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EDITORIAL

The eighteenth Mallet-Milne lecture

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The Mallet-Milne lecture is a biennial event organised by the Society for Earthquake and Civil Engineering Dynamics (SECED). The lecture is named after two nineteenth century pioneers in the field of seismology: Robert Mallet (1810–1881) and John Milne (1850–1913). The intention of the Mallet–Milne lecture is to capture a lifetime of experience from eminent professionals who have spent their careers working in the field of seismology or earthquake engineering. This objective has certainly been met over the years with a series of eminent speakers presenting a wide variety of earthquake-related topics.

The first Mallet-Milne lecture was delivered by Nicholas Ambraseys in 1987. Since then, another sixteen lectures have taken place with unswerving regularity. Only the seventeenth lecture was delayed by a few years due to unexpected circumstances. Keen observers of the chronological sequence will notice that a lecturer from the British Isles is invariably followed by a lecturer from abroad (again with one or two exceptions). This pattern is also intentional; heeding the example set by Robert Mallet and John Milne, who travelled abroad and bolstered their understanding of seismology and earthquakes through field studies, the Mallet-Milne lecture is decidedly international in outlook and ambition.

Excellent summaries of the first seventeen lectures have already been written – see for example Rossetto (2018) and Kontoe (2022). The full list of past Mallet–Milne lectures is also available through the SECED website along with recordings of the most recent lectures. The eighteenth lecture, which is entitled "Interrelationships between practice, standardisation and innovation in geotechnical earthquake engineering", will be delivered by Prof Alain Pecker in May 2023 at the Institution of Civil Engineers in Westminster, London. The following paper is Prof Pecker's manuscript for the lecture.

Prof Pecker has enjoyed a long and distinguished career. He graduated from *Ecole Nationale des Ponts et Chaussées* in 1972 and obtained a Master of Science degree from the University of California, Berkeley, in 1973. Until 2015 he was Chairman and Managing Director of *Géodynamique et Structure*, a French engineering consulting firm he founded 42 years ago. He subsequently became an independent consultant. He has contributed to sev-

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eral large infrastructure projects in seismic areas, including the impressive Rion-Antirion Bridge (now officially known as the Charilaos Trikoupis Bridge) which crosses the Gulf of Corinth near Patras, Greece. He is Past President of the French Society of Soil Mechanics and Geotechnical Engineering, Honorary President of the French Association for Earthquake Engineering and member of the executive committee of the European Association for Earthquake Engineering. He was elected to the French National Academy of Technologies in 2000. He is a member of the drafting panel for Eurocode 8 and President of the French Committee for seismic codes. He is a Professor at *Ecole des Ponts ParisTech* (formerly *Ecole Nationale des Ponts et Chaussées*) and at the European School for Advanced Studies in Reduction of Seismic Risk (IUSS of Pavia, Italy). He has authored or co-authored eight books and more than 150 technical papers, been invited as keynote speaker in conferences and received several awards for his work, most notably the Adrien Constantin de Magny and the Aymé Poirson awards from the French National Academy of Sciences, and the Albert Caquot award from the French Association of Civil Engineers. His work on the Rion-Antirion Bridge has been recognised through the Outstanding Structure Award from IABSE, the Outstanding Concrete Structures Award from *fib* and the Outstanding Project Award from the Deep Foundations Institute.

In his manuscript, Prof Pecker addresses a problem faced by many practising civil and structural engineers – namely that large, exceptional civil engineering projects such as bridges, dams and power stations are unique prototypes. Each project is shaped by a unique set of environmental and societal conditions, which require different and sometimes unproven design solutions. Full-scale testing is not available to the engineer; scaled model testing is, but this is often expensive and, in any case, associated with limitations. Codes and standards may be consulted for guidance, but code clauses are frequently limited to ordinary structures and circumscribed by the empirical basis upon which they rest. The problem is more pronounced in seismically active areas because few similar structures, if any, have been subjected to seismic excitation of design basis intensity. Faced with this difficulty, Prof Pecker makes a strong case for greater reliance on *first principles* – that is, analysis based on rigorous application of mechanics and other laws of physics. To equip engineers with the required ability, education founded in the scientific method is indispensable. That is not to say that experience, judgement and empiricism has no role to play; on the contrary, as Prof Pecker points out, the successes and failures of past projects, from ancient works to modern infrastructure, should always be a source of inspiration.

Prof Pecker then examines the concept of innovation, which is one of the central themes of his manuscript. Innovation, according to Prof Pecker, is different from research because the two activities occur on different time scales, have different funding requirements, and are carried out by different groups. Research is typically the preserve of academics, whereas innovation is mainly the preserve of practitioners. The two activities are complementary: innovation can be guided by the products of research, and research can be inspired by an innovation. The key role of innovation, however, is to push the boundaries of feasible projects; and for innovation to be successful, it must be based on strong understanding of first principles.

In the remainder of the manuscript, Prof Pecker illustrates these salient points by means of several examples. In the first example Prof Pecker offers a condensed summary of the key challenges faced in the design of the Rion-Antirion Bridge. The high seismicity of the region and the unfavourable geotechnical conditions proved particularly challenging. It is

fascinating to read Prof Pecker's account of the project, and it is deeply impressive that the bridge was realised at all – a feat which owes much to the ingenuity of Prof Pecker and his colleagues.

The second example offered by Prof Pecker concerns the Atlantic Bridge in Colón, Panama, which spans the Atlantic entrance to the Panama Canal. This project was also characterised by relatively high seismic hazard and challenging ground conditions. Prof Pecker notes that the solution for the bridge foundations was inspired by the success of the foundations of the Rion-Antirion Bridge and is based on a relatively novel design concept, which relies on non-linear foundation behaviour to limit the seismic load effects transmitted into the superstructure.

In his third and final example, Prof Pecker shows how the justification of an existing solution that has proved its efficiency in resisting earthquakes can be bolstered through research. The example considers the foundations for the new prefecture building in Fort-de-France, Martinique. The soft soil deposits below the proposed site were prone to liquefaction with concomitant lateral spreading. To prevent liquefaction, the ground was improved using a deep soil mixing technique. Evidence from Japan indicated that this technique would be effective. Further research was then carried out to develop practical design guidelines. The example illustrates how an actual project may be a source of motivation and inspiration for design-oriented research that can then be turned into design guidelines for future projects. Thus, innovation fosters research and vice versa.

Prof Pecker ends his manuscript with an exhortation to increase collaboration between scientists and engineers. This requires an effort on both fronts: scientists must put themselves within the reach of engineers, and engineers must not forget to cultivate their scientific roots.

I am pleased that the editors of the Bulletin of Earthquake Engineering have once again agreed to publish the manuscript for the Mallet–Milne lecture in a special issue, available to download from the Springer website, and as a hard copy (albeit in limited print). I am confident that the manuscript will be a valuable resource and an inspiration for academics and practitioners alike for years to come.

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