

# Chapter 13

## The Soil Scientist's Hidden Beloved: Archetypal Images and Emotions in the Scientist's Relationship with Soil

Nikola Patzel

### 13.1 Introduction

From the outset, the practice of modern soil science has been a *double-grounded process*, being simultaneously in touch with outer observations and inner images. Scientists have studied soils with their senses and their means of consciousness, while also being fascinated, driven and guided by other factors of their inner life. These internal factors are emotional inner images and ideas, and they act often unconsciously. Some keywords of emotional inner images, expressed by pioneers and leaders of soil science, are: *Mother Earth*, *vital force*, the *Stone of the Sages*, the *encompassing whole*, and *total control*. They can be found in the writings of Liebig, Sprengel, Fallou, Dokuchaev, and Jenny, as well as contemporary soil scientists, and I call them their *inner soil*.

To qualify these internal factors forming the inner soil of soil science, we can name them 'archetypal' (following the psychologist Carl Jung), because their general structures are not individual achievements, but common to all humans. The work presented here has been done relying on a hypothesis (central to depth psychology) which is not common sense in present Western societies, albeit there is much empirical evidence for it: That we humans think, judge and act not only out of conscious rational decisions, but also out of unconscious motivations with their own kind of rationality or non-rationality. The unconscious is not just 'feelings' or 'emotionality'; it is a whole world supporting and surrounding our conscious lives. For those readers, who want to have an idea about the author's concept of the unconscious before reading the whole text, I offer the following three indented paragraphs:

This text has been published in  
Edward R. Landa and Christian Feller (eds.):  
**Soil and Culture**  
2010, part 3, p. 205-226

A copy is available at:  
<http://www.springerlink.com/content/m1178678508k1j13/>  
DOI 10.1007/978-90-481-2960-7\_13

Nikola Frederik Patzel  
Seestraße 5, 88662 Überlingen, Germany  
e-mail: nikola@patzel.info

### What about the unconscious?

- 1) When our consciousness is asleep (or in some other 'absent states'), clinical measurements show our brains to be periodically highly active, especially during the REM (rapid eye movement) periods of sleep. The inner perspective of this state of activity is a world of dreams—from unconscious wishes seeking for their place in our life to the deepest religious visions; from a chaotic whirlpool of emerging strange images to experiences of order and harmony unlike any we have ever had when awake.
- 2) With the methods of scientific psychology or comparative religion, we can observe some common patterns of dreams and visions all over humanity (research pioneers have been Carl Jung, Mircea Eliade, Erich Neumann and others). And from an inner perspective, countless dreamers and visionaries have reported the impression that there is something spiritual that transcends the borders of their own subjectivity and individuality. To highlight the commonness of groups of similar inner images, they have been named by Jung "archetypal images", emerging in individuals out of common layers of the unconscious, which can be characterised therefore as "collective unconscious" (Jung 1969). The term 'archetype' comes from Greek *archetypon* = 'original form'.
- 3) Here we work with the hypothesis that the unconscious is not only effective and relevant in the dream or vision state of a human, but also in our life in the normal daily mode, for example, when writing a scientific publication about the soil. But then, in general we don't notice its presence and its effects. But its traces can sometimes be followed, as has been done in this paper, which is mainly about emotion-rich archetypal images and ideas expressed by soil scientists.

The aim of this chapter is to give some preliminary answers to the questions:

*What are the main features of the 'inner soil' found with pioneers and leaders of modern soil science? Which modes of the scientist's relation to the inner soil are traceable? And what could be a fair and fertile way of dealing with it?*

## 13.2 Mother Earth

F.A. Fallou (1794-1877), one of the founders of modern soil science and the one who coined the term 'pedology', admired the *Earth Mother*, whose general devaluation made him suffer. In the introduction to his "Pedology", Fallou (1862, p. 3, translation by author) wrote: *"Everything ugly and miserable, useless and worthless, man can imagine, he names by the summarising words: dust, dirt, dung and mud. These are the honorary titles he has assigned to his Mother Earth in past and present. No word is breathed that he owes his existence to this cursed dirt and dung. Everybody is pleased to see good old Mother Earth rejuvenating, donning her flowery spring garment. However, nobody remembers the dirt and*

*dung concealed underneath the beautiful clothes, which he avoids touching with hands, and even prefers not to set foot on it. Everybody wishes to walk on flowers, nobody wants to know anything about the soil, without which no flower could emerge."*

And further, Fallou stated (1862, p. 46): *"Our culture and civilisation, everything we have, we owe solely to the bond, which man had entered with his Mother Earth. Because it was agriculture, which made man become himself!"* Fallou called the earth (1857, p. 2) *"mother of all"*, and the *"teachers and followers of natural studies and agronomy"* were called by him *"priests of Isis and of Ceres"*. These are the Egyptian goddess of life, matter and related magical knowledge, and the Roman goddess of Earth and agriculture.

When the ideas of *organic farming* emerged in the minds of its pioneers, Mother Earth was evoked, too. For Rudolf Steiner (1861-1925), one of the founders of organic farming, every spring, the *"divine creativity sprouts from Mother Earth"* [Steiner (1998, p. 262, translation by author)]. In Steiner's worldview, Mother Earth was a conscious spiritual being with *"an 'I' in her centre"*. Steiner (1993, p. 122, translation by author) repeated the old mythological phrase: *"The earth is the flora's mother, the heaven its father. That is really, literally the case!"* In 1932, his followers patented the name of 'Demeter' (Greek Mother Earth goddess; sister of Zeus) for the products of bio-dynamic agriculture (von Wistinghausen 1982, p. 46), a label which is still in use today.

Hans-Peter Rusch (1906-1977), another of the founders of continental European organic farming, evoked the *"holy Mother Earth"*, which could not be reduced to simple nutrient elements (Rusch 1955, p. 22; 1968, p. 71). And Sir Albert Howard (1873-1947), the British pioneer of organic farming who had strong ties to India, wrote that agriculture should be done following to the principles of nature, invoking the name of *"Mother Earth"* (1940, p. 4): *"Mother earth never attempts to farm without live stock; she always raises mixed crops; great pains are taken to preserve the soil and prevent erosion; the mixed vegetable and animal wastes are converted into humus; there is no waste; the processes of growth and the processes of decay balance one another; ample provision is made to maintain large reserves of fertility; the greatest care is taken to store the rainfall; both plants and animals are left to protect themselves from disease!"*

Howard (1940) showed his feelings towards Mother Earth/Nature with the quotations that he placed at the beginning of his "Agricultural Testament": Shakespeare ("Romeo and Juliet"): *"The Earth, that's Nature's Mother, is her tomb / What is her burying grave, that is her womb"*; and Longfellow ("The Fiftieth Birthday of Agassiz"): *"And Nature, the old nurse, took / The child upon her knee, / Saying: Here is a story-book / Thy Father has written for thee! / 'Come, wander with me', she said, 'Into regions yet untrod; / And read what is still unread / In the manuscript of God'."*

In contrast to academic soil science, which was completely male-dominated at its beginnings, organic agriculture had at least four women among its pioneers: Gabrielle Howard (1899–1990) and Maria Müller (1894–1969) as background researchers and developers (with their husbands being in the limelight), and Lady Eve Balfour (1899–1990) and Mina Hofstetter (1883–1967) working on

their own behalf. {Maria Müller's husband Hans Müller (1891-1988), a today rather-unknown organic farming pioneer, was the key promoter and social leader of the non-biodynamic branch of organic farming in continental Europe at its inception. His role was comparable to that of Jerome Rodale (1898-1971) in the United States.} It is notable that Lady Balfour started a magazine with the title "Mother Earth" (present title: "The Living Soil"); and Mina Hofstetter, founder of the first organic farming school in Switzerland, showed an approach to Mother Earth that can, in retrospect, be called 'spiritually feminist'. Hofstetter wrote in 1941 (p. 14, translation by author): *"We want to throw a light on paths we consider as wrong, which were thought up and dictated by men in a commercialistic way, instead of being empathically sensed and fulfilled by mothers. From mothers, to which the same law belongs, as to the earth."* Hofstetter claimed the importance of a spiritually receptive attitude towards Mother Earth: *"Then, suddenly, she starts talking and becomes understandable"* (1941, p. 14f). Schmitt (2006, p. 56) wrote on Hofstetter: *"... whereas Lady Eve Balfour embarked on a series of world lecture tours, others, like Mina Hofstetter, drew people from all over the world to the sites of their efforts."*

The classical idea of Mother Nature being the female master and teacher of scientists—formerly strongly held by many alchemists—was expressed by the soil scientist Karl Senft. In his textbook from 1888 (p. v, translation by author), he introduced his results with the statement, *"to use only Mother Nature as master craftswoman"* and announced his wish to convey what she teaches, as far as he could understand it, *"truly and honestly"* (p. vi). The aspect of Mother Nature, which is highlighted by Senft here, is a guiding *feminine wisdom*, as we saw it also with Howard above, being the 'know-how of life'. Earlier, the feminine wisdom of Earth-Nature was evoked, for example, by addressing the Egyptian goddess Isis, and the spiritual master craftswomen of Arabic and Western alchemists.

As a side remark, it should be mentioned that the teachings of nature were seen by a most influential philosopher of science, Francis Bacon (1561-1626), as answers under compulsion (Bacon 1863, p. 48), *"... under constraint and vexed; that is to say, when by art and the hand of man she [Nature] is forced out of her natural state, and squeezed and moulded."* And p. 134: *"For even as in the business of life a man's disposition and the secret workings of his mind and affections are better discovered when he is in trouble than at other times, so likewise the secrets of nature reveal themselves more readily under the vexations of art than when they go their own way."* Statements like these lead the ecofeminist Carolyn Merchant to draw the conclusion (1982, p. 169): *"Through vivid metaphor, he transformed the magus [sorcerer, here: scientific adept] from nature's servant to its exploiter, and nature from teacher to a slave."*

In the late 20<sup>th</sup> century, the symbol of Mother Earth remained in only a few traces in the soil science literature. One of these is the "skin of the earth" for the soil—alluding to a living body having a skin. This term was used, for example, as motto for the 2005 annual conference of the German Soil Science

Society (DBG). A stronger return to the archetypal images of Mother Earth was employed by soil scientist Daniel Hillel [(1991b, p. 404); for more, see Hillel (1991a)]: *"The adjective 'human' means 'of humus'—of the soil."* He called then to a *"returning"* and *"reawakening"* to this basis, by quoting Friedrich Nietzsche (1844-1900): *"Let your gift-giving love and your knowledge serve the meaning of the earth.' Perhaps that most common matter underfoot that many among us scarcely notice and take for granted is our most vital resource, the mother-lode of terrestrial life and the source of its productivity. For out of the earth thou art, and unto earth shall thou return,' in spirit as well as body."*

### Interpretation

What was meant by 'Mother Earth' by those speaking about her? The spectrum of archetypal meanings is sketched by the Encyclopaedia Britannica (15<sup>th</sup> ed., 1992): *"Earth Mother, in ancient and modern non-literate religions, an eternally fruitful*



Fig. 13.1 "Venus à la Corne" from Laussel, about 25,000 years old. One hand possibly holding a cornucopia which has 13 notches, the other hand on her belly. © Musée d'Aquitaine, Bordeaux. Photo L. Gaulhier; reproduced here by permission.

*source of everything. Unlike the variety of female fertility deities called mother goddesses ... the Earth Mother is not a specific source of vitality who must undergo sexual intercourse. ... The most archaic form of the Earth Mother transcends all specificity and sexuality. She simply produces everything inexhaustibly, from herself. ... In other mythological systems she becomes the feminine Earth, consort to the masculine sky; she is fertilized by the sky in the beginning and brings forth terrestrial creation. Even more limited reflections of the Earth Mother occur in those agricultural traditions in which she is simply the Earth and its fertility."*

Some important aspects of this description of Mother Earth are: She is, in the basic meaning, the primal ground and origin of the living creature. Second, being part of a primal polarity of being (like Chinese Yin and Yang), Mother Earth is the archetype of femininity, to which the masculinity (e.g., God in Heaven, or: Her Son) is seen as the complement. Third, as fertile earth and soil, she becomes more identified with the just creative living matter. {A much more encompassing and differentiated analysis of Mother Earth as one aspect of the "Great Mother" has been given by Neumann (1972).} All of these are qualities which may be activated in the soul of a soil scientist, who is touched, moved, and motivated by *Mother Earth*.

### 13.3 The Vital Forces or Spirits

In western history of ideas, Aristotle's concept of *entelechy*, meaning *life having its purpose in itself*, founded an important tradition. (For primary sources, see in the *Corpus aristotelicum*: De anima II 1, 412a, Metaphys. VII.13, 1038b 1-6, IX.8, 1050a 9-16, Phys. III, 1.) Part of this tradition is the so-called 'vitalism', the philosophy of vital forces or spirits. Before its appearance with soil and agricultural science will be discussed, the following paragraph provides some more background to the historical vitalism vs. materialism/determinism debate.

With Aristotle's renaissance in the modern period, some philosophers of the special qualities and forces of life emerged (e.g., Jan Baptist van Helmont 1577-1644, Georg Ernst Stahl 1660-1734, Albrecht von Haller 1708-1777, Paul-Joseph Barthez 1734-1806, Marie Francois Xavier Bichat 1771-1801). These authors were opposed to mechanistic and deterministic views of living beings, which were fundamental to modern 'life sciences': First the Cartesian dictum "*animalia sunt automata*" / *animals are machines*, compare Descartes (1637, p. 185; 1649); second the Baconian dictum "*nam causarum finalium inquisitio sterilis est*" / *thus, the investigation of final causes [finality] is sterile* (Bacon 1623, vol. I, part 5). As René Descartes negated all soul and spirit, except in human consciousness and within a rather abstract God image, Francis Bacon aborted the idea of purposeful development and intentional processes (do something "for the sake of ...") by reducing them to deterministic effects of determined causes. To these fundamental ideas of 'enlightened' science, vitalism formed a counter-movement.

During 19<sup>th</sup> century, this movement was called 'vitalism'—first by its adversaries (Engelhardt 1997, p. 160f; Duchesneau 1997, p.297), and then by the 'vitalists'

themselves. Within the early 19<sup>th</sup> century soil science community, Albrecht Daniel Thaer (1821, vol. 2, p. 85, § 109; translated by author) called humus "*a creation of the organic force, a compound out of carbon, hydrogen, nitrogen and oxygen, as the inorganic powers of nature cannot bring it forth*". {For more context to this quotation in the development of the *humus* concept, see Feller (1997).}

Carl Sprengel (1787-1859), the German chemist who first formulated the so-called "law of the minimum" (relating plant growth to a set of essential nutritional chemical elements) wrote in the same publication where he published the chemical "law of the minimum" [Sprengel (1830, p. 176f, translated by author)]: "*A highly organized body is therefore composed of many life atoms and many chemical atoms. ... The inner nature of the life atoms is as little explainable as that of the chemical atoms.*" These life atoms, being also the "*life principle*", would stay with the residual products of decaying organisms. The growing of a plant would also depend on the availability of life atoms (Sprengel 1930, p. 1760f). Thus, it can be stated that Sprengel's "law of the minimum" was in reality a pairing: the chemical and life 'atoms' would only together form the necessary and sufficient conditions for plant growth.

Justus von Liebig (1803-1873), the important developer and promoter of agricultural chemistry, also kept "*vital forces*" within his image and feeling of nature. In his "Familiar Letters on Chemistry", he wrote (von Liebig 1851, p. 18; see also von Liebig 1878, p. 14): "*Let us, however, carefully distinguish those effects which belong to the chemical, from those which depend peculiarly upon the vital force, and we shall then be in the right channel for obtaining an insight into the latter. Chemical action will never be able to produce an eye, a hair, or a leaf.*" However [von Liebig (1878, p. 144, translated by author)], "*The vital forces are not disposable to our will in the same way as are heat, light, gravitation etc.*" As examination of different editions of his works (beginning in the late 1850s) show, Liebig was somewhat torn between materialistic and vitalist ideas, but tried to reconcile them [von Liebig (1878, p. 213, translated by author)]: "*Exact science has shown, that all the powers of matter really play a part in the organic process. Now, the extreme reactionary forces pretend, per contra to the former opinion, that only chemical and physical forces would determine the phenomenon of life, and that no other force would be acting in the body. However, in the same way as former philosophers of nature were not able to prove that their vital force makes everything, yesterday's materialists cannot show a proof that it is done by inorganic forces, that they are sufficient to bring forth organisms, even the mind. ... Truth lies in the middle, which transcends the one-sidedness, acknowledging a formative principle, a ruling idea for organic life, within and together with chemical and physical forces.*"

The most effective disciple of Liebig in Germany, Adolph Stöckhardt (1809-1886), wrote in his most popular book entitled "Chemical Field Sermons" (1851, pp. 14, 16, translated by author): Whereas chemical forces would act unhindered in the soil, they would stay within plants under the "*tutelage of a mysterious higher power*", which could be called "*vital force*" or "*God's breath*", on which the chemist would have no power.

At the beginning of 20<sup>th</sup> century, the 'vitalism' discussion of the 19<sup>th</sup> century was summed up, for example, by Butschli (1901), Wolff (1905) and Braeuning (1907), and culminated with the bio-philosophical vitalism of Driesch (1922). Its next cycle started with the modern-era organic farming movement. Vitalist ideas were crucial for some important founders of organic agriculture. For Hans-Peter Rusch, the keyword was "*living substance*". First, he identified the 'living substance' with cell organelles and macromolecules (Rusch 1953, p. 15; 1960, p. 53), which he considered to become part of the humus, the latter being considered as the primeval appearance of "*living tissue*" on earth (Rusch 1955, p. 155). Under the pressure of contradictory scientific evidence, Rusch retired this biological hypothesis and went back to the core statements of the vitalist tradition, interpreting living matter as the appearance and materialization of a "*really spiritual principle*" (Rusch 1968, p. 33). For biodynamic farming, Rudolf Steiner worked out a sophisticated model of psychic and spiritual forces and 'beings', which would form and inhabit plants, animals, and humans. In his view, the "*farm organism*" (compare Steiner 1984, p. 202; Raupp 2000) would be the organisational level where the unifying transformation of the different kinds of forces would take place.

The "*living principle*" was also important for the co-founder of organic agriculture in Great Britain, Lady Eve Balfour (1943, p. 18): "*In our modern world, which is largely ruled by chemistry, we have tended to overlook this continuity of the living principle in nature*", that is, the "*organic circle ... This ever recurring cycle of birth, growth, reproduction, death, decay, decay passing once more into birth, is often called the Wheel of Life.*" Balfour might have been inspired in this by Sir Albert Howard, who stated (1940, p. 22f) that one must look at the "*wheel of life as one great subject... made up by two processes—growth and decay*".

### Interpretation

From the quoted sources above, we see the traces of the following cultural and mental development: After the blow stroke on the image of enchanted nature by the 'Enlightenment' (Bacon, Descartes and others as spearheads), the (re-)emerging vitalism offered a new framework for some of the old beliefs.

The tension between vitalism and materialism, which coexisted in the mind of distinguished 19<sup>th</sup> century scientists, lead then to a segregation of worldviews into 'mainstream science' and 'undercurrent science', the latter forming some of the important roots of European organic agriculture. One may say that the idea of special organizing 'vital forces' and life capacities emphasizes the qualitative difference of life from its 'abiotic' environment. This has connections with the ideas that the soul steers the body, and God makes the plants grow. More generally, there are links to the ideas that there are non-material factors acting in the plants, whose expressions in folk beliefs have been labelled with the term *vegetational spirit* (Mannhardt 1875-77, Frazer 1914-18, and others).

## 13.4 The Stone of the Sages

From late antiquity on, the *Stone of the Sages* (*lapis philosophorum*) was a well-known name for the highest value that Arab and European alchemists strived to achieve with all their efforts. One of its properties, in popular belief, was the potential of this most precious stone to give immortality—to transcend the limits of material existence. Within this context stands the following idea of the agricultural chemist Adolph Stöckhardt. In his "Chemical Field Sermons", which was one of the most popular books of agricultural chemistry in Germany for decades (Henning and Suntheim 1997), Stöckhardt wrote (1851, p. 1) under the chapter heading "Chemistry as the farmer's concubine" ("Die Chemie als Hausfreundin des Landwirthes"):

*"Since all times up to present, man had the following two big wishes: He would like to be everlasting young and healthy, and in addition to be quite rich. Following a dim legend, somewhere in nature should be a wonderful jewel hidden or to be distilled out, which would be able to fulfil these two wishes; it was called Stone of the Sages. ... During a millennium, this treasure was sought-after, but not found. ... To a certain degree, chemistry really owns these powers, one had attributed to the stone of the sages ..."*

{Note the similar title of the extremely successful textbook (written in question and answer format) of J.J.F. Weir (1844): *Catechism of Agricultural Chemistry and Geology*; a book that had about 50 editions and reprints within 50 years.)

### Interpretation

Here we see very clearly, how Stöckhardt transferred the symbolism of alchemy, which meant ultimately (at least in spiritual alchemy) the transformation of human soul and spirit and its union with God, in a very concrete way, to chemistry. This is in line with one of the main tendencies of the western cultural mainstream since the Enlightenment: *to consider knowledge of the outer world and mastering of matter as the highest value, effectively replacing spiritual values.* To make the hypothetical link from Stöckhardt's chemistry to the "Stone of the Sages" clearer, the argument is drawn again step by step:

1. The Stone of the Sages was, throughout the centuries, an alchemical symbol for the highest value and goal of human life.
2. In Stöckhardt's time, the spiritual dimension of alchemy (and with it also, of matter and its elements) was more and more dismissed as 'mystic' and 'superstition', as opposed to emerging 'modern' chemistry.
3. The new chemistry did not loose the whole psychic and religious energy, linked before (in Alchemy) with a *highest value* as the Stone of the Sages, but became itself a most promising realm of human striving.
4. As a part of this value shift, Stöckhardt transferred the fascination with the highest value of human striving from the Stone of the Sages to chemistry.

For material showing that Stöckhardt was not a single case, compare Carl Jung's work about "Psychology and Alchemy", with a special focus on his conclusion about the psychological dimension of the transformation process alchemy-chemistry (Jung 1968, par. 432).

## 13.5 The Whole—and Its Control? 13.5.1

### *The Classical Four Elements*

When dealing with soil fertility, the classical four elements—water, fire, air, and earth—sometimes appear to the mind. The outstanding 19<sup>th</sup> century soil scientist Karl Senft (1888) used the idea of the four elements for structuring his model of soil processes: He stated that the soil, being a "laboratory", prepares the food for plants mainly "in the way, that it absorbs atmospheric air, humidity and warmth" in the proportion and distribution which is needed to transform mineral and organic residues (Senft 1888, p. 95). This corresponds to the alchemical idea of the stepwise union of the four elements: water, air, and fire being united with each other and with the fourth one, namely the earth (soil), which is vitalized and renewed by this union of opposite factors.

A new canon of four elements was proposed by Adolph Stockhardt (1850, p. 574, translated by author): "Carbon, oxygen, hydrogen and nitrogen: these four elements are, what God's almightiness fixed as elementary pillars for the whole construction of the organic creation." A recurrence of the classical four elements took place in the 20<sup>th</sup> century with the organic-farming pioneer Mina Hofstetter (1941, p. 16), who believed that God created life out of the four elements 'fire (sun/ light), air, water and earth .... And the synthesis [in alchemical language: the "quintessence"] of those is the plant, which nourishes beast and men!"

### **Interpretation**

The number four often serves to give complete conscious orientation on earth (Abt 2005, p. 127-130); for example, by means of the four cardinal points, the four seasons, the classical four elements (worked out by Empedocles, Aristotle, Plato, Hippocrates, Paracelsus and others), or, in science, as the Cartesian cross or as four-dimensional space-time. In agriculture, you find the four corners of the field, and symbolic fourfold structures like the Christian cross brought into or near the fields, or Indian cross-ploughing (Högger 2000). The number four has the archetypal quality of orientation and ordered totality. This archetype of orientation was also attractive for structuring the complex phenomenon of soil fertility. In addition, it led to the symbolism of life (plants, etc.) as the central fifth element, seen symbolically in the centre of the cross or as offspring from the union of the four elements.

## 13.5.2 *The Primeval Factors and the Whole*

The first scientist to speak of the soil as an "organised whole" was the Danish researcher P.E. Müller (1840-1926). Within that whole, he saw a complicated interplay of "factors" such as fungal mycelium, soil animals, water percolation, and climate [Müller (1887, notably p. 3, 87f and 176f); see also Feller (2005)]. But then it was Vasilii Vasil'evich Dokuchaev (1846-1903), the Russian pioneer of modern soil science, who made the term 'pedology' popular, and who established a more complete, multifactor approach to understand soil genesis. One of Dokuchaev's main new points was that he criticised the purely analytic approach in soil science, which only looked at separate parts and pieces, and called instead for a holistic soil science. The following quotations illustrate Dokuchaev's new approach [Dokuchaev (1949-50, pp. 399 and 397), as quoted by Dobrovol'skii (1996, p. 107-108)]:... *link that exists between forces, bodies, and phenomena; between dead and living nature; between the vegetative, animal and mineral kingdoms on one hand, and between man, his everyday life, and even mental world on the other. It is this relationship, this natural interaction, that makes up the essence of nature cognition ...—the best and supreme fascination of natural science.* And further: "... in the study of these factors and particularly in mastering (if there is such a wish) them, the entire, single, integral, and indivisible nature must be, by all means, reckoned with as far as possible, and not its fragmentary parts; all its principal elements must be revered and studied alike; otherwise, we shall never be able to control them, and we shall never learn what belongs to one factor and what to another." We see that Dokuchaev's highest value was an all-encompassing picture of nature, including its humanistic dimension, and the relation patterns of all of its elements, with the soil and its forming factors at the centre of interest. This approach made Dokuchaev an ecological pioneer within soil science.

Building upon the foundation established by Dokuchaev, the Swiss-American soil scientist Hans Jenny (1899-1992) worked out his famous "factors of soil formation" model (Jenny 1941). In addition to their description, Jenny tried to grasp the primeval factors of soil genesis as state variables which could be described by mathematical means (Jenny 1984): "I enjoyed seeing field data aligned by equations and derived aesthetic pleasure from the shapes of the curves. ... I could solve the equation. That was the new approach." Jenny showed some similarities to Fallou, who, in a certain way, was drawn to both Mother Earth (quoted above), and simultaneously to clear, man-made, rational order (Fallou 1865, p. 158f): "Formerly, nature lay before us like a dismembered clockwork." But then, "after having lined the chaotic army of beings one by one [German: *allgemach*] in formation, and thus having finally ordered and classified everything according to a well reasoned plan", he exclaimed: "The whole nature has become [like] a big state!" With "state", Fallou had probably the Prussian State ideal of his time in mind: a rational world order, established and ruled by a hierarchy of 'enlightened powers'.

But as Jenny shared with Fallou the pleasure of seeing soils and soil data aligned in rational order, he also shared with him the strong emotional attachment to the

soil: "... if you are used to thinking of soil as dirt, which is customary in our society, you are not keyed to find beauty in it." The soil "speaks to us through the colors and sculptures of its profile, thereby revealing its personality; we acknowledge it by giving soil a name, albeit in a foreign tongue, but we don't mention our emotional involvements. In fact, our soil language is lifeless." And further: "/ am intrigued by the thought that good soils make good people, but that notion seems untenable. Well, not wholly so. ... Observing soils, studying them, and reflecting on them induces respect, if not wonder. All of us relate unconsciously in our daily nourishments that make us participants in the continuous flow of nutrient atoms that originate the soil. And in the final act our bodies are returned to the soil. Over the years I have acquired a kind of reverence for the soil, for the creature-world inside it, and for its character expressed in the profile features. ...My attitude may be a quirk, or a result of lifelong interest in soil" [Jenny (1984); compare with the quotes of Hillel above in this chapter].

You see with Fallou and Jenny the polarity between the emotional and feeling approach on the one hand, and the fascination with rational order on the other hand. This points to a very important problem that still confronts scientists: How to deal with the separation between the "lifeless language" of scientific discourse on one side, and the "personal quirk" of feelings, fantasies and emotional bonds with the object of their study on the other side? For example, in terms of scientific development and human society's relationship with soil: what can happen when Fallou's feeling that earth has aspects of a Goddess ("Isis and Ceres"), or Jenny's "respect", "wonder" and "reverence for the soil" get suppressed or lost? In fact, this had been widely the case, and one might argue that this contributes to the accelerated and ongoing soil deterioration and destruction in large parts of the world.

### 13.5.3 Holism in Organic Agriculture

'Holism'—the attitude and philosophy working with the assumption that everything is a part of a single whole, with every part being interconnected with others—played a fundamental role for the founding of organic agriculture. Steiner wrote (1984, pp. 169 and 103, translated by author): "... nature is a whole, from everywhere are powers acting" Therefore, "It is thought [in his approach] out of the whole." Subsequently, the so-called "farm organism" has become a central image of the bio-dynamic branch of organic farming (e.g., Raupp 2000). On the non-biodynamic side, Rusch wrote (1968, p. 30, translated by author): "Soil fertility is the basis of all life, its origin and the place of its continuous renewal; its reflection/ contemplation [German: Betrachtung] compels us to see things as a whole, otherwise it [soil fertility] is unfathomable." Rusch argued (1955, p. 39) that for a holistic approach to be fully realized, not only logic would be needed, but also the whole human nature: "... also our spiritual, psychic [German: seelisches] and bodily being, our character as well as instinct and intuition."

In the Anglo-Saxon roots of organic agriculture, Sir Albert Howard (1940, p. 23) stressed that, as "the wheel of life is uninterrupted throughout, ...it must therefore be studied as a working whole." And Lady Eve Balfour (1978, p. 5) wrote about her "wholeness approach", that "... the biota is a whole, of which we are a part," every part having its own right to exist. And: "If I am right, this means that we cannot escape from the ethical and spiritual values of life for they are part of wholeness:"

### Interpretation

According to Scofield (1986), the word 'organic' in 'organic farming' went back to the 1940 book "Looking at the Land" by Lord Northbourne [Walter Ernest Christopher James (1896-1982)], a bio-dynamic practitioner in England. He used the term not in the chemical sense (i.e., as opposed to 'mineral'), but in the sense of the 'organic whole' of a farm or of a society. Indeed, the holism of organic agriculture shows features of an organismic worldview. The idea of also comparing human societies with organisms has deep roots in the West [see, for example, Plato's "Republic" as a Utopian state, and the physiocratism of Modern Age: e.g., Quesnay (1694-1774)]. A new dimension has more recently been added to the concept: the idea of the whole earth being like one (super-)organism. Heckman (2006) pointed out the similarities of the Gaia Hypothesis with agricultural holism: "This concept of organic is similar in many respects to the holistic ideas more recently expressed by James Lovelock in the 'Gaia Hypothesis' [i.e., (Lovelock 1979)] and Lynn Margulis in her book 'Symbiotic Planet' [1998], but on the smaller scale of a whole farm as a symbiotic unit."

### 13.5.4 The Wish to Control

The approaches of Dokuchaev and of Jenny have led to the ever more sophisticated mathematical modeling efforts. The possibility to which Dokuchaev hinted at—i.e., of "mastering (if there is such a wish) them [the factors/elements]" [Dokuchaev 1949-50, p. 399 as quoted by (Dobrovolskii 1996, p. 108)]—has become one of the major purposes of research of modern pedology and agricultural science. Of course, discoveries and knowledge bring the human power drive into the arena: the wish appears to control all relevant factors of the soil. That was clearly stated by the US National Research Council, Board on Agriculture (1997, p. 1): "Precision agriculture is a phrase that captures the imagination of many concerned with the production of food, feed and fiber. ... Precision agriculture conjures up images of farmers overcoming the elements with computerized machinery that is precisely controlled via satellites and local sensors and using planning software that accurately predicts crop development. This image has been called the future of agriculture." The phrase "overcoming the elements with computerized machinery" means to have dominion over the soil and nature's elements; and the word "overcoming" indicates an

attitude, as if they have to be defeated. Will that attitude towards nature be the "future of agriculture"? What feelings and emotions go with this image?

In the heyday of communism, formulations were found which carried the negation of soil dignity and autonomy as a living natural body to extremes [Rosenkranz (1963, p. 196, translated by author)]: "*When detaching forceful from such folksy but scientifically untenable ideas: the soil would be something special, full of life, life-bringing, fertile, maybe even mysterious and unfathomable in its coherence and action, and when replacing these ideas by a dialectic materialistic perspective [i.e., the world interpreted by relying on its 'objective' material features; compare Stalin (1938)], then the soil will become a carrier system, one of many means for work, like others, who allow humans, when used by them, to produce plants out of water, sun energy and elements for plant nutrition. Solely man is producing; neither plants nor animals, nor the soil is 'capable' to bring forth a harvest?*" This quotation has been chosen because of its radical and ruthless formulation of a certain devaluation of natural life and autonomy concerning soil and agriculture ("I produce wheat, milk and meat ..."); similar views have also surfaced in the capitalist world.

### Interpretation

For many centuries, the Christian cultural tradition has included the image of 'God's Eye' in a triangular frame, viewing the whole world from above, and at the same time seeing the tiniest events on earth. Even today, we see an image of 'God's Eye', for example, on the U.S. one-dollar bill, and in different shapes on amulets in various cultures. We now have man-made satellites orbiting the earth. They enable humans to see their planet as a whole globe for the first time in history—this is an innovation whose cultural impact cannot be underestimated. So, one may comment that the place of 'God's eye' in heaven had been imitated by man-made 'machine eyes' in the sky. In addition, the human capacity to perform the most detailed measurements of what goes on in the soil, to create complex environmental-process databases and models, and to calculate future scenarios, has increased enormously (compare Psalm 139 from the Old Testament). In this cultural frame, new techniques such as remote sensing and continuous in-situ measurement of soil properties and processes give new tools to the human power drive and to the related self-understanding of being the controller and steerer of nature—that is, to our hubris.

## 13.6 Conclusions

### 13.6.1 Outer and Inner Soil

When working with the soil, as scientists or as farmers, humans encounter more than the outer soil. (Concerning farmers' attitudes in the 'pre-enlightened' European agrarian culture, see chapter 16 of this book: *European*

*Religious Cultivation of the Soil.*) One may also encounter emotions, feelings, intuitions and 'just-so' convictions which are associated with one or more guiding ideas and inner images. These archetypal inner images and ideas arising from the unconscious have often proved to be attractive or irritating, motivating or possessive—and to be fertile. Where do they come from? These mental phenomena cannot be deduced from the outer observations. They are typical expressions of the human's internal system and the world's 'inner space' and 'beyond', traditionally called *soul* and *spirit*. Therefore when working with the soil, one is also confronted with elements of his/her own soul and with all the spirits appearing from there to 'me' (the empirical 'I')

When dealing with outer nature and its phenomena, one is also dealing with phenomena from inner nature. Inner nature is understood here as the unconscious appearing to us from or through the psyche. When working with the soil, a human I with its ego-consciousness enters a relationship with two aspects of nature: Its material appearance (the *outer soil*, perceived by the senses and through measurement data) and its mental appearance (the *inner soil*, affecting consciousness from the unconscious and by its symbols). The four topics which were discussed above: *Mother Earth*, *vital forces*, *Stone of the Sages* and the idea of the *whole*, are examples of structures of the inner soil, that is of the unconscious, which act by archetypal images and emotions in the mental framework of the scientist.

### 13.6.2 Factors of the Inner Soil

Where archetypal images of *Mother Earth* are effective in the scientist's soul, his or her 'I' (ego) may react with a worshipping attitude in relation to earth and soil. The 'I' may also react with an emancipation program: to become independent from the 'mother', or by activating the power complex: wanting to have dominion over the big nourishing being. Below this polarity of attitudes we see, in most cases, a certain scientific baseline—i.e., scientists wanting to understand how Mother Earth 'functions', and what are her 'principles' or 'laws'. A more spiritual approach where the earth is perceived and treated as a Goddess, was taken by the pioneers of organic agriculture, and was sometimes perceivable within soil scientists of the past and present.

The ideas of *vitalism*, that *matter is not mere matter* (in the sense of materialism), were quite strong at the beginning of modern scientific soil analysis. Perhaps vitalism was a conceptual vessel for the *feeling* of enlightened thinkers and matter analysts—a sense that there is something other, which they cannot grasp? But, suspected to be just a custodian concept for phenomena that are not yet explainable, vitalism generally disappeared in later soil science—except within the continental European branches of organic agriculture. There, vitalist concepts were developed further, subsequently forming a new scientific subculture. The explicit identification of chemistry with the *Stone of the Sages* (Adolph Stöckhardt) can be seen as a symbol for a general psychic undercurrent in Western enlightenment: to transfer psychic energy from spiritual values to material values, and to strive for scientific knowledge concerning to this as a central aim of human cultural work. Carl Jung (1968: par. 432) has shown how alchemists



projected even the highest value, namely the ideas of the immortal soul and of God, into matter. This has been, following Jung, the starting point for both modern chemistry and of philosophical materialism. The similar formulations "*chemical catechism*" (Weir 1844), "*chemical gospel*" (Liebig [Henning and Suntheim 1997]) and "*chemical field sermons*" (Stockhardt 1851) are also indicators of that transference process.

The image and idea of the *whole* is very present in current sciences. A symbol for that is the image of the whole earth seen from the space, which is present on the covers of many scientific and popular books, and on the television news programmes. Because of the fascination with the image and idea of the 'whole', it is more difficult for present scientists to reflect critically about it than it is with images and ideas that are not so active in their own souls. I will confine myself here to the obvious polar aspects of the *whole* and of *holism*: Do we, seeing the soil *and ourselves* as parts of a greater whole, have an attitude of adaptation, cooperation, and reverence—or rather an attitude of control, domination, and utilitarianism? Both attitudes being profoundly human, their *real* balance is most important for which scientific questions we pose and what we do with the results of our investigations.

Modern soil science has not been in complete opposition to traditional belief systems concerning the soil, as it should have been in the naive view of the Enlightenment as a new rising consciousness which emancipated all in its path from tradition and from the unconscious psyche. Modern soil scientists also had 'inner children' from archetypal ideas and emotions, known from cultural history and able to appear in the individual soul.

### 13.6.3 *The Soil Scientist's Concubine?*

*How can the factors from the inner soil be integrated into the life of a scientist who is concerned with the outer soil?* Is the inner soil split off from the official life and work of the scientist, or is it well integrated into it? Is there an unequivocal relationship, like with a concubine or fancier? Or is it the inner beloved, which is acknowledged in her/his full autonomy and meaning as a partner of consciousness—is there a respectful and fair partnership? Is a scientist sometimes possessed by an inner concubine/fancier who has, so to say, married his/her dark side (which the scientist does not know about), for example his/her power drive or vanity—or is he/she aware of these pitfalls and avoiding them carefully? These problems are not specific for scientists in general, or soil scientists in particular, but are of special interest, as these individuals serve as 'experts' on the 'management' of a natural 'body', 'system' or 'resource' essential to the survival of human society.

To present a simple and straight hypothesis: *The 'inner soil' is of equal importance as the 'outer soil'; more general: the 'inner world' is of equal*



Fig. 13.2 "Dux Natura tibi ..." (nature be thy guide ...). Picture by the alchemist Michael Maier (1618, emblem no. 42), showing the guiding aspect of the unconscious in relation to consciousness.

*importance as the 'outer world'*. This assumption given, the need becomes clear: to give to the relation with the inner soil (and the knowledge from that) the same attention as to the relation to the outer soil (and the knowledge from that). Then, the unconscious driving forces and images will no longer be treated like a 'concubine' or act like an unconsciously possessive 'demon', but will come into relationships with human consciousness that are appropriate to their nature. I know that this sounds strange to extrovert people in an extrovert culture like the present Western one. One may ask: what is the author speaking about? In this case, please look back to the examples of inner soil given in the text above; if there is something that you react to emotionally, be the emotion positive or negative, you have found an entrance to your inner soil.

### 13.6.4 *Perspectives*

A renowned soil scientist once confided to me: "*Basically, the soil is my girlfriend.*" Another told me, after I gave a talk on "the soil scientist's hidden

beloved” at a scientific conference: “*With me, too, there is, of what you gave examples in your presentation—but I feel it’s better, not to speak about it.*” Not everything which comes from inside can or should be announced and neatly laid out for examination—it is unlike a raw data collection which comes from outside. It has a different power, quality, and meaning.

The inspiring and guiding role of the unconscious psyche, not only in art and religion but also for the scientific quests of humans, has in some cases been documented. For example, the periodic table of the elements [Mendeleev (Strathern 2000)] , the benzene ring [Kekulé (Wotiz 1993)], the function of the acetylcholine in the body (Loewi 1960) , the discovery of the automorphic functions (Poincaré 1912 : 51-62) and of the Law of Quadratic Reciprocity (Gauss 1805) have been acknowledged by the authors as having involved the collaboration of the unconscious. But the help from the unconscious cannot be forced, the possibilities to ‘tap’ its knowledge are limited and the risk of being overwhelmed and possessed by it is always present. For the outer object of science, the ideal has been established that the relationship of scientists to it should be serious and honest. What, if this same ethical rule would be applied to the living mental beings of the inner soil?

Thus, the individual *relation* to the inner soil (instead of any ‘mastering’ approach) is so important—but delicate to (re-)establish, and even more delicate to talk about. For this purpose, we would have to dedicate more attention to the *language of living symbols* in science, too. Symbols can tie individual links with the non-graspable. This is why symbolic pictures and expressions are so important in arts and religions. The effects of living symbols on consciousness can complement the necessary attempts at conceptual understanding. It would go beyond the scope of this chapter to analyse the linkage of creativity to the interplay with the unconscious in more detail. But the documented evidence shows that the unconscious influences not only, what we *do with* what we find in science, but also what we *find* in science—and of course, what questions we pose. As a personal experiment with this hypothesis, the author (Patzel 2003) has systematically documented his own process of integrating dreams and respective interpretation work into the research process concerning soil fertility and soil science over some years.

In closing, let me introduce, for further reflection, another of the factors that may be important for the kind of relationship to the inner soil. It has to do with the kind of relation between the male and the female. The fertile earth is often compared by humans with their own feminine aspect, and therefore female qualities are perceived for the soil; so, the relation to the soil is also a relationship to the feminine. Considering further, that most authoritative scientists of modern soil science since 1800 were men, then, the relation to the soil is also a relation to the feminine, from a male-dominated human standpoint. For an individual or a culture which is dominated by male properties and ideals, the task to have an equal, fruitful and sustainable *relationship* with the feminine, is a difficult one, which requires personal and cultural change and engagement by women and man involved with the soil.

So, again, the question is posed: How could we personally and scientifically relate in an appropriate, fruitful, and sustainable way to our ‘inner soil’, so that it does not lead us to ideological one-sidedness and dogmatism, but may bestow on us just the right idea at the right moment, the energy and guiding symbols to follow our path to what our culture needs next?

Acknowledgments I thank Michael Esfeld (University of Lausanne) for philosophical references and Ulrich Müller-Herold (Swiss Federal Inst. of Technology) for suggestions.

## References

- Abt Th (2005) Introduction to Picture Interpretation According to C.G. Jung. Living Human Heritage Publications, Zurich
- Aristotle (no date) Corpus aristotelicum. Therein: De anima [about the soul] II 1, 412a, Metaphys. [beyond physics] VII.13, 1038b 1-6, IX.8, 1050a 9-16, Phys. [physics] III, 1
- Bacon F (1623) De Dignitate et Augmentis Scientiarum [On dignity and increase of science], caput III, London
- Bacon F (1863) The Works of Francis Bacon, Baron of Verulam, Viscount St. Albans and Lord High Chancellor of England. Collected and edited by Spedding J, Ellis RL and Heath DD. Vol. VIII, being translations of the philosophical works, vol. I. Taggard and Thompson, Boston
- Balfour Lady E (1943) The Living Soil. Evidence of the importance to human health of soil vitality, with special reference to post-war planning. Faber, London
- Balfour Lady E (1978) Towards a Sustainable Agriculture. The Living Soil. The Soil Association Quarterly Review 4(2):1-5
- Bütschli O (1901) Mechanismus und Vitalismus[Mechanism and vitalism]. Engelmann, Leipzig
- Braeuning K. (1907) Mechanismus und Vitalismus in der Biologie des neunzehnten Jahrhunderts. Ein geschichtlicher Versuch [Mechanism and vitalism in 19<sup>th</sup> century biology. A historical draft]. Engelmann, Leipzig
- Descartes R (1637) Discours de la méthode pour bien conduire sa raison, & chercher la vérité dans les sciences [Treatise on the method of good self-conduction of the intellect and looking for the truth in science]. Imprimerie Ian Maire, Leyde
- Descartes R (1649) Lettre à Morus, 5 février 1649 (extrait) [Letter to Morus, Feb. 5<sup>th</sup>, 1649 (excerpt)]. Published on [http://www.caute.lautre.net/article.php3?id\\_article=1431](http://www.caute.lautre.net/article.php3?id_article=1431), 12<sup>th</sup> Sept 2005. Cited 1<sup>st</sup> March 2009
- Dokuchaev VV (1949-51) Sochineniya [Works], vol. 6. Akad. Nauk SSSR, Moscow. Quoted from Dobrovol’skii (1996)
- Dobrovol’skii (1996) Dokuchaev and Present-Day Natural Science. Eurasian Soil Science [“Official English Translation of Pochvovedenie”] 29(2):105-110. Translation from Pochvovedenie 1996(2):117-123 Driesch H (1922) Geschichte des Vitalismus [History of vitalism]. 2. verb. u. erw. Aufl. [2<sup>nd</sup> revised and enlarged ed.] (1. ed. 1905). Barth, Leipzig
- Duchesneau F (1997) Territoires et frontières du vitalisme [Domains and frontiers of vitalism] (1750–1850). In: Cimino G and Duchesneau F: Vitalisms from Haller to the cell theory. Proceedings of the Zaragoza Symposium, XIX<sup>th</sup> Int. Congr. of Hist. of Sc., 22-29 Aug. 1993. Olschki, Firenze, 297-357
- Engelhardt D von (1997) Vitalism Between Science and Philosophy in Germany Around 1800. In: Cimino G and Duchesneau F: Vitalisms from Haller to the Cell Theory. Proceedings of the Zaragoza Symposium, XIX<sup>th</sup> Int. Congr. of Hist. of Sc., 22-29 Aug. 1993. Olschki, Firenze, 157-174

- Fallou FA (1857) *Anfangsgründe der Bodenkunde* [Founding of pedology]. G. Schönfeld's Buchhandlung, Dresden
- Fallou FA (1862) *Pedologie oder allgemeine und besondere Bodenkunde* [Pedology or general and particular soil science]. G. Schönfeld's Buchhandlung, Dresden
- Feller Ch (1997) The Concept of Soil Humus in the Past Three Centuries. *Advances in GeoEcology* 29:15-46
- Feller Ch (2005) Quand l'humus est à l'origine de la pédologie. 1. Les travaux du forestier danois
- P.E. Müller (1840–1926). [As humus stands at the beginning of pedology. 1. The works of the Danish forester P.E. Müller.] *Étude et Gestion des Sols*, Vol. 12(2):101–122
- Frazer, JC (1914-18) *The Golden Bough. A study in magic and religion* (in twelve volumes). London, Macmillan
- Gauss, CF (1805) Brief an Heinrich Olbers vom 2. Sept. 1805 [Letter to Heinrich Olbers from 3<sup>rd</sup> Sept. 1805]. Published on p. 268 in C. Schilling (1900): Carl Friedrich Gauss und Heinrich Wilhelm Matthias Olbers: Briefwechsel [correspondence]. Springer, Berlin
- Heckman J (2006) A History of Organic Farming—Transitions from Sir Albert Howard's War in the Soil to the USDA National Organic Program. *Renewable Agriculture and Food Systems*, pp. 143–150. Electronic version published at <http://www.westonaprice.org/farming/history-organic-farming.html>. Cited 1<sup>st</sup> March 2009
- Henning HL and Suntheim (1997) 1847 Erster Lehrstuhl für Agrikulturchemie in Deutschland [1847, first chair of agricultural chemistry in Germany]. VDLUFA-Kongressband 1997, VDLUFA Schrift Nr. 46
- Hillel D (1991a) *Out of the Earth*. Aurum Press, London
- Hillel D (1991b) In so many words: language in relation to soil. *Soil Science* 152(6):403-404
- Hofstetter M (1941) Mutter, gib mir Brot! [Mother, give me bread!] In: Zimmermann W, Hofstetter M, Krebs G, Häusle P, Bertholet E: Mutter Erde – Weckruf und praktische Anleitung zum biologischen Landbau [Mother Earth—wake-up call and practical guide to organic agriculture]. Fankhauser, Zielbrücke-Thielle
- Högger R (2000) The Cross-Ploughed Field [preprint]. Published later in: In Search of Sustainable Livelihood Systems. Managing Resources and Change. Edited by Ruedi Baumgartner and Ruedi Högger; Sage Publications India Pvt Ltd, New Delhi 2004, chapter 7:166-186
- Howard Sir A (1940) *An Agricultural Testament*. Oxford University Press, London
- Jenny H (1941) *Factors of Soil Formation: A System of Quantitative Pedology*. Reprint 1994, Dover Publications, Mineola, New York
- Jenny H (1984) My Friend, the Soil. (Interview by K. Stuart.) *Journal of Soil and Water Conservation* 1984 (May-June):158-161
- Jung CG (1968) Psychology and Alchemy. In Adler G and Hull RFC (series eds.), *The Collected Works of C.G. Jung* (vol. 12). Princeton University Press, Princeton (NJ). (Original work published 1952, 1<sup>st</sup> ed. 1944.)
- Jung CG (1969) Archetypes and the Collective Unconscious. In Adler G and Hull RFC (series eds.), *The Collected Works of C.G. Jung* (vol. 9 part 1). Princeton University Press, Princeton (NJ). (The original works to this volume were published 1934–1955.)
- Liebig J von (1851) *Familiar Letters on Chemistry*. London, Taylor, Walton & Maberly
- Liebig J von (1878) *Chemische Briefe*. 6. Auflage. Neuer unveränderter Abdruck der Ausgabe letzter Hand [Familiar Letters on Chemistry, 6<sup>th</sup> ed. Reprint of the last edition by Liebig]. Winter'sche Verlagshandlung, Leipzig and Heidelberg
- Loewi O (1960) An Autobiographical Sketch. *Perspectives in Biology and Medicine* 4(1). Reprint in Lambeck F and Giere W (1968): Otto Loewi. Ein Lebensbild in Dokumenten [Documents of a life]. Springer-Verlag, Berlin, 168-190
- Lovelock JE (1979) *Gaia: A New Look on Life on Earth*. Oxford University Press
- Maier M (1618) *Atalanta fugiens, hoc est emblemata nova de secretis naturae chymica, ...* [The fleeing huntress, that is, the new chymical emblems of the secrets of nature ...] Johann Theodor de Bry Publisher, Oppenheim.

- Mannhardt W (1875-77) *Wald- und Feldkulte* [Cults from woodlands and fields] (2 vol.). Reprint by Wissenschaftliche Buchgesellschaft, Darmstadt, 1963
- Margulis L (1998) *Symbiotic Planet*. Basic Books, New York
- Merchant C (1980) *The Death of Nature: Women, Ecology, and the Scientific Revolution*. Harper & Row, San Francisco
- Müller PE (1887) *Studien über die natürlichen Humusformen und deren Einwirkung auf Vegetation und Boden. Mit analytischen Belegen von C.F.A. Tuxen* [Studies on natural humus forms and their effects on vegetation and soil. With analytical evidence from CFA Tuxen]. Springer, Berlin. (This book resulted from the translation of two Danish publications from 1879 und 1884.)
- Neumann E (1972) *The Great Mother: An Analysis of an Archetype*. Transl. from German by Ralph Manheim. Princeton Univ. Press, Princeton
- Northbourne Lord [James, WECh] (1940) *Look to the Land*. Supplementary title: We have tried to conquer nature by force and by intellect. It now remains for us to try the way of love. Dent, London
- Patzel NF (2003) *Bodenwissenschaften und das Unbewusste. Ein Beitrag zur Tiefenpsychologie der Naturwissenschaften*. [Soil science and the unconscious. A contribution to depth psychology of natural science.] Ökom, München [Munic]
- Poincaré H (1912) *Science et méthode* [Science and method]. Flammarion, Paris
- Raupp J (2000) The well-proportioned farm organism. Just a pleasing image of a mixed farming system or rather a basic requirement for functioning organic husbandry? Proceedings of the 12<sup>th</sup> International IFOAM Conference, August 2000, vdf Hochschulverlag, Basel, 700-703
- Rosenkranz O (1963) Zur Ökonomik der Bodenfruchtbarkeit [Concerning the economics of soil fertility. (the unusual term “Ökonomik” instead of “Ökonomie” is theory-loaded in the sense of “economic determinism”)]. *Zeitschrift für Agrarökonomik* 6:195-200
- Rusch H-P (1968) *Bodenfruchtbarkeit. Eine Studie biologischen Denkens* [Soil fertility. A study of biologic thinking]. Haug Verlag, Heidelberg
- Rusch H-P (1953) *Das Verfahren der biologischen Boden-Untersuchung* [Method for biologic soil survey]. *Kultur und Politik* 8(1):13-18
- Rusch H-P (1955) *Naturwissenschaft von Morgen. Vorlesungen über Erhaltung und Kreislauf lebendiger Substanz* [Science from tomorrow. Lectures on maintenance and cycling of living substance]. Emil Hartmann, Künsnacht
- Rusch H-P (1960) *Über Erhaltung und Kreislauf lebendiger Substanz* [On maintenance and cycling of living substance]. *Zeitschrift für Ganzheitsforschung* 4:50-63
- Schmitt M (2006) *Fertile Minds and Friendly Pens: Early Women Pioneers*. In G. Holt and M. Reed: *Sociological Perspectives on Organic Agriculture. From Pioneer to Policy*:56-69
- Scofield AM (1986) *Organic farming—the origin of the name*. *Biological Agriculture and Horticulture* 4:1-5
- Senft K (1888) *Der Erdboden nach Entstehung, Eigenschaften und Verhalten zur Pflanzenwelt. Ein Lehrbuch für alle Freunde des Pflanzenreiches, namentlich aber für Forst- und Landwirthe* [Origin and properties of the soil, and its relation to the flora. A textbook for all friends of the plant kingdom, but especially for forest engineers and farmers]. Hahn'sche Buchhandlung, Hannover
- Sprengel C (1830) XIII. Ueber Rindviehharn. Schluss einer mehrteiligen Abhandlung [XIII. on cattle urine. Final part of a multi-part treatise]. *Journal fuer technische und oeconomische Chemie von O. L. Erdmann* 3(7):171-195
- Stalin IW (1938) *Dialectical and Historical Materialism*. In: *Stalin: Problems of Leninism*, Foreign Language Press, Peking 1976:835-73
- Steiner R (1984) *Geisteswissenschaftliche Grundlagen zum Gedeihen der Landwirtschaft. Landwirtschaftlicher Kursus* [Spiritual-scientific foundations for success in farming. The agricultural course]. 7<sup>th</sup> edition, Rudolf Steiner Verlag, Dornach. [Equivalent to Gesamtausgabe (complete works) vol. 327, 8<sup>th</sup> ed. 1999.]

- Steiner R (1993) Der Mensch als Zusammenklang des schaffenden, bildenden und gestaltenden Weltenwortes [The human being as harmony of the creative, up-building, and formative worldword], 7<sup>th</sup> edition. Gesamtausgabe [complete works] vol. 230. Rudolf Steiner Verlag, Dornach
- Steiner R (1998) Das christliche Mysterium [The Christian mystery], 3<sup>rd</sup> edition. Gesamtausgabe [complete works] vol. 97. Rudolf Steiner Verlag, Dornach
- Stöckhardt A (1850) Schule der Chemie, oder erster Unterricht in der Chemie, versinnlicht durch einfache Experimente. Zum Schulgebrauch und zur Selbstbelehrung, insbesondere für angehende Apotheker, Landwirthe, Gewerbetreibende etc. Fünfte verbesserte Auflage [Chemistry school, or first instruction in chemistry, made evident by simple experiments. For teaching and autodidactic use, especially for becoming pharmacists, farmers, manufacturers etc. Fifth rev. ed.]. Vieweg, Braunschweig
- Stöckhardt A (1851) Chemische Feldpredigten für deutsche Landwirthe [Chemical field sermons for German farmers]. Georg Wigands Verlag, Leipzig
- Strathern P (2000) Mendeleev's Dream. The Quest for the Elements. Hamish Hamilton, London
- Thaer AD von (1821) Grundsätze der rationellen Landwirthschaft. 2. Bde. in einem [Principles of rational agriculture. 2 vols, in one]. Reimer, Berlin
- US National Research Council, Board on Agriculture (1997) Precision Agriculture in the 21<sup>st</sup> Century. Geospatial and Information Technologies in Crop Management. National Academic Press, Washington D.C.
- Weir JJF (1844) Catechism of Agricultural Chemistry and Geology. Blackwood, Edinburgh, and other publishers
- Wistinghausen A von (1982) Erinnerungen an den Anfang der biologisch-dynamischen Wirtschaftsweise [Memories from the beginnings of biologic-dynamic farming practice]. Verlag Lebendige Erde, Darmstadt
- Wolff G (1905) Mechanismus und Vitalismus [Mechanism and vitalism]. 2. ed. (1. ed. 1902). Thieme, Leipzig
- Wotiz JH (1993, ed.) The Kekulé Riddle. A Challenge for Chemists and Psychologists. Cache River Press, Clearwater