THE ORIGINS OF SOIL

We need to consume 19 trace elements every day, and they come from the soil, via fruit and vegetables directly, or via meat indirectly. But how did the soil with its trace elements get there? After the last Ice Age most of the UK was bare rock, glaciers having scraped off the soil which was there previously. The bare rock will have been subjected to exposure to the elements – wind, rain, ice, snow and especially frost. Water will have penetrated a short distance and extreme cold will then have caused a thin layer of rock to crumble after the frost had thawed. Then some soil micro-organisms will have been blown in by the wind or in rain scooped up from other parts of the planet, and dumped onto the thin layer of crumbled rock. Some of the micro-organisms will have had the ability to attack the rock particles and change them chemically to form the rudiments of soil. Over thousands of years the soil layer will have built up, the soil micro-organisms progressively eating away at more rock.

Into that gradually-forming soil, after the glaciers retreated from the rock surface, will have come the first plants, whose seeds will have been blown in by the wind. Some will have been lichens, others hardy grasses. They will have grown, absorbing energy from the sun via their chlorophyll and absorbing nitrogen, carbon and oxygen from the air, water from rain and trace elements from the primitive soil. When they died they will have contributed to humus, that mysterious matter which binds soil particles into a moisture-retentive rich organic layer. More advanced plants will then have found a home in that humus-rich medium, followed by bushes and trees.

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oded rock will not have been the only source of basic material for our soil; the UK will have benefitted from dust particles blown in by the wind, and over thousands of years that will have contributed significantly to the soil layer. For example, during some sunny summer days with a southerly wind, I have noticed how cars have been covered with a fine red dust. That was dust from the Sahara desert, having been blown into the sky by sandstorms then deposited on my allotment. That will have been another source of trace elements as well as soil micro-organisms. A second example of fine dust particles being blown in is that of my leeks. I noticed how a fine jet-black powder collected at the bases of the leaves. I used to think that I had accidentally spilt soil onto those leek leaves but have now discounted that theory. The fine jet-black dust washes off the bases of the leaves really easily which would not have been the case had it been soil – which is not jet-black anyway. Dust must have been blown in and deposited on the leek leaves then washed into the bases of the leaves by rain and then held there, entrapped. The amazing thing is the quantity in the bases of the leek leaves which is substantial. That jet-black dust must have fallen on my allotment every year and so contributed to the depth of soil. I do not know the source of the black dust, but industrial pollution must be suspected, even in the Chiltern Hills remote from large cities (and largely upwind from London). Following the introduction of lead-free petrol we no longer have particles of toxic lead deposited, thank goodness, but we must have carbon particles from diesel-engined vehicles. Following the Clean Air Act we no longer have so much sulphur, which is to be regretted since sulphur is an essential fertiliser (farmers are now having to apply sulphur fertiliser to their land whereas previously they could rely on "free" sulphur from the skies).

Now, on to a more interesting aspect. The trace elements which plants need, and we need, can only be taken up by plant roots if they are in a water-soluble form. Unfortunately, being water-soluble, that means that they can be washed into the subsoil by rain, and subsequently channelled into the sea via streams and rivers and so be lost. Fortunately, Nature has thought of that one, so has ensured that most of the trace elements are not in a water-soluble form, so are not washed away by rain. Then, along come our friends the soil micro-organisms which work at the non-water-soluble trace elements and slowly change some of them into the water-soluble form for plants to take up. That is why farmers used to leave fields fallow every 4 years in the days before the "Green Revolution", leaving time for the soil micro-organisms to catch up in that 4th year. Even earlier in human history, our

ancestors moved to a new area every 10 years or so once soil was “exhausted”. Then along would come the friendly soil micro-organisms to regenerate the soil, converting some of the non-water-soluble trace elements into the water-soluble forms and rendering that soil fertile again. The whole soil system is a judicious balance. It is an ecosystem where the elements of bacteria, viruses, nematodes, mycorrhizal fungi, beetles, worms, slugs and plant roots co-exist to mutual benefit.

The song goes “Catch a falling star and put it in your pocket”. How is that relevant to the soil? Well, when it rains and washes water-soluble trace elements down into the subsoil, the plant roots have to catch these “falling stars” as they pass. The problem is, the plant roots cannot normally catch the nutrients if they are further than one-eighth of an inch away. The implications of that are enormous. Where farmers apply the fertilisers nitrogen, phosphorus and potassium, the plants will generally be able to absorb only a fraction of them if the soil is low in organic matter, so much of the fertiliser ends up in the sea via streams and rivers. If the soil is high in organic matter then the fertiliser will be held for longer, giving the plant roots more time to absorb the fertiliser, especially if the organic matter is teeming with soil micro-organisms to bring the trace elements to the roots of the plants. Unfortunately the organic matter content of farmland is gradually reducing because farmers are not putting back manure and other organic matter in the quantities necessary. In the UK, 35% of farmland was officially classed as low in organic matter in 1980. That had increased to 42% by 1995 and may be over 50% by now. The farmers also destroy the soil structure by ploughing, very bad for the soil micro-organisms. So our farmland is becoming more desert-like and the applied fertilisers pass increasingly into the sea. As regards farmland, the UK is on a one-way trip to disaster. However, for we gardeners, we can apply lots of compost and manure to the soil, have lots of soil organic matter and not need artificial fertilisers at all. My allotment soil has 7.7% weight-for-weight organic matter, well in excess of the DEFRA (Department of the Environment, Food and Rural Affairs) guidelines.

So, with the soil micro-organisms doing their work, decaying plants contributing humus, and dust fallout from the skies, what is the result? Well, we have a country where crops should grow well, together with bushes and trees. In recent times imbalances have been created where trace elements have been taken away with the crops and not always replaced, so that is a major cause of worry for the future (the “disaster” mentioned above). I have tried to enrich my allotment and garden soil by the annual application of farmyard manure. This has increased the beneficial trace elements and the soil organic matter. I have had my allotment soil analysed and it easily met the DEFRA guidelines for beneficial trace elements and the soil’s toxic elements were well within DEFRA guidelines. My allotment soil has now built up to a depth of 15 to 20 inches and is teeming with life as the micro-organisms bring the essential trace elements to the roots of my fruit and vegetables. Isn’t Nature wonderful!

Happy gardening,

MIKE MASON