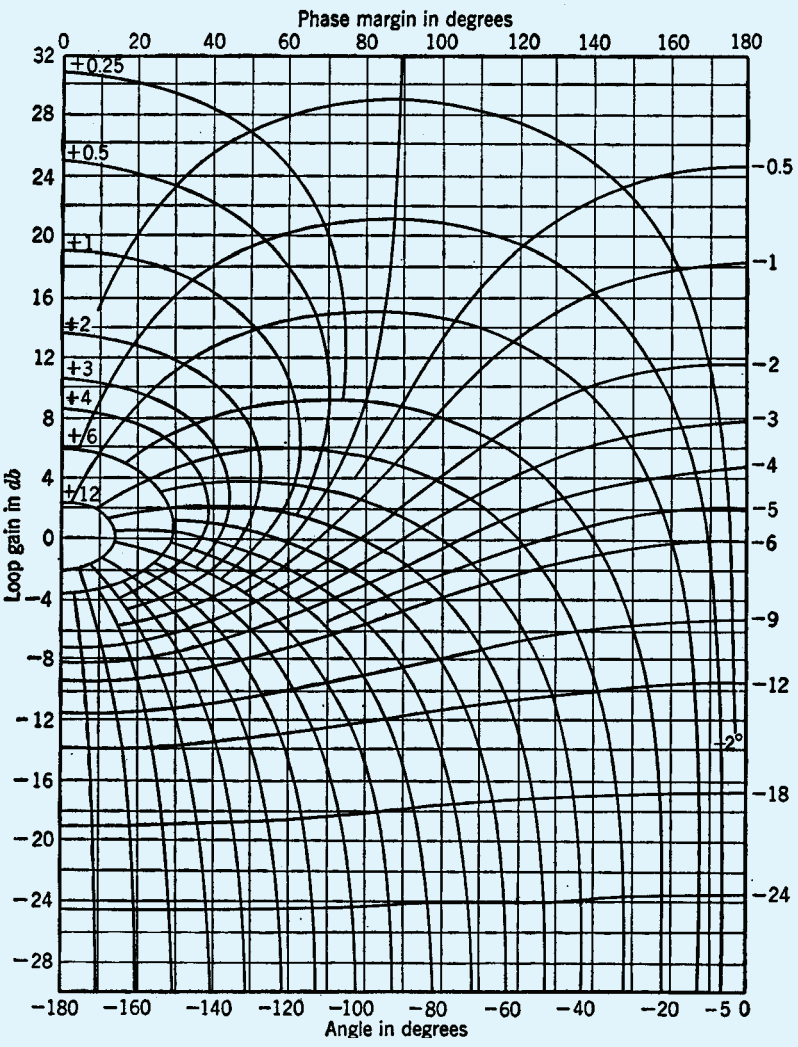
Nathaniel B. Nichols

No special issue on process control would be complete without mentioning Ziegler-Nichols tuning rules, and no series of "25 Years Ago" columns in *IEEE Control Systems Magazine* (*CSM*) would be complete without recognizing Nathaniel B. Nichols, *CSM*'s first associate editor for control systems history. Nichols is coinventor of the Ziegler-Nichols tuning rules for PID controllers, father of the Nichols chart, and coauthor with Hubert James and Ralph Phillips of volume 25 of the MIT Radiation Laboratory Series volume *Theory of Servomechanisms* [1].

In 1980, Nichols was awarded the second AACC Control Heritage Award, now known as the Richard E. Bellman Control Heritage Award, "for distinguished lifetime career contributions to the technology or application of automatic control." (Hendrik Bode was the first recipient in 1979.) In recognition of his award, the June 1981 issue of *IEEE CSM* contained the following short biography:

> Nathaniel B. Nichols received his B.S. degree from Central Michigan University in 1936, his M.S. degree from the University of Michigan in 1937, an Honorary Doctor of Science degree from Central Michigan University in 1964 and an Honorary Doctor of Science degree from Case Western Reserve University in 1968. He has worked with The Aerospace Corporation, Dow Chemical Company, MIT, Taylor Instrument Companies, University of Minnesota, and Raytheon Manufacturing Company. His professional experience includes automatic control, automatic radar tracking and fire control computers, power driven servomechanisms, industrial process controllers, recording and controlling instruments, spacecraft attitude controls, space experiment controls and instruments.

This short biography is understated to the extreme. Nichols was a giant in the field of control. The Nichols chart is arguably the most useful closed-loop system design tool in the history of control, and *Theory of Servomechanisms* is probably the most widely read control-systems design document ever written [2].



The original Nichols chart, reprinted from the 1947 textbook by James, Nichols, and Phillips [1]. The curves show contours of constant closed-loop magnitude and constant closed-loop phase. To use the chart, the open-loop frequency response is plotted on the rectilinear gain and phase coordinates, while the closed-loop frequency response is read from the contours of closed-loop magnitude and phase.

Nathaniel Nichols's career was far more groundbreaking than the above list suggests. In the late 1930s, he worked at Taylor Instruments Company in Rochester as a process control engineer. There he met chemical engineer John Ziegler, and together they developed and published simple techniques for adjusting automatic controllers for process control systems, which became known as the Ziegler-Nichols tuning rules.

In the early 1940s, the company sent Nichols to use the MIT differential analyzer, where he met Charles Stark Draper and Gordon Brown. Draper and Brown were so impressed with Nichols that they insisted he remain at MIT to work at the Radiation Laboratory during World War II. Nichols subsequently worked on two of the Rad Lab's tracking radars, specifically, the ground-based SCR-584 and the ship-based Mark-56.

After the war, Nichols returned to Taylor Instruments for four years and then held a short-lived faculty position at the University of Minnesota. Ivan Getting, with whom he had worked at the Radiation Laboratory, convinced him to leave Minnesota to become manager of research at Raytheon Manufacturing. Nichols returned to Taylor Instruments in 1957 as chief engineer. In 1963, he left Taylor to once again join Getting, who was now at the Aerospace Corporation, where Nichols stayed with the Control Systems Division until his retirement. He was associate editor for control systems history of *CSM* from 1981 to 1986. Since 1996, IFAC has awarded the Nathaniel Nichols Medal in recognition of outstanding contributions to design methods, software tools and instrumentation, or to significant projects resulting in major applications and the advancement of control education. Nichols died on 17 April 1997 after a prolonged illness.

REFERENCES

[1] H.M. James, N.B. Nichols, and R.S. Phillips. *Theory of Servomechanisms*. New York: McGraw-Hill, 1947.

[2] S. Kahne, "Remembering Nathaniel B. Nichols 1914–1997," *IEEE Control Syst. Mag.*, vol. 18, no. 3, pp. 74–75, June 1998.

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