THE SECOND SCIENTIFIC REVOLUTION AND BIO-DYNAMIC AGRICULTURE

by Nicanor Perlas

Bio-dynamic agriculture is the oldest scientific alternative to conventional, chemical- intensive farming. The practice of bio-dynamic is widespread. It is successfully applied in over 400,000 hectares or 1,000,000 acres around the world.

To understand the science behind bio-dynamic practices, we need to discuss briefly the nature of science itself and its current state of development. This is will develop an appreciation for the scientific soundness and practicality of the bio-dynamic approach.

The Limits of Materialistic Science

Throughout history, philosophers and scientists have debated what constitutes true scientific activity.[1] With the impressive application of natural science in the creation of technologies for industrialization, the materialistic philosophy of science with its variants became the institutionalized and accepted de facto definition of science.

Materialistic science permeates conventional agriculture.[2] Materialists assume that objects are "real" only when they are seen in the physical senses. These scientists define as "objective" only those things that can counted, measured, and weighed. As philosophers of science have shown, these are metaphysical assumptions because they are simply asserted and not demonstrated with logical rigor.[3]

Materialistic science, for example, has many "occult" or hidden, non- visible entities. No one really knows what electricity is although we use it everyday. The same is true with the other entities of modern physics. No one has really seen an atom, a "quark", a neutrino or quantum level. Nevertheless we base our whole industrialized civilization on these "occult" entities of materialistic science.

Scientists also question whether the "facts" of materialistic science are "discovered" or are artifacts, created by the increasing powerful tools and instruments that invariably accompany the conduct of modern science.[4] Are the modern "facts" of the physics laboratories physical entities or conceptual categories that have been reified?

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1 See, for example, the historical review of the different philosophies of science contained in Laudan, Laurens. "Theories of Scientific Method from Plato to Mach; A Bibliographical Review", History of Science, pp. 1-63.

2 For an extensive discussion, see companion essay by Perlas, Nicanor. 1993. The Seven Dimensions of Sustainable Agriculture, Paper Presented at the ANGOC Asian Conference on Sustainable Agriculture, February 22-27, 1993 at Xavier University, Cagayan de Oro City, Philippines.

3 See, for example, Burtt, E.A. (1954). The Metaphysical Foundations of Modern Science, Garden City, New York: Doubleday. The most devastating critique, however, is by Smith, J. W. (1984). Reductionism and Cultural Being; A Philosophical Critique of Sociobiological Reductionism and Physicalist Scientific Unificationism, The Hague: Martinus Nijhoff Publishers.

4 Ziman, J. (1984). An Introduction to Science Studies; The Philosophical and Social Aspects of Science and Technology, Cambridge: Cambridge University Press, pp. 38.

In addition, and contrary to the traditional scientific belief, we do not simply mirror "objectively" in our brain what we see out there. Cognitive scientists are discovering that many or our unstated assumptions and preferences including our cultural upbringing and the nature of our scientific training unconsciously censor what we ultimately see. Many of our subjective biases appear to our perception as "objective" fact.

After examining the available evidence, Van Bertalanffy, Father of Systems Theory, concludes:

> 'There are no facts flying around in nature as if they are butterflies that you put into a nice orderly collection. Our cognition is not mirroring of ultimate reality but rather is an active process, in which we create models of the world. These models direct what we actually see, what we consider as fact.'[5]

Materialists also forget that they use their thinking faculties to build their science. By their own definition, this is impossible. Thought is non- physical. Therefore, it is subjective and unreal.

Not surprisingly, philosophers of science, in a little publicized conference in 1969, formally abandoned logical positivism as a workable approach to science.[6] Logical positivism is the 20th century inheritor of the mantle of the 19th century materialism. With its demise, logical positivist research programs which dominate many scientific fields, including agriculture[7], are without any secure philosophical foundations.

In its wake, new approaches to science have emerged. Marjorie Grene, an active participant in the current reconceptualization of science, captures the characteristics of the new philosophy of science that have emerged including a move away from reductionism and materialism. (See Table 1)

Goetheanistic Science

As early as the 1900, Steiner already elaborated on many of tenets of the new philosophy of science. For example, instead of reductionism, Steiner demonstrated the need for pluralism in the scientific approach. To study life, the biologist needs to use scientific methods appropriate to living organisms. He should not attempt to reduce life to physics and chemistry.[8] To study human consciousness, the psychologist should use scientific approaches appropriate to the dynamics of the human psyche.

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6 Suppe, F. (1977). The Structure of Scientific Theories, Chicago: University of Illinois Press.

7 Johnson, G.L. (1984). Agricultural Technology Until 2030: Prospects, Priorities, & Policies, East Lansing, Michigan: Michigan State University, p.9.

8 Some prominent biologists are currently arguing for an "autonomous" biology, one that is free from exclusive reliance on physical and chemical explanations. For example, Harvard zoologist, Ernst Mayr, co-father of the current accepted theory of biological evolution, has frowned upon biological theories which try to explain the origin of species exclusively on genetic mutations and natural selection. Mayr, E. (1985). "How Biology Differs from the Physical Sciences" in D.J. Depew and B.H. Weber ibid., pp.43-63.

As his alternative, Steiner introduced an empirical approach which he called Goetheanistic Science. He named this new scientific approach after Goethe, Germany's greatest poet. Goethe considered his scientific work his most important contribution to humanity. Goethe developed[10] an empirical approach to studying the invisible reality which unifies plant existence.

TABLE 1

CONTRAST BETWEEN MATERIALISTIC PHILOSOPHY OF SCIENCE AND THE NEW PHILOSOPHY OF SCIENCE
(After Marjorie Grene, 1985)

NEW	OLD
1. primacy of perception	1. phenomenalism
2. primacy of orientation	2. hypothetico-deductivism or inductivism
3. comprehensive realism	3. positivism or thin realism (materialism)
4. primacy of history	4. discovery/justification
5. progressive problem-solving	5. ahistorical (linear)/incommensurability
6. inconclusiveness of hermeneutics	6. nomothetic/idiographic "science"
7. science as forms of life: values in science	7. fact/value [distinction] objective/subjective
8. social nature of science a. sciences as communities b. learning (tradition) in science c. science in society	8. science outside society: a. irrelevant b. irrelevant c. science prescriptive for society
9. scientific pluralism	9. unity of science [reductionism]

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Note: For a fuller discussion of Table 8-1, see Grene, M. (1985). "The New Philosophy of Science".[9]

Steiner develops an understanding for the goetheanistic method by showing how a science which unnecessarily limits itself to physical sense experience overlooks one thing. He cites the example of thousands of people looking at the same sense- perceptible fact without recognizing anything extraordinary about it. Then, one day, someone comes, sees the same facts, and discovers a new law. And why was he able to do this?

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9 In D.J. Depew and B.H. Weber (eds.), Evolution at the Crossroads: The New Biology and the New Philosophy of Science, Cambridge, MA: Bradford Books (MIT), pp. 1-20.

10 Goethe did not explicitly formulate a theory of knowledge to lay the scientific basis for his work. It was Rudolf Steiner who articulated the implicit epistemology of Goethe. See Steiner, R. (1978). Theory of Knowledge Implicit in Goethe's Conception of the World, Spring Valley, New York: Anthroposophic Press.

Steiner explains:

> "Only the fact that the discoverer understood how to look differently from his predecessors…
> [Through] thinking, he put things in the right order, and saw more than the others. He saw with the eyes of the mind…"[11]

We can see this clearly in the case of Isaac Newton, one of the scientific pillars of our modern world. In the past tens of thousand of people have seen apples falling off apple trees. But only Newton discovered the law of gravitation upon seeing the same sense-perceptible phenomena.

By focusing on this critical role of thinking in cognition, Steiner characterizes the foundation of goetheanistic science.

> "Whoever recognizes an attribute of thinking its capacity of perception extending beyond apprehension through the senses must necessarily also attribute to the thinking objects existing beyond the limits of mere sense- perceptible reality. But the objects of thinking are Ideas. As thinking takes possession of the Idea, it merges with the primordial foundation of the world; that which works without enters into the spirit of man; he becomes one with the objective reality at its highest potency. Becoming aware of the Idea within reality is the true communion of man.
>
> "Thinking has the same significance I relationship to Ideas as the eye for light, the ear for sound: it is the organ of perception."
>
> "This point of view is capable of uniting two things hitherto considered to be wholly incompatible: the empirical method and Idealism as a scientific world view… What is objectively given by no means coincides with what is given to the senses alone – as is supposed by the mechanistic world view. What is given to the senses is only one- half of that which is given. The other half is ideas, which are just as much objects of experience – naturally, a higher experience, whose organ is thinking. Ideas also are attainable by the inductive method."
>
> "The only satisfying way of grasping reality is the empirical method together with findings of research in ideas. This is Idealism; not, however, that sort of idealism which seeks for a misty, dreamy unity of things, but an idealism which searches for the concrete ideal essence of reality through experience just as truly as the hyper- exact

11 Steiner, R. (1950). Goethe The Scientist, New York: Anthroposophic Press, p. 93.

research seeks for factual content… we hold fast idealism, but we base its development … upon a clarified higher Empiricism.[12] (Emphasis in the original).

Emergence of a New and More Holistic Scientific Revolution

When Steiner first introduced his expanded conception of science at the end of the nineteenth century, he received very little attention. Steiner's scientific contributions survived on the basis of its mathematical rigor rather than being popular with the scientific community at large. However, today, Steiner's contributions may soon receive increasing attention with the emergence of an unexpected development.[13]

Behind the scenes of public life, a second and very different scientific revolution is emerging and sweeping a vast area of disciplines. The overhauling of the scientific method we briefly discussed above is the tip of the iceberg. Radical new discoveries in many other fields of science are seriously challenging the set of orthodox scientific and technological assumptions that have governed Western culture for over two hundred years. The scientific premises of conventional agriculture, a child of 19th century science, are also under scrutiny. The emergence of a new and more holistic scientific revolution is now acting as a supportive knowledge base for sustainable agriculture.

As the second scientific revolution spreads its influence throughput society, the beliefs and institutions of conventional agriculture will progressively weaken and lose credibility. Scientific and social resources will be redirected to alternative modes of knowledge and practice in farming.

Just consider what the new science has come up in this century, mostly within the last two decades, to have an idea that major changes are underway in how we perceive nature, the universe, and ourselves.

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12 Ibid., pp. 93-96.

This present book is not the place to go into a full-blown discussion on Geotheanistc science including its widespread contemporary achievements. For those who want a fuller treatment of the subject matter, you can read Steiner's Geothe the Scientist and Theory of Knowledge Implicit in Geothe's World Conception. For contemporary material you can read Jochen Bochemuhl's In Partnership with Nature and his edited volume Towards a Phenomenology of the Etheric World. I also highly recommend Wolfgang Schad's Man and Mammals. See bibliography for complete information on these books.

13 This is in addition to Europe's current widespread interest in Steiner's ideas due mostly to the valuable practical contributions anthroposophical initiatives have given to society. These includes the education of tens of thousands of students in hundreds of Waldorf schools, the healing of thousands of patients by anthroposophical doctors, and the renewal of business and government organizations using anthroposophical approaches.

* Quantum physicists have now produced experimental evidence that reality is non- local. Substances and processes of the universe are intimately connected with each other even though they are physically tens of millions of miles apart from each other.[14]

* Biologists have evidence that non- physical, "morphogenetic fields", not DNA, govern the emergence of form in living organisms. The past forms of organisms transmit their influences to other organisms in the present and the future by means which transcend normal space- time conditions.[15]

* Neurophysiologists have experimentally verified the existence of the soul in laboratory experiments. Even the simplest perceptual act, the sensation of color, already indicates a soul activity, not merely the result of brain processes.[16] Brain scientists have even pinpointed the specific location of the soul's volitional function in an important part of the brain, the supplementary motor area (SMA).[17]

* Mathematicians have formalized a new geometry which may eventually explain how living organisms develop their form and undergo metamorphosis. In place of conventional, point- centered Euclidean geometry, mathematicians illustrate how forces from the periphery of the universe instantaneously provide the matrix for the emergence of organic from in planet earth.[18]

* Astronomers now consider it possible that a universal intelligence created the galaxies and solar systems of the universe. Supporters of the "anthropic principle" are amazed at how the universe, in violation of the laws of probabilities, has evolved in such a precise way so to make it possible for the human species to emerge. For instance, "if as the universe were forming, the strength of the force of gravitation had varied by as little as a mere one part in [10, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000, 000],… this delicate balance would have been destroyed and stars such as our Sun would never have formed."[19]

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14 Herbert, N. (1987). Quantum Reality; Beyond the New Physics, Garden City, New York: Anchor Books.

15 Sheldrake, R. (1988). The Presence of the Past; Morphic Resonance and the Habits of Nature, New York: Times Books.

16 Augros, R.M. and Stanciu, G.N. (1986). The New Story of Science, New York: Bantam Books, pp. 11-16.

17 Eccles, J. et.al. (1985). Nobel Prize Conversations, Dallas, Texas: Saybrook Publishing Company, pp. 50-55. For related reading on "mentalist" brain research, see Sperry, R. (1983). Science and Moral Priority; Merging Mind, Brain, and Human Values, New York; Columbia University Press.

18 Whicher, O. (1980). Projective Geometry, Creative Polarities in Space and Time, London: Rudoclf Steiner Press.

19 Talbot, M. (1986). Beyond the Quantum, New York: Macmillan Publishing Company, p. 184.

* Climatologists have come up with biochemical evidence that the earth is a living organism. This living earth governs the upper and lower limits of chemical constituents in the atmosphere in much the same way that blood temperature and salinity are kept within a certain narrow range within the human body.[20]

* Psychologist have transcended the materialistic psychoanalytic method of Freud and the black- box, soul- denying behaviorism of Skinner. Humanistic and transpersonal psychologists have documented the vast range of human capacities and potentials including a "spectrum of consciousness" which guarantees the reality of the human spirit.[21]

* Medical scientists have created a new field, psycho- immunology,[22] which shows how the mind can be used to treat a range of diseases, including cancer.[23]

* Analytical psychologists have discovered the existence of an objective, non- personal "collective unconscious" which cultures, past and present, have tapped into.[24] Depth psychologists are currently studying the relationship of this objective unconscious, with the consciousness in nature, and the human unconsiousness.[25]

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20 Lovelock, J. (1979). Gaia: A New Look at Life on Earth, London and New York: Oxford University Press; Thompson, W.I. (ed.) (1987). Gaia, A Way of Knowing; Political Implications of the New Biology, Great Barrington, Massachusetts: Lindisfarne Press; Russell, P. (1983). The Global Brain, Speculations on the Evolutionary Leap to Planetary Consciousness, Los Angeles, J.P. Tarcher, Inc.

21 Maslow, A. (1971). The Father Reaches of Human Nature, New York: Viking; Assagioli, R. (1976). Psychosynthesis, New York: Penguin Books; Walsh, R. & Vaughan, F. (eds.) (1980). Beyond Ego: Transpersonal Dimensions in Psychology, Los Angeles: J.P. Tarcher, Inc.; Wilber, K. (1977). Spectrum of Consciousness, Wheaton, Illinois: Quest; Wilber, K. (1981). Up from Eden: A Transpersonal View of Human Evolution, Garden City, New York: Anchor Press/Doubleday.

22 Hales, D. (1981). "Psycho- immunity", Science Digest (November 1981), pp. 12-14.

23 Epstein, G. (1989). Healing Visualizations; Creating Health Through Imagery, New York: Bantam Books.

24 Jung, C. (1968). Collected Works of C. G. Jung, Vol. 9, Part 1, Princeton, New Jersey: Princeton University Press; Campbell, J. with Moyers, B. (1988). The Power of Myth, New York: Doubleday.

25 Avens, R. (1980). Imagination is Reality: Western Nirvana in Jung, Hillman, Barfield, and Cassirer, Dallas, Texas: Spring Publications, Inc.; Whitmont, E.C. (1980). Psyche and Substance, Berkeley, California: North Atlantic Books; Hillman, J. (1975). Re-visioning Psychology, New York: Harper & Row.

* The new science of consciousness has provided clean experimental evidence for the functioning of waking states outside the body. During scientific tests, dream "astronauts" perform conscious tasks while the body remains in a state of sleep.[26]

* Linguist have uncovered evidence to indicate that human consciousness has evolved giving rise to the radically different worldviews of the different civilizations in history.[27] The evolution of human consciousness explains why the ancient Indians, Persians, Egyptian, and Greeks approached the world so differently from each other and from ourselves.[28] For example, the ancient Indian's perception of the cosmos as spiritually alive is not childish fantasy but the result of an archaic consciousness which enabled them to experience directly the spiritual processes underlying nature.[29]

The second scientific revolution rescues "qualities" that have been methodologically stigmatized as "subjective" and "unreal" by the first scientific revolution. It is scientifically respectable to consider life, consciousness, and spirit as different from materials processes although these "qualities" interact with matter. The second scientific revolution sees nature as alive and ensouled and mind as operative in the universe.

Scientific Support for Anthroposophy and Bio- Dynamic Agriculture

Many aspects of the second scientific revolution are congenial to Steiner's Anthroposophy and bio- dynamic agriculture. In some instances, the facts discovered by the second scientific revolution verify[30] independently some of the findings of spiritual science.

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26 LaBerge, S. (198?). Lucid Dreaming, New York: Ballantine.

27 Barfield, O. (1985). History in English Words, Great Barrington, Massachusetts: Lindisfarne Press; Barfield, O. (1965). Saving the Appearances, New York: Harcourt, Brace & World; Sugerman, S. (ed.) (1976). Evolution of Consciousness; Studies in Polarity; Middletown, Connecticut: Wesleyan University Press.

28 Richter, G. (1985). Art and Human Consciousness, Spring Valley, New York: Anthroposophic Press.

29 This can be inferred from the evidence contained in the works of Barfield and Richter (footnotes 27 and 28, respectively). See also, Wachsmuth, G. (1961). The Evolution of Mankind, Dornach, Switzerland: Philosophic – Anthroposophic Press, p. 100.

30 In almost instances, the experiments of the second scientific revolution were not made to verify spiritual science. Nevertheless, the facts that emerged from these researches support the independent findings of spiritual science.

Neurophysiology and Living Thinking

Steiner's concept of "living thinking" is a good example of how the second scientific revolution confirms facts discovered independently by spiritual science. In Steiner's epistemological writings, he pointed to the existence of a state of consciousness he termed "living thinking", an individual's first conscious experience of his own spiritual reality. Living thinking is also the basis of true cognition and freedom.[31] Epistemologically, Steiner grounded his anthroposophy on the reality of "living thinking".

In neurophysiology, Roger Sperry, 1981 Nobel laureate for medicine, makes this very interesting observation about human consciousness.

> "… One of the more important indirect results of the split- brain work is a revised concept of the nature of consciousness and its fundamental relation to brain processing. The key development is a switch from prior noncausal, or 'interactionist' interpretation that ascribes to inner experience an integral causal control role in brain function and behavior. In effect, and without resorting to dualism, the mental forces of the conscious mind are restored to the brain of objective science from which they had long been excluded on materialist – behaviorist principles.
>
> "The spreading acceptance of the revised causal view and the reasoning involved carry important implications for science and for scientific views of man and nature. Cognitive science can no longer be ignored experimentally, or written off as a 'science of epiphenomena' or as something that must in principle reduce eventually to neurophysiology. The events of inner experience… become themselves explanatory causal constructs in their own laws and dynamics. The whole world of inner experience (the world of the humanities), long rejected by 20th century scientific materialism, thus becomes recognized and included within the domain of science. (Emphasis added.)[32]

While Sperry's work does not indicate an direct personal experience of "living thinking" in the sense of Steiner, it is clear that, through Sperry, science is coming to recognize that consciousness is not a mere secretion of brain matter.

Mentalist Brain Research. Psychoimmunology, and the Productive Power of the Non- Material Type

Goetheanistic science shows that thinking perceives the inner content of nature. This penetrative power of thinking has important ramifications for biology and agriculture.

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31 For a fuller treatment, see Steiner, R. (1986). Philosophy of Spiritual Activity, Hudson, New York: Anthroposophic Press.

32 Sperry, R. (1982). "Some Effects of Disconnecting the Cerebral Hemispheres", Science, Vol. 217, 24 September 1982, p. 1226.

Materialistic science has fallen into the fallacy of looking upon sense perception as something complete.[33] However, the content of the world does not come to us ready- made. In addition to what is directly present to us as perception, another essential aspect remains hidden. We gain access to this second aspect of the world – content through thinking. The contents determined by thinking are the organizing principles of the perceptual world.[34]

Pursued to its logical conclusion, cognition of the inner content plant as Idea is cognition of its organizing principle. We thus arrive at a new conception of the plant. The plant is not passively influenced by its own innate supersensible nature which actively expresses itself.

Steiner elaborates on this inner reality of living plants.

> "But what is this fundamental element? It cannot be anything else than that which appears in the particular in the form of the general. But what always appears in the particular is a definite organism. That basic element is, therefore, an organism in the form of the general: a general form of the organism which includes within itself all particular forms.
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> "This general organism we shall call, after the precedent of Goethe, the type… The type is not elaborated in all its entirety in any single organism. Only our rationalizing thought is capable of grasping this by abstracting it as a general image out of the phenomenal. The type is thus the Idea of the organism; the animality in the animal, the general plant in the specific plants…
>
> "The type plays in the organic world the same role as that of the natural law in the inorganic." (Emphasis added.)[35]

Or, in the words of Coleridge:

> 'That which contemplated objectively… we call law; the same contemplated subjectively… is an Idea.[36]

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33 Steiner, R., A Theory of Knowledge Implicit in Goethe's World Conception. op. cit., p. 50.

34 Steiner, R. (1981). Truth and Knowledge, Blauvelt, New York: SteinerBooks, p. 71.

35 Steiner, R., Theory of Knowledge Implicit in Goethe's Conception of the World, op. cit., pp. 88-90.

36 Barfield, O. (1977). "Historical Perspectives in the Development of Science" in Toward A Man- Centered Medical Science, Schaefer, K.E., Hensel, H., and Brady, R. (eds.), Mt. Kisco, New York: Futura Publishing Company, pp. 125-126.

Coleridge also equates the Idea as the productive power of Nature considered as natura naturans, or creating nature. He designates the nature we see with the physical eyes natura naturata, or created nature. For Coleridge, natura naturans "as [a productive] agent, is essentially one (that is, of one kind) with the intelligence which is in the human mind".[37]

We can gather from the above characterizations that although the Type can only be apprehended through cognition, the Type is not an abstract idea. The Type is a supersensible force capable of organizing physical matter.

The Type shapes the morphological traits of plants and animals. It governs the physical development and behavior of organisms. The Type also forms the organism's internal anatomy. It regulates the genetic, cellular, immunological, reproduction, and other physiological processes within the organism.

You may think it preposterous to hold that a supersensible, non- physical entity can organize the unfolding of material events. But we are now in the age of the second scientific revolution, is no longer scientifically supportable.

Nobel Laureate,John Eccles, did pioneering work in the relationship between the mind and the body. He has produced experimental evidence in the laboratory to show that mind governs the course of material events in the brain. We are not the unwilling captives of the impersonal chemistry of the brain. We have genuine freedom and our intentions trigger and govern the pattern of discharges in the nerve cells of our brain.

> "A remarkable series of experiments in the last few years have transformed our understanding of the cerebral events concerned with the initiation of the voluntary movement. It can now be stated that the first brain reactions caused by the intention to move are in nerve cells of the supplementary motor area (SMA). It is right at the top of the brain…
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> "There is strong support for the hypothesis that the SMA is the sole recipient area of the brain for the mental intentions that lead to voluntary movements. [The] immense stored repertoire of the learned motor programs of a lifetime could not be stored in the SMA… All that is necessary is for the SMA to contain the inventory of the motor programs… [The] SMA is known to have major lines of communication to the presumed storage sites [of the motor programs] in the cerebral cortex… By radio- tracer techniques these areas have been shown to be called into action in voluntary movements, and many nerve cells in these circuits have been shown to be active before the discharge of the motor cortical cells…
>
> "How can the mental act of intention activate across the mind- brain frontier those particular SMA neurons in the appropriate code for activating the motor programs that bring about intended voluntary movements? The answer is that, despite the so- called 'insuperable' difficulty of having a non- material mind act on a material brain, it has been demonstrated to occur by a mental intention – no doubt to the great discomfiture of all materialists and physicalists."[38]

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37 Ibid., p.130.

38 Eccles, J. et. al ., Nobel Prize Conversations, op. cit., pp.53, 56.

Another neurophysiologist and Nobel Laureate, Roger Sperry, agrees. He cites the phenomenon of the pain caused by the "phantom limb". A person with the amputated arm can still feel, several months later, the pain of the lost arm. Sperry argues that the pain felt in the phantom limb is not caused by "the biophysics, chemistry, or physiology of the cerebral nerve impulses as such, but by the pain quality, the pain property, per se."[39] And, for Sperry, this is the real issue.

> "Nerve excitation are just as common to pleasure, of course, as to pain, or any other sensation. What is critical is the unique patterning of cerebral excitation that produces pain instead of something else. It is the overall functional property of this pain pattern that is critical in the causal sequence of brain affairs… This is overall pattern effect in brain dynamics is the pain quality inner experience."[40]

Sperry goes on from this example to illustrate "the causal potency of an idea" in governing brain events.

> "Above simple pain and other elemental sensations in brain dynamics, we find, of course, the more complex but equally potent forces of perception, emotion, reason, belief, insight, judgment and cognition… it is exactly these encompassing mental forces that direct and govern the inner flow patterns in impulse traffic, including their physiological, electro- chemical, atomic, subatomic, and subnuclear details… It is a special characteristic of these larger functional patterns in the brain… that they have a coherence and organization that enables them to carry on orderly function in the presence of considerable disruptive damage in the lower – level components.
>
> "Near the apex of this compound command system in the brain we find ideas. In the brain model proposed here, the causal potency of an idea, or an ideal, becomes just as real as that of a molecule, a cell, or nerve impulse."41

Modern medicine has advanced to the point of utilizing the findings of "mentalist" brain research to develop unorthodox but proven methods of healing patients. Psychoimmunology is one of the newest fields of science that studies the impact of the human mind on the immune system.

Researches have confirmed that our mental states affect the physiology of immune system. Yale psychologist Stanislav Kasl and colleagues have shown that infectious mononucleosis can be activated by stress. West point cadets who had 'overachiever' fathers – and who had strong desires to succeed but were doing poorly in academics – were most likely to develop symptoms of mononucleosis. Stephen Locke of Harvard Medical School has demonstrated how anxiety and depression decrease the amount of natural – killer cell activity (NKCA) in humans. NKCA is a measure of the health of the cellular immune function.[42]

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39 Ibid., p. 58-59.
40 Ibid., p. 59.
41 Ibid., p. 59-60.
42 Ornstein, R. and Sobel, D. (1987). "Psycho- Immunity", Washington Post (Sunday, May 3, 1987), p. B3

Implicate Order, Astrophysics, and the Organizing Power of Mind in Matter

If the mind can direct the processes of the physical body, it is outlandish to think that mental forces also govern the world of matter itself? Prominent members of the quantum physics community do not think so.

David Bohm, one of the world's leading theoreticians of quantum physics, has articulated an explanation of quantum reality that is consistent with all the known facts of quantum mechanics. Yet his quantum theory leads modern world conception to a stage where it can scientifically conceive of mind and matter as different aspects of one fundamental reality.

Bohm does not view the elementary particles of physics as the fundamental building blocks of matter. Rather Bohm conceives of these particles as a temporary condensation, an explicate order, out of a vast quantum field, an implicate order. The phenomenon of the "soliton" illustrates what Bohm wants to explain.

The solitary wave or soliton was first observed by a certain J. Scott Russell. Russell observed an extraordinary wave of water that 'rolled forward with great velocity, assuming the form of a large solitary elevation, a rounded, smooth and well defined heap of water, which continued its course along the channel apparently without change of form or diminution of speed.'[43] Instead shape, for over a mile before finally rejoining the general body of water.

Today, scientists have found the soliton in a range of phenomena including brain impulses, electrical circuits, and vibrations of the atom. Some have even suggested that the solitons from an underlying nonlinear quantum field are the fundamental building blocks of matter.[44]

In addition, to an implicate order that generates the discrete particles of the explicate order, Bohm postulates the existence of a super- implicate order. The super- implicate order generates the existence of the quantum field in much the same way that the quantum field, as implicate order, generates the materialization of subatomic particles. The super- implicate order gives meaning, significance to the implicate order. Similarly, the implicate order gives significance to the explicate order.[45]

With this framework, Bohm is now able to explain why he thinks mind and matter are two manifestations of one process.

> "[There] is a principle I once thought of, I called it 'soma- significance'. Instead of 'psychosomatic'. The word psychosomatic emphasizes two entities, mind and soma (body), but I want to emphasize two sides of one process. Any process can be treated either as somatic or as significant.

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43 Peat, F.D. (1987). Synchronicity, The Bridge Between Matter and Mind, New York: Bantam Books, Inc., p. 74

44 Ibid

45 Weber, R. (1986). Dialogues With Scientists and Sages: The Search for Unity, London: Routledge and Kegan Paul, p. 37.

> A very elementary case is the printed paper: it's somatic in that it's just printed ink; and it also has significance… The essential point about intelligence is the activity of significance… I am trying to say that all of nature is organized according to the activity of significance.[46] (Emphasis in the original.)

Bohm is not alone. Physiologist and Nobel Laureate George Wald argues for the deep unity of mind and nature.

> '… mind, rather than emerging as a late outgrowth in the evolution of life, has existed always…, the source and condition of physical reality… It is mind that has composed a physical universe that breeds life, and so eventually evolves creatures that know and create… In them, the universe begins to know itself.'[47]

Astrophysicists are also coming to the same conclusion. Mind must have been in the beginning of the origin of the universe to guide the latter's evolution to the point that an intelligent species like Homo sapiens could emerge.

Brandon Carter, an astrophysicist from Cambridge, is a leading exponent of the Strong Anthropic Principle (SAP). According to SAP, specific initial conditions in the beginning of the universe favored the creation of intelligent life. His colleague, Steven Hawking, gives an example of such condition. Hawking answers the question of why the universe is expanding at precisely the proper rate to avoid collapsing.

> 'The only 'explanation' we can offer is one based on a suggestion of Dicke (1961) and Carter (1970). The idea is that there are certain conditions which are necessary for the development of intelligent life… Thus our existence requires the Universe to have certain properties. Among these properties would seem to be the existence of gravitationally bound systems such as stars and galaxies and a long enough time- scale for biological evolution to occur. If the universe were expanding too slowly, it would not have this second property for it would recollapse too soon. If it were expanding too fast, regions which had slightly higher densities than the average or slightly lower rates of expansion would still continue expanding indefinitely and would not form bound systems. Thus it would seem that life is possible only because the Universe is expanding at just rate required to avoid recollapse… [The] isotropy of the Universe is a sequence of our existence.[48]

Physicist Arthur Eddington summarizes the revolutionary implications of quantum physics.

> "To put the conclusion crudely – the stuff of the world is mind- stuff."[49]

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46 Ibid., p. 38
47 Ibid., p. 243
48 Augros, R.M. and Stanciu, G.N., op. cit., pp. 65-66.
49 Weber, R., op. cit., p. 231.

Depth Psychology, Morphogenetic Biology and The Archetypal Plant

To understand further the idea of the Type, let us take root radish as an example. We take a particular radish variety and grow it under different levels of soil fertility and light conditions. Under poor soil conditions, the radish will have a stunted form and hardly yield any root. Under rich soil conditions, the radish will grow luxuriantly and produce bountiful quantities of juicy roots. Under shade, the radish will have an elongated appearance. Under full sunlight, the radish will have a more compact appearance.

No matter how we alter the environment, the radish remains a radish plant. In its shriveled or exuberant appearance, we still recognize the same characteristics which make it a radish.

Conventional scientists will scoff at the idea of the Type. They will assert that the genetic traits of the radish account for the form of the radish.

Genes, conceived as DNA sequences, cannot account for the emergence of form in living organisms. DNA governs the sequence of amino acid and protein production but does not contain the program of "information" as to how these amino acids are to be organized in three- dimensional space.

Plant physiologist Rupert Sheldrake highlights this problem.

> "Calculations designed to predict the three- dimensional structure of proteins, using various methods of approximation, invariably give far too many solutions. In the literature on protein folding, this is known as the 'multiple – minimum problem".
>
> "There are persuasive reasons for thinking that the protein itself does not 'test' all these minima [50] until it finds the right one… 'If the chain explored all possible configurations at random by rotations about the various single bonds of the structure, it would take too long to reach the native configuration. For example,… [a simple chain of 150 amino acids] would take [100, 000, 000, 000, 000, 000, 000, 000, 000] years to examine all possible conformations. Since the synthesis and folding of a protein chain such as that of ribonuclease or lysozyme can be accomplished in about 2 minutes, it is clear that all conformations are not traversed in the folding process.' …
>
> "This discussion leads to the general conclusion that the existing theories of physics may well be incapable of explaining the unique structures of complex molecules and crystals; they permit a range of possible minimum- energy structures to be suggested, but there is no evidence that they can account for the fact structures is realized."[51]

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50 Proteins, following different sequences of folding, eventually reach the same structural end- point. This stable end- point is believed to be a minimum- energy structure. Sheldrake, R. (1981) A New Science of Life, Los Angeles: J.P. Tarcher, Inc., p. 69.

51 Ibid., p. 70.

Our discussions, so far, have emphasized the reality and creative power of the Type in the realm of matter. However, to be more precise, we must distinguish between the Type as such and another inner principle.

Bio- dynamic scientists view the Type as the "intelligence' responsible for the characteristic form and behavior of a species. The Type as generative of species is also known as the "astral" principle.[52]

This species- force uses an intermediary to enable its influence to manifest in the physical world. Bio- dynamic scientists call this intermediating principle the "formative forces body" or the "etheric body". The etheric principle casts and preserves the shape of the organism in the present. The etheric also transmits the shape of the organism into future generations.

To further differentiate between the astral and the etheric principles, let us take the analogy of pottery making. The potter has an idea of how his vase should look like. He secures the proper clay materials to build the vase. With his hands, he moulds the clay vase. His ideas concerning the specific appearance of the vase guide his hands as the latter forms the clay according to the idea of the potter.

The astral principle is akin to the potter's particular idea of the vase. The astral principle imparts the characteristic properties of a species. The etheric principle is like the potter's hands. The etheric principle is the direct creator of plant and animal forms. Just as the idea of the potter guides his hands in the actual creation of the vase, the astral principle guides the etheric to ensure that the etheric shapes the form of the organism according to the specific content of the astral principle. The physical substance of the organism is akin to the clay material of the vase. Physical matter enables the idea of the potter and the specific traits of the species to manifest in the physical world. The characteristic organization and the emergence of the organism in the sense-perceptible world is the result of the action of both the astral and etheric principles respectively.

The second scientific revolution has discovered psychological and biological realities that are first steps[53] towards comprehending these supersensible principles that Anthroposophy has investigated in great detail.

Carl Jung, famous colleague of psychoanalyst Sigmund Freud, analyzed many dreams and myths around the world. Through this research, Jung discovered the existence of "archetypes" in the "collective unconscious". Both the collective unconscious and archetypes have an objective existence outside the individual human psyche. These archetypes shape many cultures even though these cultures have no physical contact and exist in different periods of history.[54]

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52 It is beyond the scope of the essay to distinguish further between the astral principle of the Type in contradistinction to the Type's spiritual origins.

53 The "archetype" of Jung and the "morphogenetic field" of Sheldrake are not the exact equivalents of the "astral" and the "formative" or "etheric" forces of bio- dynamic scientists. However, they are "first steps" in the sense that the students of Jung and the colleagues of Sheldrake have discovered some phenomena which can be characterized as astral and etheric respectively.

54 Jung, C. (1976). Collected Works of C. Jung, Volume 18, Princeton, New Jersey: Princeton University Press, pp. 227-243; Peat, F.D., op. cit., pp. 99-104.

Depth psychology, following the findings of Carl Jung, speaks of "archetypes" in nature and in human consciousness.[55] Scientists have started using these Jungian categories to explain biological phenomena.[56] These "archetypes" touch on facets of what bio- dynamic farmers call the "astral body".

Modern psychology views the "unconscious" as extremely intelligent and permeated by reason. The nuance and association of irrationality that often accompanies the use of the term "unconscious" refers more to the temporary failure of ordinary human consciousness to understand the inner logic of the "unconscious". One can therefore scientifically speak of the "collective unconscious" as a form of intelligence that pervades both nature and the human mind.

Disillusioned by the failure of conventional biology to explain a range of important processes and phenomena in nature, an increasing group of biologists are now also postulating the existence of "morphogenetic fields".[57] These fields act instantaneously across large distances and their influence is not bounded by time. The past influences the present and the future even if the past occurrence is already physically non- existent. These "morphogenetic fields" are reminiscent of the "formative forces body" of bio- dynamic scientists.

Rupert Sheldrake characterizes the nature of morphogenetic fields and his hypothesis of formative causation.

> "The hypothesis of formative causation proposes that morphogenetic fields play a causal role in the development and maintenance of the forms of systems at all levels of complexity. In this context, the word 'form' is taken to include not only the shape of the outer surface or boundary of a system, but also its internal structure… Morphogenetic fields can be regarded as analogous to the known fields of physics in that they are capable of ordering physical changes, even though they themselves cannot be observed directly…
>
> "The morphogenetic field can be thought of as a structure surrounding or embedding the morphogenetic germ, and containing the virtual form; this field then orders events within its range of influence in such a way that the virtual form is actualized. In the absence of the morphic units [morphogenetic germ] which constitute the parts of the final system, this field is undetectable; it reveals itself only through its ordering effects on these parts when they come within its influence. A rough analogy is provided by the 'lines of force' in the magnetic field around a magnet; these spatial structures are revealed when particles capable of magnetized, such as iron filings, are introduced into the vicinity.

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55 Avens, R., op. cit., pp. 79-84

56 Watson, E.G. (1962). The Mystery of Physical Life, New York: Abelard - Schuman.

57 Sheldrake, R., A New Science of Life, op. cit.

> Nevertheless, the magnetic field can be considered to exist even when the iron filings are absent; likewise, the morphogenetic field around a morphogenetic germ exists as a spatial structure even though it has not yet been actualized in the final form of the system.[58]

We can see the form- imparting properties of this morphogenetic field in an important medical phenomena. Medical doctor Larry Dossey shows how genes cannot be the form- giving principle in organisms because all genes are replaced and renewed every year. Dossey calls this phenomena, "biodance".

> "But our insistence on seeing ourselves as genetically unchanging individuals, even for our lifetime, also turns out to be an illusion. For our genes are made of protein – DNA, the basic component of all genes – and the life span of protein molecules in the body is brief. A single DNA molecule is shortlived, existing only for a few months… To put it another way, nothing in our genes today was present in them a year ago, having been totally renewed in the interval."[59]

Dossey goes on to show that our entire body is also renewed down to the last atom every five years. In the meantime, we maintain the form of our physical body.

> "Radioisotopic techniques allow us to trace the chemicals that enter and leave the body. Aebersold has concluded that 98 percent of the 10 [to the 28^{th}] atoms of the body are replaced annually. Some tissue, such as bone, is especially dynamic. Each body structure has its own rate of reformation: the lining of the stomach renews itself in a week; the skin is entirely replaced in a month; the liver is regenerated in six weeks… But even though these rates of replacement differ, after five years one can presume that the entire body is renewed, even to the very last atom."[60]

The phenomenon of "biodance" clearly points to the existence of the etheric principle. The genes and other substances of the physical body are all totally replaced, yet the physical form of both remains the same. There must exist a supersensible force that maintains the overall pattern of form and development while the constituent parts are undergoing renewal. This force is the morphogenetic field, an aspect of the etheric principle.

The New Biology, Community Ecology and the Astral Principle

Bio- dynamic scientists also point to another important property of the Type as astral principle. The astral principle can reach out beyond individual organisms. It can weave an integrating pattern encompassing populations of the same species as well as create organic associations between plants and animals.

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58 Ibid., pp. 71, 72, 76.

59 Dossey, L. (1982). Space, Time & Medicine, Boulder, Colorado: Shambhala Publications, Inc., p. 73.

60 Ibid., p. 74.

Goetheanistic scientist Herman Poppelbaum describes this astral principle which governs species populations and ecological communities.

> "[The] astral body may reach out and cover an associated plant species and weave a common pattern of belongingness between animal and plant. It really establishes the mutual dependence of plants and insects, with all their intricate so- called adaptations to each other. It makes for instance the head and proboscis of a moth fit into a blossom as tightly as a key fits into a lock. The two are made with and for each other, and the 'gradually acquired mutual adaptation' of the Darwinians falls pitifully shirt of the actual facts…
>
> "The attunement of the animal's organs to one another within the same body is only the same phenomena on a lesser scale. With the change of one competition between them, but balance and adjustment. In a similar fashion animal species are dependent on one another as if they were organs within a larger organism whose limits cannot be physically traced. The Darwinian conception has falsified this fact and misinterpreted it as a mere numerical reciprocity of predators and victims. It has thus dulled our perception for the various types of mutuality which we must learn again to bring before our concrete vision. Birds and insects, insects and flowers, fishes and birds, trees and birds, birds and mammals, 'co-exist' in a much deeper sense than serving each other as food."[61]

The biology of the second scientific revolution argues that mutualism and harmony among species is more pervasive in nature than the competition principle championed by the followers of Darwin. The facts uncovered in nature by the new biology supports the goetheanistic scientists' discovery of the trans- organism and trans- species effect of the astral principle.

Experiments done with the rodent family, for example, reveal that the weight of the thymus and reproductive glands decrease following an increase in the population size. The dimunition of these glands decreases reproduction in rodents.[62]

Similar results from dozens of studies in internal regulation of species population are leading scientists to the following conclusion:

> 'Setting all preconceptions aside, however, and returning to a detached assessment of the facts revealed by modern observation and experiment, it becomes almost immediately evident that a very large part of the regulation of numbers depends not on Darwin's hostile forces but on the initiative taken by the animals themselves; that is to say to an important extent it is an intrinsic phenomenon.'[63]

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61 Poppelbaum, H. (1961). A New Zoology, Dornach, Switzerland: Philosophic – Anthroposophic Press, pp. 13-14.

62 Augros, R. and Stanciu, G. (1987). The New Zoology: Discovering the Wisdom in Nature, Boston: Shambhala, p. 126.

63 Wynne- Edwards, V.C. (1965). "Self- Regulating Systems in Populations of Animals", Science 147 (26 March 1965): 1543. Cited in ibid., p. 128.

The hundreds of mutualistic interactions that ecological science has discovered also support the reality of the activity of astral forces in nature. Naturalists marvel at the closely- knit cooperation between ants and Acacia as well as figs and gall- wasps. They also admire the mutual dependence of wasps, flowers, and larva of insects. These relationships of community ecology are indicators of the astrality which organizes the different species of a biological community into one organism. Some ecologists have actually characterized these wisdom- filled, mutualistic associations as "organismic"[64], admitting that the totality of the biotic community is a dominant force in organizing the dynamics of individual species in the community.

Chronobiology and Cosmic Forces

Terrestrial ecological factors are not the only influence on the Type. Experiments have shown that plants, with the same genetic stock, when sown every month throughout the year, will express striking diversity in from.[65] This indicates that subtle forces of an etheric and astral nature from the sun, moon, planets, and stars also play an important role in influencing the physical development, appearance, and nutritive quality of agricultural crops.[66]

Chronobiology, the science which studies biological rhythms, has uncovered facts which support the practices of bio- dynamic scientists and farmers. Chronobiology recognizes the important role of sun rhythms in crop development. Scientists call this reality "photoperiodism" and classify plants as either "short- day" or "long- day". Long- day plants grow vegetatively when the days are short but need the long sunny days of the summer to flower. Short- day plants grow best when the days are long but need short sunny days to flower.[67].

> "In one experiment, Biloxi soybean plants grew 9 inches tall and flowered in 23 days under a 10½ hour photoperiod, but were 30 inches tall and flowered in 60 days under a 14½ hour photoperiod."[68]

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64 Richardson, J.L. (1980). "The Organismic Community", Bioscience 30:465-471; Wis et. al. (1986). "Anthropod Community Structure", Annual Review of Entomology 31: 455-478.

65 Bockemuhl, J. (1981). In Partnership with Nature, Wyoming, Rhode Island: Bio- Dynamic Literature, pp. 31-33.

66 These experiments also throw a new light on the meaning of heredity: "The plant is the totality of all formative possibilities which can come to expression in the course of the year. Through the substance (genes) of the seeds, these formative possibilities are limited to the extent that they can give rise to single plants of different types, conforming to the time of year." (Emphasis in the original.) Ibid., p. 31.

67 Martin, J.H., Leonard, W.H., and Stamp, D.L. (1976). Principles of Field Crop Production, New York: Macmillan Publishing Co., Inc., p. 44.

68 Ibid.

Chronobiology has also discovered the existence of moon rhythms. At least two hundred lunar rhythms in living organisms have now been established.[69] The correlations between the rhythmic behavior of animals and a lunar cycle of 12.4 hours are striking.

> "The grunion, or smelt, of California, ride at last flood tide wave onto shore to deposit eggs and sperm in the sand and ride the first ebb tide wave back out into the sea. Two weeks later, the next tide that is equally high, is the exact moment when, at least the crest of the tide, the larvae hatch to be swept out into the sea."[70]

Herbert Koepf, former head of the School of Biodynamics and Earth Sciences at Emerson College in England, summarizes the evidence on the influence of lunar rhythms on living organisms.

> "If one looks at the evidence, a rather unequivocal picture emerges: lunar periods occur in the watery element both outside and inside organisms, and in many cases they are related to reproduction. Water is the medium through which the moon works. This view also underlies traditional rules on sowing, planting, applying manure to the fields, pruning, and tree felling. The important rhythm is the synodic rhythm of 29.5 days from full moon to full moon… The practical application is obvious. Sowing seed in damp earth during the waxing moon furthers the growth of plants. The period in question extends from the yet small crescent up to 1-2 days before full moon."[71]

Joachim Schulz, an astronomer, has shown that the yields of beechnut trees are correlated with the positions of Jupiter, Mars, and Saturn in the various constellations. Based on records of beechnut harvests since 1799 and known movement of Jupiter, Saturn, and Mars, Schulz predicted the pattern of future beechnut yields. Other scientists subsequently established that Schulz's predictions were accurate.[72]

Schulz also demonstrated that planets influence the form of plants. Leaf arrangements (phyllatoxy) around the stem of plants form mathematical progression known as the Fibonacci series.[73] Schulz has shown that the Fibonacci sequence is also found in the pattern of movements of planets if viewed geocentrically. Plants mirror the movement of the planets in the heavens.[74]

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69 Koepf, H. (1989). The Biodynamic Farm, Hudson, New York: Anthroposophic Press, p. 114.

70 Storl, W.D. (1979). Culture and Horticulture, Wyoming, Rhode Island: Bio- dynamic Literature, p. 211. Storl is summarizing the work of Frank Brown, one of the pioneers of the new field of chronology.

71 Koepf, H., op. cit., p. 114.

72 Storl, W.D., op. cit., p. 213.

73 The mathematical progression of the Fibonacci series goes as follows: 1/ 2, 1/ 3, 2/ 5, 3/ 8, 5/ 13, 8/ 21, 13/ 34, and so on.

74 Storl, W.D., op. cit., pp. 217-218.

> "Venus forms five loops (retrogressions) below the ecliptic in eight years, dividing its path into five parts… creating the… Fibonacci series 2:5. A picture of geocentric perspective of Venus's path looks like the core of an apple and characterizes the geometry of such plants as the Rosaceae. The spiral configuration of Mars approaches a 3:8 ratio, as found in the leaf placement of the Cruciferae (cabbage family)."[75].

Biologist Frank A. Brown of Northwestern University has spent many years of his scientific career researching the life of organisms in relationship to the rhythmicity of their environment. Brown suggests that the facts provide "incontrovertible evidence" that "all the rhythms in the universe" somehow impress themselves on the organism.[76]

Eminent astronomer Fred Hoyle concurs that events on Earth are influenced by distant parts of the universe.

> 'Present- day developments in cosmology are coming to suggest rather insistently that everyday conditions could not persist but for the distant parts of the Universe, that all our ideas of space and geometry would become entirely invalid if the distant parts of the Universe were taken away. Our everyday experience even down to the smallest details seem to be so closely integrated to the grand- scale features of the Universe that it is well-nigh impossible to contemplate the two being separated.[77]

In the 1970's, the Dutch government investigated the claims of bio- dynamic agriculturists and other proponents of sustainable agriculture. The Board for Agricultural Research conducted the scientific study with a supporting grant from the Netherlands Ministry of Agriculture and Fisheries. The Board concluded that cosmic influence in plants as claimed by bio- dynamic practitioners "is not as improbable as is often suggested by representatives of conventional agriculture".[78]

> "The working of cosmic forces in organic and inorganic nature by means of rhythmical processes, such as ebb and flood movements, precipitation maxima and growth processes in crops in correlation with lunar phases, may be approached from the point of view of bio- meteorology…
>
> "The behavior of animals which can be correlated with the phases of the moon is for example, the sexual activity of the crustaceans, oysters and paloloworm in tidal zones.

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75 Ibid., p. 219.

76 Brown, F.A., Jr. (1959). "The Rhythmic Nature of Animals and Plants", American Scientists 47:166.

77 Dossey, L., op. cit., p. 79.

78 Ulbricht, T.L.V. and Boeringa, R. (eds.). (1980). "The Dutch Report on Alternative Agriculture", Agriculture and Environment, Vol. 5(1,2), p. 41.

> The factors which determine the causality of these correlations are probably the rhythmical variations in moonlight, gravity and temperature as influenced by tidal movements… Some plant growth- processes which can be correlated with the phases of the moon are for example the blooming of the South African iris… and the water uptake by the seeds of the Phaesolus vulgaris bean… On the basis of experiments on rice seedlings at the nuclear centre at Ispra, the theory that the variations in growth of these seedlings are influenced by electro- magnetic radiation caused by solar eruptions has been advanced. Experiments with crabs, seaweed, shellfish, salamanders and potatoes (measurement of their oxygen consumption and of the opening and closing of the shells of shellfish) have demonstrated remarkable similarities between the patterns of activity of these organisms and the fluctuations of the nucleonic component of cosmic radiation; the experimenters assume an indirect causal relationship or else an identical influence on both phenomena by a third…
>
> "It is clear from the foregoing that the perspective of biodynamic agriculture on the extra- terrestrial influences on earthly organisms is not as improbable as is often suggested by representatives of conventional agriculture."[79]

Quantum Physics and Cosmic Forces

In addition to the discovery of facts which further the principles of bio- dynamic agriculture, the second scientific revolution has introduced thought habits that make it easier to conceive of the spiritual processes and forces discovered by anthroposophy. Quantum physics, for example, within certain limits, can make it easier to understand why the vast distances separating the earth from the planets and stars do not interfere with the action of etheric and astral forces raying in from the cosmos on terrestrial organisms.

In 1982 three French scientists- Aspect, Daliband, and Roger – brought to a close a debate that has been going on in the physics community since quantum reality is non- local.[80] Their experiment, which is of world historical significance, forever shattered the hegemony of the old concepts of space, causality, and time as championed by classical physics.

What does non- local reality mean?

Ordinary reality as we normally experience it is considered "local". For cause and effect to take place in ordinary space, there has to be physical contact between the two objects involved. For a billiard ball, A, to move billiard ball, B, billiard ball, A, must come into direct physical contact with billiard ball, B.

Non- local influences, however, are not mediated by fields nor by direct physical contact. When A connects with B non- locally, nothing crosses the intervening space, hence no amount of interposed matter can shield this interaction.

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79 Ibid., pp. 40-41

80 Herbert, N., op. cit., pp. 211-231.

Non- local influences also do not diminish with distance. They are as potent at a million miles as at a millimeter. In addition, non- local influences act instantaneously. The speed of their transmission is not limited by the velocity of light. A non- local interaction is, in short, unmediated, unmitigated, and immediate.[81]

Non- local reality broadens the concept of mechanical causality and expands it to include influences and causes that are non-material and acting at a distance instantaneously. It is now scientifically acceptable for an action to take place million of miles away in the cosmos have an instantaneously impact on events on earth, and vice- versa.

The non- local reality of quantum physics also opens up new vistas concerning time and makes its easier to understand the action of morphogenetic fields discussed above. Under the new worldview, time's arrow no longer unidirectional. Time does not only flow from the past, present, and into the future. Because non- local influences travel faster than light, time is now accessible instantaneously in all directions. The past and the future are contained in the present.

Quantum physics does not prove anthroposophy. However, it contains ideas about space, time and causality that make it easier to appreciate the spiritual scientific foundations and practices of bio- dynamic agriculture. The latter no longer seems alien given these recent developments in science.

Non- Euclidean Geometry and Cosmic Forces

Relatively recent developments in mathematics also support and make it easier to understand the action of cosmic forces on terrestrial organisms.

Many of us have been trained to see space in terms of Euclidean geometry. And Euclidean geometry has heavily influenced how we view reality. For example, through Descartes, we have learned to view Euclidean space as absolute and impenetrable. Only one entity can occupy a Euclidean space. Co- inherence is impossible. The absolute, rigid, and finite space of Euclidean geometry gradually conditioned our mind to look for point- centered explanatory principles including atomic particles.[82]

However, now there are a multitude of non- Euclidean geometries that are altering the way we perceive reality. Perhaps, the most famous of these new geometries is Reimann's non- Euclidean geometry. Albert Einstein used Reimann's geometry to create his general relativity theory of gravity.

One of these non- Euclidean geometries is Synthetic or Projective Geometry. This new geometry discovered that three-dimensional space does not proceed alone out of the point- centered perspective of Euclidean geometry. Projective geometry shows that the forms that arise in Euclidean space is produced through the balanced interaction of the point and the plane.[83]

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81 Ibid., p. 214.

82 Adams, G. and Whicher, O. (1980). The Plant Between Sun and Earth, London: Rudolf Steiner Press, p. 41; Whicher, O. (1977). George Adams: Interpreter of Rudolf Steiner, Sussex, England: Henry Goulden Limited, p. 133.

83 Adams, G. and Whicher, O., op. cit.

The point of projective geometry is not an ordinary point. Its point is of infinite content. It is always found embedded in a matrix of lines and planes. The ideal plane is also of infinite extent. It exists at the periphery, at infinity, and rays in, as it were, its forces in the process of creating form in Euclidean space.

Anthroposophical scientists have discovered that projective geometry has proved highly useful in elucidating the properties of etheric forces. George Adams, a pioneer in the application of projective geometry to an understanding of etheric forces in plants, describes the relevance of projective geometry for an understanding of etheric forces.

> "What are the parts or members of the point? They are the planes that pass through it in all directions… Just as the plane is divisible into points or point- centered regions, so is the point divisible into planes and 'planar regions'… Just as the plane is in one aspect an organism of infinitely many points and of infinite diversity…, so does the point in space now represent an organism of infinitely many planes, no less wisely and diversely membered.
>
> "The purely geometrical idea we have here unfolded (it is the so- called 'Principle of Duality' [of Projective Geometry]…) is the ideal counterpart of a cosmic fact of Nature… In the ethereal world the whole is by no means greater than the part; it is on the contrary smaller… Manifold streams and influences are flowing together from the cosmos. At the place where they interpenetrate, there arises by their interplay… the etheric organ as a whole. These currents from the universe are the cosmic parts, the etheric members of the organ. The organ as a whole is therefore smaller than its parts. This is an absolutely real process, perceptible to supersensible consciousness. In the world of pure thought, i.e., in Geometry, the corresponding truth is in its most ideal form the conception of the point as an organism of many planes – inwardly membered and composed of the planes that weave through it in all directions."[84]

The reliance of Adams and his colleagues on mathematics to advance s frontier of knowledge has respectable precedents in history. There are many instances in the field of mathematics where mathematical models, initially generated through pure logic, eventually describe the laws of particular phenomena in nature.

The mathematics of Subrahayam Chandrasekhar, an astrophysicist at the University of Chicago, is a case in point. For many years, Chandrasekhar intensely studied a mathematical abstraction known as the ellipsoid. Despite discouragement from colleagues who thought he was wasting his time, Chandrasekhar persevered and eventually published a comprehensive book on the subject. Twenty years later, scientists discovered that the shape of the galaxies were ellipsoidal. Today scientists use Chandrasekhar's mathematics to understand, among others, what organizes the Milky Way together as it spins.[85]

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84 Adams, G. (1965). Physical and Ethereal Spaces, London: Rudolf Steiner Press, pp. 22-23.

85 Talbot, M., op. cit., pp. 191-192.

Projective Geometry, Homeopathy, and Dynamic Action of Small Quantities of Substances

Etheric forces have another property that, on the surface, defies explanation. Bio- dynamic scientists and farmers speak of "dynamic" action of very small quantities of substances. Bio-dynamic farmers routinely use very small quantities of herbal and other substances to guide the unfolding of living processes in the farm including the decomposition of organic matter.

Homeopathic medical doctors also use a similar approach. They heal patients with substances that have been diluted to vanishing small amounts. In many instances, these dilutions are such that, theoretically, no single molecule of the substance remains. Yet doctors have cured thousands of patients for over a century using homeopathic dilutions of medical substances.

Recently, Nature, one of the two most highly respected scientific journals in the world, published an article which detailed experiments supporting the practice of homeopathy.[86]

In the experiment, Jacques Benveniste and his colleagues used a special type of white blood cell and an antibody, anti- IgE. Benveniste diluted the antibody to one part anti- IgE in 10 to the 20^{th} parts of distilled water. At this level of dilution, it is virtually impossible for a single molecule of anti- IgE to remain in the solution. Yet, Benveniste and his colleagues showed that white blood cells placed in this homeopathic solution were affected by the virtually non- existent anti- IgE. They obtained a "reaction between something and nothing".[87]

Projective geometry provides a scientific framework for understanding this peculiar trait of etherically active substances.

> "We spoke just now of the physical outward growth and of the ethereal inward growth of a sphere. Let us reverse the thought and imagine a physical sphere decreasing in magnitude- shrinking towards its centre. If it contains physical substances, this latter will grow concentrated, as the same quantity is now distributed over an ever smaller volume.

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86 Beneviste, J. et al. (1988). "Human Basophis Degranulation Triggered by Very Dilute Antiserum Against IgE", Nature, (June 30, 1988).

87 Browne, M.W. (1988). "Impossible Idea Published on Purpose", The New York Times, (Thursday, June 30, 1989). Browne reports that the editors of Nature considered the results of Benveniste "utterly implausible". 'The essence of the result is that an aqueous solution of an antibody retains its ability to evoke a biological response even when diluted to such an extent that there is a negligible chance of there being a single molecule in the sample. There is no physical basis for such an activity'. However, since Nature's board of scientifically qualified critics could not find a flaw in the research, Nature published the article, but only after Nature wrote an editorial explaining their 'reservation'.

> What of the corresponding ethereal process: The sphere becomes attenuated, it 'shrinks outward' (physically, and therefore paradoxically speaking). Externally it grows in size, but the apparent growth is not a real one; in fact the ether- sphere is becoming smaller. It becomes ever nearer to the celestial sphere, its middle plane.
>
> "… How will it be on the other hand if the said physical substances is united with something ethereal – if for example as a vegetable essence it is connected with life… A sphere of ether- forces has its 'cosmic point', its 'infinitude', in the domain of this portion of physical substance… What happens now when we dilute the physical substance? We really concentrate…, we intensify the specific sphere of ethereal force and substance which is united with this physical. Thus it is fully intelligible… that by dint of physical dilution we can generally make the ethereal influence more strong.[88]

Bio- Dynamic Practices

Now that we have explored modern scientific discoveries that shed light on the theoretical aspects of bio- dynamic agriculture, we are now in position to look at some of its more innovative practices.

Bio- Dynamic Preparations

The use of bio- dynamic preparations is one of these unique characteristics of the bio- dynamic approach. The plant is influenced by terrestrial and cosmic forces. The bio- dynamic preparations helps in the mediation of these forces in both the soil and the plants. Only very small amounts, measured in ounces per acre or less[89], are needed to attain the desired result. Greater plant yields, vitality and nutritional quality are among the benefits of using the bio- dynamic preparations.

Preparation 500 is cow manure processed in a specific way.[90] It has an affinity with the earth forces that vitalize the soil. Preparation 500 is applied towards the end of the day during the final stages of land preparation.

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88 Adams, G., op. cit., pp. 61-63.

89 Note the similarity in dosage with the micronutrients discussed in Chapter 6. However, there is a major difference. Bio-dynamic preparations stimulate the life forces and processes of the soil and the plants. Micronutrients work more by being taken up as substances.

90 For more details on the preparations, see Steiner, R. (1974). Agriculture, London: Bio- Dynamic Agricultural Association. The American Bio-Dynamic Farming and Gardening Association, Inc. will also be helpful in providing practical details. See Resources section in the appendix.

Preparation 501 is made from silica- based materials like quartz. It is used as a regulator of cosmic forces.[91] We time the application of Preparation 501 to coincide near the onset of the maturity phase of the vegetable or crop. We spray during the waxing of the sun forces in the day.

Preparations 502-507 have the common objective of vitalizing plant and/or animal compost so that the latter would be able to transmit more life and sentient forces to the soil, and, from the soil, to the plants. The general idea is not to add substance but to stimulate these forces that are already contained in plant and animal matter.

Table 2 gives the source of each preparation and its intended effect in the farm or garden. The Terms used in the "FUNCTION" column of the preparations carry the meaning ascribed to them in the discussions above.

The preparations are all processed in a methodological manner. When they are ready for use, they are placed in specific locations in the compost pile.[92] From our experience, composts treated with bio- dynamic preparations decompose mush faster and have better quality.[93]

There is one other preparation that bio- dynamic farmers use. Preparation 508, made from horsetail, helps prevent plant diseases, especially fungus attacks.

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91 Cosmic forces give plant species their characteristics outer form (phenotype) and inner properties including taste, aroma, and keeping quality. The inner properties are similar, but not totally convergent to what is known in conventional physiology as products of the secondary metabolic pathways of photosynthesis.

92 For more details, see Koepf, H., Pettersson, B.D., and Schaumann, W. (1976) Bio- Dynamic Agriculture, An Introduction, Spring Valley, New York: Anthroposophic Press and Pfeiffer, E. (1983). Soil Fertility, Renewal and Preservation, Sussex, England: The Lanthron Press.

93 See also Herbert Koepf's new book, The Bio- Dynamic Farm, op. cit., for a discussion of scientific experiments showing the efficacy of bio- dynamic preparations.

TABLE 2

BIO- DYNAMIC PREPARATIONS, SOURCE AND FUNCTION
(Based on R. Steiner, Agriculture, 1972)

PREPARATION	SOURCE (Plant Part)	FUNCTION
502	Yarrow (blossoms)	> regulates potash process with the help of sulfur
503	Chamomile (blossoms)	> regulates calcium process also with the help of sulfur; aids in stabilizing nitrogen content of plants
504	Stinging nettle (whole shoot in bloom)	> multiple functions; similar to heart in human organism; regulates potassium, calcium, and iron with help of sulfur; makes manure inwardly sentient and sensitive; makes the earth itself intelligent and permeates it with reason; soil individualizes itself and allows proper relationship between soil and specific plants
505	Oak (bark)	> calcium regulation; helps control plant diseases
506	Dandelion (flowers)	> stimulates transmutation of chemical elements, for example potassium to nitrogen; helps regulate cosmic influences; sensitizes plant to environment; plants are stimulated to draw in what they need and not just from soil environment
507	Valerian (flowers)	> regulates phosphorous process

Cosmic Forces and the Sowing Calendar

Concrete understanding of the cosmic forces discussed above leads to an understanding of the intimate relationship between plant processes and form and planetary forces.

After more than 30 years of study[94], bio- dynamic scientists have confirmed that certain stellar and planetary configurations are more beneficial for the expression and growth of the leaf form, others for the root form, and still others for the flower and fruit forms. They have used this finding to help them with the practical questions related to the timing of sowing of vegetable and other plant seeds.

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94 Thun, M. (1979). Work on the Land and the Constellations, Sussex, England: The Lanthorn Press.

In the United States, bio- dynamic farmers and gardeners use Kimberton Sowing Calendar[95] as their key aid to sowing with the stars and the planets. Based on astronomical data, the calendar gives guidance on when to sow leaf vegetables (lettuce, collards, kale, etc. and leaf herbs), root vegetables (carrots, radish, etc.), fruit vegetables (summer squash, tomatoes, etc.) and flowers (carnation, strawflowers, etc.).

Goetheanistic Approach To On- Farm Innovation

We have already seen the importance of on- farm innovation in any sustainable agriculture project. Bio- dynamic farmers rely on the Goetheanistic approach to develop new farming techniques suited to the unique conditions of their site.

We saw, for example, the importance of functional diversity in creating a stable productive agroecosystem by naturally controlling pest populations. However, in practice, ecological farmers have difficulty inn establishing such a farm. It is hard to determine whether introducing a new species will harmonize with the other species in the farm. The major problem lies in the determination of the ideal goal state towards which a potential organismic community can evolve into. Goetheanistic science may provide an answer.

Goetheanistic scientists, for example, have discovered the fourfold nature of the plant.[96] The formative forces at work in the root, leaf- stem, flowers, and fruit- seed of plants are qualitatively different from each other. They have also shown that the whole is active in every plant organ.[97] This can be readily seen in vegetative propagation where a leaf bud or a root part can regenerate the whole plant.

In addition, goetheanistic scientists have shown that insect metamorphosis and behavior are intimately connected with the fourfold plant.[98] The larva, for example, has an affinity with the leaf building process in plants. The larva and the leaf are differentiations of the same formative process, with astral forces modifying the expression of the formative process in the larva.

We have seen the etheric and astral forces are organizing principles. They are the wholes which shape the physical form of living organisms and which govern their harmonious interaction in an ecological community. Goetheanistic scientists consider the mutualistic interactions between plants and animals, including insects, as living expression of an astral organism which permeates the farm.

Knowing that the part exemplifies the whole, we can gain an idea of the organizing objectives of this astral organism. In plants, the astral principle has differentiated the etheric formative forces into a fourfold process.

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95 See Resources section for information on how to obtain the Kimberton Sowing Calendar.

96 Wildfeuer, S. (1988). The Kimberton Hills Agricultural Calendar, Kimberton, Pennsylvania: Kimberton Hills Publication, p. 7.

97 Steiner, R., Goethe The Scientist, op. cit., p. 7.

98 Grohmann, G. (1974). The Plant, London: Rudolf Steiner Press, pp. 51-57; Koenig, K. (1982). Earth and Man, Wyoming, Rhode Island: Bio- Dynamic Literature, pp. 159-192. See also, Poppelbaum, H., op, cit., pp. 42-47.

This indicates that the astral principle may also differentiate the generalized etheric formative forces[99] in nature into a similar fourfold unity. This fourfold etheric differentiation in nature may then govern the direction towards which ecological communities organize themselves.

This hypothesis is explain, for example, why continuous cropping leads to loss of vitality in plants and increased attack by insects, diseases, and other pests. Continuous cropping of leaf vegetables in the same bed, for example, depletes the leaf- forming etheric forces of the farm organism. The vegetable lose their vitality. As we have seen, loss in vigor makes plants more susceptible to pest attack and damage. The depletion may also favor soil insects including nematodes that thrive on attenuated leaf-forming etheric forces.

In addition, this fourfold cropping scheme encourages the settlement of insect and other animal species that will most likely keep pest populations under control. Root, leaf, flower, and fruit crops bring with them their associated fauna. If, for example, the garden has flowers in addition to leaf vegetables, it will encourage wasps, which feed on leaf worms, and other beneficial animals to thrive in the garden.

In practice, you will need to work out the actual proportions of root, leaf, fruit, and flower crops to plant. You will need to undertake careful field observations and experiments to establish the mixture appropriate for your plant site. This cropping mix may also vary with the season and the climate.

So far, in our experience, the hypothesis is working. By consciously diversifying our cropping pattern according to this fourfold organizing force of the astral principle, we are nearing a point of dynamic balance and harmony among plant and animal species. Many of our vegetables are no longer being devoured by voracious worms and other plant- eaters. In addition, we hardly have any vegetable diseases.

The Farmer as Co- Creator of the Farm Organism

All agriculture, whether chemical or biological, is a reshaping of nature. With the use of chemicals, we intervene with the workings of nature. When we use biological control methods, we also interfere with the relationships in nature. The farmer cannot avoid the role as co- creator of the farm organism.

To work in partnership with nature, the farmer needs to understand nature as natura naturans, as creating nature. The goetheanistic method is a crucial first step in this direction.

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99 The generalized etheric forces are those that are not employed in building up the physical body of an individual species.

The goetheanistic approach requires a new mode of disciplined thinking. The corollary is that the bio-dynamic farmer makes a free decision to undergo a process of self- transformation. Without self-knowledge, we will be blind to the cognitive biases we impose on nature. Without developing aesthetic perception, we can never behold the operative wholes in nature. Without taking hold of the dynamism of our own cognitive processes, we will never understand how our thinking can participate in and arrive at knowledge of natura naturans.

With this, we reach an important theme that lies at the very heart of the first principles of sustainable agriculture. This is the scheme that will be taken up in another essay, to complement this one.

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