

Soil: our common ground – a humanities perspective

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Abstract

The story of soil is essentially the story of humanity. The words 'earth and 'ground' are among the oldest in human language. Soil is the basis of our ancient religions, and of all our civilisations, and for the past 10,000 years its destruction has been the precursor of different civilisations' downfall. All human communities have a cultural, sensual and spiritual attachment to the soil, but Western society has lost this attachment because of material prosperity, disconnection from the land, and a scientific culture that has fractured soil and its meaning, and in so doing, put it out of the reach of non-scientists' understanding. As the repository of most soil knowledge, soil scientists have an important role in reconnecting people to soil.

Introduction

I came to soils late. Twelve years ago my journalism experience earned me a job producing soils information for farmers. My academic background had focussed on literature, drama and psychology. I knew nothing about soils, despite the fact that I had spent my childhood in the country, and my father was an agricultural scientist. My employers were unperturbed. We have more than enough information about soils, they said, but it is not accessible to farmers. We want you to make it easy to understand. So I set to work, and the most extraordinary thing happened. I fell in love with soil. There is no other way to explain it. I had finally found a key to the meaning of life. I felt like William Bryant Logan (1995:97) who wrote 'We spend our lives hurrying away from the real, as though it were deadly to us. It must be somewhere up there on the horizon, we think. And all the time it is in the soil, right beneath our feet.' Here, at last, was something to which I could give my heart with no expectation that it would prove unworthy of my attention. This new, surprising love was fanned into passion by conversations with the farmers I was writing for. I found them curious and intrigued about the soil under their feet, hungry to know more about the material that was their major asset, provided their livelihood and gave their lives meaning. It began to occur to me that soil was not just brown stuff that held up plants, it was actually a metaphor for life.

But this was not the message I found in the soil texts I read. Nor did I find it in the soil science conferences I attended. As a non-scientist surrounded by scientists I stepped carefully, not wanting to be thought too radical in my ideas, but I was emboldened by the farmers' passion and, with time, others' interest in soil once I had alerted them to its possibilities. Almost everyone, I realised, is fascinated by soil, once they are shown how to access it. It is a secret world, hidden underneath its often unpromising surface and disguised by complex science and terminology. The key to unlocking its secrets is to connect it with our lives. Our western scientific approach to understanding soil as the result of geological and biogeochemical processes is one particular perspective understood by a tiny percentage of the population. Another way to look at soil, one we can all understand and identify with, is to see it as the source of our survival, the means and meaning of our existence.

This paper has been a wonderful opportunity for me to explore soil from the perspective of the human condition: In the next few pages I look at the historic relationship between humans and soil, explore possible causes of our society's disconnection from soil, and suggest ways we can help people reconnect with it. It's a subject worth a whole book, I realise, and I have barely scratched the surface. I have no hypothesis to prove, I offer a variety of ideas and viewpoints from a range of sources that I hope add new perspectives to your thinking as soil scientists. Many of these ideas are presented as direct quotes from other sources, for you to use in your own work to excite and inspire others to understand and care about soils.

In the beginning was the word

The story of soil is essentially the story of humanity. Soil is shorthand for life, for without it, we cannot survive as a species. Soil's fundamental importance in our lives can be seen in the virtually unchanging etymology of the words 'ground' and 'earth'. According to the *Shorter Oxford English Dictionary*, the word 'earth' derives from the Old English *eorpe*, the Dutch *aarde*, modern Greek *erde*, and the original Teutonic *erpa*. The word 'ground' is derived from the Old English *grund* derived from the original Teutonic *grundu-z* and the pre-Teutonic *ghrntu-s*. The minor etymological changes in the development of these words over thousands of years indicate how intrinsic these words are to human society. Humus is a Latin word meaning ground, derived from the Latin *humi* 'on the ground', the same etymological root that gives us the word humble. Hillel (1991) suggests that the Latin for 'man', *homo*, is also derived from the same root as humus, further linking the association between human beings and soil. Interestingly, the word 'soil' has much more recent etymology and draws on French origins. Soil meaning 'earth' or 'ground' is a late Middle English word which came from the French *sol* and the Latin *solium* meaning 'ground'. Soil meaning 'dirty', is also a late Middle English word which derives from the Old French *soille*, and is linked to the Latin *sus* meaning pig. The noun refers to pig wallows, filth, excrement, sewage and manure. The verb means to defile, or pollute, make foul or dirty, and wallow in filth. Similarly, 'dirt', a Middle English word, is derived from the Old Norse *dirt* meaning excrement. Herein lies one of the sources of our disconnection from soil, for we have come to associate the word with dirt and filth rather than life.

Soil, dirt, ground, earth – these are the main words we use to describe the life-giving matter beneath our feet. There are other words - clay, silt, sand, alluvium, loess, loam, bole, and marl among others, but considering how diverse soil is, we are relatively inarticulate about it. Francis Hole (1994) a passionate soil scientist who devoted much of his life to revealing the excitement of soils, suggests that this paucity of words reflects our culture's unfamiliarity with soil. Native cultures have many more words, words that describe the nature of the soil as they experience it. The Zuni Indians, for instance, have 'fat' fertile soils, and 'hot' soils that dry out quickly. The Lari farmers have phrases such as 'rot roots' for heavy clays that hold water, 'water needy' for soils that drains too rapidly to grow crops, and 'weak' or 'lazy' soils that need more ash or organic fertiliser (Pawluk 1999). In south-east Asia, Lao farmers have many words for their soils, including 'worm soil' 'sticky in water', 'glass rock', 'sliding rock' 'near stream', 'fruity black soil', 'yellow melting' and 'goat dung rock' (Manivong 2003).

Soil worship

What is worship? To worship means not to figure out, not to analyse, not to pin down like a dried butterfly on a grid, but to value. Deeply to value (Logan 1995:9)

Soil's fundamental importance to human life is reflected in ancient religions, many of which had soil gods. In ancient Egypt, for instance, the creator sun-god Khepri is represented by a scarab or dung beetle, pushing the sun up from the underworld, the image inspired by the busy dung beetles rolling their balls of dung across the ground and emerging from inside the balls. Khnum the ram-headed god was also a potter-god who had a strong association with the Nile inundation and soil fertility, and is sometimes shown modeling clay on his potter's wheel to form the bodies of humanity (Egyptology online 2004). Native tribes of the American south-west believe they came into the world from under the ground, summoned from the underworld by the Sun. 'The story of the people's emergence from under the ground, usually climbing up a reed or tree, mimics the emergence from the soil of the corn and other plants harvested by the horticultural tribes of the south-west' (Abram 1997:218).

Ancient cultures personified the earth and nature, gave them human feelings, and interpreted their actions as human because they saw in nature the same cycles that they themselves were part of: birth, maturity, death and decay. The earth was revered as the mother, 'the source of fertility, the site of germination and regeneration, indeed the womb of life' (Hillel 1991:15). Embraced by the male energies of sun and rain, she gave birth to new life. The early Greek creation story has Gaia, the goddess of the earth, impregnated by her son and consort Uranus, god of the sky. Her descendants include Demeter the goddess of agriculture, fertility and marriage (Hillel 1991:14). Geologist Gregory Retallack of the University of Oregon has found an interesting correlation between Greek deities and the soils where they were worshipped.

For example, the temples of Aphrodite and Poseidon, deities associated with the sea, were built on dry desert soils. Because such soil was unsuitable for farming, the local inhabitants would have looked to the sea for sustenance. On the other hand, the temples of Demeter, the goddess of the harvest, and Dionysus, the god of vineyards, were associated with a fertile grassland soil called xeralf. Sites sacred to Hades and Persephone, the god and goddess of the underworld, had bare, inhospitable rock at the surface (Svitil 2003).

Western culture's creation story of Adam and Eve in the Garden of Eden also links soil and life. The name Adam is derived from the Hebrew 'adamah' meaning 'dust from fertile soil' (Davis 2004) so Adam is literally an 'earth being'. The name Eve is derived from 'hava' which means living (Hillel 1991:14). The story of Adam and Eve's banishment from the Garden of Eden can be interpreted as the oral history of a newly established agricultural culture nostalgic for its earlier, easier, way of life (Mason 1993), and hence symbolises 'humanity's transformation from the carefree "child of nature" hunting-gathering-wandering phase of existence to a life of toil and responsibility as permanently bound tillers of the soil' (Hillel 1991:63). The early history of mankind narrated in the Bible suggests that from the beginning, human activity has damaged the soil so that 'the first eleven chapters of Genesis, that quick and dirty history of early humankind, is, from one perspective, the story of humanity's progressive alienation from God and fertile soil' (Davis 2004).

The Bible is written by a people eking out their existence on poor soils who knew how precarious their lives were as a result. 'Ancient Israel understood that we are not free to act upon the fertile soil without regard for its inherent character; we are charged to serve its needs as well as our own' (Davis 2004). The Israelites were desert nomads who at the beginning of the Iron Age, around 1200 BC, reached the Promised Land, and found a land of milk and honey in the fertile coastal valleys. However, these were already well populated, so the Israelites had to settle in the central mountain ranges of Judea, Samaria and Galilee, rugged ranges where the soils were shallow, stony and erodible. To farm them they built rock-walled terraces on the contours and rested the land every seven years (Hillel 1991:99). The back-breaking work required to make these soils arable, and maintain their fertility, is the basis of many of biblical parables. 'From Deuteronomy to Hosea to Psalms to Proverbs and more, they [biblical writers] cite the condition of the soil as the best index of the health—or the erosion—of the relationship between Israel and its God' (Davis 2004).

Civilising the soil

The nation that destroys its soil destroys itself. (Roosevelt 1937)

Human cultures began changing from a nomadic hunter-gatherer culture to a settled, agricultural culture around 10,000 years ago. The causes for this transition are still debated (Ponting 1991) but one of the most likely causes was an increasing population and a decreasing supply of wild food. People began to settle in groups to raise animals and plants for food. As they began to produce a surplus of food for their needs, settlements were able to support non-food growing residents such as soldiers, priests and artisans. The word 'civilisation' is derived from the Latin *civis* meaning citizen, that is people who live in cities, towns and villages who do not have a direct relationship with the soil and eat food grown by others. The basis of civilisation then is a society able to produce surplus food. As food production has had a big impact on soils, there is an inextricable link between civilisation and soils. 'So direct is the relationship between soil erosion, the productivity of the land, and the prosperity of people, that the history of mankind, to a considerable degree at least, may be interpreted in terms of the soil and what has happened to it as the result of human use' (Bennett & Lowdermilk ca 1930s). This linkage has been explored with skill and passion by many writers, among them David Hillel (1991), Clive Ponting (1991) Edward Hyams (1976), Carter and Dale (1955), and Lowdermilk (1948). All outline a litany of civilisations reduced to impoverished populations living on sand and rock due to soil mismanagement and resultant loss of agricultural productivity and food supplies. Edward Hyams even describes human beings as the most virulent soil pathogen of all because of the damage they have done to soils over millennia (1976:69).

As human populations expanded they cleared forests to grow food, and provide fuel and construction materials. It is estimated that no more than 10% of the original forests that once stretched from Morocco to Afghanistan in 2000 BC still exist (Ponting 1991:76). It is sobering to think that mountain ranges that are now little more than bare rock were once covered with lush forests. The story of Adam and Eve in the

Garden of Eden can be interpreted as longing for these forests that were destroyed as human settlement took hold in the region (Kovarik 2004). In a bid to feed their populations, civilisations overgrazed cleared land, which meant forests could not regenerate, and cultivated the thin soils to grow food. 'In the history of civilisation, contrary to the idealistic vision of the prophet Isaiah, the ploughshare has been far more destructive than the sword,' says David Hillel (1991:75). The bare soils eroded, filled water courses and formed swampy deltas and marshes at river mouths. Erosion material flowing down the Tigris and Euphrates rivers is estimated to have filled in the Persian Gulf for almost 300 kms in the past 4500 years (Thomas 1956). The Koran records the process: 'Do they not travel through the earth and see what was the end of those before them?...They tilled the soil and populated it in great numbers...there came to them their apostles with clear signs, which they rejected, to their own destruction. It was not Allah who wronged them, they wronged their own selves' (Hillel 1991:17).

In Mesopotamia, the Sumerians transformed the swampy floodplains of the lower Euphrates and Tigris rivers into fertile fields and orchards, only to see their rivers, canals and drains clogged by silt-rich floodwaters pouring off the deforested mountains in Armenia to the north. The flood irrigation of the low-lying lands also raised the watertable, resulting in salinity. The Sumerian culture was well organised, using its food surplus to feed its bureaucracy and army. In 3500 BC it grew equal amounts of wheat and barley, but by 2500 wheat comprised 15% of the total crop due to salinity. In 2000 BC reports described an earth turned white from salt, and by 1700 BC salt levels in southern Mesopotamia were so high no wheat was grown at all. Over this time crop yields declined, so that the society could not feed its bureaucracy or army, and could not longer defend itself. By 1800 BC when yields were only a third of 2500 BC, Sumer's agricultural base had collapsed, and the region became insignificant. 'What is remarkable is the way that the political history of Sumer and its city states so closely follows the steady decline of the agricultural base,' says Clive Ponting (1991:72). Sumer's battle with salinity gave rise to one of its myths in which the goddess of love and procreation was envied by her sister and enemy, the goddess of death who meted out her revenge by having saltwater rise through life-giving soil and kill it (Hillel 1991:87).

The mountains of Lebanon were famed for their dense stands of cedars, used for buildings and ships once the Phoenicians settled the area around 1000BC. The wood was also sold to treeless Mesopotamia and Egypt. As the Phoenicians prospered from their trade, their population grew, and people settled the now treeless hillsides, leading to erosion. But their soil could not grow enough food for their burgeoning populations, so they colonised other areas of the Mediterranean before being defeated by the Greeks in 332BC.

The Greeks used the trees on their thickly forested hillsides for housing, furniture, chariots and ships, and turned wood into charcoal to fire pottery and bricks and reduce mined ores. Shepherds burned woody vegetation to encourage grass which was then overgrazed. Farmers cultivated the shallow hill soils for cropping. Not surprisingly, the soil eroded, particularly in the wet season, creating Greece's familiar rocky landscape. The process was described in the Iliad: 'Many a hillside do the torrents furrow deeply, and down to the dark sea they rush headlong from the mountains with a mighty roar, and the tilled fields of men are wasted.' As the soil eroded the Greeks shifted to grapes and olives which could grow in the poorer conditions. Silt accumulated in lower reaches, creating swamps and disease. The pass at Thermopylae where Greek soldiers kept the huge Persian army at bay in 480BC no longer exists because so much soil washed down from the hills above that the pass is now a wide floodplain (Attenborough 1987: 169).

What now remains of the formerly rich land is like the skeleton of a sick man, with all the fat and soft earth having wasted away and only the bare framework remaining. Formerly, many of the mountains were arable. The plains that were full of rich soil are now marshes. Hills that were once covered with forests and produced abundant pasture now produce only food for bees. Once the land was enriched by yearly rains, which were not lost, as they are now by flowing from bare land into the sea. The soil was deep, it absorbed, and kept the water in the loamy soil, and the water that soaked into the hills fed springs and running streams everywhere. Now the abandoned shrines at spots where formerly there were springs attest that our description of the land is true.' Plato Dialogues (in Hillel 1991:104)

The Roman Empire suffered a similar fate. Supporting its rapidly growing urban population required more and more food, so all available land was cleared for agriculture, and soils exploited heavily. The expansion of the empire required ships built with timber stripped from foothills and mountains. The soil that washed off the bare hillsides formed marshy deltas at the mouths of rivers which provided a home for mosquitoes that introduced malaria to Italy around 200BC. Many writers commented on Italy's declining productivity.

Lucretius for instance described it in detail. He believed that the earth was dying. Livy wondered how the vast armies of the Volscians, Aequians and Hernicians, which the Romans had fought four centuries earlier, could have been sustained by lands which, in his time, were so poor that they could support but a small population of slaves tending their masters' livestock and caring for sparse olive groves and vineyards. St Cyprian of Cathage, around AD250, complained that the world was dying. Springs were drying up and famines were increasing over the whole Mediterranean area. (Goldsmith 1989)

One Roman writer who disagreed with this diagnosis was Columella who attributed the decline due to the disappearance of yeoman farmers and replacement with slaves who did not provide the care the soil provided. Greedy landowners did not give the soil enough manure to restore its fertility so, he said 'there is one remedy, namely to come to its aid with manure' (Goldsmith 1989).

The Romans' approach to the soil was that it was there for human use. As they expanded their empire across the known world they repeated the pattern of forest clearing, overcultivation and overgrazing to feed Rome. In north Africa, then known as the granary of Europe, their deforestation eroded so much soil from the mountains that the ancient city of Utica at the mouth of the Bagradas River lost its access to the sea and is now buried under 10 metres of silt, seven kilometres from the coast (Hillel 1991:191). Similarly, the complex, sophisticated culture of the Indus River Valley in what is now Pakistan lasted less than 500 years, from around 2300 BC to 1900 BC. It is thought that a combination of irrigation-induced salinity, deforestation of the mountains to fuel brick-drying ovens, overgrazing, erosion of the hill soils, and silting of waterways reduced the food surplus to such an extent that it could not support the army, making it vulnerable to conquest (Ponting 1991:74).

The Nile valley escaped a similar fate because its silt derived from the rich volcanic uplands of Ethiopia, adding an annual layer of fertile soil to the floodplain each year, and because the floods occurred in summer, reducing evaporation and salinity potential. 'This all-important annual pulsation of the river and the associated fluctuation of the water table under a free-draining floodplain created an automatically repeating, self-flushing cycle by which salts were leached from the irrigated land and carried away by the Nile itself' (Hillel 1991:91). However the construction of the Aswan dam to allow Egypt to manage its water supply and increase irrigation now keeps the water table high resulting in the same waterlogging and salinity that has plagued other river systems.

In China, natural forests originally covered three quarters of the land, but by the early 19th century much of it had been completely deforested (Ponting 1991:255). The erosion from deforestation was compounded by the poorly structured loess soil in the north-west highlands. Loess is a silty yellow sediment hundreds of metres deep deposited for millennia by winds from the Central Asian desert and easily eroded by wind and water. The Yellow River which rises in this area carries so much silt that the river bed in the lower reaches is much higher than the surrounding floodplain which is also formed from the silt. For the past 2500 years the Chinese have attempted to reinforce the natural levees to stop the river flooding onto the plain, but this means the silt settles in the river bed and raises the bed even higher, and hence more prone to flooding (Hillel 1991:169).

In the Oceania region, deforestation in Easter Island effectively starved its population to death as there was no food and no boats to leave the island (Ponting 1991:7). Siltation in New Guinea swamps has accelerated over the past 9000 years due to forest clearance for shifting agriculture. In Fiji, massive erosion and burning regimes were well established 2000 years ago, due to extensive clearance for shifting cultivation on steep hillsides. Vanuatu shows extensive valley filling and filling in of the shore line due to hillslope erosion. In Australia the indigenous use of frequent low intensity fires to increase plant and animal foods over thousands of years is thought to have resulted in extensive erosion due to removal of groundcover (Hughes, Sullivan 1986:119).

Despite all these examples from history, we continue to make the same mistakes, following the same destructive template: deforestation, over-grazing, cultivation, all leading to erosion and loss of soil fertility. In February this year the American Association for the Advancement of Science said deforestation, erosion, soil depletion and salinisation due to agriculture were as much of a threat to modern civilisation as they were to other now-vanished societies. Biologist Jared Diamond told the conference that soil erosion was as big a problem as global warming, but didn't attract media interest. 'There are about a dozen major environmental problems, all of them sufficiently serious that if we solved 11 of them and didn't solve the 12th, whatever that 12th is, any could potentially do us in,' he said. 'Many of them have caused collapses of societies in the past, and soil problems are one of those dozen' (Radford 2004). Given the grim lessons of history, why are we still making the same mistakes? Is it that we don't read enough history, or we don't know enough about the crucial role of soils in our survival, or do the short-term imperatives of food supply and money-making blind us to the obvious? Of the 11.5 billion ha of vegetated land on earth, 17% is degraded through erosion, and one in every 6 ha can no longer support crops, all due to deforestation and overgrazing (Kaiser 2004). In Central Asia the diversion of the region's two rivers, the Amu Darya and the Syr-Darya, for irrigation has so shrunk the Aral Sea, once the fourth biggest inland sea in the world, that it is now a salty plain where the wind blows dry salt for hundreds of kilometres, creating a scene of Biblical devastation. 'The sky is covered by a salty curtain, the sun becomes crimson and disappears in the salt dust. In the entire province, not one tree grows on the land. The livestock are perishing, and the people are getting sick and dying' (Hillel 1999). Today, destruction of protective vegetation along the Amu Darya River has exacerbated the effects of drought and allowed the formation of a sand dune belt that is some 300 kilometres long and 30 kilometres wide. These dunes, moving up to one metre per day, are blocking roads and swallowing villages no longer shielded by local forests (Larsen 2003).

Human civilisation has been described as the formation of deserts in the footsteps of mankind (Carter, Dale 1955) and current statistics seem to support this view. Desertification plagues up to one-third of the Earth's land area, affecting more than one billion people in 110 countries (Larsen 2003). However there is currently some debate whether desert formation is all due to human activity or is a natural occurrence due to climate change (Warren 2004). What is undebatable is human civilisations' dependence on soil for food production and survival. 'In the last reckoning, all things are purchased with food. Food production is thus the final and fundamental measure of adjustment of a people to its land resources (Lowdermilk 1948). Over the past 10,000 years, most civilisations have lasted only 40 to 60 generations (1000-1500 years) on average. 'In most cases, the more brilliant the civilisation, the shorter was its progressive existence. These civilisations declined in the same geographical area that had nurtured them, mainly because man himself despoiled or ruined the environments that helped him develop his civilisations' (Carter, Dale 1955). More recently, biologist Jared Diamond has concluded that history has shown that countries that get into environmental trouble are likely to get into political trouble both for themselves and to cause political troubles around the world (Diamond 2003a).

Soil and human culture

Hospitality is the fundamental virtue of the soil. (Logan 1995:19)

While civilisations and soil have been mutually destructive, individuals and communities have enjoyed a mutually beneficial relationship, a concept that occupied the mind of inspirational soil scientist Hans Jenny (1999) who said 'I can't help thinking of the claim that healthy soils make healthy people, and as an extension, I am intrigued by the thought that good soils make good people'. The term culture itself is based on the concept to cultivate land, that is, agriculture. The meaning we ascribe to it today, to develop mind and manners, is an 18th century meaning. Thus the concept of human culture as we know it, is actually based on our cultivation of the soil. Some of the earliest written documents were agricultural manuals on soil management (McNeill, Winiwarter 2004:1627), and techniques such as terracing to reduce erosion, and manuring to build fertility, have been practised from the earliest days of civilisation (Tisdale, Nelson 1975:5). In France, young girls' dowries were fixed according to the weight of manure produced on her father's farm, and, if you sold a farm you received credit for the compost you'd saved. (Logan 1995:39). Ethnopedology, the cross-cultural study of soil knowledge, is showing us that indigenous people have substantial knowledge about their soils, based on soil properties they see and experience when they try to grow food in local soils (Pawluk 1999; Ettema 1994). Many soils have human stories attached to them. For instance, we now realise that the highly fertile Amazonian dark earth,

for instance, also known as *terra preto*, was created by pre-Columbian Indians from 500 to 2500 years ago, and abandoned after the invasion of Europeans. We don't know whether the soil was created deliberately or is a by-product of other activity, but we do know it has a very high carbon and phosphorus, and higher cation exchange capacity and pH than the soil around it. It is similar to charcoal and research has found that adding charcoal to soil significantly decreases nutrient leaching and increases crop growth (Lehmann 2004).

Soils can determine the quality of a culture. For instance 2.2 billion people in 130 countries are at risk from iodine-deficient soils which can lead to goitre, cretinism and low IQ. The deficiency is due to leaching of iodine by glaciation, high rainfall, or flooding of river valleys or vast estuaries (Hetzl 2001), and the physical, mental and social health of entire communities has been improved by adding iodine to their diet.

All civilisations have relied on soil for material to make their buildings, crockery and art. The Sumerians used clay tablets to record their activities. Using clay to make pots and bowls for human use is one of mankind's oldest arts, and because the materials are so enduring they have provided useful clues to our early history. The oldest known body of pottery dates from the Jomon period (from about 10,500 to 400 BC) in Japan, while excavations in the Near East have revealed primitive fired-clay vessels made more than 8,000 years ago. Potters were working in Iran by about 5500 BC, possibly earlier, while Chinese potters had developed characteristic techniques by about 5000 BC. Many pre-Columbian American cultures developed highly artistic pottery traditions (Woodhouse no date).

In every culture's poetry and literature the word soil is used as a metaphor for life, fertility, belonging, groundedness, richness and productivity. Metaphors are used to make the unknown familiar, and are particularly useful when they relate to people's experiences, so the extensive use of soil as a metaphor indicates earlier cultures' familiarity with soil activities. In Shakespeare's *Antony and Cleopatra* 'He ploughed her and she cropped' is Agrippa's description of Julius Caesar's liaison with Cleopatra, which resulted in the birth of Caesarion. Joshua Reynolds (1774) wrote: 'The mind is but a barren soil; a soil which is soon exhausted and will produce no crop, or only one, unless it be continually fertilised and enriched with foreign matter.' St Paul wrote to the Ephesians (3:16-17) 'I pray that God may grant that Christ may dwell in your hearts through faith, as you are being rooted and grounded in love'. It would be interesting to know how often soil is used in metaphors today given our culture's disconnection from soil.

Sensual appeal

The truth, when really perceived and not simply described, is always a wonder. (Logan 1995:2)

Soils appeal to our senses, to our sight, touch, our sense of smell, even taste. Hans Jenny (1999) admired soils for their intrinsic beauty:

I have seen so many delicate shapes, forms, and colours in soil profiles that, to me, soils are beautiful. Whenever I offer this reaction to an audience, I notice smiles and curiosity, but when I follow up with slides that depict ebony black mollisols of Canada, titian-red oxisols of Hawaii, and gorgeous soil-profile paintings by such famous artists as Grant Wood of Iowa, Dubuffet of France, and Schmidt-Rottluff of Germany, the hesitancy turns into applause.... Soil-profile art is not akin to classic paintings with themes; rather, it resembles abstract art: and if you are used to thinking of soil as dirt, which is customary in our society, you are not keyed to find beauty in it.

Soil tasting is an old practice to test whether soils are sweet or sour. Roman farmers distilled soil through a wine strainer with water and drank the liquor. 'The best soils had neither salinity nor bitterness, but a sweet and open taste like the smell of fertile soil when it opens in the spring' (Logan 1995:64). Many cultures practise geophagy, or soil eating. A Siberian tribe carried small balls of local earth to nibble on their travels to remind them of home. Central American native communities ate clay tablets, Swedish and Finlanders used clay to extend bread in famine times, while the Japanese Ainu people have a clay lump soup. West African women eat earth processed by termites to obtain calcium. Many of us take a kaolin-based mixture to settle upset stomachs (Whole Earth 1999). Immunologists (Rook, Stanford 1998) think we need to eat more dirt as children to build up our immune systems.

We don't smear dirt on our lips and inhale mycobacteria. We've broken the bonds of tens of millions of years of coevolution of dirt and terrestrial-vertebrate immunology. Maybe it goes back even further. No matter. Without early childhood contact with these agents in soil (and unpurified water), with every flex of our First-World fetish for cleanliness, fewer antigens enter into our bodies to rehearse the ancient immunological troops. Without certain small diseases early in life, we may have more allergies later (Whole Earth 1999).

Hans Jenny had a very sensual approach to the soil: 'Soil appeals to my senses. I like to dig in it and work it with my hands. I enjoy doing the soil texture field test with my fingers or kneading a clay soil, which is a short step from ceramics or sculpture. Soil has a pleasant smell. I like to sit on bare, sun-drenched ground and take in the fragrance of soil' (Jenny 1999). Many farmers and gardeners are enthralled by soil, not only because it feels good but because it 'brings us into relationship with the primal forces of life and death, both physically and symbolically. We nourish life from a seed, watch it grow, thrive, spring full of colour and vitality, and then wither and die. This is the natural order of things, of all life' (Johnson 2003).

Spiritual core

While we respect the soil, we also take care of the soul. (Kumar 2000)

Touching the soil literally earths us, connects our human spirit to our core. 'We are electric, energetic beings,' says Bela Johnson (2003). 'Our connection to a ground in the earth is crucial if we are to remain healthy in body, mind and spirit. When we stick our hands in the soil, we affirm our connection to that which sustains us.' Clarissa Pinkola Estes (1996) wrote something similar in her book *Women who run with the Wolves*: 'I'm always taken by how deeply women like to dig in the earth. They plant bulbs for the spring. They poke blackened fingers into the mucky soil, transplanting sharp-smelling tomato plants. I think they are digging down to the two-million-year old-woman. They are looking for her toes and paws. They want her for a present to themselves, for with her they feel of a piece and at peace.' This connection with the earth is the same connection that our ancestors had with their soil gods. We are more sophisticated and knowledgeable today, but we still have a subconscious link with the soil that goes deep to the core of our existence on earth and connects us to the spirit of what it means to be alive.

In some intuitively perceivable sense, the quest for a deeper understanding of the soil's role in the natural environment and in the life of humanity, is more than an intellectual exercise or a merely utilitarian task. It might even be something of a spiritual pilgrimage, impelled by an ancient call, a yearning to return to a life of greater authenticity. (Hillel 1991:18)

Knowing and understanding soil connects us to a wider perspective than our current existence. 'The soil of any one place makes its own peculiar and inevitable sense. It is impossible to contemplate the life of the soil for very long without seeing it as analogous to the life of the spirit' (Berry 1996). We depend on soil for food to survive, and when we die we return to the earth to make soil. The Bible's Book of Genesis expresses this in fairly bleak terms: 'In the sweat of thy face shalt thou eat bread, till thou return unto the ground; for out of it wast thou taken: for dust thou art, and unto dust shalt thou return' (Genesis 3:17-19). However many other cultures see death as the beginning of new life in the soil. Xenophanes (580BC) wrote 'For all things come from earth and all things end by becoming earth' and Omar Khayyam said it more exquisitely:

I sometimes think that never blows so red
The rose as where some buried Caesar bled
That every hyacinth the garden wears
Dropt in her lap from some once lovely head. (Tisdale & Nelson 1975:7)

Chief Seattle expressed similar ideas in 1854 when making a treaty with the white settlers who had taken over his lands: 'the very dust upon which you now stand responds more lovingly to their footsteps than yours, because it is rich with the blood of our ancestors, and our bare feet are conscious of the sympathetic touch' (Smith 1887).

Disconnection

We have become divorced from the soil. (Kirschenmann 1997)

In our Western culture this feeling of connection to the soil through history and the cycles of life and death barely exists. While there are farmers, gardeners, soil scientists who are passionate about soils, soils are not part of most peoples' conscious lives in our urbanised Western culture. This disconnection was identified by Fred Kirschenmann, a US organic farmer, theologian and educator who wrote a paper 'On becoming lovers of the soil', calling people to reconnect.

Soil is the connection to ourselves. From soil we come and to soil we return. If we are disconnected from it we are aliens adrift in a synthetic environment. It is the soil that helps us to understand the self-limitations of life, its cycles of death and rebirth, the interdependence of all species. To be at home with the soil is truly the only way to be at home with ourselves, and therefore the only way we can be at peace with the environment and all of the earth species that are part of it. It is, literally, the common ground on which we all stand. What has happened to our modern industrialised society is that we have gone through a divorce. We have become divorced from the soil. And I submit that until we heal that divorce and become lovers of the soil again, many of our social problems will go unsolved – including our food safety and environmental protection problems. (Kirschenmann 1997)

Our urbanised Western culture is powered by money, technology and knowledge. This power has enabled us to separate from the means of our survival, so that we can turn on taps for water, obtain our foods in shops, and produce synthetic materials to dress and house ourselves. Most of us live in cities, and rural areas have been so depopulated that few of us know anyone who lives on a farm any more. In a 2002 survey, for instance, the Kondindin Group, a WA-based agricultural information supplier, found that 88% of children surveyed hadn't visited a farm, compared with 20% in 1970, and 76% didn't know a farmer (Aitken 2002). Our version of the country is quaint tourist villages or backpacking wilderness. We have little way of connecting with the soil that feeds us and keeps us alive. Soil for us is inconvenient stuff that dirties our clothes and dusts our furniture. We are physically, socially and spiritually removed from soil.

But there is another, more insidious, reason for our disconnection from soil - the way we have studied it. Francis Bacon (1561-1624) is regarded as the father of modern science for his introduction of inductive reasoning to study nature, that is 'to disassemble every system into components or phenomena that were to be studied in isolation, assuming all other things to remain equal' (Hillel 1991:48). We now know enough about living systems to know that the interactions between system components are so complex that studying any one of them in isolation can be meaningless and destructive.

To try to understand the soil by taking a few trowelful and submitting them to chemical tests is like trying to understand the human body by cutting off the finger, grinding it to paste, and performing the same tests. You may learn a lot about the chemistry of pastes, but about the intricate anatomical linkage of systems – and about the body's functions as a whole – you will learn nothing at all. (Logan 1995:177)

Inductive reasoning led Bacon to suggest that the principal nourishment of plants was water and that the main purpose of soil was to keep plants erect and protect them from heat and cold (Tisdale and Nelson 1975:10), a view of soils that has held until only a few decades ago. The need to find meaningful results from experiments led scientists to concentrate on soil chemistry and physics, and neglect the complexities of soil biology, the crucial key to soil health. The inductive approach also excluded non-scientists from discussions about the natural world. People's direct experiences and anecdotal accounts were dismissed as being 'data free' and lacking evidence. Yet, as Jared Diamond noted 'the word science isn't derived from the Latin word for "replicated laboratory experiment", but instead from the Latin word 'scientia' for knowledge. In science, we seek knowledge by whatever methodologies are available and appropriate' (Diamond 2003b).

The study of ethnopedology is also helping us realise that Western science's inductive approach may be a little narrow when it comes to understanding soil. When Roman Pawluk began studying ethnopedology, that is how other cultures understand soil, he realised that he had only learned about soil in the context of increasing agricultural production as part of a national strategy to integrate agriculture and commerce.

No classification system is 'right'. Each meets needs of its creators. At the same time, we should remember a concept forcefully expressed by Clifford Geertz: 'Depiction is power'. The whole business of describing what others see and feel and do reflects our own cultural biases and is subject to relations of the dominant culture and the dominated. (Pawluk 1999)

Feminist writing has also recognised a desire for domination in Western science. Reuther (1988) suggests that Western science is based on left-brain thinking that suppresses right-brain relational sense and is more dominant in males than females, possibly due to later verbal development in males. Left-brain thinking, she says, 'screens out much of reality as "irrelevant" to science and reduces scientific knowledge to a narrow spectrum fitted to dominance and control. But the systems it sets up are ecologically dysfunctional because they fail to see the larger relational patterns within which particular "facts" stand. This rationality tends towards monolithic systems of use of nature' (Reuther 1988:148).

Western inductive science has played a major role in disconnecting society and culture from the soil that sustains it because it has studied soil in isolation from the ecosystem it inhabits; has dismissed direct experience and therefore discouraged non-scientific involvement in soil; has concentrated primarily on aspects of soil that make money such as crop production; and has used technical, complex language that makes soils inaccessible to non-scientists. It has attempted to remove emotion and spirit from the understanding of the substance that underpins our existence and gives us life, by reducing it to part of a scientific equation that equals agricultural production. What we need to do is recover the magic of science, 'its capacity to kindle awe, wonder and the desire for knowledge, for explanation'. (Broderick 1993). We need to devise new methodologies that will allow observation and evaluation of ecosystems in situ, and incorporate a variety of experiences, observations and perspectives to provide meaningful results. All science is done in a context of human activity; we need to transparently situate our science within the philosophical and ethical frameworks of that activity. These frameworks are rarely spelled out, and as Damien Broderick says, it has taken hefty spadework by the women's movement to show that Western science is undertaken in a way that suits a certain type of thinking, and which has excluded other types of experience and knowledge of the world (Broderick 1993). All of us, scientists included, need to remember our real place in the natural world.

The soil scientist digs a hole: He digs through thousands of years in a few feet of soil, then pauses to catch his breath. While he stands in his hole gazing out over the land, you almost remember silts and clays filtering down through impounded water, water rushing under ice, washing sands and gravels into stratified beds, glacial advance and retreat, outwash and deposition, great calves of ice spawned in the drainages. His gaze passes through time and matter. After a while, you begin to wonder about the importance of these human beings clustered around the hole, all of us looking intently in, or following his gaze out to the landscape, nodding our heads gravely in agreement. (Lewandowski 1992).

Reconnection

The soil is the great connector of our lives, the source and destination of all. (Berry 1996)

The key question for us all is how to reconnect with soil so that we understand its crucial importance to our physical and spiritual lives. Soil scientists have a major role to play here as they possess much of the knowledge that others need to be able to reconnect. 'To be responsible to the soil is to respond to its gift with our own' (Logan 1995). But soil science is often impenetrable to non-scientists because of the way it is studied, written and presented. Good communication is critical for reconnection. After working in the area of soil information for the past 12 years, and experiencing both outstanding and woeful soil science communication, I have some ideas about how we can excite and inspire people about soil.

Be human

Scientists and their audiences always have one thing in common, they are human, so wherever possible, connect as a human being. Be personal, bring yourself into the presentation. Introduce human analogies into your presentations and writing. At a soil biology workshop earlier this year I heard soil aggregates described as houses for bacteria, without which the bacteria would die, a description that resonated with the farmers in the audience. Another specialist in rhizobia, the biota that attach themselves to plant roots, had his audience rocking with laughter as he compared the rhizobia's efforts to attach itself to a plant root to a pickup in a bar.

Become knowledgeable about the history of soil and civilisations, so that you can provide a wide human context and perspective about soils.

Be passionate

To love soil requires that we see more than dirt. It requires that we become intimately involved with soil – see its life and beauty, smell its rich aroma, hear its voice. (Kirschenmann 1997)

Scientists tend to avoid emotion because it is subjective and unscientific. Unemotional communication, however, is an oxymoron. If you want to communicate your passion and interest in soils you have to be passionate and interested. Passionate interest is one of the fastest ways you can make people sit up and take notice of what you are saying. Passion and professionalism are not mutually exclusive. If you think back to people who have inspired you and made you feel excited about something, chances are they were passionate and inspiring. Passion makes things memorable.

Confronting an exposed soil cut may be an exciting event. Soil speaks to us through the colors and sculptures of its profile, thereby revealing its personality: we acknowledge it by giving soil a name, albeit in a foreign tongue, but we don't mention our emotional involvements. In fact, our soil language is lifeless, and the soil descriptions in our publications are utterly boring to farmers, ranchers, foresters, sportsmen, and newcomers who are supposed to read them. Articulation would strengthen our feelings about the soil body, casually and in formal lectures, we may want to talk more openly about soils and do it more enthusiastically. We may even become more interesting persons. We may gain new friends, and they might hold a positive opinion of the soil resource. (Jenny 1999)

Make soils exciting

Make soils exciting when you write and talk about them. Consider this voluptuous passage from Theresa Whitehill's 'The soil conversation': 'The land is most generous with those who pay attention to her curves and mood, who are willing to spend time listening and observing and giving back to the soil. To these admirers she has much to say and much to give' (Whitehill 2004). You could summarise this statement as 'It is important to understand soil' but the sentence does not have the resonance of Whitehill's words. She has made the land human, accessible and sensuous. I was once dared to make soils 'sexy' and, responding to the challenge, I combined photographs, quotations and a soundtrack of Ella Fitzgerald singing 'How much do I love you' in an audiovisual presentation. I was nervous, but it worked. It worked so well that it has been used by many people to ignite passion in others about soil.

Hans Jenny was scathing about his fellow scientists' ability to make soils dull and uninteresting: 'I suspect that our intellectual isolation and our invisibility have to do with the lack of formulating exciting ideas about soils themselves and their relations to people, and the shortage of popularising soil science writers' (Jenny 1999). Popular science writers are not necessarily intellectually lightweight; they are popular because they have considered their audience when they write, rather than just writing to inform an audience of their knowledge. Good science writers address the concerns of their readers no matter what their subject. There is an emerging 'third culture' of science writers who are exploring ideas about what it means to be human 'rendering visible the deeper meanings of our lives, redefining who and what we are' (Brockman 1995).

Writing teacher Stephen Feikes says it's not the subject matter but the ingenuity of the writer that makes something 'boring' or 'interesting'. He cites William Bryant Logan, author of *Dirt: The ecstatic skin of the earth* (1995) as an exemplar of good scientific writing for non-specialists. Logan's essays mix experience and research, show stylistic ingenuity, are written in a spirit of philosophical inquiry, and draw from a wide range of sources, not only soil science, but astrophysics, literature, natural history, and engineering (Feikes, no date). Readers have commented about Logan's book: 'What a beautiful testimony to the earthly process of life and death in which we all participate' and 'Logan makes earth-centered philosophy accessible to anyone who has ever had a gut feeling that the land is good' (Amazon.com 2004). Soils are intrinsically exciting, so soil science does not have to be boring.

Allow doubt

Don't feel you have to know everything. To a non-scientist such as myself, it often appears that scientists are writing only for their peers who are, as their profession requires, critical of new ideas. This makes scientists anxious to be 'right' and can make non-scientists feel inadequate in their lack of knowledge. However, no one can know everything, and it is liberating and empowering for non-scientists to hear

scientists say they don't know something, and to invite ideas. Such admissions make you human, level the playing field and involve your audience in the process of thinking and learning.

Why is Earth's dirt special? To a scientific mind, it is hard to admit that we don't, and possibly can't, know the answer. Answerless questions are the best kind. What's more, it seems that things that can't be figured out can still be *seen* to be true. Confession, not of 'sin' but of ignorance, and meditation, not on some mantra but on the created, yield results that are different from analysis and much more powerful. (Logan 1995:9)

Encourage and use local soil knowledge

Soils are so heterogeneous they can vary from metre to metre. We need to encourage non-scientists to understand their soils and their relationship to the system they are working in, whether it be farming, gardening or building. Farmers' living experiences of their soils are actually long term data sets that can provide valuable information. We need to develop ways to integrate local knowledge within soil science frameworks. Science aims to develop universal principles; living ecosystems have a way of upsetting such ambitions. Encouraging local knowledge empowers people, and makes soil science the province of scientists and non-scientists alike.

Study soil as a living system

The complexity of soils is universally acknowledged, but inductive science has encouraged a splintered approach to soils by studying their chemistry, physics and biology in isolation. It is misleading to study such a complex system in parts, so we need to develop methodologies that integrate all areas of soil science. The increasing scientific interest in soil biology and its impact on soil chemistry and structure is a heartening sign of a more holistic approach to soil science. People who live closely to the soil, such as farmers, know intuitively that the soil is living, and they are hungry for information about how to keep it living. 'If all the elephants in Africa were shot, we would barely notice it, but if the nitrogen-fixing bacteria in the soil, or the nitrifiers, were eliminated, most of us would not survive for long because the soil could no longer support us' (Jenny 1999).

Connect soil with food

The starting point for all communication is to connect with the audience. Our urbanised society's principal connection with soil is through eating food and gardening, so the best way to reconnect city people with the soil is by providing information about gardening, composting and food growing. Where people have no space or time for food growing we need to connect them with nearby farmers. There are already strong community-initiated movement for closer connection to food growing (Australian Community Gardens Network 2004), and to local farmers (eg Hawkesbury Harvest 2004), so it would be relatively easy for soil science to link with this interest base to promote urban interest in soils. Growing food, says Fred Kirschenmann, will 'acquaint us with the energy cycle that revolves from soil to seed to flower to fruit to food to offal to decay and around again. We will, in other words begin to see the soil as part of the cycle of life that feeds us and to which we return' (Kirschenmann 1997).

Promote soil as a non-renewable resource

It takes longer than once person's lifetime to renew soil, so it is effectively a non-renewable resource like oil and we need to promote it this way. If we don't, Bob Kerrey's quote will be all too relevant: 'If you run out of water, you pray for rain. If you run out of soil, you pray for forgiveness' (Kerrey, no date). However, it is important to give people ideas about how they can help keep their soil, otherwise soil issues can seem overwhelming.

Develop tools to help people understand their soils.

When trying to interest people in soils, soil scientists often think first of activities they can do, but activities will only succeed if they are part of a bigger plan to reconnect humans and soils, as outlined above. This means activities not only have to be informative, but they need to be exciting, inspiring and relevant to the human condition. All activities need to be developed with the help of the target audience to ensure they connect with that audience. Familiar activities include booklets, posters and websites. More innovative approaches include soil tour guidebooks which show walking tracks with interesting soil sites, *in situ* soil profiles, information boards and museum exhibitions; and soil calendars (Huck 2004), and soil monoliths. School materials are an important way to inspire early understanding of soils (Bridges 1997),

and there are some innovative ideas on science and education websites, such as NASA (2004) ISRIC (2004) National Health Museum (Graham 2004), National Resources Conservation Service (NRCS 2004), and Discovery School (2004).

Conclusion

As a species, we have had an enormous impact on the soils of this planet. Our need for food has led to environmental destruction and the downfall of countless civilisations. At the same time, our dependence on soil for our existence, and soil's contribution to our cultures, means soil has an important place in our physical, spiritual and emotional life, and we need to recognise that in our soil work. 'The purpose of science is to pursue the truth of the universe. Likewise, the aim of the arts is to express the human condition' (Kelly 1997). But inductive science, on its own, has limitations in understanding and managing soil, and lacks integration with human activity and emotion. Humanities on their own, are limited by lack of scientific fact. Together, though, science and humanities can help us understand soil and our interactions with it, and improve both our soils and our human condition. As the repository of most of our current knowledge, soil scientists have a huge role in educating the community about the importance of soil, but they will only be successful if they work with non-scientists to do so.

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