Sir Albert Howard and The Indore Process

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Sir Albert Howard (1873-1947) (Fig.1) is considered to be one of this century's most important advocates of organic agriculture (Conford, 1988). Born in England, Howard received advanced education at Wrekin College, Royal College of Science, South Kensington, and St. John's College, Cambridge. He was employed as a lecturer in agricultural sciences at Harrison College, Barbados, in 1899. From 1899 to 1903, he was a mycologist and agricultural lecturer in the Imperial Dept. of Agriculture for the West Indies. He subsequently served for 2 years as a botanist at the Southeastern Agricultural College, Wye, England. His most important work occurred in India where he was the imperial economic botanist to the Indian government from 1905 to 1924 and director of the Institute of Plant Industry, Indore, from 1924 to 1931. His first wife Gabrielle Matthaei, whom he married in 1905, died in 1930; he married her younger sister Louise in 1931. Both his wives were capable agricultural scientists. Howard was knighted in 1934 for his contributions to Indian agriculture (*Times of London*, 1947).

Howard is remembered not so much for his extensive and sound scientific work, but more for his popular writings, which supported controversial viewpoints involving organic agriculture and criticisms of the agricultural research establishment. His book *An Agricultural Testament*, published in 1940, summarized most of these concepts along with many of his research experiences. Howard acquired his reputation as an organic agricultural extremist due largely to his exaggeration of fundamentally sound ideas.

Soil and health

A key idea advanced by Howard was that plant and animal diseases were due to unhealthy soils (Howard, 1943). This idea went beyond the

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Fig. 1, Sir Albert Howard.

scientifically sound relationship that soils deficient in one or more elements essential for animals, but not for plants, may produce crops unhealthful for animals. Howard's idea was that any plant, animal, or human disease was caused by unhealthy soil, and that if the soil was made healthy by organic techniques, there would be no diseases. This extreme, if not preposterous, view still is embraced by some proponents of organic agriculture. Despite his scientific background and the lack of scientific data to support such a total cause-and-effect relationship between soil health and disease, Howard championed this theory using testimonial and circumstantial evidence. For example, the extraordinary health of the Hunza people, who practiced a primitive type of organic agriculture in the Himalayas, was attributed to their organically grown food (Rodale, 1948). Other factors, such as their heredity, active lifestyle, and environment, were not considered, and a cause-and-effect relationship between organically grown food and health was simply assumed. Howard did participate in studies where human or animal health and disease resistance improved dramatically when diets were supplemented with organically grown produce rather than with chemically fertilized produce (Rodale, 1948). These studies apparently lacked a control treatment, since there was a complete switch to organically grown produce. Despite the lack of sound data, Howard provided the organic agriculture cause a strong advocate, because his stature as a scientist lent credibility.

Agricultural research establishment

Some of Howard's strongest criticisms were aimed at the agricultural research establishment. Many of his criticisms appeared valid then and still seem valid today. For example, he questioned the need for the bloated bureaucracy that controlled agricultural research, the excessive paperwork, the extreme specialization of agricultural re-

searchers, the overuse of statistics, the emphasis on maximizing agricultural profits rather than on sustainability, the separation of science and practice, and the emphasis on "learning more and more about less and less" (Howard, 1943). Howard believed that individual investigators should receive broad interdisciplinary training and be given resources and freedom from administrative constraints so that they could tackle whole problems on their own, rather than give each specialist a small piece of the problem.

One of Howard's most notable attacks was on the "NPK mentality" in agricultural research (Howard, 1943). He criticized Liebig's overturning of the humus theory of plant nutrition, because Liebig had little knowledge of practical agriculture. As he often did, Howard exaggerated his valid point that too often scientists simply focused on soil chemistry, with fertilizers as the cure-all for agricultural problems, rather than also consider soil biological and physical properties. His experiences in India demonstrated that soil physical properties often could be the major reason for crop failures.

Reputation

These very negative and scientifically flawed attacks ruined Howard's stature in the scientific community but made him a hero to many nonscientists, especially organic agriculture proponents. This loss of his scientific reputation is unfortunate, because an examination of his scientific work reveals that Howard was a most capable and highly productive scientist. He was a good example of his ideal—that agricultural scientists should be generalists and work closely with the land and the practical world of agriculture. In fact, when he first arrived in India as imperial economic botanist, he was supposed to do laboratory work only. However, he insisted that he be given a plot of land so he could grow plants (Howard, 1954).

His unscientific attacks in *An Agricultural Testament* are not reconcilable with his work as a scientist. Rather, they were the views of Howard the crusader, who probably intentionally exaggerated the arguments to convince people to adopt his views. Howard believed that loss of soil fertility seriously threatened the future of agriculture and that recycling organic materials via composting was necessary to avoid an agricultural catastrophe. While most would agree that agriculture is still strong more than 40 years after his death, society now is moving closer to many of his views on agricultural sustainability and composting. Composting is becoming increasingly important as a partial solution to solid waste disposal problems, and public paranoia about pesticide safety and pollution caused by fertilizer and pesticide runoff is leading to a reexamination of organic and sustainable agricultural techniques.

Howard's harsh criticisms of the scientific establishment of his time resulted from a lifetime of frustrations with the bureaucratic inertia and

ineptitude that hampered him throughout his career. Howard's seemingly deliberate exaggeration of the benefits of organic agriculture could be viewed in the most charitable light as a tactic in his fight to have composting techniques adopted. Howard's target audience was not the scientific community but farmers and everyday citizens who did not understand science. His exaggeration cannot be condoned, despite the fact that it is a standard procedure in politics and advertising.

Howard should not be considered an organic extremist in the mold of Rudolph Steiner and his biodynamic agriculture, which contends that manure rotted inside a buried cow horn has magical properties (Thompkins and Bird, 1989). In fact, Howard clearly stated that he did not believe Steiner's bizarre theories (Howard, 1943). Rather, Howard probably belongs in a class by himself, since he was an accomplished scientist and effective crusader for composting and the natural maintenance of soil fertility.

Indore Process

The Indore Process was Howard's name for the composting process he developed in Indore between 1924 and 1931 (Howard and Wad, 1931). Composting was not invented by Howard, nor was he the only composting advocate of his day. The widespread use of composting in Chinese agriculture greatly impressed Howard (King, 1926). When Howard arrived in India, however, plant wastes often were burned, and much of the animal manure was dried and used as fuel. Since fertilizer was too expensive for most Indian farmers, Howard advocated composting of organic wastes as a source of plant nutrients and for improving soil properties.

The Indore Process is not greatly different from modern composting processes. Plant wastes, animal manure, limestone or wood ashes to neutralize acids produced during decay, water, and air were the necessary ingredients (Fig. 2). Plant stalks often were laid in the roadway so cart traffic would crush them into small pieces, which would compost more readily. Urine earth (soil that had absorbed livestock urine) was crushed in mortar mills. The preferred method was to make compost in pits 30 × 14 × 2 ft deep, but in the rainy season pits could not be used. The piles were turned and moistened periodically; these are still typical practices.

The Indore Process became well known because Howard promoted it extensively. A large-scale composting facility was established at the experiment station at Indore, and optimal composting methods were developed after extensive research. Courses were set up to certify people in composting so that they could instruct others. Howard's publications on composting were circulated widely, and the Indore Process was adapted for use in a wide variety of climates and crops, even for English town wastes.

Other research work

Besides composting, Howard worked on a wide array of agricultural problems, including wheat and tobacco breeding, mycorrhizae, root system distribution, irrigation, soil aeration, plant competition, weeds, plant disease, fruit tree cultivation, budding, fruit transport, and human disease. One of his greatest economic successes was in breeding the superior 'Pusa' strains of wheat, which by 1925 were planted on at least 7.5 million acres in India. These wheat strains were not only superior in yield, but also of much greater quality for milling and baking than previous Indian wheat varieties. The economic impact was substantial, since the 'Pusa' wheat sold at a premium price and, unlike previous Indian cultivars, was of adequate quality for the export market.

Trees and grass. One of Howard's most notable studies examined the effect of grass on fruit trees and was published in the prestigious *Proceedings of the Royal Society* (Howard, 1925). Howard grew eight fruit tree species—custard apple, mango, peach, plum, lime, guava, litchi, and loquat—in plots with and without grass. Yields were measured, annual root growth patterns determined, soil CO₂ content measured, root systems excavated down to 20 ft, and the effects of aeration trenches examined. General conclusions were that grass greatly inhibited tree growth and that the lack of soil O₂ under grass appeared to be an important cause of the decrease in growth in all but one species.

Soil diseases. Howard used the term "disease" very loosely, applying it to all types of soil problems, including erosion, formation of alkaline soils, and low soil aeration (Howard, 1943). His discussion of erosion and alkaline soil problems was in keeping with accepted theories, and he cited such well-known authorities as Hilgard. Poor soil aeration was a major problem in India. Howard solved this problem with a variety of low-technology methods, including incorporating potsherds into the soil, adding compost, and using

deep-rooting plants as natural soil aerators (Howard, 1954).

Lathyrism. One of his most intriguing research projects involved lathyrism, an incurable paralytic disease associated with the consumption of *Lathyrus sativus*, a pulse (Howard, 1954). Although a serious problem, 45 years of research by numerous scientists had not revealed a solution. In 1921 Howard was asked to grow *Lathyrus* for Indian medical studies on lathyrism. He quickly solved the problem simply by his routine standard of using pure seed in research, which necessitated hand removal of all weed seed. *Lathyrus* seed was nearly always contaminated with seed of *Vicia sativa angustifolia*, a persistent weed. *Vicia* seed was nearly identical to pulse seed. The pure stands of *Lathyrus* that Howard grew caused no disease when eaten, and scientists quickly identified a toxic alkaloid in the *Vicia* seeds grown in Howard's pure stands. Howard also provided a low-technology solution for peasant farmers—sow *Lathyrus* in rows rather than by broadcasting, so *Vicia* seedlings could be identified easily and pulled before they set seed. Howard's rapid and simple solution to this long-standing problem was a tribute to his ability and gave him another example of what he considered to be the general ineptitude of much of the scientific research of his era.

Spike disease. In 1915 peaches exhibited spike disease, which is characterized by leaf drop, stunting, and, eventually, death. Everyone assumed the disease was caused by a pathogen. However, Howard carefully studied the trees and found that the problem was one of faulty budding that resulted in a poor union of stock and scion. Howard considered the supposed pathogen as a lazy way to explain a problem (Howard, 1954).

Fruit transport. One of the most vexing problems Howard solved dealt with improving the shipping of fruit by railroad in India. The original situation was chaotic and inefficient. Fruits were packed in whatever container was available. Most containers lacked ventilation and did nothing to prevent bruising. Fruits often were packed with

wet leaves, which promoted fruit decay, and the railroads charged not by total weight, but individually based on the size and shape of each container. After years of battling bureaucratic inertia, Howard convinced the fruit industry and the railroads to adopt a uniform system of reusable packing containers and a reasonable system of assessing shipping charges (Howard, 1954).

Conclusion

Howard was an extraordinarily capable agricultural scientist who made many advances for agriculture in India during the first third of the 20th century, including promoting modern systems of fruit cultivation, composting, irrigation, and soil aeration and developing genetically improved wheat and tobacco cultivars. Often overshadowing these accomplishments were his writings at the end of his career on the ideal of recycling all organic waste materials by composting to maintain the "health" of the soil. While this concept of composting plant and animal wastes and the use of compost to improve soil fertility and structure is fundamentally and environmentally sound, Howard went beyond established fact to embrace the idea that all plant and animal diseases were due to "unhealthy" soils. He also made several extreme criticisms of the contemporary agricultural research establishment, which, in retrospect, were unjustified. Yet, most of Howard's controversial writings, such as *An Agricultural Testament*, were generally scientifically sound and logical. Unfortunately, several ideas relating to soil health and disease, exaggerated beyond logic, ruined Howard's scientific reputation and marked him as an organic agriculture extremist.

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Fig. 2. Indian compost-making in the rainy season when the pile had to be formed on top of the ground rather than in a pit.