

BROWNIAN MOVEMENTS

(According to "Hypothesis on MATTER")

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Abstract: Currently, analyses of ‘Brownian motion’ are limited to its relevance to other scientific phenomena. Observed motion of a microscopic solid particle, suspended in a liquid, is attributed to assumed random motion of liquid molecules. This type of motion remains one of many assumptions of ‘kinetic theory’. There is neither a logical cause nor a mechanism nor a known mover, acting on liquid molecules. Hence, root cause of Brownian motion remains a mystery. Aim of this article is to explain a logical mechanism for random motion of molecules (which causes Brownian motion) of liquid macro body, based on structural behaviour of its matter-particles, rather than to analyse observed motion and its significance to other phenomena.

In free space (where a macro body experience no external influence related to other macro bodies), least dense matter-particles in a fluid macro body, settle at its centre and the macro body itself becomes spherical in shape. External pressure on a macro body reduces its size and thereby increases its matter-density and internal pressure. Internal pressure, within a macro body, acts as external pressure on its constituent primary matter-particles. Enhancement of external pressure on primary matter-particles enlarges their sizes and reduces their matter (and energy) content levels to lower their matter-density, as it happens during heating.

In a fluid macro body, situated near a massive macro body, reduction of matter-density of its constituent primary matter-particles (corresponding to their location within the macro body) tends to produce convection current. This is the root cause of ‘Brownian movement’ of suspended microscopic solid particles in the fluid macro body. If no massive macro body is near the fluid macro body, there will be no Brownian movements in it. Phenomenon of Brownian motion takes place only on or near the surface of earth-like celestial macro bodies.

Keywords: Brownian motion, Gravitational pressure, Kinetic theory of gas, Primary matter-particles, Hypothesis on MATTER.

Introduction:

An alternative concept (still at its conceptional stage), put forward in ‘Hypothesis on MATTER’, advocates a radically different dynamics. In it: Matter is the only substance in nature and it provides existence and objective reality to all physical entities in space. Matter exists in the form of ‘quanta of matter’. Quanta of matter, outside three-dimensional matter bodies, form two-dimensional latticework structures – ‘2D energy fields’. 2D energy fields (in all possible planes) fill entire space outside three-dimensional matter particles and together they form an all-encompassing universal medium with definite structure and properties. All actions, in nature, are by and through universal medium.

Matter content of a macro body and energy about it are distinctly separate. Matter content is the total quantity of three-dimensional matter in a macro body. Energy is the stress developed in universal medium about the macro body, due to ‘distortions’ in natural arrangements of 1D quanta of matter, in and about the macro body. Deformed region of 2D energy fields about a 3D matter-particle is its ‘distortion field’. A macro body’s matter content and energy content about it cause and support each other for their existence and stability. They are not convertible into each other.

Parts of 2D energy fields within body-dimensions of a macro body contain sufficient distortions to sustain integrity and stability of the macro body in its current state. This part of 2D energy fields is the ‘matter field’ of the macro body. Distortions in a matter field are the ‘work’ associated with the macro body and it determines macro body’s state (of motion). Force is the rate of work (distortions) being stored in the matter field of a macro body with respect to macro body’s displacement in space. Energy, associated with a macro body, is the stress due to distortions in its matter field. Action of an effort is simple structural reshaping of the matter field, transfer of distortions in universal medium and resulting displacements of any 3D matter-particles, present in the region. State of a macro body depends on the work (energy stored) in its matter field rather than on magnitude of external effort, applied on it. 3D matter is inert. All apparent interactions between 3D matter-bodies take place through universal medium (2D energy fields). This avoids the assumption of ‘actions at a distance through empty space’.

External pressure, on a primary 3D matter-particle, increases its size with corresponding reduction in its matter content and matter-density. Similarly, reduction in external pressure about a primary 3D matter-particle reduces its size with corresponding increase in its matter content and matter-density. This phenomenon leads to the expansion of a macro body’s primary 3D matter-particles during compression (or heating) and their contraction during decompression (or cooling). Expansion of a macro body’s primary 3D matter-particles, during compression is usually overcome by reduction in the size of the macro body by pushing its 3D matter-particles towards macro body’s centre. Contraction of a macro body’s primary 3D matter-particles, during decompression is usually overcome by enlargement of macro body by displacement of its 3D matter-particles outwards from macro body’s centre. Contrary to present theories, a macro body gains matter and energy contents during cooling or decompression and it loses matter and energy contents during heating or compression. A macro body is at its highest matter and energy content levels when it is coolest and in free space. A 3D matter-particle is at its lowest matter and energy content levels in its hottest state and in the centre of a macro body.

All conclusions, expressed above, are taken from ‘*Hypothesis on MATTER*’ [1]. For details, kindly refer to the same.

Kinetic theory:

The idea that molecules of a gas are constantly in motion, colliding with each other and bouncing back and forth, is a prominent part of ‘kinetic (-molecular) theory of gases’. Kinetic theory of gas was originally developed to explain macroscopic properties of (ideal) gas. Although this theory is based on numerous assumptions, it gives no reason for physical movements of molecules in a gaseous body. One of the assumptions simply states that molecules of a gaseous body are in constant, random motion and these rapidly moving particles constantly collide with the walls of the container and with each other. Speed of motion is further assumed to be in proportion to temperature of the gas. Assumed collisions with container wall and with each other, presumably explains internal pressure and increase in internal pressure during heating of the gaseous macro body.

With more modern developments, liquids are also included in the purview of kinetic theory. Currently

all theories on Brownian motion are based on these assumptions, which give no reasons for random motions of molecules in a liquid macro body. Instead, these theories analyse observed displacements of suspended microscopic solid particles in a liquid macro body. As long as reasons for basic random motion of molecules are not explained, such theories remain theoretical exercises on random motions only. These theories explain nature of Brownian movements under an assumed condition rather than its real causes and mechanism. Although reasons for random motion are not given, mathematical treatments on observed random motions give accurate analysis for many similar events.

Compression of a body:

External pressure on a macro body, compresses it. Compression is nothing but inward efforts, acting at macro body's surface, towards a common centre. Force is the rate of work, introduced into matter field of a macro body by external effort. Work, in and about a macro body, is in the form of distortions in its matter field. Distortions in the matter field of a macro body determine macro body's current state. External effort on a macro body acts against the reactions at 2D energy field-junctions in its matter field.

Constituent matter-particles of a macro body are held together by compression by gravitational (apparent) attraction and interactive field forces, between macro body's constituent 3D matter-particles. Gravitational attractions between 3D matter-particles tend to move them towards each other. 3D matter-particles are prevented from colliding into each other by interactive (repulsive) field forces about them. During compression, a macro body's 3D matter-particles are pushed towards a common centre and nearer to each other. In most cases, this can be seen by a reduction in size of the macro body. Reduction in distances between macro body's 3D matter-particles increases repulsion between them. Changes in interactive field forces are due to changes in the distortion-density of matter field in the area. Reactive component of this repulsion provides external compression on primary 3D matter-particles in fundamental particles of the macro body. Work done, due to compression of macro body, is stored in the form of additional distortions in its matter field. Increased distortion-density compresses primary 3D matter-particles in the macro body. As primary 3D matter-particles are compressed, they expand in size and lower their matter and energy contents. Matter content, lost from the primary matter-particles, if in sufficient quantity, form photons to be radiated away in the form of heat or light. This phenomenon heats up gas under compression and produces radiations of various frequencies from very massive bodies.

Actions on a macro body, during compression and heating are similar. Heating is a process of reducing matter and energy contents of a macro body by enhancing surrounding pressure. Reduction in matter content of primary 3D matter-particles under compression lowers mass of corresponding atoms/molecules of the macro body. At the same time, primary 3D matter-particles expand in size, leading to expansion of atoms/molecules. These actions, together, reduce the matter-density of constituent atoms and the macro body, as a whole. Expansion of macro body, as a whole, may be compensated (up to an extent) by decrease in macro body's volume due to external compression, by moving its atoms towards each other. Application of external pressure on a macro body reduces macro body's volume by bringing constituent atoms/molecules of the macro body nearer, against interactive repulsions, which are keeping them away from each other. This may affect a change in matter-density of the macro body, as a whole, but leaves matter-density of constituent atoms/molecules, unaffected. Variations in matter-density of primary 3D matter-particles are produced by changes in their matter contents. Expansion of primary 3D matter-particles in a macro body increases the size of a heated macro body, which is under no external compression. Applying external pressure on a macro body compels the macro body to lose its matter and energy contents.

Constituent matter-particles (atoms/molecules) of a macro body are held together, to maintain integrity of the macro body, by mutual gravitational attraction and other interactive field forces between its constituent 3D matter-particles. In any macro body, inner most atom/molecule is under highest pressure due to gravitation. Higher external pressure on this atom/molecule reduces its matter-density by a larger magnitude compared to reduction in matter-density by atoms at other locations within the macro body. If a macro body is located in free space (where there is no other external effort/pressure on it), atom at the macro body's centre has least matter-density. Matter-density of atoms in the macro body gradually increases as their locations approach towards surface of the macro body. If there are other macro bodies, nearby, location of atom/molecule with least matter-density may differ from centre of the macro body.

Brownian motion:

A microscopic matter-particle, suspended in a liquid, is observed to have random displacements within the liquid. This phenomenon is known as ‘Brownian motion’. It is named after Robert Brown, who first (in modern times) observed random movement of particles suspended in a fluid, when he examined pollen grains in water. Analysis of random nature of movements in this phenomenon has developed into many concepts related to probability and fluctuations. Mathematical model of Brownian motion has several real-world applications, related to data-fluctuations. Mathematical model describing such random movements is often related to ‘particle theory’.

As there was no logical reason for the observed random movements of microscopic solid particles suspended in a fluid, cause of such motion was attributed to an assumption in ‘kinetic(-molecular) theory’ of liquid [similar to and derived from kinetic(-molecular) theory of gas] and the same is used in explanations that confirmed existence of atoms and molecules. Einstein suggested that random movements of suspended solid particles in a liquid as being a result of random thermal agitation of molecules, which compose surrounding liquid. Later on, calculations based on Brownian motions helped to determine sizes of liquid’s atoms. All these and similar conclusions are true only if there is a logical explanation to random thermal agitation of a liquid macro body’s molecules. Since the assumption of random motion of matter-particles in ‘kinetic theory’ of liquid, itself has no logical basis, an alternative explanation (based on concepts in ‘Hypothesis on MATTER’) is given below.

Constituent matter-particles in any macro body have definite relative positions. In atoms, adhesion of primary 3D matter-particles and fundamental particles are very strong. They can resist all reasonable efforts to change their relative positions. Atoms in molecules are also strongly bonded. Usually they may change their relative positions only under very strong influences, produced during chemical interactions. Each type of atom has unique nature of its distortion field. Complimentary atoms, guided by their distortion fields, join in definite pattern to form a molecule. By completing the structure of a molecule, constituent atoms locate themselves in relation to the structure so that resultant distortion field about the molecule will be electrically and magnetically neutral.

Free atoms or molecules in a macro body are relatively free of each other. It is the gravitational attractions that hold them together to form an integral macro body. Repulsion developed between their distortion fields, when they approach each other keeps neighboring molecules apart, irrespective of gravitational attraction between them. Depending on their matter and energy contents and natures of their distortion fields, strengths of bonds between neighboring free atoms/molecules vary. It is the strength of inter-atomic/molecular bonds in a macro body that determines its physical state. In solid macro bodies, inter-molecular bonds are very strong and therefore, usually, no relative displacements of constituent atoms/molecules are allowed.

Constituent atoms/molecules of a fluid macro body are not held rigidly. At the same time, they do not have independent free relative movements. Degree of floppiness is expressed in terms of fluid’s viscosity. Depending on the viscosity of the fluid macro body, its molecules have certain degree of restricted freedom to move about each other, in groups, within the limitations imposed by their molecular formations. Such motions help to form convection and other types of currents in fluid macro bodies.

If a fluid macro body is situated on or near the surface of a large macro body, each of the fluid macro body’s atoms/molecules is gravitationally (apparently) attracted towards the large macro body. Denser atoms/molecules of the fluid macro body tend to move towards the large macro body, under greater gravitational attraction. Disregarding any actions of external pressure on primary 3D matter-particles, the fluid macro body achieves a stable state with its denser atoms/molecules at the bottom (towards the large macro body) and lighter atoms at the top.

Within the fluid macro body, its atoms/molecules are also (apparently) attracted towards each other due to gravitation. Inter-atomic attraction due to field forces, in association with gravitational attraction towards the large macro body, applies higher external pressure on the atom/molecule, which is at the bottom-centre of fluid macro body. This atom will have least matter-density, compared to all other atoms/molecules in the fluid macro body. Due to its lowest matter-density, magnitude of gravitational attraction on it towards large macro body becomes least, compared to magnitudes of gravitational

attractions on other atoms/molecules. Other atoms/molecules, on which magnitudes of gravitational attraction towards large macro body are higher (due to higher matter-density), tend to move towards the large macro body – that is, to the bottom of fluid macro body. Atom/molecule, which is at the bottom-centre and least dense will be replaced by another atom/molecule, which is denser. Displaced atom will slowly move upwards to the top of fluid macro body. As denser atom/molecule reaches bottom-center position in fluid macro body, due to higher external pressure on it, it will discard part of its matter content corresponding to increased external pressure and thereby lower its matter-density. Now, this atom/molecule becomes least dense in the fluid macro body, to be replaced another denser atom/molecule.

In the mean time, atoms/molecules, rising to the top, are relieved of excess external pressure. They will absorb matter content from surrounding universal medium (2D energy fields) to compensate the loss suffered. Depending on the rate of absorption of matter content by the atoms/molecules, their upward movements to the surface are restricted by the viscosity of fluid macro body. Gravitational actions, external pressure and rate of absorption of matter content by their primary 3D matter-particles, produce certain randomness in their possible movements. It tends to initiate a continuous convection current within the fluid macro body. This tendency of convectional motion, amplified by characteristic properties of fluid macro body's material, affects very small solid particles suspended in the liquid macro body.

Possible convectional motions of atom/molecule, located at the bottom-centre of the fluid macro body (near a larger macro body) are as described above. Atoms/molecules in other locations, throughout the fluid macro body, depending on their relative matter-density and magnitudes of gravitational attraction towards the large macro body, also tend to undergo similar convectional motions. Unless additional impetus is provided (like heating) inter-atomic/inter-molecular attractions will be sufficient to restrict free convectional current within the liquid macro body.

In any macro body, constituent molecules are arranged in definite pattern, determined by the distribution of their resultant distortion fields. A molecule or atom, moving from its current location in a macro body, can settle only in a different location that has similar distribution of (neighbouring) distortion fields, as at the location of its present existence. Field forces, holding a molecule or atom in its current location will prevent or impede external efforts that are trying to dislodge it from the place of its present existence. As and when external efforts overcome retaining field forces, a molecule or atom may be dislodged from its present location. But it can be accommodated only in another location with similar distortion field-configuration. If there are suitable locations nearby, the molecule/atom will immediately occupy one of them. If suitable locations are not available, the molecule/atom will slip back into or remain in its original location. However, relocation of the molecule/atom takes place very fast. Speed of molecules during relocation is determined by molecular field forces rather than the speed of possible conviction motion in the fluid macro body. Hence, a molecule or atom, dislodged from its present location is propelled very rapidly to its new location in the fluid macro body.

A molecule moving under this effect moves with small but quick jerky motions from one location to another. Although these movements are initiated by variations in matter-density of the molecules, movements of molecules are governed by their distortion fields-distribution. A molecule, ejected from its location finds another location with identical distortion fields-distribution. During its stabilisation at new location, the molecule may twist or turn to conform to the local distribution of distortion fields. Departure of molecule from one place and its arrival at another location produce corresponding movements of all molecules around it. Moving atoms/molecules do not directly collide with other atoms/molecules on their path. Instead, their distortion fields come within interacting distances to transfer momentum of moving atom/molecule (in part or full) to distortion fields of atoms/molecules on their paths. Momenta of high-speed movements of these molecules may be transferred to any (sufficiently small) suspended solid particles in the fluid macro body as small kicks. Hence, motion of suspended solid particles is not smooth, but appears to be in random directions or erratic and jerky in fashion. This phenomenon produces 'Brownian motion'. Average movements of suspended solid particles are calculated by using probability principles.

All constituent atoms of a macro body have mutual gravitational attraction. This provides the macro body with its viscosity. In solid macro bodies, viscosity is very high and its constituent atoms cannot have relative motion. In fluid macro bodies, viscosity is low enough that its constituent atoms/molecules may

have limited motion relative to each other. As temperature of a fluid macro body is raised, its viscosity comes down and magnitude of external effort, required to move its molecules (relative to each other) decreases. Molecules/atoms of the fluid macro body move more freely. If temperature of a fluid macro body is raised, without creating convectional currents of its own, magnitude of Brownian motion of a suspended solid particle in it, will increase.

Power of tendency to form convectional current (not due to heating) in the liquid macro body depends on magnitudes of: (1). Mutual gravitational attractions between 3D matter-particles of liquid macro body and (2). Gravitational attractions between very large macro body (on which the liquid macro body is situated) and 3D matter-particles of liquid macro body. Therefore, magnitude of Brownian motion increases as matter content (mass) of very large macro body (on which the liquid macro body is situated) becomes greater. Magnitude of Brownian motion will be greater on or near surface of larger celestial bodies.

Brownian motion of a suspended solid particle in fluid macro body will continue as long as the fluid macro body is within the gravitational (attractive) sphere of a larger macro body. In the absence of a larger macro body in the vicinity (in free space) of the fluid macro body, Brownian movements cannot take place in it. Least dense atom/molecule will come to settle at the centre and the fluid macro body will attain a stable spherical shape. In this state all atoms of the liquid macro body are held at their relative positions within the macro body by gravitational attraction and field forces. Irrespective of their energy states, they can have no relative motion without help from external efforts. Convectional currents, during heating of a fluid macro body will also be absent in free space.

Conclusion:

In any material, whichever physical state it may be, there is a definite pattern of arrangement for its constituent atoms/molecules. Unless affected by external efforts, they cannot have relative motion between them. Bond between atoms/molecules may be very strong as in solids or weak as in fluids. But it will not permit relative motion between constituent atoms/molecules of a macro body, unless affected by external influences. Hence, ‘kinetic theory of gas’, which presumes relative motion of gaseous (or liquid) macro body’s constituent atoms/molecules in proportion to their energy level, without appropriate external efforts, is illogical. An explanation to phenomenon of Brownian motion needs not have random motion of a liquid macro body’s atoms/molecules. Effects of external pressure on matter contents of 3D matter-particles in a liquid macro body and their compulsion to settle in locations with similar distortion fields-configuration produce jerky movements of constituent molecules. Moving molecules collide with microscopic solid particles, suspended in the liquid macro body and cause their erratic motion in random directions. Brownian movements in fluid bodies can take place only within gravitational sphere (immediate neighbourhood) of another large macro body. Higher the magnitude of gravitational attraction, more energetic the Brownian movements will be.

References:

References [1] and [2] are self-published by the author. They are neither edited nor reviewed.

- [1] Nainan K. Varghese, *Hypothesis on MATTER* (second edition), (2008).
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- [2] Nainan. K. Varghese, ARTICLES, <http://www.matterdoc.info>
- [3] Wikipedia, *Brownian motion*, http://en.wikipedia.org/wiki/Brownian_motion

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