

A history of organic farming: Transitions from Sir Albert Howard's *War in the Soil* to USDA National Organic Program

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Review Article

Abstract

The organic farming concept developed in the period prior to 1940 and was pioneered by Sir Albert Howard (1873–1947). Howard, born and educated in England, directed agricultural research centers in India (1905–1931) before permanently returning to England. His years of agricultural research experiences and observations gradually evolved into a philosophy and concept of organic farming that he espoused in several books. Howard's thinking on soil fertility and the need to effectively recycle waste materials, including sewage sludge, onto farmland was reinforced by F.H. King's book, *Farmers of Forty Centuries*. Howard developed a system of composting that became widely adopted. Howard's concept of soil fertility centered on building soil humus with an emphasis on how soil life was connected to the health of crops, livestock, and mankind. Howard argued that crop and animal health was a birthright and that the correct method of dealing with a pathogen was not to destroy the pathogen but to see what could be learned from it or to 'make use of it for tuning up agricultural practice'. The system of agriculture advocated by Howard was coined 'organic' by Walter Northbourne to refer to a system 'having a complex but necessary interrelationship of parts, similar to that in living things'. Lady Eve Balfour compared organic and non-organic farming and helped to popularize organic farming with the publication of *The Living Soil*. Jerome Rodale, a publisher and an early convert to organic farming, was instrumental in the diffusion and popularization of organic concepts in the US. Both Howard and Rodale saw organic and non-organic agriculture as a conflict between two different visions of what agriculture should become as they engaged in a war of words with the agricultural establishment. A productive dialogue failed to occur between the organic community and traditional agricultural scientists for several decades. Organic agriculture gained significant recognition and attention in 1980, marked by the USDA publication *Report and Recommendations on Organic Farming*. The passage of the Federal Organic Foods Production Act in 1990 began the era of accommodation for organic farming in the USA, followed by another milestone with official labeling as USDA Certified Organic in 2002. Organic agriculture will likely continue to evolve in response to ongoing social, environmental, and philosophical concerns of the organic movement.

Key words: Indore composting, humus theory of plant nutrition, the Law of Return, organic agriculture, USDA Certified Organic, F.H. King, E.B. Balfour, J.I. Rodale, Albrecht Daniel Thaeer, Justus von Liebig, Carl Sprengel

Introduction

Many people active in organic agriculture today are unaware of the important role played by Sir Albert Howard¹ and others of his generation, including F.H. King, Walter Northbourne, Lady Balfour, J.I. Rodale, and Louis Bromfield, in the development and diffusion of organic farming concepts. For a better understanding of organic concepts, there is still much that can be learned from reading the foundational writings of Sir Albert Howard. The recent rapid growth of the organic movement has resulted in a loss

of connection with the historical figures and roots of organic agriculture. Scientists conducting organic farming research, farmers considering organic transition and the general public may benefit from knowing more of this history. It remains to be seen how much the situation has changed from the assessment more than two decades ago by Richard Harwood: 'There is an extremely dismal record of attempts in the USA to scientifically approach the study of organic agriculture'². Also, the effective practice of organic farming requires more than a superficial knowledge of the USDA rules for organic certification³.

These and other assertions made in this paper are based on an analysis of the historical literature, over two decades of professional experience as an agronomist, and many years of collected observations as the son of an organic farmer, Norbert J. Heckman of Yorkshire, OH,⁴ who began farming by the organic method around 1950. Here, I will briefly review the life and work of Howard and other historical figures involved in the development, evolution, and diffusion of organic agricultural concepts from the international stage to the USA, focusing on the most significant features and milestones of what is a long and complex history. A more comprehensive and related review is provided by Conford in *The Origins of the Organic Movement*⁵. Although biodynamics⁴ is an important branch of organic farming that was founded by Rudolf Steiner, it is not a focus of this paper, which is primarily concerned with Howard's contributions. Furthermore, it has been noted elsewhere⁵ that Howard 'was uncompromisingly skeptical about Steiner's biodynamic cultivation'.

Telling a history of organic farming—as with other great movements, such as alternative medicine—requires exploring the interplay between science, social values, economics, and the recalcitrance of established organizations to adopt new approaches. In tracing the historical trajectory from the genesis of Howard's major organic concepts and practices (a living connection between soil fertility and plant and animal health, the Law of Return and composting) to the widespread adoption of these beliefs and practices, one encounters a series of battles between intellectual and economic stakeholders. Although support for the organic movement has grown with public awareness, opposition to it has never gone away. These issues are reflected in the history of Howard's contributions to organic farming. The story of this development of organic concepts in the 1930s to their fate as expressed in the current USDA National Organic Program occurred in a series of stages—the development of organic concepts and methods, polarization around them, then their recognition, accommodation, and finally their further extension.

Organic Farming Concept Development

Although some concepts of organic farming predated his work, today Sir Albert Howard (1873–1947) is regarded by most as the founder and pioneer of the organic movement^{5–7}. Born into an agricultural life, he never strayed far from it. Raised on a farm in England, and educated at Cambridge, he served for a time (1899–1902) as mycologist in the Imperial Department of Agriculture for the West Indies, before returning to England to teach agricultural science from 1903 to 1905 at South-Eastern Agricultural College at Wye⁷. He then moved to India where, for 26 years he directed several agricultural research centers before permanently returning to England in 1931. It was after his return that he became well known for his concepts and philosophy of organic farming. By drawing on his many years of agricultural research experience, he

wrote several widely read books espousing his concepts and theories of composting, soil fertility, and health and disease.

In 1943, Howard published the book *An Agricultural Testament*, in which he described a concept that was to become central to organic farming—the importance of utilizing available waste materials to build and maintain soil fertility and humus content⁸. According to what he called 'The Law of Return', he strongly advocated the recycling of all organic waste materials, including sewage sludge, back to farmland. Recalling his experiences in India, he described his original 'Indore' (after a region in India) method of composting. Here, he prescribed a certain pile size, heat, moisture, aeration, and mix of plant, animal, urine-soaked earth, and ash materials as a proper composting recipe^{8,9}. Especially important to a good mix of composting materials, Howard stressed, were residues from both plants and animals. He was not alone in his thinking and found support for his ideas on soil fertility and the need for effective recycling of waste materials to farmland in F.H. King's book¹⁰, *Farmers of Forty Centuries, Permanent Agriculture in China, Korea, and Japan*, which appeared in 1911 but then lay in relative obscurity. Such a sustainable soil fertility management was vividly described by Victor Hugo¹¹: 'Not a Chinese peasant goes to town without bringing back with him, at the two extremities of his bamboo pole, two full buckets of what we designate as filth. Thanks to human dung, the earth in China is still as young ...'

In *Farming and Gardening for Health or Disease* (later published as *Soil and Health*), Howard introduced the idea that disease, whether in plants, animals, or humans, was caused by unhealthy soil and that organic farming techniques would make the soil and those living on it, healthy¹². As evidence he cited his observation that animals fed with crops grown in humus-rich soil were able to rub noses with diseased animals without becoming infected. More generally, he argued that crop and animal health was a birthright and that the correct method for dealing with a pathogen was not to destroy the pathogen but rather to try to learn from it or to 'make use of it for tuning up agricultural practice'¹².

Howard's concept of soil fertility was centered on building soil humus with an emphasis on a 'living bridge' between soil life, such as mycorrhizae and bacteria, and how this chain of life from the soil supported the health of crops, livestock, and mankind¹². While Howard acknowledged that soluble salts from humus were important to plant nutrition, he also wrote that plants 'do compensate themselves by absorbing organic nitrogen'¹². Here, Howard disagreed with both Albrecht Daniel Thaer (1752–1828) who advocated the Humus Theory of Plant Nutrition and with Justus von Liebig (1803–1873) who advocated that plants 'find new nutritive material only in inorganic substances'¹³.

Like many of his generation, Howard was probably not aware of the work of Carl Sprengel (1787–1859), when he described Liebig's work as 'a great advance' and

'illuminating' and that 'artificial fertilizers were born out of the abuse of Liebig's discoveries'¹². Sprengel, Thae'r's student, refuted the humus theory and played an important role in the development of the theory on mineral nutrition of plants, and the formulation of the Law of the Minimum¹³. Liebig never acknowledged Sprengel's discoveries and passed them off as his own¹³ (Liebig is often given sole credit for these discoveries still today in soil science textbooks¹⁴). Since he was indefatigable in his struggle for the acceptance of the doctrine of mineral nutrition of plants, Liebig used his reputation as a world-renowned and celebrated scientist to devalue the important role of humus in soil fertility and soil quality¹³. While Howard recognized the significance of Liebig's writings on agricultural chemistry, he was no Liebig devotee. Howard thought that Liebig was 'a sinner' for vigorously combating the so-called humus theory and instituting the so-called 'NPK mentality'¹². One of Howard's main criticisms was that Liebig focused attention on soil chemistry to the neglect of soil biology and physics¹². As a result of this single minded focus on chemistry, the once great appreciation for soil organic matter fell to a position of low esteem. In recent decades, however, there has been a renewed appreciation for soil organic matter¹⁵. Howard never lost his appreciation for humus and continued to extol its profound influence on the health of soils, plants, animals, and mankind.

While the Sprengel-Liebig Law of the Minimum became a widely accepted agronomic principle^{13,14}, an appreciation for Howard's Law of Return was limited mostly to organic farmers. Consequently, in non-organic farming versus organic farming, the value placed on the return of organic waste materials to the land has typically been viewed differently. With ready access to concentrated chemical fertilizers in non-organic farming, disposal became the primary interest in land application of organic waste materials. In organic farming, a high value continues to be placed on organic waste materials for building and maintaining soil organic matter content as well as nutrient recycling.

Although Howard knew that certain nutrients could be severely limiting in some soils, he opposed using chemical fertilizers^{5,16} even though they could more easily correct specific nutrient limitations than could the use of compost. Thus, Howard's extreme position against any use of chemical fertilizers created a challenging situation for organic farmers attempting to balance nutrient supply, i.e., to effectively deal with the Law of the Minimum. Howard's hard-line position against the use of chemical fertilizers, however, was not shared by some of his contemporary supporters who felt that the use of artificial fertilizers could sometimes be justified⁴. Howard was, however, open to the use of some naturally occurring mineral sources such as pulverized rocks^{8,17}.

Liebig's absolute concept of 'only' inorganic nutrient uptake by plants is obviously inaccurate¹⁸ and yet it has persisted in modern soils literature¹⁹. This represents a case

of mechanistic rigidity in the history of science that illustrates a lack of a functional understanding of natural systems²⁰. Likewise, the hard-line position of Howard against the use of any chemical fertilizers may represent a case of extremism. Moreover, Howard's extreme position contributed to the common but mistaken impression that organic is simply defined as farming without the use of synthetic fertilizers.

In Howard's long and distinguished career as a scientist, he made discoveries and contributions relating to a wide range of areas beyond composting and soil fertility. These areas included plant breeding, irrigation, mycorrhizae, root systems, soil aeration, fruit tree cultivation, post-harvest produce transport, weed management, and diseases of plants and humans^{12,21}. For these sound contributions to agriculture, he was knighted in England. While having earned the respect of his scientific peers, in his later years Howard became extremely critical of the agricultural establishment^{16,21,22}. His ideas on humus, soil fertility, and disease became viewed as exaggerations of otherwise fundamentally sound ideas and he was becoming known as an extremist²¹. In 1946, he acted out his new role of agricultural activist most explosively in *The War in the Soil*¹⁶. He opened this book with the powerful assessment that: 'The war in the soil is the result of a conflict between the birthright of humanity—fresh food from fertile soil—and the profits of a section of Big Business in the shape of the manufacturers of artificial fertilizers and their satellite companies who produce poison sprays to protect crops from pests and who prepare the various remedies for the diseases of live stock and mankind.' Howard loudly criticized field plot and statistical methodology used in classical research at the Rothamsted agricultural experiment station that was established to compare the long-term effects of artificial fertilizers (inorganic chemical fertilizers) and manure. He thought that these studies were flawed because they did not exclude invasion from burrowing earthworms into the chemically fertilized plots, relied on continuous cultivation without crop rotation, and used new seeds from an outside source.

A true comparison of organic farming to non-organic farming, Howard argued, would not be an easy task¹⁶. For example, he suggested that such a comparison should begin with 'two large areas of similar worn-out land side by side', a period of at least ten years, and that a minimum of five years was required for the conversion to an organic system¹⁶. He further suggested that such a study should compare responses of soils, earthworms, crops, and livestock. Clearly, Howard favored the study of whole systems over reductionism. Such a study comparing organic and non-organic farms was attempted from 1939 to 1969 in England by Lady Eve Balfour. Her observations from this comparison of whole farms were described in her widely read book *The Living Soil and the Haughley Experiment* first published in 1943 and republished in 1974²³.

Although Howard was a passionate advocate of organic farming, he did not coin the term 'organic' in reference to

this system of agriculture. But in 1940, in *An Agricultural Testament*, Howard describes the main characteristics of what he called 'Nature's farming'. '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'⁸.

Walter Northbourne was apparently the first to apply the word 'organic' in application to farming²⁴. In 1940, Northbourne published an influential book, *Look to the Land*, in which he elaborated on the idea of the farm as an 'organic whole'—in the philosophical sense, 'organic' refers to 'having a complex but necessary interrelationship of parts, similar to that in living things'. This concept of organic is similar in many respects to the holistic ideas more recently expressed by James Lovelock in the 'Gaia Hypothesis' and Lynn Margulis in her book *Symbiotic Planet* but on the smaller scale of a whole farm as a symbiotic unit²⁵. In this respect, the organic farmer functions in concert with the symbiotic unit by being in daily contact with and having a feeling for the whole farm organism. It is also important to distinguish this meaning of 'organic' as it applies to a system of farming from the common misunderstanding that 'organic' specifically refers to the carbon-based chemistry of the fertilizers that are often used in organic farming.

Polarization into Organic versus Non-organic

While Howard played a pivotal role in developing the concepts of organic farming and popularizing them around the world, he was also a polarizing figure. The period from about 1940 to 1978 may be called the era of polarization of agriculture into organic and non-organic camps. During this period, there was little effective dialogue between the organic community and conventional agriculture. American businessman and publisher, Jerome Rodale, was an early convert to organic farming as a result of reading the works of Howard^{26,27}. So moved was Rodale by Howard's organic vision—which he described as being hit by a 'ton of bricks'—that he purchased a farm near Allentown, PA, and began experimenting with composting and organic farming techniques. In 1942, Rodale began publishing *Organic Farming and Gardening* magazine with Howard serving as the associate editor²⁶. Through this magazine and other publications, Rodale diffused and popularized organic concepts in the US²⁷. Rodale's 1945 book *Pay Dirt*¹⁷, with an introduction by Howard, summarized organic farming concepts for a wide audience. His missionary zeal for promoting organic farming in the USA is suggested by the

title of his 1948 book²⁸, *The Organic Front*, which followed on the heels of Howard's book, *The War in the Soil*. Both Howard and Rodale saw the conflict of organic versus non-organic agriculture as a struggle between two different visions of what agriculture should become as they engaged in a war of words with the agricultural establishment^{16,28}.

Although Howard was not a fan⁵ of biodynamic farming⁶, Rodale was interested in the work of Ehrenfried Pfeifer, a protégé of Rudolf Steiner. Rodale often visited Pfeifer's farm in Pennsylvania to share ideas and he published articles by Pfeifer in *Organic Farming and Gardening* magazine²⁹.

Initially, agriculturalists from the non-organic establishment largely ignored the organic farming movement. Agricultural colleges and experiment stations, however, were increasingly besieged with letters of inquiry from the public³⁰ and it became impossible to ignore the organic movement. One of the first attempts to respond to the organic advocates was undertaken by Firman E. Bear, a prominent soil chemist at Rutgers University, who in a 1947 article 'Facts ... and Fancies About Fertilizer'³⁰, referred to Sir Albert Howard, E.B. Balfour, J.I. Rodale, and E.H. Faulkner as 'gloomy prophet[s]'. Similarly, in 1963, Emil Truog, a soil scientist at the University of Wisconsin, called the 'Organic School' a 'Cult'³¹. Other articles critical of the organic movement were published during this period of polarization such as 'Organics only?—Bunkum!'³², and 'The great organic gardening myth'³³.

These critics argued that there is no difference between nitrogen derived from organic materials and inorganic fertilizer nitrogen because organic sources needed to be mineralized to ammonium or nitrate (i.e., inorganic N) before they are available to plants. This notion that plants only uptake inorganic forms of nutrients may be traced back to the writings of Liebig and persists to this day in literature that is critical of organic farming¹⁹. Current literature, however, provides evidence that some plants can uptake and utilize limited amounts of organic forms of nitrogen such as amino acids and peptides¹⁸. Not only were those early arguments incorrect, but they also misrepresented the principles of organic farming as if it were defined by carbon (organic) chemistry rather than a philosophy of living systems. Another implied argument is that the biological processes occurring in the soil and responsible for mineralization are of no value to soil quality. Recently, however, there has been an increasing appreciation for the biological processes associated with the soil food web¹⁵. This may be seen as a rebirth of Howard's thinking regarding important biological linkages between soil organisms that extend to and influence the health of crops, livestock, and humans.

Notable American advocates of building soil fertility by using organic farming methods included Louis Bromfield and Edward Faulkner, both of whom were popular agricultural writers but not organic purists^{5,16,34,35}.

In addition to novels that were made into movies by Hollywood, Louis Bromfield published the widely read books *Pleasant Valley* (1945), *Malabar Farm* (1948), and *Out of the Earth* (1950)³⁵⁻³⁷. Edward Faulkner, author of the best selling book *Plowmans Folly* (1943), was a controversial figure in his time but is now regarded as a pioneer of no-till and conservation tillage farming^{34,38}.

The era of polarization also occurred at a time when problems in soil fertility and in crop pest control were being treated by the so-called 'miracles' of chemistry. Technical optimism^{39,40} was not, however, limited to agriculture but also prevailed in all facets of life during the era lauded by *Time* magazine in 1961 as the 'Age of Science'. Atomic power, for example, was being sold to the public with unbounded optimism as a safe and almost unlimited power source that would be too cheap to meter⁴⁰. In agriculture, the publication of *Silent Spring* by Rachel Carson in 1962 began a change of focus and attention as it ignited the environmental movement while raising concerns about the excessive use of pesticides in agriculture^{41,42}.

Over the next two decades, public interest in the organic method continued to grow. For example, the circulation of *Organic Gardening* magazine increased from 260,000 in 1960 to 1,300,000 in 1980²⁷. Many factors, such as the migration of some people from the cities to the country, the growing environmental movement, and the anti-establishment social revolution, were responsible for the increasing popularity of Rodale Press publications. A review article²⁷ about the Rodale Press and *Organic Gardening* stated that 'Over time, the polarization between land-grant colleges and Rodale Press decreased to the extent that a few organic gardening courses began to appear about 1970, serving mostly students who were not in the applied agricultural departments.' The agricultural community, however, being very proud of its recent success in markedly increasing productivity using agricultural chemicals, continued to reject organic farming as a viable alternative⁴³.

Recognition for Organic Agriculture

The period from 1979 to 1990 may be described as the era of recognition for organic farming at a national level in the USA. With a growing public interest in organic food and farming, interest in establishing standards for organically produced foods also increased⁴⁴. As a sign of the new times, in 1979, California passed a law establishing a legal standard for organic production.

Under the direction of Secretary of Agriculture, Robert Bergland, the USDA began surveying the organic farming sector. In 1980, the USDA published the *Report and Recommendations on Organic Farming* for the expressed purpose of 'increasing communication between organic farmers and the USDA'⁴⁵. In 1981, the American Society of Agronomy held a Symposium on Organic Farming to examine the question 'Can organic farming contribute to a

more sustainable agriculture ...?' They concluded: 'The most probable answer is that it most definitely can ...' and also that '... the soils for the two farming systems may be quite different, each with its own unique chemical and biological properties and crop production capabilities'⁴⁶. Although the USDA publication⁴⁵ did not cite Howard's work on organic farming, the American Society of Agronomy symposium publication⁴⁶, *Organic Farming: Current Technology and its Role in a Sustainable Agriculture*, did.

This new attention and recognition led to a backlash in 1981 from the incoming Reagan administration, which tried to bury the *USDA Report and Recommendations on Organic Farming*⁴⁷. The new administration also abolished the recently established position of Organic Resources Coordinator, held by Garth Youngberg who had been a member of the USDA Study Team for Organic Farming. During this time, a former Secretary of Agriculture, Earl Butz, released his infamous statement that millions would starve if all farmers adopted organic methods⁴³. Clearly the USDA and the US political structure were not ready to promote widespread adoption of organic farming.

In spite of the changing political situation at the national level, the already published *USDA Report and Recommendations on Organic Farming* continued to be read, and served to stimulate a growing interest in organic farming. A few land-grant colleges began to offer courses in organic farming to serve the interests of applied agricultural students²⁷. In the early 1980s when organic farming was deemed a subject area worthy of classroom time and attention, this author (at that time as a graduate student at the University of Maryland) recalls feeling that this represented a significant level of recognition for what was previously considered unacceptable in academic agriculture.

It was also around this same time that some advocates for organic farming began supporting the term 'sustainable agriculture' in hopes that it would invite respect for organic farming^{47,48}. One of those advocates, Garth Youngberg, later established an effective professional organization to support sustainable agriculture, now known as the Henry A. Wallace Institute for Alternative Agriculture. Under the broader umbrella of sustainable agriculture, this institute has been an important supporter of organic farming. While organic farming and sustainable agriculture are both part of the alternative agriculture movement, these terms are not synonymous⁴⁹.

While the conflict¹⁶ that Howard described as a 'War in the Soil' did not end in the 1980s, organic farming was clearly gaining a new level of legitimacy and recognition. In the 1980s, while there were summit meetings between the two Cold War powers, there was also a kind of 'Summit Meeting' held between the Rodale Press (representing organic farming) and the Fertilizer Institute and the Potash and Phosphate Institute (representing the chemical fertilizer industry)⁵⁰. Also in the 1980s, some USDA

scientists carried out research in association with the Rodale Institute⁵¹.

Accommodation for Organic Agriculture

The passage of the Federal Organic Foods Production Act of 1990 marks an era of accommodation for organic farming in the USA⁵². This Act set out to:

1. establish national standards governing the marketing of organically produced products,
2. assure consumers that organically produced products meet a consistent standard, and
3. facilitate inter-state commerce in both fresh and processed organic foods.

The writing of the official USDA rules for what defined organic farming and organic food required more than a decade. Initially, the proposed standards did not prohibit the use of sewage sludge, food irradiation, and genetically modified organisms (GMOs). But these initial allowances resulted in an enormous public outcry, which eventually led to their elimination from the final rules, which were officially unveiled with labeling as USDA Certified Organic on October 21, 2002.

Although it is impossible to know today what Howard would think of the USDA rules, it is interesting to note that he encouraged the use of sewage sludge because the recycling of human manure was consistent with the Law of Return. Nevertheless, given Howard's concern over poison sprays, it seems unlikely that he would approve of the contaminating substances that are now known to be present in some sewage sludges⁵³. Although GMOs were not an issue in Howard's time, his stated position against artificial insemination would seem to suggest opposition to other such 'artificial' technologies¹². The USDA rules, which allow for the use of some synthetic micronutrient fertilizers, when a need is demonstrated, would seem to collide with Howard's opposition to the use of any chemical fertilizer¹⁶.

As far back as 1942, J.I. Rodale presciently predicted: 'One of these fine days the public is going to wake up and will pay for eggs, meat, vegetables, etc., according to how they were produced'²⁶. In the early years of the organic movement and before there was a significant market for organic products, organic farming was done out of a passion for the philosophy³. Today, with the growing demand for organic products, price premiums are, in some cases, attracting new converts to organic farming for financial survival. While organic farming and organic food continue to be the target of criticism by skeptics in agriculture and food science, USDA Certified Organic appears to be here to stay. During the past 15 years, the market demand for organically produced food has increased by about 20% annually⁵⁴⁻⁵⁶. Nationally, organic product sales currently exceed \$8 billion and there is an estimated 2.3 million acres farmed organically⁵⁴⁻⁵⁶. With new incentives from the USDA to transition land into certified organic production, these growth trends are actively encouraged⁵⁶.

Beyond USDA Certified Organic

The establishment of USDA standards for organic production was an important milestone in the organic movement. It also served to formally define organic as 'A production system that is managed in accordance with the Organic Foods Production Act and regulations to respond to site-specific conditions by integrating cultural, biological and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity'⁵⁵. This definition, however, has not satisfied all within the organic movement^{57,58}. Some would like to see a greater emphasis placed on issues such as locally produced foods, biological diversity, raising livestock humanely and on pastures, certified raw dairy foods, renewable energy, environmental stewardship, subtle energies, and social justice⁵⁸⁻⁶⁵.

Sir Albert Howard would likely be dissatisfied with the current status of the organic movement. In 1946, he declared¹⁶ that 'The downfall of the artificial manure industry and of its satellite companies will mark the end of the war in the soil' and that 'The last episode in the war in the soil is the conversion of the agricultural experiment stations and the agricultural colleges all over the English-speaking world from inorganic to organic farming'. While the agricultural chemical industry exhibits no sure sign of a downfall, there has been some progress in the conversion of agricultural experiment stations and colleges to organic farming. Some land grant universities as well as other agricultural institutions are now offering courses in organic production and are establishing certified organic experiment station land⁵⁴. Iowa State University, has already employed America's first organic agriculture extension specialist⁶⁶. Similar positions are being created at other institutions. It is impossible to predict the outcome of this current trend. It is, however, quite possible that non-organic agriculture will benefit from the research and extension programs on soil fertility and pest management conducted under the organic model. For example, studies have shown that, in some cases, organic management of soils may reduce pest preference for the crop⁶⁷. Research toward a better understanding of such biological processes involved would benefit agriculture in general.

Ignoring Howard's 'Law of Return' has resulted in the accumulation and poor utilization of manures and other organic wastes in some regions of the US. Meanwhile, a tendency to practice the Law of Return excessively by some organic and non-organic farmers has caused nutrients, such as P, to accumulate in soil to levels of environmental concern⁶⁸. Transitions to organic farming on soils that today often have a higher nutrient status due to previous chemical fertilizer inputs may benefit subsequent organic production but careful attention to the Law of Return will be required to maintain soil fertility. The current ban on the use of human manure in organic farming makes complete nutrient cycling—as originally recommended by Howard—difficult if not impossible for wide-scale sustainable organic

farming. Composting and recycling systems, as described in *The Humanure Handbook, A Guide to Composting Human Manure* by Joseph Jenkins⁶⁹, could help solve the human manure problem provided the emotional, technical, and policy concerns can be overcome. Although careful attention to Howard's Law of Return can never reach 100% efficiency in nutrient cycling, there is a huge potential for improving the recycling of plant and animal wastes to restore and maintain soil fertility in the US and the world⁷⁰. To the extent to which research, extension, and agricultural policy encourage the effective utilization of waste materials with their associated nutrients for soil fertility maintenance, as originally envisioned by Howard, the need for chemical fertilizers could be reduced accordingly.

Howard contributed significantly to developing the art and science of composting⁹ that continues in today's organic farming but with new standards for compost pile temperature maintenance and turning. While the USDA standards for composting are important for ensuring protection from pathogens that can come from manure, the greater requirement for equipment and capitalization has unfortunately discouraged the composting of manure by some smaller organic farmers.

While much of Howard's passion and vision for an organic agriculture has not come to fruition in the National Organic Program nor in the current status of organic farming in the USA, Howard and other organic advocates did inspire generations of farmers, gardeners, and consumers to change their philosophical views on waste materials, soil management, soil quality, health and disease, pesticides, synthetic materials, and the environment^{39,43,71}. Tension and debate continues between the different philosophical, political and scientific ideas and ideals of organic and non-organic farming and even within the organic farming community itself. As these differences play out, they can be a positive and creative force to stimulate new lines of agricultural research leading to more environmentally sound and sustainable agriculture, provided there is open communication and the prevailing agricultural paradigms are allowed to be questioned.

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