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Editorial

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It is a considerable honour to provide the first editorial for the Institution of Civil Engineers' new journal *Engineering and Computational Mechanics*. As we know, mechanics has a very long history, and is fundamentally important to most branches of engineering. 'Mechanics' is defined by the Oxford English Dictionary as 'That body of theoretical and practical knowledge which is concerned with the invention and construction of machines, the explanation of their operation, and the calculation of their efficiency' and 'That department of applied mathematics which treats of motion and tendencies to motion: comprising *kinematics*, the science of abstract motion, and *dynamics* (including *statics* and *kinetics*), the science of the action of forces in producing motion or equilibrium'. In essence, mechanics is concerned with the forces acting on and the response of bodies, and the resultant interaction with the environment.

The origins of mechanics can be traced back to the ancient civilisations of Greece, China and India. For example, the school of Aristotle (~ 280 BC) discussed the principles of the lever and pulley and introduced the idea of a force parallelogram. Aristotle also introduced the concept of continuity and observed that the atmosphere could heat up due to moving objects, and noted in *Meteorologica* that a body 'will either necessarily stay at rest or, if in motion, will move indefinitely unless some obstacle comes in collision with it' – a partial statement of what later became Newton's law of inertia. Archimedes (287–212 BC) pioneered many major developments in geometry, mechanics and hydrostatics. By presuming that fluids are continuous, Archimedes showed that any applied pressure is transmitted throughout a fluid, and that pressure thrusts drive fluid flows. Hero (or Heron) of Alexandria (~ 10–70 AD) invented the first steam-powered machine, the *aeolipile*; a machine designed for lifting heavy weights using cog-wheels, a vending machine, and a wind wheel for powering an organ. Hero also wrote *The Mechanics*, three books explaining the theory and application of the windlass, the lever, the pulley, the wedge, and the screw. The ancient Greeks developed early concepts of pressure, force, and moment, notably Archimedes with his analysis of buoyancy upthrust. It is therefore quite appropriate that the word *mechanics* derives from the Greek for machine, μηχανική.

Classical mechanics evolved in the 17th century, with the fundamental laws stated by Galileo Galilei (1564–1642) and

Isaac Newton (1643–1727), supplemented by the invention of calculus by Isaac Newton and Gottfried Leibniz (1646–1716). Analytical mechanics then developed rapidly due to contributions from Leonhard Euler (1707–83), Joseph Louis de Lagrange (1736–1813) and William Rowan Hamilton (1805–65). Although Newtonian classical mechanics has remained applicable to a huge range of engineering problems, it is nowadays replaced by quantum mechanics at the atomic scale and relativity in cases where velocities are of the same order as the speed of light.

In the 21st century, the subject of mechanics remains pivotal to engineering. Great advances are taking place, ranging from nanotechnology to civil engineering mega-structures. The computer has made it possible to solve accurately equations derived up to two centuries ago, whose solution could only have been dreamt of by their originator. For example, the equations of elastic-solid bodies propounded by Claude-Louis-Marie-Henri Navier (1785–1836) in the *Mémoire* he read to the Académie Royale des Sciences in 1821, could not be solved for arbitrary geometries until the advent of finite-element computations almost 150 years later. Modern developments in numerical modelling techniques mean that it is now standard practice for engineers to use finite-element packages, computational fluid dynamics software, and so on, in routine analysis and design. *Engineering and Computational Mechanics* is therefore timely and highly relevant to practising engineers and researchers.

This first issue commences with a briefing that comprises a series of short articles reviewing potential developments in the areas of environmental fluid mechanics, computational solid mechanics, civil engineering applications, water resources, sub-sea engineering and computational modelling of multi-fracturing structures and elements. The remaining four papers provide insight into hydraulics, multi-phase flow, concrete mechanics and structural dynamics. More specifically, they deal with unsteady turbulent and aerated free surface flows in channels, the use of computational fluid dynamics to predict the flow of slurry in a pipe bend, finite-element modelling of crack growth in concrete and the dynamic behaviour of an anchorage. The final briefing concerns light gauge steel. The spread of papers across such a wide range of engineering disciplines indicates that classical mechanics is thriving as an applied science.