Chapter FIVE

INERTIA

Sluggishness to complete an action by a 3D matter-body is generally understood as its inertia. All 3D matter-bodies are inert and hence they are incapable to act. Inertia, attributed to 3D matter-body, should really belong to universal medium, which performs all actions on and about 3D matter-bodies. Hence, inertia is a property of universal medium. Inertia is caused by inherent property of universal medium to strive towards homogeneity and serenity. Chapter five dwell on all aspects of inertia, as provided by universal medium to all its actions.

5.1. Physical body:

A physical body is usually defined as 'a collection of masses, with extension in physical world'. It can be described by various theories and can be perceived by senses (or instruments) of rational beings. However, at times, different branches of philosophy or even different branches of physics have different definitions of physical body. In this concept, a physical body is defined as 'an entity with objective reality in space, whose substance is provided by matter'. It has structure and form. Its objective reality makes it perceivable by rational being's senses or instruments. Although matter occupies all available spatial dimensions, matter-bodies in 1D and 2D spatial dimensions are not recognized by us as real entities. We, being 3D rational beings, consider only 3D matter-bodies as physical bodies.

3D matter-bodies, in their 'real' physical-aspect, are considered in this section. Bodies are not considered as events in space-time or as their histories or in any other abstract form. They are real physical objects with positive existence in 3D space (3D matter-bodies). Since our spatial-system is three-dimensional, for us, all real matter-bodies are three-dimensional too. Their existence does not depend on any other factor, including rationality of observer.

A 3D matter-body cannot simultaneously exist in more than one place. More than one 3D matter-body cannot occupy same volumetric space at the same time. There are no virtual or imaginary bodies in nature. A physical body has to have substance (or stuff), provided by matter. A macro body is a union of basic 3D matter-particles. Photons are the only basic 3D matter-particles in nature. They, in various combinations, form different kinds of material bodies of larger sizes.

Every 3D matter-body, including photon, obeys all basic physical laws under all circumstances, irrespective of differences in their parameters or external conditions. Phenomena of singularity and other similar assumptions, presently used to provide irrational explanations to certain phenomena of 3D matter-bodies, are not necessary.

Matter occupies space. Matter-density of basic 3D matter-particles cannot be changed. For their existence, as basic 3D matter-particles (photons), it is imperative that their matter-density should be maintained at a constant maximum value. Matter cannot be compressed or dilated to increase or decrease its density different from this value (in all spatial systems) and to reduce its volume to irrational magnitudes. Under no circumstances, matter-content of a 3D matter-body can be compressed to zero size.

Matter is inert and a 3D matter-body cannot participate in any interaction on its own. All actions on or about a 3D matter-body are results of external influences. Separate actions between universal medium and different 3D matter-bodies, when considered relative to each other, may appear as interactions between them.

Fundamental (spatial) dimensions define a matter-body. Spatial dimensions are measure of (distance between points in) space, occupied by matter-bodies. Hence, spatial dimensions of a macro body include not only region of space occupied by its matter-content, in the form of basic 3D matter-particles, but also inter-particle spaces between macro body's constituent basic 3D matter-particles. Measurement of space is in terms of distance between matter-particles / bodies. Length of a matter-body represents distance between two basic 3D matter-particles situated at its extreme ends.

In 3D spatial system, three mutually perpendicular planes, through a reference point (origin) divide space into eight parts. Correspondingly, we have length, breadth, and depth as fundamental (spatial) dimensions. A part of space, defined as a macro body, is filled with 2D energy-fields of universal medium in all possible directions. Parts of 2D energy-fields, within this space and its immediate neighborhood, contain all distortions needed to sustain constituent basic 3D matter-particles and maintain their unity to form a composite macro body. All macro bodies are three-dimensional matter-bodies.

Matter-content of a macro body, in the form of unstable photons, forming subatomic, atomic and larger 3D matter-particles, sparsely populate space defined as a macro body. Hence, measurements of a macro body correspond to space occupied by its basic 3D matter-particles as a composite body and (parts of) 2D energy-fields that sustain basic 3D matter-particles, individually. Photons, constituting a (macro) matter-body, are permanently unstable. Matter-cores of unstable photons continuously interact with 2D energy-fields within macro body's borders to maintain their distortion-fields. Unstable photons, in a macro body, move at their critical speeds in an orderly fashion within constituent superior 3D matter-particles.

Interactions between unstable photons and 2D energy-fields within a macro body introduce, more or less, continuous distortions in universal medium within the macro body in various directions. Accordingly, we may consider that parts of latticework-structures of 2D energy-fields within the space, defined as a macro body, are permanently distorted. This distorted part of 2D energy-fields, within the confines of space, defined as

macro body, is 'matter-field' of that macro-body. Matter-field and constituent basic 3D matter-particles (photons) contained in it, together constitute a macro body.

Because of latticework-structure of 2D energy-fields, matter-field of a macro body extends outside its body-dimensions for a small distance, until distortions in universal medium due to constituent unstable photons of macro body, disappear. State of a macro body's matter-field is in a condition peculiar to its body-material. Magnitudes and directions of distortions in latticework-structures of 2D energy-fields within matter-field are unique to any type of 3D material body. A matter-field (distorted part of universal medium) is necessary for stable existence of a macro body's matter-content (photons) and to keep its photons together as a single composite unit.

5.1.1. State of motion:

Presence of matter is essential for creation of a material body. Matter provides substance (stuff) to material body. Actions of matter are confined to its structure-less state. In its structured state, matter is inert. It provides a platform for actions by universal medium. A macro body is a union of numerous photons and its associated matter-field. A macro body continues to stay in a 'steady state' (of rest or motion) as long as its matter-field remains in a steady state with respect to universal medium.

It is the state of (motion of) matter-field that determines state of (motion of) a macro body. In its steady state, a matter-field contains enough distortions in universal medium to sustain stability, integrity and motion (at constant speed) of a macro body, as a whole, and its constituent basic 3D matter-particles. Since no structured material body can stay static, in space, all basic3D matter-bodies are in steady states of motion with respect to absolute reference. However certain types of composite macro bodies may stay in space without translational motion.

We observe displacements of 3D matter-bodies in space with respect to references − another macro body or a point on it. Without a reference, motion of a 3D matter-body is not tangible. Best reference is a fixed point in space itself. This would provide an absolute reference frame for all action about a 3D matter-body. However, since the space has no structure or physical form, it cannot provide a reference point. All points in space are identical with respect to a moving 3D matter-body. As long as space is considered formless, we may have no absolute reference or absolute motion.

Next best alternative for observation of a 3D matter-body's state of motion is a relative reference frame. In this, a 3D matter-body in space or a point on a 3D matter-body is assumed static, so that instantaneous locations of other 3D matter-bodies may be referred to this static body / point. Parameters of motion and location of referred 3D matter-body with respect to reference 3D matter-body / point can be accurately predicted.

However, while considering observational relative reference frame, we are not definite about which of the 3D matter-bodies is moving. It could be either referred 3D matter-body in one direction or reference 3D matter-body in opposite direction. In either case, only relative parameters of motion are correct. Observational relative reference frames cannot give true parameters of a 3D matter-body's motion, its location in space or shape of its path. Work, done to change state of a reference 3D matter-body's motion in one direction may appear to be equal to magnitudes of work, done to change states of motion of each of many referred bodies in opposite direction. This is not true.

Relative reference frames of observations, related to states of motion of 3D matter-bodies, may be generally classified into inertial and non-inertial reference frames. 'Newton's laws of motion' are true in any reference frame that is moving at a constant velocity (inertial reference frame). In an inertial reference frame, at any instant, phenomenon of inertia compels a moving 3D matter-body (in its stable state) to travel in a straight line.

To move in a circular path, a linearly moving matter-body requires action of an external effort (called 'centripetal force') towards centre of curved path. 3D matter-body accelerates towards centre of curvature of desired path. It is believed that displacement of 3D matter-body, along its straight-line path and displacement due to acceleration by 'centripetal force' towards centre of curvature of desired path, together; result in 3D matter-body's circular path.

It should be noted that at every instant, 3D matter-body is moving towards centre of its circular path under acceleration provided by 'centripetal force', taking it nearer to centre of circular path. Considering this motion in inertial frame of reference, matter-body would logically move in a path spiralling towards centre of its curved path. Since this does not happen, this action cannot be considered in inertial frame of reference. In order to overcome this inconsistency, situation is considered in rotational frame of reference (a non-inertial reference frame). Continuous radial acceleration of 3D matter-body justifies this choice.

Observations, related to states of motion of 3D matter-bodies, do not appear true in accelerated (non-inertial) reference frames. Instead, in an accelerated reference frame, moving 3D matter-bodies appear to have external efforts, which are not in fact present, acting on them. These apparent efforts are called 'pseudo (or imaginary) forces'. Since rotational motion is always an accelerated motion, 'pseudo (imaginary) forces' are always associated with rotating frames of reference.

When whole macro body is considered as a single unit, periodical variations within its matter-field (produced by orderly movements of its constituent photons), required to maintain its integrity and stable existence, are ignored in following sections. Within the matter-field of a macro body, its constituent basic 3D matter-particles (photons) are in

continuous motion of their own in orderly fashion. Systematic changes, taking place within the confines of a matter-field, also do not affect state of (motion of) a macro body. When considering macro body as a whole, there may also be orderly local distortions taking place within its matter-field. However, with respect to universal medium, outside border of macro body (or any other reference point outside macro body), matter-field as a whole and hence the macro body is in a steady state (of motion). Internal efforts cannot change state of (motion of) a macro body, with respect to its whole body motion.

To define state of (motion of) a matter-body, its instantaneous positions are compared with a reference. Universal medium, in free space, could provide an absolute reference. Unfortunately, presence of even one photon or an electromagnetic wave in a region is enough to corrupt its 'absolute static' nature, in that region. Still, universal medium provides nearest possible (theoretical) absolute reference. On a large scale, it is steady and is absolutely at rest. Steady state of (motion of) a 3D matter-body can be determined only with respect to steady universal medium.

2D energy-fields, in universal medium, being functional entities with respect to us (who consider only 3D matter as real); it is impossible to relate a 3D matter-body or its instantaneous positions to them. Consequently, we cannot positively determine absolute state of (motion of) any 3D matter-body in nature. We are compelled to use relative references with respect to most probable static points in space or between different 3D matter-bodies. State of (motion of) one 3D matter-body is related to the state of (motion of) another 3D matter-body.

All actions on or about a 3D matter-body are with respect to universal medium (absolute reference). Let universal medium in a region of space have constant and identical distortions throughout the region. Parameters of a 3D matter-body within the region of this space, measured with respect to distorted universal medium (in the same region), also provide absolute parameters of 3D matter-body. Since distortions in latticework-structures of 2D energy-fields (in the region) affect universal medium and matter-fields of 3D matter-bodies identically; they affect state of (motion of) 3D matter-bodies and stable state of universal medium, identically.

Constant nature of distortions affects both, parameters of 3D matter-body and parameters of universal medium, identically. Various parameters of a 3D matter-body, in relation to universal medium in a region, can be said to remain unaffected (in other words, they are affected by equal magnitudes and in same direction). Parameters of a small 3D matter-body, determined within the matter-field of a larger 3D matter-body, can be considered as absolute parameters for all purposes, within the same matter-field.

Parameters of a 3D matter-body on the surface of earth are measured with respect to earth and its matter-field. Distortions in latticework-structures of earth's matter-field affect parameters of earth and all 3D matter-bodies on it, identically. Steady state of

(motion of) a 3D matter-body, determined within matter-field of earth, can be regarded as its absolute steady state (of motion) for all purposes in relation to other 3D matter-bodies within earth's matter-field. For this, we presuppose that earth is in a steady state of rest within steady and undistorted universal medium. This practical method is good enough, when dealing with smaller 3D matter-bodies within earth's matter-field.

However, when considering 3D matter-bodies, outside earth's matter-field, parameters of a 3D matter-body determined within larger matter-field of earth are not of absolute value. To relate two 3D matter-bodies in matter-fields of different types of distortions, it is necessary to relate their parameters with respect to an absolute reference. Due to difficulty in determining parameters of 3D matter-bodies (in different parts of space) in absolute terms, many of our present-day theories in astronomy depend on apparent or relative parameters of 3D matter-bodies, as determined from earth and in relation to earth's matter-field. They are presented to justify observed or apparent parameters. These theories are based only on empirical (observed) data, which are mostly false. This method is not very correct.

5.1.2. Interactions between 3D matter-bodies:

All actions, in nature, take place between universal medium and basic 3D matter-particles. However, when resultant of actions between universal medium and constituent photons of a macro body is related to similar resultant actions in another macro body, these macro bodies appear to interact between them. Other than in extreme cases, basic 3D matter-particles (constituent photons of macro bodies) of two macro bodies do not come in contact, during macro bodies' apparent interactions. When they do come in contact, due to their high-speed motions, photons disintegrate, at least partially. In extremely rare cases, transfer of matter-content between macro body's basic 3D matter-particles may take place. Normally, interactions between different macro bodies are always between their matter-fields. In this paragraph, we shall neglect individual distortion-fields of macro body's 3D matter-particles and local disturbances in it. Only those additional distortions in macro body's matter-field, which cause its motion as a composite matter-body, are considered for explanation.

Causes of actions, which produce delayed changes in mechanical motion of macro bodies and thus produce phenomenon of inertia associated with change of state of (motion of) macro bodies, are considered as inertial-efforts. An inertial-effort is external to macro body. Inertial-efforts act from one side of macro body towards its other end. Inertia is a property of universal medium. Hence, it is applicable in all cases of development of distortions (photons' inertial-pockets, distortion-fields and matter-fields).

In cases of gravitational-efforts, inertial delays are present during formation/re-formation of basic 3D matter-particles (photons). Once gravitational-fields are developed about photons, further actions by gravitational-fields are of instantaneous nature. In

cases of field-efforts, inertial delays are present during developments or variations of electric fields about primary 3D matter-particles. Once electric fields are developed about primary 3D matter-particles, further actions by electric fields are of instantaneous nature. Unlike gravitational-efforts, in case of field-efforts, interaction between two or more distortion-fields is necessary to produce motion of a macro body. All such interactions are inertial actions and they are governed by inertial delays.

An external (inertial) effort on a macro body acts or is applied on its matter-field. This may be done by matter-field of an approaching macro body. Transfer work from matter-field of 'force-applying body' to matter-field of 'force-receiving-body' is the effort. Consider a 'force-applying body' moving towards a 'force-receiving body'. However close they may approach, there is certain distance between matter-contents (in nearest molecules) of 'force-applying body' and matter-contents (in nearest molecules) of 'force-receiving body'. Matter-field is nothing but a part of universal medium within the space of body-dimensions and having enough and required distortions in their latticework-structures to maintain stability and integrity of macro body's matter-content and state of motion.

All movements in nature are originated by quanta of matter in latticework-structures of universal medium and any motion (of 3D matter-bodies) can take place only by movements of quanta of matter in latticework-structures of universal medium about a macro body. There are no actions through empty space. A direct effort originating at junction-points of quanta of matter in latticework-structure of a matter-field may act on (transferred to) junction-points of quanta of matter in same latticework-structure of another matter-field. Before reaching its destination, this effort has to be transmitted through intervening quanta-chains in universal medium. Distortions in each 2D energy-field are transferred only in its own plane. Since all 2D energy-fields (passing through matter-fields of both macro bodies) take part in transfer of distortions, simultaneously, transmission of work (action of an effort) appears as taking place in 3D spatial system.

Certain work is done by universal medium to develop and maintain integrity of a 3D matter-body. This work is intrinsic with the matter-body. Intrinsic work can be delivered only on disintegration of 3D matter-body. Hence, we shall not discuss intrinsic work at this stage. Action of an effort produces additional work about a 3D matter-body. Additional work can be done only by having change of state of motion (and displacement) of 3D matter-body. Variation in matter-content of a 3D matter-particle does not constitute work-done (hence, heating or cooling a 3D matter-body is not work; they vary matter-content of a matter-body).

Motion or displacement of a 3D matter-body may be that of whole body or of a small part of it. Therefore, action of an effort essentially requires a movement of point of its application with respect to a reference. State of motion of a 3D matter-body has to

undergo a change. Otherwise, applied effort can be considered as inactive. When it is inactive, applied effort is continuously neutralized by reaction (or an effort in opposite direction) and hence it cannot produce additional work about 3D matter-body or disturbance.

To do additional work, point of application of an effort has to move in relation to other parts of same 3D matter-body or system. If no movement can take place, no additional work is done and it may be considered that, though effort is present (effort is being applied), it is not acting. This is the same as stating that no energy is transferred and hence no additional work is done. Work-done on a 3D matter-body is the changes in shapes of latticework-squares in 2D energy-fields, associated with 3D matter-body (See section 6.1), produced by movement and displacements of constituent quanta of matter in it. As long as an effort cannot introduce appropriate movements of quanta of matter in latticework-squares of 2D energy-fields, associated with the 3D matter-body, it cannot be considered as acting on it. Since 'energy' is related to work, action of an effort means transfer of work associated with one 3D matter-body to associate with another 3D matter-body or from one part of a 3D matter-body to another part of same 3D matter-body. Mere presence of an effort (or its application) does not constitute action by it. In short; action takes place only when work is done.

5.2. Inertial-efforts:

Phenomenon that causes delay between cause (of an effort) and its full execution may be understood as 'inertia'. An effort (currently called 'force') that is instrumental to phenomenon of inertia may be called 'inertial-effort'. Actions of inertial-efforts displace macro bodies, in space and invoke property of inertia in universal medium about them. Inertia about a macro body, delays changes in its states of motion. Action of an effort is to invest additional distortions (work) into matter-field of a macro body. Transfer of additional distortions into a matter-field causes disorder in it. Inertial delay is the time taken for matter-field to stabilize itself and attain a steady state (of motion). During inertial delay, macro bodies accelerate or decelerate. On completion of stabilization, matter-field and associated macro body attain steady state (of motion) that can continue indefinitely, unless modified by action of another external effort.

In nature, actions are recognized by displacements (motion) of macro bodies in space. Irrespective of associated phenomenon, all actions related to displacements of macro bodies in space are 'inertial actions'. Inertial actions move macro bodies at constant speeds along steady straight-line paths, accelerate or decelerate them along their path of motion or change their directions of motion. Therefore, all phenomena, which may cause different types of actions by various 'natural forces' (gravitational, electromagnetic, nuclear, or any other), are recognized ultimately by inertial actions they can cause on macro bodies.

Inertia is often understood as some sort of resistance that produces sluggishness on the part of physical bodies to respond to external stimulations on them. An external effort that stimulates change in 3D matter-body's state (of motion) cannot simultaneously be a resistance to change of its state (of motion), also. Similarly, a moving 3D matter-body cannot produce resistance for its own change of state (of motion). Therefore resistance to change of state (of motion) of a 3D matter-body has to be offered by an external entity that is distinct from external effort-producing entity and the 3D matter-body, whose state of motion is being changed. Since 3D matter-body is inert and there is no other entity, besides universal medium, universal medium surrounding a 3D matter-body has to fulfill both roles of 'force-applying mechanism' and resistance-producing element to 3D matter-body's change of state (of motion).

Distortions in universal medium are work-done. During inertial period, additional work (distortions) in a macro body's matter-field (part of universal medium) is stabilized and distributed evenly throughout its matter-field. Therefore, changes in consistency or constitution of universal medium is also liable for inertia. Inertia is applicable to developments of 'gravitational-fields', 'distortion-fields' and 'field-efforts' also, during their initial set up. Inertial effects are limited to duration of development of (additional) distortions in universal medium and during development of inertial actions on macro bodies. Once distortion-fields are developed in universal medium, changes in magnitudes of efforts due to various types of 'fields' or their interactions are instantaneous, on variation of their parameters. However, actions of field-efforts (due to interactions between two or more distortion-fields) to produce inertial action on macro bodies are, once again, governed by inertia.

All efforts, which produce inertial actions on 3D macro bodies, to displace them in space, are included in this group of 'inertial-efforts'. Although results of field-efforts are also inertial actions (to produce displacements of macro bodies), they are treated separately to differentiate distinctions in developments of inertial and field-efforts. Inertial-efforts are applied by 'force-applying mechanism' to 'force-receiving body'. 'Force-applying mechanism' transmits (invests) additional work into matter-field of a macro body ('force-receiving body') to change its state (of motion). Therefore, action of an inertial-effort changes state (of motion) of a physical body.

Inertia is a property of universal medium by which it takes certain time to stabilize state of distortions in it. Inertia appears as sluggishness or resistance, on the part of macro bodies, to respond to external efforts on them and attain steady states (of motion). Because of this property, inertia is measured in terms of sluggishness of a macro body to obey external effort on it. 'Mass' is the measurement of inertia (of matter-field of a macro body) and it is measured with respect to macro body's displacement in linear path during action of an external effort. Since we have no standard reference to measure

matter-content of an object, we use its mass (or units derived from it) to represent matter-content, for all practical purposes.

5.2.1. Nature of effort:

Force and power are rates of doing and undoing (changes in) additional work, associated with a macro body. Force is rate of transfer of additional work with respect to displacement of macro body. It is a mathematical relation (between mass of macro body and its acceleration). All mathematical relations are functional entities. Force, being a functional entity, cannot be physically transferred. Since it has no physical form or structure, force is intangible. It can neither act on a physical body nor can it be acted upon by a physical body. It is the work, in the form of (additional) distortions in universal medium, which is always transferred from matter-field of one macro body to another. Rate of this transfer is force. In following explanations, term 'force' is also used occasionally in its general sense as cause of an action to indicate exchanges (or transfer) of additional work, force, power or energy between macro bodies. However, term 'effort' is mostly preferred instead of 'force' to indicate cause of an action. Effort means an attempt or exertion and its result.

In contemporary physics, force is treated almost like a real entity. Force is an influence that causes changes in state of an object. It is able to act and be acted upon. However, force is measured in terms of mass of a macro body and its acceleration (ML/T^2). In this concept, force is given its rightful place as a mathematical relation. Effort is substituted in all other places, where force is currently used as cause of an action.

Force, being a mathematical relation, it is an abstract term. There are no different types of forces. There is no logic behind classification of forces into various types of 'natural forces', except to illustrate phenomena they are associated with. All efforts, in nature, are similar. Universal medium produces efforts and transfers resulting work within itself. Since universal medium is a combination of 2D energy-fields, all efforts (in general) may be called 'field-efforts'**.** All efforts and their interactions are results of simple mechanical movements of quanta of matter in latticework-structures of 2D energy-fields in universal medium.

Following explanations on efforts are confined to their actions in latticework-structure of single 2D energy-field in universal medium. Therefore all efforts, described in paragraphs below, are coplanar efforts only (unless specifically stated). Although it is physically impossible for an effort to act at or through a point, as is general custom, hypothetical efforts are considered to act at junction-points in latticework-structures of 2D energy-fields. Explanations are confined to general natures of actions by efforts.

Latticework-structure of a 2D energy-field is an inherently stable system. Distortions in its parts are automatically transferred from region of higher distortion-density to

region of lower distortion-density (in universal medium). This phenomenon may be understood as transfer or investment of work. Rate of investment of work with respect to displacement of a macro body is force. Transfer of distortions in universal medium affect locations of constituent photons of a macro body (without affecting their natural motions) and displace them in space. Displacements of constituent photons (they being integral parts of macro bodies), in turn, subscribe to movements of macro bodies.

Field-efforts are primary efforts and they form basis of all other manifestations of efforts. All efforts are recognized by their inertial actions on macro bodies. In this text, natural efforts are classified into three main groups. Various 'inertial-efforts', which produce movements of 3D matter-bodies/particles, form one group. Other two groups are 'gravitational effort' and 'field-efforts' (a group of electromagnetic and nuclear efforts. Since, conventionally, they are related to various types of fields, same name is retained). Mechanisms of working of all efforts are similar and their classification into three main groups, in this text, is only for convenience and clarity of explanations. Production, transmission and action of all these efforts are similar but within certain minor restrictions.

Although gravitational effort is classified separately, it is also a field-effort. Its actions are distinct from other field-efforts and hence it is dealt with under a separate heading. Distortions in 2D energy-fields, producing gravitational effort, are created by discontinuity of their latticework-structures by presence of basic 3D matter-particles in them. Distortion-field, produced by mere presence of a 3D disturbance, is a gravitational-field and it remains constantly in association with the 3D disturbance. Hence, gravitational effort requires no time lag while being transferred with 3D disturbance and changes its magnitude, instantaneously, on variation of parameter of macro body/3D disturbance. Change in magnitude of gravitational attraction is instantaneous on changing parameters of concerned 3D matter-bodies. Gravitational efforts act simultaneously on all basic 3D matter-particles of a macro body. Changes in gravitational attraction are continuous and invoke no inertial delay. However, inertial motions, produced by gravitational attraction are governed by inertial delays.

All other field-efforts are included in a general category of 'field-effort', which includes 'electromagnetic and nuclear efforts'. Field-efforts are related to distortions in universal medium, which in turn are caused by relative displacements of quanta of matter in latticework-structures of 2D energy-fields. Relative displacements of quanta of matter in latticework-structures are too small to be measured by 3D measuring systems. Inertial motions of 3D macro bodies in a region, where field-efforts are produced, are understood as actions of field-efforts. Therefore, magnitude of a field-effort is always measured in comparison with an inertial-effort that makes equivalent inertial action on a macro body. Consequently, all groups of efforts came to be measured by same measurements system.

Distortion-fields, producing field-efforts, are created by motion of unstable photons in 3D matter-particles of macro bodies. Developments of distortion-fields are inertial actions. Once distortion-fields are produced, their interactions are instantaneous on changes of parameters. In this case also, motion of a macro body under interaction between two distortion-fields is governed by inertial delay.

Unstable photons have constant linear speed, even in their curved paths (See chapter 9). Distortion-field, about a primary 3D matter-particle (produced by its constituent unstable photons), remains in association with the primary particle and moves along with photons at their speed. However, changes in magnitude or direction of a distortion-field require new developments or restructuring of latticework-structures. These are governed by inertial properties of universal medium. Hence, changes in magnitude or direction of a distortion-field (producing a field-effort) is transmitted through universal medium at the only (highest possible) linear speed of transfer of distortions in universal medium. This is the linear speed of light.

Single distortion-field cannot induce (inertial) motion of macro body. A macro body may be moved by additional work, created by field-efforts. Interactions between two or more distortion-fields produce field-efforts. Field-efforts produce inertial actions of related macro bodies. Thereafter, motion of macro body is governed by inertial delay. We may say that at this point, field-efforts are transformed into inertial-efforts. Development of macro body's motion by action of field-effort in its matter-field is the origin of additional work in 3D spatial system. Additional work from matter-field of one macro body is then transferred to matter-fields of other macro bodies to do additional work in 3D spatial system (by inertial-efforts).

2D energy-fields in universal medium maintain their stability and serenity. These may be violated only by presence of 3D disturbances in them. Presence of 3D disturbances produces distortions in their latticework-structures. Movements of 3D disturbances through universal medium need additional distortions. Additional distortions, traveling through universal medium, may approach another 3D disturbance / matter-particle in universal medium. Approaching distortions increase distortion-density about receiving 3D matter-particle on the side of their approach. Additional distortions on one side of a 3D matter-particle create difference in distortion-densities on opposite sides. Difference in distortion-densities (on opposite sides of a 3D matter-particle) causes its displacement towards region of lower distortion-density. Rate of change of speed of displacement, with respect to distance moved, is 'inertial-force'.

Inertial-efforts include all mechanical and direct efforts (caused by resultant gravitational efforts or field-efforts produced by interactions between distortion-fields), which produce motion or change of state of 3D matter-bodies in 3D spatial system. They do so, by transfer of additional work from one macro body's matter-field to another

macro body's matter-field. Displacements of 3D matter-particles are necessary to create inertial-efforts. Inertial-efforts are applied from outside a macro body's matter-field. Additional distortions in universal medium, produced by inertial-efforts in a macro body's matter-field, are invested from external sources, either by field-efforts, gravitational efforts or motion of external macro bodies towards it.

As 'force-applying body' approaches 'force-receiving body', distortion-fields about nearest 3D matter-particles in both macro bodies come within their interacting distance. 3D matter-particles of macro bodies tend to keep their relative distance between them. In the process, 3D matter-particle of 'force-receiving body' is pushed away from approaching 'force-applying body'. Movements of 3D matter-particles in 'force-receiving body' enhance distortion-field about 'force-receiving body' by transferring additional distortions from its own matter-field. Mechanism of transmission of distortion-field is the same as described in section 2.8.3.

Speed of transmission of additional distortions (within receiving macro body's matter-field) depends on speed of external macro body that invests them. To transfer additional work (from one macro body's matter-field to another macro body's matter-field), additional work produced by gravitational effort or field-efforts are at first (apparently) transformed into inertial action (effort). Only inertial nature of efforts can transfer tangible additional work from one macro body's matter-field to another macro body's matter-field. Speed of transfer of additional work is related to inertial-effort, applied by external macro body. Hence, inertial-efforts may be transmitted at any speed, lesser than linear speed of light. Highest linear speed possible, is limited by ability of macro body's constituent 3D particles to maintain their integrity.

Distortion-fields, whose interactions produce field-efforts, have limited range. (E.g. Electric-efforts). Because of their limited range, magnitude of field-effort at a point depends on distance between source of effort and point under consideration. Different parts of same macro body may experience different strengths of a field-effort. Sense and magnitude of inertial actions by interaction of two distortion-fields depend on their strengths, senses and distance between elements producing distortion-fields. Parts of a macro body, under denser distortion-field, produce inertial action faster than parts of the same macro body, which have rarer distortion-field. If a macro body is reasonably rigid, faster moving part of macro body tend to carry its slower moving part also along with it and slower moving part tends to retard motion of faster moving parts.

It may be noted that; basically, inertial actions of all efforts are transfer of distortions in latticework-structures of 2D energy-fields in universal medium. In case of field-efforts, interaction between distortion-fields, created by inherent motions of elements (producing field-efforts), act directly and simultaneously on all constituent unstable photons of a macro body. In case of inertial-efforts, distortion-field is created by relative

displacements of neighboring 3D matter-particles of a macro body to act on each other in sequential order, from one end of macro body to other end. Action of an inertial-effort transfers additional distortions from matter-field of 'force-applying body' to matter-field of 'force-receiving body'.

Fictitious efforts, (like centrifugal force, coriolis force, etc. currently called as inertial forces) invoked by an observer to maintain validity of present theories and apparent forces, related to different frames of reference, are not considered as real efforts, in this concept. They serve for easier but irrational explanations and (mis)understanding of various phenomena. These imaginary forces are not considered as inertial-efforts or field-efforts in this book.

Due to latticework-structure of 2D energy-fields, a distortion-field in it, even if it is of angular (or radial) nature, can be transmitted only in straight-line path. If there are more than one external effort, acting on a 3D matter-body, each set of additional distortions is transmitted in same direction as action of effort. 3D matter-body is moved in a resultant direction due to combined actions of efforts. This necessitates that 3D matter-body move away from directions of action of both efforts. Additional distortions, introduced into a 3D matter-body's matter-field, cannot change their direction of transfer. Hence, as and when, 3D matter-body moves out of line with direction of transfer of additional distortions, corresponding magnitudes of additional distortions are lost from 3D matter-body's matter-field, into space. Additional distortions, left in 3D matter-body's matter-field, are only those required for its steady state of motion in resultant direction. This is the reason, why momentum of a 3D matter-body (moving in a circular path) is maintained constant irrespective of continuous action of ('centripetal force') external effort on it.

As there can never be a point-direct effort (because matter-field of any body is extremely large compared to a latticework-square of a 2D energy-field), explanation in following section is only a hypothetical case where a point-direct effort is considered to bear upon one or few latticework-squares of a matter-field. Principles of actions of various groups of efforts are similar. Terms, '2D energy-fields', 'matter-field' and 'distortion-field' are used interchangeably in this section.

Matter-field is a block of parts of 2D energy-fields in 3D space, containing the required distortions for a macro body's sustenance as an integrated 3D matter-body. Matter-field of a macro body contains distortion-fields of all constituent 3D matter-particles in it. Parts of 2D energy-fields may or may not have distortions in them. Part of a 2D energy-field within a macro body's perimeter is part of its matter-field. Matter-field does not extend far from border of a macro body.

Matter-fields of two macro bodies are differentiated only in individual region of distortions in 2D energy-fields, within their body-dimensions. Taking a plane, passing through both macro bodies, it is one latticework-structure of same 2D energy-field

passing through both macro bodies, in this plane. Nevertheless, parts of this 2D energy-field within confines of border of each macro body are distorted, appropriate to each of macro bodies and are parts of their matter-fields. Consequently, when it is said that a macro body is applying an effort on another macro body, it means that additional distortions in matter-field of a macro body is brought to bear up on distortions of matter-field of another macro body. 3D matter-particles of macro bodies do not touch each other. In the process, both matter-fields try (they being part of the same latticework-structure in their plane, tend to share total distortions by influencing each other) to modify each other.

Because of latticework-structure of matter-field, no single latticework-square can be deformed or strained in isolation. Strain in a latticework-square is automatically transferred and shared by neighboring latticework-squares in same plane. When a macro body is said to meet or collide with another macro body, it is their matter-fields, which meet or collide. Matter-field represents distortions in universal medium within and about a macro body. Collision between matter-fields, depending on strength of collision between matter-bodies, transfer part of additional distortions in their matter-fields to each other. Since no transfer of matter takes place, matter-contents of macro bodies are not affected.

Consider an example of a moving macro body ‘A’ coming into contact with a static macro body ‘B’. Matter-field of a macro body has enough and required additional distortions in it, to maintain its state of motion, in addition to distortion-fields required to maintain stability and integrity of its 3D matter-particles and the macro body as a whole. Motion of macro body A, as a whole, is produced by additional distortions in its matter-field, introduced by an external effort. Additional distortions that produce macro body’s motion are over and above natural distortion-fields existing in its matter-field. These additional distortions are transferred at a constant linear speed through 2D energy-field. As distortions are transferred through space, macro body’s matter-field, bearing 3D matter-particles of macro body, achieves identical translational motion in the same direction.

As soon as matter-field of moving macro body A encounters matter-field of static macro body B, there is a restriction for forward motion of 3D matter-particles of macro body A. Additional distortions in 2D energy-fields, associated with macro body A, tend to move (carrying macro body A) at constant linear speed. Parts of additional distortions, in line with 3D matter-particles in macro body B, are prevented form moving at this speed by necessity to carry 3D matter-particles in macro body B also with them. Due to latticework-structure of 2D energy-fields, additional distortions, which are in line with inter-particle spaces, are also held back by additional distortions, whose linear speed is restricted by necessity to carry 3D matter-particles in macro body B.

Other than slowing down, there is no restriction for transfer of additional distortions from matter-field of macro body A into matter-field of macro body B. Thus, depending on various other factors, whole or part of additional distortions in matter-field of macro body A are transferred into matter-field of macro body B. If whole of additional distortions in matter-field of macro body A are transferred into matter-field of macro body B, macro body A will come to a halt and macro body B will move, carrying additional distortions in its matter-field. Whole of (kinetic) energy, producing motion of macro body A is now transferred to matter-field of macro body B. For partial transfer of additional distortions, both macro bodies will behave correspondingly. Here, macro body A is 'force-applying body' and macro body B is 'force-receiving body'.

If effort from 'force-applying body' is able to act on 'force-receiving body', both of their matter-fields are modified. Normally we take only modifications done in matter-field of 'force-receiving body', unless we are taking reaction to effort also into consideration. In case, contact with macro body B produces certain additional distortions in matter-field of macro body A, due to their relative speed, macro body A will move in opposite direction. Such motion is considered as a reaction to original effort. Effort, responsible for this motion, is called 'reaction' or 'reactive effort'.

It is possible that a latticework-square in a matter-field, which receives additional distortions, is already deformed. If a latticework-square was already deformed, its additional deformation due to an inertial-effort varies correspondingly. Stress, developed in arms of a deformed latticework-square of 2D energy-field, transfers part of deformation to next latticework-square in front of it, in the direction of applied effort. Similar actions are repeated in forward direction, in sequence.

Additional distortions, received into matter-field of 'force-receiving body', are additional work and stress they develop in matter-field is energy received by 'force-receiving body'. Reduction in distortions in matter-field of 'force-applying body' is additional work-undone and stress reduced in its matter-field is energy given away. In a case, where action of one macro body causes a change (of state of motion) in another macro body, magnitudes of additional distortions in matter-field of 'force-applying body' are reduced and magnitudes of additional distortions in matter-field of 'force-receiving body' are increased. It is to say, that additional work is undone in 'force-applying body' and additional work is done on 'force-receiving body'.

Additional work-done and additional work-undone are equal in magnitude. Energy lost by 'force applying body' is equal to energy gained by 'force receiving body'. Additional work, done in matter-field of 'force-receiving body', is due to a direct effort and alteration to additional work in matter-field of 'force-applying body' is due to reaction. Magnitude of additional distortions, received by 'force-receiving body', is the same as magnitude of additional distortions lost by 'force-applying body'. Hence,

numerically action is equal to reaction. Direction of resultant additional distortions in matter-field of 'force-receiving body' is same as the direction of effort. Direction of resultant additional distortions in matter-field of 'force-applying body' is opposite to direction of effort.

All actions, in nature, take place between universal medium and basic 3D matter-particles (photons). However, when resultant of actions between universal medium and constituent photons of a macro body is related to simultaneous and similar resultant of actions in another macro body, these macro bodies appear to interact between them. Other than in extreme cases, basic 3D matter-particles (constituent photons) of two macro bodies do not come in contact, during macro bodies' apparent interactions. When they do come in contact, due to their high-speed motions, photons disintegrate, at least partially. In extremely rare cases, transfer of matter-content between macro body's constituent photons may take place. Normally, apparent interactions between different macro bodies are always between their matter-fields.

5.2.2. Action of inertial-effort:

In explanations of actions, usually, only its active part is considered for study and its reactive part is ignored. In order to understand a phenomenon fully, descriptions of both, action and reaction, are required. Action is possible only against a reaction. Action and reaction are complimentary. In steady state conditions, they are equal in magnitude and opposite in directions. Action takes place only when its magnitude tends to exceed magnitude of reaction. Mixing reaction with action may complicate descriptions of phenomena. Hence, only in cases, where reaction is equally important to understand a phenomenon, its description is added. Otherwise, as is usual, only actions are explained and reactions are ignored.

Generally, all physical actions are understood by displacement (motion) of macro bodies or their parts in space. Action at a distance, currently assumed to accomplish movements of a macro body through empty space, is an impossible proposition. A macro body can affect another macro body only through contact, either directly between their 3D matter-particles or through an intermediary entity, which is in direct contact with 3D matter-particles of both macro bodies. To accomplish motion in space, four things are essential. They are; 1). a macro body that is being moved, 2). an entity that is instrumental to motion, 3). a logical mechanism of motion and 4). a reason or cause for motion.

Mechanism of motion is provided by natural actions of all-encompassing universal medium, which is an intermediary between all basic 3D matter-particles in nature and acts as instrumental to all types of movements in universe. Cause or reason for universal medium to act and cause movements of macro bodies is relative changes in consistency of universal medium, about a macro body, due to various reasons. Although mechanism

of motion is basically identical in all conditions, due to peculiar structure of universal medium, there are slight differences in actions and mechanism, when causes of motion are in different directions or in different planes. Fundamentally, cause for displacement of a macro body in space is stabilizing actions of universal medium, to sustain its homogeneous nature.

'Force' is usually considered as an influence that causes a macro body to undergo a change in its state of motion (or rest) or shape. It is the result of a physical effort. 'Standard Model' of physics considers that exchange of (undefined) particles called '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' that make it a real entity with magical properties. 'Quantum field theory' considers 'force' as a redundant notion, resulting from momentum of virtual particles. Virtual particles can live and act only in rational minds. They cannot take part in any physical action. 'General relativity theory' considers 'force' as a superfluous entity arising from conservation of momentum, which may be derived from properties of space. In both these theories, idea of 'momentum' is usually considered more fundamental than the concept of a 'force'. Thus 'force' is better understood as a sort of 'interaction'.

However, in 'classical (Newtonian) physics': 'Force' is defined as a product of a constant (mass of a 3D matter-body) multiplied by its acceleration. ($F = ma$) It is a mathematical relation between two functional entities. Even while a physical effort on a 3D matter-body exists, magnitude of 'force' may reduce to zero value by absence of either mass or acceleration of 3D matter-body. 'Force' appears to be 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 rate of work-done on (energy transferred to) a 3D matter-body with respect to its displacement. $(F = W \div d)$. It is the spatial derivative of energy. Here, even while a physical effort on a matter-body exists, magnitude of 'force', depending on magnitudes of work-done on and displacement of 3D matter-body may vary between zero and infinity. Rate is a mathematical relation and hence a functional entity. Functional entities cannot perform physical actions.

All actions in nature are caused, initiated and accomplished by work. As given above, mathematical relation between magnitude of 'work-done' about a macro body and its displacement in absolute terms, during work is being accomplished, is 'force'. $(F = W \div d)$. Work, being physical changes in universal medium about a macro body, is tangible and hence a physical entity. Physical entities are real and they can accomplish real action on 3D matter-bodies. Therefore, it is logical to consider 'work' as the real and primary entity and 'force' as one of its aspect. Actions are effects from 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 impossible suggestion. When we consider action of an effort, as pulling-action, in reality its mechanism of action pushes at '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 knot. Therefore, character of all efforts (natural 'forces' like; gravity, electromagnetic, nuclear, etc.) in nature is of push. All efforts are activated by push action on 3D matter-particles by universal medium, which is in direct contact with every basic 3D matter-particle in universe.

Parts of 2D energy-fields, constituting matter-field of a macro body have sufficient distortions in it to maintain stability and integrity of macro body. Additional distortions in its matter-field cause macro body's movement. When motion of a matter-field A (of matter-body 'A') influences and causes changes in another matter-field B (of matter-body 'B'), quanta of matter in matter-field B are additionally moved and displaced. [Motion of matter-field signifies transfer of additional distortions in 2D energy-field from one region in space to another region in space]. Part of additional distortions in matter-field A is transferred to matter-field B.

Quanta of matter in 2D energy-fields are not moved from one matter-field to another, only their distortions are transferred. As matter-field B receives certain additional distortions, strain in its latticework-structure is increased. Stress, developed in matter-field B due to additional strain, is the energy transferred from macro body A to macro body B. Additional stress developed in matter-field B is equal to stress relieved from matter-field A. If motion of matter-field A cannot produce movement or displacement of quanta of matter in matter-field B, it may be considered as only an application of effort and no work is done in matter-field B. No transfer of additional distortions takes place and stresses in matter-fields A and B do not change. Hence, effort applied by macro body A is not active on macro body B. Because of application of effort, attempt to do work is available but work can be done in matter-field B only during action of the effort.

During action of an effort, quanta of matter in matter-field of 'force-receiving body' are displaced with respect to their neighbors in latticework-structures of 2D energy-fields. Displacements of quanta of matter due to external effort are over and above displacements they already possess. We call displacements of quanta of matter in latticework-structure due to external effort as additional distortions (additional work). Relative displacement of a quantum of matter varies divergence angle between constituent quanta of matter at junction-points in latticework-structure.

All quanta of matter at the junction-point are strained and corresponding stress develop in them. It is their natural tendency, to return to stable state with respect to each other. Stress, developed in quanta of matter, at a junction-point due to displacement of one or all quanta of matter of junction-point, remains with latticework-structure of 2D

energy-field until the quanta of matter are allowed to return to their stable state. This strain and corresponding stress, when released, produces a reactive effort.

Stress, stored in displaced quanta of matter in latticework-structure of 2D energy-field, is 'energy' stored in (matter-field of) macro body. Relative displacements of quanta of matter are work. Hence, work and energy can be considered as numerically equal (depending upon the measurement system used). Normally, work and energy stored are considered to be same and their names are used interchangeably.

Additional 'work-done' and 'energy-stored' about a macro body may be related either to time or to displacement of macro body. When they are related to time, resulting functional entity is 'power'. 'Force' is another functional entity resulting from relating work to displacement of macro body. Energy, power and force are not real entities. They are mathematical relations between work-done and the matter-content in a macro body. Work-done and matter-content are real entities. They are related to universal medium and quanta of matter in its latticework-structures.

Since quanta of matter and 2D energy-fields are (presumed with respect to us) functional entities, fundamentally, both matter-content and work-done in 2D spatial system are functional entities with respect to 3D spatial system. For this reason, we have no dimensional measuring system, directly related to them. Available dimensional measurement systems are formulated for tangible measurements in 3D spatial system.

Down to the scale of quanta of matter, measurements used in 3D spatial system are too large to be useful and measurements become negligible. For practical purposes, matter-content and work-done are considered on macro scale only. Hence, they become tangible in terms of some other functional entities used in 3D spatial system. Matter-content of a macro body is represented by a functional entity **–** mass. Another functional entity used to represent matter-content of a macro body with respect to a reference macro body is its 'weight'. Work-done is measured in terms of changes in parameters of macro bodies.

Matter-contents of macro bodies are not transferred during transfer of additional work (energy). Action of an effort indicates transfer of additional work. Application of an effort indicates presence of effort that can transfer additional work (energy). Depending on certain factors, an effort applied on a macro body may act or abstain from acting on it.

Action of an effort always presupposes ability of 'force-applying body' to move faster than 'force-receiving body', in the direction of effort. In the event, linear speed of 'force-receiving body', in the direction of effort, equals or exceeds linear speed of 'force-applying body' external effort will not subsist any more.

For the time being, we may assume that a 'force-receiving body' remains static irrespective of action of an external effort and consider actions within its matter-field.

Consider a small hypothetical direct (point) effort being applied to a junction-point of a latticework-square of matter-field of a macro body. To do additional work, there has to be a movement. Assuming the point of application of this effort has moved junction-point by a small distance, along with other quanta of matter attached to it in latticework-structure, effort can be regarded to have acted on macro body. Certain magnitude of additional work is done in matter-field of macro body by making changes in its matter-field, namely, movements of certain quanta of matter in relation to its neighbors in latticework-structures of 2D energy-fields.

Movements, produced in matter-field, are that: the first latticework-square in line of effort is deformed to maximum (corresponding to strength of effort), next latticework-square to a lesser degree and next latticework-square to a still lesser degree and so on, up to effective range of effort. This chain of action continues until a latticework-square at certain distance from the point of application of effort does not receive any deformation at all. Each latticework-square preserves certain amount of distortion in it and passes on the rest.

After, whole of distortions are absorbed in latticework-structure, subsequent latticework-square does not feel the effort at all. This makes a direct effort, applied on a macro body, is of limited range. This is the reason why interactive efforts (inertial-efforts), between two macro bodies, are of limited range while gravitational effort (which is not originated within or about macro bodies and hence not an interactive effort) is of long range.

If the action of effort continues or magnitude of effort, acting on macro body, is increased, magnitude of strain in latticework-squares of macro body's matter-field increases and few more latticework-squares, in the direction of effort, are deformed. Deformations of latticework-squares, produced by an effort, may be regarded as temporary additional work-done about macro body. These distortions remain with latticework-squares until they are transferred to their neighbors. This is all the effect, a direct effort can cause to a macro body / its matter-field. Consequences due to this effect, like motion of macro body, etc. are the result of reactions, developed in macro body's matter-fields to additional distortions, introduced into it.

Additional distortions, introduced into macro body's matter-field, continue to increase as long as effort continues to act on it. Once effort ceases to act, increase in magnitude of additional distortions in macro body's matter-field also ceases. But there is no natural mechanism to remove additional distortions already introduced into matter-field. They will remain within the matter-field. All effects due to additional distortions remain permanently with macro body, until they are neutralized.

Additional distortions, introduced into macro body's matter-field, may be neutralized by introducing additional distortions in opposite direction by another external effort.

Magnitude of newly introduced additional distortions are equal to existing additional distortions but in opposite directions. By neutralization of additional distortions, displaced quanta of matter are brought back to their original (stable instantaneous) relative positions in latticework-structures of 2D energy-fields in universal medium. Neutralization of additional distortions removes existing additional work in macro body's matter-field.

Consider a macro body, whose matter-field can absorb additional distortions, introduced by an effort, without action or reaction other than additional deformation of few of its latticework-squares. Matter-field stores no permanent additional distortions in it. Let the 'force-applying mechanism' become free, after action of effort into matter-field and ceases to apply effort. As soon as the macro body is freed of action from 'force-applying mechanism', deformed latticework-squares of its matter-field tend to regain their original shape and relative positions in latticework-structures of universal medium. Distorted latticework-squares in matter-field commence to return to their original shape and place. In doing so, they shall apply a reaction on to 'force-applying mechanism', which applied effort that introduced additional distortions.

Latticework-squares, in matter-field of 'force-receiving body', while returning to their original shape and place, push back 'force-applying mechanism'. This reactive effort, applied by matter-field on to 'force-applying mechanism', is equal but opposite in direction to original effort. Thus, (temporary) additional work, done in matter-field of macro body is released and it (energy associated with additional work) is now returned, to 'force-applying mechanism'. 'Force-applying mechanism' returns to its original state. If 'force-applying mechanism' is absent, additional distortions, corresponding to (temporary) additional work, are transferred out of macro body's matter-field into space. This phenomenon is a fully elastic collision.

If effort caused certain permanent additional distortions (work) in latticework-structure of matter-field and matter-field returns less additional work to 'force-applying mechanism', collision between 'force-applying mechanism and 'force-receiving body' is not fully elastic. Certain additional work, done in matter-field of 'force-receiving body', is retained in its matter-field. That is, its matter-field is modified permanently with certain additional distortions. There is no change in quantity or state of either macro bodies' matter-contents. Any change of state of a macro body, due to an external effort, is not of its matter-content, but of its matter-field. A change of state of matter-field may at times cause changes in matter-content of a body, as explained later in the book. Thus, an external effort can sometimes affect matter-content of a body, only indirectly.

Now, we may consider how investment of additional distortions into matter-field of a macro body causes its motion (displacement in space). It is natural tendency of deformed 2D energy-fields in universal medium to restore their stable neutral condition. Owing to its latticework-structure and continuous effort to stabilize itself, additional distortions,

introduced into latticework-structure of a 2D energy-field, cannot remain static in place. Additional distortions, retained by matter-field of a macro body, are transferred in the direction of effort (or in the direction of least resistance). They are distributed within matter-field. Additional distortions are transferred through latticework-structures of 2D energy-fields and passed successively from one latticework-square in it to the next latticework-square, in sequence.

Let us consider a larger direct inertial effort, applied on a macro body for longer time and 'force-applying mechanism' remains stopped in position, relative to matter-contents of macro body, after action of effort. During its action, external effort has invested certain work by additionally deforming matter-field. Every deformed latticework-squares in matter-field of macro body now strains against each other to regain their original shape. As 'force applying mechanism' is not free and stays in relative position, these latticework-squares cannot regain their shape by moving backward and returning additional work to 'force-applying mechanism'. They can regain their original shape only by passing on additional deformation in the same direction as that of external effort.

Each latticework-square of matter-field transfers its additional deformation to latticework-square next to it, in front. Additional distortion, transferred forward, is over and above original additional distortions passed on during reception of external effort. Transferred additional distortions are part of original additional distortions absorbed by each latticework-square. By transferring all additional distortions gained, latticework-squares nearest to 'force applying mechanism' are restored to their stable state first, followed by subsequent latticework-squares. Thus, whole latticework-structures of matter-field of 'force-receiving body' moves forward by a distance equal to distance penetrated by 'force-applying-mechanism' into its matter-field. Only additional distortions are transferred and latticework-squares themselves remain in their relative positions within their latticework-structures.

Let the first latticework-square, immediately next to 'force-applying mechanism', has fully regained its original shape by transferring all its additional distortions to latticework-square in front, before 'force-applying mechanism' is removed. That is, macro body (its matter-field) has moved away from 'force-applying mechanism' by a distance equal to distance penetrated by 'force-applying mechanism'. All of additional distortions, introduced into macro body's matter-field by the effort, are now contained within matter-field of macro body.

These additional distortions continue to be transferred in forward direction. Thus, whole of the matter-field (macro body) continues to move in forward direction at linear speed, at which additional distortions are transferred within matter-field. 3D matter-particles of macro body are carried along with its matter-field. 'Force-applying mechanism' acted on 'force-receiving body' to produce its motion in space. Motion of

macro body continues as long as effects of action, in the form of moving distortions, remain within the macro body.

As soon as 'force-receiving body' starts to move in the direction of external effort, it may sever its contact with 'force-applying mechanism'. Effort is not acting on latticework-squares in matter-field of 'force-receiving body' any more. Its latticework-squares are free to regain their stable and original shape by expanding in opposite direction, rearward to original effort. This is done and additional distortions, introduced into matter-field of 'force-receiving body' are now transferred not only in forward direction but in backward direction as well. Additional distortions, introduced by external effort, are fully contained within matter-field of moving macro body. Additional distortions are being transferred in both the directions, forward and backward, so that latticework-squares in matter-field may regain their original and stable state.

However, matter-field of 'force-receiving body' as a whole (and along with 3D matter-particles in it) is moving (after the action of external effort) at certain linear speed in forward direction. Let magnitude of linear speed of 'force-receiving body' equals magnitude of linear speed, at which additional distortions in matter-field are being transferred in backward direction. Then result is that, all latticework-squares leaving limit of matter-field to its rear would have regained their stable undistorted state (natural distortions due to macro body's 3D matter-particles would be carried along with it). In addition, all those latticework-squares entering limit of matter-field from front would have gained equal amount of additional distortions as is being lost from latticework-squares, leaving matter-field, to the rear of moving macro body.

Whole of additional distortions, introduced into matter-field of 'force-receiving body' by external effort, are now confined within its matter-field. Additional distortions are distributed within the matter-field such that latticework-squares at the middle of matter-field have maximum additional distortions and additional distortions in latticework-squares, towards limit of matter-field in forward and rearward directions, gradually lessen until there are no distortions in latticework-squares just outside limits of matter-field, in front and back. Additional distortions in the matter-field attain their stable state within a short distance from macro body. Change in linear speed of macro body, at which this stable condition is reached, is the change of state of its motion imparted to macro body by action of the external effort. Hence, as long as additional distortions remain within matter-field of 'force-receiving body', the macro body will continue to move in a straight line at a constant linear speed.

When a macro body is moving under actions of additional distortions, it is displaced with respect to 2D energy-fields. Matter-field of macro body is moving in universal medium. It is the additional distortions in latticework-structures of 2D energy-fields, which are transferred in universal medium. 3D matter-particles of macro body are carried

along with matter-field. 2D energy-fields are in constant existence throughout space. Therefore, wherever a macro body is in space, it has similar 2D energy-fields about it. Moreover, 2D energy-fields are functional entities with respect to 3D matter-bodies. Hence, it is impossible to determine relative motion between a 3D matter-body and 2D energy-fields.

We may determine a macro body's movements with respect to other macro bodies or any other references in space. In this case, 2D energy-fields are equivalent of 'aether' in 'aether theories'. We will not be able to detect an 'aether drag' or 'aether wind' about a moving macro body. Because, equivalent of 'aether' in this concept (2D energy-fields), does not move. However, since additional distortions in 2D energy-fields are moving along with macro body, effectively, there is no relative motion between macro body and 2D energy-fields, surrounding it, even while the macro body is moving through universal medium.

While matter-field of a macro body moves forward, it leaves behind undistorted latticework-squares in 2D energy-fields, through which the macro body moves. Latticework-squares in parts of 2D energy-fields entering space of macro body from front are distorted by same magnitude (of additional distortions) as magnitude of additional distortions relieved from latticework-structures of parts of 2D energy-fields leaving the space of macro body to its rear. Once this process has started, there is nothing in matter-field of macro body or outside it, which can reduce or stop transfer of additional distortions or motion of macro body.

To arrest macro body's motion (under inertial action) or reduce its linear speed, it is necessary to remove or reduce magnitude of additional distortions introduced into its matter-field by original external effort. This may be done by introducing additional distortions of equal value in opposite direction (by an equal but opposite effort) into macro body's matter-field to neutralize additional distortions in it, wholly or partially. Thus, it is seen that though assigned to 'mass' of a macro body, inertia is the property of its matter-field (surrounding 2D energy-fields); to remain at rest or to move at a constant speed in straight line, till acted upon by an external effort. Since additional distortions are transferred in 2D energy-fields and all 2D energy-fields exist in their own planes, additional distortions can be transferred only in straight-lines. Each 2D energy-field passing through a macro body transfers additional distortions in its own plane.

A macro body is constituted mainly by its matter-field. Macro body also has numerous 3D matter-particles in it. An external inertial-effort, acting on a macro body, modifies additional distortions in its matter-field. Additional distortions encroach into a matter-field from the direction where external effort is acting. As additional distortions are transferred through matter-field, they move the first 3D matter-particle 'A' that happens to be in its way. As 3D matter-particle A moves forward, it approaches another 3D matter-

particle 'B' in front. Matter-field between 3D matter-particles A and B are compressed and they produce reactive effort. As 3D matter-particle A is anchored on additional distortions, introduced by external effort, inclination of compressed part of matter-field, between 3D matter-particles A and B, to expand to in forward direction, pushes at 3D matter-particle B, to move it also in the same direction. Similarly, every 3D matter-particle in the macro body is carried forward along with its matter-field.

If matter-field of macro body, between the first and subsequent 3D particles, is some how able to absorb additional distortions and desist from pushing at subsequent 3D matter-particles in the matter-field at any stage, additional distortions introduced by inertial-effort do not advance or spread out in the matter-field. Macro body, as a whole, can not move. In this condition, action of external effort comes to a stop after first (or few) 3D matter-particle, in its way of transfer, are displaced. Thereafter, external effort remains inactive irrespective of the fact of its continuous application on macro body. Effort by external effort, to introduce additional distortions into a matter-field, is present as long as external effort continues to be applied. It may continue to increase additional distortions about the first few 3D matter-particles. But additional distortions are prevented from advancing in the matter-field. This is what happens, when a pressure compresses a macro body.

An external effort is unable to act on a macro body under two conditions. In one condition, additional distortions, introduced by external effort, are absorbed by a part of its matter-field. In this condition, 3D matter-particles in the macro body are too few and they are far apart (like in a low-pressure gas). Extents of matter-fields between 3D matter-particles in macro body are too large so that they do not invoke sufficient reactive effort against applied inertial-effort. Additional distortions, introduced about a 3D matter-particle, are lost by the time they cover the distance to next 3D matter-particle. Additional distortions are absorbed by 2D energy-field and they operate on only one or few 3D matter-particles in the direction of external effort. Work-done by external effort is limited only in the displacement of first one or few 3D matter-particles. Work-done is stored in macro body's matter-field as reactive pressure applied in opposition to applied external effort. Action of an inertial-effort requires displacements of 3D matter-particles of a macro body. Thus, a small effort applied on a very large macro body (or on a highly compressible macro body) does not produce motion of whole macro body.

In the second condition, additional distortions are prevented from entering matter-field of a macro body or they are neutralized as soon as they enter into matter-field of a macro body. This is explained in section 5.3.2.

5.2.3. Inertia:

Property of matter-field to contain all additional distortions, introduced into it, and to act accordingly to maintain macro body in steady state of motion is currently assigned to

its 3D matter-body as 'inertia'. Matter-field of macro body is a block of universal medium in and about macro body's dimensions. Hence, we can say that inertia is a property of 2D energy-fields (universal medium).

Process of motion, explained above, is not instantaneous. It takes certain time for additional distortions to be transferred through latticework-structures of 2D energy-fields and to stabilize themselves in a matter-field. Therefore, a time delay is always associated with inertia. Certain time interval is required for transferred additional distortions to reach stable state and achieve constant value of transfer speed, in universal medium. Inertia, with respect to constant linear speed (steady state of motion in straight line) is 'ability of universal medium to transfer additional distortions in latticework-structures of matter-field of macro body at a steady state (speed)'.

Present-day explanations on 'forces' and their actions presuppose that most 'forces' are of pull nature. In order to find resultant actions of 'forces', even a push 'force' is represented as acting away from point of application. In this concept, all efforts are of 'push' nature. A macro body or 3D matter-particle is pushed ahead of additional distortions in latticework-structures of 2D energy-fields. All efforts and their resultants act towards their points of application. However, to reduce confusion, following paragraphs on actions of efforts use present-day conventions. Efforts are considered as if they are of 'pull' nature and they act away from the point of application.

In order to change state of (motion of) a macro body, certain work has to be invested in association with it or removed from its association (macro body's energy content is changed). Work, additionally invested in association with a macro body or removed from its association, changes its state of rest or of uniform motion. Change in its state of motion does not take place instantly, but it is delayed. It takes some time for the work to become fully effective and stabilize about macro body. A macro body changes its state of motion gradually and this delay is attributed to property of inertia.

Contemporary concepts consider that acceleration of a macro body takes place only during action of an external effort on it. Actions within macro body, during the time between cessation of effort and achievement of final state of motion after a time delay, are ignored. Contrary to such belief, a macro body reaches its final state of motion only after a delay from cessation of action of effort. According to mechanism of action of efforts, explained below, it can be seen that additional work that is invested with a macro body by external effort continues to change macro body's state of motion during the interval between cessation of external effort and achievement of macro body's final state of motion. That is to say that a macro body is under its accelerating state, even after cessation of external effort, for a period equal to inertial delay.

Due to inertia, external effort gradually increases velocity of a macro body to bring it to its final velocity after a definite time. Magnitude of this delay depends on strength of

external effort and quantity of matter, the macro body contains. Therefore, both, effort and matter-content are defined on this basis. 'Force' is determined by relation between matter-content of a macro body (represented by its 'mass') and rate of change of macro body's velocity. 'Mass', currently used to represent matter-content of macro body, is also defined by same relation, which is used to define 'force'. We use circular logic for these definitions.

Magnitude of inertia, associated with a macro body is additive. More matter-content a macro body has, higher will be magnitude of inertia associated with it. Magnitude of inertia depends also on efficiency of external effort.

5.2.4. Efficiency of effort:

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

Knowing magnitudes and directions of external efforts, acting on a 3D matter-body, alone is not sufficient to find their resultant magnitude on it. Ability of 'force-applying mechanism' to act on 'force-receiving body' and their linear speeds also need to be considered. An effort can exist only when 'force-applying mechanism' is capable to move faster than 'force-receiving body'. Efficiency of an external effort is highest (100%), when absolute linear speed of 'force-receiving body' in the direction of effort is zero. Efficiency of external effort is zero or it is unable to act on 'force-receiving body', when absolute linear speed of 'force-receiving body', in the direction of external effort, becomes equal to highest possible speed (in the direction of motion) in universal medium.

Efficiency of action of an effort, η, depends on highest possible absolute linear speed, Vmax, in universal medium and present absolute linear speed, V, of 'force-applying mechanism'.

$$\text{Efficiency of an external effort, } \eta = \frac{(V_{max} - V) \times 100}{V_{max}} \ \% \qquad \textbf{(5/1)}$$

This fact gives rise to phenomenon of 'relativistic mass'. As absolute linear speed of 'force-receiving body' approaches linear speed of light, in the direction of external effort, efficiency of external effort, to act on a 3D matter-body, is greatly reduced. This reality is misinterpreted (without considering relative direction of effort) to show that 'energy' (an undefined functional entity) presumably invested by 'force-applying mechanism' is

converted into 'mass' (a functional entity, defined as mathematical relation between external effort and acceleration of a 3D matter-body), which represents matter-content of 3D matter-body. This assumption attempts to justify disproportionate acceleration of a 3D matter-body, moving at very high linear speed, due to an external effort. That is, an external effort cannot accelerate a 3D matter-body according to mathematical equation that describes relation between external effort and acceleration of 3D matter-body that is moving at lower linear speed.

Relative linear speed between 'force-applying mechanism' and 'force-receiving body' also affects efficiency of external effort. Usually, ability of 'force-applying mechanism' to move faster than 'force-receiving body' is always presupposed. Without such capability of 'force-applying mechanism' effort cannot exist. Inability of 'force-applying mechanism' to move faster than 'force-receiving body' greatly reduces efficiency of external effort on a 3D matter-body.

Only a faster moving 'force-applying mechanism' can distort latticework-squares in latticework-structures of matter-field of 'force-receiving body' and thus invest work into its matter-field. A 'force-applying mechanism' is able to act on a 'force-receiving body' only until its ability to move at linear speed that exceeds linear speed of 'force-receiving body'. Even if both 'force-receiving body' and 'force-applying body' move at same linear speed (zero relative speed) during action of external effort, 'force-applying mechanism' is incapable to press into 'force-receiving body' and cause change in linear speed of 'force-receiving body'. Since 'force' is the rate of work-done, as and when 'force-applying mechanism' becomes incapable to do work, force does not exist any more.

In equation (5/1), if direction of V is in negative direction (opposite to external effort);

$$\text{Efficiency of an external effort, } \eta = \frac{[V_{max} - (-V)] \times 100}{V_{max}} = \frac{(V_{max} + V) \times 100}{V_{max}} \ \% \qquad \textbf{(5/2)}$$

In case of two photons colliding head on, $V = V_{max}$ and efficiency of collision is 200 %.

5.3. Mechanism of inertial motion:

Inertial motion of a macro body may be visualized in relation to its constituent 3D matter-particles. A molecule (in rare cases, atoms) is the smallest macro body that can exist independently. It may contain atoms of one or more elements. Each molecule contains millions of photons in it. These photons are in their unstable states and continuously interact with surrounding universal medium to maintain stability of their matter-contents and integrity of their unions. For all practical purposes, a large macro body may be considered as a union of its molecules. Here, for the present, we may assume that molecules are independent 3D matter-bodies, each one with its own envelope of distortion-field. Distortion-fields of all molecules, together, make matter-field

of macro body. Each constituent molecule is an independent 3D matter-body within matter-field of macro body. Distances between neighboring molecules are much greater than sizes of molecules.

External (inertial) effort can act only on periphery of a 3D matter-particle (that is why it is called external effort). We shall consider action of an effort on a 'force-receiving body'. As 'force-applying mechanism' meets a 'force-receiving body', distortion-fields of nearest molecules from both macro bodies make contact. Latticework-structures of 2D energy-fields, between molecules, get compressed in the direction of macro bodies' approach.

First layer of molecules in 'force-receiving body' moves in the direction of external effort. Matter-field of 'force-receiving body', between first and second layers of molecules, is now compressed. Latticework-structures of matter-field cannot remain compressed for long. They try to expand to their original states. This can be done either by pushing first layer of molecules backward or pushing second layer of molecules forward. Due to presence of 'force-applying mechanism', first layer of molecules cannot move backward. Only option left is for the second layer of molecules to be pushed forward. Similar actions are repeated till layer of molecules at other end of 'force-receiving body' and whole of 'force-receiving body' is displaced in space. Continuing action of external effort continues to move 'force-receiving body' at increasing speed.

Action of effort, between first and second layers of molecules, is repeated between all subsequent layers of molecules in 'force-receiving body'. These actions do not take place simultaneously. Sequential action of effort through various layers of molecules in 'force-receiving body' causes inertial delay. Once the 'force-applying mechanism' is removed, matter-field of 'force-receiving body' settles down to a stable configuration of distortions in it as explained in previous section. These actions are explained below with respect to molecules of 'force-receiving body':

Figures 5.1, 5.2, 5.3 and 5.4 show parts of matter-fields in two macro bodies, in one plane. We shall ignore all intrinsic distortions in latticework-structures of matter-fields and consider only those additional distortions, which are concerned with inertial-effort on 'force-receiving body'. Molecules of macro bodies, shown by black circles, sparsely populate their matter-fields. Circles in dotted lines represent outer limits of distortion-fields of individual molecules. Distortion-field of each molecule subscribes sufficient distortions to sustain its own integrity and steady states of macro bodies. Resultant distortions of latticework-squares in matter-field (subscribing to linear motion of macro bodies) about molecules (in a row) are represented by rectangles in black lines. These rectangles represent resultant shape of latticework-squares in latticework-structure of 2D energy-field (ignoring distortions in individual distortion-fields) about each molecule.

In figure 5.1, matter-field of static macro body ('force-receiving body'), shown on left, contains no resultant additional distortions. Distortions, in latticework-structure of matter-field, required to maintain integrity and state of macro body are ignored. Let us assume that this macro body is in a steady state of rest. Molecules are distributed evenly within macro body. 'Force-receiving body', on left, has no absolute motion in space.

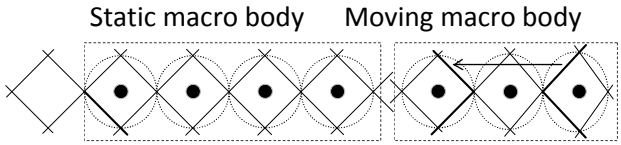


Figure 5.1

Matter-field, shown on right, represents a moving macro body that would become 'force-applying mechanism'. Latticework-structure of its matter-field contains additional distortions corresponding to certain additional work (energy) that is moving 'force applying mechanism' in the direction of arrow. Resultant distortions of latticework-squares in matter-field are represented by rectangles in black lines. They are distorted in horizontal direction. Arrow shows direction of motion of 'force-applying mechanism'.

If these two macro bodies are allowed to come in contact, as shown in figure 5.2, 'force-applying mechanism' starts to apply external effort on 'force-receiving body'. Both matter-fields tend to influence each other. Although matter-fields are distinct for each matter-body, they are parts of same latticework-structures of 2D energy-fields. When contact between macro bodies is established, 'force-applying mechanism is arrested in its path. However, additional distortions in matter-field of 'force-applying mechanism' tend to spread into matter-field of 'force-receiving body', as shown by leftward arrow in dotted line. This process may continue until additional distortions in both matter-fields become equal.

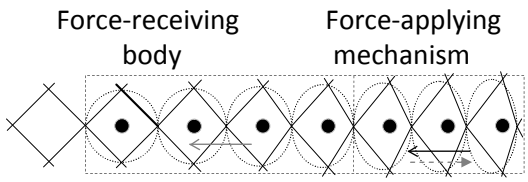


Figure 5.2

Total resultant additional distortions in matter-field of 'force-applying mechanism', on right, reduce. Resultant additional distortions in matter-field of 'force-receiving body', on left, increase. Additional work (energy) is invested into 'force-receiving body' from 'force-applying mechanism'. At this stage, 'force-receiving body' has not developed linear motion. Additional distortions of latticework-squares in matter-field of 'force-receiving

body' develop reactions in them. Reactive effort is applied by 'force-receiving body' to 'force-applying mechanism', as shown by rightward arrow in dotted line.

Both macro bodies change their state of motion. As soon as matter-field of 'force-receiving body' receives additional distortions from matter-field of 'force-applying mechanism', its accelerating stage commences. 'Force-receiving body' accelerates as shown by leftward arrow in dotted line. Distortion-fields of molecules, situated at rear end of 'force-receiving body' are pushed forward, in the direction of acceleration, by moving distortions from matter-field of 'force-applying mechanism'. Resultant additional distortions in distortion-fields of molecules in force-receiving body' are gradually increased. Forward displacement of rear-most molecules compresses latticework-squares between them and molecules in front. Tendency of 2D energy-field, to regain its stability, pushes molecules in front, forward. This process continues until all molecules in 'force-receiving body' are moving forward.

For an instant, when contact between macro bodies is established, 'force-applying mechanism' is stopped in its path. As 'force-receiving body' accelerates, matter-body (molecules) of 'force-applying mechanism' starts to move with 'force-receiving body'. Gradually, linear speed of 'force-applying mechanism' increases along with linear speed of 'force-receiving body'. Linear speed of 'force-applying mechanism' is reduced, as shown by the smaller arrow in solid line. 'Force-applying mechanism' is decelerated by reaction from matter-field of 'force-receiving body', as shown by rightward arrow in dotted line. As long as 'force-applying mechanism' is capable of moving faster than 'force-receiving body', additional distortions from its matter-field continue to transfer into matter-field of 'force-receiving body', to increase magnitude of additional distortions in it. Additional work is done by 'force-applying mechanism' on force-receiving body'. Increasing magnitude of additional distortions in matter-field gradually increases linear speed of 'force-receiving body'.

Similar processes in all common 2D energy-fields continue until linear speeds of both 'force-applying mechanism' and 'force-receiving body' become equal or until 'force-applying mechanism' is removed. States of motion of macro bodies become steady only after additional distortions in their matter-fields are distributed in a pattern that provides both macro bodies with steady states of motion.

During action of inertial-effort, magnitude of additional distortions in latticework-squares of matter-field in 'force-receiving body' near 'force-applying mechanism' (at the right) is largest but less than magnitude of additional distortions in matter-field of 'force-applying body'. During accelerating stage, magnitude of additional distortions in matter-field of 'force-receiving body' gradually reduces as location of latticework-square shifts to its forward end (left). Acceleration of 'force-receiving body' continues as long as additional work is being introduced into its matter-field. By the time accelerating stage is

over, additional distortions in its matter-field are distributed in a manner corresponding to its steady state of motion.

As soon as action of external effort is terminated, by removing contact between 'force-receiving body' and 'force-applying mechanism', resultant additional distortions in matter-fields of both macro bodies tend to stabilize. Figure 5.3, represents state of distribution of distortion-fields of molecules at the instant of removal of external effort. Since there is no external effort from right, resultant additional distortions in distortion-fields of molecules start to spread rightwards also. Speed, at which additional distortions are spread, depends on difference in magnitudes of additional distortions in distortion-fields of subsequent molecules.

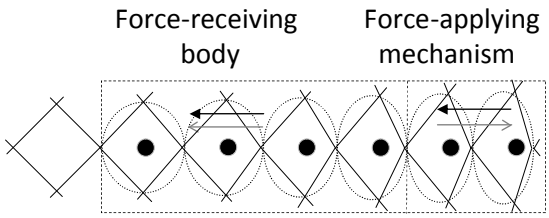


Figure 5.3

At the instant of severance of external effort, latticework-squares in matter-field to the right of 'force-receiving body' are distorted more. Right-hand sides of latticework-squares (as shown in the figure) have larger angular divergence between them, compared to angular divergence between left-hand sides of latticework-squares. Effort applied by latticework-square to transfer additional distortion to the right is less than its effort to transfer additional distortion to the left. It is easier to transfer additional distortions to left (forward) than to right (rearward). Once the accelerating stage is over, additional distortions are transferred in forward direction at a steady linear speed. Similar actions take place in the event both matter-bodies reach same linear speed and external effort is incapable to accelerate 'force-receiving body' any more.

At the same time, due to larger distortions on rear end (right-hand side) of latticework-squares in matter-field, whole of additional distortions (along with matter-body) are moving forward (to left), in the direction of applied effort. Due to forward (leftward) motion of matter-field, speed of expansion of latticework-squares in matter-field is limited to less than the speed of transfer of additional distortions forward (to left). Difference between magnitude of transfer of distortions forward (to left) and magnitude of expansion of latticework-squares rearward (to right) is the accelerating component of applied effort.

Resultant additional distortions in latticework-squares of matter-field gradually reach a stable state, at which rearward (rightward) transfer of additional distortions is nullified by forward (left-ward) displacement of 'force-receiving body'. When such state is reached, the macro body has achieved a steady state of motion and it has no further

acceleration. Resultant additional distortions in matter-field of a matter-body, under steady state of motion, are shown in figure 5.4. It may be noted that acceleration period continues even after removal of external effort and until matter-field of whole macro body attains steady state of motion. Therefore, there is a difference between state of motion of a macro body, at the instant of severance of an external effort, and its state of motion, when it has reached steady state of motion.

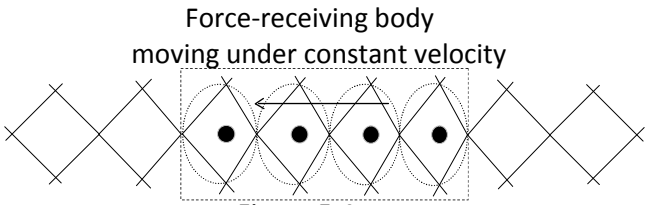


Figure 5.4

By the time additional distortions in latticework-structures of matter-field have reached a steady state, macro body (as a whole) has attained a steady linear motion at constant linear speed with respect to universal medium. This steady state of motion is maintained indefinitely unless another external effort modifies resultant additional distortions in matter-field of the macro body. Due to resultant additional distortions in matter-field of moving macro body, few latticework-squares of 2D energy-fields outside its body-dimensions, immediately in front and rear, are also distorted. Distortions in latticework-structures of 2D energy-fields, outside body-dimensions, gradually reduce as distance from macro body increases. A moving macro body has its matter-field extended outside its body-dimensions in proportion to its total matter-content and linear speed.

As additional distortions in latticework-structures of matter-field spread forward, molecules of macro body that are moving forward, keep their alignments relative to additional distortions and to each other. Both, additional distortions in latticework-structures of matter-field and constituent molecules of macro body, move in synchronism with each other. Linear speed of transmission of additional distortions in latticework-structures of 2D energy-field and linear speed of a macro body (its matter-field) are equal and proportional to magnitude of additional distortions (work) introduced in macro body's matter-field by 'force-applying mechanism'.

Inertial actions during accelerating stage may be considered as actions due to difference between distortion-densities at two points in space. 'Force-applying mechanism' introduces additional distortions into rear part of matter-field of 'force-receiving body' and cause higher distortion-density compared to lower distortion-density at front part of its matter-field. Inertial action of universal medium generates flow of additional distortions from region of higher distortion-density to region of lower distortion-density.

In doing so, additional distortions change state of motion of 'force-receiving body' by carrying its 3D matter-particles along with additional distortions. As 'force-receiving body'

moves forward, locations of higher distortion-density shift in space at linear speed of 'force-receiving body'. Accelerating components of additional distortions in matter-field diminish during its stabilization. After that, only those additional distortions, which cause 'force-receiving body' to move at a constant linear speed, are left in its matter-field. At steady linear speed of transfer of additional distortions, 'force-receiving body' continues to move at a constant linear speed.

Action of external effort on a macro body is to introduce additional distortions into its matter-field. Magnitude of additional distortions in the matter-field of a macro body is magnitude of additional work, done about that macro body, as a whole. Newly introduced additional distortions in matter-field of a macro body;

(1) If they are in same direction as additional distortions, already present and maintaining inertial motion of the macro body, will add together to accelerate macro body and enhance its constant linear speed.

(2) If they are in opposite direction to additional distortions, already present and maintaining inertial motion of macro body, will subtract from each other to decelerate macro body and reduce its constant linear speed.

(3) If they are in any other direction, they will accelerate macro body in their direction and deflect macro body's direction of motion.

Additional distortions in a macro body's matter-field travel only in straight lines and thus directing steady state motions of all its constituent 3D matter-particles in straight lines. As long as magnitude (and direction) of additional distortions (additional work) in matter-field of a macro body remain constant, macro body continues to move at a constant linear speed (in a straight line). A change in magnitude (or direction) of additional distortions produce instability in macro body's state of motion. It will take certain time for the changed additional distortions to stabilize. This is accelerating or decelerating period of macro body.

Considering a macro body, moving at a constant linear speed, it appears to move at a steady relative motion with respect to surrounding universal medium. That is, undistorted latticework-squares of 2D energy-fields appear to enter into space occupied by macro body from front, to be changed into macro body's matter-field by acquiring distortions within its dimensional limits and an equal magnitude of distorted latticework-squares from matter-field of macro body leave space within its border to rear to be changed into ordinary undistorted latticework-squares of 2D energy-fields.

In reality it is the additional distortions in latticework-structures of 2D energy-fields, which transfer themselves rather than 2D energy-fields or their latticework-squares moving in and out of space occupied by macro body. Additional distortions in latticework-structures in 2D energy-fields, under translational motion, carry (move along with) basic

3D matter-particles of macro body. This appears as a relative motion between universal medium and macro body.

5.3.1. Effort on macro body:

If we disregard intrinsic distortions in matter-field of a macro body, universal medium in the region of a static macro body is homogeneous and isotropic. We shall consider matter-field of macro body, while ignoring all its intrinsic distortions, to analyze effect of inertial motion of macro body on an external effort, acting on macro body. Accordingly, a macro body, in its static state has no distortions in its matter-field and a macro body in motion has only additional distortions in its matter-field, which provides its linear motion.

Figure 5.5 shows representations of two molecules and corresponding latticework-squares in their distortion-fields. Vertical central lines through junction-points of latticework-squares are shown by lines YY. Grey rectangles represent latticework-squares in distortion-fields of molecules. Their sizes are highly exaggerated, compared to sizes of molecules. Grey circles in centre of rectangle represent 3D matter-bodies of molecules. Larger circles in dotted lines show outer limits of their distortion-fields. Intrinsic distortions in distortion-fields are ignored and only additional distortions of latticework-squares are represented in figure.

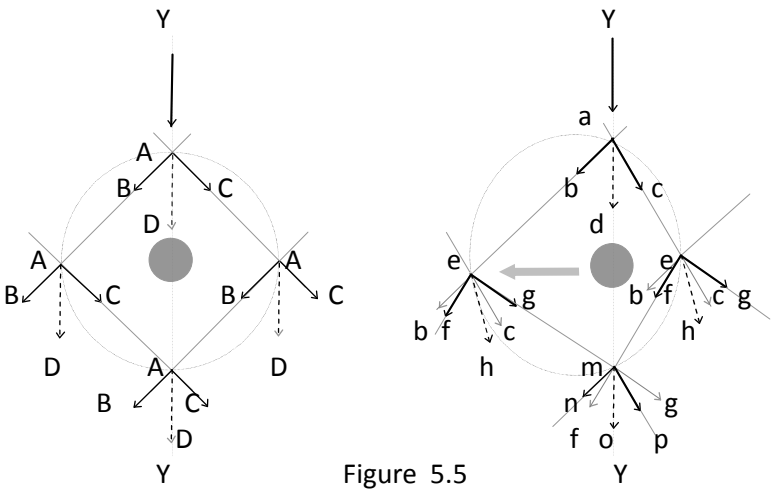


Figure 5.5

Figure on left represents a latticework-square in matter-field of a molecule in state of rest with respect to universal medium. It has no motion with respect to universal medium. Arms of latticework-squares are symmetrically placed about its central line, YY. An external effort, shown by arrow at A, applied at one of its junction-point, A, is evenly distributed through its arms, for further transmission. Arrows B and C show resolved components of external effort, transmitted through respective quanta of matter in

latticework-square. Combining components B and C, of external effort A, gives their resultant as shown by arrow D, in dashed line. Effort represented by arrow D is identical to external effort represented by arrow at A in magnitude and direction.

Transmission of effort at every junction point is similar. Whole of external effort is transmitted through matter-field of macro body in linear direction, without change of style. (Refer section 2.7).

Figure on right represents a latticework-square in distortion-field of a molecule, moving at a constant linear speed with respect to universal medium. Thick grey horizontal arrow, F, shows direction of motion of molecule (along with its parent macro body), with respect to static universal medium. Arms of latticework-squares are unsymmetrical about vertical central line YY. An external effort, shown by arrow at a, applied at one of its junction-point, a, is unevenly distributed through its arms, for further transmission. Arrows b and c show resolved components transmitted through respective quanta of matter in latticework-square. They are angularly displaced through angles corresponding to additional distortion, currently existing in macro body's matter-field.

Combining components b and c (shown by grey arrows), of external effort at junction-point e, gives their resultant as shown by arrow h, in dashed line. Effort represented by arrow, h (in dashed line), is not identical to external effort represented by arrow d at junction-point, a, in direction and magnitude. Difference in magnitude of effort is used to compress quanta of matter. In this case, direction of resultant effort, h, is deflected anti-clockwise. Correspondingly, magnitude of external effort at junction-point a (causing diagonal collapse of latticework-square) is greater than magnitude of external effort (causing diagonal collapse of latticework-square) at junction-point e.

Components of effort, h, at junction-point e are transmitted further along quanta of matter, as shown by arrows f and g. These efforts are combined at next junction-point m, in similar fashion. Combining components f and g (shown by grey arrows), of external effort at junction-point m, gives their resultant as shown by arrow o, in dashed line. Effort represented by arrow, o (in dashed line), is not identical to external effort represented by arrow h at junction-point, e, in direction and magnitude. Difference in magnitude of effort is used to compress quanta of matter. In this case, direction of resultant effort, o, is deflected clockwise. Correspondingly, magnitude of external effort at junction-point e (causing diagonal collapse of latticework-square) is greater than magnitude of external effort (causing diagonal collapse of latticework-square) at junction-point m.

Components of effort, o, at junction-point m are transmitted further along quanta of matter, as shown by arrows n and p. These efforts are combined at subsequent junction-points, along latticework-structure until magnitude of external effort, causing diagonal collapse of latticework-square, is reduced to nil. Hence there is a definite size of (part of) moving macro body, through which an external effort (in perpendicular direction to its

linear motion) can be transmitted. This range is directly related to absolute linear speed of macro body.

In the latticework-square shown on right-hand side in figure 5.5, junction-point e in front (in the direction of linear motion of macro body) is farther away from central line YY of latticework-square than junction-point e at the rear. Resultant efforts, acting through these junction-points, shown by arrows h, are similar in magnitudes and direction. Because of difference in perpendicular distances of their lines of action from central line YY, they for a resultant couple, which tends to turn the latticework-square (as shown in figure) in anti-clockwise direction. Whole of latticework square angularly deflects anticlockwise. Additional distortions transferred through the matter-field of macro will have an angular component, which may endow matter-field with rotary displacement, as shown in figure 5.6 by circular arrow in dashed line in central figure B.

Figure 5.6 shows parts of matter-fields of three macro bodies, which are under action by external efforts, shown by thick vertical arrows. Matter-field A belongs to a macro body that is static with respect to universal medium (intrinsic distortions in all matter-fields are ignored). An external effort, shown by thick black arrow at top, acting on the matter-field is transmitted through it without changes. External effort passed on through the part of matter-field is represented by thick black arrow at bottom. This helps to produce pure linear motion of macro body, with respect to universal medium. Whole of external effort is utilized to produce linear motion of macro body.

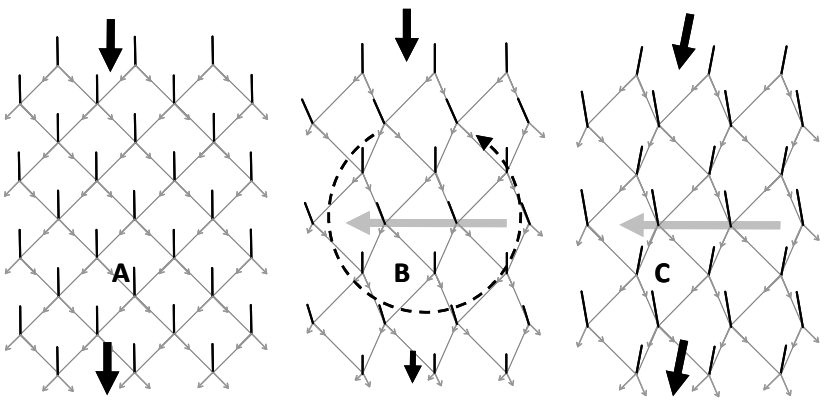


Figure 5.6

Matter-field B belongs to a macro body that is moving at a constant linear motion, as represented by thick grey arrow. An external effort, as shown by thick vertical arrow acts on upper part of matter-field of macro body. Distance through which distortions can be transmitted is limited, as explained above. Magnitude of external effort passed on beyond

the part of matter-field is represented by small vertical arrow at the bottom. Additionally, transmission of distortions tends to rotate the macro body, as shown by circular arrow, by angular deflection of transmitted effort.

If the macro body is very large, so that distortions due to external effort cannot be transmitted through and through its matter-field, external effort will be unable to produce linear displacement of macro body. Whole of work, invested by external effort will be stored in macro body as pressure energy. If the macro body is reasonably large, so that certain part of distortions by external effort is passed through its matter-field, macro body may gain linear displacement corresponding to this part of distortions. Remainder of distortions will be stored in its matter-field as pressure energy. Linear speed, gained by macro body in the direction of a steady external effort and rotary motion of the macro body depend on its linear speed and size of matter-field. This phenomenon helps planetary bodies to gain spin motion. (See section 16.5).

Part C of figure shows the same part of matter-field B in similar conditions. It belongs to a macro body that is moving at a constant linear motion, as represented by thick grey arrow. An external effort, as shown by thick arrow acts on upper part of matter-field of macro body, at angle to vertical. Deflection of external effort is such that its direction of action is displaced from arms of latticework-squares at junction-points. Resultant efforts at all similar junction-points in latticework-structure are similar in magnitude and direction. As can be seen in figure, distortions due to external effort are freely transmitted through this part of matter-field without any modification, as shown by arrow at bottom of figure. It is able to produce linear motion of macro body, corresponding to magnitude and direction of external effort. This phenomenon causes leading and lagging of terrestrial tides from local meridian (See section 16.6.2).

Figure 5.7 shows a part of latticework-structure of 2D energy-field in matter-field of a macro body. Intrinsic distortions in matter-field (required for integrity and steady state of its motion) are ignored. Black circles, A, B and C represent three 3D matter-particles of macro body. 3D matter-particles are shown extremely small compared to greatly enlarged quanta of matter in latticework-structure of 2D energy-field. Let a hypothetical effort, shown by black arrow, act at one of junction-points in latticework-structure. Latticework-structure around junction-point is distorted as shown in the figure 5.7.

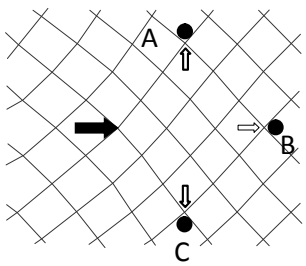


Figure 5.7

Latticework-squares between point of application of effort and matter-particles are in compressed state. Due to inherent property of universal medium, compressed latticework-squares tend to expand, back to their stable shape. Expanding latticework-

squares push at 3D matter-particles A, B and C in directions shown by block arrows. 3D matter-particles are pushed away from region of higher distortion-density towards region of low distortion-density.

3D matter-particles A, B and C are constituents of same macro body. They are linked to each other by mutual bonds. Inertial actions on 3D matter-particles A and C are in opposite directions. Since they are part of same macro body, their independent motions are restricted. There is no resultant effect on macro body due to inertial actions on 3D matter-particles A and C. 3D matter-particle B is pushed forward (to right as shown by block arrow). 3D matter-particle B is free to move to right, provided, it can carry all other 3D matter-particles in macro body along with it. Such motion of 3D matter-particle B results in linear motion of whole macro body in the direction of external effort.

If 3D matter-particles are free from each other, all of them move in directions shown by block arrows. Direction of external effort and direction of inertial motions of 3D matter-particles do not match. Independent matter-particles move away from region of higher distortion-density to region of lower distortion-density, irrespective of direction of external effort or any other phenomena that may produce variations in distortion-densities in universal medium.

5.3.2. Addition of co-linear motions:

Consider two external unidirectional efforts applied on a macro body. Both of them tend to introduce corresponding additional distortions into matter-field of macro body. Larger of the two efforts, introduces greater and faster moving additional distortions. Additional distortions push at macro body's 3D matter-particles to move macro body at linear speed corresponding to larger external effort.

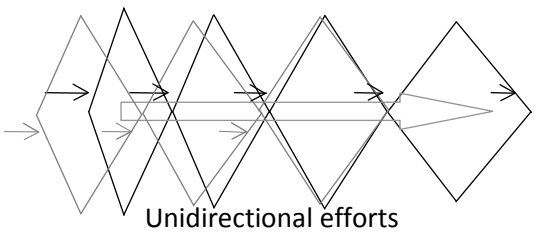
Smaller external effort also tries to introduce additional distortions into macro body's matter-field. However, additional distortions by smaller effort are unable to be formed in latticework-structures of matter-field due to faster motion of additional distortions, already present in latticework-structure, developed by larger external effort. Therefore, in cases, where two co-linear external efforts are simultaneously applied on a macro body, only larger external effort is able to act on macro body.

Only condition, when both of two co-linear, unidirectional, external efforts can act on the macro body is when they are exactly of equal magnitude in same direction. These external efforts share total effort on macro body. Equal magnitudes of additional distortions are invested by both efforts. Magnitude of action of an effort is related to linear speed of 'force-applying mechanism'. In order to apply equal forces, both 'force-applying mechanisms' have to move at equal linear speeds.

It is like two horses pulling a cart. Effort to pull the cart is shared, equally, by both horses only when they are moving at same linear speed and in same direction. There can

be no relative motion between horses. Should their linear speeds differ; relative motion develop between horses and whole of effort, to pull the cart, will be derived from effort by faster-moving horse. Result is that though both horses are applied to cart, only the faster moving one is acting to pull the cart. Effort, put-in by faster-moving horse, is used to do whole of additional work and slower-moving horse, though applied, does not act on cart.

Figure 5.8 shows part of a macro body's matter-field. It consists of four latticework-squares, at one end. Black and grey arrows, on left, represent two external efforts applied to macro body. Black arrow shows larger effort and grey arrow shows smaller effort. Grey rectangles represent probable distortions, smaller effort could introduce, if it was acting alone. However, action of larger effort has introduced greater distortions in matter-field, as represented by black rectangles. Macro body develops linear motion (as shown by block arrow) as per larger effort. Due to faster and larger distortions of latticework-squares, smaller external effort is unable to act on macro body.



Unidirectional efforts
Figure 5.8

Second condition, mentioned in section 5.2.2, develops when two equal but opposite external (inertial) efforts act on a macro body. In case, they are unequal, equal components of both inertial-efforts act, as given below. Surplus magnitude of one of the external efforts can be considered as independent inertial-effort acting / applied on macro body.

Equal and opposite components of (both) external efforts act on macro body to introduce equal magnitude of additional distortions into macro body's matter-field. External efforts being in opposite directions, additional distortions introduced by them are also in opposite directions. Both sets of additional distortions overlap each other and they being equal and opposite, deactivate 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. Quanta of matter in universal medium within matter-field of the macro body have no resultant relative displacements, which cause translational displacement of macro body, due to actions of these efforts. This phenomenon is 'neutralization of the efforts'.

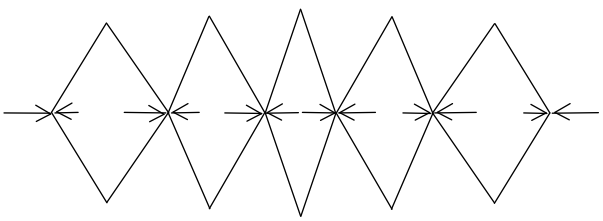
Neutralization of efforts does not mean additional distortions or energy developed by them are nullified. External efforts introduce equal magnitudes of additional distortions in opposite directions (of each quantum of matter). Latticework-squares of matter-field are

compressed from opposite sides to distort them. Latticework-squares change their shapes to parallelograms. Distortions in latticework-squares store energy in the form of (compressive) pressure energy within macro body's matter-field. Total additional distortions in matter-field are not translational but compressive. This does not change state of motion of macro body and macro body maintains its state of rest or of motion at constant linear speed, irrespective of stored pressure energy.

Additional distortions in matter-field, introduced from opposite directions, tend to compound each other. Additional distortions in each plane, containing directions of external effort, increase. Matter-field, along with macro body, suffers reduction in its length in the directions of external efforts and enlarges its body-measurements in directions perpendicular to directions of external efforts. Should expansion of macro body in perpendicular direction is restricted; external efforts are no more able to distort latticework-squares of matter-field, additionally, as required.

Instead of creating relative angular displacements of quanta of matter in latticework-structures of matter-field, external efforts tend to compress quanta of matter in latticework-structures to reduce their lengths. Thus, external efforts are now utilized to store energy within quanta of matter of matter-field, in the form of pressure energy. Macro body develops internal pressure in quanta of matter within its matter-field. A macro body may develop internal pressure only when its expansion due to opposing external efforts (perpendicular to directions of external efforts) is restricted. This phenomenon is 'compression' of a macro body.

Length of a compressed macro body, in the direction of opposing external efforts, is reduced during compression. For this, inertial motions of certain constituent 3D matter-particles of macro body are essential. During this stage, forces are in existence. Since no force is generated after initial period of stabilisation, we may say that external efforts on macro body remain 'being applied' and they are inactive after initial period of compression. This state of macro body may be considered as a neutral state (of motion), for external efforts.



Opposite efforts
Figure 5.9

Figure 5.9 shows part of a macro body's matter-field. It consists of five latticework-squares, spanning length of a macro body. Black arrows represent two equal external efforts acting on macro body from opposite ends. Both efforts introduce their own distortions into matter-field. Latticework-squares are

compressed from sides. Their distortions reduce total length of macro body and increase height of macro body in the middle. External efforts do not cause translational motion of macro body.

Forces may develop or efforts may do additional work on macro body again only when internal pressure within matter-field of macro body varies for any reason and deformation of matter-field's latticework-squares are permitted. Though external efforts applied on a macro body seem to deactivate each other, as long as they are applied, macro body is maintained in altered state of internal pressure. This is not normally accepted as a change in state of macro body. Hence, only further actions of efforts are considered as neutralized. Additional work, already invested in matter-field, to compress macro body, remains within macro body's matter-field.

However, compression of a macro body causes some other changes in its constitution, other than changes in its volumetric dimensions. During compression of a macro body, its constituent atoms / molecules are pushed nearer. Distortion-density of inter-atomic / inter-molecular space, in macro body's matter-field, increases. Increase in distortion-density in inter-particle space in a macro body is experienced by every 3D primary matter-particle ('biton') of macro body as external pressure on it. External pressure on a 3D primary matter-particle causes its volumetric expansion, which in turn produce heating of macro body. (See section 9.8).

If magnitudes of opposing inertial-efforts (on a macro body in opposite directions in same straight line) are different, they form a resultant inertial-effort on macro body. Magnitude of resultant inertial-effort is equal to algebraic sum of external efforts and its direction is the same as that of larger external effort. It may produce translational motion of macro body Resultant effort produces appropriate force, during its action on the macro body.

In case of mutual deactivation of translational motions by opposing efforts, external efforts are continuously and simultaneously applied on macro body. External efforts stop their inertial actions on macro body, after its matter-field develops sufficient reactive effort to oppose both external efforts. External efforts are no more able to introduce additional distortions into matter-field of macro body. Hence, no displacements of macro body or quanta of matter in its matter-field can be produced after initial period of development of reactive efforts within matter-field.

Additional work, transferred into matter-field of macro body during initial stage, is stored within macro body's matter-field and it is exhibited as internal pressure and associated pressure energy. Matter-field of macro body is additionally distorted as if compressed by external efforts. Hence, two equal and opposite external efforts applied on a macro body are able to compress a macro body, rather than produce its linear

motion. (Similar actions on a single quantum of matter by two opposing efforts may break down quanta-chain, as explained section 2.6.1).

5.3.3. Resultant of concurrent motions:

Generally, 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. As an example, we may analyse two concurrent coplanar forces (results of actions by external efforts) in perpendicular directions with respect to each other.

Due to latticework-structures of 2D energy-fields, a distortion-field in it, even if it is angular (or radial) in nature, is transmitted only in straight-line direction. If there is more than one external effort, acting on a macro body, additional distortions invested by each of them is transmitted in the directions of forces, generated by efforts. Macro body is moved in resultant direction of generated forces, due to combination of additional distortions invested by efforts at rates given by forces.

Motion of macro body in resultant direction necessitates that it should move in a different direction from directions of external efforts (and forces) on it. Additional distortions introduced into macro body's matter-field cannot change their direction of transfer. They can be transferred only on straight-line directions, whereas macro body moves in resultant direction. Additional distortions due to external efforts and macro body travel in different directions. Hence, as and when, macro body moves out-of-line with direction of transfer of additional distortions by external efforts, corresponding magnitudes of additional distortions are lost from matter-field of macro body, into space. Additional distortions, remaining in the matter-field of macro body, are only those distortions required for macro body's steady state of motion in resultant direction. These are composed of residue from additional distortions invested by external efforts and/or additional distortions created by displacements of macro body's constituent basic 3D matter-particles in resultant directions.

Basic 3D matter-particles of a macro body that is under two inertial actions are carried in a resultant direction. Initially, there are no additional distortions in macro body's matter-field, which are transferred in present direction of displacements of basic 3D matter-particles. However, displacements of basic 3D matter-particles in resultant direction, through latticework-structure of 2D energy-field, generate their own additional distortion in the direction of motion of basic 3D matter-particles. These additional distortions remain with macro body's matter-field and guide its constituent basic 3D matter-particles in resultant direction, after loss of original sets of additional distortions.

We shall consider action of an external effort on a linearly moving macro body. If an external effort acts on a linearly moving macro body, in a direction deflected from its line of motion, it will introduce additional distortions into macro body's matter-field, in its own direction. These will form another set of additional distortions besides original additional distortions, which are already moving macro body at constant linear speed.

Consider a macro body, moving in a straight line at a constant linear speed. Macro body is under inertial actions from universal medium. Macro body continues to move at its (steady) state of motion until acted upon by an external effort. Let an external effort act on macro body in a direction other than its direction of motion. External effort introduces additional distortions in macro body's matter-field (generate force) in its own direction and corresponding to its magnitude. In the mean time, due to its linear motion, macro body is also moving away from direction of newly introduced additional distortions by external effort. If action of external effort is only for a limited time, macro body will gradually move away from influence of additional distortions due to external effort. These additional distortions escape into (space) universal medium, outside the macro body's matter-field.

Force, generated by external effort, may be resolved (analytically) into two components. Component of force, in direct assistance or opposition to inertial actions of macro body's matter-field, modifies macro body's (linear) inertial actions.

Component of force, in perpendicular direction to inertial motion of macro body, has no effect on present (linear) inertial action of macro body's matter-field. However, it (theoretically) introduces its own inertial actions in macro body's matter-field by investing additional distortions, at right angle to macro body's present (linear) inertial action. Additional distortions, introduced by (component of) force in perpendicular direction, modify additional distortions already existing in matter-field of macro body. Basic 3D matter-particles of macro body modify their direction of motion corresponding to present status of additional distortions. Macro body modifies its course of motion to resultant of these two inertial actions.

Resolution of force (generated by an effort), into components at right angles to each other, is a mathematical operation. In actual cases, this does not happen. We may theoretically consider that each component of force introduces its own additional distortions into matter-field to create inertial actions of macro body, in its own direction. Basic 3D matter-particles of macro body are susceptible to additional distortions from both sources (forces). Initially, basic 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 gradually loses additional distortions in its matter-field that are producing inertial actions from both forces.

From then onwards, basic 3D matter-particles of the macro body are influenced by resultant additional distortions generated and contained within macro body's matter-field, due to displacements of constituent basic 3D matter-particles in resultant direction. As line of motion of macro body moves away from lines of action of external efforts, additional works (distortions) introduced due to their forces, to move macro body in original direction, are gradually lost from macro body's matter-field into space (universal medium). Appropriate additional distortions in its matter-field are re-created by movements of constituent basic 3D matter-particles in resultant direction, to provide new inertial actions to matter-field of macro body. After loss of original additional distortions in matter-field of macro body, newly created additional distortions provide inertial actions to macro body in its new (resultant) direction. It is thus, both magnitude and direction of resultant motion differ from its components.

Additional work, invested into matter-field of a macro body, takes certain time (inertial delay) to stabilize itself and provide macro body with a constant linear speed. This is true even after external effort is terminated. Additional work, not yet stabilized before termination of external effort, continues its stabilization in normal course of time. In other words, a macro body remains under action of external effort (acceleration / deceleration), even after effort (producing external force) is removed, until inertial delay period is completed. Acceleration / deceleration stage continues until all additional work (introduced due to external effort) has stabilised in its matter-field by removing their acceleration / deceleration component and 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 macro body's linear motion. External effort introduces additional distortions into macro body's matter-field at a 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 is changed at a 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 macro body's matter-field. Simultaneously, additional distortions are introduced into macro body's matter-field at a constant rate due to external effort. These additional distortions tend to move macro body in perpendicular direction to its linear motion and thus deflect macro body's direction of motion.

However, as macro body moves forward, additional distortions, which are moving macro body in perpendicular direction, are also soon lost from macro body's matter-field. Additional distortions due to external effort can affect displacement of macro body, only during their presence within its matter-field. Every instant, new additional work is invested into and equal magnitude of additional work is lost from matter-field of macro

body. Due to constant renewal of additional distortions in its matter-field by external effort, macro body continuously accelerates at a constant rate. At the same time, as magnitude of newly introduced additional distortions and additional distortions lost from matter-field are equal, total magnitude and direction of additional distortions (in perpendicular direction to its linear motion) in macro body's matter-field remain constant in magnitude.

A constant magnitude of additional distortion in a macro body's matter-field drives the macro body at a constant linear speed. Constant magnitude of additional distortions in perpendicular direction to macro body's linear motion moves macro body at a constant linear speed in perpendicular direction to its linear motion. Hence, a linearly moving macro body, under steady action of an external effort of constant magnitude in perpendicular direction to its linear motion simultaneously accelerates at a constant rate and moves at a constant velocity in perpendicular direction. Due to this fact, even though a macro body (moving in a circular path due to 'centripetal force') is accelerating continuously at a constant rate towards centre of its circular path, its (radial) speed also remains constant. A macro body, moving in circular path under action of 'centripetal force' moves at a constant radial velocity and at a constant radial acceleration, simultaneously.

Let perpendicular external effort on a linearly moving macro body cover whole of its area (in the direction of effort) rather than act on a point on the macro body. (e.g.: effort like gravitational attraction). Since macro body is moving at a constant linear speed, magnitudes of additional distortions present in any plane, perpendicular to line of its motion are different. Let us consider the macro body as a combination of great many slices in as many planes, perpendicular to line of its motion. Each slice contains parts of basic 3D matter-particles in that plane.

At any instant, matter-field in the most forward plane, perpendicular to line of macro body's motion, receives new additional distortions. Forward displacement of macro body carries its basic 3D matter-particles, but distortions in matter-field remain in same plane. As soon as basic 3D matter-particles in this plane move forward they lose actions by all freshly introduced additional distortions in the plane of their previous existence. In the next instant, plane of their current existence receives fresh additional distortions. Plane behind forward-most plane also receives equal magnitude of new additional distortions. However, this plane already has additional distortions invested during previous instant in forward-most plane. In this way, magnitudes of additional distortions in each plane of macro body's matter-field gradually increase towards its rear end. Hence, additional distortion-density, in planes perpendicular to direction of linear motion, gradually increases towards rear of macro body.

Gradual increase in additional work in planes, perpendicular to line of macro body's motion, towards rear end of macro body cause correspondingly increased displacement of basic 3D matter-particles associated with these planes. In other words, in the same period, displacements of basic 3D matter-particles in different planes of macro body (towards its rear) increase. These uneven displacements amount to a shift in centre of action of effort (and centre of gravity / centre of mass of macro body) to rear of macro body. Part of an effort, acting away from centre of gravity of a free macro body, forms a couple about macro body's centre of gravity. Shift in the centre of action of effort to the rear tends to rotate macro body about its centre of matter-content (geometrical centre, in case of homogeneous macro body), in addition to linear motion. This phenomenon causes of spin motions of celestial bodies in many-body-systems.

5.3.4. Linear momentum:

Linear momentum of a macro body may be generally understood as a measure of its translational motion. It is defined as the product of its relative velocity and mass (representing its matter-content). Relative velocity depends on chosen frame of reference and mass of a macro body depends on its absolute linear speed. Because of its dependencies on relative velocity and mass, linear momentum is not an absolute parameter of a macro body.

Momentum is the product of 'real mass' of a macro body (equivalent to its matter-content) and its absolute velocity. Mass of a macro body is likely to change corresponding to magnitude of its absolute linear speed even without a change in its matter-content. Linear speed, in relative reference frame, is an observed measurement (rate of displacement) with respect to another macro body, which may be moving in any direction at any linear speed. Therefore, momentum of a macro body, calculated in any relative reference frame, has no relevance to its true parameters. A change in momentum, according to (Newton's) second law of motion is the product of (constant) magnitude of a 'force' and time duration of its action on a macro body. In the concept, currently under discussion, 'force' is the rate of additional work invested with matter-field of a macro body by an external effort. Hence, momentum would equal total additional work done on a macro body.

Considering in absolute terms, momentum of a macro body is proportional to total additional work in association with a macro body. Momentum of a rigid macro body is the sum of momenta of all 3D matter-particles in it. Being proportional to velocity, momentum is a vector quantity. It has both magnitude and direction. Although additional work associated with a macro body is a scalar quantity, its actions are directed in the direction of its cause, the external effort. Additional work is transferred in the direction of external effort that caused it.

Linear momentum of a macro body corresponds to magnitude of additional work associated with it. As long as magnitude of associated additional work remains constant, momentum of a macro body does not change. A change in matter-content of a macro body is reflected by a corresponding variation in its absolute linear velocity. State of motion of a macro body depends on magnitude of additional work associated with it. (Intrinsic work associated with a macro body develops and sustains integrity of its 3D matter-particles and whole body as a single unit). Magnitude of additional work, associated with a macro body remains constant unless changed by actions of external efforts. This tendency gives rise to phenomenon of 'conservation of linear momentum'. A change in matter-content of a macro body cannot vary, magnitude of additional work associated with it. Therefore, reduction in matter-content of a moving macro body increases its linear speed and vice versa. As long as, magnitude of additional work, associated with a macro body, does not change its linear momentum remains a constant.

Additional work, associated with a macro body, can be transferred only in a straight line through universal medium. State of motion of a macro body, corresponding to certain additional work, can remain steady only as long as macro body (as a whole) is not deflected away from the line of transmission of additional work in its matter-field. If macro body is deflected away from this straight-line motion, part (or whole) of additional work in its matter-field is lost and macro body's linear speed reduces. If a linearly moving macro body is deflected from its line of straight-line motion, by action of another external effort, the macro body will move in a resultant direction, while losing whole or part of original additional work and newly introduced additional work in its matter-field (in both directions). Present motion of 3D matter-particles of macro body creates additional work corresponding to their resultant motion in association with the macro body to change macro body's momentum to correspond to its present state of motion.

5.4. Torque:

Work (or distortions) may be transmitted, through universal medium, only in straight-line directions. Hence, all types of inertial motions of a macro body take place only in straight-line paths. Simultaneous motions of a macro body, produced by many efforts in different directions may appear as movement of a macro body in curved path. Additional work, introduced into matter-field of macro body, to produce its linear motion, remains within its matter-field as long as macro body's path is along the line of transfer of additional distortions, producing macro body's motion. Similarly, additional works, introduced into a rotating macro body, in various linear directions remain within its matter-field, irrespective of absence of macro body's linear motion.

Consider a small effort, applied at the center of a macro body of infinite length and negligible girth, in the direction of its length. This external effort introduces additional distortions in matter-field of a static (with respect to universal medium) macro body.

Additional distortions tend to accelerate macro body as a whole (initially, only a small part and gradually whole of macro body) to achieve constant linear speed (corresponding to magnitude of external effort and duration of action) in the direction of its length.

Additional distortions, transferred into matter-field of a macro body, spread throughout with gradients in distortion-density, decreasing towards forward and rearward ends of macro body. As macro body is of infinite length, this action of distributing additional distortions within matter-field of the macro body, along its length should continue indefinitely, while part of macro body (where additional distortions are present) continues to move. Since the macro body is of infinite length, its forward and rearward ends move only after infinite time, when additional distortions in matter-field reach them. In the mean time, although the macro body as a whole is static in space, parts of macro body (in front of macro body's central point) are moving in the direction of external effort.

Though this is a hypothetical condition, it is the working principle of rotary motion of a macro body. During rotary motion of a body, about a center of rotation, any point within the space occupied by macro body is always within limits of its body-dimensions. Therefore, as far as this point (in universal medium) is concerned, macro body is of infinite length. Additional distortions of matter-field, spreading-out in forward direction, never reach end-point of macro body; because in a circular macro body there are no end-points. Therefore, a spinning macro body continues to spin at constant angular speed indefinitely, until another external effort acts on it to modify its spin motion.

An external effort causes linear motion of a macro body. Rotary motion of a macro body is caused by two coplanar external efforts (called a couple), acting along parallel lines, in opposite directions (centre of rotation will be in between them), in their plane. Rate of additional work by a couple (of efforts), invested in matter-field of a macro body, which is instrumental to rotary motion of macro body is 'torque'. Torque, in rotary motion, is similar to force, in linear motion. In both cases, they are rates of action by external effort.

An external effort invests only one set of additional distortions in one straight-line direction in matter-field of a macro body, in the plane of its action. A torque invests two sets of additional distortions in two straight-line paths in opposite directions, away from centre of rotation, in matter-field of a macro body, in their plane. These additional distortions are lost from macro body's matter-field, as and when they reach limit of body-dimension in their straight-line transfers. In steady state of rotary motion, integrity of macro body is instrumental for continuous re-creation and sustenance of distortions in macro body's matter-field at steady magnitudes.

In order to produce torque, two parallel (non-concurrent) efforts (or their components) acting in opposite directions are necessary. In case of a supported macro

body, one of the efforts may be supplied by external means while other effort is provided by reaction from its pivot or support. In case a macro body is not pivoted and on which a single external effort is acting, depending on distribution of its 3D matter-particles in the macro body, inertia about 3D matter-particles may act as additional effort (in opposite direction) to complete a couple. Torque is produced by efforts applied in the plane of rotation, about a point at a distance away from pivot and in a direction other than along a line passing through pivot. An external effort, acting through pivot or steady center of matter-content of a macro body cannot subscribe towards a couple.

To analyze motion, produced by a torque, we shall consider a thin ring supported and pivoted at its center. Let a linear effort act on the ring, at a point on its rim, in a direction tangential to its rim at the point. 3D matter-particles at this point tend to move in the direction of external effort. Since they are bonded to other 3D matter-particles in the ring, interactive efforts between them develop due to intended relative displacement between them. These interactive efforts act on each of the 3D matter-particles (in front and rear) in macro body, to move them in appropriate directions so that integrity of thin ring is maintained.

Efforts on each of these 3D matter-particles act as external efforts on them, to induce their inertial motion. Additional distortions are developed throughout matter-field, within the ring, in appropriate directions. Only those additional distortions, introduced at the point of application of external effort, are directly induced by external effort. Additional distortions, developed throughout matter-field of thin ring are by reactions due to relative displacements of its constituent 3D matter-particles.

We shall consider additional distortions, induced at the point of application of external effort, for further explanation. Additional distortions, introduced by thin ring's matter- particles, in its matter-field in various directions also operate in similar manner.

Taking a small part of ring, we can see that, as it turns, point (3D matter-particle) influenced by initial distortions moves away and out of influence of these distortions. Distortions in matter-field move in straight line but 3D matter-particles, in turning ring, are carried in a circular path. Therefore, 3D matter-particles at a point on ring are bound to go out of line of action by distortions introduced by external effort.

Due to integrity of ring, all 3D matter-particles in the ring also move in circular path. Movements of 3D matter-particles create additional distortions in matter-field of ring in association with every 3D matter-particle, in appropriate directions. As soon as a 3D matter-particle starts to move, it will go out of alignment with corresponding additional distortion in matter-field. Due to rotary motion of ring, any point in it is always occupied by one or other 3D matter-particle. With respect to any point in ring, the ring acts like a macro body of infinite length.

Before additional distortions, associated with a 3D matter-particle, can escape out of body-limit of ring, another 3D matter-particle in ring is brought to occupy place of original 3D matter-particle and additional distortions in matter field are now interacting with newly placed 3D matter-particles. In other words, due to the rotary motion of the ring, additional distortions in its matter field are supplied with new 3D matter-particles continuously, to act with. Magnitude of additional distortions at any point in matter-field of ring is sustained by each 3D matter-particle, producing appropriate distortions in right direction to act on 3D matter-particle, following it. Although additional distortions introduced by external effort is long lost from matter-field of ring, movements of all 3D matter-particles in ring, together, create and sustain total additional distortions in matter field of ring.

Should there be radial projections or spokes, extending from a rotating macro body, they do not have benefit of infinite length, available to a circular parts of rotating macro body. Their rotary motion is maintained by reactions from (matter-fields of) materials in shoulders, which join them to rotating macro body.

Thin ring acts as a macro body of infinite length at the point of application of external effort. Ring continues to accelerate (angularly), as long as external effort is acting on it. All additional distortions, produced in its matter-field, in response to external torque are stored within its matter-field as angular distortions of latticework-squares, required for its rotary motion. They are superimposed on any other additional distortions, already existing (or which will be introduced in future) in ring's matter-field. After external effort is withdrawn, additional distortions in its matter-field, all around the ring, stabilize and the ring continues to rotate at constant angular speed. As long as no external torque acts on it, magnitude of additional work in ring's matter-field is maintained constant. A change in additional work in its matter-field will appear as change in its speed.

5.4.1. Mechanism of rotary motion:

Inertial-efforts (which invoke phenomenon of inertia in a macro body) can act only in straight lines and within the plane of their application. Uneven action of a linear effort about centre point of a macro body produces a couple (of efforts) and resulting rotary motion of macro body about its centre, in addition to any linear motion, the same efforts may cause. Rotary motion of a macro body is nothing but sum of linear motions of its 3D matter-particles, moving at different linear speeds and in different directions about a centre point. With respect to a radial line of a rotating macro body, linear speeds of its 3D matter-particles increase in proportion to their distances from centre of rotation.

Transfer of additional distortions in latticework-structure of macro body's matter-field (at unequal linear speeds, corresponding to distance from centre of rotation) moves 3D matter-particles in any region of macro body at corresponding linear speeds and

directions. With respect to rotary motion of a macro body that has no translational motion, additional (linear) distortions in its matter-field, producing macro body's rotary motion, remain steady in space and the macro body itself acts as a moving body of unlimited length, in all directions in each plane of rotation. Latticework-squares in matter-field at centre of rotation have no additional distortions and hence 3D matter-particles in that region do not move. 3D matter-particles, whose distances from the centre of rotation are in opposite directions, move in opposite linear directions.

Figure 5.10 shows representations of three latticework-squares, A, B and C, (in a plane of rotation) in matter-field of a rotating macro body. They are placed in radial line, YY. Latticework-square A is near perimeter, C is at centre of rotation and B is somewhere in between centre of rotation and perimeter of macro body. [Intrinsic distortions in matter-field of macro body, maintaining its integrity and steady state of rest are ignored].

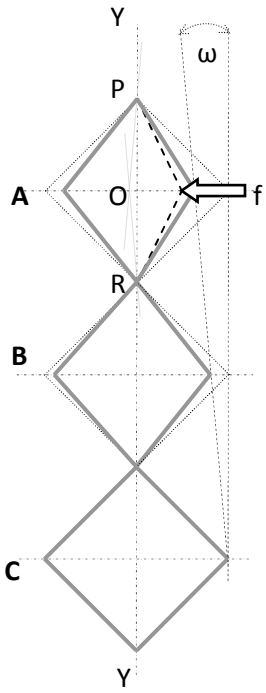


Figure 5.10

Figures in dotted lines show original shapes of latticework-squares, when macro body has no motion at all. In their original shapes, arms of all latticework-squares are symmetrical about a reference line YY (radial line, passing through centers of all latticework-squares, shown in figure). Due to symmetry of latticework-squares A, B and C, about a radial line in matter-field, external effort acting along reference (radial) line, YY, is evenly distributed through their arms and resultant action of external effort is experienced linearly along reference line, YY. Macro body tends to move in the direction of external effort.

Figure 5.10, shows action of external effort, f, on macro body in its static state, away from its centre of rotation and in a direction, perpendicular to reference line YY. External effort distorts latticework-squares of matter-field in the region of its action. Due to integrity of macro body, applied external effort, f, gradually distributes invested additional work about the point of its application. Additional work, in the form of distortions in latticework-structures of matter-field, invested in rotating macro body's matter-field at various points are proportional to its distance from macro body's centre of rotation.

Although external effort directly distorts only the latticework-square A, all other latticework-squares in macro body's matter-field are also distorted due to integrity of macro body. Due to varying distances from point of application of external effort, average magnitudes of additional distortions in latticework-squares, A, B and C are not equal.

Differences in magnitudes of additional distortions of latticework-squares produce different magnitudes of linear speeds. Magnitude of linear speed is highest at macro body's periphery and a point at centre of rotation has no linear motion at all. Magnitudes of linear speeds of points beyond centre of rotation are in opposite direction, highest linear speed is of point on periphery of macro body. Magnitudes and directions of linear motions of all points in macro body differ correspondingly to suit their relative locations in macro body. Steadily varying magnitudes and directions of linear speed of points from centre of rotation to periphery of macro body cause its spin motion about centre of rotation.

Representations of distorted latticework-squares (in a radial line) in matter-field of macro body, rotating at constant angular speed, are as shown by thick grey lines. Dashed lines shown in latticework-square A shows acceleration component of additional distortion during inertial delay period. Acceleration components of additional distortion in other latticework-squares and elongations of all latticework-squares in radial direction, due to additional distortions, are not shown. Latticework-square C, being at the centre of rotation, is not affected by external effort and hence it is not distorted. Due to integrity of macro body, distortion in latticework-square B achieves magnitude and direction corresponding to its distance from centre of rotation and relative location in macro body. As relative locations of latticework-squares in matter-field approach perimeter of macro body, magnitude of additional distortion in them approach highest value corresponding to external effort. Directions of additional distortions in latticework-squares vary, corresponding to their relative angular locations in matter-field of macro body.

Speeds of transfers of additional distortions in matter-field are proportional to their magnitudes. Outer most latticework-squares in matter-field, having highest magnitudes of additional distortions, transfer additional distortions fastest and speeds of transfer of additional distortions in other latticework-squares, placed nearer to centre of rotation, gradually diminish as their relative locations approach centre of rotation. Directions of additional distortions, in latticework-squares, are perpendicular to radial line passing through latticework-squares and depend on their relative locations in matter-field of macro body. Constituent 3D matter-particles of macro body are carried along with moving additional distortions. 3D matter-particles, near perimeter of the macro body, have highest linear (tangential) speed and linear speeds of 3D matter-particles nearer to centre of rotation are lower. Due to different linear speeds of 3D matter-particles, macro body as a whole rotates about its centre of rotation.

Unlike in the cases of linear motion, magnitudes of additional distortions in latticework-squares of matter-field of a rotating body, about a reference radial line, are different for each latticework-square. Angle, subtended by magnitude of linear speed of a peripheral point of rotating body at its centre of rotation is macro body's angular speed of

rotation, shown in figure 5.10 as angle ω. It is equal to difference in magnitudes of additional distortions in latticework-squares at peripheral point and at centre of rotation in matter-field of macro body. When external effort is terminated, macro body will attain steady state of rotation only after inertial delay, with steady additional distortions in all latticework-squares of its matter-field.

Differences between magnitudes of additional distortions in latticework-squares of matter-field of a rotating macro body, along a radial line, create asymmetry in positions of arms of latticework-squares with respect to radial line. Due to this asymmetry, action of an external effort along radial line is bifurcated into unequal components. (Refer section 5.3.1). One component of action produces angular deflection in the direction of rotation of macro body to increase its angular speed and other component imparts linear motion to rotating macro body along radial line.

As long as 'centripetal forces' on 3D matter-particles do not vary, angular deflections of latticework-squares in 2D energy-fields continue at steady state and additional distortions in matter-field of rotating macro body continue to be transferred in angular path. Additional distortions, in matter-field of a linearly moving macro body, could be modified only by investment of additional distortions by external efforts. This is applicable to rotary motion also. Further, additional distortions causing rotary motion of macro body can be modified by changes in 'centripetal forces', inherently existing in rigid macro bodies. Changes in 'centripetal force' may change angular deflections of latticework-squares in 2D energy-fields and vary macro body's state of rotary motion.

Direction of resultant action of external effort is deflected from direction of its application by an angle whose magnitude is proportional to angular speed of rotation. In order to produce pure linear motion of a rotating macro body, in its plane of rotation, external effort has to act along a line deflected away from geometrical radial line of rotating macro body. This is the radial line of macro body's matter-field, corresponding to arms of its latticework-squares. Angular difference between geometrical radius of a rotating macro body and radius of its matter-field is proportional to angular speed of rotating macro body. This phenomenon gives rise to deflections of terrestrial tides from local meridians. (See sub-sections 5.3.1 and 16.6.2).

An external effort, acting through center of rotation of a rotating macro body (in steady state of linear motion or rest) in the plane of its rotation, introduces its own set of additional distortions into macro body's matter-field. These additional distortions are in the direction of external effort and they modify additional distortions in every part of rotating macro body's matter-field. 3D matter-particles in any part of macro body will have corresponding linear motion in addition to its original rotary motion. Resultant additional distortions, acting on each of macro body's 3D matter-particles, are modified to endow them with transfer in resultant direction. Changes in macro body's matter-field

cause shift in instantaneous center of rotation of macro body. During this unstable period, rotation of macro body becomes eccentric and if macro body is free in space, it tends to rotate about instantaneous center of rotation, which is away from its 'center of mass' (or gravity). 3D matter-particles of macro body will be under cyclical acceleration and deceleration according to their relative position within the macro body.

5.4.2. Inertia of rotary motion:

Figure 5.11 shows quarter part of a plane (perpendicular to the spin axis) of a rotary macro body. Black circles represent 3D matter-particles (molecules) and circles around them in dotted line show limits of their distortion-fields. Distortions in latticework-structures of macro body's matter-field, required to maintain stable state of linear motion and integrity of macro body, are ignored. Rectangles in grey lines around few of macro body's 3D matter-particles represent additional distortions in latticework-squares of resultant distortion-fields of molecules. Thick black arrow shows direction of rotation of macro body.

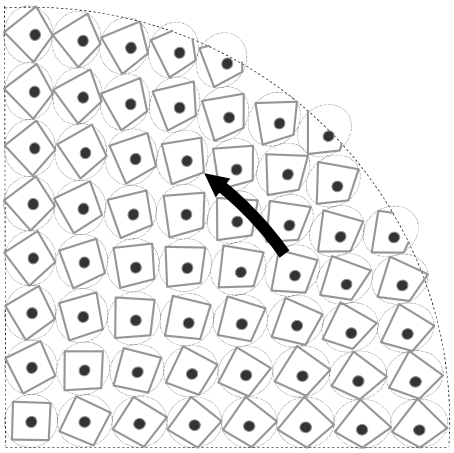


Figure 5.11

Although, additional distortions in universal medium are transferred in straight lines, in matter-field of a rotating macro body, they are transferred in circular paths. This is why directions of additional distortions in distortion-fields about molecules are different. Magnitudes of changes in direction of additional distortions are greater towards centre of rotation of macro body.

Inertia is a property of universal medium and it is related to linear transfer of additional distortions in latticework-structures of 2D energy-fields. There is no special inertia related to rotary motion. Additional distortions in distortion-fields, related to instantaneous linear motion of 3D matter-particles in a rotating macro body, have associated inertia. In case of linear motion, additional distortions in matter-field of a macro body are transferred in same direction. They have an average value and a definite linear speed corresponding to their magnitudes.

However, distortions of latticework-squares in distortion-field of each molecule of a rotating macro body have different magnitudes and directions. They have opposite natures on opposite sides of centre of rotation of macro body. Instantaneous linear motions of different molecules in a rotating body vary widely in magnitudes and direction. They cannot have an average value or definite direction. Inertial actions on 3D matter-

particles of a rotating macro body changes from instant to instant. There are no lasting inertial actions on them. Rotational inertial action depends on and lasts only as long as 'centripetal forces' (due to rigidity of macro body) on rotating macro body lasts. Hence, inertia of rotary motion cannot be directly measured. Instead, a similar attribute, called 'moment of inertia', (mass moment of inertia, rotational inertia, angular mass, etc.) is indirectly estimated.

Each 3D matter-particle, in a rotating macro body, is considered as moving in straight-line path and its inertia (mass) is determined. Further, moments of resistance (mass) about centre of rotation for each 3D matter-particle in rotating macro body can be established. Average of moments of all 3D matter-particles in rotating macro body is its moment of inertia. Moment of inertia of a rotating body is equivalent of 'mass' of a macro body, with respect to its linear motion. It is a property of universal medium, described with respect to spin axis. Both, mass and moment of inertia are measures of resistance to change of state of respective motion of a macro body. Inertia describes resistance to change of state of motion with respect to straight-line motion in the direction of action of external effort. Moment of inertia describes resistance to change of state of rotary motion with respect to centre of matter-content of macro body.

Hence, moment of inertia of a rotating body may be taken for equivalent of moment of total additional work in its matter-field or matter-content of a rotating macro body about its central axis. Moment of inertia is additive. It is the sum of moments of all basic 3D matter-particles in a macro body about a reference-spin axis. Part of a rotating macro body has corresponding part of moment of inertia. It is a functional (and mathematical) term that represents moment of whole matter-content of a macro body about central spin axis. It is applicable only to pure rotary motion of a macro body that has no translational motion.

Moment of inertia of a macro body is preserved under all conditions (as long as parameters of macro body are maintained constant). It has only one reference axis of spin and that passes through centre of macro body's matter-content, in the plane of rotation.

However, in contemporary mechanics, moment of inertia of a macro body is used in wider context. Moment of inertia of a macro body is defined as average moment of its 3D matter-particles about pre-determined axis of rotation (within or without the macro body). This definition essentially includes certain inertia due to translational motion of macro body, also. Hence, magnitude and direction of moment of inertia depends on choice of reference spin axis or centre of curvature of curved path, directions of external efforts and shape of macro body. Product of moment of inertia and angular velocity of a rotating macro body gives its angular momentum.

5.4.3. Angular momentum:

Angular momentum is a property, related to rotating macro body or a macro body moving in circular path, representing its rotational inertia about an axis. It shows ability of macro body to continue its angular motion at a constant rate, presumably, without external effort (torque) on it. Angular momentum may be classified into two types.

One type of angular momentum is related to rotational motion of a macro body about its centre of matter-content in the plane of rotation. Inertial component of angular momentum is supplied by additional angular distortions, invested in matter-field of a rotating macro body. Latticework-structure of 2D energy-fields in macro body's matter-field transfer additional distortions in presumed circular paths. As long as rigidity of macro body is preserved, magnitude or direction of this part of additional work can be changed only by investment of additional work by external efforts, acting as couple. This part of additional work is preserved in macro body's matter-field, irrespective of any other movements the macro body may acquire.

Generally, macro bodies in solid state have higher viscosity. This keeps integrity of a macro body under stable conditions. Hence, every matter-particle in a rotating solid macro body moves in circular path about macro body's centre of rotation. Viscosity of body-material provides ample 'centripetal force' on its 3D matter-particles to keep them in their circular paths. As this 'centripetal force' is inherent in solid macro body, its actions are usually ignored, unless spin speed of macro body is very high or radial size of macro body is very large.

In cases of spinning macro bodies, angular momentum is derived by relating its moment of inertia with their angular velocities. In this case, angular momentum is one of rotating macro body's real parameter.

$$\text{Magnitude of angular momentum} = I\omega$$

Where I is moment of inertia of macro body about its spin axis through centre of matter-content in the plane of spin motion and ω is angular speed of its spin motion.

Angular momentum characterizes rotary inertia of a macro body about its axis of rotation through centre of its matter-content. Since linear motion of spinning macro body is not considered during determination of its angular momentum, value determined corresponds to a relative reference frame with respect to centre of rotation of macro body, which is assumed static in space. Linear motion of rotating macro body moves its centre of rotation, away from center of its matter-content, by distance proportional to linear speed. Even then magnitude and direction of angular momentum of rotating body is not affected.

In a rotating rigid macro body, 'centripetal force' is provided by adhesion within it, between its 3D matter-particles. Since this effort is always present, as long as rotating

macro body maintains its integrity, magnitude of its angular momentum obeys law of conservation of angular momentum.

Second type of angular momentum is related to linear motions of a macro body in circular path, about an axis, assigned by observer. Usually, when angular momentum of a macro body, moving in circular path, is considered, its rotational inertia, as explained above, is neglected. As angular momentum due to rotation and angular momentum due to linear motion in curved path are distinctly separate, this omission does not make any discrepancy in practice.

Angular momentum of a macro body, moving in curved path, about a point (in an inertial frame) is moment of the macro body's linear momentum about that point of reference. Hence, angular momentum of a macro body is also known as moment of momentum. Angular momentum is derived by relating linear momenta of all its 3D matter-particles to axis of rotation. Sum of angular momenta of all its 3D matter-particles gives angular momentum of macro body about reference axis. It is equal to the product of moment of inertia of macro body and its angular velocity about axis of rotation. Angular momentum is not one of macro body's real parameter. Moment of inertia of a macro body depends on the location of its axis of rotation. Magnitude of angular momentum depends on the choice of observer in selecting axis of rotation. It is related more to relative location of macro body's spin axis than to macro body.

We shall consider a macro body, moving in a circular path, whose centre of rotation is outside the macro body. Since all inertial motions are in straight lines, to move a macro body in circular path, it is imperative that a 'centripetal force' of constant magnitude should act continuously on it. Although parameters of circular motion appear steady, theoretically, it cannot be termed as a steady state of motion. Continuous action of 'centripetal force' necessitates uninterrupted linear acceleration of macro body towards its centre of rotation. Angular momentum can be sustained only as long as action of 'centripetal force' is present without affecting radius of circular path.

In order to satisfy 'balance of efforts' during steady state of angular motion of a macro body in circular path, real effort ('centripetal force') acting continuously on macro body is presumably neutralised by an imaginary 'centrifugal force' in opposite direction. This may help mathematical derivations (where angular momentum is a vector quantity, requiring specification of both a magnitude and a direction for its complete description) but does not represent reality of actions. Hence, angular momentum of a macro body, moving in circular path, is an assumed quantity under imaginary conditions.

If a macro body's axis of rotation is outside its body-limits, its angular momentum has to be considered, as in the case of angular momentum for macro bodies moving in circular path. In cases of spinning macro bodies moving in curved paths, their (a) angular momentum due to spin motion, (b) angular momentum due to motion in curved path and

(c) momentum due to linear motion remain distinctly separate. In each case, additional work associated with macro body maintains its distinctive identity in macro body's matter-field. Changes in any one of them cannot vary the other two. However, resultant additional distortions move macro body's 3D matter-particles and motion of macro body may appear to an observer as a resultant of all motions.

A macro body, moving in a circular path, acts exactly in the same manner as a macro body, moving in a straight line. Inertial action on it is the same as that of inertial action on a macro body moving in a straight line. Thus, law on inertia (in its present context) need not have any qualification for state of (motion of) macro body or direction of macro body's motion. The law can be restated, as 'A matter-body will continue to be in a steady state (of motion) until influenced by external efforts.' It is equally applicable on all 3D matter-bodies whether in state of rest, motion in linear direction or motion in circular path.

A macro body should be considered as a union of its constituent 3D matter-particles. Present laws require their qualifications, only because whole macro body is considered as a single unit, instead of a composite unit of 3D matter-particles and an effort is presumed as applied to 'center of mass' of macro body. This view should be changed to consider a macro body as composed of numerous 3D matter-particles and an external effort as being applied by universal medium directly on to each of basic 3D matter-particles of a composite macro body.

5.5. 'Centrifugal force':

A macro body, without translational motion, rotating at a constant angular velocity, is in a stable state of motion. Additional distortions in its matter-field, facilitating rotary motion are transferred in presumably circular paths to maintain constant spin speed. Inertia of universal medium, about rotating macro body, maintains direction and magnitude of macro body's motion. Hence, a separate action by 'centrifugal force' is not required to explain macro body's rotary motion. However, when rotary motion of a rotating macro body is analyzed in terms of linear motions its individual 3D matter-particles, 'centrifugal force' will come in, to play as described for motion of a macro body in circular path.

A macro body, moving under inertial action, has certain magnitude of additional work, invested in its matter-field. That is, the macro body has certain quantity of kinetic energy stored in its matter-field. 'Centripetal force' on macro body also invests additional work in association with it, to curve its path. 'Centripetal force' also stored certain quantity of kinetic energy of its own, into macro body's matter-field. As there is no change in 'mass' of macro body, according to present laws, combined kinetic energy, from both sources, should have increased linear speed of matter-body in its curved path. This

does not happen. This is where; an imaginary effort, called 'centrifugal force', comes to rescue the situation and provides an explanation. It is not logical. An imaginary 'force' cannot overcome a real effort.

In contemporary theories, in order to balance mathematical equations on angular motions, a pseudo-effort called 'centrifugal force' is used. This imaginary 'force' is often considered as 'real inertial-effort' acting on macro body moving in curved path. 'Centrifugal force' is used to account for departure of macro body from its curved path. In case of rotating macro bodies, for easier explanations, it is often considered that 'centrifugal force', of equal magnitude but of opposite direction, to 'centripetal force' is always present in the system.

As it is an inherent nature of universal medium to transfer additional distortions in linear direction, inertial actions of universal medium about a macro body tend to prevent deflections (curvatures) of macro body's linear path. At any instant, a macro body moves in a straight-line path. With respect to circular path, macro body (moving in a straight-line path) appears to move outwards. In order to maintain curvature of circular path, it is necessary to alter direction of additional distortions in macro body's matter-field. A real effort is required to invest additional distortions, which may alter directions of existing additional distortions in matter-field of macro body. This external effort is 'centripetal force'.

In order to qualify steady state of motion, a moving macro body should have no actions on it. It should be moving at constant (linear) speed in straight-line path. That is, all external efforts on it should balance to provide nil resultant effort. This status is possible only for motion in linear path. However, under certain circumstances, macro body's regular motion along some other type of path (curved, circular, etc) may appear as a steady state of motion. It may simplify explanations if this apparently steady state of motion could be considered as real steady state of motion. This is an imaginary situation that can be satisfied only by invented components.

In order to balance external efforts, in various directions, on a macro body moving in circular path and thereby reduce magnitude of total resultant effort on it to nil value, imaginary 'centrifugal force', is assumed to act on macro body, in the direction opposite to 'centripetal force'. 'Centrifugal force' is then assumed to accelerate macro body by an equal magnitude as that is provided by 'centripetal force', but in opposite direction. Assumed neutralisation of acceleration due to 'centripetal force' by opposing acceleration by 'centrifugal force' is considered to prevent movement of macro body towards centre or its circular path. Having efforts in opposite directions (in perpendicular direction to their instantaneous linear paths), leaves macro body to pursue its linear motion at constant linear speed in circular path, around centre of rotation at a constant angular speed.

'Centrifugal force' is an assumed quantity (peculiar to a rotating macro body or a macro body moving on a circular path) that has same magnitude and dimensions as 'centripetal force' but apparently acts in opposite direction. 'Centrifugal force' is invoked by an observer to maintain validity of Isaac Newton's second law of motion in a rotating (or otherwise accelerating at a constant rate) reference frame. In an inertial reference frame, 'centrifugal force' refers to a 'fictitious effort', which appears to act on a macro body moving in circular path (or constituents of a rotating macro body) and in a non-inertial reference frame; it refers to 'reaction' to 'centripetal force', by which a macro body moving in circular path (or constituents of a rotating macro body) influences other macro bodies. When used as a 'fictitious effort', it is useful in analyzing motion of matter-bodies in rotating reference frame (which prevents collapse of rotating macro body or keeps a macro body in its circular path).

'Centrifugal force' is an imaginary entity that appears in (non-inertial) rotational reference frames. Usually all attributes of a real effort are assigned to it. Since Newton's first law of motion is not applicable in rotational reference frame, a macro body moving in circular path is assumed to maintain its circular path when resultant of a system of external efforts on it is nil. This is achieved when magnitude of 'centrifugal force' is equal to magnitude of 'centripetal force' and they are in opposite directions. In a rotating reference frame, it is assumed that motion of a macro body under inertia (its steady state of motion) is along a circular path. 'Centrifugal force' appears only when there is 'centripetal force' present in a system. Magnitude of action of 'centrifugal force' is equal to magnitude of action of 'centripetal force' and it is in opposite direction. This is as good as ignoring 'centripetal force', all together.

Magnitude of imaginary 'centrifugal force', on a macro body moving in circular path, can be increased by increasing either (1) linear speed of macro body, (2) mass of macro body, or (3) radius of macro body's circular path (distance of macro body from the centre of its curved path). None of these methods produce, augment or create real efforts in the direction of 'centrifugal force'. Magnitude of imaginary 'centrifugal force', F, on a macro body, moving in a circular path at a (small) constant linear/angular speed is given by relation;

$$F = \frac{mv^2}{R} \qquad \textbf{(5/3)}$$

Where F is magnitude of 'centrifugal force', m is 'mass' of macro body, R is radius of circular path and v is tangential (average) linear speed of macro body.

'Centrifugal force' is usually expressed in terms of acceleration due to gravity.

Considering magnitude of 'centrifugal force' in terms of linear momentum of the body; where 'mv' is linear momentum of a macro body.

Splitting equation (5/3) for magnitude of 'centrifugal force';

$$F = (mv)\omega \qquad \textbf{(5/4)}$$

where 'ω' is angular speed of (linearly moving along its circular path) macro body about its centre of rotation and is equal to v/R.

Acceleration of outward departure of macro body from tangent to circular path,

$$d = v\,\mathrm{Tan}\,\omega / \text{unit time}$$

For small values of 'ω', $\omega = \mathrm{Tan}\omega$

$$d = v\mathrm{Tan}\omega\,/\text{unit time} = v\omega\,/\text{unit time}$$

$$F = \frac{mv^2}{R} = mv\frac{v}{R} = mv\omega = md\ /\ \text{unit time} \qquad \textbf{(5/5)}$$

Under assumption that macro body's linear speed is unaffected, its linear momentum remains constant. Magnitude of 'centrifugal force' on the macro body (moving along a circular path at constant linear speed) is equal to magnitude of 'centripetal force' (but in opposite direction). Change in magnitude of 'centripetal force' by help of external action is automatically reflected in magnitude of 'centrifugal force' and corresponds to change in magnitude of angular speed of macro body. Equation (5/4) remains valid only for values of angular speed of macro body, 'ω', much less than π/2 per unit time.

A macro body, moving in a circular path, is continuously changing direction of its velocity and therefore, accelerates towards centre of its circular path. External effort, required to produce this acceleration, is provided by a 'centripetal force'. If macro body is moving at constant linear speed, provided by inertia, 'centripetal force' is the only external effort acting on it. If 'centripetal force' is terminated, macro body (because of inertia) will appear to continue to move in a straight line, tangential to its previous circular path. Observation of this fact has led to assumption (without any logical reason) that direction of a macro body's instantaneous linear motion is always tangential to its circular path. This assumption is valid only in cases, where value of angle subtended by tangential displacement of macro body in unit time and trigonometric ratio of angular displacement of macro body are approximately equal.

Length of segment of a circle is assumed as the product of angle subtended by it at centre of circle and length of circle's radius. Hence, instantaneous tangential linear speed of a macro body, moving in circular path, is assumed as the product of angular speed (in radians) and radius of its circular path. It may be noted that; however small a segment of a curve is, its length is different from length of tangent (enclosed by angle subtended by the segment) at any point on the segment. For all practical purposes, involving small macro bodies moving in curved paths of reasonably large radius, calculations based on these assumptions do not make observable differences. However, if macro body involved

is very large with reasonably large radius of curvature of its circular path or macro body is very small with small radius of curvature of its path, considerable discrepancy will appear in the result.

5.5.1. Bucket argument revisited:

Isaac Newton's 'bucket argument' was designed to show that true rotational motion could be defined only with respect to absolute space (a static universal medium). It cannot be defined with respect to surrounding matter-bodies, whatsoever states of motion they have. Even if whole universe (surrounding a bucket of water on earth's surface) rotates about the bucket, water surface in the bucket will remain flat, unless the bucket itself has a true spin motion with respect to an absolute reference. [Flatness of surface is subject to gravitational attraction on water in bucket]. Real spin motion of bucket with water in it is bound to change shape of upper surface of water in bucket.

Further mathematical analysis has pointed towards a real action by imaginary 'centrifugal force'. It is not logical for imaginary efforts to cause real action. However, analysing actions of 3D matter-particles of water-body (in rotating bucket with respect to universal medium) by work associated with them (instead of equilibrium of 'forces' on it) can give logical explanation of actions, without use of imaginary 'centrifugal force'. Changes in the shape of water surface in a spinning bucket are produced by two independent actions.

One of the actions is produced by additional work associated with motion of 3D matter-particles of water-body, moving in circular path, in conjunction with additional work associated with gravitational attraction on 3D matter-particles towards earth. Other action is produced by additional work associated with 'centripetal force' by rigid bucket on water-body.

For the time being, we may neglect the container and use rotary motion of a fluid macro body for discussion. Intrinsic work about a macro body creates and develops constituent 3D matter-particles and sustains integrity and stability of macro body. State of motion of a macro body, as a whole, depends on additional work associated it, in its matter-field. Motions of 3D matter-particles may represent additional works, associated with each action on and about water-body. In this paragraph, we may neglect intrinsic part of total work associated with macro body and consider only additional work, which is responsible for macro body's motions and deformations, as sole additional work associated with it. Since 'force' is mathematical relation between work and displacement, action of effort or additional work invested in matter-field of macro body may be represented by its motion in direction and magnitude.

Direction of instantaneous motion of 3D matter-particle of a rotating macro body (away from centre of rotation) is deflected away from tangent to circular path traced by it

(as explained below). If rotating macro body is fluid (or solid of lower viscosity), inertial actions on it tend to spread its material content radially, in the plane of its rotation. 3D matter-particles, attempting to move away from center point, are resisted by cohesive efforts ('centripetal forces') within macro body. Magnitudes of radial motions of 3D matter-particles are proportional to their (derived) tangential linear speed.

A fluid macro body has low rigidity and its 3D matter-particles are free, up to an extent permitted by viscosity of the fluid, to move in relation to neighbouring 3D matter-particles. 3D matter-particles nearer to point of action of an external effort, usually, move faster than 3D matter-particles away from point of action of external effort. 3D matter-particles, at the point of action of external effort, are moved directly by 'force-applying mechanism' and nearby 3D matter-particles are pulled along with faster moving 3D matter-particles by adhesion between them. Hence, (derived) tangential linear speed of a 3D matter-particle in a rotating fluid macro body need not always be in proportion to its distance from point of application of external effort.

If fluid macro body (rotating in a plane parallel to its surface − horizontal plane) is on or near the surface of a larger macro body, rotating fluid macro body is under influence of gravitational attraction towards larger macro body, in addition to inertial actions about it due its rotating motion. Gravitational attraction on fluid macro body's 3D matter-particles tends to move them towards larger macro body, in a direction perpendicular to their motion in circular paths, in this case, downward. Now, each 3D matter-particle of rotating fluid macro body is under two independent motions. They are;

(1) Angular motion in horizontal plane, about centre of rotation. This may be resolved into two components;

a) Angular motion about centre of rotation subscribing to linear motion, tangential to its curved path.

b) Linear outward motion, away from centre of rotation, in the plane of rotation. (We shall consider this component, when fluid macro body in a container is considered)

(2) Linear motion in vertical plane, due to gravitational attraction towards larger macro body.

If 3D matter-particles of fluid macro body were free to move downwards (towards larger macro body due to gravitational attraction), magnitudes of their displacements in vertical planes would have been equal for all of them. Hence, additional work invested about each 3D matter-particle (in downward direction) is equal in magnitude. This is because, irrespective of actual displacement, magnitudes of acceleration due to gravitational attraction are equal on all of them.

Magnitudes of additional work (rate of displacement) in horizontal plane, produced by rotational motion, are proportional to angular speeds of 3D matter-particles. Resultant directions and magnitudes of additional work about 3D matter-particles depend on their angular speeds and gravitational attractions on them. Greater angular speed of a 3D matter-particle reduces rate of its displacement towards larger macro body, due to gravitational attraction. Lower angular speed of a 3D matter-particle increases rate of its displacement towards larger macro body, due to gravitational attraction.

If fluid macro body is in a container, in static state, its 3D matter-particles cannot have relative displacement towards larger macro body. However, in a spinning fluid macro body, changes in magnitudes of additional work associated with matter-particles (actions equivalent to magnitudes of possible displacement) can make changes in their locations relative to each other. Relative positions of 3D matter-particles, situated along radial lines on the surface of fluid macro body determine shape of its upper body-surface.

If rotating effort (cause of torque) is applied near periphery of fluid macro body (like, liquid kept in a spinning container) placed on the surface of another larger macro body, 3D matter-particles nearer to its periphery have greater angular speed (with corresponding higher tangential linear speed) compared to 3D matter-particles nearer to its centre of rotation. Consequently, resultant additional work / displacement of 3D matter-particles nearer to periphery of fluid macro body have lesser deflection towards larger macro body compared to resultant additional work / displacement of 3D matter-particles nearer to centre of rotation of fluid macro body.

Difference in magnitudes of deflection of resultant additional work, exhibited by probable displacements (corresponding to additional work) creates variation in compression experienced at different parts of fluid macro body. Rotating fluid macro body has lower downward pressure nearer to its periphery and higher downward pressure, nearer to center of its rotation. In order to reach equilibrium state, fluid macro body's upper surface (away from larger macro body) assumes concave shape. Surface of fluid rotating macro body, nearer to periphery, rises above original surface level and surface nearer to centre of rotation falls below original surface level, as seen in 'whirlpools' or as seen in 'Newton's bucket experiment'.

Figure 5.12 shows part of surface of a fluid macro body (between two radial lines marked in grey dashed lines) in a container, placed on or near the surface of a large macro body. 'a', 'd', 'g' and 'j' are few 3D matter-particles of fluid macro body, near its surface. 3D matter-particle 'j' is near outer periphery and others are evenly placed nearer to centre of rotation of fluid macro body.

Let an anti-clockwise torque, acting at its periphery, rotate fluid macro body. Initially, outermost layer of fluid macro body attains angular motion. 3D matter-particle j is carried along curved path jk. As this layer is rotated, friction between subsequent layers tends to

turn whole of fluid macro body along with outer layer. However, due to low viscosity of fluid, fluid macro body picks up angular motion, gradually. First, outer layer near its periphery starts to rotate and this rotary motion is transferred gradually to inner layers of fluid macro body. At any instant, outermost layer has highest angular speed. Angular speeds of inner layers, towards centre of rotation, gradually reduce.

Curved arrows, 'ab', 'de', 'gh' and 'jk', show magnitudes of additional works associated with distortion-fields of 3D matter-particles, a, d, g and j, respectively, corresponding to their tangential linear speeds subscribing to their angular motions. Magnitudes of additional works associated with gravitational attractions on all matter-particles in fluid macro body are equal and they are represented by downward arrows, 'bc', 'ef', 'hi' and 'km', towards large macro body. Resultant of 'ab' and 'bc' is 'ac', resultant of 'de' and 'ef' is 'df', resultant of 'gh' and 'hi' is 'gi' and resultant of 'jk' and 'km' is 'jm'. Curved arrows in dotted lines, ac, df, gi and jm are in planes inclined to surface of fluid macro body.

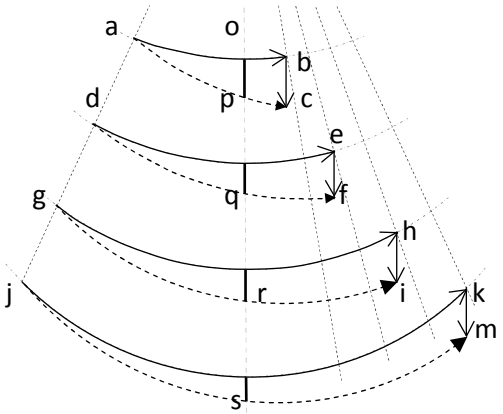


Figure 5.12

If 3D matter-particles were free to move downwards, their resultant motions would have matched with resultant additional work associated with them, along arrows 'jm', 'gi', 'df' and 'ac'. Considering 3D matter-particles along a radial line os (at the centre of figure), magnitudes of resultant additional works associated with them (corresponding to probable displacements) in downward direction are shown by thick lines 'p', 'q', 'r' and 's'. They show relative magnitude of downward displacement of matter-particles, when they reach central radial line os, shown in figure.

Magnitudes of vertical displacements 'p' > 'q' > 'r' > 's'.

Downward deflections of probable paths of 3D matter-particles increase as their distances from centre of rotation reduce. Tendency for unequal vertical displacements of 3D matter-particles create internal pressure within fluid macro body. Internal pressure of fluid macro body equalizes by varying its upper surface level. To reach equilibrium, surface of fluid macro body assumes appropriate curved shape. 3D matter-particles nearer to centre of rotation have greater downward pressure on them. 3D matter-particles farther from centre of rotation have lesser downward pressure on them. 3D

matter-particles nearer to centre of rotation depress by greater magnitude to raise matter-particles nearer to outer periphery and form concave shape on surface of fluid macro body.

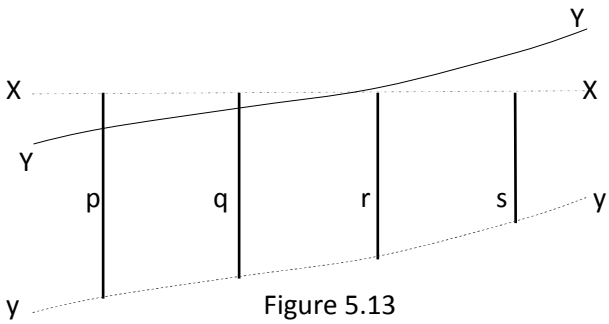


Figure 5.13

Figure 5.13 shows part of cross section of fluid macro body in a rotating container. Left-hand side of figure of part of fluid macro body is towards centre of rotation and right-hand side is towards its periphery. Dashed line XX is a radial line on its surface, when fluid macro body is not rotating. Thick vertical lines, 'p', 'q', 'r' and 's' show probable depth, to which fluid macro body's surface could be depressed due to rotary motion. Curved dotted line 'yy' joins points of equal internal pressure within fluid macro body, when it is spinning. Since volume of fluid macro body cannot be reduced, its top surface on one side of centre of rotation reaches resultant level as shown by curved black line, YY. Similar curvatures are formed along every radial line on surface of fluid macro body. Surface nearer to periphery rises and surface nearer to centre of rotation falls to create a concave surface.

As fluid macro body is in a container and viscosity of fluid macro body is low, there no rigid contact between them. Lack of rigid contact paves way for relative motion of fluid macro body with respect to container, which is bound to cause additional efforts on fluid macro body. Let us consider water in a bucket situated on surface of earth. When bucket is in steady state of linear motion with respect to earth, surface of water in the bucket may be considered as flat. Let us spin the bucket. As bucket starts to spin, friction between bucket and water body initiates spin motion of water in it. Rotational speed of water body towards centre of rotation diminishes gradually. Difference in angular speeds of matter-particles in water cause surface of water to form concave shape as explained above.

In addition, as fluid macro body is contained, free motion of its 3D matter-particles are restricted within the container. Container restricts outward motion of 3D matter-particles in horizontal plane. Container exerts reactive effort on 3D matter-particles to neutralize their outward component of angular motion. This effort, 'centripetal force', is a real effort and hence it can invest additional work in matter-field of fluid macro body. Additional work, introduced by 'centripetal force' neutralizes certain part of additional work associated with angular motion of 3D matter-particles in horizontal plane. Reduction

in outward additional work (due to rotary motion) by inward additional work (invested by 'centripetal force') not only compensates for removal of outward displacements of 3D matter-particles but also displaces them inward, towards centre of rotation, to maintain steady curvatures of their paths.

Rigid container restricts periphery of rotating fluid macro body, within the container. Tendency of 3D matter-particles to move outward tends to press on container wall and thus increase compression in fluid macro body near container wall. Magnitude of compression is related to angular speed of 3D matter-particles. 3D matter-particles nearer to periphery of fluid macro body experience greater compression and 3D matter-particles nearer to centre of rotation experience lesser compression. In order to reach equilibrium state, surface of fluid macro body, near and towards container wall rises and curve surface of fluid macro body into concave shape. Magnitude of this curvature is in addition to magnitude of concave curvature formed by rotary motion of fluid macro body. This action, in a non-inertial reference frame, refers to 'reaction' to 'centripetal force', applied by container, which restricts outward motion of 3D matter-particles of fluid macro body.

From above explanations, it can be seen that concave shape of water surface, obtained during 'bucket experiment' is due to differences in rotational speeds of 3D matter-particles and internal compression caused by 'centripetal force', provided by rigid container. These are the real causes of changes in shape of water surface in bucket experiments, rather than assumed real actions by fictictious 'centrifugal force'.

If rotating effort (cause of torque) in fluid macro body (on the surface of another larger macro body) is applied near its centre (like; a fluid body spun by an impeller at its centre), its 3D matter-particles nearer to periphery have lower angular speed compared to matter-particles nearer to its centre of rotation. Rotating mechanism at the center provides rotating effort and inertia of fluid macro body (and friction from static container) provides resistance to rotation. Rotational speed of fluid macro body towards its periphery diminishes gradually.

Consequently, resultant additional work / displacement of 3D matter-particles nearer to periphery of fluid macro body have greater deflection towards larger macro body compared to resultant additional work / displacement of 3D matter-particles nearer to centre of rotation of fluid macro body. Difference in magnitudes of deflection of resultant additional work, exhibited by probable displacements (corresponding to additional work) creates variation in compression experienced at different parts of fluid macro body. Rotating fluid macro body has greater downward pressure nearer to its periphery and lower downward pressure, nearer to center of its rotation. In order to reach equilibrium state, fluid macro body's upper surface (away from larger macro body) assumes convex shape. Surface of rotating fluid macro body, nearer to its centre of rotation, rises above

original surface level and surface nearer to periphery falls below original surface level, as seen in cyclones. Tendency of central region to rise enhances any other lifting effort, present in central part of fluid macro body.

Figure 5.14 shows part of surface of a fluid macro body (between two radial lines marked in grey dashed lines) in a container, placed on/near the surface of a large macro body. ‘a’, ‘d’, ‘g’ and ‘j’ are few 3D matter-particles of fluid macro body, near its surface. 3D matter-particle ‘j’ is near outer periphery and others are evenly placed nearer to centre of rotation of fluid macro body.

Fluid macro body is rotated in anti-clockwise direction (looking from top) by an impeller situated at its centre. As impeller rotates, it tends to turn fluid macro body also along with it. However, due to low viscosity of fluid macro body, it picks up rotating motion, gradually. First, the layers near centre start to rotate and this rotary motion is transferred gradually to outer layers of fluid macro body. At any instant, inner most layer (nearest to rotating impeller) has highest angular speed. Angular speeds of outer layers towards periphery of fluid macro body gradually reduce.

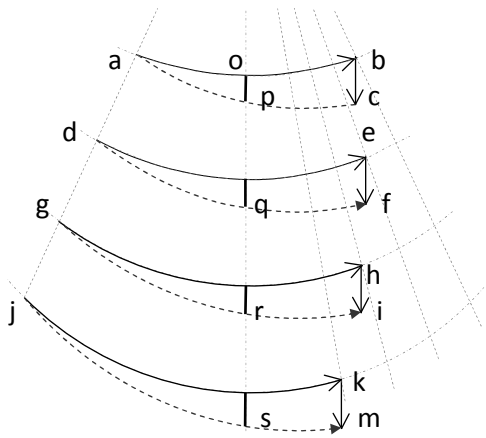


Figure 5.14

Curved arrows, ‘ab’, ‘de’, ‘gh’ and ‘jk’, show magnitudes of additional works associated with distortion-fields of 3D matter-particles, a, d, g and j, respectively, corresponding to their tangential linear speeds subscribing to their angular motions. Magnitudes of additional works associated with gravitational attractions on all matter-particles in fluid macro body are equal and they are represented by downward arrows ‘bc’, ‘ef’, ‘hi’ and ‘km’, towards large macro body. Resultant of ‘ab’ and ‘bc’ is ‘ac’, resultant of ‘de’ and ‘ef’ is ‘df’, resultant of ‘gh’ and ‘hi’ is ‘gi’ and resultant of ‘jk’ and ‘km’ is ‘jm’. Curved arrows in dotted lines, ac, df, gi and jm are in planes inclined to surface of fluid macro body.

If 3D matter-particles were free to move downwards, their resultant motions would have matched with resultant additional work associated with them, along arrows ‘jm’, ‘gi’, ‘df’ and ‘ac’. Considering 3D matter-particles along a radial line os (at the centre of figure), magnitudes of resultant additional works associated with them (corresponding to probable displacements) in downward direction are shown by thick lines ‘p’, ‘q’, ‘r’ and ‘s’.

They show relative magnitude of downward displacement of matter-particles, when they reach central radial line os, shown in figure.

Magnitudes of vertical displacements ‘p’ < ‘q’ < ‘r’ < ‘s’.

Downward deflections of probable paths of 3D matter-particles increase as their distances from outer periphery reduce. Tendency of unequal vertical displacements of 3D matter-particles create internal pressure within fluid macro body. Internal pressure of fluid macro body equalizes by varying its upper surface level. To reach equilibrium, surface of fluid macro body assumes appropriate curved shape. Matter-particles nearer to centre of rotation have lesser downward pressure on them. 3D matter-particles farther from centre of rotation have greater downward pressure on them. 3D matter-particles nearer to outer periphery depress by greater magnitude to raise 3D matter-particles nearer to centre of rotation to form convex shape of top surface of fluid macro body.

Figure 5.15 shows part of cross section of fluid macro body, in a container and spun by an impeller at its centre. Left-hand side of figure of part of fluid macro body is towards centre of rotation and right-hand side is towards its periphery. Dashed line XX is a radial line on its surface, when fluid macro body is not rotating. Thick vertical lines, ‘p’, ‘q’, ‘r’ and ‘s’ show probable depth, to which fluid macro body’s surface could be depressed due to rotary motion. Curved dotted line ‘yy’ joins points of equal internal pressure within fluid macro body, when it is spinning. Since volume of fluid macro body cannot be reduced, its top surface on one side of centre of rotation reaches a resultant level as shown by curved black line, YY. Similar curvature is formed along every radial line on surface of fluid macro body. Surface nearer to periphery falls and surface nearer to centre of rotation rises to create a convex surface.

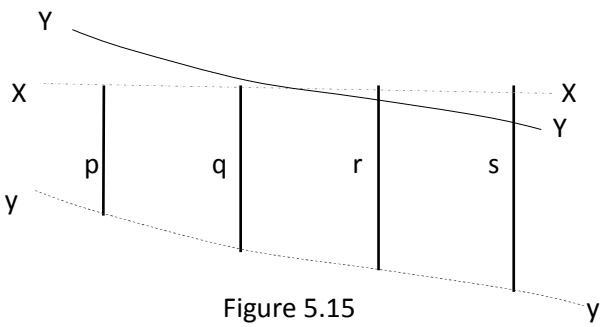


Figure 5.15

Reaction from container tends to oppose formation of convex surface and reduce its magnitude. Hence this phenomenon is more pronounced, where fluid macro body is not restricted by container, like open atmosphere.

Consider a case, where rotating effort is applied uniformly throughout fluid macro body. Angular speeds of all 3D matter-particles in rotating fluid macro body are equal. Fluid macro body’s surface tends to remain flat. No curvature is created at surface due to gravitational attraction towards larger macro body. However, outward radial component of linear motion along circular path will cause 3D matter-particles of fluid macro body to

spread outwards. If a rigid container restricts outward spread of fluid macro body, 'centripetal force', created at the restriction will produce subsequent internal compression of fluid macro body to curve fluid body's upper surface in concave shape.

If rotating fluid macro body in a container is situated in free space (where fluid macro body is not influenced by presence of any other large macro body), both free surfaces (perpendicular to plane of rotation) of fluid macro body tend to form concave shapes.

5.6. Motion in circular path:

Mechanism of motion, envisaged in this book, explains motion of a macro body in a circular path without assumption of imaginary 'centrifugal force' and with respect to an absolute reference frame. Currently, due to lack of an absolute reference, we are unable to determine true parameters of a macro body's motion. It is also understood that state of motion of a macro body has certain effects on its body-parameters. (E.g. Contraction of length in the direction of its linear motion.) Hence, it should be (at least, theoretically) possible to assess true parameters of motion of a macro body by checking symmetry of its body-shape.

In order to sustain a macro body's motion in a circular path, in a system unaffected by external influences, four conditions should be satisfied.

First: macro body should have an inherent linear motion at a constant linear speed.

Second: a constant external effort ('centripetal force') should act on macro body, in a direction perpendicular (restricted as given in sub-section 5.3.1) to tangent of circular path and towards centre of circular path, at all times.

Third: centre of circular path should be at rest with respect to an absolute reference.

Fourth: at any instant, magnitudes of instantaneous linear speed and future linear speed of macro body should be equal and constant.

These conditions can be satisfied only in systems as geometrically represented in figure 5.16. In figure 5.16, curved arrow POBT shows part of a circular path, whose centre is in a state of absolute rest. A linearly moving macro body is currently at position O on circular path: Arrow OA shows instantaneous displacement of macro body (in magnitude and direction), due to its present linear speed. Dashed line Y'Y represents instantaneous displacement of macro body (in magnitude and direction) under acceleration due to 'centripetal force' F. Arrow OB represents instantaneous displacement of macro body (in magnitude and direction) due to its future linear speed and line OC represents its average instantaneous displacement. Line OC is along tangent XX to curve POBT at O.

It can be seen that direction of present instantaneous linear motion of a macro body, moving in a circular path, is deflected outwards from tangent XX to circular path. [Reason

as to why instantaneous linear motion appears tangential to circular path is given below in sub-section 5.7.4]. Magnitudes of instantaneous displacements, due to present and future linear speeds, are equal and their directions are angularly deflected equally in opposite directions from tangent XX to circular path at current location of macro body. Magnitudes of angular deflections are proportional to macro body's 'centripetal acceleration' and curvature of its circular path.

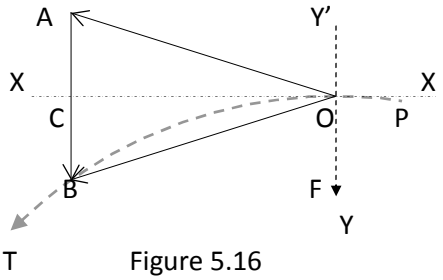


Figure 5.16

A system of displacements, as shown in figure 5.16, is essential to maintain circular path of a moving macro body. Magnitude of resultant displacement, OB, of displacement due to present instantaneous motion of macro body, OA, and displacement due to 'centripetal force', AB, is equal to magnitude of displacement that would have been the result of present instantaneous motion of macro body under inertia. There is no need for imaginary 'centrifugal force' in this system to account for macro body's departure away from centre of circular path. Departure is due to deflection of macro body's current linear motion from tangent, XX, to its circular path. Displacement due to 'centripetal force' not only accounts for neutralisation of outward departure of macro body's path from tangent, but also accounts for its inward departure from tangent to maintain circular nature of its path.

As the macro body is already moving at a constant linear speed, its matter-field is in stable state and contain sufficient additional distortions to sustain its constant linear speed. Action of 'centripetal force' invests additional distortions, in its direction of action, into macro body's matter-field to deflect macro body's path from straight line. It does not subscribe towards angular momentum of macro body due to rotary motion. Additional distortions due to 'centripetal force' subscribes towards angular momentum of macro body, due to its motion in circular path.

During a macro body's displacement towards centre of curvature of its path, certain part of additional work (producing its motion in straight-line path) is lost from its matter-field and certain quantity of additional work (producing its motion towards centre of curvature) is stored within its matter-field. These additional distortions together form resultant additional distortions in the matter-field, to produce macro body's motion in resultant direction of both motions. Due to forward motion of macro body, additional distortions invested into its matter-field in perpendicular direction to instantaneous straight-line path, are continuously lost from its matter-field. However, due to continuous action of 'centripetal force', equal amount of additional distortions are invested into matter-field to replace additional distortions, lost due to forward motion of macro body.

Instantaneous magnitude of additional distortions in the direction of 'centripetal force' is maintained constant, to sustain constant acceleration as well as constant velocity towards centre of circular path. Instantaneous changes in resultant direction of macro body's motion cause the curvature of its path.

In figure 5.16, let point O represents a small macro body. Additional work is invested into its matter-field by continuous action of 'centripetal force' (along the arrow Y'OY – shown as a pull-force) towards centre of curvature of its path. Y'Y is the direction of macro body's centripetal acceleration. Due to curvature of macro body's path, direction of 'centripetal force' with respect to macro body's direction of motion changes continuously.

Absence of centripetal acceleration would have taken macro body to point A, at the end of unit time. However, centripetal acceleration of macro body causes its displacement to point B at the end of unit time. Resultant motion of macro body is along OB and magnitude of resultant speed of macro body is represented by length of OB. Average linear speed of macro body, given by the average of linear speeds OA and OB, is equal to $OC = v$. Angle between tangent OC and direction of resultant motion OB is taken as angular speed, ω, of the macro body.

Radius of curvature of circular path, $R = v/\omega$ (for very small values of ω)

Magnitude of 'centripetal force' is F, m is mass of macro body (representing its matter-content) and a is macro body's centripetal acceleration. Additional work introduced by external effort ('centripetal force') is equal to its action on macro body, which is proportional to its acceleration, a, in the direction of effort. Considering motion of macro body in absolute reference frame (an inertial reference frame with respect to universal medium);

$$a = F \div m$$

Magnitude of additional work done about macro body (in perpendicular direction to its circular path at O) in unit time, due to centripetal acceleration;

$$AB = a \div 2$$

(ignoring constancy of proportion and putting, t = one unit in equation;

displacement = $at^2/2$)

At the end of unit time, macro body is displaced to position, B, which is the result of original additional work associated with macro body's inertial motion and additional work introduced by 'centripetal force' in unit time.

Let OA represent macro body's present instantaneous linear velocity, V, when it is at O;

$$OA = V \text{ units} \quad \text{and} \quad AB = a/2 \text{ units}$$

As long as linear speed of macro body and its centripetal acceleration remain constant, macro body moves in a circular path, POBT. Macro body appears in a steady state of motion. At the same time, system of efforts on macro body is neither balanced nor magnitude of external effort on it is nil. To move in a circular path, macro body's instantaneous linear speeds at all points on its path have to remain same, while magnitude of external effort also remains constant. Therefore, for motion in circular path, a macro body can appear in steady state of motion even while it is under continuous action of an external effort.

Therefore, future instantaneous linear speed, $OB = OA = V$

Average linear velocity of macro body, OC = v, which is tangential to circular path at point O.

In right-angled triangles AOC and BOC; Side OC is common to both, Side OA = Side OB, Angles ACO and BCO are right angles.The triangles are similar; Side AC = Side BC

$$\angle AOC = \angle {}^{AOB}\!/_{2} = \text{Angular speed}\,\omega$$

$$\text{Since } AB = a/2\,,$$

$$AC = BC = {}^{a}\!/_{4} = V \sin\omega \qquad \textbf{(5/6)}$$

Average linear speed of macro body along tangent to its path,

$$OC = v = V \cos\omega \qquad \textbf{(5/7)}$$

Macro body continues to move in a circular path. Direction of its present instantaneous linear motion, OA, is deflected away from tangent XX, by an angle equal to its angular speed.

Radial speed of macro body, required to maintain its circular path, by equation (5/6);

$$AB = AC + BC = \frac{a}{4} + \frac{a}{4} = \frac{a}{2} = 2\,V \sin\omega \qquad \textbf{(5/8)}$$

5.6.1. Momentum in circular motion:

Consider a small macro body O, moving in circular path, POBT, around a central point, to which the macro body is attached by a rigid link or string OY, as shown in figure 5.17. At any instant, natural inertial motion of macro body is in a straight line, slightly deflected outward from the tangent, XX, on its path. Action of 'centripetal force' displaces macro body sideways (towards centre of rotation) during its travel, to deflect its path.

Figure 5.17 (not to scale) represents displacements of macro body in unit time. It shows macro body at point O in its circular path, POBT. XX is tangent to circular path at O. OA represents macro body's probable displacement due to instantaneous linear speed, in unit time. OY is its probable displacement due to centripetal acceleration in unit time.

As the macro body is moving in a circular path, its future position, at the end of unit time, is at point B on circular path. However, original inertial action on macro body tends to take it to position A. This can be permitted only by an extension of rigid link. Therefore, natural inertial motion of macro body, due to its linear momentum, appears to attempt to increase length of rigid link, OY.

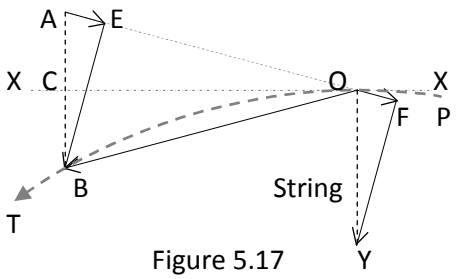


Figure 5.17

Cause of attempt to increase length of link is assigned to imaginary 'centrifugal force'. Attempted action by imaginary 'centrifugal force' is nothing but an apparent action derived from macro body's inertial linear motion. Inter-particle 'field force' that maintains rigidity of link resists attempt by inertial linear motion to move macro body to position A by stretching length of rigid link. This reaction acts to (apparently) pull macro body inward, towards centre of curvature of its path. Since production of reaction involves structural changes in matter-field of rigid link, it is a real effort. This external effort acts on macro body to curve its path and it is called 'centripetal force'.

Resolving displacement, OY, produced by 'centripetal force' into two components, we have one component, OF, in line with linear inertial motion of macro body, OA, and the other, FY, perpendicular to linear inertial motion, OA. Component, OF, in line with linear inertial motion is in opposite direction and hence its action is to reduce linear speed of macro body. Other component, FY, acting in perpendicular direction to linear inertial motion, displaces macro body to its new position, B, on curved path.

Component of action of 'centripetal force', OF = AE, that is against linear inertial motion of macro body, tends to reduce macro body's linear momentum. It invests additional work with macro body's matter-field in opposite direction to additional work, which produces macro body's inertial motion in straight line OA. Additional work corresponding to OF neutralises part of additional distortions producing linear inertial motion OA, by magnitude corresponding to AE. Total additional work in association with the macro body is reduced to correspond to linear displacement OE, in the direction of macro body's linear inertial motion.

At the same time, perpendicular component of action of 'centripetal force', FY = EB, displaces macro body to a new position, B. By doing so, macro body's linear momentum is restored to a value corresponding to macro body's current linear motion, OB, which is the same as macro body's linear momentum corresponding to its original linear inertial motion, OA. Additional work, corresponding to component FY, by action of 'centripetal force', EB, adds to remaining additional work in matter-field of macro body,

corresponding to OE. Total magnitude of resultant additional work in association with macro body, now corresponds to OB, which is equal to magnitude of additional work, originally associated with macro body. Combining additional work corresponding to FY (which is perpendicular to additional work corresponding to OE) changes direction of resultant additional distortions in macro body's matter-field and displaces macro body to position B on its circular path. In moving along a circular path, macro body's momentum is kept constant irrespective of continuous action of a 'centripetal force' to accelerate it towards centre of macro body's circular path.

A real external effort – the 'centripetal force' – continuously acts on macro body, moving in circular path. Action of this external effort is to introduce additional work in association with macro body. At the same time, due to macro body's constant change of direction of motion, it loses additional work associated with its linear inertial motion at the same rate as macro body receives additional work from action of 'centripetal force'. Therefore, magnitude of additional work, associated with a macro body, moving in circular path, remains constant. Continuous action by constant magnitude of 'centripetal force' preserves constancy of its linear speed and linear momentum in its circular path. Magnitude of original inertial action on macro body is preserved.

Work, constituted by distortions in universal medium, can be transferred only in straight lines. Additional work, producing inertial motion of a macro body at constant linear speed is transferred in straight line in the direction of its instantaneous linear inertial motion. Change of direction of macro body from its straight-line motion (due to action of 'centripetal force') moves macro body (partially) away from the region of additional distortions in universal medium, producing its linear inertial motion. Reduction in additional work reduces macro body's linear speed.

At the same time, 'centripetal force' introduces its own additional work in another direction. Part of additional work, introduced by 'centripetal force' is also lost from matter-field of macro body due to macro body's linear inertial motion. Matter-particles of macro body are moved simultaneously in directions of both sets of additional works. As matter-particles of macro body are moved in resultant direction, their displacements in universal medium create additional distortions in their new direction of motion. Part of additional work invested by action of 'centripetal force' and newly created additional work by displacement of matter-particles in resultant direction, compensate for losses and restore magnitude of total additional work associated with the macro body (every instant) to its original value. This is indicated by constancy of instantaneous linear speed of macro body.

Although there is continuous loss of additional work, associated with a macro body moving in circular path, at a constant rate, it is restored at the same rate by action of

'centripetal force'. This prevents any change in linear momentum of a macro body, moving in circular path.

In case of a macro body, moving in circular path, magnitude of its angular momentum is equal to the product of its linear momentum (product of its mass m and average linear velocity v) and perpendicular distance 'r' from centre to tangent (line in the direction of macro body's average linear motion) of circular its path and passing through macro body's centre of gravity.

Magnitude of angular momentum, L, of a macro body moving in a circular path;

$$L = m\,v\,r$$

where 'm' is mass (representing matter-content of macro body), 'v' is macro body's average linear speed and 'r' is radius of its circular path.

Use of 'r' in the equation facilitates to ignore continuous action by external effort – the 'centripetal force' – on macro body. Changing magnitude of 'centripetal force' on a macro body (moving in circular path) varies magnitude of its average linear speed 'v' and radius 'r' of its circular path. Currently, continuous action of 'centripetal force' (which is neutralised by assumed action by imaginary 'centrifugal force') is ignored and change in magnitude of radius 'r' is considered as the cause of change in average linear speed of macro body. This phenomenon is the basis of 'law of conservation of angular momentum'.

To find real angular momentum of a macro body, moving in circular path, it is necessary to consider parameters of macro body and parameters of its motion with respect to an absolute reference. Only real angular momentum can be considered as proportional to total additional work associated with a macro body. By considering additional work associated with matter-field of a macro body as the basis, radius of its circular path will not appear in the equation. Radius of curvature of circular path, R, may be calculated from macro body's angular speed, ω, and average linear speed, v, in absolute reference frame.

$$R = v / \omega$$

Angular momentum of a macro body, moving in circular (curved) path is derived by relating its linear momentum to an axis perpendicular to plane and through centre of its curved path. No singular macro body can remain static in space. Therefore, all references with respect to other macro bodies are relative references. Parameters of a macro body, moving in circular path, in relative reference frame cannot give its real angular momentum, corresponding to total additional work associated with it. A circular path in relative reference frame will not be a circular path in absolute reference frame. Behaviour of an independent macro body corresponds to its real parameters and real parameters can be obtained only in absolute reference frame.

Angular momentum of a macro body, moving in circular path, will become nil value on termination of action by 'centripetal force' on it. Macro body will be left only with its linear momentum. In other words, its angular momentum is not conserved. It will last only as long as the 'centripetal force' is active on it.

Work, associated with linear and spin motions of a macro body are entirely separate. Each one can produce only its type of motion. Consider a hypothetical macro body at absolute rest in space. It has no translational or spin motion.

Let a torque be applied on macro body. Work invested by torque, into matter-field of macro body, spins the macro body about its 'centre of mass'. 'Centre of rotation' coincides with 'centre of mass' of macro body. After removal of torque and stabilization of inertial motion, macro body is in a steady state of spin motion at constant angular speed. Magnitudes and directions of additional distortions in macro body's matter field maintain its constant speed of rotary motion. They can be modified only by additional work invested by another torque. Otherwise macro body's spin speed will remain constant irrespective of any other motion, imparted to it.

With respect to a straight line, passing through centre of rotation, every point (except centre of rotation) in macro body have translational motion in space. Their displacements may be resolved into two components, one component along the straight line through centre of rotation another component perpendicular to it. Resolved components in same direction on opposite sides of centre of rotation are in opposite directions. Macro body, as a whole, continues to stay without translational motion.

Let an external effort act on macro body. Work done by external effort in its matter-field provides macro body with translational motion in a straight line in space. Magnitude and directions of displacements of every point in macro body change. They are now be moving in resultant directions of linear motion and instantaneous linear displacement due to rotary motion. Let us call resolved components of displacements as horizontal and vertical components, with respect to direction of linear motion of macro body.

Horizontal components of their motions on one side of centre of rotation increase and on other side of centre of rotation they reduce. Vertical components of their motions on both sides of centre of rotation maintain their magnitudes without changes. Centre of rotation of macro body is that point in it, which has no translational motion. Due to changes in horizontal components of macro body's resultant motion, centre of rotation of macro body shifts to a different point in macro body.

Direction of shift of centre of rotation is in the direction, where linear motion of macro body and horizontal components of rotary motion are in opposite directions. As linear speed of rotating body increases, centre of rotation continues to shift in this direction. When centre of rotation is outside macro body, macro body appears to trace

wavy path in space. All constituent 3D matter-particles in macro body are moving in same direction, in curved paths, with oscillations about a median straight line. Even in this state of motion, magnitudes and directions of additional works, invested in macro body's matter-field for translational and spin motions maintain their independence from each other.

5.7. 'Centripetal force':

Consider a macro body, O, of constant linear speed, moving in a circular path, POBT, as shown in figure 5.18. Let OA represent magnitude of additional work in association with macro body's inertial motion (or its instantaneous present linear speed), V. AB is equal to magnitude of additional work introduced into macro body's matter-field (or macro body's displacement) due to action of 'centripetal force', F, represented by Y'Y. OB is magnitude of resultant additional work in association with (or instantaneous resultant linear speed of) macro body. Since OA = OB, macro body travels in a circular path, POBT. OC is macro body's average (tangential) speed, v, at any point on its circular path.

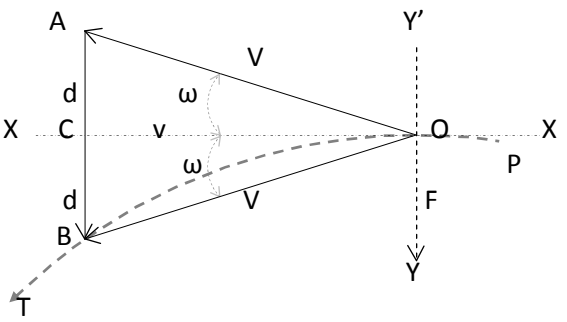


Figure 5.18

Let $AC = CB = d$ units , $AB = 2d$ units/sec , $OA = OB = V$ units/sec , $OC = v$ units/sec ,

$\angle AOC = \angle COB = \omega$ rad/sec and $\angle AOB = 2\omega$ rad/sec.

Angular speed of macro body in circular path is measured with respect to tangents to the path, POBT.

Angular speed of macro body, $\angle COB = \omega$ rad/sec

Total angular deflection of macro body's path from OA to OB, $\angle AOB = 2\omega$ rad/sec

From triangle AOC; $v \div V = \text{Cos}\,\omega$, $V = v \div \text{Cos}\,\omega$

$$d^2 + v^2 = V^2 = v^2 \div \text{Cos}^2\omega$$

$$d^2 = \frac{v^2}{\text{Cos}^2\omega} - v^2 = v^2\left(\frac{1}{\text{Cos}^2\omega} - 1\right) = v^2\left(\frac{1 - \text{Cos}^2\omega}{\text{Cos}^2\omega}\right) = v^2\,\frac{\text{Sin}^2\omega}{\text{Cos}^2\omega} = v^2\,\text{Tan}^2\omega$$

$$d = v\,\text{Tan}\omega\,,$$

Total radial displacement = $2d = 2v\,\text{Tan}\omega$

Let the 'centripetal acceleration' = a units/sec^2

Total displacement in unit time, $2d = a\frac{t^2}{2} = \frac{a}{2}$ (putting time, t = unit measure)

$$\therefore \frac{a}{2} = 2v \operatorname{Tan} \omega, \quad a = 4v \operatorname{Tan} \omega$$

Considering the action in inertial reference frame;

$$\text{External effort, } F = m\,a$$

where 'F' is magnitude of 'centripetal force' (external effort), 'm' is mass (neglecting effects of linear speed on mass of macro body) and 'a' is linear acceleration of macro body due to 'centripetal force'.

In case of a macro body, moving in circular path, 'centripetal force' is the only external effort, acting on it. Hence, magnitude of 'centripetal force', acting on macro body;

$$F = ma = 4mv \operatorname{Tan} \omega \qquad \textbf{(5/9)}$$

'Centripetal force' of this magnitude alone can maintain circular path of a linearly moving macro body. There is no need for an assumed 'centrifugal force'. Linear speed of macro body should remain constant and constant magnitude of 'centripetal force' must continuously act on the macro body.

If magnitude of 'centripetal force' is less than ($4\,m\,v \operatorname{Tan} \omega$), linear speed of macro body gradually increases and macro body will move away from centre of its circular path to trace larger circular path. If magnitude of 'centripetal force' is greater than ($4\,m\,v \operatorname{Tan} \omega$), linear speed of macro body reduces and it will gradually move towards centre of its circular path to trace a smaller circular path.

In rotational reference frame, magnitude of 'centripetal force' (equal and opposite to magnitude of 'centrifugal force') given by equation (5/4) is $F = (mv)\omega$. This equation is valid only for very small values of angular speeds, ω.

Irrespective of magnitude of angular speed, magnitude of assumed 'centrifugal force' determined by equation (5/4), is directly proportional to magnitude of angular speed of macro body. Should the angular speed of macro body approaches or exceeds (π / 2) radians per second per completed circular path, result given by equation (5/4) becomes illogical.

In inertial reference frame, magnitude of 'centripetal force' is given by equation (5/9) as $F = (mv)4 \operatorname{Tan} \omega$. This value may be taken as equivalent to assumed 'centrifugal force' on macro body. Here, magnitude of 'centripetal force' is related to linear momentum of macro body by a factor ($4 \operatorname{Tan} \omega$). Relation to 'tangent of angular speed' limits action of 'centripetal force' to macro bodies with angular speeds below (π / 2) radians per second per each completed circular path. When angular speed of macro body approaches (π / 2) radians per second per each completed circular path, magnitude of 'centripetal force' will approach infinite proportions.

This shows that as direction of external effort become perpendicular to direction of linear motion of the macro body, additional work associated with macro body and producing its linear motion will be lost from macro body's matter-field. Macro body's original linear motion will be lost along with distortions producing it. Macro body will be displaced in perpendicular direction to its original linear motion. It will no more respond to lost additional work from its matter-field. Therefore, angular speed of a macro body, moving in circular path is limited to much less than (π / 2) radians per second per each completed circular path.

If a spinning macro body is a mixture of 3D matter-particles of different materials of unequal matter-densities and of irregular sizes, 3D matter-particles of higher matter-contents (mass) tend to have outward radial motion at higher speed, compared to 3D matter-particles of lower mass. By equation (5/9), 'centripetal force' required to keep a matter-particle in its circular path is proportional to its 'mass'. Magnitude of 'centripetal force' that can be provided by a macro body depends on its consistency and it is common to all its 3D matter-particles.

For two matter-particles of different matter-contents (masses), moving in same circular path about macro body's centre of rotation, 'centripetal force' required by each of them is proportional to its mass. As magnitudes of 'centripetal force' on all 3D matter-particles of macro body are same, heavier 3D matter-particles tend to enlarge their circular paths, by moving away from centre of rotation. Outward motion of heavier 3D matter-particles is due to lower magnitude of 'centripetal force' on them than that is required to keep their circular path stable rather than due to actions of fictional 'centrifugal force' on them. This is the working principle of centrifuge mechanisms.

5.7.1. Reduction in 'centripetal force':

Reduction in magnitude of 'centripetal force' reduces its action on macro body. Less additional work is invested with matter-field of macro body. Macro body fails to deflect its path to suit motion in original circular path, as shown in figure 5.19. OY is magnitude of motion due to action of reduced 'centripetal force'. OF is resolved component of OY that acts in opposition to OA to reduce its resultant magnitude to OE, which is more than magnitude of OE in figure 5.18.

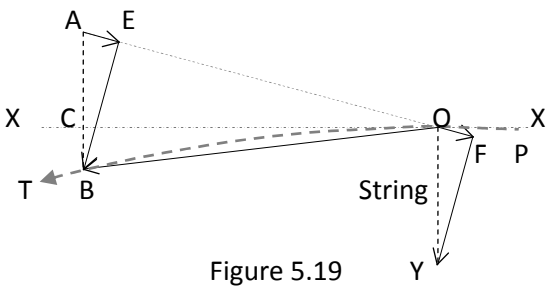


Figure 5.19

Macro body loses less additional work associated with its original linear inertial motion. Lower magnitude of additional work (invested with matter-field of macro body by reduced 'centripetal force') reduces deflection and magnitude of its resultant motion, OB,

from original inertial motion, OA. OB shows resultant motion of macro body in magnitude and direction. Macro body's new path, POBT, is deflected less from direction of its instantaneous linear motion, OA. Outward deflection of instantaneous linear inertial motion moves macro body away from centre of its original circular path to enlarge its circular path. Radius of circular path increases.

Magnitude of OB is less than that of OA. Instantaneous linear speed of macro body is reduced. Matter-content of macro body being the same, a reduction in its linear speed reduces macro body's linear momentum. Reduction in 'centripetal force' on a macro body moving in circular path, increases diameter of its circular path with corresponding reduction in macro body's instantaneous linear speed and linear momentum. Both these factors subscribe towards reduction in macro body's angular speed in its circular path.

5.7.2. Increase in 'centripetal force':

Increase in magnitude of 'centripetal force' enhances its action on a macro body. More additional work is invested with matter-field of macro body. Macro body deflects its path by greater magnitude than that is required to suit motion in original circular path, as shown in figure 5.20. OY is magnitude of motion due to action of enhanced 'centripetal force'. OF is resolved component of OY that acts in opposition to OA to reduce its magnitude to OE, which is less than magnitude of OE in figure 5.18.

Macro body loses more additional work associated with its original inertial motion. Greater magnitude of additional work (invested with matter-field of macro body by enhanced 'centripetal force') increases deflection and magnitude of its resultant motion, OB. OB shows resultant motion of the macro body in magnitude and direction. Macro body's new path, POBT, is deflected more from the direction of its instantaneous linear inertial motion, OA. Inward deflection of instantaneous inertial motion moves macro body towards centre of rotation of its circular path to contract its size. Radius of circular path reduces.

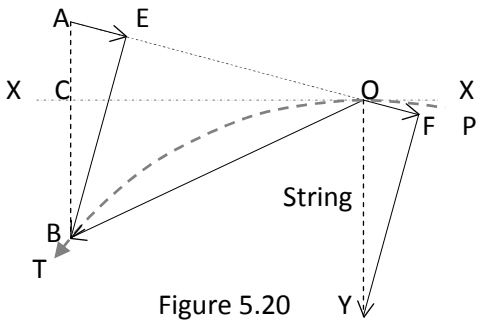


Figure 5.20

Matter-content of macro body being the same, an increase in its linear speed enhances macro body's linear momentum. Increase in 'centripetal force' on a macro body, moving in circular path, increases magnitude of resultant instantaneous linear speed of macro body in circular path and reduces diameter of its circular path. Macro body's linear momentum increases corresponding to its linear speed. Both these factors subscribe towards enhancement in macro body's angular speed in its smaller circular path.

Similar arguments hold good for linear momenta of every matter-particle in a rotating macro body. In this case, 'centripetal force' on matter-particles is continuously present, even when macro body is not rotating. It keeps integrity of the macro body.

5.7.3. Termination of 'centripetal force':

In calculations, involving a macro body's motion in a circular path, effects of inertia associated with 'centripetal force' on macro body, after termination of 'centripetal force' are not usually taken into consideration. It is assumed that as soon as 'centripetal force' is terminated, all effects due to this external effort also cease. This belief is based on observed path of a 3D matter-particle, detached from rim of a rotating wheel (or similar phenomena). Detached 3D matter-particle appears to move in tangential direction to its path, at the instant of its detachment. This is only an apparent phenomenon and it is not true direction of 3D matter-particle's instantaneous motion, until it is stabilised as inertial motion in straight-line path.

During an action, it takes inertial delay for an external effort to stabilise its effect on a macro body. Only after inertial delay, macro body reaches its stable state of motion. Hence, it is only logical to think that termination of an external effort also takes similar inertial delay to stabilise its effect on macro body's state of motion.

We shall consider effects due to termination of 'centripetal force' on a macro body (moving in circular path POBT as shown in figure 5.21), when macro body is at point O, by cutting the string attaching it to centre of circular path: [Figure 5.21 may be compared with figure 5.18]. In figure 5.21, arrow F in dotted line shows average 'centripetal force' and arrow AC shows radial displacement of macro body during inertial delay period.

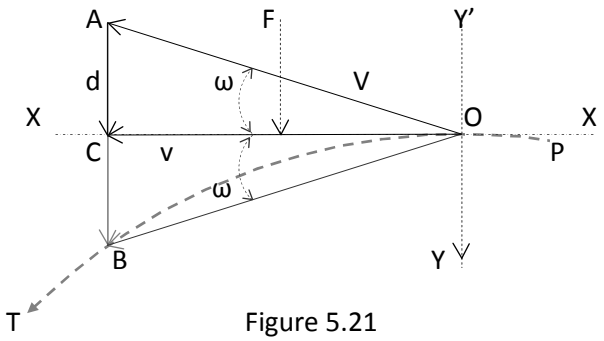


Figure 5.21

During inertial delay, after termination of 'centripetal force', additional work already introduced into matter-field of matter-body (at the instant of termination of 'centripetal force') continues to accelerate macro body towards centre of its circular path. Since 'centripetal force' is now terminated, magnitude of original acceleration due to additional work, introduced by 'centripetal force', is gradually stabilized and reduced. Stabilization will continue until all acceleration components of additional work, introduced by (now-removed) 'centripetal force' are lost from macro body's matter-field. As magnitude of acceleration becomes zero after inertial delay, we can take that average magnitude of

acceleration during inertial delay is equal to half the value of acceleration during action of 'centripetal force'.

Let rate of magnitude of additional work, invested in matter-field of macro body, due to 'centripetal force';

during macro body's steady state of motion in circular path = W units/sec

Magnitude of additional work in matter-field of macro body due to 'centripetal force', at the instant of termination of 'centripetal force' = W units

Magnitude of additional work in matter-field of macro body, due to 'centripetal force', at the end of inertial delay = 0

Average magnitude of additional work, due to 'centripetal force',

during inertial delay = W/2 units

As steady state of macro body's motion in circular path is terminated, its radial velocity and radial acceleration will no more be of constant values. Centripetal acceleration is proportional to magnitude of additional work (invested by 'centripetal force' before its termination) in macro body's matter-field.

Average centripetal acceleration during inertial delay = a/2 units/sec2

Let duration of inertial delay = t units of time

Using equation of linear motion, displacement = ½ at^2, where 'a' is linear acceleration; and 't' is time interval.

Displacement of macro body, due to reduced centripetal acceleration after termination of 'centripetal force', during inertial delay period = a t^2 / 4 units

Macro body attains its steady state of motion on completion of acceleration period and in the mean time; macro body is displaced by a distance, $d = {at^2}/{4}$ (shown by arrow AC), to point C on tangent XX through point O on circular path. At point C, macro body is no more under action by terminated 'centripetal force', to curve its path. It will continue to move in a steady state of linear motion under linear inertia associated with it, along OC, which coincides with tangent to curved path at point O. Magnitude of resultant linear speed of macro body, OC = v, is same as average linear speed of matter-body during its steady state of motion in circular path. This is the reason, why a macro body moving in circular path or a 3D matter-particle from a rotating macro body, released from 'centripetal force' moves in tangential direction to its circular path.

Original direction of macro body's instantaneous present linear motion is along OA, which is deflected outward from tangent, XX. Angular deflection of direction of instantaneous linear motion, OA, creates an illusion that matter-body is trying to move away from centre of curvature of its circular path. This apparent attempt is assigned to

action by an imaginary effort, 'centrifugal force'. Imaginary forces cannot act on a real macro body.

5.7.4. Tangential motion:

All 3D matter-particles of a rotating macro body travel in circular paths around spin axis of macro body. Figure 5.22 shows path of motion of a 3D matter-particle, just after it is detached from rotating macro body. Curved arrow POBD shows periphery of rotating macro body and arrow in the direction of its spin motion. We shall consider a 3D matter-particle O on periphery of rotating macro body.

At any instant, 3D matter-particle, O, at the periphery of a steadily spinning wheel simultaneously has two motions. (Here, a very small part of body-material is taken as a unit 3D matter-particle and motions of other individual constituent 3D matter-particles within the spinning wheel are ignored). One motion, OA, displaced by an outward angular deflection from tangent, XX, is provided by its linear speed along circular path, POBD. Another linear motion, OE, is displacement provided by 'centripetal force', F, due to viscosity of body-material, which maintains integrity of wheel.

Cause of 'centripetal force' may be any or all of various efforts by gravitation and 'field forces'. 'Centripetal force' accelerates 3D matter-particle towards centre of rotation of spinning wheel. In this state, system of spinning wheel is stable and 3D matter-particle at its rim moves in a circular path relative to centre of rotation of wheel. 3D matter-particle has a constant linear speed; it is simultaneously under constant radial velocity and constant radial acceleration. The word 'constant' indicates that numerical values of speed, velocity and acceleration do not vary.

In figure 5.22, grey curved line POBD shows part of circular path of 3D matter-particle O. Present instantaneous linear motion of 3D matter-particle at O is represented by

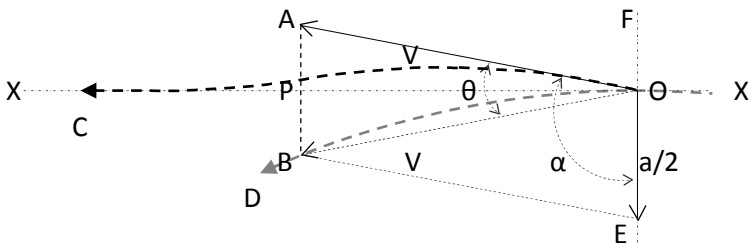


Figure 5.22

arrow, OA, which is equal to V (being displacement in unit time). Instantaneous lateral motion a/2, due to 'centripetal force' is represented by arrow, OE. Line XOX is tangent to circular path at O. Resultant instantaneous motion of 3D matter-particle, along its circular path, POBD, is shown by arrow, OB, in dotted line.

$$AB = OE = a/2, \quad OA = OB = V, \quad \angle AOB = \theta, \quad \angle AOE = \alpha$$

By parallelogram law of forces, in rectangle OABE,

$$OB^2 = OA^2 + OE^2 + 2 \times OA \times OE \times Cos\angle AOE$$

$$V^2 = V^2 + \left(\frac{a}{2}\right)^2 + 2V\frac{a}{2}Cos\alpha,$$

$$\left(\frac{a}{2}\right)^2 = -2V\frac{a}{2}Cos\alpha, \; a = -4VCos\alpha$$

$$\frac{a}{4V} = -Cos\alpha, \quad Cos(180 - \alpha) = \frac{a}{4V}, \qquad \alpha = 180 - Cos^{-1}\frac{a}{4V}, \; \angle AOP = \frac{\theta}{2} = \alpha - 90$$

Substituting value of α;

Outward deflection of present instantaneous linear motion from tangent to the curved path;

$$\frac{\theta}{2} = \left(180 - Cos^{-1}\frac{a}{4V}\right) - 90$$

$$\frac{\theta}{2} = 90 - Cos^{-1}\frac{a}{4V} \text{ degrees} \qquad \textbf{(5/10)}$$

Let 3D matter-particle break away from spinning wheel, when it reaches point O. Its residue linear speed (additional work, existing in its distortion-field) tends to carry it in the direction, slightly deflected outward from tangent to circular path, by angle (θ/2) degrees. At the instant of detachment, 3D matter-particle is also under 'centripetal force' and this effort has been providing 3D matter-particle's radial acceleration. When unity of 3D matter-particle with spinning wheel is severed, 'centripetal force' is no more present, on 3D matter-particle. However, radial acceleration, provided by action of 'centripetal force', at the instant of detachment, takes some time to die away. This is inertial delay period.

If inertial delay is taken as unit time, displacement of matter-particle in radial direction, i.e., towards tangent XX is numerically equal to half the magnitude of radial acceleration. In other words, direction of motion of detached 3D matter-particle is changed to be along tangential line XX, during inertial delay, by action of additional work due to 'centripetal force' that existed at the instant of detachment. Curved dashed arrow OC shows the approximate path of 3D matter-particle after it broke away from spinning wheel, until it achieves a steady state of linear motion along tangent, XX, to circular path at O. If 3D matter-particle was originally moving along the tangent to rim of spinning wheel, 3D matter-particle would be flying away from rim along a path that is deflected inward from tangent. This does not happen.

Generally, component of linear motion of 3D matter-particle (deflected outward from tangent), perpendicular to tangent is attributed to imaginary 'centrifugal force'. In such case, present instantaneous linear motion of 3D matter-particle is assumed to be in tangential direction to its circular path, same as its average linear motion.

5.8. Linear motion of rotating body:

Every 3D matter-particle, in a rotating macro body (with constant spin speed), moves at constant angular speed, ω. In order to facilitate this, 3D matter-particles at different locations in macro body needs different linear displacements (in unit time) along their curved paths. Speed of linear displacement of a 3D matter-particle is proportional to average magnitudes of additional distortions in latticework-structures of surrounding matter-field. Magnitudes of additional distortions, in different locations in a rotating macro body, are different and depend on their locations relative to centre of rotation. Latticework-squares of matter-field nearer to macro body's periphery have more additional distortions (with lower angular deflections) and latticework-squares of matter-field towards centre of rotation have fewer additional distortions (with greater angular deflections). Combination of linear distortions in different directions in a latticework-square endows it with resultant distortion with certain angular deflection. Resultant deformation of latticework-square can be understood as angular distortion.

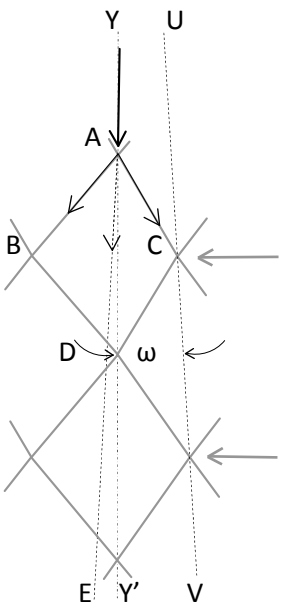


Figure5.23

Figure 5.23 shows representation of two latticework-squares of matter-field of a rotating macro body, in same radial line YY'. Angle between radial line YY' and line, UV, representing average additional distortions (instrumental to rotary motion of macro body), ω, is angular speed of rotating macro body. A, B, C and D are junction-points associated with one of the latticework-squares shown in figure. Grey arrow directed to junction-point C represents inertial action that causes macro body's rotation at constant spin speed. Additional work in macro body's matter-field distorts its latticework-squares as shown in figure. Due to additional work (for rotary motion), arms of latticework-squares are unsymmetrical about radial line YY' of macro body. Line of symmetry, YE, between upper arms of latticework-squares AB and AC is deflected from radial line YY' by angle EAY'. Magnitude of deflection between radial line of macro body and line of symmetry of action of external effort varies and depends on location of latticework-square in matter-field of macro body.

Let there be an external effort, shown by arrow YA, acting (vertically downwards, through junction-point A of latticework-square) on rotating macro body, along radial line YY'. Due to asymmetry of arms of latticework-square ABDC, magnitude of action of external effort through each arm of latticework-square is different. Each arm has different angular deflection from reference line, YY'. Action of effort along reference line, YY', towards centre of rotation is no more in balance. With respect to reference line, YY', action in each arm produces different couples. Equal magnitudes of couples on either side add together to produce resultant linear effort to be transmitted further through junction-point D. Unequal part of a couple through one arm produces angular deflection to turn the latticework-square. Action of external effort is bifurcated into two parts. One part tends to turn and the other part imparts linear motion to macro body. Part of action that tends to turn the macro body assists macro body's current spin motion.

Figure 5.24 shows representation of two latticework-squares of matter-field of same rotating macro body, in diametrically opposite radial line YY' on other side of centre of rotation. Angle between radial line YY' and line, UV, representing average additional distortions (instrumental to rotary motion of macro body), ω, is angular speed of rotating macro body. A, B, C and D are junction-points associated with one of the latticework-squares shown in figure. Grey arrow directed to junction-point B represents inertial action that causes macro body's rotation at constant spin speed. Additional work in macro body's matter-field distorts its latticework-squares as shown in figure. Due to additional work, arms of latticework-squares are unsymmetrical about radial line of macro body. Line of symmetry, YE, between upper arms of matter-field-latticework-square AB and AC is deflected from radial line YY' by angle EAY'. Magnitude of this deflection varies and depends on location of latticework-square in matter-field of macro body.

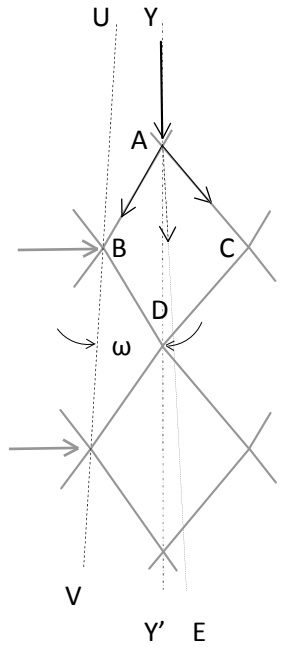


Figure 5.24

External effort, transmitted through macro body's matter-field, is shown by arrow YA, acting (through junction-point A of latticework-square) on rotating macro body, along radial line YY'. Due to asymmetry of arms of latticework-square ABDC, magnitude of action of external effort through each arm of latticework-square is different. Each arm has different angular deflection from reference line, YY'. Action of effort along reference line, YY', away from centre of rotation is no more in balance. With respect to reference line, YY', action in each arm produces different couples. Equal magnitudes of couples on either side add together to produce resultant linear effort and

transmit further through junction-point D. Unequal part of a couple through one arm produces angular deflection to turn latticework-square. Action of external effort is bifurcated into two parts. One part tends to turn and the other part imparts linear motion to macro body. Part of action that tends to turn macro body opposes macro body's current spin motion.

Resultant direction of action of external effort is deflected from direction of its application by an angle whose magnitude is proportional to angular speed of macro body's rotation. Directions of angular shifts are in opposite directions on either side of centre of rotation. On the side of centre of rotation, where external effort is applied, additional angular deflection tends to enhance macro body's spin speed. On the opposite side of centre of rotation, additional angular deflection tends to reduce macro body's spin speed. Unless there is a considerable distance between centre of mass and centre of rotation, effects of additional angular deflections are bound to nullify each other. Simultaneously, part of external effort acts to produce rotating macro body's translational motion.

On termination of external effort (after inertial period) macro body will settle down to a steady state of combined motion of linear and spin motions. Due to difference in angular speeds on either side of centre of rotation, location of point in macro body that does not rotate (its centre of rotation) is shifted away from current centre of rotation, in a direction 90° behind direction of external effort in opposite direction to direction of spin of macro body.

Let an external linear effort act on a spinning macro body, along a line deflected from its radial line. Let us also assume that arms of latticework-squares in its matter-field are symmetrical about the direction of external effort. Although external effort does not act through centre of mass of macro body, it produces no angular component of motion on macro body. Macro body has to develop pure linear motion in addition to its original rotary motion. However, all 3D matter-particles, of spinning macro body, move in curved paths about macro body's centre of rotation.

On one side of centre of rotation, 3D matter-particles of rotating macro body (moving in same direction as the direction of external effort) have newly introduced additional distortions (or their components) assisting their tangential motion in curved paths. On opposite side of centre of rotation, 3D matter-particles of rotating macro body (moving in opposite direction to direction of external effort) have newly introduced additional distortions (or their components) opposing their tangential motion in curved paths. 3D matter-particles of rotating macro body, moving in any other direction will have corresponding components of additional distortions added to / reduced from their distortion-fields.

Rotation of macro body is no more about its centre of mass. Macro body's centre of rotation shifts without affecting its rotational speed. If magnitude of external effort is large compared to macro body's matter-content and spin speed, a stage may come when its centre of rotation may move outside its body-dimensions. From then onwards, macro body would travel in wavy-path about a median straight line. (See section 16.3).

Magnitude of additional angular acceleration / deceleration of constituent 3D matter-particles of a rotating macro body, under action of an external effort, depend on magnitude of external effort as well as location of 3D matter-particle within the macro body. Due to higher asymmetry of latticework-squares about 3D matter-particles, situated nearer to periphery (farther from centre of rotation) of macro body, they are bound to have greater additional angular acceleration / deceleration (due to external effort) compared to 3D matter-particles nearer to centre of rotation. In very large spherical cosmic macro bodies, with considerable distance between their centre of rotation and centre of mass, this phenomenon subscribes to higher spin speed at their equatorial region compared to relatively lesser spin speeds towards their poles and nearer to spin axes. (See section 16.5).

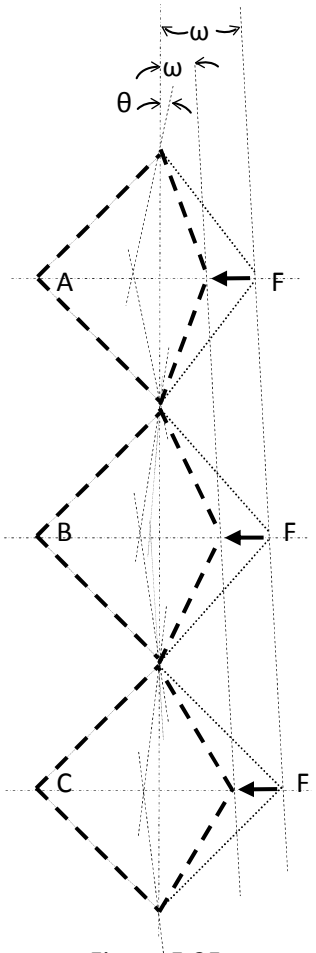


Figure 5.25

Figure 5.25 shows representation of three latticework-squares, A, B and C, in matter-field, situated at different locations, of a spinning macro body, along a radial line on one side of its centre of rotation. An external effort, F, acts on macro body, perpendicular to direction of radial line of latticework-squares shown, in the plane of its rotation. Latticework-square A is situated near macro body's periphery, latticework-square C is situated near its centre of rotation and latticework-square B is situated somewhere in the middle. Thin dotted lines represent latticework-squares with sufficient additional distortions to sustain macro body's spin motion at constant angular speed, ω.

Let an external effort, F, as shown in figure 5.25, act evenly on macro body, which is in steady state of rotation at an angular speed ω. All latticework-squares in matter-field of macro body are distorted identically by external effort, as shown by small arrows, F. Additional linear motion of macro body, produced by effort F, has its own additional linear distortions invested in

macro body's matter-field. These additional distortions are shown by deformations of latticework-squares in matter-field as shown by dashed thick lines. Angular deflection between radial reference line and line joining right-hand side corners of latticework-squares does not change by action of external effort, F. External effort, F, acting evenly on macro body does not alter macro body's rotary speed.

Latticework-squares on opposite side of centre of rotation of macro body are also distorted in similar fashion. Since whole of matter-field is additionally distorted identically in linear direction, macro body gains and maintains linear motion without affecting angular speed of its rotary motion, which remains steady at magnitude of ω. Macro body attains a steady state of linear motion in addition to its steady state of spin motion. Angular and linear motions of macro body remain independent of each other, irrespective of changes in any of them. However, for all purposes of observations, a linearly moving, rotating macro body or its constituent 3D matter-particles appear to have resultant motions in space.

However, asymmetry of arms of latticework-squares, shown by angle, θ, is affected. As shown in latticework-square, A, angular deflection θ between median line between arms of latticework-square and reference radial line, YY, is amplified in proportion to linear speed gained by macro body. Correspondingly, angular deflection of additional distortions in each latticework-square from reference radial line, YY, is enhanced in proportion to linear speed, gained by macro body. Change in asymmetry of arms of latticework-square is bound to affect actions of external linear effort along radial reference line (as explained above). Magnitude of variation in action of external effort (along radial line passing through centres of latticework-squares) depends on magnitude of macro body's linear speed. Action of an external linear effort on a spinning body depends not only on its magnitude but also on symmetry of latticework-squares in its matter-field with respect to direction of external linear effort. This phenomenon causes shifts in directions of tides from local meridian of a spinning planet. (See section 16.6).

Actions of external effort on constituent basic 3D matter-particles of a spinning macro body depend not only on parameters of external effort and macro body but also on locations of individual basic 3D matter-particles within macro body. Those basic 3D matter-particles, moving (or has a component of their motion) along the direction of action of external effort, suffer only linear accelerations. Magnitude of their linear acceleration is proportional to component of their motion along the direction of external effort. Those basic 3D matter-particles, moving (or has a component of their motion) across the direction of action of external effort, suffer not only linear accelerations but also angular accelerations. Magnitude of their linear acceleration is proportional to component of their motion along direction of external effort. Magnitude of their angular

acceleration is proportional to component of their motion across the direction of external effort.

If a macro body is very large, it will not be easy or quick enough to shift its centre of rotation, during action of external effort. It may take quite some time to move whole macro body and complete inertial stabilization of its state of motions. [This is particularly true for continuous action, on a very large spherical macro body, by external effort.] In the mean time, newly introduced linear motion cannot affect a spinning macro body's rotary motion. In order to satisfy this requirement, appropriate changes in curvatures of constituent 3D matter-particle's paths about centre of rotation are developed within macro body's matter-field.

Changes in curvature of paths of 3D matter-particles, while keeping their tangential linear speed (in circular path around centre of rotation) constant, requires shift in centers of their curved paths. During linear accelerating stage of a rotating body (in perpendicular direction to body's spin axis), its radii in different directions in various planes (perpendicular to spin axis) differ all around body's centre of rotation. Cross sections of a spinning spherical macro body (perpendicular to spin axis) attains elliptical shapes. Macro body bulges outwards (in both directions) along line of external effort's action. Spinning macro body's shape will revert to original spherical shape as macro body attains steady state (of linear and rotary motions).

Figure 5.26 shows equatorial plane of a rotating macro body – circle in dotted line. Curved arrows in dotted lines on periphery of equatorial plane show direction (anticlockwise) of macro body's spin direction. A, B, C, D, E, F, G and H represent resultant distortions in few latticework-squares of its matter-field, in different locations in macro body. Although, they are represented in the shape of latticework-squares, they represent directions of reactions developed in latticework-squares. (All efforts have to be conveyed only through arms of latticework-squares in 2D energy-fields). They represent spin-part of resultant additional distortions in matter-field, rather than actual latticework-squares in matter-field of macro body. Let spin speed of macro body is equal to $+\omega$.

Small arrows, in vertical direction, show parts of an external effort applied, evenly, on macro body (here, a field-effort that affects, simultaneously, on all 3D matter-particles of macro body, rather than an external effort that acts at a point, is assumed). Deflection to direction of action of an external effort on a spinning body is not mentioned separately. Direction of external effort is assumed along deflected direction and therefore arms of latticework-squares along radial line in the direction of external effort are symmetrical about direction of external effort. External effort is applied equally on every latticework-square in matter-field. All junction-points in latticework-structures of matter-field experience equal resultant actions in the direction of external effort. Although actions of external effort are to introduce identical linear distortions about every latticework-square

of matter-field, orientation of resultant distortions in latticework-squares at different locations cause slight differences.

At A, D, E and H, arms of latticework-squares are symmetrical to (towards source of) external effort. Effort experienced at all junction-points and distances between junction-points, in perpendicular direction to external effort, are equal. Additional distortions, introduced by external effort, are purely linear and work introduced is used solely for linear motion of macro body in the direction of external effort.

At locations C and F, orientations of latticework-squares (distortion) are deflected anticlockwise. Distances between middle junction-point and junction-points on either side are different. Junction-point to the right is farther than junction to the left. Although magnitudes of vertical efforts are same, difference in distances to junction-points on sides of latticework-squares, produce turning movements of latticework-squares in clockwise direction, as shown by curved arrows in bold line. Direction of this deflection is in opposition to additional distortions producing macro body's spin motion and thus it tends to reduce tangential linear speeds of 3D matter-particles in these locations.

At locations B and G, orientations of latticework-squares (distortion) are deflected clockwise. Distances between middle junction-point and junction-points on either side are different. Junction-point to the left is farther than junction to the right. Although magnitudes of vertical efforts are same, difference in distances to junction-points on sides of latticework-squares, produce turning movements of latticework-squares in anti-clockwise direction, as shown by curved arrow in bold line. Direction of this deflection is same as direction of additional distortions producing macro body's spin motion and thus it tends to enhance tangential linear speeds of 3D matter-particles in these locations.

Spin motion of macro body can be modified only by another torque. External linear effort, considered here, acting on macro body is purely linear in nature. Hence, it is unable to change spin speed of macro body. Spin speed of a macro body depends on relative differences between tangential speeds of macro body's 3D matter-particles at different locations in it. Spin motion of a macro body is measured in terms of angular displacement of its matter-particles with respect to a reference line passing through macro body's centre of rotation. Turning movement of additional distortions in matter-field, explained above also causes angular displacement of macro body's 3D matter-particles. Therefore, effect of turning motion of latticework-squares in matter-field is also measured in terms angular displacement of 3D matter-particles.

However, action of turning motion of latticework-squares on macro body is without affecting tangential speeds of its 3D matter-particles (producing macro body's spin motion). To satisfy these conditions, angular speeds of constituent 3D matter-particles of macro body should vary without altering angular speed of macro body, constituted by

them. This is achieved by modifying curvatures of paths of constituent matter-particles, without altering their tangential speeds.

As shown in figure 5.26, a 3D matter-particle, on equatorial surface of a spinning macro body;

Moves outward from O (centre of rotation) during its travel from location E to A;
Moves inward towards O during its travel from location A to location D;
Moves outward from O during its travel from location D to location H and
Moves inward towards O during its travel from location H to location E.

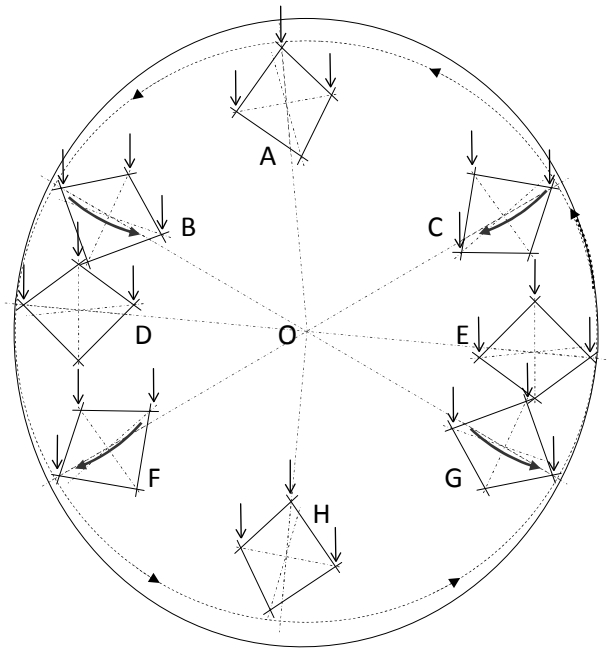


Figure 5.26

Path of a 3D matter-particle on equatorial surface is shown by ellipse in bold line, in figure 5.26. Changes in paths of constituent 3D matter-particles, during action of external effort, alter macro body's shape. Change in shape of macro body will last only during macro body's accelerating stage (during action of external effort). Once the external effort is terminated and accelerating stage is over, macro body will reach a steady state of combined motions of spin and linear motions and it will revert to its original shape. During linear acceleration-stage of a spinning macro body, as a whole, it elongates in both directions along the direction of external effort. This phenomenon gives rise to tides on spinning cosmic macro bodies with linear motion, under action of external linear efforts in any direction.

5.8.1. Rotation by linear effort:

Consider a small spherical macro body (as shown in figure 5.27) in steady state of linear motion, along straight line, XX, in horizontal plane. Arrow on line XX shows direction of macro body's linear motion. Macro body's matter-field has sufficient additional distortions in its latticework-structures to sustain its linear inertial motion at constant speed.

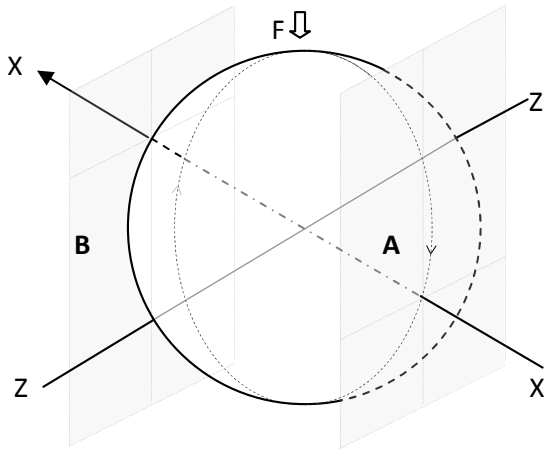


Figure 5.27

Consider parts of two parallel 2D energy-fields, as shown by shaded rectangles A and B in grey dashed lines, perpendicular to direction of linear motion of macro body. 2D energy-field A passes through rear edge of macro body and 2D energy-field B is near but just outside forward edge of macro body. 2D energy-field A includes matter-field of macro body. 2D energy-field B is outside macro body's matter-field. However, as macro body has only linear motion and both 2D energy-fields are perpendicular to direction of linear motion, they do not contain additional distortions of macro body's matter-field.

Let an external effort, F, (as shown by block arrow F) in the plane of macro body's linear motion, act uniformly on macro body at right angle to its direction of linear motion. External effort introduces its own additional distortions into matter-field of macro body in all parallel planes, including plane A, perpendicular to macro body's direction of linear motion. Now, macro body has two independent linear motions – its original linear motion and linear motion, resulting from additional distortions introduced by external effort – in different (perpendicular) directions. Macro body starts drifting away from its original linear course in the direction of external effort.

As macro body moves forward, 2D energy-field A goes out of limit of matter-field of macro body. Additional distortions in 2D energy-field in plane A, which were part of work done by external effort, are free to spread out in latticework of 2D energy-field in all directions in its plane. Work invested to produce this part of additional distortions in macro body's matter-field is lost into space. Speed of macro body in the direction of external effort correspondingly reduces. Total kinetic energy invested with macro body's matter-field by external effort reduces.

At the same time, due to forward movement of macro body, 2D energy-field in plane B is now included within limit of macro body's matter-field. However, 2D energy-field in plane B has no additional distortions, due to external effort, in it. Integrity of macro body compels 3D matter-particles, encompassed by plane B to continue to move with rest of macro body in the direction of external effort. Due to relative motion between 3D matter-particles and latticework-structure of 2D energy-field, additional distortions are produced in front of them (in the direction of external effort). Effort, required to produce these additional distortions are derived from additional distortions in matter-field due to external effort. Certain part of additional work in matter-field is consumed to move parts of 3D matter-particles in plane B.

Reduction in additional work acts as resistance in direction opposite to external effort. Resistance to linear motion in vertical direction (of external effort) will continue until fresh additional distortions of equal magnitude as those lost from macro body's matter-field, is invested into 2D energy-field in plane B by external effort. By doing so, total magnitude of additional distortions in macro body's matter-field (in the direction of external effort) is restored to its original value. Macro body continues to drift in vertical direction at original linear speed. This process takes place in all vertical planes, leaving from rear and entering from front in macro body's matter-field. Macro body drifts from its linear course at a constant linear speed. Resultant of constant linear speed due to inertia and constant linear speed of drift moves macro body in circular path, as explained earlier.

Let us split inertial action by external effort into forward and rearward parts about vertical center plane passing through middle of macro body. Due to continuous entry of fresh latticework-structures in planes from front, forward part of macro body has less additional distortions to push its 3D matter-particles and it has certain resistance on movement of some 3D matter-particles. Rear part of macro body continues to have actions by full magnitude of additional distortions on its 3D matter-particles.

Thus, there is an imbalance in actions, experienced by forward and rearward parts of macro body. External effort is more effective on rearward part and less effective on forward part of macro body. This imbalance creates a torque on macro body to turn it so that point of application of external effort turns backward (in the direction shown by curved arrows in figure) part of macro body, about centre of actions of external effort. Macro body will develop rotary motion, as shown by curved arrows in figure. Its spin axis ZZ is perpendicular to both, direction of linear motion and direction of external effort.

Similar actions take place in additional distortions in macro body's matter-field, providing its inertial motion, also. As macro body drifts sideways, additional distortions in planes in farther side (from where external effort is acting) loses additional distortions and additional distortions are recreated in nearer planes. Difference in magnitudes of

additional distortions in farther (upper as in figure) part and in nearer (lower as in figure) part of macro body create imbalance in their actions. Greater push action on farther part and lesser push action on nearer part of macro body create imbalance in their actions. Torque produced by this imbalance tends to rotate macro body in direction opposite to curved arrows in figure.

Rotating actions by inertial motion and external effort are in opposite directions. Their magnitudes depend on magnitudes of linear speed of macro body and magnitude of external effort. Consequently, macro body will develop spin motion proportional to resultant rotating actions. Direction of spin motion will depend on direction of resultant torque.

Action of an external effort on a macro body, moving at a constant linear speed, is to change its direction of motion and to add / subtract additional turning motion to its current spin speed, if any. Magnitude of diversion of direction of motion is proportional to external effort on macro body. Magnitude of resultant torque on macro body depends on many factors, like relative magnitudes of inertial linear motion and external effort, size of macro body, place of and direction of application of external effort etc.

If external effort is maintained continuously, rates of both turning motion of macro body and diversion of macro body's path from its straight-line course can be maintained constant. Macro body will move in a circular path and simultaneously accelerate / decelerate in spin motion about an axis perpendicular to plane of its circular path. This is the mechanism of orbital and spin motions of planetary / satellite bodies about a central body. Without such actions by inertial-efforts, a planet / satellite, under influence of 'central force', can only shift its direction of motion about its central body. It cannot produce spin motions of planetary bodies. (See section 16.5)

5.9. Gyroscopic inertia:

A gyroscope is a spinning macro body supported by gimbals, to afford free movements about all coordinate axes. Free floating spinning macro bodies in space also has all properties of gyroscopes. A gyroscope continues to spin at a constant rate and with a fixed orientation of its axis in space unless influenced by external effort.

Inertial actions, associated with a 3D matter-particle in a rotating macro body, tend to sustain its constant linear speed in a straight line. Simultaneously, continuous action by 'centripetal force' (provided by integrity of macro body) maintains curvature of 3D matter-particle's path by deflecting its course from straight line of inertial action on it. These two motions, together, determine absolute plane in which 3D matter-particle moves. As long as no external efforts are acting on rotating macro body, every 3D matter-particle in it will continue to move only in absolute plane of its motion. Absolute plane is a plane in universal medium.

Since a gyroscope has free movements in all coordinate planes, relative movements of its supports do not affect gyroscope's absolute plane or absolute direction of its axis. This tendency gives rise to the property of 'rigidity in space' to gyroscope's spin axis. Spin axis of a gyroscope tends to maintain its direction steady in space irrespective of any movements of its support mechanism.

Rigidity of gyroscope's axis in space tends to resist attempts to deflect it from its stable orientation. This phenomenon is known as 'gyroscopic inertia' due to reluctance shown by gyroscope's axis, to act according to an external effort on it. Gyroscopic inertia is not due to any special nature of spinning macro body but due to arrangements of its gimbals, which allow free movement of spinning macro body in all coordinate planes.

5.9.1. Gyroscopic precession:

A 3D matter-particle in gyroscope moves in an absolute plane in space. External effort on it tends to change its direction of motion and thereby change its absolute plane of motion. Any such change is with respect to an axis, passing through point of application of external effort. External effort on gyroscope, at a point away from its spin axis and in a direction perpendicular to plane of its spin motion, produces its result in a plane perpendicular to both (macro body's rotational plane and plane of action of external effort). Action will appear (π/2) radian ahead of point of application of external effort, in the direction of spin motion. This phenomenon is known as 'gyroscopic precession'.

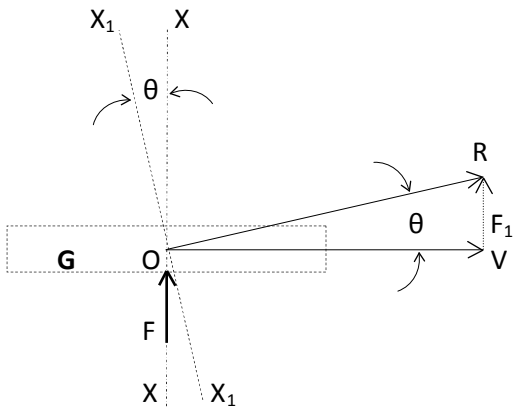


Figure 5.28

Rectangle G (in grey dashed lines), in figure 5.28, shows rotor of a gyroscope (looking from the top). XX is rotor's spin axis. O represents a 3D matter-particle at top most part of its outer periphery. Direction of average linear motion of this 3D matter-particle, OV, is (approximately) along tangent to macro body's periphery at O. Let an external effort, F, act on 3D matter-particle at point O on macro body's periphery. Additional work introduced by external effort, acts to deflect direction of motion of (already-moving) 3D matter-particle, in its direction of action. OV represents average linear motion of 3D matter-particle in its circular path. F_1 represents movement of 3D matter-particle due to action of external effort, F. Resultant of these two independent motions is directed along OR. OR is deflected from OV by angle θ. All 3D matter-particles passing through location O are identically deflected. Integrity of macro

body compels it to turn itself in the direction of deflection, so that spin axis of macro body is deflected from XX to X_1 X_1 with angular difference of θ.

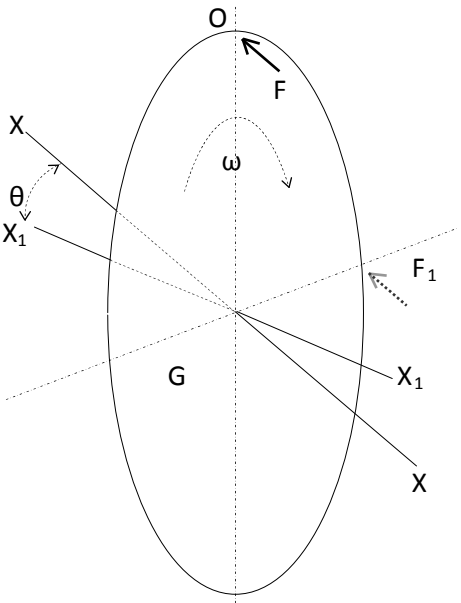


Figure 5.29

Same spinning macro body is represented in its plane of rotation by ellipse G in figure 5.29. Macro body rotates in the direction of curved arrow, ω. Axis of spin is XX. External effort F is applied to top-most point on vertical line passing through centre of rotation. Due to gyroscopic precession, external effort will appear to act in horizontal plane at F_1. This action turns spinning macro body in horizontal plane about a vertical axis through O, by deflecting its spin axis from XX to X_1 X_1 with an angular difference of θ.

Since additional work, introduced by external effort is across plane of rotation, it is transferred in same direction. This work will be lost from macro body's matter-field as soon as it traverses thickness of spinning macro body. Usually, thickness of spinning wheel, used in a gyroscope, is very small compared to its diameter. Hence, precession of a gyroscope will stop as soon as external effort ceases.

External effort, F, is applied at point O on the spinning macro body at a distance, r, from spin axis.

$$\text{Torque by external effort} = Fr$$

If the macro body was not spinning, this torque would have caused an angular acceleration, α, about centre of mass of macro body to tilt its axis in vertical plane.

$$\alpha = \frac{Fr}{I}, \qquad \text{where I is moment of inertia of macro body.}$$

$$\text{Angular displacement of tilt in unit time} = \alpha\frac{t^2}{2} = \frac{Frt^2}{2I} = \frac{Fr}{2I} \quad \text{(putting t = one unit)}$$

$$\text{Additional work required for this motion} = k\frac{Fr}{2I},$$

where k is constant of proportion between magnitude of additional work and spin speed.

Additional work, W, about every 3D matter-particle of macro body, causing its steady spin motion, is proportional to average (tangential) linear speed or displacement in unit time, $OV = v$, of 3D matter-particle, where, $v = r\omega$ and $W = kv$

External effort F reflects on macro body as F_1. $RV = F_1$

Additional work, corresponding to external effort F_1; introduced by external effort, F_1, about 3D matter-particle for its linear displacement in horizontal plane;

$$F_1 = k\frac{Fr}{2I}$$

This additional work acts to turn spinning macro body about a vertical axis passing through O to angularly displace spin axis of the spinning body from X X to X_1 X_1.

Angular difference between OV and OR, angle θ, is angular displacement of spinning macro body about a vertical axis through O, such that;

$$\text{Tan}\theta = \frac{VR}{OV} = \frac{F_1}{W} = \frac{kFr/2I}{kv} = \frac{Fr}{2Iv}$$

Putting $v = r\omega$, where v is the tangential speed of body-particle in the spinning macro body at the point of application of external effort, r is distance between spin axis and point of application and ω is the angular speed of the spinning macro body.

$$\text{Tan}\theta = \frac{Fr}{2Iv} = \frac{Fr}{2Ir\omega} = \frac{F}{2I\omega} \qquad \textbf{(5/11)}$$

Angular speed of deflection = θ = Rate of precession;

$$\theta = \text{Tan}^{-1}\frac{F}{2I\omega} \qquad \textbf{(5/12)}$$

Usually, magnitude of precession rate, θ, is small so that value of (Tan θ) is very small. Value of (Tan θ) is directly proportional to magnitude of external effort and inversely proportional to moment of inertia of the spinning macro body and its spin speed. Increase in spin speed or macro body's moment of inertia increases rigidity of macro body in space and reduces its precession for certain external effort.

In order to take advantage of these factors, rotor of a gyroscope is shaped such that for same matter-content, its material is distributed to attain very high moment of inertia about centre of matter-content and rotor is spun at very high angular speed. As spin speed of rotor reduces, rate of precession for identical external effort increases until at very high values of factor $F/2I\omega$, rate of precession approaches 90° to topple gyroscope in the direction of external effort.

5.10. Effect of very large explosion:

As a macro body moves forward under inertial action, undistorted latticework-squares of 2D energy-fields enter limits of body-dimensions from front, to be deformed into macro body's matter-field and then leave to rear of limits of body-dimensions as undistorted latticework-squares of 2D energy-fields in universal medium. In fact, 2D energy-fields are steady and it is the macro body, along with distortions in latticework-squares, which moves through universal medium. If we consider a moving macro body (with associated additional distortions in its matter-field) as static, there is an apparent or relative translation of 2D energy-fields through limits of body-dimensions of macro body in reverse linear direction.

If similar relative motion between a macro body and distortions in 2D energy-fields can be produced by any other means, it will turn out to be an inertial action on or of macro body. In case of inertial motion, additional distortions in matter-field move with respect to steady 2D energy-fields in universal medium. In reverse condition, latticework-structures of 2D energy-fields move with respect to macro body and its matter-field.

If distortions in latticework-squares of 2D energy-fields in the region of a macro body can move with respect to steady matter-field of macro body, it constitutes an inertial motion of the macro body or action of an inertial-effort on macro body, with respect to universal medium. With respect to other external references, macro body may be at rest, but since all absolute motions are with respect to universal medium, relative motion between macro body and universal medium constitutes a movement of macro body. This phenomenon can be noticed in regions of universal medium, into which large numbers free quanta of matter are released or from where large numbers of quanta of matter are consumed suddenly. Such environments develop during sudden and huge explosions of macro bodies or electric discharges or during certain other phenomena, as explained in section 16.1.6.

During sudden explosion of macro body, many of its parts come under excessive compression. Sudden and excessive compression of 3D matter-particles release lot of free quanta of matter into the region of universal medium, in and about macro body. Free quanta of matter, within latticework-structures of 2D energy-fields, either migrate into their latticework-structures or form disturbances. Disturbances are then converted to basic 3D matter-particles (photons) of various frequencies and radiate away in the form of heat, light or other radiations.

Quanta of matter, which migrate into latticework-structures of 2D energy-fields, integrate themselves into universal medium. Migration of quanta of matter into quanta-chains or newly created latticework-squares in 2D energy-fields in a region; expand universal medium in all directions (each 2D energy-field in its own plane) from epicenter of explosion. Outward expansion of universal medium, from point of explosion, has its

own distortions in universal medium. When these distortions pass through matter-field of another macro body (at a distance from point of explosion), they act as moving additional distortions in its matter-field, in radial directions away from a center of explosion.

Additional distortions in a matter-field tend to carry 3D matter-particles of macro body along with them in the direction of their transfer, away from epicenter of explosion. Since outward expansion of universal medium is not related to any 3D matter-particles, relative transfer of associated distortions can take place infinitely, in all directions from center of explosion, at the speed of light. 3D matter-particle of macro body, nearest to the point of explosion experiences inertial action first and then next 3D matter-particle little farther away and so on. In this way, macro bodies away from point of explosion experience inertial action (in sequence), at the speed of light.

Distortions, associated with expansion of 2D energy-fields can move 3D matter-particles and macro bodies on their way. Once, 3D matter-particles in a macro body are moved by expansion of universal medium, additional distortions created in latticework-structures of universal medium, in linear direction, by motion of 3D matter-particles, sustain inertial action on macro body. Due to high porosity of macro bodies to 2D energy-fields, macro bodies in line of transmission of distortions in universal medium cannot be screened to stop distortions moving through them. Distortions in 2D energy-fields, which are not intercepted by 3D matter-particles of macro body, are free to pass through macro body and affect any other macro bodies in their way.

Expansion of universal medium is from center of a region with excess presence of free quanta of matter and away, in radial directions. All macro bodies around the point of explosion (or reversion of 3D matter into lower dimensional spatial systems) experience inertial actions in directions away from point of explosion. These actions, when taken together appear to be radial in 3D space. This type of radial inertial action is noticed around points of very huge and fast explosions (or at places of reversion of 3D matter into lower dimensional spatial systems). Macro bodies around epicenter of an explosion appear as if pushed away from center and this action is transmitted at the speed of light. This inertial action is in addition to efforts applied by any sound waves (in case, explosion takes place in an atmosphere) that are produced by explosion, which are transferred at the speed of sound.

Large gaps may be formed in latticework-structures of 2D energy-fields due a local breakdowns or large scale consumption of quanta of matter from their latticework-structures, in a region of universal medium. (See subsection 16.1.6). Due to gaps formed in latticework-structures of 2D energy-fields, universal medium from all directions rush-in to fill the gaps. If gaps are created by local breakdown of latticework-structures of 2D energy-fields, disturbances are also produced in gaps to create photons to be radiated away. If a gap, created in latticework-structure of a 2D energy-field is large enough with

less number of free quanta of matter in it, radial displacement of quanta-chains towards centre of gap may be noticed far from the point of breakdown. Displacements of quanta-chain (inward motion of 2D energy-fields, towards gap), when pass through matter-field of a macro body (at a distance from the gap), act as relative motion of macro body, in radial directions towards a center point.

Those quanta-chains of 2D energy-fields, which are intercepted by 3D matter-particles of macro body, tend to push 3D matter-particles, towards centre point. This push is an inertial action. Displacements of 3D matter-particles create additional linear distortions (appropriate to inertial motion) in matter-field of macro body. 3D matter-particles of macro body, nearest to the gap, experiences inertial action first and then 3D matter-particles in next macro body little farther away. In this way, macro bodies away from gap will experience inertial action in sequence, at the speed of light.

Since inward motion of latticework-structures of 2D energy-fields are not related to 3D matter-particles, inertial action can travel from infinite distances in all directions (distortions in each 2D energy-field, in its own plane) to center point of gap, at the speed of light. They can move 3D matter-particles and macro bodies on their way. Once, 3D matter-particles in a macro body are moved by inertial actions of 2D energy-fields, additional linear distortions created in matter-field by motion of 3D matter-particles sustain inertial action on macro body. Due to high porosity of macro bodies to 2D energy-fields, macro bodies in line of transmission of distortions (due to consumption of universal medium), cannot be screened to stop them. Distortions in 2D energy-fields, which are not intercepted by 3D matter-particles of macro body, are free to pass through macro bodies and affect any other macro bodies in their way.

A macro body, at a distance from gap, also feels movement or shifting of 2D energy-field (distortions) through its matter-field. This constitutes an inertial action on macro body. Since contraction of 2D energy-fields are boundless, all macro bodies kept in line in same direction from gap feel inertial action in sequence (one after other and in decreasing magnitude, away from centre point of gap) at the speed of light in reverse order. Direction of inertial action is same as direction of motion of distortions in 2D energy-fields – towards the gap. A macro body, nearest to gap moves towards the gap first. A macro body, farther from gap, moves towards the gap after a delay (corresponding to speed of light), then next macro body and so on. Because of this property, inertial action, experienced by macro bodies under this condition, is often mistaken as caused by gravitation.

Motion of 2D energy-fields is from all around towards the place of local breakdown / consumption of quanta of matter in their latticework-structures. All macro bodies, around of epicenter of implosion, feel inertial actions in a direction towards the centre. These inertial actions, when taken together appear to be actions of (inward) radial nature. This

type of action is noticed around points of dielectric breakdown or around regions, where latticework-structures of 2D energy-fields are depleted at very high rate (see section 16.1.6). Macro bodies, around epicenter of implosion, appear as if they are pushed towards a center point and the action is transmitted at the speed of light.

Inertial actions, similar to those produced by nuclear fields, due to revamp or depletion of latticework-structures of 2D energy-fields appear in 3D space. Inertial actions, produced by them, act radially in all directions from or towards epicenter. Due to spherical nature of their transmission, magnitudes of inertial actions, decrease as distance from epicenter increases. Reduction in magnitude is caused by enlargement of spherical region considered.

With regard to changes in sates of macro bodies, actions produced by inertial actions due to outward / inward displacements of latticework-structures of 2D energy-fields are similar to those produced by inertial-efforts. But unlike actions by inertial-efforts, their actions are radial in nature (outward or inward) and transmission of action (from one macro body to next) is at the speed of transmission of distortion-fields (speed of light). Inertial fields have limited ranges and they can be screened by macro bodies. Actions, due to revamp or depletion of latticework-structures of 2D energy-fields in a region are of infinite range, they are similar to gravitational actions. Gravitational actions are instantaneous but inertial actions, created by expansion / contraction of 2D energy-fields in a region, transfer from one macro body to next macro body at the speed of light.

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