

COPLANAR FORCES

According to 'MATTER (Re-examined)'

Nainan K. Varghese, matterdoc@gmail.com
<http://www.matterdoc.info>

Abstract: All physical actions are caused, initiated and accomplished by work. Relation between magnitude of work, done about a macro body and its displacement during work is 'force'. Hence, 'force' is a mathematical aspect related to work and work is the real entity. However, the term 'force' is usually understood as a 'cause' or 'effort' required for an action. Actions are effects of efforts due to causes. Action by an effort results in definite effect on or about a 3D matter-body. Certain mechanism is essential to perform an action. Generally, all physical actions are understood by displacement (motion) of macro bodies in space. 'Action at a distance through empty space' is an impossible proposition. To accomplish motion in space, four things are essential. They are; a macro body that is being moved, an entity that is instrumental to the motion, a mechanism of motion and a reason or cause for the motion. Although mechanism of motion is basically the same in all conditions, there are slight differences in its actions, when causes of motion are in different relative directions or in different planes. This article briefly describes mechanism of motion (by universal medium that is instrumental to motion of a macro body), when causes in a plane are involved.

Keywords: Force, Effort, Work, Energy, Quantum of matter, 2D energy-field, Universal medium, Inertia.

Introduction:

Change of state (of motion or rest) is action. Action is the result of additional work-done about a 3D matter-body. Usually a change in the state (of motion or rest) of a 3D matter-body neither changes its 3D matter-content nor changes relative arrangements of its constituent 3D matter-particles. Therefore, it is logical to conclude that work-done about a macro body exists outside its 3D matter-content but in close association with it. A real entity that exists outside 3D matter-particles of a macro body, but enclosing the whole of macro body is the all-encompassing universal medium. Hence, universal medium about a 3D matter-body is the logical place for work to exist.

'Force' is usually considered as an influence that causes a 3D matter-body to change its state of motion (including rest) or shape. It is the result of a physical effort. 'Standard Model' of physics considers exchange of (undefined) 'gauge bosons' through empty space is the fundamental means by which 'forces' are emitted and absorbed by macro bodies. This ascribes certain physical and mystical qualities to 'force', which makes it a real entity with magical properties. 'Quantum field theory' considers 'force' as a redundant notion, resulting from momenta of virtual particles. Virtual particles can live and act only in minds of rational beings and in mathematical analyses. They cannot take part in physical actions. 'General relativity theory' considers 'force' as a superfluous entity arising from conservation of momentum, which may be derived from properties of space. In these theories, idea of 'momentum' is usually considered more fundamental than the concept of 'force'. Thus, 'force' is better understood as a sort of 'interaction'.

However, it may be noticed that in 'classical (Newtonian) physics'; 'Force' is defined as a product of (constant) mass of a 3D matter-body multiplied by its acceleration, ($F=ma$). Even while a physical effort on a 3D matter-body exists, magnitude of force may reduce to zero by absence of either mass or

acceleration. 'Force' appears as a mathematical relation between two properties of a 3D matter-body, which may vary between positive values to zero. A mathematical relation is a functional entity.

'Force' is also defined as the rate of work-done on (or 'energy' transferred to) a 3D matter-body with respect to its displacement, ($F=W/d$). It is the spatial derivative of additional work-done. Here, even while a physical effort on a 3D matter-body exists, magnitude of force, depending on the magnitudes of additional work-done and displacement may vary between zero and infinity. Rate is a mathematical relation and hence a functional entity, which cannot perform physical actions.

All physical actions are caused, initiated and accomplished by work. Work, associated with a 3D matter-body, for its creation and development may be termed as intrinsic work and all further actions on the body are accomplished by additional work. As given above, mathematical relation between magnitude of additional 'work-done' about a 3D matter-body and its displacement in absolute terms, during accomplishment of additional work, is the 'force'. Work, being physical changes in universal medium about a 3D matter-body, is tangible and hence a physical entity with positive existence. Physical entities are real and they can accomplish real action on 3D matter-bodies. Therefore, it is logical to consider 'work' and 'additional work' as real and primary entities and 'force' as one of their aspects. However, the term 'force' is often used in this article in its general sense to mean 'cause or effort' required for an action. Actions are effects of causes. To perform an action that results in definite effect, besides a cause, certain mechanism of action is also essential.

A pulling effort (force) is logically an impossible suggestion. When we consider action of an effort, as pulling-action, in reality its mechanism of action pushes at the 'force-receiving body' to make the action possible. During pull-action by a rope tied to a macro body, inner part of the knot actually pushes at the part of macro body, which is in direct contact with inner part of the knot. Therefore, character of all efforts (natural forces like; gravity, electromagnetic, nuclear, etc.) is of push. All efforts are activated by push action on 3D matter-particles by universal medium, which is in direct contact with every 3D matter-particle in universe. Generally, all physical actions are understood by displacement (motion) of macro bodies in space. Action at a distance, currently assumed to accomplish movements of a macro body through empty space, is an impossible proposition. A 3D matter-body can affect another one only through direct contact, either directly between them or through an intermediary entity, which is in direct contact with both of them.

To accomplish motion in space, four things are essential. They are; a macro body that is being moved, an entity that is instrumental to the motion, a logical mechanism of motion and a reason or cause for the motion. Mechanism of motion is provided by natural actions of an all-encompassing universal medium, which is intermediary between all 3D matter-particles and acts as instrumental to all types of motions in the universe. Cause or reason for the universal medium to act and produce movements of macro bodies is relative changes in its consistency, about the bodies, due to various reasons. Although mechanism of motion is basically the same in all conditions, due to peculiar structure of universal medium, there are slight differences in its actions, when causes of motion are in different directions or in different planes. Cause for displacement of a macro body in space is the stabilising actions of universal medium to sustain its homogeneous nature. Working mechanism of direct interaction between two efforts in one plane (coplanar forces) is briefly described in this article. All conclusions expressed in this article are from the book, 'MATTER (Re-examined)'. For details, kindly refer to the same.

Universal medium:

An alternative concept, proposed in the book 'MATTER (Re-examined)', envisages that entire space, outside basic 3D matter-particles, is filled with all-encompassing universal medium. It is formed by two-dimensional latticework-structures, called 2D energy-fields, by 'quanta of matter' (in all possible spatial planes/directions). Different 2D energy-fields co-exist at points of their intersections. In stable state, quanta of matter, in latticework-structure of a 2D energy-field, form sides of a square. Parts of 2D energy-fields, within body-dimensions of a macro body, contain sufficient distortions to sustain integrity and stability of the macro body, in its current state. This part of universal medium is 'matter-field' of the macro body. Distorted region in universal medium about a 3D matter-particle in a macro body is the

matter-particle's 'distortion-field'. 2D energy-fields may be deformed against their inherent property to remain isotropic and homogeneous. Magnitude of distortions in a matter-field, associated with a 3D matter-body, is the magnitude of 'work' associated with that 3D matter-body. Magnitude of distortions in matter-field of a macro body at rest, with respect to absolute reference (universal medium), is 'intrinsic work', associated with it. 'Additional distortions' in its matter-field (over and above those required to maintain integrity of the macro body) are 'additional work' existing in association with the macro body and it determines state of (motion of) the macro body.

Universal medium is aether-like, but a real entity with definite constituents, structure and properties. It is reasonably static and homogeneous to provide an absolute reference frame, for all apparent interactions between 3D matter-bodies. Matter is inert and incapable of any actions or movements on its own. It is the 'inertial actions' (actions, which invoke property of inertia) of the universal medium about a 3D matter-body, which move it. All apparent interactions, between 3D matter-particles/bodies, take place through the medium of universal medium, which is in direct contact with every basic 3D matter-particle in universe. This avoids the illogical assumption of 'actions at a distance through empty space'.

Displacements of quanta of matter (including the changes in their dimensions) in universal medium are tangible in 2D spatial system. They constitute 'work-done' about a macro body. Stress, produced in the latticework-structures of universal medium, by their deformations is the 'energy', associated with the work-done. Energy has no independent existence in any form. Rates of distortions (work), being introduced into universal medium, is 'force' or 'power'. Ultimately, 3D matter-bodies are displaced in space by transfer of latticework-distortions from higher distortion-density region to lower distortion-density region in universal medium. Constituent 3D matter-particles of a macro body are carried by moving distortions to create motion of a macro body.

Mechanical re-arrangement of quanta of matter in 2D energy-fields is an action (of an effort). Whichever may be the manifestation of effort (gravitational, electromagnetic, nuclear, inertial, etc.); they all have only one mechanism and act in similar manner. Thus, fundamentally, there is only one type of effort (natural force) in nature, of which different causes are associated with each phenomenon. Force, due to action of an effort on a 3D matter-body, is the rate of mechanical rearrangement of quanta of matter in universal medium, in and about a macro body, with respect to distance moved by the body during an action. Fictitious forces (like centrifugal force, etc. currently called as inertial forces), invoked by observer to maintain validity of present theories and apparent forces, related to different frames of reference, are not considered as real forces, in this concept. They serve for easier but irrational explanations and understanding of various phenomena. All explanations, given below, are related to actions in absolute reference frame.

Mechanism of inertial action:

The term 'inertial' indicates a function that invokes phenomenon of 'inertia'. Although, 'force' is the rate of work, it is used here in its general meaning as an effort or the cause of an action. Action of a force always presupposes ability of 'force-applying body' to move considerably faster than 'force-receiving body', in the direction of force. In the event, speed of 'force-receiving body' in the direction of force equals or exceeds speed of 'force-applying body', external force cannot subsist any more. In 3D spatial system, an effort (force) is recognized by its inertial action on a 3D matter-body. Displacements of 3D matter-particles in space are necessary to create inertial actions. 'Inertial forces' are applied from outside a 3D matter-body. Distortions in universal medium, produced by inertial forces in and about a 3D macro body, are invested from external sources, either by 'field forces', by 'gravitational forces' or by motion of external 3D matter-bodies towards it.

Consider action of a force on 'force-receiving body' by 'force-applying body'. 'Force-applying body' is assumed to move faster than 'force-receiving body'. Work-done, about a macro body, is the magnitude of additional distortions developed (in universal medium) about the macro body and force is the rate of their development. Work-done, in each plane, interacts (directly) only with other works-done in the same plane. Hence, in 3D spatial system, forces interact separately in each plane. As a 'force-applying body' approaches 'force-receiving body', distortion-fields in universal medium (matter-field) about the nearest

3D matter-particles in both bodies come within interacting distance. 3D matter-particles of macro bodies tend to keep their relative distance between them. In the process, 3D matter-particles of 'force-applying body' push 3D matter-particles of 'force-receiving body'. Movements of 3D matter-particles in 'force-receiving body' create additional distortions in the matter-field of 'force-receiving body'. Additional distortions, received into matter-field of 'force-receiving body' transfer in the direction of (approach of 'force-applying body) application of effort/force.

Speed of transmission of additional distortions (within a macro body's matter-field) depends on the rate of additional distortions, invested into the matter-field. In 3D spatial system, only inertial nature of forces can transfer tangible work from (matter-field of) one macro body to (matter-field of) another. Inertial forces may be transmitted at any speed (directly proportional to magnitude of force) but at speeds lesser than the speed of light. Highest possible absolute speed in space is limited by ability of macro body's 3D matter-particles to maintain their integrity by avoiding local breakdown of latticework-structure of universal medium. Action of an inertial force transfers additional distortions from (matter-field of) 'force-applying body' to the (matter-field of) 'force-receiving body'. As there can never be a point-direct force (because matter-fields of 3D matter-bodies are extremely large compared to a latticework-square of 2D energy-field), explanation in the following section is only a hypothetical case where a point force is considered to bear upon one or few of latticework-squares of a matter-field.

Matter-fields of two macro bodies are differentiated by their locations, magnitudes and directions of distortions in individual 2D energy-fields, within their body-dimensions. A plane, passing through both macro bodies, has the same 2D energy-field. Nevertheless, parts of this 2D energy-field, within the confines of border of each macro body, are distorted appropriately for nature of macro body and its current state (of motion). They are parts of separate matter-fields. Therefore, when it is said that a force is acting, it means that additional distortions in matter-field of 'force-applying body' bears on additional distortions in matter-field of 'force-receiving body'. In the process, both matter-fields modify each other. They being part of same latticework-structure, in a plane, tend to share total additional distortions by mutual influence. When a macro body is said to contact another macro body, it is their matter-fields, which come in contact. 3D matter-particles or any material components of these macro bodies do not touch each other. Matter-field represents additional distortions in universal medium within and about a macro body. Collision between matter-fields, depending on strength of collision between macro bodies, transfer part of additional distortions to each other. Since no transfer of matter takes place, macro bodies' 3D matter-contents are not (usually) affected.

Intrinsic work in matter-field of a macro body consists of all distortions in universal medium that is required to sustain integrity and stability of its 3D matter-particles and the macro body as a whole. Additional work in its matter-field maintains macro body in its current and constant state (of motion). Macro body's state (of motion) may be changed by introducing additional distortions into its matter-field from external source. In this article, we shall consider only additional distortions introduced by external sources to cause changes in the state (of motion) of 'force-receiving body'.

Latticework-squares in matter-field are deformed to the extent that is required for stable existence of the macro body. Introduction of additional distortions from external sources vary these deformations correspondingly. Stress, developed in the arms of one latticework-square, due to its deformation, transfers part of deformation to next latticework-square in front of it (in the direction of force). Similar actions are repeated forward, in sequence. Because of latticework-structure of matter-field, no single latticework-square can be deformed or strained in isolation. Due to inter-linking nature of latticework-squares in 2D energy-field, distortion in one latticework-square is automatically transferred and shared by neighboring latticework-squares in the same plane. Additional distortions, introduced by a force acting at any part of a 2D energy-field, are progressively absorbed by latticework-squares of macro body's matter-field, allowing them to be strained and distorted. Latticework-square, nearest to the point of application of force is distorted by highest magnitude, latticework-square next to it in front is distorted to a lesser degree, latticework-square next in front is distorted to still lesser degree and so on. This is how a distortion-field, created by inertial force, is transmitted through a 2D energy-field. Relative displacements of quanta of matter in 2D energy-field deform its latticework-structure. In fact, it is the distortions in 2D

energy-field (additional work), which are transmitted and not the 2D energy-field itself. A latticework-square moves only so much as required to store additional work of its share. Rest of additional work is transferred to the next latticework-square in front and so on. During transmission of a distortion-field, each square of latticework-structure absorbs part of additional work by remaining in distorted state to certain degree and passing on rest of distortion to subsequent latticework-squares. They become free to return to their stable condition only on removal of the 'force-applying mechanism' (or its action). As additional distortions, received by a matter-field, progress in the direction of force, 2D energy-field and its latticework-squares remain in place in space. Although a macro body is displaced with respect to absolutely steady universal medium, there is no relative motion between them that may produce resistance to macro body's motion. This is because; 2D energy-fields themselves are instrumental to macro body's displacement.

Since a 2D energy-field extends only in one plane, distortion-field cannot be transmitted directly into third spatial dimension. A 3D matter-particle simultaneously occupies gaps in many 2D energy-fields (3D space) in same location. A distortion-field, acting on a 3D macro body in a plane, tends to move its 3D matter-particles. 3D matter-body being three-dimensional, during its motion, produces distortions in all 2D energy-fields occupied by it. In this way, distortion-field in one 2D energy-field may be indirectly transferred to other 2D energy-fields. A force, (presumably) acting, through universal medium, on a 3D matter-particle has its components in one or more of 2D energy-fields in planes occupied by the particle. Each 2D energy-field transmits distortion-field only in its plane. Such actions by various 2D energy-fields, occupied by the 3D matter-particle, together, produce a straight-line transmission of distortion-fields (associated with 3D matter bodies) in 3D spatial system. Motion of a macro body, as a whole, is produced by additional distortions in its matter-field, introduced by an external effort. These additional distortions are transferred at constant speed through its matter-field and thereby, transfer matter-field itself through universal medium in space. As these additional distortions are transferred, macro body whose matter-field bears them achieves translational motion in the same direction.

Let a moving macro body 'A' collide with a static macro body 'B'. It is their matter-fields, which contact each other and not their 3D matter-particles. As soon as 'A' encounters 'B', 3D matter-particles of 'A' experience restriction for their forward motion. However, additional distortions in matter-field of 'A' tend to move at original constant speed of 'A'. Parts of additional distortions, in line with 3D matter-particles of 'B' are prevented from moving at original speed by the necessity to carry 3D matter-particles with them. Due to latticework-structure of 2D energy-fields, additional distortions, which are in line with inter-particles space, are also held back by the additional distortions, which are required to carry 3D matter-particles. There is no other restriction for transfer of additional distortions in 'A' to move into 'B'. Thus, depending on various other factors, whole or part of additional distortions in matter-field of 'A' are transferred into matter-field of 'B'. Rate of transfer depends on ability of 'B' to move at linear speed corresponding to additional distortions transferred into its matter-field.

If whole of additional distortions in matter-field of 'A' are transferred into matter-field of 'B', 'A' will come to a halt and 'B' will move, carrying the additional distortions with it. Whole of (kinetic) energy (stress), due to additional distortions, that produced motion of 'A', is now transferred to matter-field of 'B'. Assuming 3D matter-contents of both macro bodies are equal, matter-field of 'B' will gradually stabilise and move 'B' at a constant speed, which is equal to original linear speed of 'A'. For partial transfer of additional distortions (or for macro bodies of different 3D matter-contents), both macro bodies will behave correspondingly. Here, 'A' is 'force-applying body' and 'B' is 'force-receiving body'.

Action by effort from 'force-applying body' on 'force-receiving body' modifies both of their matter-fields. Normally we consider only those modifications done in matter-field of 'force-receiving body', unless reaction is also taken into deliberation. In case, 'B' produces certain changes in magnitude of additional distortions in matter-field of 'A' (due to their relative speed), 'A' also will start to move. If this motion is in opposite direction, it is considered as a result of reaction to original force. Reaction, corresponding to action of effort and is responsible for this motion, is called a reactive effort/force.

Additional distortions (strain), received into matter-field of 'force-receiving body', are 'work-done'

and stress developed due to resulting strain is energy received. Reduction in additional distortions in matter-field of 'force-applying body' is 'work-undone' and the stress reduced in its matter-field is energy lost. In a case, where action of one macro body changes state (of motion) of another macro body, magnitudes of reduction of additional distortions in the matter-field of 'force-applying body' and increase of additional distortions in the matter-field of 'force-receiving body' are equal. That is to say, that work is undone about 'force-applying body' and equal work is done about 'force-receiving body'. In normal cases, energy lost by 'force-applying body' is equal to energy gained by 'force receiving body'. Work-done in matter-field of 'force-receiving body' is due to 'direct force' and alteration to matter-field of 'force-applying body' is due to 'reaction'. Numerically action is equal to reaction. Direction of resultant additional distortions in matter-field of 'force-receiving body' and body's inertial displacement is along the direction of original force. Direction of resultant additional distortions in matter-field of 'force-applying body' is opposite to direction of original force. Here, change of direction indicates reduction in magnitude of original additional distortions.

State (of motion) of a macro body depends on distortion-density of additional distortions and distribution of additional distortions in its matter-field. Introduction of additional distortions from external source into a matter-field and their stabilizations takes time. This time delay and ability of additional distortions to maintain constant speed of a macro body, after the delay, gives rise to the property of 'inertia', which is presently attributed to body's mass (representing its 3D matter-content). Inertia is a property of associated matter-field of a macro body (universal medium). 3D matter-content of a body is inert. It is the associated universal medium that produces all apparent actions/interactions, presently attributed to 3D matter-bodies.

Once, certain magnitude of additional distortions are introduced into matter-field of a macro body, it remains permanently within the matter-field and continues to keep the macro body in its current state (of constant motion) indefinitely, until the additional distortions are lost or removed (neutralized by additional distortions in opposite direction) by an external effort. Since additional distortions (introduced by external source and moving 3D matter-particles) in a matter-field are associated with 3D matter-particles, speed of their transfer is limited by magnitude of additional distortions. Hence, a macro body may move at any speed, lower than the maximum permitted speed by universal medium (less than the speed of light). As linear speed of a macro body approaches speed of light, constituent 3D matter-particles of the macro body break down to inferior particles, until speed reaches the speed of light. At speed of light, only photons (from macro body) can survive. Beyond this speed no 3D matter-particle can be moved. This limits the speed of 3D matter-bodies in space to less than the speed of light. Gradually, even 3D matter-contents of photons revert back to quanta of matter in universal medium. Continuous recycling of matter between 3D macro bodies (where the entropy increases) and universal medium (where high order is maintained) keeps entropy of universe within limits.

Additional distortions in matter-field of 'force-receiving body' deform latticework-squares of its matter-field in the direction of force. As additional distortions, causing a macro body's constant linear motion is stored permanently in its matter-field, the matter-field as a whole is effectively compressed and deformed. Space, occupied by macro body's matter-field, in the direction of its linear motion shortens with corresponding enlargements in planes perpendicular to direction of macro body's linear motion. Hence, a macro body contracts in the direction of its linear motion (similar to 'Lorentz contraction' of a moving body) and expands in planes perpendicular to the direction of its linear motion. Magnitudes of changes in macro body's dimensions are proportional to its linear speed.

Inertia is a property of universal medium, produced due to latticework-structures of its 2D energy-fields. Attraction due to gravitation is the product of difference in extents of universal medium on opposite sides of 3D matter-bodies in a pair. Both these phenomena have nothing to do with mass of macro body, which is a mathematical relation between external force and its acceleration. Hence, differentiation into gravitational mass and inertial mass is arbitrary.

Forces are mathematical relations between work and macro body's linear displacement in space, during action of effort. Forces, being functional entities with no objective existence, cannot interact.

Interaction between two forces means superimposition of additional work, introduced by one force in a macro body's matter-field, on additional work, introduced by another force or additional work, already associated with the macro body. Work-done is nothing but additional distortions introduced into matter-field of a macro body. Hence, interaction between two forces indicates modifications to additional distortions in a macro body's matter-field and corresponding changes in their inertial properties, both, in magnitude and direction. Since a 2D energy-field is confined to its plane, action of force in each plane is confined to its plane. Additional distortions (work) introduced by two or more forces in the same plane may produce a resultant work.

A macro body exists in three-dimensional spatial system. Actions of forces in each of the planes, passing through macro body, are separate and independent of actions in other planes. Resultant, of inertial actions in different planes, on a macro body depends on the combination of all actions in different planes. Linear forces, acting in different directions on a macro body, not only produce linear motions of the macro body but they also may cause couples of forces, causing torque. Therefore, we shall consider interactions between two coplanar-concurrent linear forces, acting on a macro body in two separate cases. In one case, the linear forces are coplanar and act along the same straight line (co-linear). In the second case, linear forces are coplanar but act in different directions. For convenience, we shall resolve one or both of these forces with respect to a reference and consider resolved parts as acting in perpendicular directions in same plane. Separate inertial actions on 3D matter-particles of a macro body, in perpendicular directions in same plane, combine to produce macro body's resultant inertial motion.

Coplanar forces:

Thickness of a plane is so minute that it cannot be represented in three-dimensional measurements. Forces act through 2D energy-fields, which are two-dimensional. Hence, it is practically impossible for a 2D force to be represented in 3D spatial system. In 3D spatial system, a force is combination of forces in many planes, acting simultaneously in as many 2D energy-fields. Depending on angular difference between directions of actions, coplanar concurrent forces or their resolved components may be further classified into three classes; unidirectional forces, opposing forces and forces in perpendicular directions.

Unidirectional forces:

'Unidirectional forces' include efforts or their resolved parts, applied in the same direction. Usually, magnitudes of two external unidirectional forces, acting on a macro body, are algebraically added for their resultant. However, this gives correct results only in few cases. Magnitudes of forces depend on their ability to cause acceleration of identical macro bodies. Larger force relate to higher magnitude of work and greater speed of 'force-applying body'. This will correspond to higher magnitude of additional distortions introduced into matter-field of a macro body and greater speed of their transfer.

Consider two external unidirectional forces, applied on a macro body. Both of them tend to introduce corresponding additional distortions into macro body's matter-field. Larger of the two forces, introduces greater and faster moving additional distortions. These additional distortions push at 3D matter-particles of macro body to accelerate whole of macro body at rate provided by larger external force. Smaller external force also tries to introduce additional distortions into matter-field of macro body. However, additional distortions by smaller external force are unable to be formed in the matter-field, because of faster motion of additional distortions in matter-field's latticework-structure, already developed by larger external force. Thus, in cases, where two co-linear forces are simultaneously applied, only the larger force is able to act on a macro body.

Only condition when two co-linear, unidirectional, external forces can act on a macro body is when they are exactly of equal magnitude. This is possible only when both 'force-applying' bodies are moving at same linear speed, in the direction of force. 'Force-applying' bodies share total effort on 'force-receiving' body. Both forces invest equal magnitudes of distortions. Action of a force is related to linear speed of the 'force-applying mechanism'. In order to apply equal forces, their 'force-applying mechanisms' have to move at equal linear speeds. There can be no relative motion between them. Difference between their linear speeds causes whole of effort to come from faster moving mechanism.

As a result, only the faster moving mechanism acts on ‘force-receiving’ body. Effort, by the faster moving mechanism does work and slower moving mechanism does not work.

Highest possible speed of movements of quanta of matter in universal medium corresponds to critical linear speed of a photon (corpuscle of light). Hence, highest linear speed, at which distortions in 2D energy-field can be transferred, is the linear speed of light. This linear speed, V_{\max} , corresponds to highest linear speed at which 3D matter-bodies can be moved through space. If a 3D matter-body is already moving at linear speed V_{\max} , no external force in the direction of its linear motion can act on it. For an external force to be fully effective, the 3D matter-body has to be (absolutely) static in space and with respect to ‘force-applying mechanism’.

Knowing magnitude and direction of an external force, acting on a 3D matter-body, alone is not sufficient to find ‘resultant magnitude’ of additional work invested in its matter-field (resultant force acting on a body). Linear speed of ‘force-receiving body’ with respect to absolute reference (universal medium) is also required to be taken into consideration. Efficiency of a force, depends on highest possible speed, V_{\max} , in universal medium and present absolute linear speed, V , of ‘force-receiving body’.

$$\text{Efficiency of a force, } \eta = \frac{(V_{\max} - V) \times 100}{V_{\max}} \%$$

Speed or ability of ‘force-applying mechanisms’ to act on ‘force-receiving body’ also needs to be considered. A force can exist only when ‘force-applying body’ is capable to move faster than ‘force-receiving body’. Efficiency of an external force is highest (100%), when absolute linear speed of ‘force-receiving body’ in the direction of force is zero. Efficiency of external force is zero or it is unable to act on ‘force-receiving body’, when absolute linear speed of ‘force-receiving body’ in the direction of force becomes equal to highest possible speed (in the direction of motion) in universal medium. This fact gives rise to the phenomenon of ‘relativistic mass’. As absolute linear speed of ‘force-receiving body’ approaches linear speed of light, in the direction of force, efficiency of external force to act on a 3D matter-body is greatly reduced. This reality is misinterpreted to show that energy (an undefined functional entity) presumably invested by ‘force-applying body’ is converted into mass (a functional entity, defined as mathematical relation between external force and 3D matter-body’s acceleration), which represents 3D matter-content of the body. This assumption apparently justifies disproportionate acceleration of a 3D matter-body, moving at very high linear speed. That is, an external force cannot accelerate a 3D matter-body according to mathematical equation that describes relation between external force and acceleration at low linear speeds of 3D matter-body.

Relative motion between ‘force-applying body’ and ‘force-receiving body’ also affects efficiency of external force. Usually, ability of ‘force-applying mechanism’ to move faster than ‘force-receiving body’ is always presupposed. Inability of ‘force-applying mechanism’ to move faster than ‘force-receiving body’ greatly reduces efficiency of a force. Only a faster moving ‘force-applying mechanism’ can distort latticework-squares of 2D energy-field associated with ‘force-receiving body’ and invest work into its matter-field. ‘Force-applying mechanism’ can act only until its ability to move reaches linear speed of ‘force-receiving body’. Even if both bodies are moving at same linear speed (zero relative speed), ‘force-applying mechanism’ is incapable to press into ‘force-receiving body’ to change its linear speed. Since ‘force’ is rate of work-done, as and when ‘force-applying mechanism’ becomes incapable to do work, force ceases to exist.

Opposing forces:

‘Opposing forces’ include efforts or their resolved parts, applied in opposite directions on a 3D matter-body. This condition develops, when two equal but opposite external (inertial) sources acts on a macro body. In case, their magnitudes are unequal, actions of equal components of both inertial actions constitute ‘opposing forces’ and act as given below. Surplus magnitude of one of the inertial actions can be considered as independent action of an effort, acting /applied on the macro body.

Equal and opposite components of both external efforts act to introduce equal magnitudes of

additional distortions into matter-field of macro body. External efforts, being in opposite directions, introduce additional distortions into macro body's matter-field in opposite directions. Both sets of additional distortions overlap each other. They being equal and opposite, neutralize their translational actions on each other, within the matter-field. Additional translational distortions introduced in one direction is nullified by additional translational distortions introduced in opposite direction. This phenomenon is neutralization of 'forces'. This does not mean that distortions or energy developed by them are nullified. Latticework-squares of macro body's matter-field are compressed, against reaction from within, from both sides to distort them. Latticework-squares change their shapes to parallelograms. Additional distortions store energy in the form of (compressive) pressure energy within macro body's matter-field. Total additional distortions in the matter-field are not translational but they become compressive. This does not change the state (of motion) of the macro body and maintains its state of rest or constant motion, irrespective of stored pressure energy.

Additional distortions in macro body's matter-field, introduced from opposite directions, tend to compound each other. Macro body reduces in length and enlarges in directions perpendicular to directions of forces. Should macro body's expansion in perpendicular direction is restricted for any reason; external forces are unable to distort latticework-squares of macro body's matter-field, as required. Instead of creating angular distortions of quanta of matter in their respective 2D energy-field, additional work appears in the form of compression of quanta of matter (in the latticework-structure of matter-field) to reduce lengths against their inherent nature to lengthen outward. Thus, effort is now utilized to store work within quanta of matter in the form of pressure energy. Macro body develops internal pressure within quanta of matter as well as in latticework-structure in inter-particle spaces. A macro body may develop internal pressure only when its expansion due to opposing external forces is restricted by any means. This phenomenon is the 'compression' of a macro body.

However, as they are continuously and simultaneously acting on macro body, opposing efforts stop inertial actions after macro body's matter-field develops sufficient reaction to oppose both external efforts. External efforts cannot further introduce additional distortions into macro body's matter-field. External forces (rates of work-done) on the macro body cease to exist, irrespective of the fact that external efforts continue to act against reaction from matter-field to sustain compression of macro body. Hence, macro body or quanta of matter in its matter-field are displaced after initial period of development of reaction within matter-field. Additional work-done, transferred into macro body's matter-field, during initial stage of action is stored within the matter-field and it is exhibited as internal pressure energy of macro body. Matter-field of macro body remains additionally distorted as if compressed by external efforts. Hence, two equal and opposite external efforts on a macro body are able to compress it, rather than producing its linear inertial motion. Under these conditions, no force is generated from efforts, after initial stage. However, work-done and corresponding energy remain stored in macro body's matter-field, even without macro body's translational motion in space.

Length of a compressed macro body, in the direction of opposing external efforts, reduces. Since no force is generated after initial period of stabilisation, we may say that external forces remain 'being applied' and they become inactive. This state of macro body may be considered as a neutral state (of motion), for the forces. Forces may develop or efforts may act to do additional work on the macro body again only when internal pressure within its matter-field changes for any reason and deformation of matter-field's latticework-structures are permitted again. Though opposing efforts, applied on a macro body, seem to neutralize each other, macro body is maintained in a different state of internal pressure as long as they are applied. This is not normally accepted as a change in the state of the body. Hence, only further actions of forces are considered as neutralized. The work, already put-in to compress the body, remains within macro body's matter-field.

Compression of a macro body causes few other changes in its constitution other than changes in its volumetric dimensions. During compression, macro body's constituent atoms/molecules are pushed nearer. Distortion-density in inter-atomic/molecular spaces in macro body's matter-field increases. This is experienced by every 3D primary matter-particle (biton) of macro body as increased external pressure and causes its volumetric expansion. Volumetric expansion of 3D primary matter-particles in a macro

body enhances internal pressure within its matter-field and causes 3D primary matter-particles to discard constituent quanta of matter from 3D matter-cores of their photons. If quanta of matter are released at adequate rate and in sufficient quantity, they form new photons, to be radiated from the region of their creation, in the form of heat or light radiation. Macro body appears heating up during its compression. This phenomenon is the basis of radiations from very large cosmic bodies under gravitational collapse. As and when compression is relieved, macro body's 3D primary matter-particles will return to their original size by accepting quanta of matter from surrounding universal medium. This process is the cooling.

If magnitudes of inertial efforts, on a macro body in opposite directions but co-linear are different, resultant inertial effort on the macro body that may produce its translational motion is equal to algebraic sum of efforts and its direction is same as that of larger effort. Resultant effort will produce appropriate force on the macro body.

Forces in perpendicular directions:

Different efforts, applied at a point on a macro body, may have angular difference between their directions. In order to find their resultant action, it is convenient to resolve forces generated by them into perpendicular components with respect to a common reference. Consider two concurrent coplanar forces acting in perpendicular direction with to each other. Due to latticework-structure of 2D energy-fields, distortion-field in it is transmitted only in straight-line direction. If there is more than one external effort, additional distortions invested by each of them is transmitted in the direction of force, generated. Macro body is moved in resultant direction, due to combination of additional distortions. Motion in resultant direction necessitates that the macro body move in a different direction from the directions of all external forces on it. Additional distortions introduced into macro body's matter-field cannot change their direction of transfer. Additional distortions due to external forces and macro body travel in different directions. Hence, as and when, macro body's path deflects from direction of transfer of additional distortions by external forces, corresponding magnitude of additional distortions are lost from its matter-field. Additional distortions, remaining in its matter-field, are only those required for macro body's steady state of motion in resultant direction. These are composed of residue from additional distortions invested by forces and/or additional distortions created by displacements of macro body's 3D matter-particles in resultant direction. This is the reason, why momentum of a macro body (moving in a circular path) remains constant irrespective of constant action of external (centripetal) force on it.

Consider a macro body, moving in a straight line at constant linear speed. This macro body is under inertial actions from universal medium. It will continue to move at (steady) state of motion until acted upon by an external effort. Let an external effort act on the macro body in a direction other than its direction of motion. External force, generated, may be resolved (analytically) into two components. A component of external force, in direct assistance or opposition to inertial actions of macro body's matter-field, modifies its (linear) inertial actions. Component of external force, in perpendicular direction to inertial motion, has no effect on present (linear) inertial action of macro body's matter-field. However, it will introduce its own inertial actions in the matter-field by investing additional distortions, at right angle to present (linear) inertial action. Additional distortions, introduced by (component of) external force in perpendicular direction, modify additional distortions already existing in matter-field. 3D matter-particles of macro body modify their direction of motion corresponding to present status of additional distortions. Macro body's direction of motion changes to suit resultant of these two inertial actions.

Resolution of force, into components at right angles to each other, is a mathematical operation. In actual cases, this does not happen. Each force introduces its own inertial actions into matter-field of a macro body, in its own direction. 3D matter-particles of macro body are susceptible to additional distortions from both sources (forces). Initially, 3D matter-particles and macro body tend to move as dictated by both forces. Before long, as macro body shifts away from its original line of motion, it loses parts of additional distortions in its matter-field that are producing inertial actions from both forces. From then onwards, 3D matter-particles of macro body are influenced by resultant additional distortions generated and contained within matter-field due to displacements of 3D matter-particles, in resultant direction. As line of motion of macro body moves away from lines of action of external forces, additional

work (distortions) introduced due to forces, to move the macro body in original directions, are gradually lost from its matter-field. Appropriate additional distortions in its matter-field are being re-created to provide inertial actions to macro body in its new (resultant) direction of motion.

Additional work, invested into matter-field of a macro body, takes certain time (inertial delay) to stabilize itself and provide the macro body with a constant linear speed. This is true even after external force is terminated. Additional work, introduced into matter-field of macro body and not yet stabilized before termination of external force, continues its stabilization in normal course of time. In other words, a macro body remains under action of an external force (acceleration/deceleration), even after effort, producing external force, is removed until inertial delay period is completed. Acceleration/deceleration stage will continue until all additional work (introduced by external force) has stabilised in matter-field and the macro body has attained its final constant linear velocity.

Let us consider a linearly moving macro body under action by an effort of constant magnitude in perpendicular direction to its linear motion. External effort introduces additional distortions into macro body's matter-field at constant rate. Force (rate of resulting additional work, introduced into macro body's matter-field) is of constant magnitude. Because of this additional work, macro body's direction of motion changes at constant rate. At any instant, due to change in macro body's direction of motion, certain part of original additional distortions (producing macro body's linear motion) is lost from its matter-field. Simultaneously, additional distortions are introduced into macro body's matter-field at a constant rate by external force. However, as macro body moves forward, these additional distortions, which are moving in perpendicular direction, are soon lost from macro body's matter-field. Additional distortions due to external force can affect displacement of macro body only during their presence within matter-field. Every instant, new additional work is invested into macro body's matter-field and equal magnitude of additional work is lost from matter-field. Hence, a linearly moving macro body will accelerate at a constant rate and simultaneously move at a constant velocity in perpendicular direction. Irrespective of macro body's constant acceleration in perpendicular direction, it has also a constant velocity, over and above its constant linear velocity.

Conclusion:

Action of an effort is simple mechanical re-arrangements of quanta of matter in a macro body's matter-field. Magnitude of distortions in a macro body's matter-field is the work, associated with it. (Rate of) additional work-done, with respect to displacement of a body during an action, is force. All forces, irrespective of their origin, are recognized by inertial action on 3D matter bodies in 3D spatial system. 2D energy-fields being two-dimensional, actions of forces in each 2D energy-field are independent of their actions in other planes. Variation in efficiency of an external effort to accelerate a linearly moving macro body, as its linear speed approaches speed of light, causes 'relativistic mass'. Actions of opposing external efforts on a macro body, whose matter-field is restricted from expansion in perpendicular direction to external efforts, compress it. During compression, a macro body's 3D matter-particles discard quanta of matter. This process is heating. Discarded quanta of matter form fresh photons, to be radiated away. This mechanism produces heat, light and other radiations from stars, under gravitational collapse. During decompression of a macro body, its constituent basic 3D matter-particles assimilate quanta of matter into their 3D matter-cores from surrounding universal medium. This process is cooling. Inertial delay is applicable even during termination of external force on a macro body.

Reference:

- [1] Nainan K. Varghese, '*MATTER (Re-examined)*', <http://www.matterdoc.info>

* * * * *