Goethean Science and the Reciprocal System

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The understanding of natural sciences is an essential requirement of living in today's world, not only because of its utility in daily life, but also due to the effect science and technology have had over current thinking patterns and human values. Many thinkers and experimenters have labored over at least five centuries to develop these sciences, culminating in the world-view of physical science today. Be it biological proteins or chemical reactions, rocket science or cell phones, eventually the ideas involved in their development can be traced back to this world-view and identified by the ideas of scientists such as Isaac Newton and Descartes (Mechanics), Albert Einstein (Relativity) and, among others, Werner Heisenberg (Quantum Mechanics).

While there are certain variations in the approach of each of these fields, there is a common factor to all of them: their treatment of space, time, and matter. Newton postulated *absolute space*, *absolute time* and *mass* with the additional comment - "I do not define time, space, place, and motion, as being well known to all." Since then, there developed a view of the universe that can be called the *Universe of Matter*, where matter exists in a background setting formed by space and time. Put simply, it is the view of a tennis ball occupying a certain position at a certain time, and all measurements in the sciences can ultimately be reduced to these quantities. Even if the more recent developments in Quantum Mechanics are considered, where wave properties are included, the role assigned to space and time as being a sort of "background" or "stage" in which the events of the world occur has continued. In physics parlance, this stage is called "reference frame", with three dimensions of space and one of time. The tennis ball (or water, in the case of waves) set in a reference frame, forms the basis of most concepts, from the nanometer range to the far reaches of the galaxy.

While this view of looking at space, time and matter might have been a very useful one, as a scientific concept it is subject to the same bar of scientific accuracy as any other concept: it can only survive as long as it matches reality accurately. No assumptions or theorizing can survive which do not match the phenomena, and when this test is applied to the concepts above, it holds some surprises. For example, it can be observed that one never measures space without time, and time without space. Every measurement of distance, whether it is a galvanometer, microscope or a simple ruler, involves at least a small passage of time. Similarly, every tick of the clock or vibration at an atomic-scale involves traversing a certain distance (or angle). In other words, space and time are intimately intertwined, and there is no separation of one from the other. Moreover, they always occur whenever a change or velocity occurs. The pure phenomenon reveals that space and time are secondary concepts, while the velocity or change is the primary concept. This stands in stark contrast to the rest of physical science, which treats velocity as a secondary quantity, as a relation of space to time.

While this might appear to be a minor difference, since it occurs in the very heart of the scientific worldview of measurements and quantification, it leads to entirely different consequences. Just as a deviation of half a degree in an airplane's flight path can lead one to a different continent if not corrected, a conceptual problem at the basis of science can lead one similarly astray. The correction to the concept comes from the phenomenon itself, and this approach of putting the phenomenon first is called *phenomenology*. Theories and postulates may come and go with every scientific revolution, but the phenomenon persists, making it a suitable starting point for scientific enquiry.

Goethean Science

Phenomenology as a science was inaugurated in the early 1800's by Johann Wolfgang von Goethe, more widely known for his poetic works in German. By focusing on the phenomena, and assigning the task of the experimenter to identify the interrelationships between the phenomena, Goethe's approach was in stark contrast to the highly mathematical approach of the day. It was taken for granted by Goethe's contemporaries that understanding the world necessarily involved theories based on mathematical rules. However, Goethe insisted that it was the mathematical *mode of thought* of systematically passing from one fact to another which was important and not just the mathematics itself, and the phenomena should guide the mathematics (if at all) instead of the other way around. This approach of placing the phenomenon at the center of scientific activity met with little understanding, as most scientists preferred to take the view that Goethe had not "gotten" mathematics and had rejected it for that reason. As a result, the physicists did not understand what his *Theory of Colors* was all about, while biologists failed to understand his morphological approach to plant development. A few decades later, another brilliant experimentalist, Michael Faraday, opened up the domain of electromagnetism by this method of systematic thinking, even when he did not know the rudiments of the mathematics of his time. Nevertheless the connection with phenomenology passed unnoticed as his discoveries were immediately put in mathematical form. Even today it is commonly assumed that Goethe's thoughts on science are a curiosity at best. Goethean science was hence relegated to the sidelines of scientific development.

With the renewal of interest in Goethe's natural scientific works by the philosopher Rudolf Steiner, it was possible to proceed forward on the same lines by examining the fundamentals of natural science in a phenomenological way. In a series of lectures, including those on Light, Heat and Astronomy, Steiner pointed out the approach to be taken if one had to move forward in the physical sciences; particularly with respect to the properties of space and time:

> Now the opinion prevails that what is actually given in real Nature in such a case is the distance ***s*** the body passes through, and the time ***t*** it takes to do it. We are supposed to be dividing the real distance ***s*** by the real time ***t***, to get the velocity ***v***, which as a rule is not regarded as being quite so real but more as a kind of function, an outcome of the division sum. This is the prevailing opinion. And yet in Nature it is not so. Of the three

> magnitudes — velocity, space and time, — velocity is the only one that has reality. What is really there in the world outside us is the velocity; the s and t we only get by splitting up the given totality, the ***v***, into two abstract entities… From the velocity, the one thing actually there, we by our thinking process have sundered space and time; yet the space in question is not there at all save as an outcome of the velocity, nor for that matter is the time.
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> R. Steiner, *First Scientific Lecture Course (Light)*, Lecture 5, Dec. 27, 1919.

> If you were physicists, I would draw your attention to how people reckon with distance traversed and time. They call the velocity, usually denoted by 'v', a function of distance and time, and they arrive at the following equation: v = d/t
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> But, my dear friends, that is absolutely false. The velocity is not a resultant; the velocity is an elementary principle or quality that something, be it material or spiritual, bears within it. And this velocity we analyse; we split it up into distance and time. We abstract the two things out of it — space and time. Space and time, however, are not real things in themselves. Velocities, varying velocities, are real. This observation I make for the benefit of physicists.
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> R. Steiner, *Mission of Michael*, Lecture 7, Dec 6, 1919

These indications showed that the actual phenomenon was once more placed in the center of the investigation. After identifying the phenomenon, the next step was to identify the interrelationships between the phenomena, which was where another key-concept of Goethe's – *polarity* – was brought to the fore:

> Polarity inheres in the phenomena of Nature in so far as we think of them in a material sense. It consists in this: everything of a material nature expresses itself in two opposites, like the magnet, in a north and a south pole.
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> R. Steiner, *Goethe's Conception of the World*, Chapter 6, 1897.

Goethe treated the polarity of light and darkness as a primary relationship between the phenomena, leading the way to his *Theory of Colors*. Steiner indicated a similar path to move forward in the physical sciences, while quoting the words of Wilhelm Ostwald, the famous chemist:

> "The task of science is to bring realities, demonstrable and measurable magnitudes, into a definite relationship to each other, in such a way that when certain realities are given the others can be deduced; and this task cannot be accomplished by basing things on some hypothetical picture or other, but only by demonstrating the *reciprocal relationships* (italics mine - GKV) of dependency between measurable magnitudes." If one disregards the fact that Ostwald is speaking in the sense of a natural scientist of the present day and therefore sees in the sense world nothing other than demonstrable and measurable magnitudes, then his view corresponds entirely with mine, in the way I have expressed it,

> for example, in the statement: "Thinking consideration must encompass what is perceptible ... and must seek the interrelationships within this area."
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> R. Steiner, *Goethean Science*, Chapter 17, 1897.

This means that *ad-hoc* theorizing is ruled out, and the conventional Kuhnian view that we are eternally doomed to keep making up better and better "models" of reality is fully abandoned as useless. There is only reality and phenomena facing us, and bringing the phenomena into the right relationship, like rearranging the letters of a word in order to read from the Book of Nature, is the task of the scientist.

However, there were not many who carried forward this task, even when a deluge of experimental results were available during the war years and thereafter. Ernst Lehrs, in his wide-ranging work *Man or Matter* (1958), makes a great beginning by treating the physical properties phenomenologically and identifying the polarities in it. For example, he identifies a polar opposite to Gravity, which he calls Levity, and a polar opposite to Inertness (or inertia), which is called Alertness, and utilizes these concepts to shed light on a host of physical facts. Nevertheless, while outlining the qualitative behavior of several physical phenomena, the quantitative relations were not examined in his work. No further significant development of the ideas came from Europe, instead it was from America that this obscure path was taken up once more.

Reciprocal System of Dewey Larson

In the 1920's and early 1930's, a chemical engineer, Dewey Larson (1898-1990), began investigating afresh the properties of substances in his gas company, after noticing that many of the standard equations did not yield adequate results and had too many *ad-hoc* constants. Being quite unaware of Goethe, Steiner or Lehrs' work, Larson independently came upon the polarity between space and time as related to velocity. He called this polarity "Reciprocity", the fundamental phenomenon "Motion", and related velocity to the speed of light in his Reciprocal System of Physics. This provided a *quantitative* basis for the development of a general physical theory, to supplement the qualitative descriptions of Lehrs. Furthermore, he also realized that dealing with physical phenomena using reciprocity in velocity also made motion prior to matter. This questioned the fundamental assumption of mainstream physics, that space and time formed the stage on which "matter" acted. Instead, his studies indicated that matter is simply a three-dimensional expression of space and time, so the "actors" and the "stage" are one and the same.

This was an important advancement on the path of Goethean studies, because it made use of both the phenomenology as well as the polarity, in terms of physical magnitudes. In sharp contrast to modern physics which extrapolates the laws in the laboratory to the far reaches of the universe, the Reciprocal System deals with all quantities as having their natural reciprocals, leading to natural limits beyond which their action also becomes reciprocal. Most importantly, there are no fundamental constants used except those closely related to velocity: light-speed, and a reference

for unit space. The magnitudes of all the other fundamental constants of physics are derived out of this relationship. With this approach, identification of physical magnitudes becomes equivalent to identifying the interconnections in a beautifully woven carpet, as opposed to postulating patches of cloth to cover each section of the floor. It also removes the artificial dichotomy of "matter" and "space time background" and replaces it with the polarity within the magnitudes themselves:

> Previous investigators have not realized that the "setting" concept is a creature of the "matter" concept; that it exists only because that basic concept envisions material "things" existing in a space-time setting. In attempting to construct a theoretical system on the basis of the concept of a universe of motion while still retaining the "setting" concept of space and time, these theorists have tried to combine two incompatible elements, and failure was inevitable. When the true situation is recognized it becomes clear that what is needed is to discard the "setting" concept of space and time along with the general concept of a universe of matter, to which it is intimately related, and to use the concept of space and time that is in harmony with the idea of a universe of motion.
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> Dewey Larson, *Nothing But Motion*, Chapter 2, 1959

This reversal of basic concepts is fully in line with what develops out of Goethean studies. While describing the process of development of matter in the lectures on *Spiritual Science*, Steiner indicates:

> … a picture of the origin of matter… In the act of assuming form, it is in movement; for movement precedes form.
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> R. Steiner, *World of Senses and World of Spirit*, Lecture 4, Dec 30, 1911.

In addition, with the reciprocal relation of space to time, Larson was able to highlight the importance of time on par with that of space. Normally, space is seen as being three dimensional, and time as being one-dimensional with a doubtful connection with space. With reciprocity, both space *and time* can have three dimensions, yet their mutual relationship is opposite: increase in space implies reducing the time.

> Motion is defined as the relation of space to time. Its mathematical expression is the quotient of the two quantities. An increase in space therefore has exactly the same effect on the speed, the mathematical measure of the motion, as a decrease in time, and vice versa. In comparing one airplane with another, it makes no difference whether we say that plane A travels twice as far in the same time, or that it travels a certain distance in half the time.
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> The three dimensions of time have the same physical significance as the three dimensions of space.
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> Dewey Larson, *Nothing But Motion*, Chapter 6, 1959

Once more, this polarity in the relationship of temporal dimensions to spatial ones is clearly brought out in Spiritual Science as well:

> This is difficult for the modern consciousness. Hence even the most well-meaning people — well-meaning for the conception of spiritual things — have tried to escape from Space by transcending the three dimensions. They come to a fourth dimension. They pass from the three-dimensional to the four-dimensional. So long as we remain within the mathematical domain, the thoughts which we arrive at in this way are quite in order. It is all perfectly correct. But it is no longer correct when we relate it to the reality. For the peculiar thing is that when we think the fourth dimension in its reality, it eliminates the third. Through the fourth dimension the third dimension vanishes. Moreover, through the fifth dimension the second vanishes, and through the sixth the first vanishes, and we arrive at length at the point.
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> R. Steiner, *On the Dimensions of Space*, June 24, 1922

In the Reciprocal System, this polarity led Larson to predict the existence of a polar opposite to matter -- what he called the "Cosmic Sector" -- a direct analogue of the Etheric World in Spiritual Science. He utilized this polarity to explain a host of high energy phenomena that have resisted explanation to this day.

With the development of the Reciprocal System, understanding of Goethean science in the domain of physical magnitudes and dimensions became possible as well, and Larson spent nearly 60 years developing the consequences of these ideas in a series of volumes. They ranged from the study of basic condensed matter physics, to electromagnetism and astronomy. A brief summary of some of his work is given below:

QUASARS AND PULSARS (1959): Description of these unique astronomical phenomena, and identification of their odd characteristics as direct consequences of crossing certain physical dimensional limits.

CASE AGAINST THE NUCLEAR ATOM (1963): Showing the unfeasibility of the "tennis ball" model at smaller scales, and a criticism of the current method of inventing a new particle to fill every gap in theory.

BEYOND NEWTON (1964): Description of the one-sidedness of gravitation, and explaining the need for an opposing expansion.

NOTHING BUT MOTION (Vol I, 1979): Comprehensive development of structure of the elements, derivation of the periodic table and describing the new concept of the atom. Derivation of fundamental constants and subatomic masses from first principles, followed by an analysis of "cosmic matter" (the polar opposite of conventional matter) and their role in cosmic ray decay. Revised understanding of solid cohesion and chemical bonding.

BASIC PROPERTIES OF MATTER (Vol II, 1988): Lattice constant calculations for elements and compounds, from the theory. Boiling point, melting point and specific heat calculations, electricity and magnetism, electro-magnetism, isotopes and radioactivity. Calculation of electric resistivity.

UNIVERSE OF MOTION (Vol III, 1984): Astronomy overview, galaxies, nebulae, and globular clusters. Physical limits, and the related behavior of white dwarfs, quasars, pulsars and binary stars. Relationship of the redshifts to light speed and supernovae. Bode's Law derivation.

Thus, nearly six decades of work by a lone investigator unknowingly along Goethean lines, created one of the major paths to develop a different and more philosophically accurate understanding of the natural science, one in keeping with reality. There have also been a few researchers who have worked on similar lines. Georg Kaufmann, Nick Thomas and others developed a Polar Geometry to accommodate the behavior of polar spaces (counterspace), per the recommendations of Steiner. Miles Mathis again independently discovered the existence of the reciprocal force of levity and extended the consequences of it to several areas untouched by Larson or Spiritual Scientists, such as general relativity, tidal theory and quantum mechanics. Mathis also indicates how the polar forces were introduced into several equations which form the basis of modern physics, without clearly recognizing them. Some scientists working in association with the Goetheanum have also been tackling this topic.

Hence, it is inevitable that the way forward in the sciences is to pursue, afresh, the fundamental stream of ideas developed in the heyday of Central European culture that have been set aside for nearly a century for reasons of utility or comfort. It is essential that both the researchers of the Reciprocal System and related Goethean sciences, and those who recognize the importance of this mode of research come into contact with one another. These endeavors can then be supported by them in any way they can. As the saying goes: "Truth will out!" and it must.

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