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Article XI: Reaction Forces

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Purpose

Reaction forces are perhaps the most misunderstood group of forces in all of science. Although they play an essential role in every event involving acceleration, they seldom receive correct recognition from our scientists. Science authors frequently grant impossible qualities to a reaction force only to later conclude that the reaction force in question is "fictitious" or "imaginary" since these impossible reaction force qualities turn out to be notably absent from the author's event. Such false conclusions regarding the roles of reaction forces have led many of our top scientists astray. The trickledown effect has fostered a wide range of scientific misadventures that have led us far away from understanding the truth. Accordingly, the purpose of Article XI is to establish the reality of reaction forces along with identifying their real and true qualities.

Article XI

Compared to action forces, reaction forces somehow seem unimportant. By now we should all understand that action forces are always the cause of an event in which forces have a role. Equally important is to embrace the realization that reaction forces are never the cause of any event. The general lack of this understanding is the primary reason reaction forces are so widely misunderstood within the scientific community. In their attempts to identify reaction forces, our scientists all too often begin with the false expectation that if real, the reaction force in question should be capable of acting as the cause of some event in the predicted direction. What they do not understand is that the reaction force in question does not possess the ability to "act" as the "cause" of any event in any direction. Expectations to the contrary have resulted in such unscientific statements as "CENTRIFUGAL FORCE IS FICTITIOUS". All caps are often used for emphasis. In one instance, of which I am aware, the science authors go so far as to say: "We promise never to mention centrifugal force again." True to their word, in the 1200 pages that follow, they remain silent on the subject of centrifugal force.

(2) How is it that such science authors can present dozens of rotational and orbital events, complete with force vector drawings, with nary a mention of the outward-directed, measurable-by-scale, acceleration/Reaction force that is popularly termed centrifugal? As a solution to this problem, the exclusionary drawing technique known as a free-body diagram is employed. By limiting the vector drawing of an accelerational event to show only the action forces affecting the test object, and specifically neglecting to show any reaction forces the test object may be experiencing internally or impressing externally against an acceleration-causing second object, science authors have managed to present an appearance of understanding by limiting the scope of the force vector drawing to include only those forces deemed acceptable for a free-body diagram. Thus, through the exclusionary technique of presenting the action-force-half

of the truth via the technique of a free body diagram, modern science authors successfully avoid having to explain the remaining reaction-force-half of the truth, a truth which they clearly do not understand.

(3) To be fair, as members of the general public, we must bear some of the responsibility for this strange turn of events. You see, while modern science authors do not understand the truth about the centrifugal acceleration/Reaction forces present in each and every circular event, they do recognize the logical reasons why the general public's understanding is often incorrect. Further, science authors and teachers have been unnecessarily burdened with having to repeatedly correct (as far as they are able) the misunderstandings of a never-ending legion of non-scientists on this issue.

(4) Common misunderstandings of centrifugal force are revealed in the following events: (a) The student whirls a bucket of water overhead. Not a drop of water is lost from the bucket. The student declares that the water's centrifugal force is causing the water to stay in the whirling bucket, even when overhead. (b) The potter, while "throwing" a large diameter clay pot on a slow-turning wheel, accidentally steps on the speed pedal causing the wheel to suddenly increase its rate of rotation. As a result, the soft clay pot is observed to bulge out at its rim and then flop. The potter concludes that the outward pull of centrifugal force is the cause of the pot's demise. (c) As a car enters a turn to the left, a book on the dash is observed by the passenger to begin accelerating to the right as it slides along the car's smooth dash. Again the observer concludes that centrifugal force is the cause. After all, at one moment the book is resting on the dash and the next moment it is seen accelerating to a faster and faster pace as it travels across the dash. To some observers it seems natural to conclude that some unexplainable force, directed away from the center of the car's turn, is suddenly present and acting as the cause of this event. Is this not a perfect example of an event where an object's observed centrifugal acceleration is being caused by a "center fleeing" centrifugal force in full agreement with Newton's LAW I?

(5) I must admit that I feel some sympathy for the teacher whose job it is to dispel these notions of the existence of an outward-directed acceleration-causing action force. In these three events, the truth is that no such outward-directed acceleration-causing action force exists. In each of the three events if the path, relative to Earth, of the object in question, (a) the water in the bucket, (b) the rim of the clay pot or, (c) the book on the car's dash, is plotted, one will discover the truth that no acceleration in an outward direction (beyond a straight-line path) is occurring to the object under study. But sadly, in the process of repeatedly refuting these general misunderstandings regarding the nature of centrifugal force, scientists have inadvertently allowed these same non-scientific misunderstandings to stand as the definition for centrifugal force. Then, by showing that such an action force, complete with all the characteristics described by non-scientists, does not actually exist in any event involving centripetal acceleration, scientists feel justified in drawing the conclusion that "centrifugal force is fictitious". A more accurate refutation would be "the imagined outward-directed "centrifugal action force", as thought by the non-scientist to be present and acting as the cause of imagined outward-directed acceleration for an object in an event involving centripetal or inward-directed acceleration, does not, in fact, exist in such events.

(6) Should the authority of a thousand modern science authors be reason enough to end all scientific discussion regarding the reality of centrifugal force? It should, according to the science authors of my 1300 page Physics text. "We promise to never mention centrifugal force again.", they state with apparent relief. By example it is clear that they hope others will follow their lead.

(7) Are you wondering, as am I, why it is that scientists seem content to allow non-scientists to be the ones to define and describe the characteristics of centrifugal force? Is there no scientist willing to step forward with a definition of his/her own, a scientifically-based definition for all to consider? To this end, I propose the following definition for the centrifugal acceleration/Reaction force.

(8) **Definition: Centrifugal Force** is the internal, outward-directed, reaction-to-centripetal-acceleration force that is reactively generated within each accelerating component of an object's matter with this acceleration/Reaction force always being caused by, and always providing the required support and termination for, the internal or external, inward-directed, centripetal, acceleration/Action force that is responsible for acting as the cause for each component's centripetal or inward-directed acceleration away from a straight path of travel repeatedly drawn tangent to the component's curved path of travel.

(9) Now that we have a definition that is compatible with the concepts and understandings of Universal Physics, what then are the characteristics of this centrifugal reaction force? How is its presence predicted by Newton's laws? What did Isaac Newton write regarding the reality of centrifugal force? When can its presence be measured by a force scale? When can its presence not be measured by any scale? If centrifugal force can be measured by a force scale, even some of the time, how is it that Modern scientists continue to deny its existence? What does it mean when acceleration in circular events is said to be directed "away from a straight path of travel repeatedly drawn tangent to the the component's curved path of travel?" With centrifugal force being the acceleration/Reaction force that is present in every event involving centripetal acceleration, does there exist an identical acceleration/Reaction force in every event involving linear acceleration? While centripetal acceleration is caused by centripetal (inward-directed) acceleration/Action forces, does the acknowledgement of a centrifugal (outward-directed) acceleration/Reaction force mean that "centrifugal acceleration" is a possibility? While reaction forces are present during the forceful activity of acceleration, are they also present during forceful events where acceleration is absent? In general, these questions will help direct our investigation into the reality and characteristics of reaction forces.

(10) The centrifugal (outward-directed) force reacting to centripetal (inward-directed) acceleration is an internal (Type 1 or Type 2) support force that is being reactively generated, within each accelerating component of the object experiencing centripetal acceleration. The centrifugal acceleration/Reaction force is an internal force as indicated by the presence of the stacking-of-forces effect whenever the object's acceleration is being caused by an external (contact) force. This effect is an important tool in our Force Investigation Toolbox. We know from its application that any time an external (contact) force being applied to an object is opposed by an internal force being generated within each component of the object, the stacking-of-forces effect is present within the object's matter. In a centripetal acceleration event such as when an

astronaut is standing on the inner surface of the outer wall of a rotating wheel-like space station, the inward-directed centripetal acceleration/Action force is the external (contact) force impressed against the astronaut's feet. As each component of the astronaut's body bears with it own outward-directed centrifugal acceleration/Reaction force of weight while transferring in this same direction the accumulation of all such a/R forces from similar components that are positioned inward within the astronaut's body, the stacking-of-forces effect is fully present. Thus it is safe to conclude that the acceleration/Reaction force reacting to centripetal acceleration is always fundamentally an internal force.

(11) The acceleration/Reaction force is also always directed opposite to the physical activity of acceleration that is being caused by the acceleration/Action force. Thus the acceleration/Reaction force in a linear event is like a passenger who sits facing the rear in a car that is accelerating forward. No arrangement of thought can change the fact that the acceleration/Reaction passenger is facing opposite to the direction of the activity of acceleration. Equally true is the fact that no rearward-directed event is occurring. The acceleration/Reaction passenger is just along for the ride while acting as the cause of nothing.

(12) The same holds true in circular events. Thus the acceleration/Reaction force in a circular event is like a passenger who sits sideways facing outward in a turning car that is traveling at a steady speed while experiencing the activity of inward-directed (centripetal) acceleration. Again no arrangement of thought can change the fact that the acceleration/Reaction passenger is facing opposite to the direction of the activity of acceleration. Again it is obvious that no outward-directed event is occurring. The acceleration/Reaction passenger is just along for the ride while acting as the cause of nothing.

(13) Now that we recognize the inability of the centrifugal acceleration/Reaction force to act as the cause of any event, realize that Ernst Mach and later on, Albert Einstein, missed this point when they mistook the outward-directed centrifugal acceleration/Reaction force that one experiences on an amusement park "merry-go-round" as an outward-directed event-causing "dynamic gravitational force" of a type "unknown to Isaac Newton". Here you can see the problems that result when one gets off to a false start where logic is lost right at the beginning. In Universal Physics we recognize that the outward-directed centrifugal forces experienced on a "merry-go-round" are all acceleration/Reaction forces being caused by and providing support for the inward-directed centripetal acceleration/Action forces that are the forces responsible for causing the inward-directed centripetal acceleration of the orbiting objects. Contrary to Mach's and Einstein's baseless thought experiments, there are no outward-directed acceleration-causing action forces present in a merry-go-round event. Instead the outward-directed forces present are centrifugal acceleration/Reaction forces that provide the Newton LAW III predicted and required support for the inward-directed centripetal acceleration/Action forces that truly are the forces acting as the cause of this inward-directed event.

(14) Meanwhile, Isaac Newton's understanding of these events remains essentially correct. He did refer to such centrifugal acceleration/Reaction forces in his spinning bucket of water event (popularly known as "Newton's Bucket") as being "forces receding from the axis of circular motion." This statement, along with his recognition of acceleration in general and centripetal

acceleration in particular as an activity that is always caused by an action force (LAW I), which action force, in turn, is always the cause of its own reaction force (LAW III), means to me that had he known of their work, Newton would not have offered any kind of support for Mach's or Einstein's thought experiments regarding their theories concerning the source and role of centrifugal acceleration/Reaction forces.

(15) In fact, had Newton been more complete in explaining his understandings concerning the effects of force upon the motion of objects, his reader's understandings would have been more complete, effectively closing the door of acceptance when Ernst Mach's thought experiment, that granted impossible properties to centrifugal acceleration/Reaction forces, was first proposed. And had Ernst Mach's understanding been more complete, perhaps he would never have considered such imaginary thought experiments as being worthy of expression. Finally had Ernst Mach never expressed his misunderstanding of the role of centrifugal acceleration/Reaction forces, Albert Einstein might never have burdened us with his forceless theory of gravitation known as the "General Theory of Relativity". (For an analysis of "Mach's Principle", refer to Question 3. For a more complete and less confusing set of rules refer to Article X, Universal Physics Rules for Force & Motion. For an analysis of gravitation as a Newtonian Universal force consult Article VIII, Universal Gravitation. For the setting aside of Einstein's "General Theory of Relativity" read Article VI, Gravitation = Acceleration?)

(16) When is a centrifugal acceleration/Reaction force measurable with a scale? Centrifugal a/R forces may be measured in events where the centripetal acceleration/Action force is an external (contact) force. When the a/A force is an external force impressed in one direction against the test object at one or more points of contact with a second object, the cumulative total of the accelerating test object's myriad of internal acceleration/Reaction forces is equally present as an external force in the opposite direction at the same mutual points of contact. Insertion of a compression or tension scale at these mutual points of contact will allow for the measurement of this action/reaction pair of centripetal/centrifugal forces.

(17) Just such an event is the one, often expressed, of swinging by hand a paver on the end of a short rope. Insert a tension scale anywhere between the hand and the paver. The scale will display what is ultimately a single external centripetal inward-directed acceleration/Action force causing and thereby being supported by the cumulative total of a myriad of individual internal centrifugal outward-directed acceleration/Reaction forces. Place the tension scale between the hand and the rope for the highest a/A verses a/R force reading. Place the scale at mid-rope for a lesser force reading. Place the scale between the rope and the paver for an even lesser reading. Divide the paver into two parts and place the scale between the parts for an even lesser reading of the mutual pair of centripetal/centrifugal a/A and a/R forces. (Please allow me to address only horizontally-directed forces in this simple event.)

(18) Understand that with each test, you are measuring the magnitude of the inward-directed, acceleration-causing, centripetal action force which is also causing its own terminating support in the form of the outward-directed, acceleration-reacting, centrifugal reaction force. Understand also that in each experiment you are using a mechanical scale to reveal the forceful presence of a centrifugal or outward-directed force. Now I ask you, which statement do you think represents

the truth: (a) Centrifugal force is measurable by scale in certain events and therefore is a real acceleration/Reaction force that provides terminating support for the event-causing centripetal acceleration/Action force present, or (b) Despite being measurable by scale, centrifugal force is still imaginary and therefore the experts are correct in labeling it "fictitious".

(19) If you choose (a) as representing the truth then that decision puts you ahead of every Physics author but one in my library of books on the science. If you choose (b) as representing the truth then you must think that once a conclusion has been accepted, it remains permanent even when all "facts" supporting its acceptance have been swept away.

(20) When is the presence of a centrifugal acceleration/Reaction force not measurable by any scale? To understand the answer to this question it is essential that you understand the difference between internal and external forces. The centrifugal acceleration/Reaction force is always fundamentally an internal force that is being reactively generated within each component of the accelerating object's matter. Meanwhile the acceleration/Action force, being the action force that is the cause of the object's acceleration, can take the form of either an external (contact) force impressed across a mutual point of contact the object is sharing with a second object as demonstrated in the wheel-shaped rotating space station event and our whirling paver event, or the acceleration/Action force can be another internal force which in this case is being actively generated within each component of the accelerating object's matter. Here no contact with a second object is required. A good and common example of an internal acceleration/Action force is the force of gravitation when it is acting as the cause of an object's linear or orbital acceleration.

(21) Like all other action forces, gravitation is capable of acting as the cause of an object's acceleration. But if conditions of support do not allow the object to accelerate then the force of gravitation remains present as a non-acceleration/Action force (n-a/A force), as when you measure the n-a/A force of your gravitational weight against Earth using a compression scale that is firmly supported by an unyielding floor.

(22) When you stand on the railing of the basket of a high-altitude balloon, the structure of the basket is supported by the buoyancy of the balloon overhead restricting your body's component's gravitation toward Earth to the role of a Type 2 non-acceleration/Action force. While wearing both main and backup parachutes, as you step off the railing, your body loses the balloon's external (contact) support force. With little speed difference between your body and the air in the vertical direction, your body's force of gravitation now becomes almost 100% a Type 1 acceleration/Action force as it actively and initially causes your body to accelerate in a linear manner at the rate of nearly 32 ft/sec/sec toward Earth's surface.

(23) Once losing support from the balloon's structure, your acceleration is not only immediate but it is also temporarily at its highest rate during your entire journey after leaving the basket. Your vertical speed relative to both the balloon and Earth's surface far below, is initially low but your rate of acceleration being caused by the myriad of acceleration/Action forces being actively generated within each of your myriad of component's of matter is immediately at its highest value. There is no delay in this acceleration as in the "physics" of cartoon characters who step off the cliff's edge but do not begin accelerating toward the canyon floor until after the realization of their

plight takes effect. In truth your acceleration upon leaving the basket is immediate. There is no hesitation. Nor is there present any fabled "resistance" force within your body objecting to your immediate acceleration at its highest rate. Your immediate acceleration is just as predicted by Newton's formula: acceleration = Force / mass. There exists no fudge factor stating that Newton's formula takes effect only after a short delay while the fabled "resistance forces" are being "overcome". These false terms are based solely upon wishful thinking of the author and not in the slightest upon any observable fact.

(24) How immediate is your acceleration? As immediate as now. As a test, stand against Earth while holding a rock out at arm's length. Now release your grip on the rock. As its acceleration causes an increase in the velocity of its motion away from your hand in Earth's direction, are you able to notice any hesitation prior to the rock's acceleration? Try this experiment again and again. Film it with a high-speed camera. For certain the rock's velocity relative to your hand is initially low compared to the rest of its acceleration run in Earth's direction. But acceleration is not speed nor is it velocity which is speed in some specific direction. Simply put, acceleration is the active object's rate of change of motion (change in speed and/or direction of motion, or change in velocity) from when it was inactive. The rock is almost 100% inactive in its rest-motion while being supported by your hand. As you release the rock, its velocity away from your hand initially increases at the acceleration rate of 32 ft/sec for each second of fall. There exists no hesitation or delay in this event as your accelerating rock experiment will verify. Suggestions by others to the contrary are based solely upon wishful thinking, not upon any physical experiment. Galileo proved long ago that such wishful "thought experiments" should be ignored for they are of no lasting value.

(25) Returning to our sky-jumping balloon event and the question of when is the presence of a centrifugal acceleration/Reaction force not measurable by any scale, understand that the only difference between a centrifugal acceleration/Reaction force and a linear acceleration/Reaction force is simply the ever-changing direction of the centrifugal acceleration/Reaction force as compared to the non-changing direction of the linear acceleration/Reaction force. No other differences exist between these two internal reaction-to-acceleration support forces for they share the same acceleration/Action force cause while reactively providing the same equal and opposite acceleration/Reaction support force.

(26) Thus when you step off the basket's railing, the internal Type 2 non-acceleration/Action force of gravitation being generated in Earth's direction within each of your body's component's of matter switches to become a Type 1 acceleration/Action force and begins instantly to cause the highest rate of downward-directed acceleration each component will experience during its entire fall toward Earth's surface. Each such internal acceleration/Action force within each component of your body's matter is causing not only that component's acceleration but also acting as the cause of that component's internal acceleration/Reaction support force as predicted to exist by Newton's LAW III, the Universal Law of Mutual Forces, and Rule 7, Part 2 of the Universal Physics Rules for Force and Motion.

(27) The problem we face is how to measure the acceleration/Reaction force present within each accelerating component of matter. While in all events, the acceleration/Reaction force is always

an internal force, here in the high-altitude balloon jumping event, the event-causing acceleration/Action force is also an internal force. Since here in this event they are both Type 1 internal forces, recognize that the action force and the reaction force are both present at the same time within each and every single accelerating component of your body's matter. For this reason the a/R force cannot be measured as it exists to provide terminating support for the gravitational a/A force which also cannot be measured for there is no possible way to insert an impossibly small scale in between one such action/reaction pair of internal forces. As Isaac Newton might say, 'This time the thing is altogether desperate!', for once inside a single component of your body's matter, no clear division exists between the gravitational acceleration/Action force acting in one direction and the resulting acceleration/Reaction force reacting in the opposite direction. Thus here there is no way the internal a/A force can possibly be restricted to one side of the impossibly small scale while the internal a/R force can possibly be restricted to the other side of the impossibly small scale. It is for these reasons that there exists no mechanical way to directly measure a Type 1 internal force when its opposing or supporting force is another Type 1 internal force.

(28) With direct mechanical measurement of opposing pairs of Type 1 internal forces not a possibility, there do remain satisfactory methods of "measuring" each such force. By substituting a Type 3 external (contact) stacking force of identical magnitude for one of the internal action or reaction forces, a mechanical scale will do nicely in measuring the presence of the internal force that remains.

(29) Consider the event of an object above Earth's surface that is freely accelerating in Earth's direction while inside the frictionless environment of a vacuum chamber. We know an action force is always present during every event involving acceleration (change in velocity including speed and/or direction of motion). We know that in this event the action force is the internal force of Earth gravitation being actively and separately generated within each component of the falling object's matter. We also know that every acceleration/Action force always causes the reactive generation of it own supporting reaction force which is known herein as the internal acceleration/Reaction force. Thus in this falling-in-a-vacuum event two internal forces of action and reaction are present within each component of the falling object's matter.

(30) By now we know there is no way to directly measure these mutually opposing internal forces using any type of scale. This time "The thing is not altogether desperate...", for by providing an external contact force of support for the the object thus preventing its fall, a compression scale can be inserted between the support and the object effectively measuring the cumulative total of the object's myriad of what are now Type 2 internal action forces of Earth gravitation. I will establish this measured non-acceleration/Action force of the object's Earth gravitational weight to be a 12 lb force.

(31) What then of the falling object's acceleration/Reaction force? Is there a way through substitution by an external (contact) force that its presence can also be revealed by measurement? Suppose instead of allowing the object to accelerate at 32 ft/s/s by falling in a vacuum due to the Type 1 internal 12 lb acceleration/Action force of Earth gravitation, we cause the object to accelerate horizontally in a vacuum at the same rate of 32 ft/s/s rate through the application of a

horizontally-directed Type 3 external (contact) stacking force that Newton's formula, F = m*a predicts to be 384 Poundal or 12 lb. A diminutive compression scale can be inserted at the contact point where this horizontal 12 lb. external acceleration/Action force is being applied to the object. Here we recognize that the external force the object is impressing back against the other side of the scale is the 12 lb. cumulative total of the myriad of the object's Type 2 internal acceleration/Reaction forces. Again through external force substitution another internal force, this time being the internal acceleration/Reaction force, has yielded its presence through direct measurement.

(32) By looking back at the original falling-in-a-vacuum event we now are able to discuss this common action/reaction pair of internal accelerational forces with confidence knowing full well that the presence of each yields to direct measurement through the technique of external (contact) force substitution. Here is yet another tool we may add to our Universal Physics Force Investigation Toolbox.

(33) What of circular events where inward-directed (centripetal) Type 1 internal acceleration/Action forces being generated within components of the orbiting object's matter are causing the immediate reactive generation within the same components of outward-directed (centrifugal) Type 1 internal acceleration/Reaction forces of support? Can our Type 3 external stacking force substitution tool yield their presence as well as it does during linear acceleration events?

(34) The answer is a qualified yes. The problems inherent with such a test are many. For example, a common event where an object's centripetal acceleration is being caused by a Type 1 internal acceleration/Action force is where a weightless object inside an orbiter, such as a Space Shuttle, is being caused by the Type 1 internal a/A force of Earth gravitation to accelerate away from a straight-line tangential path in the direction of Earth's core while orbiting Earth on a circular path at a fairly constant speed and fairly constant distance. Direct measurement of the magnitude of the force of Earth gravitation being generated within the object's components is possible but not practical. Imagine that the object is released from the body of the orbiter and forced to a "halt" by the thrust from the nose cone of a small rocket so that the object's orbital speed around Earth is zero. Then the small rocket is redirected so that its thrust against the object is upward-directed and just sufficient so that the object's altitude above Earth's surface remains constant at the same distance as its former orbital radial distance. Now, with a diminutive compression scale inserted between the rocket's nose and the object, it is possible to effectively measure the magnitude of the object's now Type 2 non-acceleration/Action force of Earth gravitation being opposed by the Type 3 non-acceleration/Action stacking force of thrust from the rocket.

(35) Another even less practical method of directly measuring the internal force of the object's Earth gravitation in this orbiting object event is to construct an impossibly tall tower mounted on horizontal rails installed at Earth's equator in an east/west direction. By causing the tower to travel in the westerly direction at about 1000 miles/hour to cancel the effect of Earth's rotation, the top of the tower may be used to support the "halted" object at the same position of constant elevation as did the small rocket in the previous event. Here a compression scale inserted

between the object and the top of the impossibly tall (and impossibly massless so as to not contribute to the gravitational forces present) tower again will effectively measure the magnitude of the object's Type 2 non-acceleration/Action force of Earth gravitation. This time the force of opposition is Earth's Type 2 non-acceleration/Action force of object gravitation. These two internal forces being actively generated within the object's matter and Earth's matter will accumulate through the stacking of forces effect to reach the maximum Type 3 external (contact) stacking forces present at each side of the compression scale.

(36) An accurate, practical, but non-direct method of verifying the object's force of Earth gravitation is the employment of Newton's formula for the mutual gravitation of two objects in the direction of each other.

Newton's Formula For Universal Gravitation

Force = Gravitational Constant x (Mass1 x Mass2 / Distance2)

For a thorough application of his formula, consult Question 4 regarding the orbit of the A.C.E. satellite.

(37) It is sufficient for our exercise here to accept that we have determined, by whatever means, the magnitude of the internal force of Earth gravitation that is causing the weightless object's curved path of orbit of Earth while it is located inside the body of the orbiter. The task at hand is to substitute an external (contact) force of the same magnitude that is impressed at right angle to the object's motion through space. Only this time, the speeding object will be located in deep space far from any large body. As long as the object's speed relative to the axis of rotation remains the same as the speed it possessed as it followed the path of its orbit of Earth's axis, here in deep space, with Earth missing, by the application of this Type 3 external (contact) acceleration/Action stacking force by whatever means at right angle to the object's motion, the object will once again experience centripetal acceleration causing it to travel a fairly circular path about an imaginary axis located where Earth's axis would exist if Earth were present. Here using a Type 3 external (contact) force substitute for a Type 1 internal gravitational centripetal acceleration/Action force, by inserting a diminutive compression scale between the orbiting object and the second object (rocket?), direct measurement of the cumulative total of the object's internally generated, outward-directed, (centrifugal) Type 1 now turned Type 2 acceleration/Reaction forces becomes possible. (For a complete explanation of the differences of Type 1 and Type 2 internal forces and Type 3 and Type 4 external forces, consult Article IV The Nature of Force.)

(38) Mathematical verification of the inward-directed (centripetal) external (contact) force required to cause our speeding test object to orbit this imaginary axis in deep space at a given radial distance may be found by using Newton's formula Absolute Force = mass x speed2 / radius. If instead of an answer in absolute units for Force such as the Poundal or Newton you prefer an answer in the more commonly recognized force units of lb.f or kg.f then the formula is force = mass x speed2 / radius / g. At 32 ft/s/s or 9.8 m/s/s, g is the approximate conversion of the Poundal to lb.f or of the Newton to kg.f.

(39) Understanding the acceleration of an orbiting object that is following a circular path can be confusing. Since acceleration is a change in velocity and velocity is speed plus direction, any change in speed where the object in following a linear path represents acceleration while any change in direction where the object is following a curved path also represents acceleration. The confusing part about acceleration in a circular event is that this acceleration is said to be centripetal or inward-directed. While true, this statement, without explanation, plants a false expectation in the mind of the reader. Based upon our understanding of acceleration in linear events, where if the acceleration is in the forward direction, the accelerating object will always draw nearer to stationary objects to the front, when the reader of a circular event is told that the orbiting object's acceleration is centripetal or inward-directed, it is logical for the reader to assume that over time the object's radius of orbit will decrease as the object's inward-directed centripetal acceleration will cause it to draw nearer to the axis. The converse of this assumption predicts that if instead the object's radius of orbit increases, then an outward-directed centrifugal acceleration must now be present. The confused reader may even conclude that an outward-directed centrifugal acceleration-causing action force must also be present. Lacking the proper explanation and insight, our reader has been betrayed by his/her own logic.

(40) The problem here is the reader's false expectation that inward-directed acceleration in a circular event automatically predicts that a reduction in the accelerating object's radius of orbit will occur. The solution is to look at centripetal acceleration the way Isaac Newton did during his analysis of such an event. First Newton thought of the object as forcelessly traveling a linear path at a constant speed. (In Universal Physics this forceless event is represented as the object's inactive, default state of rest-motion where no acceleration/Action force is present.) Next Newton applied a sideways-directed force against the object causing it to veer away from this linear path. As the object departed, the linear path of reference became a line tangent to the object's new curved path of travel. At first the linear tangent path was an effective reference line from which to gauge the object's accelerated departure. But after a short period of time, Newton discovered that the tangent path lost its usefulness as an acceleration reference line as the departing object even goes so far as to travel in the reverse direction on the back side of the circle. Newton solved this problem by repeatedly redrawing the tangent reference line around the circle to shorter and shorter intervals of the object's time of departure. Here it became clear to Newton that the object's acceleration was represented by a physical departure at an increasing rate from the line of tangency and not by a physical approach to the center or axis of the new curved path of travel.

(41) In a linear event, such as the acceleration of a dragster from start to finish it is natural and correct to think of the dragster as accelerating toward the approaching finish line. It is equally correct to recognize the dragster as accelerating away from the departing start line. In a circular event while stating that the acceleration is inward-directed or centripetal, it is incorrect to expect the accelerating object to make any effort to approach the axis yet it is correct to expect the accelerating object to depart at an increasing rate from a tangent reference line. It is for this reason I like to refer to acceleration in circular events as being directed "away from a straight path of travel repeatedly drawn tangent to the the object's curved path of travel." To think of acceleration in circular events in this manner is to upgrade one's logic to match with the logic employed by Isaac Newton.

(42) Next for us to consider is the event where an orbiting object's radius is increasing as the object moves away from the axis to a more-distant orbit. Is this behavior evidence of the presence of outward-directed centrifugal acceleration caused by a net outward-directed centrifugal action force? All that is required to reach the correct understanding is to study the object's path. A good and common event is one where you are driving a car around a circle in a large empty parking lot. When viewed from above, the counter-clockwise path of your car is curved inward to the left indicating that since a straight-line path is not being followed, inward-directed (centripetal) acceleration caused by an inward-directed acceleration/Action force is present. This event-causing action force is caused by the pavement's inward-directed push against the car's leftward turned front tires. The result is a certain rate of inward-directed acceleration away from tangent reference lines.

(43) Now you turn the car's steering wheel to the right which is a little bit closer to straight. The car will immediately begin turning a larger-diameter circle in the parking lot. A view from above still shows the car's path to be curved inward to the left only now the curve is less pronounced. The event-causing action force from the pavement is still centripetally directed only less in magnitude. The rate of inward-directed acceleration is also less. But most importantly it is still greater than zero. Here you can easily see that outward-directed "centrifugal acceleration" is not occurring. Instead as long as the car's path curves to the left, inward-directed "centripetal" acceleration will continue to occur.

(44) What happens when you return the front wheels to the straight ahead position? Inward-directed centripetal acceleration will cease as your car leaves the circle to follow the straight-line path of a tangent reference line. Still there exists no sign of "centrifugal acceleration". Turn the steering wheel a bit to the right from straight and the pavement will now begin forcing the car to veer away to the right from the tangent reference line. Centripetal acceleration is again occurring only this time it is present to the right as the car begins to follow a clockwise path around an entirely new circle. Again no "centrifugal acceleration" and most importantly no outward-directed "centrifugal" acceleration-causing action force is present. Only changing rates and directions of inward-directed centripetal acceleration caused by changing magnitudes and directions of inward-directed centripetal acceleration/Action forces are present.

Conclusion I:

(45) There exists no such event as outward-directed "centrifugal acceleration". Also there exists no force capable of acting as the cause of such an imaginary non-event as "centrifugal acceleration".

(46) In case you think the above conclusion is obvious leaving you to wonder why I have devoted time and effort to this issue, realize that Ernst Mach and Albert Einstein both adopted the illogical belief that "centrifugal acceleration" is real. Yet no matter how an event is arranged, even if the orbiting object has the help of the thrust of an onboard, outward-directed rocket, only centripetal acceleration of various rates and directions will result. A study of the orbiting object's path is all that is required for one to recognize this truth. It is for these reasons that there exists no test capable of proving that "centrifugal acceleration" is possible. With this understanding

comes the realization that despite their mental efforts in this area, both Ernst Mach's and Albert Einstein's thought experiments regarding the spinning turntable/whirling Universe event have been shown to be of no real value.

(47) Have you noticed that in this investigation into the nature of reaction forces only acceleration/Reaction forces have been discussed? What then of non-accelerational events such as when you push with a horizontally-directed action force against a fence post? Is not the fence post reactively pushing back with an equal and opposite reaction force being caused by your event-causing action force? The answer might surprise you. To recognize the truth in all such forcefully caused non-accelerational events all one has to do is to adopt the impartial attitude of a Universal Observer.

(48) While the downward and upward action forces of gravitation play a role in the pushing-against-a-fence-post event, I will focus our attention on the horizontally-directed forces present. While the action force of your push has already been identified as being impressed horizontally against the post, what if instead of trying to dislodge the fence post, your intent was to accomplish some horizontally-directed event with your feet? Suppose you were merely bracing yourself against the fence post with your hands while really trying to prevent a log positioned on an inclined plane from rolling downhill in your direction. Then you might be inclined to say that the action force in this event is being impressed by your feet against the log. The impartial truth is that both the force from your hands against the fence post and the force by your feet against the about-to-roll log are action forces. This holds true in all such horizontally-directed events where acceleration is absent. In a non-accelerational event, when an event-causing non-acceleration/Action force is impressed by an object as an external contact force in one direction, there is always present an event-causing non-acceleration/Action force impressed as an external contact force by the object in the opposite direction.

(49) We agree then that the force impressed by your hands against the fence post and the force impressed by your feet against the log are both event-causing action forces. From this point on I will ask you to study the Action Force Loop while looking for the presence of a reaction force. To simplify things, let us say that the log is now a skateboard that is tied by rope to the base of the fence post. Your action force push against the post tries to dislodge the post in one direction while your action force push against the skateboard tries to dislodge the skateboard in the opposite direction. The tension in the rope prevents either event from happening while providing a conduit so that each action force can loop around to oppose the other action force. No reaction forces are present. How do we know this as true? If there were reaction forces present then they would effectively double the forces present at any given point. Since the looping action forces fully account for all horizontal forces present, there simply is no room in this event for the addition of one or more reaction force(s). This truth can be taken as proof that none exist.

(50) For a clearer explanation of the Action Force Loop (another tool for our Force Investigation Toolbox) consider that you have taken a flexible plastic pipe and laid it horizontally on a flat sheet of plywood so the pipe forms a circle where its ends are touching just as you might form a circle by touching the tip of your index finger to the tip of your thumb on the same hand. Now separate the ends of the pipe by a distance of 1 ft. and fix the pipe in place on the plywood. Then using

appropriate sized marbles, roll as many as needed to fill the pipe so that only a half-inch of free space exists at each end. Now slowly push against the marbles at one end with a finger of one hand while slowly pushing against the marbles at the other end with a finger of your other hand. Hopefully this marble event will help you to realize that in an Action Force Loop, no reaction forces are present. This is due to the simple fact that each action force present is equally opposed by the other action force present.

Conclusion II:

(51) Acceleration/Reaction forces are the only reaction forces that exist in nature. Acceleration/Reaction forces are present in all accelerational events, such as in linear events where an object's speed of motion is changing or in circular events where the object's direction of motion is changing. Reaction forces exist nowhere else. This means that while non-acceleration/Action forces exist, such as the n-a/A force you are impressing against each end of the marble-filled Action Force Loop, there is no such thing as a non-acceleration reaction force.

(52) Now that we have reached this acceleration/Reaction force conclusion, realize that prior to Universal Physics, no credibility has been given to this reaction force role. In circular events, the outward-directed acceleration/Reaction force is correctly termed centrifugal while incorrectly termed "fictitious". In linear events the acceleration/Reaction force is ignored altogether by the incorrect "net" force theory of acceleration supported by the half truths of the free body diagram drawing technique. What this science is in need of is the whole truth, not just half.

(53) An astronaut is standing on a compression scale inside a rocket that is about to begin its acceleration from the launch pad at Cape Canaveral, Florida, USA. Just before the rockets are ignited, the external force the astronaut is freely bearing against the scale is 165 lb.f. of gravitational weight. Sometime after liftoff, as the rocket expels fuel matter, its rate of acceleration reaches its maximum. Now the external force the astronaut is freely bearing against the scale equals 825 lb.f. While Modern Physicists associate the astronaut's new weight with his gravitational weight back at the launch pad by referring to his new weight in the accelerating rocket as being the equal of 5 gravitational weights, no satisfactory explanation of the additional downward-directed 660 lb.f is given. The additional upward-directed 660 lb.f is no mystery. The role of this acceleration/Action force is made perfectly clear by Isaac Newton's formula F = mass * acceleration. But the mutual 660 lb. reaction force caused to exist by the 660 lb.f acceleration/Action force, rather like an acceleration/Reaction force reflection back from the astronaut's accelerating body is not acknowledged within the teachings of the science of Modern Physics. Instead the "free body diagram" technique is employed to cover up this general lack of understanding.

(54) To arrive at the truth, all one has to do is acknowledge that the force from the rocket has to be an action force and since no Action Force Loop exists then the supporting force has to be a reaction force. Since 660 lb. of the rocket's action force is causing acceleration of the astronaut this means that this action force portion is an acceleration/Action force. Since the supporting reaction force from the astronaut is only present during the astronaut's acceleration and then always a match for the rocket's variable acceleration/Action force, one is safe to conclude that the

660 lb. of downward-directed reaction force from the astronaut is an acceleration/Reaction force. The truth is that now the external force of weight the accelerating astronaut is freely bearing against the scale is one part Earth gravitational force of weight (165 lb.f) and 4 parts acceleration/Reaction force of weight. While both of these forces are fundamentally internal forces, here they manifest themselves as Type 2 internal forces as they externally stack up or culminate to reach a maximum external 825 lb. force of weight freely impressed by the astronaut's feet against the scale.

Conclusion III

(55) The only reaction forces that exist are acceleration/Reaction forces. They are caused to exist by the event-causing acceleration/Action forces and therefore are never themselves the cause of any event. Acceleration/Reaction forces are often measurable, by one method or another, in many accelerational events. Possessing both absolute magnitude and direction, every internal Type 1 or Type 2 acceleration/Reaction force is a vector quantity worthy of inclusion in every drawing of an accelerational event.

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Author's Commentary

Recognition of the supportive nature of acceleration/Reaction forces brings a long overdue clarity to the science of Physics. The challenge facing us now is to recognize each and every reaction force misunderstanding that is currently being used in support of more advanced theories. There is a conservative tradition in Physics whereby once a concept such as "aether", Newton's misunderstood version of inertia or "spacetime" becomes accepted, even after the removal of all known support, the concept continues to remain in general acceptance. In Universal Physics, no concept attains acceptance without firm and logical support nor retains that acceptance after the loss of such support.

Ethan Skyler

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