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Obituary

Nathaniel B. Nichols 1914-1997

It was the red suspenders which first caught your eye across the lobby of the conference hotel. Nick always wore those suspenders. As you got closer you noticed the engineers plastic pocket protector, the pipe (often unlit), on special occasions his train engineer's peaked cap, and the rugged features of this giant of our field. On 17 April 1997 Nick died after a prolonged illness. The last time most of us saw him was at the IFAC Congress in San Francisco. He and his family attended the opening ceremony where the first IFAC Nichols Medal was awarded to Dr. Juergen Ackermann for contributions to the field of automotive control. Nick was not in good health but I think he certainly was aware of how his community was honoring him by creating this award.

To mark his passing, we have used recollections from some of his closest colleagues and have tried to highlight the lifetime contributions of Dr. Nichols. He would have shuddered at being called Doctor but his two honorary degrees - from Case Western Reserve University and from Central Michigan University - entitled him to such recognition.

Nick was born in Michigan in 1914 and earned a BS degree from Central Michigan University in 1936. He went from there to the University of Michigan, earning a MS degree in physics in 1937.

John Ziegler (a University of Washington chemical engineering graduate and presently living in Scottsdale, Arizona) had gone to Taylor Instruments in Rochester in 1937 as a process control engineer. The job included determining means for tuning PID controllers using graphical procedures but he needed analytical help to avoid the traditional cut-and-try approaches which were used up to that time. Nick Nichols' arrival at Taylor resulted in a productive professional relationship between these men. Their goal was to determine practical means for adjusting control parameters to assure system stability and to optimize system performance. In 1942 Ziegler and Nichols published a paper in the ASME Transactions (Vol. 64, Pg. 759) describing a set of parameters (later known as the Ziegler-Nichols tuning parameters) which were rough approximations to optimal settings for open loop transfer functions to ensure prescribed behavior in closed loop PID realizations. The procedure used an ad hoc and often not very satisfactory definition of optimal closed loop behavior, but it did encourage a standard approach to feedback system design which was useful for a long period of time after the war. Present day readers must remember that there was no computer aided control system design in those days so a table lookup method which worked reasonably well in numerous practical cases was a real contribution to the field in the 1940s.

After several productive years at Taylor, near the beginning of World War II, the company sent Nichols to MIT to use Vannever Bush's differential analyzer to run some solutions to the process control problems. While there he got to know Charles Stark Draper and Gordon Brown. They were part of a group working on hydraulic servomechanisms for anti-aircraft fire control, and were having trouble matching system performance with the calculated performance. Nick suggested that the trouble might be in unmodeled compressibility of oil used in the power drives. It turned out that Nick's contributions to the solution of this stability problem so impressed the MIT team that Draper and Brown insisted that Nick remain at MIT to help with the war effort. These were the days when many technically educated people were being taken from the civilian sector into defense related work. Thus Nick turned his attention to technical innovations important for various weapon systems including the emerging field of radar. This was an international cooperation with scientists and engineers most of whom were in the United States and England and many of whom later were involved in the creation of IFAC. Immigrants from various European countries ended up at one of these centers working on exciting technical projects. Many of them were responsible for important technical breakthroughs which led to a shorter and less deadly war. This work was particularly important to a servo control group at the Radiation Laboratory.

Ivan Getting was a senior manager there and later went on to several major leadership positions including President of the Aerospace Corporation and of the IEEE. Nichols was part of group under the overall leadership of Getting which was developing the SCR-584 ground anti-aircraft automatic angle tracking system. This technology plus the proximity fuse were key parts of a very effective weapon system used in the war zones. Even today, one can find ancestors of this technology in use in military systems. Near the end of the war the team created the MK-56 naval angle tracking antenna which required rather sophisticated control technology to ensure that suitable angle tracking rates could be maintained in a shipborne environment.

closed loop system gain and frequency at which that gain occurred was somewhat tedious, even for the linear system models which were used. It was from this need that the graphical design aid was created which we now call the Nichols Chart. The Nichols Chart is a tool for the designer to read off closed loop gain and phase directly from a plot of open loop logrithmic gain and phase, parametrized by frequency. It has proven to be arguably the most useful closed loop system design tool in the history of the control field. The chart was brought to the attention of the control engineering community primarily by its inclusion in one of a series of books to emerge from the MIT Rad Lab efforts after the war. Chapter 4 of the now famous Volume 25, "Theory of Servomechanisms" by James, Nichols and Phillips, published in 1947, is probably the most widely read control systems design document ever written. It is remarkable that this treatise, written in the late 1940's has retained such currency in our fast moving control field with its ever changing technology. The Nichols Chart is one contribution among several for which Nick Nichols was honored by the creation of the IFAC Nichols Medal.

As a 1945 student in GE's Advance Engineering Program, Bill Miller recalls studying Nick's MIT Rad Lab work on feedback control systems. Bill was impressed; so was his management. A GE systems design engineering project was set up to use the Nichols' concepts to redesign the more than twenty main drive systems, and more than one hundred auxiliary drive systems being provided to domestic steel companies on five tandem cold strip reduction mill drive systems. By June 1947 all mill feedback control systems had been redesigned, modified and were being installed, tuned and placed into production. As reported at the AIEE 1948 Winter General Meeting, these were the first successful production applications of feedback control in industry. Nick's technical contributions to the concepts, design, and performance of industrial electric drive systems caused world-wide change which are estimated to be several orders of magnitude greater than the introduction of Ward Leonard drives.

After the war and after the writing of the James, Nichols and Phillips book, Nick returned to Taylor from 1946 to 1950 and then on to a faculty position at the University of Minnesota for a year. From there his friend and Rad Lab boss Ivan Getting invited him to accept a position as Manager of Research for Raytheon Manufacturing Company where Getting went after the war. Nick remained at Raytheon from 1951 to 1955. He moved back to Taylor for a third time, this time from 1957 to 1963 as Chief Engineer. In the meantime Getting had gone to the Aerospace Corporation in El Segundo, California and, in 1963 once again called on his friend and colleague, Nick Nichols to join him, this time at Aerospace. Getting recently stated that Nichols was in part responsible for Getting's own success as a corporation executive. This productive association lasted until 1987 when Nick retired from the Control Analysis Department of Aerospace's Control Systems Division.

Miller recalls Nick's participation in a 1987 AACC/People to People International Mission to China on Automatic Control Technology. It appeared that every control engineer in China wanted to meet Dr. Nichols, talk with him, and sit next to him for breakfast, lunch, and dinner. Everyone wanted to have a personal conversation with this great engineer who had made feedback control understandable and subject to analysis.

The host, Science and Technology Minister, Professor Song Jian (himself a control engineer) in his Banquet address thanked People to People International, the AACC and all participants. Prof. Song singled out Dr. Nichols to compliment him "for his outstanding contributions to automatic control technology," and to thank him "for honoring Chinese control engineers by coming to China to meet and talk with them on a one to one basis," which Nick did so elegantly.

Denny Pidhayny, a young control engineer at that time, recalls his first meeting with Nick at the time of the first IFAC Executive Council meeting which was held in Chicago in 1959. An after hours informal discussion took place which included himself, Nick, Professor Alexis G. Ivakhenko from the Institute for Cybernetics in Kiev, and several others. An exciting discussion ensued about the practical aspects of feedforward control and continued into the night. Before it was over Ivakhnenko produced and shared a bottle of mint-flavored vodka which he had brought with him from the Soviet Union. Nick was the sort of man who enjoyed such informal technical discussions. Younger engineers seemed particularly attracted to the very approachable design engineer who always had time to explain some esoteric aspect of a control systems problem.

Nick, in his red suspenders, occasionally wearing his train engineer's hat, and the pipe and pocket protector, was a regular attendee at the JACC (later ACC) and often at the CDC as well. He was President of the IEEE Control Systems Society in 1968 and the American Automatic Control Council in 1974 and in 1975 when the IFAC Congress was first held in the US. His influence on the control field has been continuous since 1942 with that ASME paper - and there is no end in sight. We will miss his person and will continue to benefit from his technical contributions.