YEOMANS' KEYLINE DESIGN FOR SUSTAINABLE SOIL, WATER, AGROECOSYSTEM AND BIODIVERSITY CONSERVATION: A PERSONAL SOCIAL ECOLOGY ANALYSIS

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Abstract

The potential for farming systems to be 'redesigned' and improved based on our understanding of biology and ecology is enormous. Among the few pioneers who have led the way in this 'project', the late P.A. Yeomans' work in NSW is exemplary. His understanding of soils as living systems, farms as complex, integrated and evolving systems, and landscapes as the appropriate scale for planning and major decision-making was key to the development of his 'Keyline' approach to agriculture. In addition to learning how to make up to 10 centimetres of topsoil in three years (it normally takes 100s to 1000s of years), he designed a landscape that did not suffer from lack of water, was fireproof, high in biodiversity, and highly productive and profitable. Despite this, his 'whole healthy system design' approach has been largely neglected in favour of component focused curative approaches to problems. Here a social ecology[1] analysis of Yeomans' contributions is provided with the hope that it may inspire a new wave of 'whole healthy system' approaches to agroecosystem design and management.

Introduction

Soil is the primary natural habitat that determines the long-term wealth of nations. Most declines in civilisations throughout history have been largely caused by the mismanagement and subsequent degradation of the land (Carter & Dale 1974; Hyams 1952; Hillel 1992).

Although the highest levels of biodiversity are found in tropical rainforests, coral reefs and soil, among these ecosystems it is the activities of the communities in soil (also the home of most plant biomass) that are largely responsible for the survival and persistence of our species (Hill 1986; 1989). However, because most of the species that live in the soil are barely visible to the naked eye, and live below the surface, out of sight, in an environment that is aesthetically unattractive to most – and regarded as just 'dirt' by the majority – and because of the extreme complexity of the physical, chemical and biological relationships and processes in soil, throughout history this habitat has had few champions and crusaders for its responsible care and management. Consequently**,** soil has most usually been taken-for-granted, used-and-abused, and treated as the 'Cinderella' of the ecosphere. There are some parallels to our own skin. If we lose a third of our skin, through severe burns for example, we invariably die. If the earth were to lose a third of its vegetative cover, through

[1] Social ecology is "the study and practice of personal, social and ecological sustainability and change, based on the critical application and integration of ecological, humanistic, community and 'spiritual' values" (Hill 1999a, p. 199).

desertification, clearing, and bare-soil management systems, which is currently increasing by millions of hectares every year, then the earth will also start to become uninhabitable for our species, and for most other terrestrial vertebrates. We are already close to this situation.

P.A. Yeomans (1958; 1971; 1978), an innovative farmer in NSW who recognised the above, developed the most innovative, and most sustainable, integrated landscape design and management system that has ever been developed and tested. Sadly the importance of his contributions are yet to be widely appreciated and implemented. This is particularly difficult to understand because, more than any other designs and practises, his are able to address the growing challenges of water and biodiversity conservation, salinity, fire management, soil fertility maintenance, and livestock health. Here, I will provide a preliminary social ecology (Hill 1999a) analysis of Yeomans' approach, its development, the difficulties he faced, and future needs and possibilities.

Some Contextual Background and Personal Opinions[2]

Most in our society do not have Yeomans' understanding of ecological systems, and so nearly all of us live in ways that undermine ecological processes and miss numerous opportunities to benefit from them. This is partly because, for most of us (even those living in rural areas), our lives are dominated by non-living technologies, which exhibit linear relationships – we press on the gas and the car goes faster – and most also increasingly live under the illusion of being separate from nature. Relationships in nature are non-linear and change may not be noticed until thresholds are crossed (Commoner 1970) – so, although progressive degradation may be occurring, things will appear fine (to the insensitive and untrained eye) and then suddenly the system collapses. Usually there are early warning signs – like the sudden decline of particularly sensitive species, such as frogs, or the less familiar examples of many groups of insects (such as Proctotrupid wasps around cities). Tragically, our culture has not yet learnt how to extensively notice or respond to these indicators of change and, rather than take appropriate action, would prefer to argue endlessly about their level of significance, carry out what I call 'monitoring-our-extinction' or 'measuring-the-problem' studies, and wait for more dramatic signs of collapse, when denial and postponement is no longer an option. At this stage, however, it is often too late (as in the extinction of a species) or too costly to take appropriate action, whereas early intervention is usually conceptually challenging, but much less expensive.

The problem is that the economics of addressing these problems is also non-linear. So the costs of turning things around increase by orders of magnitude as we chose later-stage reactive interventions over earlier-stage, or more ideally proactive, interventions. We can see this clearly throughout Australia at the moment in our postponing, token-responses, and already frightening calculations of the costs of properly addressing global warming and climate change, soil degradation, salinity, drought and flooding, wild fires, and habitat and biodiversity loss. These are all factors that commonly get omitted from most production based cost-benefit analyses.

Julian Huxley (1952) and others (e.g., DeMause 1982) have argued convincingly that our own evolution is far from complete – not our biological evolution, but our psychosocial

[2] These are presented mostly without extensive referencing as their inclusion is intended to make transparent the position of the author, rather than to open up debate as to their validity, which I (and many others) have argued elsewhere in numerous publications.

evolution. Psychosocially – and in terms of our development of an ecological and social self (Mathews 1994; Plumwood 1993) – we are still at a very early stage in our evolution – witness the extent of personal distress, social unrest and ecological crises in the world. This is both frightening and, paradoxically, hopeful. Unless individuals, communities and societies become involved in human development and radical cultural transformation, things will only get worse, and it will do this in non-linear ways. If we start to take significant transformative action now, however, then the benefits will also be reaped in non-linear ways.

Actually, we are all already, to varying extents, and with varying levels of awareness, involved in such transformative thinking and action. Who amongst us has not at one time or another doubted the wisdom of the deceptively simplistic notion that ongoing economic growth can solve our problems – as the ecological economist Kenneth Boulding once remarked, "anyone who believes that economic growth can continue in a finite world is either a madman or an economist". And we have all already tried to do some of the things that would be characteristic of a fundamentally transformed sustainable society. Perhaps we have changed the way we manage our soil, set aside some of our land for wildlife, dared to ask an unaskable question, told a truth in the face of silence and denial, collaborated across a challenging difference – as farmers, environmentalists, and politicians did in the creation of Landcare (Hill 1999b) – changed our consumption, eating or waste-management habits, or took time to support a child in discovering, according to their own agenda, the wonders of nature and of working together in harmony, rather than in competition. These are what I call 'small meaningful initiatives that we can guarantee to carry out'. I believe that it will be primarily through taking such actions, and sharing and publicising our experiences and outcomes that we will be able to turn things around. This is in contrast to the more usual naive hope that only mega-'Olympic'-scale-projects, into which most public resources get channelled, and which rarely achieve their goals, will solve the problems. The key to sustainable change is for each of us to individually and collectively start to think and initiate conversations about what such a transformed society and lifestyle might be like in a truly ecologically, culturally and personally sustainable society – and then gain the knowledge and skills and prioritise our actions to bring this about. Paradoxically, by not over-focussing on economics – as we currently do by using money as the primary 'bottom-line' – we will actually be creating an economically sustainable and truly profitable system of production and exchange.

Over the past 30 years, I have worked with thousands of students, primary producers and others in society who have effectively started to do just what I am advocating here. Graziers and farmers, through their involvement in various expressions of 'Ecological Agriculture' (e.g., Holistic Resource Management, Organic and BioDynamic Farming, or Yeomans' Keyline System of Landscape Management), are being supported in reflecting on their values, and are fundamentally transforming the design and management of their production systems, with gains in soil health, habitat diversification, biodiversity increase, and improved profit and personal, family and community wellbeing. We are at this time, I believe, at a critical threshold, and it will only be by our unwillingness to any longer go along with what, deep down, we know is unjust, uncaring and unsustainable, and choose the opposite path, that we will be able to turn things around. It is important to support, and not waste energy ridiculing, one another's efforts, to meet one another where each of us are, and to value a diversity of approaches; especially because each context possesses unique qualities, and it demands actions that are sensitive to this; and because we are each most powerful and effective when we are taking the next meaningful step in our own development – and not following a universalised formula of someone else.

Developing an appreciation of our 'psychosocial diversity', and how to collaborate across such differences, is as important as understanding the importance of biodiversity and how nature primarily works in mutualistic ways. Some of us are visionary, creative and intuitive (my primary 'gift'), some are highly practical and able to pay attention to important details, others are logical and able to analyse and develop carefully thought-out strategic plans, and follow through in their implementation, and still others are extremely passionate and able to touch the heart of all with their commitment and caring (Keirsey 1998). Clearly we need all of these expressions and competencies working together.

My particular approach to working with change emphasises 'Redesign', and distinguishes this from the more common 'Efficiency' and 'Substitution' approaches so common today (Hill 1985; Hill & MacRae 1995). My experience is that most existing systems can benefit from fundamental redesign, based on the creative application of our understandings of life, particularly in relation to ecology and psychology. An initial list of such understandings in ecology, with some of their social implications, is provided in Table 1.

This 'deep' approach to natural resource management and change is profoundly different from the more usual tinkering approaches that merely aim to use existing inputs more efficiently within flawed designs (such as monocultures in agriculture, forestry and fisheries), substitute inputs (such as renewables, biologicals, including genetically modified organisms, for non-renewables and synthetics), and that focus on problem solving and symptoms (usually regarded as 'enemies' to be attacked, instead of feedback or indicators of poor designs and ineffective management). Redesign initiatives aim to create self-maintaining and self-regulating optimally productive healthy systems in which problems are largely prevented, or solved internally, as a by-product of their healthy functioning.

Yeomans' approach to landscape design and management is examined below as a case study that illustrates the potential gains that may be made as a result of engaging in this fundamentally different way of thinking. Whereas efficiency and substitution approaches may serve as stepping-stones towards such redesign approaches, they may also act as barriers to the latter if they are regarded as endpoints. It is important to realize that the transition being advocated here is partly associated with a shift from a focus on products (particularly those used as curative solutions to problems and as distracters from psychological distress) to services (using our knowledge and skills for the design and management of sustainable systems and activities). In agriculture, this whole-systems approach to change requires a critical review of purpose (why), strategies (how), of where to do things, when to do things and what to do. By taking such an holistic and integrated approach it soon becomes evident that the opportunities for improvement are extensive, and that the main barriers to their achievement are largely psychosocial and a result of our ignorance of ecological and psychological processes, together with the lack of appropriate institutional supports, rewards and penalties. Areas where initiatives need to be taken in relation to the latter are listed in Table 2.

Table 1. Comparison of ecological understandings and prevailing assumptions and practices within industrial societies.

Ecological understandings	Prevailing assumptions/practices
• Responsive to early indicators	• Wait for crises
• Cyclical, regenerative relationships	• Linear material flows
• Growth subject to limiting factors	• Unlimited growth (unsustainable)
• Most resources used for maintenance	• Production overemphasized
• Based on solar and renewable energy	• Reliant on fossil fuels and nuclear power
• Mutualism favoured	• Competition emphasized
• Functional diversity and complexity confer stability	• Simplified, highly controlled systems (dependant and unstable)
• Rich diversity of specialists, generalists, roles and niches within communities	• Few specialists and roles valued
• Uniqueness of time and place (reflected in all structures and processes)	• Structures and processes universalised (everything the same, everywhere, all the time)
• Gradual co-evolutionary structural change, with occasional bursts of creativity	• Rapid, forced change with few beneficiaries and many 'casualties'
Cultural and personal imperatives	
• Building personal, social and ecological capital and wellbeing, and a sense of enough; and living off the interest	• Inequitable and accumulating personal wealth (unsatisfiable and unsustainable); and living off the capital
• 'Conserver Society' (equitably meeting basic and aesthetic needs)	• Growing consumption (increasingly emphasising compensatory wants)
• Appropriate scale, resource efficient (solar, renewables); structures processes and technologies minimizing waste and impact	• Mega, powerful resource consuming; Structures, processes and technologies Are waste producing and impacting
• Values-based decision making by an informed, participatory population (public education, access, transparency and inclusion) – for the greatest good (social justice)	• Market forces (political and consumer manipulation through advertising and exclusion; short-term narrow focus, with neglect of externalities) – monetary system of values (economic rationalism)
• Regional self-reliance, shared leadership and responsibility; and context sensitive and specific designs, products and services	• Transglobal corporate managerialism and hierarchical control; homogenized designs, products and services
• Right to meaningful work (sense of purpose, place and valued roles within vibrant communities)	• Mobile, disposable workforce (loss of sense of purpose, meaning, connection to place and community)
• 'Understanding', creative, and design focused science, technology and arts, and their integration	• Controlling and problem solving, specialized science and technology (understanding science and arts as disposable luxuries)

Table 2. Political strategies for supporting change.

FORM OF POLITICAL ACTION
Supports • Education, demonstration, and models • Extension and other services • Research and development • Legislation and regulation Rewards (only available during a transition period to prevent the development of dependence) • Tax incentives • Subsidies • Low interest loans Penalties (for those who act irresponsibly) • Monitoring programs • Legislation

Yeomans Keyline: An Example of the Application of Our Ecological Understanding to Design/Redesign in Agriculture

Percival Alfred Yeomans (1905-1984), or PA as he preferred to be known, was an exemplary deep redesign/design thinker and practitioner. Although the importance of his contributions to agriculture are yet to be fully appreciated and applied (Mulligan & Hill 2001), he was a major source of inspiration for the development of Permaculture (Mollison & Holmgren 1978; Mollison 1988; Holmgren 2002), and his 'Keyline' system of landscape management is familiar to many who are at the cutting edge of applying our ecological understanding to design and management in agriculture. David Holmgren (*pers. comm*. 1999) put it succinctly when he stated that "Yeomans has made Australia's greatest contribution to sustainable land use, because he introduced the practice of design to what previously had been just husbandry and cultivation". The following 'story' of Yeomans' contributions was constructed based on his own and others writings, and interviews, particularly with his eldest son, Neville (in July, 1998).

PA had extraordinary observational powers, he read widely, loved to experiment, was pragmatic and persisted where others might have given up. Prior to purchasing his first farm in 1943 (1000 acres of poor unproductive land near Richmond in NSW), he had developed a deep understanding of landscape as an assayer and valuer of gold and tin mining projects throughout eastern Australia and New Guinea, and a fascination with water conservation and management. After becoming disappointed with the results of applying the latest soil conservation strategies, he started to develop and apply his own ideas. He had had years of

experience observing landscapes, which had included seeing how immigrant Chinese miners had stored water in arid environments in temporary dams and directed it across slopes to where it was needed. He also had experience working with chisel plows, which he had introduced into Australia, and he had read widely, becoming familiar with the literature on organic farming, much of which is devoted to the creation of a healthy soil. But more important than this, he was driven by a deep desire to transform Australia from an arid landscape to one where water is widely available. This was initially triggered by a frightening experience when his three-year-old son Neville had wandered off into the bush during a camping trip. As time went by, PA feared that Neville would surely die for lack of water. Happily, a local aborigine, who knew where to obtain water, found Neville. This concern for water was reinforced a year after purchasing his farm when his brother-in-law, who managed the farm, tragically perished in a grass fire that got out of control.

Because of his fascination with water, PA had the habit of going out in the rain to observe the movement of water across the landscape. On one of these occasions, when it was raining heavily, he had noticed a reflective band running across some of the hillsides where they change from being convex above to concave below. He reasoned that on sloping land this is where the water table is most near the surface, this being the highest point on the slope where a dam can most easily collect water and be used to irrigate the land below. He later called this line the 'Keyline', and the points where it crosses the drainage lines within primary valleys the 'Key Points'. PA was also quite stubborn, persistent and had little time for those with less inquiring minds. While this enabled him to continue to experiment and implement his ideas, it also made him unpopular with some in government and university. This, together with the fact that the development of his more complex, integrated, whole-system approach coincided with the introduction of deceptively simple management tools to agriculture, such as superphosphate, was probably responsible for his approach not receiving the attention it deserved. It remains, however, as an exemplary model of the design/redesign approach being advocated here.

Faced with an eroded and degrading landscape, he set out to fundamentally redesign it so that it could recover, build natural capital, come alive and be sustainably productive. He had the novel idea that perhaps rather than just trying to conserve soil, he could actually create soil (in fact he was able to create 10 cm of topsoil in three years, whereas previously it was assumed that this would take several hundred to several thousand years!). He reasoned that because soil is a decomposer system its development is likely to be limited by inputs of dead organic matter, which can most readily be added *in situ* in the form of dead plant roots. Furthermore, he reasoned that all processes in soil are, in turn, limited by the suitability of the prevailing conditions (particularly access to air, water and potentially limiting nutrients). This he was able to transform through his Keyline system of ploughing (across the slope, veering slightly down from the Keyline, using his Keyline plough), periodic flood irrigation (from his redesigned Key Point dams, with their irrigation channels), and a single 'priming' application of limiting nutrients. Ploughing across the slope was repeated annually, ideally when the weather is warm and rain is expected, for just three years at increasing depths (e.g., 20cm, 30cm and 40cm or more, depending on the particular conditions and depth of the existing soil). This enabled the roots of pasture plants to penetrate progressively deeper into the soil, and the channels running across the slopes enabled the irrigation water to flow out to the ridges. By practicing rotational grazing (Voisin & Lecomte 1962; see also Savory & Butterfield 1999), enormous amounts of organic matter can be added to the soil -- when the top is browsed off by livestock (or, less ideally, is mowed), an equivalent amount of roots die and add fibre to the soil. The plough that PA used was also redesigned to create aeration and

drainage channels in the soil, break any hardpans, and shatter the clods, thereby permitting better root penetration and ideal conditions for soil life and soil formation. His Keyline plough, which was then marketed as the "Bunyip Slipper Imp with Shakerator", was in 1974 awarded the "Prince Philip Prize for Australian Design" by the Industrial Design Council of Australia. By attaching a vibration device to the plough, in addition to helping to break up the soil, he was able to reduce resistance and so enable the plough to be pulled by a lower horsepower tractor, thereby saving energy and environmental impact. All of this was just part of a larger redesign approach that involved arranging the various features of the farm in a 'Hierarchy of Permanence', recognizing that different strategies are required for working with features exhibiting different levels of permanence. Climate, land shape and water supply he called the 'inseparable trinity of landscape design', with roads, trees, farm buildings, subdivision (fences) and soil being the more negotiable remainder of the hierarchy. In his book, *The Challenge of Landscape*, Yeomans (1958) examined each of these in detail. Windbreaks, fences, roads and buildings were all placed at specific locations (attention to place) and all operations were carried out at optimal times (attention to time). Records were kept so that he could learn from his experiences. The various features of Yeomans' approach to sustainable landscape management described above are summarized in Table 3.

Table 3. Key features of Yeomans' Keyline design/redesign initiatives.

Conceptual

- Learn from nature, others and one's own experiences (indigenous, immigrant and organic farming cultures)
- Create, as well as conserve, soil (and natural capital in general)
- 'Hierarchy of Permanence' as basis for strategic decision making
- Support and effective use of ecosystem processes and 'services' (through careful choice of the nature, time and place of all structures and processes, e.g., 'Keylines' and 'Key Points')
- Use of inputs and processes to build natural capital and 'prime' systems

Structural

- Keyline plough (modified chisel plough with vibrator)
- Keyline dams and irrigation channels
- Nature and placement of all structures

Procedural

- Timing of all operations (ploughing, irrigation, rotational grazing)
- Keyline pattern of ploughing
- Rotational grazing

Sir C. Stanton Hicks (1955), who was Professor of Human Physiology and Pharmacology at the University of Adelaide and one of the few who recognized Yeomans' genius, wrote:

" The bare ridges became covered with lush pasture. Erosion in the valleys ceased. Earthworms, which had never been seen, appeared in their myriads. Soon bare loose red shale became submerged in rich black soil…. In three years he has produced four inches of friable black soil where bare weathered shale or sandstone so recently comprised the barren soil….

"The Keyline Plan is simple to put into effect. It is inexpensive. Results are rapidly produced and the land values improve quickly.… It is a complete plan [that] … deals with … water and air in the soil. It places the dams in the most effective situations and constructs these by the cheapest technique.… The plan appeals to me as the basis for renaissance in Australian land use. Through its application we may well hope for the much needed extension of rural population in Australia, that will rapidly become profitable even if poor to begin with."

Yeomans recorded his ideas and experiences in several books, the most accessible being *The Challenge of Landscape* (1958), *Water for Every Farm Using the Keyline Plan* (revised edition 1978) and *The City Forest, the Keyline Plan for the Human Environment Revolution* (1971). PA's youngest son, Ken Yeomans, has twice revised and republished his 1978 book as *Water for Every Farm: Yeomans Keyline Plan* (Yeomans 2002). In 1960, Professor J. Macdonald Holmes, who was then Head of Geography at Sydney University, and who had spent some time working with Yeomans on his ideas, published a small booklet entitled *The Geographical Basis of Keyline*. Ken Yeomans continues to work as a Keyline consultant and has placed several articles about Keyline on his website (www.keyline.com.au). PA's middle son, Allan, continues to market an improved version of the Keyline plough. He has a draft manuscript on the web (www.yeomanskey.com) about the broader implications of his father's discoveries, including an extensive argument concerning the ability of the Keyline system of landscape management to effectively fix carbon dioxide and so address the threat of global warming. According to his calculations, this would be more effective than by planting trees, and so should be appropriately acknowledged though the awarding of 'carbon credits'. This level of carbon capture would also increase the water holding capacity of the soil, such that the extra water held within the system would likely be orders of magnitude greater than that held in the more obvious dams that Yeomans integrated into the landscape.

While it is tragic that Yeomans' ideas have not been more widely adopted or further investigated and developed, his Keyline system nevertheless remains as an outstanding model of the kind of integrated design/redesign approach that is desperately needed in all of our productive endeavours. Compatible initiatives in agriculture can be found in the extensive literature on Organic, Ecological and Natural farming (Altieri 1995; Fukuoka 1985; Hill 1985; 1991; 1998; Hill & MacRae 1992; 1995; Hill & Ott 1982; Lamkin 1990), Biodynamics (Koepf 1989), Permaculture (Mollison 1988, Holmgren 2002), rotational grazing (Voisin & Lecomte 1962), and Holistic Resource Management (Savory & Butterfield 1999). For a more extensive discussion of such ecological thinking, including further details of Yeoman's contributions, see Mulligan and Hill's (2001*) Ecological Pioneers: A Social History of Australian Ecological Thought and Action*, and for the application of such ideas to pest control see Hill (in press).

Lessons from Yeomans' Approach to Landscape Design/Redesign

It may be helpful, using Lewin's (1935) 'force-field analysis', and a social ecology approach that considers personal, social and ecological aspects (Hill 1999a, Hill 2001), to reflect on the strengths and weaknesses, and driving and restraining forces (barriers), that affected the outcomes of Yeomans' initiatives. Although there can be no neat formulae for effective change, and many cases exist where despite obvious advantages change did not occur, and where change did occur within unsupportive conditions, much can be learned from such retrospective analyses.

Strengths and driving forces for Yeomans' initiative are listed in Table 4, and weaknesses and restraining forces in Table 5. Lewin (1935) argued that change can be facilitated by strengthening and adding to the driving forces and by weakening and removing the restraining forces. Because of the frequent overlap of these strategies, suggestions concerning them have been presented in a single table (Table 6).

The late Neville Yeomans, PA Yeomans' eldest son, who I interviewed in 1998, was an innovative psychiatrist, who applied his father's ideas to the field of social psychology, labelling his approach 'Cultural Keyline" (see his preface in Yeomans 1971 and his website: www.laceweb.org.au). This willingness to apply insights and wisdom gained in one area to another apparently quite different area is a key insight from this approach.

Table 4. Strengths and driving forces affecting Yeomans' Keyline initiative.

Personal

- Exceptional powers of observation (especially of water movement across the landscape)
- Deep interest, commitment, rebelliousness and 'drivenness' re water, soil and pasture management (near loss of son to desiccation, loss of brother-in-law in a grass fire)
- Diverse complementary experiences and competencies (mining assayer, seeing mining dams, and aboriginal knowledge, earth moving, time with nature, extensive reading, travel overseas)
- Cross-boundary (applying water management in mining to agriculture) and integrative thinking (Hierarchy of Permanence, Keyline as a whole design system)
- Lateral and paradoxical thinking (creating vs just conserving soil)
- Ongoing experimentation and careful record keeping
- Implementation of small, meaningful initiatives (including small risks) that can contribute to larger, longer-term plans (initial dam construction etc.)

Social

- Post-war programs/tax benefits facilitated farm purchase
- Importation of initial chisel plough from USA
- Involvement of others with complimentary qualities and competencies (aboriginal influence, Holmes, Hicks, children etc.)
- Communication of findings and ideas (open days, training sessions, talks, articles, books, establishing a Foundation and journal, media)
- Commercialisation of products (Keyline plough) and services (Keyline consulting, dam construction, self-publishing)

Ecological

- Capitalizing on forces and 'services' of nature (natural water flows, gravity, carbon capture, soil formation, windbreaks, grazing management, working effectively with place and time)
- Using nature as a model and source of inspiration

Table 5. Weaknesses and restraining forces affecting Yeomans' Keyline initiative.

Personal

- Personality and psychological problems (intolerant, low level of patience, somewhat isolated, some difficulties with collaboration)
- A style of writing that some find difficult to follow

Social

- Most of society in a relatively uncritical phase of fascination with deceptively simple 'magic bullet', technocentric solutions (superphosphate, conventional irrigation) for 'solving' complex ecological, social and personal challenges (sustainable landscape and lifestyle design and management)
- Unavailability of affordable mobile electric fencing (for rotational grazing)
- Lack of long-term funding for on-farm, design focused, participatory action research
- Lack of supportive government policies and programs and interest by researchers in universities and government laboratories
- Lack of consumer demand and markets for 'green' produce, and low public awareness of ecological imperatives and long-term implications of current practices

Ecological

- Still a fairly limited and rudimentary understanding of nature and ecology, soil ecology, plant nutrition and ecology, ecological services, livestock behaviour and ecology, including optimisation of rotational grazing and pasture management

Table 6. Suggestions for improving Yeomans' chances of success

Personal

- Personal development work (recovery, therapy, self-knowledge, relationship counselling, group support)
- Willingness to collaborate more widely to achieve shared ownership and enrichment of the project (with those in the region and beyond, those in university and government, public interest and consumer groups)
- Linking Keyline to superphosphate use as a short-term strategy for adoption (capitalizing on the existing trends)
- Working with a smaller part of the property as a more intensively managed experiment (with controls for comparison)
- Working with others with better communication skills (to erect clear signage on the property, prepare pamphlets, write articles and books, and to prepare grant proposals and submissions to government)

Social

- Access to all of the resources listed as deficiencies in Table 4
- Greater effort to form alliances and linkages with others to achieve shared sense of ownership and collaboration in achievement of aims
- Greater use of the media for public education and for influencing political and cultural change

Ecological

- Going further in mimicking and working with nature
- Being willing to 'become the other' as a strategy for deepening understanding of limiting factors, influencing variables, relationships and opportunities

Conclusions

The message here is that to achieve sustainable progress we must pay much more attention to the factors that are most commonly neglected when working with change. Key among these are the broad range of personal and psychosocial limiting factors, whole-system design/redesign approaches, cross-boundary thinking and ways of working with the unknown, and the full spectrum of co-factors involved in change, including the need to simultaneously work with others to facilitate fundamental structural and institutional transformation, based on the kinds of assumptions discussed above. If we do this, then I believe that significant progress can be made. If we persist in denial, postponement, and in focussing on narrow approaches (e.g., just efficiency and substitution strategies), rather than on broad, integrated, whole-system, deep design/redesign approaches, grounded in our understanding of nature, ecology, psychology and culture, then progress will remain slow and much of the change will be counter-productive. The choice is ours. Because effective change is limited by our awareness, empowerment, vision, values and worldviews, and by the contexts within which we are operating, these are the areas where most attention needs to be applied.

The following four key points need to be emphasised.

1. We are at a critical threshold – a moment of profound choice – in the 'psychosocial' development of our species – of continuing with ways of living that destroy our soils, habitats and consequently those dependent on them, including ourselves, or of taking "the road less travelled" – through emphasising personal, cultural and ecological sustainability and wellbeing – towards healthy soils, habitats and species.

2. All of us have already started down this road and wondered, even if only in very preliminary ways, about what to do next, and about how to dare to do it, and find the allies and other supports to help us. It is imperative that we acknowledge, share, celebrate, continue and, where appropriate, to expand on these initiatives.

3. Further sustainable change will be achieved largely not through mega-projects, but by each of us individually and in small mutually supportive and collaborative groups, taking small meaningful, locally relevant actions, and sharing the processes involved, and publicly celebrating the outcomes, to make them available to others (thereby "making such 'healthy' approaches contagious").

4. Even small groups of people – if truly committed to such action – can play a major role in this process of cultural transformation. A great diversity of other small compatible groups and initiatives are, at this time in our history, emerging across the world. This process of synchronous emergence and eventual reaching of thresholds of significant transformative change, which has been called 'Morphogenic Change' (Sheldrake 1981) or the '100th Monkey Phenomenon', is just one expression of the non-linear nature of change in nature. This may be your moment to take your next significant step in your own process of development and ecological/social action. I encourage you to use this opportunity to get the information and support that you need, and to dare to act on it. If we all postpone taking such action, it is certain that the quality of life of future generations will progressively be degraded as we continue to lose our soils, habitats and other species with which we share this amazing planet.

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