that the object moves across the table nonetheless. (This, too, may perhaps be viewed in the light of sequential tempos of time; but we don't require this here.)

Thus we now see the exact reason for the failure of the classical mechanical theorem that an isolated system of particles cannot alter the velocity of its center of mass that depends upon considering all possible subsystems containing exactly two distinct particles and then noting that by the third law, the force of particle one upon particle two is equal but opposite the force of particle two upon particle one (with these forces being parallel to the line segment joining the two particles) and then the conclusion being that these pairwise forces cancel and only outside forces remain; but we assume the system isolated so there are no outside forces.

However, what if the force upon particle one due to particle two is a primary force, but not the reverse? Well, we have just seen that then the pair center of mass will be *not* be un-accelerated, but rather will instantaneously begin to accelerate due to the asymmetry of primary and secondary (inertial) force! Thus, what's wrong with the third law is that it simply "lumps together oranges and apples" … so to speak. You cannot prudently do this, of course.

It might be worth noting two additional points. First, we have that if C is a smooth particle path, and if there is at each point of C a time independent continuous force function **F**, then the work done on a particle that traverses C under the this force function alone is independent of the particle inertial mass because it is $\int \mathbf{F} \bullet \mathbf{ds}$ that is *not* a function of the particle mass … although, of course, it must have *some* non-zero mass. This appears to (partially) explain Gutsche's assertion that energy methods are superior to mere momentum methods … in that it says that there cannot be an inertial mass (third law) problem here since inertial mass fails to come into this analysis … even though kinetic energy is defined in terms of inertial mass!

The second point is that primary forces trump inertial (secondary) forces in that, for example if a gyroscope has its rotor supported 100% by some part of the system, then it fails to precess even though it may be spinning very rapidly. (The rotor must "feel" the gravity to precess.) So the inertial forces can only appear when there is an imbalance among the primary forces … and so can be said to be *parasitic* upon the primary forces. Thus, there are *no* inertial forces in statics, for example, whence the third law should hold there.

We conclude by noting that, as is pointed out on pages 688-91 of [5], when a horizontally precessing gyroscope is analyzed by using Newton's **F** = m **a**, then both centrifugal and Coriolis forces act on the rotor particles due to the precession and rotor spin, with both being *inertial* forces (pages 507 & 514). Thus, it is *false* that *all* interior forces among the rotor particles are active forces since the rotor is a rigid body held together by strong forces between adjacent particles. And these adjacent particles are generally at slightly different radii from the rotor center, and then the farther one pulls at the nearer with a small centrifugal (inertial) force while the nearer counters with a small centripetal (active) force. Thus, adjacent rotor particles may have (internal) inertial forces in addition to the active forces!

2 GOING INTO MORE DETAIL

Let us further consider primary (contact) forces and secondary (inertial) forces. Since we can assume that we are using Cartesian (rectangular) coordinates, if we consider two point particles of mass dm, we may further consider them to be cubes of mass (or matter) using the usual point particle approximation. Thus, consider two such (identical) cubes of the same mass dm that have side length dz so that their volumes are both dz^3. If the two are right next to each other with their common face the same, then if you were to push the one on the right (with your right hand) to the left … and to push the one on the left (with your left hand) to the right … but both pushes being equal and opposite … it would then happen that neither cube would accelerate … as we have here two equal but opposite primary forces. And if the two same cubes of matter or mass were such that the one on the right were pushed with a non-zero force to the left but there were no opposing forces primary force to the right on the left cube, then it would happen from Newton's second law that the pair of cubes would accelerate to the left with acceleration (F/(2 dm)), where F is the leftward primary force.

However, it may happen that (say) there is the primary force F to the left on the cube on the right that has a common face with the cube on the left so that this force F is contact transmitted to the cube on the left; but if there were also a force of magnitude F/2 on the left of the cube toward the right that partially countered the afore mentioned force F to the left; then the two particles would accelerate to the left as a unit, but with acceleration (F/2)/(2 dm) = (F/(4 dm)) in this case, and so there would then be an inertial force of magnitude (F/2) on the left cube to the right that when added to the primary rightward force of (F/2), we would obtain a rightward total force of F … as, of course, we certainly must … according to the third law of motion, anyway, because the leftward (total) force is F. So, then, we see that in the case of a pair of particles in contact, one of the third law forces can be a non-trivial sum of a primary and a secondary (inertial) force, both forces being parallel!

3 OUR GENERAL FALLBACK SOLUTION

The most general solution to this problem of the third law forces each being the (possible) sum of an inertial force vector and a primary force vector would be that $\mathbf{F}_{i\,j} = \mathbf{I}_{i\,j} + \mathbf{P}_{i\,j}$ with $\mathbf{F}_{i\,j}$, $\mathbf{I}_{i\,j}$, and $\mathbf{P}_{i\,j}$ the total, inertial, and primary force of the i^{th} particle on the j^{th} particle, respectively, is clearly that if $\mathbf{F}_{i\,j}$ is considered anchored at the i^{th} mass particle and pointing exactly toward the center of mass of the j^{th} (cubic) particle, then both $\mathbf{I}_{i\,j}$ and $\mathbf{P}_{i\,j}$ should [after projection onto the vector $\mathbf{F}_{i\,j}$] have their particular projection parallel, not anti-parallel, to $\mathbf{F}_{i\,j}$. It would seem that if $\mathbf{F}_{i\,j}$ considered anchored at the center of mass of the i^{th} particle points away from the j^{th} particle, then both $\mathbf{F}_{i\,j}$ and $\mathbf{F}_{j\,i}$ should be both primary forces alone and have no inertial component at all since we assume that they share a cube face and so then contact forces cannot repel them from each other as in the case where they cannot be considered in contact with each other and pushing against each other with any contact forces.

Thus it is the Aristotelian contact forces [6] that seem to be those which go hand in hand with the problems in the third law of motion. And, although we do think that we can get by with $\mathbf{F}_{i\,j}$ simply being parallel to $\mathbf{I}_{i\,j}$ and $\mathbf{P}_{i\,j}$, we are not being dogmatic here, and certainly are willing to fall back to this general solution discussed above if it should turn out that examples show that this must be done to the third law in order to obtain the experimentally correct mechanical predictions.

And it follows from Chapter 2 of [2] concerning "The Hydra Effect" that it is *very* important to only alter Newton's mechanics *minimally* so as to "inherit" its remarkable ability to enable the skillful engineer using it to "meet his specs" for his part of the particular mechanical device that is being developed! Newton's mechanics has excellent physical content, and we hope and pray that our proposed update does as well!

4 NEWTON'S VIEW OF HIS THIRD LAW FORCES

Newton is quoted ([4], pages 287-8) as saying (in regard to his third law): "One body may be considered as attracting, another as attracted, but this distinction is more mathematical than natural. The attraction really is of each body towards the other, and is thus of the same kind in each." (This quotation is part of a larger one of Newton's that reinforces it … as Prof. Howard Stein points out and also elaborates upon there.) Thus he considered (say) that an object one causes an object two to move toward it and that object two causes object one to move toward it as one simultaneous physical action, but he formulated his third law (as he did) merely to bring the mathematics in line with his physics. And Richard Feynman famously said in one of his excellent books on quantum mechanics [7] that "the mathematics is right, but the physics isn't"; however, Newton avoided that problem to a certain extent with his formulation of the third law of motion. This law was mainly (1) for his Universal Law of Gravitation and (2) for his centrifugal and centripetal forces, and Gutsche points out [1] it is the very general use of this law that gets Newton mechanics into difficulty. Moreover, *all* Gutche's formulas from his copy of the Kurt Gieck handbook seem to boil down to very specific uses of the laws of motion … where it is intuitively clear that his use of them is solidly grounded in the detailed physics of the device he is analyzing and does *not* claim to apply to a vast class of physical situations *far* beyond all human imagining and reckoning!

5 TREATING PASSIVE FORCES IN MECHANICS

We have argued above that active forces should not be treated the same as passive forces (such as inertial and also frictional forces), and now we give a concrete example of a way frictional forces are treated in the author's work … while noting that the same general methodology may be applied to inertial forces as well as they, too, are passive.

We consider a chassis on four wheels that can only move in a straight line and may be visualized as moving to the right or the left of the page with rolling coefficient of friction "μ" so that the frictional force in magnitude is given by (μ (M + m) g), where "g" is the gravitational acceleration, m is the chassis mass and M is the mass of a small sphere of lead that is connected by a (weightless) rigid and horizontal shaft (of length L) from a pivot mounted and fixed on the chassis and turning at constant angular velocity "ω" relative to the pivot point (and without any friction) in the horizontal plane passing through the pivot point. We desire to calculate the (one dimensional) motion of the pivot point (and so also the chassis) by using Newton's formula $F = M L \omega^2$ for centrifugal force (derived by changing the algebraic sign of the centripetal force using the third law).

We know that if θ is the angle the shaft makes with the forward direction of the pivot point (i.e. to the right of the page) and measured counterclockwise, that the active force in the right-left direction will then simply be

$$M L \omega^2 \cos(\theta),$$

since only the projection of the centrifugal force along the left-right line matters. And since the frictional force, projected upon this line of chassis travel, is in the reverse direction to the velocity of left-right travel, the total equation of motion then **might** be thought to be (where if z is a variable, then Dz = dz/dt and SIGN(z) is the algebraic sign of z):

$$(M + m)\ DDx = M\ L\ \omega^2 \cos(\theta) -$$

$$((\mu\ (M + m)\ g)\ SIGN(\cos(\theta)(Dx));$$

However, we must also take into account that the frictional force is a passive force, and thus *it cannot affect the magnitude of the chassis velocity* Dx *by increasing it!* Consequently, since this increase can happen if and only if both SIGN[DDx (-(μ (M + m) g) Dx cos(θ))] = 1 {that says that DDx, the chassis acceleration, and the frictional force (-(μ (M + m) g) Dx cos(θ)) have the same algebraic signs so then the frictional force is in the same direction as the chassis velocity} and also SIGN(Dx DDx) = 1 {that says that the chassis velocity and acceleration have the same algebraic sign and so the chassis is being accelerated in its velocity direction, and so then the magnitude of the chassis velocity Dx is being increased}. Thus, consider the multinomial in variables Z1 and Z2:

$$[(Z1 - 1)\ (Z2 - 1) - (Z1 - 1)(Z2 + 1) - (Z1$$

+ 1)(Z2 – 1)] / 4.

If we only set each of Z1 and Z2 to either one or negative one, then it vanishes if and only if Z1 = Z2 = 1, and otherwise equals one. So we simply set

Z1 = SIGN[(DDx)(- μ (M + m) g) Dx

cos(θ))]

and

Z2 = SIGN(Dx DDx),

(by way of substitution) and then multiply the result times the frictional force in the right side of the displayed force equation above so that in the case where frictional force would be increasing the magnitude of the chassis velocity Dx, the "friction is zeroed", that is, "turned off"; but otherwise it's multiplied by unity that does not alter the frictional force in the above displayed total force equation at all!

[Of course, the alert reader has no doubt noticed that it would have been considerably easier (in this very special case) simply to take a shortcut and just multiply the magnitude of the frictional force by –SIGN(Dx) rather than by –SIGN(cos(θ) Dx) would then take into account the fact that the frictional force is a passive force completely; however, in a more complicated analysis, such a handy shortcut might well elude the working researcher!]

The author hopes and prays that now the reader sees just how to handle passive forces that occur in elementary problems … such as that just discussed of calculating the chassis velocity; the key is to make sure that a passive force is *never* allowed to preform actively, but otherwise it *may* be correct to treat it the same as an active force!

APPENDIX 1
A SUMMARY OF TECHNIQUE

We now summarize our ideas on how to proceed mechanically so as to avoid calculation problems, where **we assume that variable inertial mass** – treated in Dr. Jeremy Dunning-Davies's and my [2] – **does not occur** to any significant degree:

(1) While it's not true, in general, that either momentum or angular momentum are separately conserved, and so these two "laws" should never be employed, in general; still, in many special cases, they are valid. However, it's best not to use either; and to instead to use equations closely tied to the physics of the devices or situations that are under analysis.

(2) In ordinary (low-tech) mechanical calculations, not involving electromagnetic phenomena, energy does seem to be conserved with kinetic energy being the usual ($\frac{1}{2}$ m v^2) and gravitational potential energy being the usual (m g h), and so energy methods may be used freely to obtain solutions in closed form. (But should variable inertial mass occur significantly, then the definition of kinetic energy must be *uniquely* altered to retain work-energy equivalence [2, Chapter 4 appendix].)

(3) However, in case the solution is not to be or cannot be obtained in closed form, but must instead be obtained by numerically integrating the system of ordinary differential equations of motion with the independent variable being time; then it is best not to use energy methods since then numerical accuracy problems may arise. Our preliminary work seems to indicate that since we accept the notion of Prof. Oleg D. Jefimenko's that the cause must precede the effect in physics (see Appendices 2 and 3 below), then it follows that causality propagates through a system at finite velocity. So, then, in order to optimally track causality, we should assign natural propagation formal velocities of propagation of v for momentum propagation and ($\frac{1}{2}$ v^2) for kinetic energy propagation [yes, the dimensionality of the latter is not that of velocity, but we are proceeding formally here], where v is the non-negative scalar velocity of a given particle of matter. Then, roughly, problems in numerical integration appear to occur when the quantity $|v - \frac{1}{2} v^2|$ becomes too large.

(4) So, then, since in a case where angular momentum, moments of inertia, and so on … are used, then often conservation of energy must also be used to obtain the correct answer – such as in a nutating gyroscope with a fixed pivot point – where angular momentum methods fail without the additional use of energy methods; it is best also not to use such rotational physics if there is going to be the

numerical integration of equations of motion in view of (3) just above. And this may seem almost impossible, but since angular momentum physics is derived from (linear) momentum physics [1, 3, 4], this is always possible; and it also seems to be always possible to avoid energy methods too … as energy methods are also derived from momentum methods … although the use of energy methods will tend to make it *much* easier to obtain closed form solutions to the (ordinary differential) equations of motion … if this is actually possible in the reader's problem.

(5) To illustrate the above, we direct the attention of the reader to the author's computer simulation of the Veljko Milkovic oblique pendulum driven cart inertial propulsion device (mentioned above in our Introduction) on the research web site "ResearchGate" … where it may be downloaded for no cost under the author's name there .

Finally, we note that in the case of passive forces that are discussed in our last chapter above, the techniques give in that chapter for handling them must be utilized to avoid difficulties; passive forces [5] cannot be routinely be used as if they were active forces, and the use of the algebraic ideas in that above chapter should save one from serious mistakes if properly employed.

References

[1] G. E. Hay, *Vector and Tensor Analysis*, pp 66-101 (Dover, 1953).

[2] Dennis P. Allen Jr., and Jeremy Dunning-Davies, *Neo-Newtonian Mechanics With Extension to Relativistic Velocities,* second edition, (CreateSpace.com, 2014).

[3] J. L. Synge & B. A. Griffith, *Principles of Mechanics* (McGraw–Hill Book Company, 1949).

[4] A. P. French, *Newtonian Mechanics,* (W.W. Norton & Co., 1971).

[5] I. Bernard Cohen & George E. Smith (Editors), *The Cambridge Companion to Newton,* Chapter 2 (Cambridge University Press 2002).

APPENDIX 2

CAUSALITY IN MECHANICS

Dennis P. Allen Jr.

There appears to be considerable confusion in classical physics, not involving electromagnetic or gravitational phenomena, concerning causality. The late Prof. Oleg D. Jefimenko writes near the beginning of chapter 1 of his "Causality Electromagnetic Induction and Gravitation" that: "One of the most important tasks of physics is to establish causal relations between physical phenomena. No physical theory can be complete unless it provides a clear statement and description of causal links involved in the phenomena encompassed by that theory. In establishing and describing causal relations it is important not to confuse equations which we call 'basic laws' with 'causal equations.' A 'basic law' is an equation (or a system of equations) from which we can derive most (hopefully all) possible correlations between the various quantities involved in a particular group of phenomena subject to this 'basic law.' A 'causal equation,' on the other hand, is an equation that unambiguously relates a quantity representing an effect to one or more quantities representing the cause of this effect. Clearly, a 'basic law' need not constitute a causal relation, and an equation depicting a causal relation may not necessarily be among the 'basic laws' in the above sense."

"Causal relations between phenomena are governed by the *principle of causality*. According to this principle, all present phenomena are exclusively determined by past events. Therefore, equations depicting causal relations between physical phenomena must, in general, be equations where a present-time quantity (the effect) relates to one or more quantities (causes) that existed at some previous time. An exception to this rule are equations constituting causal relations by definition; for example, if force is defined as the cause of acceleration, then the equation $\mathbf{F} = m\mathbf{a}$, where $\mathbf{F}$ is the force and $\mathbf{a}$ is the acceleration, is a causal equation by definition."

"In general, then, according to the principle of causality, an equation between two or more quantities simultaneous in time but separated in space cannot represent a causal relation between these quantities because, according to this principle, the cause *must precede* its effect. Therefore the only kind of equations representing causal relations between physical quantities, other than equations representing cause and effect by definition, must be equations involving 'retarded' (previous-time) quantities."

It is evident that he sees no way to introduce causality into mechanics other than by definition. And Prof. A.P. French, in his widely used "Newtonian Mechanics" beginning physics text, also appears to be similarly confused as he says in his section on gyroscopic nutation; "However convincing the analysis of gyroscopic precession may seem, one may still wonder how a gyroscope can possibly defy gravity in the way it appears to do. The answer is that this immunity *is* indeed only apparent. If a flywheel is set spinning about a horizontal axis, with both ends of the axle supported, the first thing that happens if the support at one end (A) is removed is that this end does begin to fall vertically. Immediately thereafter, however, the precessional motion in a horizontal plane begins, and as this happens the falling motion slows down, until the point A is moving in a purely horizontal direction. It does not stay like this; what happens next is that the precession slows down and the end of the axle rises again, ideally to its initial level. The whole sequence is repeated over and over … The process is called *nutation…"*

Thus French also seems to fall short of demonstrating causality … although he seems to allude to the idea that first in this gyroscopic situation (after the gyroscope at t = 0 suddenly becomes unsupported at one end) nutation begins which then immediately causes precession to commence – a sort of causality that is apparently not completely definitial as in Jefimenko's just given quotation; but the difficulty is that this simultaneity is shown by the exact solution to the system of two second order ordinary differential equations describing the ensuing precession and so on. However, this difficulty is easily obviated as follows:

First notice that empirical physics has the property that since measurement of physical variables is only approximate to just so many significant figures, this means mathematically that one begins by "making the continuum discrete" in that (say) the relevant physical variables can only be measured to one significant figure, then if we truncate (rounding is much the same) our numbers in (for example) French's nutation case (just quoted), then all numbers x with $2 \leq x < 3$ will then assigned the one significant figure 2 … and so on. [In the case of (say) $0 < x < 1$, we note that if we write x scientifically as (k 10^n), then clearly the absolute value of n is bounded in our experimental work.] Thus, when we assign measured numbers to this gyro situation and then numerically integrate the system of two second order ODE's (while it may appear that French has one first order and one second order ODE, nevertheless, just above the first numbered first order ODE is the second order ODE it came from via integration) by Euler's method (the most elementary and straight-forward method) [1] after choosing a sufficiently small time step $\Delta t > 0$; instead of referring to French's solution, we see that the nutation angle (measured from the horizontal) together with its time derivative and also the precession angle together with its first two time derivatives are all zero at $t = 0$ (the initial conditions); but when the one support is removed, nevertheless, the second nutation angle time derivative does **not** vanish as it is accelerated by gravity instantly. This results in the initial values of all but the second time derivative of the nutation vanishing at $t = 0$, but after a time step of Δt, we see that the first time derivative of the nutation then also becomes non-zero, and, of course, the nutation second time derivative remains non-zero too as a time step of Δt occurs … and the precession second time derivative may now become non-zero too after this one step. But the other three quantities remain zero here. Further, after another such time step, the nutation angle then becomes non-zero too, just as the nutation first and second time derivatives are non-zero as well. However, what about the precession angle? We find that the precession angle is still zero after two time steps … although the nutation angle is not! Thus, in making the continuum discrete, one sees here that the nutation precedes the precession, and so it can then be said in the sense of Jefimenko above that there **is** a true causal relation here with the nutation causing the precession as the physical process develops from t = 0!

It should be noted that the continuum is dearly beloved by mathematicians, and even the late Prof. Errett Bishop, in his monumental "Foundations of Constructive Analysis," mentions that Luitzen Brower (of the Brower fixed point theorem and an important earlier constructivist as well as one of the founders of modern topology) seemed to feel that the continuum would [constructively] turn out to be discrete "if he did not personally intervene"! But continuum mathematics, nevertheless, obscures causality in mechanics, and that is rather unfortunate, of course! This clearly illustrates that the over-mathematization of physics nowadays is certainly not without its deleterious foundational effects!

Finally, we recommend Prof. Robert M. Kiehn's six volumes in "Non-Equilibrium Systems and Irreversible Processes" … as he, too, has investigated the possibility that continuum mathematics might not always be the right setting for theoretical physics … and very extensively as well.

References

[1] Wilfred Kaplan, *Ordinary Differential Equations,* 400-1, Addison-Wesley Publishing, 1958; (but the author does not mention Euler's name).

APPENDIX 3

A NUMERICAL CALCULATION TO ILLUSTRATE THE PREVIOUS APPENDIX'S DESCRIPTION OF THE EULER INTEGRATION OF A GYROSCOPE'S TWO SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS SHOWING CAUSALITY

We refer the interested reader to the web site "ResearchGate" where, under the author's name, there is a spread-sheet (that may be freely downloaded) containing an detailed (numerical) Euler integration of the system of two ordinary differential equation found in A. P. French's "Newtonian Mechanics"[5] under the heading of gyroscope nutation. This numerically illustrates the words of the previous appendix.

APPENDIX 4

BOEING'S LONG HISTORY OF USING INERTIAL PROPULSION TO REPOSITION THEIR SATELLITES INTO NEW AND DIFFERENT ORBITS

Long time Boeing engineering supervisor, Michael Gamble, has given a talk recently at the "Seventh International Conference On Future Energy" (COFE7) concerning the extensive history of Boeing's using inertial propulsion (IP) of the forced precession type … that still continues today. (He refers to this in his talk by using the company name "Control Moment Gyros".) And a DVD of this COFE7 talk may be ordered from the conference sponsor, the "Integrity Research Institute" at (888) 802-5243.

This is especially significant because there is, of course, very little air friction in outer space, and such IP devices as discussed in our introduction are usually attempted to be explained away by naysayers as frictional effects of some sort. But, needless to say, such arguments cannot and do not apply to Boeing's multimillion dollar IP technologies as exposited by Gamble.

His talk is about a hour in length, and he is quickly seen to be a good, solid engineer whose explanations are both clear and concise. There is **no** ambiguity nor any esoteric theory in his presentation … that also contains many, high quality photographs of the actual equipment used by Boeing over the years.

The author highly recommends the DVD containing Gamble's talk to the interested reader!

APPENDIX 5

AN INTRODUCTION TO GOTTFRIED GUTSCHE'S POINT OF VIEW IN HIS INERTIAL PROPULSION WRITINGS

In this appendix, we aim to introduce Gutsche's point of view in his inertial propulsion devices. It centers on the analysis of the flow of mechanical energy within mechanical devices … that begins with potential energy (for example, a compressed spring) and then flows from this. And his key simple device plays a similar role in his theory to the simple harmonic oscillator's role in classical mechanics.

This device is a pair of masses that are not, in general, the same; but they are located at opposite ends of a simple coiled Hooke type (massless) spring, and are allowed to oscillate freely & without any friction. Thus, if the spring between the two masses M and m is compressed and then released at t = 0, the device's subsequent oscillations are tracked by the laboratory velocities V and v of M and m, respectively. One certainly *could* analyze the device's compound motion using the conservation of momentum applied to the system's center of mass that might be taken as the center of coordinates, but this is quite unnecessary as Newton's second and third laws suffice without the conservation of momentum applied to the center of mass's velocity vector. And, in fact, one need not even employ the definition of the center of mass of a system of particles at all here!

Now, Gutsche's key insight is that at any time $t > 0$, we have $M/m = e/E$, where $e = ½\ m\ v^2$ and $E = ½\ M\ V^2$, the kinetic energies of masses m and M, respectively. That is, although in Newton's theory, mass gravitates toward other mass with a larger mass resulting in a proportionally stronger attraction; yet, in the case of mechanical kinetic energy, this energy moves rather toward smaller mass concentrations and away from larger mass concentrations … if it is free to flow or move … as it is in his key simple two masses and a spring device.

Then he goes on to introduce a new mechanical concept called (by him) the "mechanical kinetic energy momentum" and having formula ($½\ m^2\ v^2$) … that may helpfully be viewed either as half the dot product of the momentum vector with itself … or else as a simple product of the mass and the kinetic energy … so that, in this key simple device, both masses at any time $t > 0$ have equal mechanical kinetic energy momentums.

Thus, this novel concept may be viewed as a "hybrid" concept lying between the momentum and the kinetic energy, and the derivative of this mechanical kinetic energy momentum with respect to the scalar momentum is just this scalar momentum itself.

This, then, leads him to proclaim that "momentum is conserved *as* kinetic energy".

Now, in electrodynamics, it was John Henry Poynting who originated the "Poynting vector" that is the key to tracking the flow of electromagnetic energy and also of electromagnetic momentum … with the two being connected by Einstein's famous $E = M c^2$ (that, however, was known earlier to J. J. Thompson). But, to the best of the author's knowledge, the topic of energy and momentum flow in mechanical devices is not usually treated in the best mechanical and dynamical texts very extensively … as, however, it certainly is in the best electrodynamic texts (see [9], for example) with Poynting's theorem and all.

The author hopes and prays that this brief introduction to Gutsche's rather unorthodox mechanical thinking … and especially to his very original inertial propulsion ideas … will prove helpful to the reader in understanding his convoluted inertial propulsion device writings that have proven so very opaque to so many of his prospective readers!

REFERENCES

[1] Gottfried J. Gutsche, *Inertial Propulsion: the quest for thrust from within,* (CreateSpace.com, 2014).

[2] Dennis P. Allen Jr. & Jeremy Dunning-Davies, *Neo-Newtonian Mechanics with Extension to Relativistic Velocities,* Second Ed., (CreateSpace.com, 2014).

[3] Harvey E. Fiala, "An Inertial Propulsion Patient & Working Model", Presentation, July 29, 2012, Tesla Tech, Inc., Marriot Pyramid North, Albuquerque, New Mexico.

[4] I. Bernard Cohen & George E. Smith (Editors), *The Cambridge Companion to Newton,* (Cambridge University Press, 2002).

[5] A. P. French, *Newtonian Mechanics,* (W.W. Norton & Company, 1971).

[6] M. Evans, *The Physical Philosophy of Aristotle,* (University of New Mexico Press, 1964).

[7] Richard P. Feynman, *The Feynman Lectures on Physics, Volume III, Quantum Mechanics,* 1997.

[8] Fred Reinfeld, *Hypermodern Chess, as developed in the games of its greatest exponent, Aron Nimzovich,* (Books/Magazines, 1958).

[9] J. D. Jackson, *Classical Electrodynamics,* Third Ed., (Wiley, 2009).

[10] H. Lamb, *Dynamics,* (Cambridge University Press, 1961).

ABOUT THE AUTHOR

The author earned his doctorate, master's and bachelor's degrees from the University of California at Berkeley. He has done research work for Bell Telephone Laboratories and taught mathematics at Michigan Technological University. And he has written on gravitation as an electrical phenomenon and its application to earthquake early warning, and co-authored a book with Dr. Jeremy Dunning-Davies on a minimal mechanics that takes into account inertial mass change that has definitely been experimentally detected by scientists such as Harvey Fiala, a retired Space Shuttle engineer, the late Bruce de Palma (MIT), and the late Eric Laithwaite, inventor of the trains in Germany and Japan that float on magnetic fields and so do not touch the rails. Moreover, he has authored a book on the Lesbegue measure that touches upon the continuum problem utilizing his work on the fundamental & primary cause of the first digit phenomenon and also his thesis work in algebraic automata theory under Prof. (Emeritus) John L. Rhodes (Univ. of Calif. at Berkeley's Mathematics Dept.). And he has a memoir in which he gives his experience in science and academia … as well as his philosophy of science and of truth in general. All of his books may be found on Amazon.com where they can be looked at electronically.