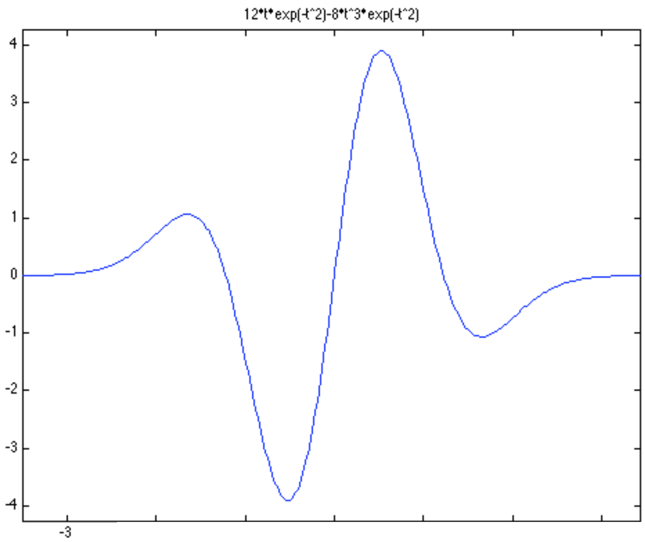
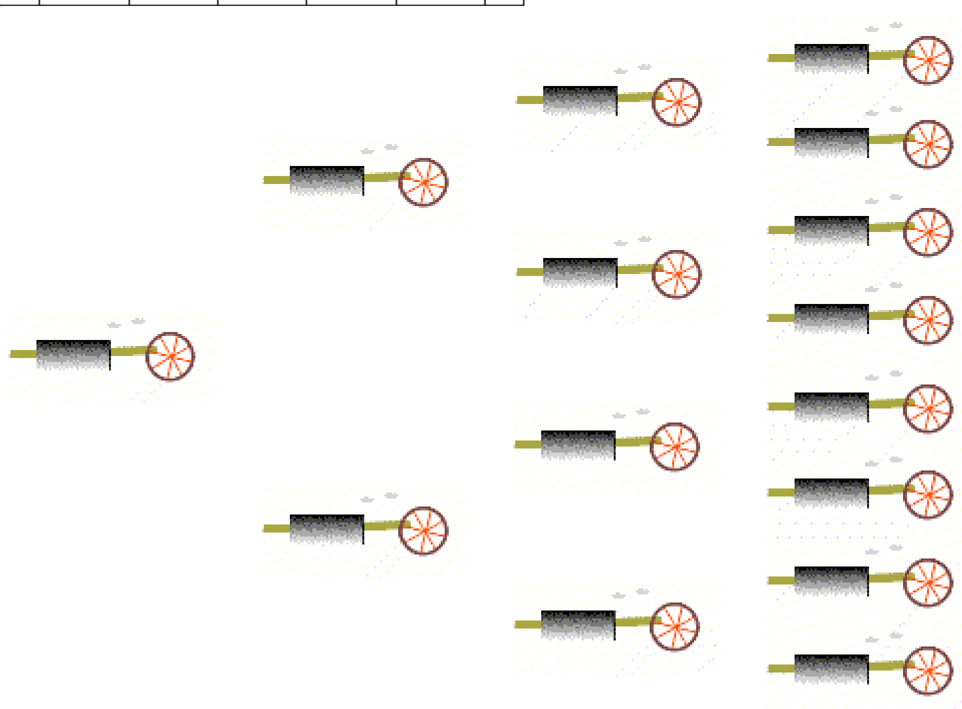
Physical History & Economics, 2nd Ed.

Supplement 1—Appendices 3 to 5

By Mark P. A. Ciotola





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Supplement One to Physical History and Economics, Second Edition

Preface

The reader is recommend to first obtain and read Physical History (2nd Edition), referred to as the “main book”, before reading this supplement. Nevertheless, this supplement may contain stand-alone material of interest such as the Appendices on Mete-Mechanics and philosophy.

Acknowledgements

Those who were thanked under Acknowledgements in the main book are thanked again, especially the reviewers.

Table of Contents

Letters contain discussions that will eventually evolve into Appendices, articles or other matter. The quality is quite rough, but these letters often represent the latest thoughts and issues in the field.

Introduction

This Supplement contains several Appendices and Letters.

Some of this material expands that introduced in main book Physical History and Economics, 2^{nd} Ed. Such is the case for Appendix 3. Other material was originally considered for the main book, but has been broken out into Appendices due to its excessively speculative nature. Such is the case for Appendix 4.

Other material was felt to excessively distract and overwhelm the reader in the main book, but may be of interest as an Appendix. This is the case for Appendix 5. Both Appendices 4 and 5 were originally part of the first edition. They may no longer be entirely consistent with the author's present thinking. Yet some readers may find them to be of greater interest than the author's current approach. They are also valuable to help trace the development of the field of Physical History and Economics.

Various topics are introduced or explained in the Letters, which comprise informal discussions. They are not up to the standards of the Appendices, but may provide the forward edge of the field or useful explanations.

Finally, the author reminds the reader that Physical History and Economics is still in its early stages, lacks the refinement and rigor the reader may be accustomed to in other works. In this regard, the author is similar to a grizzy prospector in the pioneering era of a new mining region such as the San Juans once were in Colorado. The refinements may come later with the eventual arrival of more "civilized" authors in the field.

I.2 Description of Appendix 3

Physical mechanics is introduced. This section is not meant to be comprehensive, but rather to introduce basic mechanical concepts and some of the flavor of that area. It is intended to provide some preparation for Appendix 4.

I.3 Description of Appendix 4

An approach termed as psuedo-mechanics is introduced. Pseudo-mechanics should not be confused as being the equivalent of physical mechanics; doing so may produce grossly invalid results. Yet considering various time derivatives of the Gaussian form Hubbert curves, particularly the weighted third time derivative (shock) may provide a useful analytical approach in some cases. Hubbert curves do *not* have to be Gaussian, in which case the example equations and graphs will not be applicable, except in a very general way.

I.4 Description of Appendix 5

Some philosophy is considered. The author is not well-versed in philosophy, but examines bits and pieces that seemed to have relevance to Physical History and Economics.

APPENDIX

A-3

Physical Mechanics

Physical Mechanics

Newton's Three Laws

An object will continue in motion in a straight line unless restrained by a force. This is known as inertia.

The force upon an object is the product of the mass of the object and its acceleration. Hence, $F = ma$.

For every action there is an equal and opposite reaction.

Displacement, Velocity, Acceleration and Jerk

Displacement is how much the position of an object has changed. If you drive ten miles in a straight line, your displacement has been ten miles. If your journey is over, you can say your total displacement was ten miles. However, if you drive ten miles away from your garage, and then return to your garage at the end of the day, then your total displacement for your journey was zero miles. Can you believe it? You traveled 20 miles, went on many useful errands, and all that for a total displacement of zero. You can also discuss displacement in terms of direction. For example, if you drove north ten miles in a straight line, then your displacement would be 10 miles north (or negative ten miles south). You can choose any direction, as long as you are consistent.

Speed is how fast an object travels, regardless of direction. Speed is what the "speedometer" on your car measures and too much speed is what incurs a traffic ticket. One way to think of speed is to take displacement and to divide it by time. For example 10 miles divided by 2 hours is 5 miles per hour.

Velocity is an object's speed with respect to a given direction. If we are talking about going north, then driving 200 miles north in 2 hours would be 100 miles per hour in the north direction. If you were driving 100 miles in the south direction in two hours, your velocity would be negative 100 miles per hour in the south direction. What if this time a traffic cop pulls you over and is about to give you a speeding ticket? Sure enough, you could point out that your velocity is less than 65 miles per hour in the north direction, because you were going south. However, your speed would still have been 100 miles per hour so the cop would likely be unsympathetic (although at least one judge has been outwitted by mathematical trickery on a speeding ticket).

Acceleration is the change in an object's velocity with respect to time. Any moving object that changes direction is accelerating. How can you tell if you are accelerating? Well, although the human body is not very good at "feeling" velocity, it is a pretty good detector of acceleration. When you go around a curve in a car or on a bus, you can feel your body being pulled to one side. When you speed up, you can feel your body being pulled deeper into your seat. Whenever the speedometer in a car changes, that means your speed is changing. Changes in speed involve acceleration. In fact, whenever a body (such as a car, bus or even a star or planet) moves in a curved or circular motion, the body can be said to be accelerating. If a body is slowing down with respect to a particular direction, that is said to be negative acceleration (de-acceleration).

Momentum, Force and Shock

Momentum is an object's mass multiplied by its velocity. Therefore both a rhinoceros calmly walking and a fleck of paint traveling at 10,000 miles per hour could have the same momentum. You can generally feel momentum of an object striking you. That is why bullets are so dangerous: their mass is low, but their high velocity gives them a dangerously high momentum. However, if you yourself have a high momentum (for example as a passenger in a jet plane), you won't feel it unless you are changing speed or direction). Momentum also has the important quality that for a particular system, it is conserved. It doesn't change. Say you have a stick of dynamite at rest. Its momentum is zero, because despite its mass, its velocity is at zero. Then the stick of dynamite explodes, sending bits and pieces of hot gasses in all directions. Since the gas particles have both mass and velocity, they possess momentum. However, the gas particles moving in one direction will have a positive velocity and therefore a positive momentum. The gas particles moving in the opposite direction will have a negative velocity (because the sign of velocity depends on direction), and therefore a negative momentum. If you added up all of the positive and negative momentum, the *total* momentum would still be zero. So although speed is not conserved, momentum is conserved.

Force is an object's mass times its acceleration. Unlike momentum, force is not conserved. Forces tend to pull, push or twist objects. Gravity is a force. It attempts to pull the mass of your body towards the mass of the Earth. However, like momentum, there can be negative forces. Since the Earth's gravity pulls you "downwards", you could call gravity a negative force.

Forces can be added and subtracted. If you are sitting on a chair, the chair pushes you up with a force called the *normal* force. Here, the normal force is equal in magnitude but opposite in direction to the gravitational force. If you add the normal force to the gravitational force, they cancel out. So you experience no *net* force in your chair, and you remain at rest. However, if the forces upon an object do not cancel out, that object will experience a *net* force and will accelerate. For example, any object that travels in a curved path experiences a net force.

Shock is an object's mass multiplied by its jerk. Shock can be viewed as a measure of how quickly net force changes.

Work, Energy and Power

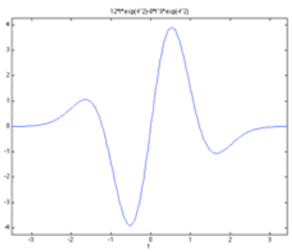
Work is the net force upon an object multiplied by how far that object has moved. Work can be either positive or negative. If an object starts at rest and remains at rest, no work is done on it.

Energy is a confusing, challenging concept. Physicists know a great deal about energy, but don't really know what energy is. The meaning of energy in typical conversation is somewhat different than that used by physicists. In typical conversation, energy refers to high-order chemical energy such as that in coal, oil or food. High order energy can be converted into low order energy in order to generate electricity, power an automobile or support metabolism. An example of low order energy is waste heat that contains energy but that is too cool or scattered to be useful. One measure of such high order, chemical energy is a substance's Gibbs Free Energy. The energy isn't really "free." It still always has a cost.

Physicists usually discuss energy in terms of motion. If an object is in motion, it has kinetic energy. Kinetic energy is one half of an object's mass multiplied by the square of its velocity. Since mass is never negative, and the square of a quantity is always positive, kinetic energy is never negative. If an object is in motion, it has positive kinetic energy. If it is at rest, it has no kinetic energy. Even when an object is at rest, it may contain atoms that are vibrating so that the atoms *do* have kinetic energy. When viewed from a macroscopic perspective, the random motion of atoms is related to an object's temperature.

Another physical concept is *potential energy*. When an object is higher than another object, it possesses potential energy relative to the lower object. This makes sense. For example, the water in a dam is at a higher level than the water downstream below the dam. When the dammed water is released, it rushes forth in a burst of kinetic energy. When physicists say energy is conserved, they mean that the sum of all of the types of energy in a system, including potential energy, cannot change over time.

Power is simply energy divided by time. A power tool is "powerful" because it contains a motor that can use up a lot of energy and do much more work in a short period of time.



APPENDIX

A-4

Pseudo-Mechanics

Appendix 5 introduces psuedo-mechanics, a method to analyze regimes and other bubbles. Terms of physics used in the following context are understood to be pseudo-forms of those terms rather than their strict physics use. Hence "force" would be understood to be "psuedo-force." Such terms are not of sufficient rigor to necessarily by constrained by the rules of physics, such as conservation of momentum and energy. Even so, psuedo-terms are still useful for analysis.

In physics, mechanics typically relates position and time, including time derivatives of the position function. In physics, position means a physical location with respect to a coordinate system. In contrast, psuedo-mechanics merely relates some dependent variable with an independent variable. That dependent variable might not have any relation to physical location or to a particular physical object.[1]

In physics, mass is multiplied by time derivatives of a position function to obtain momentum and force. In psuedo-mechanics, a weighting factor is used instead of mass. The weighting factor could represent nearly *anything*. The quality and relevance of the weighting factor expands the scope of the applicability of psuedo-mechanics while at the same time decreases its rigor. The development of improved weighting factors will be an important facet in the progress of psuedo-mechanics. Time is usually taken as an independent variable, and will be assumed to be so for this chapter. [2]

The following operational definitions would apply to regimes as well as processes and decision-making.

A5.1 Simple Time Derivatives

A5.1.1 Psuedo-Displacement

[1] Although an entire regime could be viewed as a physical object.

[2] In some cases outside the scope of this chapter, time can be the dependent variable.

The change in a dependent variable is called pseudo-displacement.

$$\Delta y = y_2 - y_1 \qquad \text{or} \qquad \Delta d = y_2 - y_1$$

For example, if automobiles produced changed from 30 million to 50 million automobiles, the meta-displacement would be 20 million automobiles. Displacement can be either positive or negative. If the number of voters supporting a political candidate decreased from 188,000 to 132,000, the pseudo-displacement would be 56,000 voters. Or if a stock price increased from $100 to $120, its pseudo-displacement would be $20. Note that there is always a unit attached to pseudo-displacement.

A5.1.2 Pseudo-Velocity

The first time derivative of pseudo-displacement with respect to time is pseudo-velocity.

$$v = \frac{dy}{dt}$$

Or more simply, the displacement divided by the change in time represents mean pseudo-velocity.

$$\mathbf{v}_{mean} = \Delta y/\Delta t \qquad \text{or} \qquad \mathbf{v}_{mean} = (y_2 - y_1)/(t_2 - t_1)$$

Mean pseudo-velocity is easier to calculate, but is less precise than pure (instantaneous) pseudo-velocity. If the number of voters supporting a political candidate decreased from 188,000 to 132,000 in 2 months, the pseudo-velocity would be (188,000 voters - 132,000 voters)/(2 months) = -28,000 voters per month. Here, we have calculated mean pseudo-velocity. To calculate instantaneous pseudo-velocity, a function is required. Mean velocity requires at least two data points.

A5.1.3 Pseudo-Acceleration

The second time derivative of pseudo-displacement with respect to time is pseudo-acceleration.

$$\mathbf{a} = d^2y/dt^2$$

Or more simply, the change in pseudo-velocity divided by the change in time represents mean pseudo-acceleration.

$$a_{mean} = \Delta v/\Delta t \qquad \text{or} \qquad \mathbf{a}_{mean} = (v_2 - v_1)/(t_2 - t_1)$$

Pseudo-acceleration is a measure of how quickly change is taking place. Pseudo-acceleration may tend to have a much greater impact than pseudo-velocity. Humans can tolerate limited amounts of change fairly well. A steady amount of change is by definition predictable and can be prepared for without much thought. However, if change is not steady, humans have much more difficulty adapting.

A5.1.4 Pseudo-Jerk

The third time derivative of pseudo-displacement with respect to time is pseudo-jerk.

$$j = d^3y/dt^3$$

Or more simply, the change in pseudo-acceleration divided by the change in time represents mean pseudo-jerk.

$$j_{mean} = \Delta a/\Delta t \qquad \text{or} \qquad \mathbf{j}_{mean} = (a_2 - a_1)/(t_2 - t_1)$$

Pseudo-jerk of large magnitude can be extremely disruptive.

A5.2 Weighted Time Derivatives

A5.2.1 Pseudo-Momentum

Pseudo-momentum is the first of several weighted time derivatives. These operational definitions concerning pseudo-momentum incorporate the above definitions concerning pseudo-displacement, pseudo-velocity, pseudo-acceleration and pseudo-jerk. In some cases, pseudo-velocity may be essentially the equivalent of pseudo-momentum.[3]

Pseudo-momentum can be determined as a weighting factor w multiplied by pseudo-velocity v.

$$\mathbf{p} = w \bullet v$$

In analyzing social data, the direction of momentum can often be ascertained, although the magnitude of momentum may be difficult to measure. In casual conversation, one may speak of a political candidate gaining "momentum."

Momentum is proportional to both the (a) change of position with respect to time, as well as (b) a "weighting" factor such as number or importance of people involved. A change in either can result in both a change in momentum.

A5.2.2 Pseudo-Force

Pseudo-force is pseudo-acceleration multiplied by some appropriate weighting factor w.

$$\mathbf{f} = w \bullet a$$

The simplest weighting factor is simply 1 times an appropriate unit (the unit may be discarded if one is merely considering proportions of pseudo-force). Another simple weighting factor is the raw value of the dependent variable.[4]

$$\mathbf{f} = w \bullet a = (y) \bullet a$$

The unit of the weighting factor will depend upon context, but should be chosen carefully. Assigning a tangible, physical unit, such as population, voters, or barrels of oil, has advantages in data collection and interpretation.

If a society maintains a constant position on an issue, there is no net pseudo-force upon that society.

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[3] In physics, the concept of momentum is frequently misunderstood as representing kinetic energy. This distinction must be noted regarding meta-momentum as well.

[4] For this simple weighting factor, the units might be absurd, but it can provide an indication of relative magnitude.

$$\Delta y = 0 \quad , \quad \mathbf{f}_{net} = 0$$

If a society changes its overall position on an issue, there exists a net pseudo-force on that society.

$$\Delta y \neq 0 \quad , \quad \mathbf{f}_{net} \neq 0$$

The magnitude of that change in position might not be measurable. Consequently, that force may be likewise impossible to measure. However, the direction of a net pseudo-force can typically be ascertained. Here, even anecdotal data may be sufficient.

If there is a change of direction (e.g. from negative to positive or from positive to zero, etc.) of the force over time, then there has been an acceleration. Pseudo-force is the time derivative of pseudo-momentum. Likewise, pseudo-momentum is the time integral of pseudo-force.

A5.2.3 Pseudo-Shock

These operational definitions concerning pseudo-shock incorporate the above definitions concerning pseudo-force. The term shock is not commonly used in this context in physics. Pseudo-shock is the time derivative of pseudo-force, or the third time derivative of pseudo-displacement. Pseudo-shock s[5] can also be determined as a weighting factor w multiplied by pseudo-jerk j.

$$\mathbf{s} = w \bullet j$$

Force is the time integral of shock. In practice, shock data may contain excessive noise, making it difficult to integrate upon.

For a sufficiently complex society or process, pseudo-shock appears to be conserved over moderate amounts of time.[6] This discovery is the most important findings of pseudo-mechanics. It is one of the few constraints that is known to operate within pseudo-mechanics. Pseudo-shock itself is of tremendous impact upon a regime. Large magnitude pseudo-shock applied over a long period of time will be indicative the development stages of the regime.

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[5] s is used here to designate shock. This does not reflect general usage in physics.

[6] M. Ciotola, "Factors Affecting Calculation of L", *Search for Extraterrestrial Intelligence (SETI) in the Optical Spectrum III*, S. Kingsley, R. Bhathal, Ed.s, Proceedings of SPIE Vol. 4273 (2001).

A5.2.4 Pseudo-Work

These operational definitions concerning pseudo-work incorporate the above definitions concerning pseudo-force.

Work is force times distance (or a suitable value or integral representing the same). We have not defined pseudo-distance, but the following is a possible formula.

$$W = \mathbf{f} \bullet \Delta y$$

Although in physics, work is not a vector quantity, it can be either zero, positive or negative, which can be analogous to direction. The direction of pseudo-work may often be ascertained. The magnitude of pseudo-work may be difficult to determine. Socially speaking, pseudo-work might be analogous to social change.

A5.2.5 Pseudo-Energy

These operational definitions concerning pseudo-energy incorporate the above definitions concerning pseudo-force. Energy exists in two chief forms: kinetic energy and potential energy. Unless otherwise stated, pseudo-energy shall refer to the analogy of kinetic energy. Pseudo-kinetic energy can be viewed at the weighted time integral of velocity, or more simply as one half of a weighting multiplied by the square of pseudo-velocity:

$$KE = (1/2)\ m\ v^2$$

Kinetic energy can be denoted by other symbols such as T, U or V. Energy is the pseudo-velocity integral of momentum. We have not discussed pseudo-velocity integrals.

A5.2.6 Pseudo-Power

These operational definitions concerning pseudo-power incorporate the above definitions concerning pseudo-force. Power is the time derivative of energy.

A rough measure of power may be the product of force times momentum. This measure incorrectly contains the square of the weighting factor. However, the direction of power might be calculated this way.

Balance of power is commonly thought to represent a balancing and therefore cancellation of forces, resulting in no net force. This is not necessarily so. Rather, balance of power can certainly involve changes of power over time. It might represent no net shock. In pragmatic terms, it means that no net power can be apparently exercised immediately. Or, that no net shock can take place.

A5.3 Pseudo-Mechanics Where A Hubbert Curve is Represented By A Normal Distribution Function

Although pseudo-mechanics can be attempted upon nearly any social function, the author primarily utilizes it to analyze Hubbert Curves. The simplest form of a Hubbert curve is produced by following equation which is a normal distribution, also called a Gaussian distribution:

$$y = e^{(-t^2)}$$

This equation differs from pure exponential growth in that the value of y starts from essentially zero as t increases from negative infinity and rises to its maximum value at t = zero. As t further increases from zero to positive infinity, y decreases and approaches zero. The area under the pure exponential growth curve approaches infinity as t increases. However, the area under a Hubbert curve can never increase beyond a certain fixed value.

Its graph is show below (this is essentially the same graph shown in the section in Chapter 9 as a normal distribution example of a Hubbert Curve). This graph begins with nearly exponential growth.

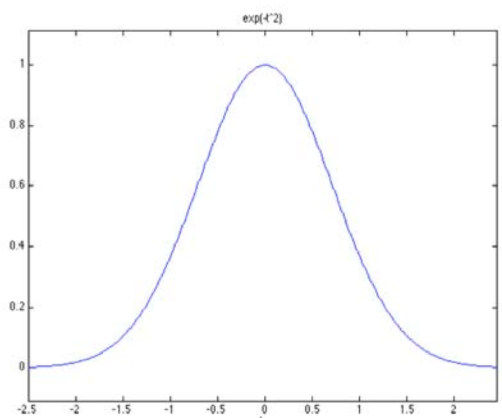

FIGURE A5-1 Hubbert curve (arbitrary scale)

The pseudo-velocity of a Hubbert curve is taken as its first derivative with respect to t (see Figure 4-2):

$$dy/dt = -2*t*e^{(-t^2)}$$

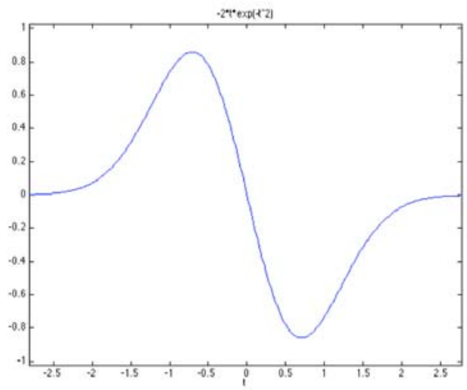

FIGURE A5-2 Pseudo-velocity of a Hubbert curve (arbitrary scale)

The pseudo-acceleration is the second time derivative (see Figure 4-3):

$$d^2y/dt^2 = -2*e^{(-t^2)+}4*t^2*e^{(-t^2)}$$

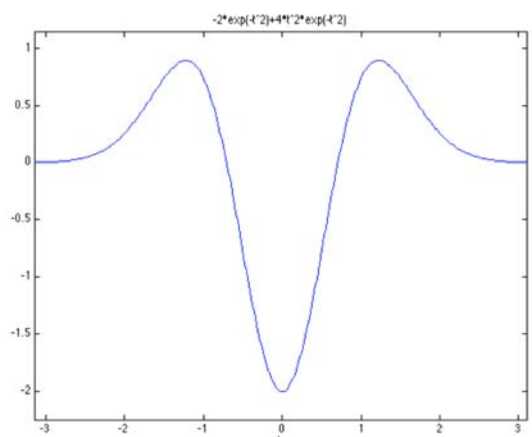

FIGURE A5-3 Pseudo-acceleration of a Hubbert curve (arbitrary scale)

The pseudo-jerk of the Hubbert curve is taken as the third time derivative:

$$d^3y/dt^3 = 12*t*e^{(-t\hat{}2)}-8*t3*e^{(-t\hat{}2)}$$

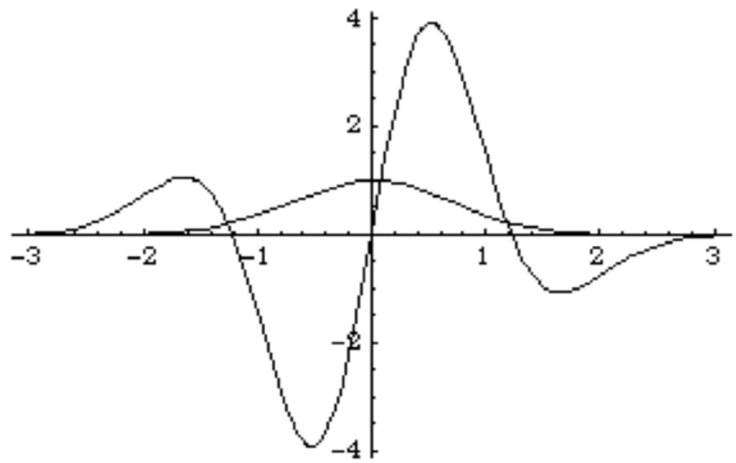

FIGURE A5-4 Pseudo-jerk of a normal distribution (superimposed on an ND)

Pseudo-jerk has a special use in profiling and comparing Hubbert curves. The first local maximum can be used as the "birth date" of the regime. Although this date might not correspond to the legal birth date, it does provide an objective and quantitative way to assign a birth date. The first minimum represents a transition point of the regime. It is entering middle age. The second maximum represents the end of middle age and the beginning of decline. The second minimum could be assigned at the effective end date of the regime. Such end date might not correspond to the legal end date. However, this avoids the issue of the endless "tail" that distributions exhibit. The regime will tend to be quite weak as it approaches the second minimum, and in fact might not even survive that long.

Note that the magnitude of pseudo-shock is greatest at the second and third transition points. An economic regime will frequently experience capital shortages at transition point 2 and severe labor crises at transition point 3.

Cumulative displacement is represented by the first integral of the Hubbert curve, which is:

$$dy/dt = 1/2*\pi(1/2)*erf(t)$$

APPENDIX

A-5

A Short Essay on Relevant Philosophy and History

Kant once pondered the relation between starry skies and moral. Although Physical History and Economics attempts to answer this question, it is desirable to consider the relevant views of past philosophers. The eventual severance between inner and outer (natural) philosophy is also considered.

A6.1 Historical Background

Physical History and Economics has its roots in both social and natural philosophy. Social philosophy can be seen as a precursor to social science, for they share many of the same subjects and concerns. Today, the social and physical sciences are quite distinct from one another. This distinction seems to have paralleled the separation of natural philosophy from inner philosophy. This separation is still the matter of some dispute:

> With the earliest Greek thinkers, to whom some physical object, or some physical quality, such as hot and cold, might seem to be the most general of all things, there was of course no question of dividing philosophy from science. The two were one. As time went on, and physical science increased, while at the same time men reflected more and more on the operation of their minds, there came to be a tendency to distinguish the two fields of thought and use philosophy only of the latter. But this restricted use of the word has never gained the consent of mankind. Men still think, and rightly think, of philosophy as the attempt to see things whole, and as the vast mass of things presented to our minds are now the subject-matter of some branch of science, it is theoretically impossible to dissever philosophy from science.[7]

[7] F. Marvin, Comte: The Founder of Sociology, Chapman and Hall, London, 1936, p. 11.

The transition from philosophy to social analysis was not surprising. Thomas Aquinas was an important medieval social philosopher who was extremely influential on later thought.

> Aquinas was a medieval philosopher who attempted to reconcile religious dogma with observations of social inequities and law. Aquinas is best known for Summa Theologica (1265-73). Social order, for Aquinas, was part of the order of the universe.[8]

Aquinas apparently felt the need to reconcile nature with morality and suggested that natural law implies an objective morality.

> Natural law had both moral and economic implications. Morally it meant that the final criterion for the rightness and goodness of an action was that it accorded with the law of God.[9]

Religion continued to link natural and social philosophy. The 1600s and 1700s were a time of great religious liberation. In England, North America, and parts of northern Europe, individuals gained the right to examine religious works for themselves in order to draw their own conclusions.[10] Indeed, many felt that such examinations were not merely a fanciful option, but their religious duty. Under Puritanism in England and Pietism in Germany this duty of quest was undertaken with the same intensity by intelligent, and learned individuals as the quest for the next IPO-worthy piece of software or computer equipment is taken in Silicon Valley. Religious freedom in those times was not a rejection of God and religion but rather a rejection of Church dogma.

These philosophers considered everything to be a creation of the Christian God and therefore requiring study,

> for in Nature is the manifestations of His power, then nothing in Nature is too mean for scientific study. [citing John Ray, Wisdom of God, 130 ff] 'The universe and the insect, the macrocosm and the microcosm alike, are indications of … divine Reason, running like a Golden Vein, through the whole leaden Mine of Brutal Nature.'[11]

Hence a social philosopher felt some duty to become a natural philosopher and vice versa. In the United States, this type of unity can be seen in individuals such as Benjamin Franklin, who both participated in the formation of the United States, wrote on both religion and philosophy and was a leading scientist in the field of electricity.

This unity gradually fell apart as scientists became more specialized, and as perhaps as science became a more lucrative profession. One could argue that the social thinkers and philosophers of the 1600s and 1700s would no

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[8] H. Fink, Social Philosophy, Methuen and Company, Ltd., London, 1981, p. 16.
[9] Ibid, p. 18.
[10] R. K. Merton, Social Theory and Social Structure, Free Press, New York, 1968, p. 628-639.
[11] Ibid, p. 635.

longer be sufficiently attracted to the science of our modern era, where graduate students spend the better part of a decade learning how to build and operate a single instrument. A contemporary news story on the decrease of domestic students entering the sciences quoted a social science major as saying he wasn't interested in science because it was not abstract enough (source unknown). As social philosophy developed into social science, motives for those entering the social philosophers eventually became to solve social problems rather than individual or religious enlightenment.

Returning to the centuries following the renaissance, science and technology began to make a slow but steady advance, culminating in the discoveries of Galileo, Newton and many others.

> Events of the most diverse types seemed to be describable in mathematical terms and to be explicable as effects of earlier events acting as causes (mechanical explanation) rather than in terms of an ideal state towards which they were all striving (teleological explanation). This crucial scientific movement was greatly stimulated by the practical use of the results of the new science in navigation, surveying, artillery and other technical fields.[12]

Such discoveries stimulated thinking on the part of those concerned with social philosophy. August Comte (1798-1857) was the founder of the field of sociology.

> Coming at the top of a wave of scientific discoveries, and excited also by the political and social changes in the European world around him, he [Comte] conceived the idea, which was shared in varying degrees by other thinkers of his time, that science might be unified and used in such a way as to harmonize the discords of human life and give an authoritative direction of human action in future.[13]

Comte took inspiration from developments in the life sciences as well as the physical sciences.

> Oaks had always come from acorns and animals bred according to their kind. Could the whole field of biology be brought under the same rule of natural law, and if so, how can we exclude the human kind, which on its animal side plainly follows a similar ordering?[14]

The next great figure in sociology, Emile Durkheim (1858-1917), moved sociology away from the natural sciences. Durkheim rejected the impact of nature and instinct.[15] This rejection may be due to the types of matters considered by sociology—cultural and deviant behavior in a post-industrial society. Nevertheless, the connection between that physical and the social remained important. "The hand placed in the fire

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[12] Fink, p. 29.
[13] Marvin, p. 11.
[14] Ibid, p. 16.
[15] Nisbit, unknown source, p. 247.

(which feels heat and pain together) recurs constantly as a philosophical example among the British empiricists."[16]

An important step towards the development of social science was taken by Thomas Hobbes, who spent most of the first English Revolution in exile in Paris as a Royalist. Although Hobbes "made use of some theological arguments, his account did not depend on any religious assumptions at all (Leviathan, 1651)," for example when discussing absolutism.[17] By taking the mysticism out of social analysis, Hobbes could argue that humans

> would be subject only to natural laws in the sense of the new natural sciences, laws such as the law of gravitation and the mechanical law that a moving body will continue its movement unless prevented by external interference.[18]

Anticipating work by Charles Darwin (The Origin of Species), Hobbes felt that

> In a state of nature, everyone would therefore do whatever they thought would secure their own survival, irrespective of whether this would harm others, or be contrary to some divine law. This, for Hobbes, was the fundamental natural right.[19]

Hobbes's right of survival implies a struggle to compete for scarce resources. Conversely, Locke advocates the assumption that the state of nature was a state of plenty (e.g. unlimited land in America in Locke's time).[20] This is an important issue, for the assumption of scarcity of resources is the fundamental assumption of classical economics (and is of paramount importance to PHE).

Along the lines of Hobbes theme of individuals competing for scarce resources, economist Adam Smith described how selfish behavior of individuals and their businesses will be sufficient to regulate a highly efficient and effective system of economics.

> The entirely selfish actions of individuals would automatically add up to the most socially beneficial result–an unconscious coordination would be achieved, as though was directed by an invisible hand.[21]

Hobbes and Smith have provided a firm basis for beginning rigorous social analysis. Highly motivated, selfish behavior is more predictable and observable than an idealistic celestial hierarchy or other positive assertions that people and society *really* are a certain way because that way is most

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[16] S. Clark, "Ancient Philosophy", Oxford History of Western Philosophy, A. Kenny, ed., Oxford University Press, Oxford, 1994, p. 134.
[17] Fink, p. 31.
[18] Ibid.
[19] Ibid.
[20] Ibid, p. 41.
[21] Fin k, p. 65.

desirable (from an aesthetic or moralistic perspective). This brings us to the next part of our discussion.

About Letters

Introduction to Letters

What Are Letters?

Letters are discussions related to physical history and economics. They explore various issues and informally introduce new material. They have been only slightly cleaned up. Some letters may be expanded into future articles, chapters or appendixes, so they may new developments or trends in some cases.

LETTER

L-1

People versus Gas Molecules; Constraints

September 7 to 9, 2009

People versus Gas Molecules

(Comments in italics are by Mansel Ismay; replies are by Mark Ciotola)

C: If I recall correctly, however, the energy referred to in Einstein solids are quanta that fill discrete energy levels in the lattice. By this reckoning, they can only vary discretely (which narrows down the values the E can take).

R: You do recall correctly. I was just trying to use a simple example, for the sake of our readers (and to save my own time). However, the energy of e.g. diatomic molecules in a gas is quantized [1], so the same principle applies.

Nevertheless, individual humans do have quite a few characteristics that gas molecules lack. Yet human behavior does frequently show sufficiently random variation to produce reasonably well-defined variations. Human mining activities are a good example. Where a sufficiently large amount of miners and mines exist, their mineral production will frequently exhibit a roughly bell-shaped curve over time. [2]

It should be noted that the typical population distribution represents a snapshot in time, where the independent variable represents a characteristic such as income, education or spending, whereas in this mining example, time is the independent variable.

The mathematics behind a purely statistical is still the same, but the time-dependent case allows for thermodynamic analysis (via fast entropy). [3]

“Artificial” versus “Natural” Constraints

C: For this reason I am more inclined to take the face validity of repeated measurements in individuals for a particular learning mechanism in a given environment, rather than accept population modeling as it is today.

R: We could be talking about two different things. This thermodynamic approach attempts to identify constraints upon populations taken as a whole rather than upon individuals. Although individuals will feel social and economic pressures due to macro effects, they will still have much freedom to act according to the science you work with, although the macro effects will tend to skew the actions of individuals. Again: the macro effects will tend to skew rather than absolutely constrain the behavior of individuals.

Reminder: the original point of my post was that a technocratic society should maximize individual freedom for individuals, in order to better model and understand the inherent constraints upon such a society and therefore plan and design more effectively. Artificially-created constraints upon individual freedom may increase short term predictability, but in some cases, they may result in "logjams" of pressure that will eventually act to bypass or mitigate the constraint. Therefore, artificially-created constraints must be applied very carefully and as seldom as needed.

C: What do you mean by "artificial constraints"? Now you're in interesting territory. Many may consider loss of private property to be an "artificial constraint" enacted by a Technate. Do you disagree with this statement?

(Note: a Technate is an alternative economic system proposed by organizations such as Technocracy, Inc., but not by either of the parties to the present discussion).

R: A good question. In this context, a natural constraint is a characteristic of the random actors of a system. Let's use a gas as an example. Here, gas molecules are the individual random actors, and they have their own characteristics. Their mass and possible quantized energy states could be considered natural constraints. Said mass constitutes a constraint upon the ability to accelerate that molecule. Possible quantized energy states constrain the quantity of energy a molecule can possess (i.e. no intermediate states are allowed).

In this context, an artificial constraint is one that we (or our control mechanism) impose. If we place the gas in a fixed-position piston, then we have imposed a fixed volume as a constraint upon that system. If we unfix the position, but exert a constant external force upon the piston, then we are imposing a fixed pressure as a constraint upon that system.

Now let's consider the example of property. There are various definitions of property. A "natural" definition of property is being able to individually maintain exclusive possession of something of value, such as an object, an area of land, of the right to perform an economic activity. Here, ownership is a function of your ability to exclude others from possessing that thing of value. Your personal characteristics and the personal characteristics of other individuals could be said to be the natural constraints in this example. If you are relatively intelligent and physically strong, you may be able to enforce your possession, and thus hold more property than individuals who are weaker or less intelligent. (In a gas, this would be the equivalent of a more massive neon atom dominating a collision with a less massive helium atom).

An "artificial" definition of property is rights of exclusive possession that are enforced by a government. Here, an "external agent" constraints the interaction between individuals. Once a property right is granted or recognized, the force of the government will constrain the efforts of an individual to de-possess another individual with recognized possession property (legally speaking, conversion). Possession can still sometimes be transferred, but only under certain conditions. Both common law and legislated property rights constitute an artificial constraint.

That said, it should be noted that technocratic government laws or policies that restrict the possession of property or that restrict its transfer among individuals (such as the inability to sell a parcel of land or a home) also constitute an artificial constraint upon the interaction of individuals.

Whether a constraint is advantageous or disadvantageous depends upon the purpose to be achieved and the nature of the constraint in question. They can be desired by the weak to protect their possession of valued things, or they be undesirable by mucking the mathematics of distributions I use.

I can't resist sounding like a broken phonograph record, so I will point out that government (or group) recognized property rights can considerably reduce conflicts over possession, thereby improving the smooth functioning of a society and allowing it to consume more energy and increase its rate of entropy production. Therefore the concept of property laws is consistent with the principle of fast entropy.

Citations:

1. Schroeder, D. V., Introduction to Thermal Physics. Addison Wesley Longman, 2000.

2. M. K.Hubbert, Hewitt, etc.

3. Ici, le citation, c'est moi.

4. Carroll, B. and D. Ostlie, An Introduction to Modern Astrophysics, 2nd Ed. Pearson Addison-Wesley, 2007.

5. Prigogine, I., Introduction to Thermodynamics of Irreversible Processes, Wiley, New York, pp. 67. ff., 1967.

6. Ciotola, M., Physical History and Economics, 2nd Ed., 2009.

LETTER

L-2

Predator-Prey Relationships

September 7 to 9, 2009

Predator-Prey Relationships and Regimes

In our discussion, we were considering how a population of rabbits will expand to maximize consumption of available growing grass, and how a population of coyotes will likewise expand to maximize consumption of available rabbits (even though this could result in a lower rabbit population).

In reality, the rabbit-coyote example will approach a steady equilibrium, but will frequently deviate it in patterns known as predator-prey relationships. (Blanchard, Devaney, Hall, *Differential Equations, 2nd Ed.*, 2002.) Such patterns are similar to dynasties and economic bubbles in that they are encouraged by fast entropy, often display exponential growth, reach limiting factors, and decline (for each population). Indeed, the relation between classes in traditional societies can often be viewed as a predator-prey pattern. History texts focus on the glorious events of the "coyotes", while it is the role of my work to also model the events and states of the supporting "rabbits". For every dynastic Hubbert curve, there are additional lagging and leading curves for "rabbits" and other aspects, but the data to confirm these models requires more time and effort than obtaining basic data for dynastic curves.

A key difference, though, between simple predator-prey model and a true "Hubbert" curve is coordinated behavior. In simple predator-prey model models, interaction is between individual coyotes and rabbits. In a complex human society, the phenomena of the group imposes additional "artificial" constraints. This certainly makes modeling more challenging, and deriving cumulative behavior from fundamental physical principles even more challenging. Yet dynastic and other group patterns repeat themselves so frequently, it is still possible to make a unified science out of this.

LETTER

L-3

Hubbert Versus Gibbs Populations

September 7 to 9, 2009

Characterizing Populations as “Hubbert” or “Gibbs” Types

One must be careful with exactly what population one considers.

For such a thermodynamic approach to society, there are two different types of population, along a sliding scale. One end of that scale are "Hubbert" populations that are relatively large and will tend to follow their own independent "path". During much of their histories, countries such as China, Russia and France would fall into this category. At the other end are "Gibbs" populations that are relatively small and whose path tends to be highly influenced by Hubbert populations. During much of their histories, countries such as Korea, Latvia and Belgium would fall into this category. (Ciotola, M., unpublished manuscript, 2009).

The terms "Hubbert" and "Gibbs" as applied to human populations and countries are my own creations, but inspired by Schroeder, etc.)

Citations:

1. Schroeder, D. V., Introduction to Thermal Physics. Addison Wesley Longman, 2000.

P.O.C.

Points of Contact

Points of Contact

Fast Entropy Commercial Site

www.fastentropy.com

Fast Entropy Non-Commercial Site

www.fastentropy.org

EQ

Basic Equations

Simple exponential formulas

$y = e^t$ (exponential increase)

$y = e^{-t^\wedge 2}$ (normal distribution)

Trigonometric formulas

$y = a \sin (b\,t + c) + d$

$y = a \cos (b\,t + c) + d$

More Exponential formulas

$y = k_1 e^{k_2 t}$ (exponential increase w/constants)

$y = k_1 e^{-k_2 t^\wedge 2}$ (normal distribution w/constants)

$y = k_{1t}^{2} e^{-k_2 t^\wedge 2}$ (simplified Maxwell-Boltzmann distribution w/constants)

Pseudo-Mechanical formulas

Pseudo-Displacement

$d = y$ or $\Delta d = y_2 - y_1$

Pseudo-Velocity

$v = dx/dt$ or $v_{mean} = (y_2 - x_{1)}/(y_2 - t_1)$

Pseudo-Acceleration

$a = d^2x/dt^2$ or $a_{mean} = (v_2 - v_{1)}/(t_2 - t_1)$

Pseudo-Jerk

$j = d^3x/dt^3$ or $j_{mean} = (a_2 - a_{1)}/(t_2 - t_1)$

Pseudo-Momentum

$p = m\,dx/dt$

Pseudo-Force

$f = m\,d^2x/dt^2$

Pseudo-Shock

$s = m\,d^3x/dt^3$

Thermodynamic formulas

Simple Thermal Conduction

$dQ/dt = -k_{tc} A\,\Delta T/\Delta x$ (k_{tc} is a constant)

Heat Engine Efficiency

$e = 1 - T_C/T_H$

Fast Entropy formulas

Variational Principle

df/dt = 0 indicates a maximum or minimum

Constants

Baseline Regime Lifetime

300 years

Maxwell-Boltzmann

1.381×10^{-23} J/K

Conversions

Temp in °C = (5/9)(°F - 32)

Temp in K = °C + 273.15

1 "food cal" = 1000 cal = 4.186 J

1 Btu/1054 = 1 J

1 W = 1 J/s = (1/1054) Btu/s

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R

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Prigogine, I., *Introduction to Thermodynamics of Irreversible Processes*, Wiley, New York, pp. 67. ff., 1967.
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Note on references:

The author independently conceived the statements made in this essay, with the exceptions, of course, of the 2nd Law of Thermodynamics and its application to heat engines, and the Big Bang, the formation of matter, the fusion of stars, the formation of planets and evolution. However, so many people have written on thermodynamics, that the author does not claim the statements are new. Nevertheless, to the author's knowledge, the author is the first to synthesize all of these statements into an integrated whole. The author has subsequently been introduced to relevant the prior work of J. A. Burt, M. K. Hubbert, Meadows, and I. Prigogine.