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Article

Thermodynamic Philosophy of Evolution

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Abstract

A semblance of a foundation towards the development of a philosophy based on a thermodynamic understanding of evolution is presented. Central to this presentation are firstly the acknowledgement that everything in the biosphere is a dynamic system of atoms, molecules, or structures of molecules attached to a substrate known as the surface of the earth; second that chemical thermodynamics is the branch of science that determines the direction of natural processes according to what are called the two laws of thermodynamics; third that in the case of the synthesis of the person over the last 13.7-billion years of the development of the known universe, the new view has emerged that the human being is 26-element molecule; fourth that, on the three previous points, any modern legitimate philosophy would need to be well-grounded in the molecular perspective or system of molecules point-of-view, a perspective in which behaviors, reactions, and evolutions of molecules or systems of molecules are dictated by the laws of energy and entropy.

Introduction

In the history of recorded knowledge, the question of the origin and function of the individual in the framework of the dynamics of the surrounding universe has been an ever-present issue of discussion and debate. The three questions most on the minds of the average person are: what happens when you die? (27%), what is love? (23%), and what is the meaning of life? (19%), where percentages indicate the dominance of the question in the minds of a random selection of one-hundred people.[1] In other words, there is about a seventy-percent chance that one of these great philosophical questions is currently on the mind of the average person.

Olden days reconciled such questions with a tradition of entertaining, morality-laden, semi-scientific stories and tales told and passed on from generation to generation. These, in turn, were incorporated, via syncretism, into the early philosophies and religions of recent millennia. The modern-day person finds such questions reconciled with a mixture of philosophy, religion, or science. To give an idea of the prevalence of how these questions are answered in the minds of the average person the current distribution of faith and non-faith beliefs in the world as well as the percentage of college degrees granted in science and engineering (in the U.S.) are tabulated below:[2]

Rank	Religion (2002)	%
1	Christian	32.8
2	Muslim	19.6
3	Hindu	12.8
4	Nonreligious	12.8
5	Chinese Religions	6.4
6	Buddhist	6.0
7	Ethnic Religionists	4.2
8	Atheist	2.5
9	New Religionists	1.7
10	Sikhs	0.4
11	Jews	0.2
12	Spiritists	0.2
13	Bahais	0.1
14	Confucians	0.1
15	Jains	0.07
16	Shintoists	0.05
17	Other Religionists	0.02
18	Zoroastrians	0.005
19	Mandeans	0.0006

Rank	Science (1998)	%
1	Social Sciences	9.2
2	Biological/Agricultural Sciences	7.1
3	Psychology	6.2
4	Engineering	5.1
5	Mathematical/Computer Sciences	3.3
6	Physical Sciences	1.3
7	Non-S&E fields	67.4

To elaborate on these numbers, in 2000 the percentage of U.S. citizens graduating from college was 25.6 percent.[3] Multiplying this by the 32.6 percent figure, as indicated above, of college graduates with degrees in science or engineering, gives an indication that about 8.3 percent of the average population has certified understanding of one of the branches of science; whereas, in contrast, 84.7 percent of the world population has committed religious adherence. In the context of these figures, 2005 polls of 32 countries found, on average, that 62 percent of people agreed that the following statement was true: 'human beings, as we know them, developed from earlier forms of life.' Curiously, however, in the United States, one of the most developed nations in the world, only 40 percent considered the statement to be true.[4] This statement is commonly known by what is called the *theory of evolution*.

In the context of this data, one discerns the view that modern science is slowly replacing the older proto-scientific views presented in religion. The effect that this replacement has taken effect, however, is marginal, particularly when it comes to some of the more dominant questions revolving around what keeps the average person moving forward. Science, for one, has never been able to define life. Scientific explanations of death are non-existent. On the question of life, owing to recent advances in neuroscience, the colloquial view has emerged, in the minds of about sixty-six percent of people, that love is a purely chemical reaction.[12] As to the public acceptance of evolution, the major impediment to this is religion and the holes it fills that science leaves open, particularly on the subjects of purpose, good, evil, and death.

The branches of science that will eventually fill in these larger holes are physics, chemistry, and thermodynamics, predominately. A few individuals who significantly helped to move us in direction of hole filling is the Darwin family and their discussions and theories on the connection between evolution, chemistry, and thermodynamics. In particular, although the term *evolution* was coined by Swiss naturalist Charles Bonnet in *circa* 1770, the more robust idea of evolution began with English physician Erasmus Darwin who, in his 1794 book *Zoonomia: the Laws of Organic Life*, expounded on the view that:

> "In the great length of time since the earth began to exist, perhaps millions of ages before the commencement of the history of mankind, all warm-blooded animals have arisen from one living filament, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions and associations, and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down these improvements by generation to its posterity."

This was following by the work of Erasmus' grandson Charles Darwin who, in his now-famous 1859 *The Origin of Species*, using British political economist Thomas Malthus' 1833 theory of an existence struggle emergent in populations found to be increasing on limited resource-laden habitats, in conjunction with the view that natural random variations exist in offspring that could be selected accordingly, presented a cogent mechanism of evolution, arguing that:[5]

> "The original spark of life may have begun in a warm little pond, with all sorts of ammonia and phosphoric salts, lights, heat, electricity, etc., present, so that a protein compound was chemically formed ready to undergo still more complex changes … favorable variations would tend to be preserved, and unfavorable ones destroyed … the result of this would be new species."

Here we glimpse the possibility that evolution may have a chemical origin and basis and may in fact still be chemical. This foundation was further advanced by Erasmus' great-great grandson English physicist Charles Galton Darwin who, in his 1952 *The Next Million Years*, arrived at the view that, according to modern physical science, human beings are technically 'human molecules' or animated structures made of atoms and that in order to study the reactions or evolutions of human molecules in their social development over the next million years that future scientists would need to use thermodynamics to make predictions on human behaviors, being that this is the branch of science which determines the physical direction of processes. In his own words:

> "Through determining some kind of laws of **human thermodynamics**, we shall be more successful in doing good in the world."

It is on this foundation, namely the 'new' science of human thermodynamics, that the modern person must look to reconcile the more wanting philosophical questions of human existence, namely those surrounding aspects of death or continuity, love, and function or meaning in life, in reconciliation of the world's older religious teachings about correct living, rules of morally correct behavior, origin, and future of the individual and their actions in time. In this sense, the most controversial aspect of the theory of evolution is not the logical framework of its presentation, which has clearly tracked the origin of humans to at least as far back as the formation of bacteria 3.8 billion years ago, but rather its implication of human evolution that human mental and moral faculties, which had been thought purely spiritual, are not distinctly separated from those of other animals.[6] Some of these implications are not so easily remedied. To elaborate on this by example, we will step through some of the outline of ideas found in C.G. Darwin's 1952 seminal work.

To begin with, in elaboration on how evolution can be understood via predictions of how processes may progress, according to laws physics and thermodynamics, C.G. Darwin gave the simple example of how the behavior of the evolution of the molecules of a body of gas is governed by the ideal gas law, which states that the pressure times the volume of a body of gas is proportional to the number of particles in the body of the gas times the temperature of its body. He explains that because we know a certain amount about the nature of these molecules that it might be possible, in some of the simpler cases, to work out in detail what happens when two gas particles collide together. He states that to work out this interaction would be in accordance with the old cause-and-effect physics, but he says would not be very useful. This is because, according to C.G. Darwin, the number of molecules is so vast, and their collisions so frequent, that the effect of a single collision is of no interest, but only the average effect of all the collisions. It proves possible to know this average by a very general method, and the average can be found without even invoking many of the properties of the individual molecules, even when these properties are well known.

C.G. Darwin goes on to explain that the most general deductions are the gas laws, which describe how the pressure of the gas depends on the volume of the containing vessel and the temperature; the most famous being Boyle's law, published in 1669 by Irish chemist Robert Boyle, which relates pressure to volume, in the sense that the pressure of the body of gas molecules is inversely proportional to its volume. Boyle's law is verified with the greatest precision and the most absolute regularity whenever it is tested, and yet, according to C.G. Darwin, it is the consequence of the wildly varying and extremely violent collisions between the molecules of the gas. He explains that in deducing the law it is not even necessary to use all the known properties of the molecules; for example we know with some accuracy the distance between the two atoms of an oxygen molecule, but in fact this distance plays no part whatever in the result.

In order to derive Boyle's law, in C.G. Darwin's view, all that is required is the knowledge that the molecules constitute what he calls 'conservative dynamical system', or thermodynamic system, in a modern sense. Although, technically, Boyle's laws can only be derived by experiment, as was done by Boyle and his associate physicist Robert Hooke in the late 1650s, C.G. Darwin is loosely correct in his analogy, going on to explain that the important part to note in the construction of a gas law is that the body of molecules be delineated by a containing vessel or 'boundary', in a thermodynamic sense, so as to be able to quantify the pressure, volume, and temperature within the boundary. He calls these 'internal conditions', otherwise quantified by what is now called *internal energy*. On this logic, he postulates that:

> "We may, so to speak, reasonably hope to find the Boyle's law which controls the behavior of the human race, and from this we should be able to predict something of man's future."

On this basis, in laying out his simplistic theory of human thermodynamics, C.G. Darwin goes on to encounter a number of common stumbling blocks to this new science. He states, for instance, that similar to how the external conditions for the gas are determined by the containing vessel, that for human molecules the containing vessel 'is obviously the earth itself'. Correctly, the study of boundaries of systems of people or human molecules, such as home boundaries, neighborhood boundaries, city boundaries, country boarders, societal boundaries, sexual boundaries, personal space, human movement probability orbitals, etc., is very intricate subject. If, for instance, one naively chooses the Karman line earth-space boundary, 62-miles above the earth surface, where weightlessness begins, the significance of the definition or work, in the classic steam engine sense, as the boundary acting to 'lift weight through a gravitation height', looses meaning, as does pressure, and so on, as there is no longer any atmosphere to lift.

As to speculating on how internal conditions, e.g. internal energy, temperature of system of humans, etc., might be formulated in the human molecular case, he states:

> "The internal principle, which is to be analogous to the property of being conservative dynamical systems, of course lies much deeper. It must depend on the laws governing the nature and behavior of **human molecules**."

He then blunders, however, on the supposed special nature or attributes of human molecules as compared to any other molecule:

> "When I compare human beings to molecules, the reader may feel that this is a bad analogy, because unlike a molecule, a man has a free will, which makes his actions unpredictable."

Here we see the apical crux of the issue, through example, of the conflict between modern hard science, namely those unified by the branches of physics and chemistry, in contrast to religion and philosophy as well as nearly every other subject, e.g. social science, humanities, literature, and so on.

It is quite clear that a human being is a molecule. The term 'human molecule' was first coined in 1869 by French philosopher Hippolyte Taine, the statement that the human body is 'a chemical formula in operation' was made by American physician George Carey in 1919, and the first calculation of the empirical molecule formula for the average human being was made independently in 2000 by Americans limnologists Robert Sterner and James Elser and in 2002 by chemical engineer Libb Thims.[7] Conversely, it is quite clear that in the history of physics and chemistry that never has anyone discovered a molecule that has a free will. This is the paradox, namely that a seasoned physicist, C.G. Darwin, of the great Darwin family, who wrote his *The Next Million Years* at the knowledgeable age of sixty-five, seems to believe that molecules have free will?

In a modern sense, however, every scientist will admit, when pressed with the question of molecules having free will, at face value, without mention of the concept of the human molecule, will certainly conclude that the idea of any molecule, such as hydrogen H_2, ammonia NH_3, or urea CH_4N_2O, etc., in possession of a free will is absurd. Yet such attributes in the case of the human being, or human molecular case, are bandied about with such parade so as to make the head spin.

It is quite clear that there exists continuity in the development of the person over the eons, from the initial synthesis of hydrogen atoms to the synthesis of humans; in other words, every structure in the mechanism of evolution, or chemical form change over time, from hydrogen to human is a molecule.[8] In this sense, it is advised that whatever theory or philosophy of human behavior, function, or existence one chooses to describe human activity, that it be one in accordance with modern molecular theory. For if it is not, one has two choices: either to disprove the prevailing molecular theory or conceit to fact that their theory is incorrect.

To give a simple example of 'molecular philosophy', in the 1890s American minister Charles Sheldon began preaching rules or practicalities on how to live a moral life, based on the teachings of the Bible, in his church in Topeka, Kansas. The unifying theme of his sermons was based on posing the question 'what would Jesus do?' when faced with moral decisions, and out of this concluding with a set of rules of conduct to operate with over the course of one-year. The rule-of-thumb philosophy given, in short, is that each day, prior to the undertaking any course of action, one must first pause, then reflect or meditate, and ask the Holy Spirit to tell them what Jesus would do, then act in that direction regardless of the results. This logic became the basis for his 1896 book *In His Steps: What Would Jesus Do?*, a publication that would sell more than 30-million copies, becoming one of the 50 highest-selling books of all time.

The modern reformulation of this title, knowing that a human being is a molecule, would be *What Would a Molecule Do?*, because that is what will happen. In this sense, prior to the undertaking of any course of action, one must not only pause, but first become schooled in the teachings of how molecules behave and react, both in isolation and in complex groups, and then ask not what was called in olden days the Holy Spirit, but rather what is called in modern terms one's subconscious potentials for the true or most thermodynamically favored reaction path to follow.

In any event, before one can fundamentally derive any type of correct 'philosophy' on how to exist, i.e. fill one's waking hours with purposeful activity, based on the science of thermodynamics, viewed in the context of the recorded observation of the phenomenon of evolution happening in time, one must be well-grounded in the teachings of a standard textbook on human thermodynamics. A difficulty here is that one does not yet exist. Without such a tool, one will only result in making unfounded superficial declarations as to a supposed 'new' philosophy based on thermodynamics. Examples of this being German chemist Wilhelm Ostwald's 1912, first law based, *energetic imperative*: '[while alive] waste no energy, turn it all to account', a philosophy on which an entire book was devoted, or American physicist Robert Lindsay's 1963, second law based, *thermodynamic imperative*: 'while we live we ought always to act in all things in such a way as to produce as much order in our environment as possible', a philosophy expounded on in several articles, lectures, and chapters over a period of more than a decade.[9] These prototype thermodynamic philosophies, however, are not fundamentally based.

A standard textbook on human thermodynamics, to clarify, would need to be constructed on the fundamental textbooks of Clausius (1865), Gibbs (1876), and Lewis (1923), on the axiom that a system of humans consists of a system of reactive 'human molecules', attached to substrate, driven via expansions and contractions of Carnot cycles of daily solar heat inputs.[10] The 2007 textbook *Human Chemistry*, the 2008 book *The Human Molecule*, and the under-construction wiki *Encyclopedia of Human Thermodynamics*, at the 1,000 plus article level as of 2009, lay out some of the precursory material to proper construction of this foundation.

As such, to construct a textbook on human thermodynamics, of which subsequent derivatives and corollaries of philosophical insight would follow, one would need to gut through the core and founding textbook of thermodynamics, namely German physicist Rudolf Clausius' 1875 *The Mechanical Theory of Heat*, utilizing the 'system of human molecules' point of view. In the following few pages, we will lay out some of this foundation.

The first page to any standard human thermodynamics textbook, as done by Clausius in his standard thermodynamics textbook, would introduce its reader to the modern definition of *work* or colloquially occupation, endeavor, or daily activity (movement), in the human thermodynamics sense.

Work

The definition of work is structurally based on the effort exerted during the lifting of water buckets out of flooded mines, through a vertical height, a common occupation for many prior to the 1690 invention of the steam engine by French physicist Denis Papin. The definition of work is as follows:

> "Whenever a body moves under the influence of a force, work is performed."

This fundamental all-encompassing definition, upon which the modern unit of energy, named the joule, is based, derives from the founding school of thermodynamics, the famous Paris engineering school the

École Polytechnique; particularly through the 1829 work of French physicist Gustave Coriolis.[11] In mathematical formulation, work W is equal to the force F multiplied by the distance d through which a body is moved by the force:

$$W = Fd$$

This equation, called by Coriolis the 'principle of the transmission of work' in the movement of a material point, in turn, derives from the fundamental axiom that every force tends to give motion to a body on which it acts, as established in 1686 by English physicist Isaac Newton. One force, however, may be prevented from imparting motion to the body by other opposing forces, so that equilibrium results and the body remains at rest. In this case, notes Clausius, the force performs no work.

These definitions apply absolutely to human activity and daily work or occupation. Successful individuals are those, typically defined, as ones who set goals for themselves and over a number of hours, days, or years actualize those goals. Others may find, during long periods of stagnation, one force tending to actuate movement towards certain objectives or goals, only to find other stronger forces, often seen as resistance or obstacles, acting to prevent the former force from imparting motion to the body. In this case, an inability to act results and the force performs no work.

It is at this point that difficulties on learned conceptions of human motion arise; a conflict between what is currently believed regarding human nature and what we know of hard science and the nature of molecules. When a man imparts a force of 5 newtons to a wooden broom, for instance, while moving in a straight line, down a hallway, while keeping the broom in contact with the floor, through a distance of 10 meters, as an integral part of his occupation as a night janitor, we say that, via the Coriolis work principle, he performs a certain amount of work on the broom:

$$Work = Fd = (5 \text{ newtons})(10 \text{ meters}) = 50 \text{ joules}$$

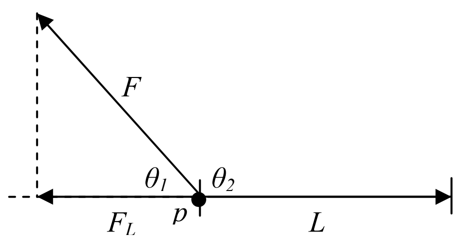
or that fifty joules of work were done during this operation. If, on the other hand, we suppose the man and wooden broom to be one unit, viewed as a material point, and thus calculate that it takes 100 newtons of force to move the single unit of man-broom a distance of 10 meters, we find that the work done is:

$$Work = Fd = (100 \text{ newtons})(10 \text{ meters}) = 1{,}000 \text{ joules}$$

In this latter operation, it becomes imperative to ask: what force is moving the man-broom unit? Did the man actively *choose* to come to work at this instance so to push the broom over a distance of ten meters or did the man's body, mind included, in the words of Clausius 'move under the influence of a force'? If we are to quantify this action thermodynamically, we must choose the latter conclusion. On this logic, we are further goaded into asking, for instance, what are these forces that move us? Current science tells us that there are only four known fundamental forces: strong nuclear, weak nuclear, electromagnetic, and gravity. Subsequently, how do these forces, if these are indeed the ones, act to cause a man to push a broom?

To go through a more simplistic example, given by Clausius, in order to investigate the subject of work, we may assume that instead of an extended body, such as in the man-broom case, the man being a twenty-six-element molecular structure griped to a hydrocarbon broom, we assume that the force acts upon a single material point. If this point, which we may call p, travels in the same straight line in which the force tends to move it, then the product of the force and the distance moved through is the mechanical work which the force performs during the motion. If on the other hand the *motion of the point* is in any

other direction than the *line of action of the force*, then the work performed is represented by the product of the distance moved through, and the component of the force resolved in the direction of motion.
The following diagram shows the line of action of the force *F* pointed in a certain the direction, indicated by the angle theta θ, with respect to line *L* motion of the point *p*:



Here we see that the *motion of the point* is in another direction than the *line of action of the force*. The work performed, subsequently, is represented by the product of the distance *L* moved through and the component of the force F_L resolved in the direction of motion:

$$W = F_L \cdot L$$

$$F_L = F \cos \theta_2$$

$$W = (F \cos \theta_2)\, L$$

This component of force in the line of motion may be positive or negative in sign, according as it tends in the same direction in which the motion actually takes place, or in the opposite. This comes from trigonometric rule, which states that when two angles sum to form 180˚ the following relation results:

$$\cos \theta_2 = -\cos \theta_1$$

The work likewise will be positive in the first case, negative in the second. In this example, θ_2 is 132˚, the cosine 132˚ is -0.67, and the work done is negative. To express the difference in words, the force may be said to *do* or *perform* work in the former case (force in the direction of motion), and to *destroy* work in the latter (force opposed to the direction of motion).

In the human case, a woman, herself considered as a material point moving on a surface, may have aims at saving up, through work, to buy or procure a new dress for herself by the end of the week, at an upscale store on the north side of town, but an unexpected costly car breakdown may arise as a force, opposed to the former, sending her and her saved money to the repair shop on the south side of town, and thus destroy the action of the earlier force, resulting in a state of equilibrium or stasis to action in respect to the new dress.

Units of work

To express these quantities of work numerically, we should take as unit that quantity of work which is performed by a unit of force acting through a distance. In order to obtain a scale of measurement easy of application, we must choose, as our normal or standard force, some force which is thoroughly known and easy of measurement. The force usually chosen for this purpose is that of gravity.

Gravity acts on a given body as a force always tending downwards, and which for places not too far apart may be taken as constant. If we now wish to lift a weight upwards, such as via a pulley-and-rope arrangement, by means of any force at our disposal (manpower, horsepower, waterpower, windpower, combustion, etc.), we must in doing so overcome the force of gravity. Gravity thus gives a measure of the force which we must exert for any slow lifting action. Hence we take as our *unit of work* that which must be performed in order to lift a *unit of weight* through a *unit of length*.

In derivation of this unit of work, from Newton's second law of motion, it is known that force is proportional to the mass of an object times its acceleration:

$$F = ma\left(kg \cdot \frac{m}{s^2}\right)$$

This unit of force, kg·m/s^2, is called the 'newton', in honor of English physicist Isaac Newton. Substituting this unit of force into the Coriolis work principle gives:

$$W = Fd = (ma)d\left(kg \cdot \frac{m^2}{s^2}\right)$$

Hence, the standard unit of work becomes:

$$\left(kg \cdot \frac{m^2}{s^2}\right) = Joule$$

This is the standard unit for any amount of work, human, mechanical, or otherwise. The name 'joule', chosen in honor of English physicist James Joule, who established the equivalence of heat and work in the 1840s, was adopted as the unit for all types of work, i.e. electrical work, heat, mechanical work, and energy in 1948 at the 9th General Conference on Weights and Measures. This unit was formally approved in 1960 in the International System of Units.

Other quantities of work, in cases where gravity does not come directly into play, can also be expressed in joules by comparing the forces employed with the standard force of gravity. In this logic, one can thus express the amount of work done by the man pushing the broom or the woman saving to buy a dress in terms of units of joules. The force in these two examples is the electromagnetic force, predominately, and the gravitation force, in residual effect.

Work done by components of the force

In the foregoing explanation it has been tacitly assumed that the active component of force has a constant value throughout the whole of the distance traveled. In reality, however, this is not usually the true for a distance of finite length. On one hand the force need not itself be the same at different points of space; and on the other, although the force may remain constant throughout, yet, if the path be not straight but curved, such as in the movement of a pendulum, a planet rotating about a star, or heat causing an expansion of body, etc., the component of the force in the direction of motion will still vary. For this reason it is allowable to express work done by a simple product, only when the distance traversed is indefinitely small, i.e. for an element of space.

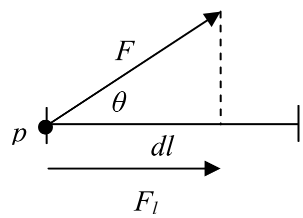
To diagrammatically go through an example, let *dl* be a length of space, F_l be the component in the direction of *dl* of the total resultant force *F* acting on point *p*, and theta θ be the angle which the direction of this resultant makes with the direction of motion of the point under consideration, then according to the rules of trigonometry, where in a right triangle the cosine of an angle equals the measure of the length of the side adjacent of the angle over the measure of the length of the hypotenuse:

$$\cos\theta = \frac{adj}{hyp}$$

where, in terms of our force component diagram, we have:

$$\cos\theta = \frac{F_l}{F}$$

we can thus calculate the infinitesimal components of any force acting on any point:



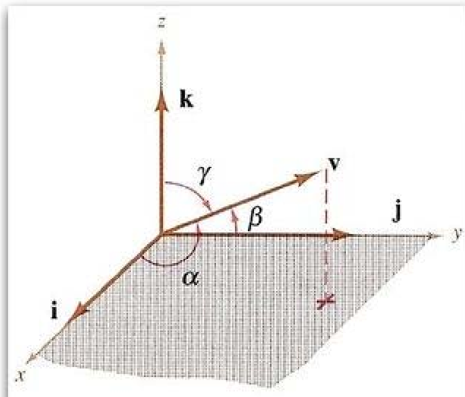
where the component of the force F_l in the direction of *dl* is:

$F_l = F \cos\theta$

and the amount of work done *dW* by the component of the force as it acts to move point *p* through its distance is:

$dW = F_l\, dl$

$dW = F \cos\theta\, dl$



Direction Angles

In three-dimensional calculations it is convenient to employ a Cartesian coordinate system of rectangular *x*, *y*, and *z* coordinates, as developed by French mathematician Rene Descartes in 1637, whereby the components of the force are resolved parallel to each axis. The standard model is shown adjacent. The angles *α*, *β*, and *γ* are called the 'direction angles' of *v*, and the quantities *cos α*, *cos β*, and *cos γ*, are called the 'direction cosines' of *v*.[13]

For the sake of simplicity, we will assume that the motion takes place in a plane in which both the initial direction of motion and the line of force are situated. This happens to the case, coincidently for most calculations of work in the case of daily human operation, which, aside from irregular situations, such as flying, elevator movement, rock climbing, etc., happen on the surface of the earth and can be approximated as occurring on a two-dimensional plane. In this system, if a given point *p* moves from a given position in the plane of the x, y coordinates through an indefinitely small space *dl*, the projections of this motion on the axes will be called dl_x and dl_y, and will be positive or negative, according as the coordinates *x* and *y* are increasing or decreasing by the motion. The components of the force *F* resolved in the directions of the axes will be called F_x and F_y, and calculated as such:

$F_x = F \cos\alpha$
$F_y = F \cos\beta$

where *α* and *β* are direction angles that the resultant force makes with the x and y axes, respectively. The same procedure is followed for the direction of motion of the point *p* in the two dimensional plane, in which the line of motion *dl* is resolved into the angles it makes with the *x* and *y* axes, which we may call angles *a* and *b*, respectively. Thus, we have:

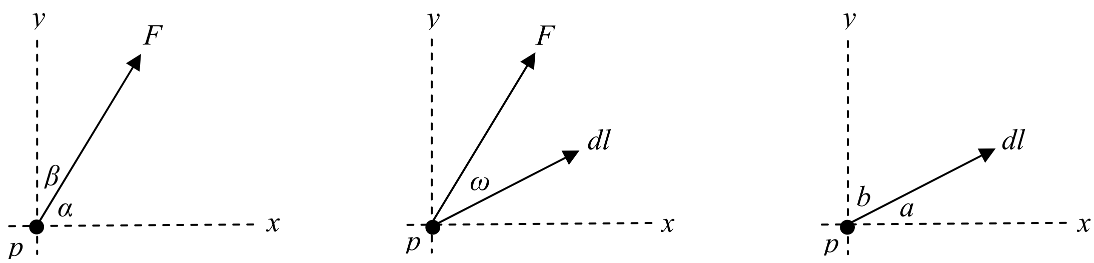
$dl_x = dl \cos a$

$dl_y = dl \cos b$

and the work done dW by a force F acting in any direction, in the $x\,y$ plane, on a point moved in any direction, in the plane, is:

$$dW = F_x dl_x + F_y dl_y$$
$$dW = (F \cos \alpha)(dl \cos a) + (F \cos \beta)(dl \cos b)$$
$$dW = Fdl\,(\cos\alpha \cos a + \cos\beta \cos b)$$

If one wishes to remove the Cartesian coordinate frame of reference, for whatever reason, one can superimpose the force vector F and the path vector dl onto one graph, as shown below in the middle:



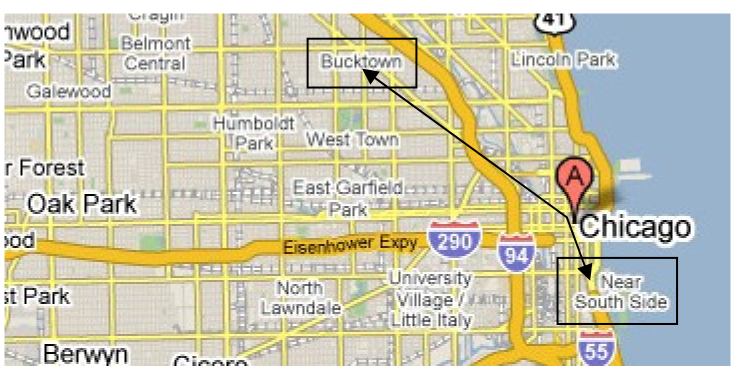
and thus find that the following rule (as can be confirmed through test calculation), which Clausius says comes from analytical geometry, will hold:

$$\cos\alpha \cos a + \cos\beta \cos b = \cos\omega$$

Hence, the work done by the force on the particle is the product of the force F times the distance traveled dl times the cosine of the angle between the direction of the force vector and the path of the particle:

$$dW = F \cos\omega \, dl$$

To go through a human molecule example, let us suppose that a man, which we will assume to be a material point moving on a surface, who lives in downtown Chicago, at point A, has in his mind the plan that when he wakes up in the morning, during the two hour window before he must go to work, that he will stop at the Bucktown gym to exercise six kilometers away from his house, as shown below:



Let us assume further that the man made the conscious decision to complete this event two days prior to the planned event. In terms of the mechanism of what is called ‘consciousness’, it is known that prior to any conscious decision to act or move the brain carries out its own internal work before one becomes consciously aware of a thought or choice to act.

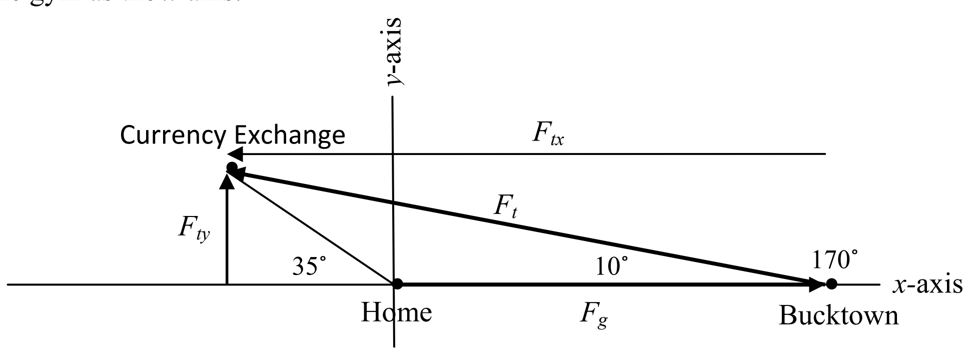
This was determined through the 1983 experimental work of American physiologist Benjamin Libet in which he demonstrated that unconscious electrical processes in the brain called a 'readiness potential', discovered previously, in 1964, preceeds decisions to perform volition or act spontaneous, implying that what one perceives as free will is a mental state brought about by internal neurochemical movements and neuroelectrical activity occurring prior to the free will state, in the sense that the former governs the latter.

In his experiments, Libet measured brain activity during voluntary hand movements and found that about 750 milliseconds before one consciously chooses to move one's hand there is a preceeding wave of brain activity.[14] This pre-conscious brain activity, called readiness potential, is in turn is driven by sets of preceeding sensor inputs, received prior to that time, which are external forces, medated predominately by the photons of the surroundings, the carrier of the electromagnetic force.

In sum, prior to conscious volution, such as in an excursion to the gym, prior sensory inputs act to mediate force through the central nervious system so to initiate the internal work of pre-conscious choice. In the case of the man, driving to the gym, we can approximate that the total set of sensory photonic inputs, prior to the working of the readiness potential, acted as a force on the man, considered here as a material point, moving him to the gym in the given time slot over a distance of six kilometers. We will designate this as force gym F_g and assign it a value of 100 newtons.

Upon arriving at the gym, while parking his car, the man encounters a meter reader who informs hims that his city sticker has just expired and that unless he leaves at that moment to get a new sticker he will receive a $120 dollar ticket. This new sensory input quickly works the readiness potential in the man's mind instilling the conscious choice that the only way to remidy the situation is to reverse his direction of motion and drive to the only open currency exchange located on the near north side, three kilometers from his house, at an angle of 170 degrees to his current direction of travel to the gym. We will designate this as force ticket F_t and assign it a value of 100 newtons.

The components of each distance and force are diagrammed below, using the line of direction from the house to the gym as the *x*-axis:



The net resultant work W completed during the course of this reverse driving situation, each force resoved into their respective x and y components, is thus the sum of the work *performed* (force in the direction of the desired action) by the gym force plus the work *destroyed* (force opposite to the direction of the desired action) by the ticket force:

$$W = W_g + W_t$$

In terms of the *x*-compoment of the total work done, given that the Home - Bucktown distance is 6 km and the Bucktown - Currency Exchange distance is 9 km:

$W_x = W_{gx} + W_{tx} = F_g (6) – F_t \cos 10^\circ (9) = 600 – 886 = - 286$ joules

In the *y*-direction, the gym force performed no work, but the *y*-compoment of the ticket force performed the following work:

$W_{ty} = F_t \cos 10^\circ (9) = 156$ joules

In this case, in the x-direction or gym direction, there was more work destroyed than performed and the net force performed no productive work in respect to the gym force or orignal plan, and in this sense the period of time and energy expended was perceptually deemed as wasteless or useless.

To summarize, in this example, according to the Coriolis work principle, the transmission of work in the movement of a material point results from the fundamental axiom, as established by Newton, that every force tends to give motion to a body on which it acts; but, as noted above, one force may be prevented from imparting motion to the body by other opposing forces, so that equilibrium results and the body remains at rest. In this case the force performs no work.

Internal energy

This simple introduction is necessary in that it leads to the derivation of the fundamental concept of internal energy, symbol *U*, of the system. In short, in any generalized system, the summation of the total set of work components done on all the particles, in the x, y, and z direction, constitute what Clausius calls the *ergal*, symbol *J*, of the system. In the human thermodynamics scenario, systems are defined by a certain number of connected people, here considered as particles or reactive human molecules, delineated by physical or conceptual boundaries, constituting a group which has a minimal amount of quantifiable interaction on a given day or time period. The summation of the total components of the micro amounts of work done by the forces on the human particles (human molecules) at any given moment constitutes the ergal of the system at a given state. This logic, according to Clausius, derives from the 1835 work of Irish physicist William Hamilton.[15]

A second component of the internal energy of the system is connected to the velocity of each particle in the system. In short, if we sum the kinetic energy of each particle in the system, or one-half the mass times the squared velocity of each particle, and call this summation the *vis viva*, symbol *T*, then we can state that the *vis viva* or 'living force' of the whole system is defined by the following expression:

$$T = \sum \frac{m}{2} v^2$$

This logic was formulated over the years through the work of mathematicians German Gottfried Leibniz (1686), Italian Joseph Lagrange (1811), and Frenchman Gustave Coriolis (1829). At any given instantaneous moment of time, then, the sum of these two quantities, the ergal *J* and the *vis viva T*, define what is called the 'energy', symbol *U*, or *internal energy* in common modern terminology, of the system:

$$U = T + J$$

This quantity is very important in thermodynamics in that changes to the energy of a body are conserved and hence if a change occurs to the body it thus must be quantified by a boundary interaction.

Thermodynamics laws

Changes to the boundary of the system, such as via heat Q or work W inputs or outputs, are quantified by what is called the *first law of thermodynamics*, defined such that when heat is added to a body its boundary will expand outward, according to what is called Boerhaave's law (1720), pushing on the surrounding space or atmosphere, thus acting so that the system does an amount of work on the surroundings:

$$dU = dQ - dW$$

The pinnacle example, in this case, of work done by the body through the boundary, is the upward movement of a piston pushing on the surrounding weight of the atmosphere.

Changes to the body of the system as heat and work are transformed into each other, as the atoms and molecules of the system do work on each other, according to what is called the *mechanical equivalent of heat*, during expansions and contractions of the system body during heat engine cycles, are quantified by what is called the *second law of thermodynamics*. In formulation the second law is defined as:

$$\int \frac{dQ}{T} \geq 0$$

This essentially means that in one heat cycle of the body, consisting of one expansion and one contraction, in a manner that the body returns to its previous state, a certain amount of heat will have been irreversibly transformed into non-recoverable internal work done by heat forces through the movement, positional changes, or work of the molecules inside the system.

The second law is the more interesting of the laws, in that transformation of heat and work internal to the system are the result of intermolecular interactions or human-human interactions. In the human system, sexual heat and its direct connection to occupation or life's work is the central example.

These two laws define what processes are allowed by nature and which are not. The laws of thermodynamics determine the spontaneity of natural process; in a sense, the direction of time and progress in evolution. The direction of evolution is embodied in the laws of thermodynamics and as such they determine the right or wrong in the supposed merits of any philosophy, religion, or creed. A great deal of work is still left to be done on this topic. Here we have functioned to lay out some preliminary foundation.

Conclusion

The modern theory of evolution asserts that all species, currently moving on the surface of the earth, have a chemical origin; originated from earlier species in time who reproduced offspring, whereby each offspring differed according to random variations; that some variations were favorable, others less favorable; that mutations of gene segments produced the variations; and that these newly formed varied species were selected accordingly, thus producing new species over time. The updated view presented herein is that this superficial picture of evolution is, in more detail, rooted in movements and reactionary dynamics of atoms and molecules, confined to systems, quantified by the mathematics of force, work, distances, time, and mass, etc., such that what are called energy and entropy determine what is favorable.

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