

## Math in Prussia: education before the 'paradigm shift'

*Nineteenth-century Prussia produced some of the leading mathematicians in world history. What sort of education did these people receive, and are there lessons to be learned by those seeking to improve American mathematics education? That question was addressed nearly 100 years ago by J.W.A. Young, assistant professor of the pedagogy of mathematics at the University of Chicago, in his book *The Teaching of Mathematics in the Higher Schools of Prussia* (New York: 1900). The following is a summary of some of Young's most interesting findings.*

Dr. Young visited several "higher schools" (*höhere Schulen*) in Prussia, sitting in on classrooms and speaking with educators. The schools took boys at the age of nine and had a curriculum covering nine years. They actually spent less time on mathematics than did American schoolchildren in those years: The Prussians gave about 1.2 of the 9 years in question to mathematics, accomplishing fully as much as the Americans, who gave 2.1 years to mathematics.

Young emphasizes that while his study may yield nothing which American educators can directly *adopt*, hints may yet be gleaned which Americans may *adapt* to their own circumstances. "Education is more a problem of humanity than of nationality, and while distinctively German methods might not prove strong elsewhere, those results which the Germans have attained as *men* and not as Germans must be of great significance the world over."

### The teacher teaches

The most prominent characteristic of the classroom, he writes, is that *the teacher teaches*. (He is not, as the modern gurus of outcome-based education would have it, a "facilitator" or a "mentor"! ) The teacher is, of course, extremely well qualified in his specialty—without this prerequisite, the entire system would not function. He does not "hear recitations"; he does not examine the pupils to see whether or not they have learned something from a book. He proceeds according to what Young calls "the Socratic method," the method of skillful questioning, of leading the class on to the desired goal by a series of carefully prepared questions, each usually fairly easy to answer in itself.

Homework and the study of books are very minor

features of the curriculum; by far the heaviest stress is laid on the class exercise, which is conducted by the class as a whole, with either the teacher or a student at the blackboard—a method known as "chalk and talk." Private work and the study of textbooks have simply the purpose of fixing in mind that which is supposed already to have been learned. Matter that has not been thoroughly explained in the class, so that the class as a whole understands it clearly, is never assigned to be studied privately by the unaided pupils. The quantity of homework is kept as small as possible—on the order of 2 hours per week in mathematics in the higher grades.

The teacher is the source of the pupil's knowledge, and Young reports that in all his visits he saw no books used in classes, except collections of exercises. A textbook is often adopted rather to comply formally with the state regulations than for the purpose of actually using the book. The teachers are unanimously agreed on one point: The study of any particular topic in the textbooks must *always* follow the development of that subject in the class.

Young writes that he was especially impressed with the custom of dividing the work into very simple steps, and repeating each new fact established over and over until it seemed that it must be imbedded in the mind of the slowest, before going on to the proof of the next problem. (This brings to mind U.S. author and publisher John Saxson's "incremental approach"—see accompanying article.) While it might seem that this procedure would hold back the brighter pupils, Young concludes that this is not necessarily so: "If, however, the galaxy of mathematicians who have sprung from the benches of the German gymnasias be taken into consideration, the question may well be raised whether or not the retardation of the gifted pupils is in fact to their detriment."

The answers to questions are always given by pupils in complete sentences, and clear and distinct enunciation is insisted upon. Every lesson in mathematics is thus a lesson in German as well.

Considerable stress is laid on the oral solution of exercises. Thus, boys about 13 years old proved the Pythagorean theorem with no figure whatever before their eyes. (Compare this to the insistence on "manipulatives" and "visuals" on the part of the National Council of Teachers of Mathematics today.) A teacher informed Young that the pupils could follow the proof on an imagined figure and that they enjoyed this kind of work, entering into it with "considerable zest."

Finally, Young reports that Prussian schools had required instruction in Christian religion. Jewish students were excused, provided they could show they were receiving equivalent instruction in Judaism.—*Susan Welsh*