Cleveland Institution
of Engineers

FOUNDERS' LECTURE

5.30pm ~ 12th May 2009

'RAILWAYS AND MATERIALS: SYNERGETIC PROGRESS'

by

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CENTURIA BUILDING TEESSIDE UNIVERSITY

Summary

Railways are uniquely identified with the material of their initial construction. The “Iron Horse” or “Chemin de fer” created a world-wide-web of iron which revolutionised as many aspects of life and communications as its modern counterpart. The identifying characteristic
of railways is now the contact of “steel wheel on steel rail”.

Over 160 years ago failures of iron railway axles led to research into what we now know as metal fatigue. Accidents throughout the ages have acted as catalysts for research and improvements: this lecture will identify some key incidents. The change from iron to steel following Bessemer’s discovery of a method of bulk production resulted in fewer materials failures and enabled greater loads to be carried at greater speeds. But the change was not easily accepted by the conservative railway industry.

Today’s railways rely on a wide variety of materials from all the major classes of metals, ceramics, polymers and composites, examples of which will be discussed. The requirements of cost, weight, reliability, crashworthiness, maintainability and inspection are often in conflict as the service loadings imposed by the modern railway on materials have become more severe. It is not therefore surprising that despite our advances in knowledge and capabilities, costly failures still occasionally occur. Nevertheless, railways have benefited from, and contributed to, advances in material engineering way beyond the initial emphasis on iron.

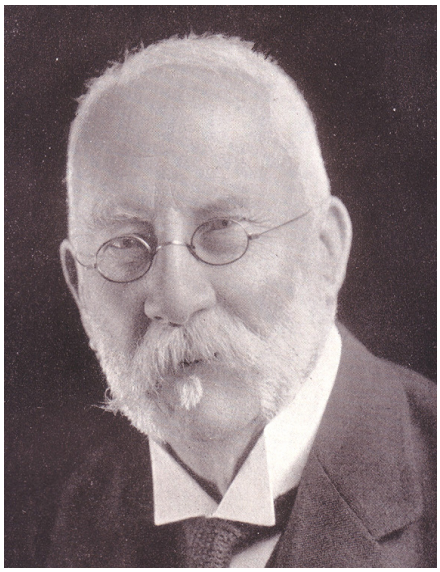
Professor Roderick A Smith has recently completed five years as Head of Mechanical Engineering at Imperial College London. He previously held appointments at the Universities of Cambridge and Sheffield, where he was Head of the Department of Mechanical & Process Engineering from 1992 to 1995. He is currently the Royal Academy of Engineering Research Professor in Advanced Railway Engineering at Imperial College.

The author of many papers on fatigue and fracture mechanics and, latterly, on railway engineering, also involving fatigue failures of critical components, he is a Fellow of the Royal Academy of Engineering and an elected member of the Council of the Institution of Mechanical Engineers. He has been called to give expert evidence in many cases involving failures of mechanical components.

He has many contacts in Japan, particularly in the railway industry and he initiated the gift of a Japanese Bullet train to the National Railway Museum in York.

Founders of the CIE

Jeremiah Head



Sir Thomas Wrightson

Thomas Whitwell

Formation of The Cleveland Institution of Engineers

In the last half of the nineteenth century, industry in Cleveland developed at a rate never again repeated. In 1830 the Stockton-Darlington railway had been extended to Middlesbrough and the port established to ship coal. During the 1850s there grew an iron industry based on the easily accessible deposits of phosphoric ironstone in the Cleveland hills, and a fledgling engineering industry stimulated by the demands of the burgeoning railway network and the ironworks themselves. The Durham coalfield was a source of excellent coking coals and the railway provided affordable bulk transport; there was easy access to the sea for export of products and the port was developed; construction of the South Gare began in 1863. Large scale production of steel from local ironstone via the Bessemer converter was made possible by development of the Thomas-Gilchrist process at Bolckow and Vaughan's works in Middlesbrough and Eston in 1878-79; and sufficient capital to finance developments was in the hands of a few men who were related by blood, marriage or religion. Conditions were thus ideal for the rapid growth of a thriving engineering industry supported by relatively cheap, locally produced iron and steel. Labour was attracted from all parts of the country and Middlesbrough grew rapidly, becoming a municipal borough in 1853, a parliamentary borough in 1867 and in 1888 a county borough.

Continued overleaf

Portrait of Thomas Whitwell courtesy of Darlington Public Libraries.
Other portraits courtesy of Teesside Archives

It was in this period of rapid industrial development and municipal growth that the Cleveland Institution of Engineers was formed, on 15th September 1864, at a meeting of seven local industrialists at Thomas Whitwell's residence in Church Row, Stockton-on-Tees. The chief promoters of the Institution were Jeremiah Head, originally articled to Robert Stephenson in Newcastle; Thomas Wrightson who initially worked in W G Armstrong's works at Elswick; and Thomas Whitwell, who was first an apprentice in Alfred Kitching's Darlington locomotive works and then in Robert Stephenson's works in Newcastle. They are the founders we honour in our Founders' Lecture. '*They had studied together and when they later found themselves working in the Cleveland district, they were anxious to draw to themselves kindred spirits to discuss engineering problems as they presented themselves for solution.'* Thus began The Cleveland Institution of Engineers which since that time has been an important forum on Teesside for the presentation and discussion of industrial problems and developments.

The three chief promoters at the formation of the Institution each served as Secretary and Vice President in its early years and each one subsequently became President: Jeremiah Head from 1871 to 1874; Thomas Wrightson from 1874 to 1876; and Thomas Whitwell from 1876 to 1878. In August 1878 in the second year of his presidency Thomas Whitwell was accidently killed by scalding steam at W Whitwell and Company's Thornaby Ironworks and a brilliant career was extinguished. Thomas Wrightson served as President for a second time in the 1914 session, the fiftieth anniversary of the Institution's founding.

Throughout most of the twentieth century the name 'Head Wrightson' signified a major engineering manufacturer and contractor trading internationally and based on Teesside. Although, unlike his brothers Arthur and Howard, Jeremiah Head was not a direct partner in the Head Wrightson organisation he had married Rebecca Ingram Wrightson, Thomas Wrightson's sister. By 1868 the principal partners in the enterprise were Arthur Head and Thomas Wrightson and Arthur Head was appointed chairman when the business became a limited liability company in 1888. On Arthur Head's retirement in 1909 Thomas Wrightson, then Sir Thomas, (in 1900 he had been created a baronet for his political services) became chairman and retained the position until his death in 1921. Some 50 years later Head Wrightson merged with the Davy Corporation which itself subsequently became part of Voest Alpine Industries, present today on Teesside as Siemens VAI.

This note has been prepared using 'Cleveland Iron and Steel: Background and Nineteenth Century History' by J K Almond, B J D Harrison, J K Harrison and J S Owen, editor C A Hempstead, published by British Steel Corporation, 1979; and other sources.