



In the Beginning - BB (Boring)

History of Control Engineering 1800-1930 and 1930-1955 by Stuart Bennett

Reviewed by Nick Sands

Stuart Bennett points out that a discipline reaches maturity only when it becomes aware of its own history. And surely the whole control discipline owes a great debt to Bennett for writing that history in the two part History of Control Engineering. The first book covers the period 1800 to 1930, published in 1979, and the second from 1930 to 1955, published in 1993. Bennett is an honorary research fellow and professor emeritus at the University of Sheffield in the UK, and a member of the IEEE Control Systems Society History committee. He clearly understands the technology, the math, and the impact of the developments on history.

The early history focuses on the development of mechanical governors, starting with grinding control for windmills, position control mechanisms for telescopes, and speed control for steam engines. Some famous names were involved with governors from the late 1700s; James Watt, Charles Porter, Werner and William Siemens. There were some advances in theory by, James Clerk Maxwell, Edward Routh, Adolf Hurwitz, Oliver Heaviside and Nichols Minorsky. This early work was around stability with little understanding of the terms (P,I, or D) of the controller. Steering control and stability control for ships required the development of servomechanisms, which dominate most of the rest of this history. Innovations included torpedo guidance control, airplane stability control and other applications of the gyroscope. Elmer and Lawrence Sperry, the Siemens, and others were involved in this work, Late in the first history, electrical controls are introduced along with the problem of generator control, and finally radio frequency control. Some other highlights are time response trends by Wilson Hartnell in 1882, x-y plots of servo inputs and outputs by Hele-Shaw and Martineau in 1911, and the invention of the repeater amplifier by Harold Black in 1925.

The second book starts with the early 1900s as background for the progress of the 1930s. Control equipment for the process industries was manufactured by companies like Bailey, Bristol, Foxboro, Leeds & Northrup, Neilan, Tagliabue, and Taylor. And in those early days, the companies were led by the men who founded them. Leeds & Northrup and Taylor introduced recorders in 1911. Foxboro introduced a flapper amplifier controller in 1915, and the Stabilog pneumatic controller with negative feedback in 1931. But after one chapter on process control the history turns to other areas that really drove the development of technology and theory.

Bell Labs played a critical part in the development of both technology and theory, such as the negative feedback amplifier invented by Harold Black, to improve telephone carrier capabilities. Harry Nyquist, also of Bell Labs, and Hendrik Bode, building on Black's work, developed frequency domain techniques. Harold Hazen and Vannevar Bush, both from MIT, built network analyzers, circuits for solving equations like the Product Integrator, the Differential Analyzer, and

the Cinema Integraph. These tools were applied during the war years when much work was done to build fire control systems for anti-aircraft guns. Much of this history covers the developments of those years. Although in 1942 and 1943, John Ziegler and Nathaniel Nichols published their two famous papers on tuning method for controllers. The post war years saw industrial applications of the many wartime developments. Books were published, professional societies formed committees, and the Instrument Society of America was founded in 1945. This was the time of classical control theory. In the early 1950s, modern control theory with state variables began to immerge.

Bennett has done a tremendous job researching these books, with over 1000 combined references and notes. There will always be a limited audience for these books, and despite the interesting facts, they can be slow reads. For this reason, and not because of the quality of the books or my own interest in the subject, it is honest to rate them a little boring (BB). If you want to buy these books, HCE 1930-1955 is available for about \$60 from IEE. Since HCE 1800-1930 is out of print, you may be able to get it through Amazon for about \$50.