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REVIEW

Symphony of the Soil, a multi-film project by Deborah Koons Garcia (www.symphonyofthesoil.com)

How do soils form? What are they made of? How do they work? How can we make best use of them and will this help to avert a looming world food-production crisis? This beautifully made documentary attempts to address all these questions and certainly succeeds in providing us with a better understanding of the first three questions and of winning our sympathy for the solutions suggested for the last one.

The formation of soils over geological time is superbly illustrated by reference to a soil chronosequence to end all soil chronosequences. This sequence was based on the various islands of Hawaii which were formed by volcanic eruptions and have been accurately dated in the context of plate tectonics and sea-floor spreading, so that we have a time-line where soils have formed on lavas of similar mineralogical composition over a period of five million years. Three hundred years of weathering has been enough to produce a soil on which forests thrive and after 20,000 years the soil has accumulated nutrients from the parent rock and the atmosphere to such an extent that almost any crop can be grown with abundance. With further weathering, however, many nutrient elements are washed out and ultimately (after 4 million years) an impermeable clay layer is formed which causes lateral water movement leading to erosion and the formation of spectacular canyon-like features in the landscape. Of course many soils are formed on pre-weathered transported material, such as river alluvium, loess or glacial drift, and so can form much more quickly. Rather surprisingly, it was estimated that most soils (75%) are formed on such material with only 25% being sedentary or residual. Different soil types are dealt with by a swift illustrative tour through the American system of soil taxonomy where the major soil groups are given alternative and more easily understood names. For example, Entisol is "Baby Soil", Inceptisol "Young Soil" and Ultisol "Old Soil".

Soil functioning is introduced and memorably encapsulated in the phrase that "soil is the interface between geology and biology". Unfortunately though, from a mineralogist's point of view, almost the entire emphasis is placed upon the biological side of the interface and, apart from a passing reference to the role of rock minerals in the P cycle, one is left with the impression that the soil minerals provide little more than an inert framework that enables biological processes to operate. This is certainly implied by the statement that 50% of the soil consists of empty space but that it is this space which drives the functioning of the soil and that of the whole ecosystem. Perhaps there should have been more emphasis on the surfaces which bound this space, because it is at these surfaces, most of which are of a mineral nature, where many of the important soil reactions occur. From this perspective, soil minerals, and particularly the fine-grained clay minerals, play a vital role in integrating the organic and inorganic aspects of soil functioning.

Notwithstanding this quibble of an unrepentant soil mineralogist, however, it must be said that the biological side of soil functioning is rather brilliantly described and illustrated in fascinating detail. Some memorable highlights include the role of plant exudates as nutrients for the growth of microbial life and the protection of the plant from disease; the consumption of microbes by protozoa thus excreting and releasing nitrogen in a plant-available form; and the role of N-fixing bacteria in the root nodules of legumes thus providing a natural source of plant-available N. It is a salutary thought that 70 to 80% of soil microbes have yet to be identified, let alone understood in terms of their functions in the overall ecology of the soil. This certainly points up the need for further research in this area.

Turning to the question of how best to manage our agro-ecosystems, the documentary comes down rather heavily in favour of organic farming. It must be said that the arguments are presented in a cogent and quite convincing manner and certainly the various presenters, a mixture of academics, practical organic farmers, and environmentalists, make a good case that organic farming conserves the natural fertility of the soil in a sustainable way, produces healthy and nutritious crops, and protects the wider environment. In comparison, it is claimed that so-called "chemical farming" is unsustainable as it degrades the soil and seriously damages the environment. Is organic farming the answer then to a prospective world food crisis? To be clear about what organic farming actually means, it is stated that that there should be no (none at all) applications of fertilizers, pesticides, herbicides, sewage sludge, or genetically engineered seeds. It is further claimed that organic agriculture can feed the world, through the extensive development of small-scale, labour-intensive organic farms. This seems to be rather an extreme and unbalanced point of view, however sympathetic one may feel towards the views of the various presenters. Apart from the social revolution that such a back-to-the-land program would cause, do we really envisage that that our best course of action would be to return to what is essentially 19th century agriculture, even though

aided by a much better understanding of how to conserve the fertility of the soil? Surely there must be an intermediate position where fertilizers and other agrochemicals can be utilized in a sustainable way without bringing about environmental damage or jeopardizing the long term health of the soil. This would be particularly important when dealing with marginal soils, where farmers struggle to make a living and where the application of even small amounts of fertilizers would bring about a disproportionately beneficial effect in terms of crop production. It would be important, however, that farmers are fully aware of how easily the soil can be damaged, receive sound and independent advice from extension services and fully take on board the lessons that can be learned from the organic farming approach which are so vividly expounded in this excellent documentary film.

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