WORK, MOTION AND ENERGY

(According to "*Hypothesis on* MATTER")

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Abstract: Energy, an undefined entity derived from work, is generally equated to motion. This has necessitated introduction of certain motion of physical bodies, wherever energy is envisaged. All actions are results of work-done rather than energy. Although energy has no definite form, structure or existence, it has gradually come to usurp rightful status of work-done about a physical body. Author proposes an alternative concept that may restore work, motion and energy to their fair and logical status.

Key words: Work, motion, energy, universal medium, Hypothesis on MATTER.

Present concept:

In contemporary physics, 'energy' appears to be the most important and most fundamental entity in our universe. It is assumed to create, develop and sustain us and all other things in nature. Mass, representing matter, is believed to be converted from it. It is supposed to appear in many forms and could be transferred from one place to another or from one body to another (somewhat similar to fluids). Energy from sun is assumed to sustain every thing on earth, including living organisms in numerous varieties. There are numerous theories dealing with various properties of energy. In fact, it seems that everything about energy is known, except what is energy or where and how is it is created, stored or transferred?

Energy, in various forms, appears to affect matter-bodies/particles in diverse ways. This gives rise to classification of energy into different types, each type associated with a different phenomenon. Energy is often represented as heat, frequency, motion, speed, pressure, electromagnetic, atomic, radiation, potential, potency, etc. They are often used as convenient parameters in mathematical treatments. However, all these are attributes of physical states of matter-bodies/particles. They symbolize changes in physical parameters/states of matter-bodies. Attributes define physical states of matter-bodies/particles, rather than 'energy'. As such, energy has no proper definition or logical form of existence.

Although it was not essential for the development of mechanics, the concept of 'energy' was vaguely introduced into mechanics by Galileo in 17th century, in the form of 'living force' that was required as cause of actions. Thus, 'energy' originally signified a cause or an effort of an action. Energy came into prominence as the measure of capacity of work much later.

Newton's laws of motion recognize a relation between magnitude of external 'force' on a matter-body and the body's acceleration in the direction of 'force'. In this relation, (F = ma), 'F' (force) represented rate of action (work) accomplished, 'm' (mass) represented a quantity corresponding to matter content of the matter-body and 'a' (acceleration) represented rate of change of body's motion with respect to another functional entity, time. Arguments on the superiority of evaluation between spatial and temporal integrations of this relation with respect to moving bodies, in the 19th century, helped to establish the following definitions [2];

1. Acceleration (rate of change of state of a body's motion) is the result of work-done on a body.

2. Force is associated with acceleration of a mass.
3. (Kinetic) energy, associated with the motion of a mass (representing a matter-body), is the result of spatial integration of 'force', acting on the mass.
4. Momentum is the result of temporal integration of 'force', acting on a mass.
5. Energy is the measure of capacity to do work.
6. Power is the time-rate of energy transfer.

These definitions are derived from mathematical operations of empirical data obtained from moving macro bodies. Generally, 'force' became a representative of an effort or cause of an action. Since no logical mechanisms of action of 'force', creation/development of work or transfer of energy are envisaged, these definitions have no conceptual basis. Currently, scientists in general, consider 'energy' as the primary entity in nature. Energy is a very vague assumption that could be used in numerous ways to suit any phenomenon. It is represented in a number of (assumed and) assorted types of functional entities, existing along with matter-bodies (real entities). Energy has different forms and properties to suit diverse occasions. Although, energy has no substance or real existence, it is treated for all purposes as a real entity. Even while energy has no real existence, it is assumed as a tangible entity that can affect matter-bodies in all fashions by doing work on them. Energy could be transferred from one matter-body to another like a fluid from one container to another.

First type of energy recognised was the kinetic energy or energy of motion. Notion of energy was progressively widened to include many other types of energies, each one associated with an empirical phenomenon. Towards the middle of 19^{th} century, even the heat was concluded as a form of energy. Recognition of heat as a form of energy and the assumption that energy can neither be created nor destroyed led to the 'energy conservation laws'. The conception of energy continued to expand to include many other types of energies, like; electric, magnetic, chemical, etc. energies. Advent of relativity theory caused the mass (representative of matter content in a body) to be equated with energy. At times, even undefined space is recognized as store-house for (flux or field) energy, from which exotic matter particles or characteristic properties may be produced. Occasions are many, where phantom states of energy (e.g.: Potential energy) are used in rationalizations. Energy is considered differently in different branches of science.

Energy, in its initial form of kinetic energy, began its development from being associated with mechanical motion. Motion of a body is easily observable, compared to some of its other parameters. Gradually, association of energy and motion became so strong that for many purposes, energy replaced the often unobservable 'work-done' in topics of motion. Advantage of this association is that for lower magnitude of linear speeds, magnitude of energy in non-rotating bodies could be derived in proportion to their linear speed.

Equating energy with motion paved way for many illogical developments. Considering heat as a form of energy necessitated certain invisible motion of constituent particles within a matter body. For this, molecules and its constituents were required to have additional motion (vibrations) over and above their natural motions. In order to satisfy certain parameters of gaseous bodies (in terms of an ideal gas) 'kinetic theory of gases' was proposed. In this theory, gas molecules were considered to have inherent linear motion in random direction, magnitude of which depended on the state of energy (heat) of the gaseous body. In fact it has become imperative to have some type of motion to indicate presence of energy. However, no logical mechanisms were provided for development of these assumed motions by energy. When proportionality of linear acceleration of a macro body and 'energy' input broke down at higher linear speed, energy was alleged to be converted into 'mass' of a matter body.

Energy is considered as a transferable or receivable attribute of a real entity. In the steady state of (motion of) a matter-body, energy associated with the body resides in the form of work-done about the body. Energy is usually associated with movements of real entities (or their constituent particles). Greater motion is understood to be associated with higher magnitude of 'energy', associated with a body. As, only real entities can have objective reality and can be displaced in space, in classical theories, real entities were essential to mysteriously bear or transfer energy. However, gradually, importance of this requirement is deteriorating. In few modern theories, energy is often associated with imaginary entities or sometimes the energy is assumed to exist independently in imaginary forms. Energy is considered as convertible into work or in some cases even into mass (vaguely suggesting a change into matter content of a body).

Currently, there are no explanations on energy's form, structure, shape, existence, origin, working, etc. Nevertheless, 'energy' is often assigned independent physical (real) existence in its own right.

'Energy' is defined in dictionaries, as the 'capacity or ability to do work'. In every-day language it is understood as the creator of an effect. Capacity or ability is a qualification and hence a functional entity. A functional entity fulfils all functions assigned to it by rational beings and nothing else. It needs not have independent objective existence or physical form. Energy is a mathematical relation and an attribute of a real entity. Energy, being a quality (to perform work), it should naturally qualify some other real entity that can be the performer of work. Then, energy will be a measure of that entity's ability (one of its qualification) to accomplish work. Since, energy is a quality; it cannot have many forms or types. All energies are of same type. They may be associated with different types of (apparent) interactions and named differently to indicate their associations. Energy is always designated according to associated physical effect. Belief in the storage and conversion of energy, from one type to another, produced the branch of physics called 'thermodynamics'.

Energy seems to have no independent existence in any form. It is a shadowy entity, derived from and complimentary to work that produces physical changes in matter-bodies. Wherever work is present, energy of corresponding magnitude develops. This has caused the misconception that energy is the entity that performs the work. Due to energy's assumed ability to be converted into work, it is also measured in the same units of work. Yet we have no accepted mechanism of action in contemporary mechanics. It is this absence of a mechanism of action, which caused the functional entity of 'energy' to usurp the rightful place of real entity of 'work' in mechanics. 'Energy' gained its acceptance as a convenience for mathematical operations. Since (due to its undefined status) it has no definite existence or form, it can be used in any theory to suit its convenience.

Since energy has no objective reality (physical form or structure) it can neither transform (to become physical objects) nor occupy space. For logical understanding of universe and its nature, we may consider only one type fundamental entity that is basis of all entities, their properties and all actions found in universe. We cannot avoid matter because it provides objective reality to all physical objects. Therefore we must conclude that matter is the most fundamental entity and all other things (including energy and work) and actions noticed in nature are derived from matter.

An alternative concept:

The alternative concept, 'Hypothesis on MATTER', envisages matter as the only and most basic fundamental entity. Matter provides substance (stuff) to all physical entities to have objective reality so they may exist in space as real bodies. In its primary nature, matter exists in the form of quanta of matter (one and only postulation used in this concept). Quanta of matter, by their inherent properties, structure universal medium, which fill the entire space. Universal medium provides structure, form and reality to space. Universal medium performs all other actions and apparent interactions in nature, including creation of 3D matter bodies, their sustenance and gradual destruction to revert 3D matter into quanta of matter.

In this concept, author of this essay advances a clear and logical mechanism of action (of a 'force'). It shows the work as a real and primary entity in the form of distortions in (all-encompassing) universal medium, in and about a three-dimensional matter-body. Since the universal medium is structured by real matter-particles, distortions in the universal medium are genuine relative displacements of its constituents and hence real. Transfer of these distortions from one place in universal medium or from (the region of) one body to another is the work-done. Wherever, distortions in the universal medium are present, its constituent matter-particles are under strain due to relative displacements from their stable configurations. Stress in the strained part of universal medium is the 'energy'. Since the work is proportional to distortions in universal medium (energy or stress), developed in the region of distortion, is also proportional to the magnitude of work.

In mechanics, work is often defined as a result of 'force', acting over a distance. This indicates that the 'force' is the cause of work or the transfer of energy. 'Force' is the rate of work-done. It is the mathematical relation between work-done and (rate of change of) distance moved by the matter-body during action of a 'force'. Hence, by doing work, it is the work itself that is being transferred and not the energy. Energy, corresponding to the magnitude of work, is always present where the work is present. Energy, defined as the capacity to do work, is the magnitude of work itself, available for transfer from one location/body to another.

Work is required to create, develop and change the state (of motion) of a real entity. Certain magnitude of work is needed for creation, development and to sustain integrity of a matter-body. This part of work may be called intrinsic work (corresponding to internal energy of a body), associated with the matter-body. This part of work may be released only on disintegration of the matter-body. Doing additional work on and about a real entity enables it to move or change its state (of motion). Only this part of work can be released from a matter-body to do additional work on other matter-bodies. Investment of additional work on or about a real entity (matter-body) develops/changes the real entity's ability to do additional work on or about other real entities. Thus it is seen that additional work on and about a real entity is the primary entity, which is being produced/transferred to or from/about another real entity. Vague and undefined entity of energy is the result of presence of (additional) work about the real entity. Transfer of additional work is generally considered as transfer of energy from one matter-body to another. In reality, it is the additional work, which is being transferred from and about one real entity to another and the energy, in the form of stress in universal medium, is inherently developed along with the additional work, in the form of additional distortions in universal medium in and around a matter-body.

Additional work in and about a matter-body confer the body with its ability to do further (additional) work (on other matter-bodies). Work, being distortions (relative displacements) in universal medium in and about a macro body is real and tangible entity. Energy is a functional entity that is inherently present wherever (additional) work is present. Work is tangible in the sense that it is the magnitude of distortions in the universal medium in and about a matter body. Unfortunately, since the universal medium is not directly observable by three-dimensional rational beings, (additional) work-done about a macro body remain obscure to us.

Since energy and work are complimentary to each other, energy may continue to be used to represent (additional) work. However, assigning the status of 'real and primary entity' to work may help to re-define the above given definitions, related to motion, as;

1. Acceleration (rate of change of state of a body's motion) is the result of additional work-done on a matter-body.
2. Force (rate of additional work-done) is associated with acceleration of ('rest mass' representing) matter content of a body.
3. (Kinetic) energy, associated with motion of a matter-body, is the result of spatial integration of 'force' acting on 'rest mass' of the matter-body.
4. Momentum is the result of temporal integration of 'force' acting on the matter content of a matter-body.
5. Energy is the measure of stress in the universal medium due to (additional) work, present in the distorted region of universal medium. It corresponds to (additional) work-done about a matter-body and may represent the matter-body's capacity or ability to transfer (additional) work to other matter-bodies.
6. Power is the time-rate of work transfer.

By considering energy in its true functional nature and bestowing its rightful place to work as the primary and real entity, many misconceptions may be corrected. Work is a real entity. Energy is a functional entity, developed due to presence of work. Energy cannot create work; instead it is developed in the universal medium due to the presence of work (distortions in universal medium). Inherently stable nature of universal medium causes development of stress (energy) in it during any type of deformations. Additional work may be transferred or stored, whereas energy can neither be transferred nor be stored. Energy being stress and work being distortions in universal medium, they cannot exist in different forms.

'Force', being the rate of doing additional work, there is only one type of 'natural force' in nature. However, uniformity of distortions in certain degrees or directions may give rise to different physical phenomena as part of their action, developed by the additional work. Linear distortions give rise to magnetic phenomena, angular distortions give rise to electrical phenomena, radial distortions give rise to nuclear phenomena, compressive distortions give rise to gravitational phenomena, moving distortions give rise inertial (causing motion) phenomena, etc. Random nature of distortions in universal medium about a macro body produces its neutral state.

'Hypothesis on Matter' envisages that every matter particle or group of matter particles are created, developed and sustained by distortions in surrounding universal medium. [These distortions are ultimately

produced by gravitational actions within universal medium]. Surrounding distortions are integral part of a physical body. Transfer of distortions through universal medium carry basic matter particles of a macro body to affect its motion. In fact, matter is inert and it is the surrounding universal medium that performs all actions, currently attributed directly to matter bodies.

Every matter particle (physical body) is a composition of its constituent elementary particles and distorted region in surrounding universal medium. Its matter-part is enveloped by a distorted region in universal medium. Additional work can be done on a matter body in the form increasing distortions in the surrounding universal medium (compression). As universal medium is a compressible entity, all matter particles and macro bodies formed by them, together with surrounding distortions in universal medium are compressible units. Due to presence of distortions in surrounding universal medium, all molecules (including those of gasses) are compressible. Depending on external compression on the distorted region, a matter particle may change its volume. Gaseous bodies, contained in a closed container are able to exert pressure on walls of the container by constituent atoms' compressible envelopes. While heating matter particles lose matter content and expand in volume. This accounts for pressure on a closed container by enclosed gas, when heated. Heating of a matter body need not have additional motion of its constituent matter particles. It can be accounted by loss of matter content and corresponding expansion by matter particles of a macro body. Atoms of the gaseous body need not have the assumed random motion (as in kinetic theory of gas) for this purpose. Atoms on a macro body need not have additional vibration to indicate their energy level.

Mass is a mathematical relation. It is a quantitative measure of resistance (inertia) experienced by a macro body during change of its state of motion. Since we have no other standard reference, it is generally used to represent matter content of a matter-body. Mass of a body does not (always) give quantitative measure of matter, contained in the body. As inertia of a macro body depends also on its current linear speed, mass of a macro body is likely to change as its linear speed changes, without corresponding changes in its matter content. This phenomenon paved way for the misconception that at very high linear speeds of a macro body, 'energy' supplied to accelerate the body is converted to increase its mass (representing matter content) rather than to increase its linear speed. An external effort attempts to transfer more additional work in association with the moving body to accelerate it. No energy is transferred from 'force-applying mechanism' to 'force-receiving body'. If magnitude of additional work (associated with a body) increases, it accelerates the body and corresponding energy is developed in distorted region of universal medium around the body.

Heat produces a change in the matter content of a macro body rather than distortions in the universal medium in or about it. Distortions in universal medium, about the body, are modified only so much as required to maintain integrity of the macro body in its current state and matter content. Additional work involved (and associated energy) during heating is minimal. Therefore, heat is not a form of energy but heat is a process of changing matter content of a matter-body.

As the universal medium fills the entire space; work and corresponding energy may exist anywhere in space (in association with matter-bodies or otherwise), even in vacuum. Wherever universal medium is distorted, corresponding magnitude of energy exists in association with the distortions. Energy and matter are entirely distinct entities. Any one of them cannot be converted or reverted to the other.

References:

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