b11 Theories and discovered facts < physical & historical sciences >

> Life is understood backwards but it is lived forwards. —Søren Kierkegaard.[1]
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> When old assumptions crumble under the press of intuition and experiment, fresh perspectives can emerge that yield previously unimaginable results. —Rodney W. Nichols.[2]
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> Scientific enquiry is the search for truth, whether or not the truth pleases us. —David Bohm's maxim as paraphrased by Lynn Margulis.[3]

Definite distinctions can be made in science between an hypothesis, a theory, and a discovered fact. In conversation, a theory and an hypothesis, along with a wild guess, an opinion, an idea, a gut feeling, or a supposition, are often taken to be synonyms. So in speech, any of these can be offered as a casual explanation for something observed or reported. Discovered facts cannot be wished away.

In science, a theory is *not* a casual explanation but has the stature of a natural law or an empirical fact. In other words, a scientific theory is a predictor that has been tested for reliableness or is an explanation that has been tested for truth and currently supersedes all other possible explanations. This righteous stance is however subverted by media reporting. In Mark Hertsgaard's review of *The High Stakes Battle Over Earth's Threatened Climate* [4] by Ross Gelbspan, he expects to be understood when he writes: "With the help from the credulous news media ... the fossil fuel lobby has achieved the goal stated in a 1991 planning memo unearthed by Gelbspan to 'reposition global warming as theory rather than fact.'"[5] In 2001, William Safire, could write: "Remember when *global warming* was a hotly disputed phrase? At the sudden order of the Great Namechanger, *global warming* was iced and *global climate change* took its place. No explanation; no argument; the order came down, and everybody on both sides of that argument marched off in lock step."[6] But visit the EPA Global Warming Site and NOAA (National Oceanic & Atmospheric Administration) websites **(*Footnote b11.1*)**

In the English language, the correct meaning of words is derivable from how native speakers use them. And there is little profit in trying to restore to a word a meaning that it has clearly lost or never really had (lexicographers since 1706 have defined theory as "a supposition"). In applied science even as early as 1866 any hope that theory has significance more than idle speculation was ended when Grove Karl Gilbert one of the most influential instructors of fledgling geologists wrote: "In the testing of hypotheses lies the prime difference between the investigator and the theorist. The one seeks diligently for the facts [observations] which may overthrow his tentative theory, the other closes his eyes to these and searches only for those which will sustain it."[7]

What one must do is sort out and make clear the differences between observation, hypothesis, theory, and discovered fact.

The following definitions are recommended:

observation — refers to something that is sensed and is so described.

hypothesis — is an ad hoc inferential explanation (an abductive inference by the informed mind) for what has been observed. From its claims, consequences still to be tested can be deduced.

theory — is a description, to a demonstrated reliability, of nature, and is product of physical sciences. Theories that are deemed laws cannot be proven so in any absolute way as the observational bases of the physical sciences, to date, resist explication. For example the observed phenomenon of gravitation is well described to two levels of excellence: Newton's and Einstein's. Neither theory, however, is derived from any understanding of the phenomenon. What gravity is, is a mystery. For that reason, theories of physical sciences are merely reliable; and understanding remains elusive.

discovered fact — is a description of nature that has an historical component. Its reality is contingent upon the existence of consistent nature. (*Historical geology discovers the facts of prehistory.*)

Jim Roddick has found corroborating evidence that much granite has a metasomatic origin.

Geological examples:

A lunar crater could, by hypothesis, be the product of volcanism (a caldera) or impact (a meteorite crater). Deduction of what observations can be made, or which experiments can be formulated, to decide and establish (and have) the fact that many and likely all Moon craters are due to impact.

"Drift" on continents is till & glacial outwash is an hypothesis. This leads to the further hypothesis that there was an Ice Age. Deduction of the consequences of these hypotheses have suggested a wide variety of tests to verify or disprove them. The facts of drift on continents being till & glacial outwash, and of an Ice Age, have been established.

Humans, chimpanzees and other great apes evolved from a (an in-) common ancestor (a concestor).[8] This is an hypothesis that can be tested against the fossil record and a knowledge of genetics. The fact is plain.

Granite is an igneous rock is an hypothesis that has been disproved in many instances. A process called *granitization* [9] is invoked (see *Granite— Monarch of the Continental Crust,* **Jim Roddick's** *website* [10]) to explain the origin of granites that fail observational tests that they are intrusive.

Here, we agree with Ludwig Wittgenstein (***Figure b11.1***) who has denied for the physical sciences the possibility of arriving at anything more than theory in that "at the basis of the whole modern view of the world lies the illusion that the so-called *laws of nature* are explanations of natural phenomena." For the physical sciences, this criticism is valid for none of the fundamental laws can be deduced and all are arrived at by induction. For example, it is not possible to prove the first through third laws of thermodynamics by deductive methods. However, these philosophical limitations are not relevant for deduced compound laws to hold at the level of the natural sciences where to quibble, as Steven Weinberg puts it, "that the laws of nature are not explanations of natural phenomenon is like telling a tiger stalking prey that all flesh is grass. ... our civilization has been powerfully affected by the discovery that nature is strictly governed by impersonal laws. As an example I like to quote the remark of Hugh [Redwald] Trevor-Roper that one of the early effects of this discovery was to reduce the enthusiasm for burning witches [also hanged, strangled, and beheaded, from 1400 to 1800 at an annual rate of some 100 female and a fifth as many male witches, Matilda Gage has estimated]."[11]

Discovered fact is distinguishable from theory (***Table b11.1***).

Historical geology is a science because it seeks to discover the facts of prehistory by using the scientific method. Nevertheless, much of historical geology can be classified as ironic science. That is, it is speculative. The principle of uniformitarianism weakens as a guide as we venture further and further into the past. John Horgan likens ironic science to literary criticism which, while thought provoking, is faddish and does not converge on unassailable truths. He points out that certain questions can *only* be answered ironically: "How exactly did life begin on earth? Just how inevitable was life's origin and its subsequent history?" [12] Even so, prospection is often successful when based on the speculations of ironic science. It's what can get us up and going. Postdiction then explains the findings and what led to them is often found to be false. Thereby, natural science advances one jot.

Do not all charms fly
At the mere touch of cold philosophy?
There was an awful rainbow once in heaven:
We know her woof, her texture; she is given
In the dull catalogue of common things.
Philosophy will clip an Angel's wings,
Conquer all mysteries by rule and line,
Empty the haunted air, and gnomed mine
Unweave a rainbow.

— Keats *Lamia* [13]

A scientist is one who answers "no" to the question and can assure that the end of wonder is not at hand. The term *scientist* applies to a person who contributes to and communicates learned (not revealed) knowledge. As a neologism it came to be so.

Science is the impartial seeking for truth by its practitioners. The development of printing in the mid-fifteenth century began the process of making a deluge of information available to the general public. Like that confronting today's users of the Internet, readers had quantity, but what of quality? What claim, or counter-claim, comes closest to truth? What should one read, and how should one read it? Initially the pursuers of truth were people who were privileged, by position and wealth, not to be grubbing for a living.[14]

Huxley's genius in the nineteenth century was to create institutions of learning that taught science which, when done, also earned a living for the scientist. In the new atmosphere, W. V. Harcourt's welcoming address at the inauguration of the British Association of the Advancement of Science (BAAS) in York, 1831, could be against clubbiness, and to stress sharing: "The chief Interpreters of nature have always been those who grasped the widest field of inquiry, who have listened with the most universal curiosity to all information, and felt an interest in every question which the one great system of nature presents. Nothing ... could be a more disastrous event for the sciences, than that one of them should be in any manner dissociated from another."[15]

Discomfort with science can be for the reason spelled out by Bertrand Russell: "Native realism [common sense] leads to physics, and physics, if true, shows that native realism is false. Therefore native realism, if true, is false; therefore it is false."[16]

The purpose of the BAAS was to open "new channels of communication" so that of scientific papers read to members at the meetings, at "least abstracts" of these should be presented in evening sessions to which would be admitted "a more popular audience." Whewell, that veritable mint of new coinages, floated the word 'scientist' at the three first meetings (1831 in York, 1832 in Oxford, 1833 in Cambridge) and in his anonymous review of *On the Connexion of the Physical Sciences* by **Mary Sommerville**[17] he wrote "that by analogy with artists, they might form scientists."[18] At the time, Sedgwick, President of the Geological Society of London, was appalled by the notion of being so labeled (***Footnote b11.2***). For, in the spirit of *Connexion* (read communication), scientist (with the whiff of the artisan about it) stood for promulgator of popular science. Whewell though was still at it in 1840: "We need very much a name to describe a cultivator of science in general, I should incline to call him a scientist." The label would finally begin to have cachet only after a Government Department of Science and Art (read technology) was established in 1853 to turn out, what chemist Lyon Playfair, Secretary of Science, and a School of Mines graduate, called "searchers after the truth ... the horses of the chariots of industry."[19]

Robert King Merton coiner of such memorable phrases as "self-fulfilling prophecy" and "role model," described in 1942 science norms to be universality, communalism, disinterestedness and peer review (organized scepticism) of its findings.[20] This "pure academic science" John Ziman in 2000 posited may have existed in scientist's minds but the public understanding of science does not discriminate between science, technology, or how these are implemented and applied. This latter was what in the 1960s, relativist, constructivist critics of science with their Kantian credo[21] were all steamed up about. Since then the scientist's and the public view of science has somewhat converged. In telling it like it is, "Post-academic science" admits that science is both social and a profession.[22]

Modernism is defined by acceptance of science as truth, verified in the public mind by the working of modern technologies. Untrue is the cliche, oft repeated (as in *Putting Science in Its Place* by David N. Livingstone, 2003),[23] that the Protestant Reformation paved the way for the Age of Enlightenment

(the Kantian motto for which is "*Sapere aude!*" or "Dare to be wise by free inquiry!").[24] The historical fact is that the Reformation (begun 31 October 1517 when Martin Luther posted his *Ninety-five Theses* at Wittenberg) was a fundamentalist movement in that it tried to reestablish revelation over interpretation. In spite of the backpedaling against the Scientific Revolution of the 16th and 17th centuries by both the Reformation and the backlash it fostered, the Inquisition, Modernism began in the 18th century by virtue of *encyclopedias* (called thus for the implication that these works encompass all human knowledge). *Encyclopédie* published in two vols. in 1728 (and produced single-handedly by an English hack, Ephraim Chambers) gave visibility to science as being the most active and rapidly changing field of knowledge that, as Richard Yeo in *Encyclopaedic Visions*, 2001, points out, dictated the necessity for frequent updating.[25] Then became vogue natural history museums that foster new knowledge through wonder and classification.[26]

Thomas S. Kuhn's historical study of *The Structure of Scientific Revolutions*, 1962, can be read as: either (which was his intention) that social factors influence the production of scientific knowledge, and that this is a fascinating tale systematically denied by philosophers; or (which was not his intention) that apparently secure scientific knowledge was never more than the collective opinion of a particular social group, and could thus be debunked by reference to the views of other groups.[27]

Post-modernism in science is a loss-of-innocence realization that science can be used as a screen for the nefarious but in arts and humanities it is a metaphysical relativism that would deny that formal rationality can really, really, add to happiness, goodness and beauty.[28] ❑

Footnote b11.1 Mean temperatures of the atmosphere at Earth's surface and the ocean above the thermocline increased about 0.8 ºC over the last 100 years and 0.037 ºC over the last 50 years respectively.[29] Tracking climate to identify possible anthropogenic (human originated) rather than natural change began near the end of the nineteenth century. In *Monthly Weather Review*, 1933, Swedish chemist Svante Arrhenius drew attention to a significant warming trend.[30] This continued until 1938 and he related it to the greenhouse effect (the modern concern) of anthropogenic carbon dioxide build up in the atmosphere: "We are evaporating our coal mines into the air" is a much quoted paraphrase (by a forgotten author)[31] of Arrhenius' voluminously expressed concern.[32] However, that trend was followed by a global cooling accelerated by anthropogenic aerosols from industrial pollution blocking out sunlight. In the industrial boom after World War II, Andrew C. Revkin points out in *Living in the Greenhouse*, 2003, one human emission was canceling out another until clean-air laws began removing the cooling veil.[33] From fear of a new ice age, the alarm then switched, with 1980s and 1990s strong warming, back to Arrhenius' CO_2 theory and concern.[34]

Footnote b11.2 Not so Dugald Stewart (1753-1828) at the University of Edinburgh who in his lecturers raised the "common" in commonsense philosophy to the "good sense" of say an Adam Smith, a *trained* political economist who will have more insight into the laws of human behavior (our propensity to 'truck, barter and exchange' vies with 'take, bully, and extort') and so be better able to predict how a certain fiscal policy will compel people to act, than the people themselves, and a Joseph Black, a *trained* experimental scientist who will be able to offer a more comprehensive and more precise account of our daily reality than our own untrained and unscientific understanding.[35]

Figure b11.1 **Ludwig Wittgenstein** (1889-1951)
As we are in this reality and cannot look at it from beyond we can only judge scientific truth as is undeniably manifest in technologies based on its revelations. To reveal more, language is inadequate. In his 70 page *Tracticus Logico-Philosophicus*,1922, written as a model of clear thinking, he posits that the way we arrive at truth cannot be expressed coherently but not to worry. James Robert Brown (in *Who Rules in Science*, 2002) provides this insight: "In his *Tracticus*, Wittgenstein offered a theory of meaning and truth. The consequence, which he fully recognized, is that all the statements in the *Tracticus* itself are meaningless. His own theory was one of those things that, by his own lights, could be shown, but not said. In other words, the *Tracticus* itself is, strictly speaking, nonsense. Wittgenstein introduced his now famous metaphor: reading and understanding the *Tracticus* is like climbing a ladder; after we have climbed to the top, we can throw the ladder away, for now we see the world aright."[36]