Environmental Geotechnics might, at first sight, seem to be a tautology in that soils and rocks are inherent parts of the natural environment. However, this evolving discipline within the umbrella of civil engineering has grown out of the realisation that the principles of geotechnical engineering can be applied very effectively in the solution of many environmental problems that have become increasingly acute with the burgeoning density of human habitation. The focus of Environmental Geotechnics, initially, as reflected in an ASCE Conference of 2000 (Zimmie, 2000), was on various forms of waste and how they behave geotechnically. What are the criteria for the structural stability of landfilled municipal solid waste, for example, especially when the material is undergoing chemical and biological degradation over many years? Sewage sludges, industrially contaminated soils and stabilised waste all have their own geotechnical characteristics when considering disposal and management (Bareither et al., 2012; O’Kelly, 2004). Clearly, where the natural environment is concerned, hydrology is frequently the driver of contaminant movement as well as structural instability problems. Hence, there is a strong overlap with hydrological considerations, particularly with respect to unsaturated conditions in both natural and manufactured materials (Kelln et al., 2007), but the geotechnical approach to analysis has much to offer in such assessments. The interaction between hydrological and geotechnical analyses has been a growing part of environmental geotechnics.

More recently, the breadth of hydro-environmental problems amenable to geotechnical analysis has widened, for example, in the field of wetland conservation (McNerney et al., 2006) — what mitigation measures can be applied to the margins of peatlands in order to prevent dessication and promote the growth of species contributing to biodiversity? The improvement, reinforcement and stabilisation of soils are related areas undergoing rapid development in techniques and methods (Phear and Harris, 2008). Some work by the authors include, for instance, investigation of geogrid reinforcement incorporating in-plane drainage capability that can facilitate the use of marginal fill in the construction of reinforced-earth structures (O’Kelly and Naughton, 2008), improvement of the geomechanical properties of sand using biopolymers (Khatami and O’Kelly, 2013) and stimulated decomposition in peat for engineering applications (Pichan and O’Kelly, 2013). The discipline of environmental geotechnics has made significant contributions to technical and design skills in the field of soil and groundwater remediation (Bhandari et al., 2007), installation and performance of containment systems for control of contaminant migration (Rowe, 2014) and geothermal science (Banks, 2012). The influence of climate change on many of these environmental issues presents significant challenges to both hydrological and geotechnical analyses to which Environmental Geotechnics as a discipline has much to contribute.

It could be argued that many of these areas are not exclusive enough to define a new discipline of environmental geotechnics, distinct from traditional geotechnical engineering. Indeed, in the early years of geotechnical engineering, the problems were considered in terms of classical soil mechanics and soil science. Typically, the work concentrated on hydro-mechanical interactions, such as consolidation and chemical–mechanical interactions involving clay mineralogy and pore fluid geochemistry (Soga and Jefferis, 2008). Many of these treatments could be considered steady state or aimed at determining long-term equilibrium conditions. The detail of the time dependency of the chemical, biological or biogeochemical processes was considered too complex to analyse, or they were simply treated as ‘lumped’ processes. As geotechnical engineering has begun to tackle more environmentally related problems, and, indeed, to use biological or chemical processes in the engineering of soil properties (Mitchell and Santamaria, 2005; O’Kelly and Pichan, 2014; Tastan et al., 2011), much deeper consideration has been given to the nature of the processes involved and their time dependency. Other examples are to be found in understanding the nature of biological clogging (McIsaac and Rowe, 2007; Nikolova-Kuscu et al., 2013) or the bio-chemical improvement and (or) stabilisation of soils and the optimisation of such processes. Descriptions of the potential of soil improvement by biocalcification, for instance, are provided by De Jong et al. (2013) and Martinez et al. (2013). While geotechnical engineering by its nature has crossed a number of disciplines, the greater involvement of broader environmental aspects has increased the multi-disciplinary nature of the subject to the extent that Environmental Geotechnics is considered a distinctive subject area.
Another dimension to engineering research in recent years, perhaps in the face of climate change and increasing economic pressures, is the need to define ‘sustainability’ in any design (Griffin and O’Kelly, 2014; Holt et al., 2010). Given its interdisciplinary character, the concept of sustainability is no less a fundamental part of the growth in environmental geotechnics, for example, including areas of material reuse, recycling and reengineering, foundation rehabilitation and reuse (Butcher et al., 2006). Conventionally, sustainability incorporates the three pillars of economics, sociology and environment/technology, and already papers are emerging specific to geotechnical engineering. For example, Jefferson et al. (2007) have suggested 107 environmental geotechnical indicators to be used to define sustainability for geotechnical projects. Clearly, the concept of sustainability is embracing much broader issues than involved in previous approaches of determining ‘design life’ for a project. The interdisciplinary nature of sustainability, as now widely recognised, means that the concept is very much the remit of environmental geotechnics. Although geotechnical design has always been understood to incorporate the need for a ‘balance with nature’, just what this means in terms of current definitions of ‘sustainability’ will require much more thought and research.

Thus, the process-dependent nature of interaction with ‘the environment’ is fertile ground for the growing research in environmental geotechnics, which is already resulting in a better understanding of soil biogeochemistry and its management (Manassero et al., 2013). The inherent interdisciplinary aspects of environmental issues have given rise to evolving ideas as to the meaning of sustainability in geotechnical engineering. The Proceedings of the ICE, Environmental Geotechnics is a welcome and much needed focus and forum for the publication and discussion of the growing research in these areas.

REFERENCES


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