

David V. Widder was a student of G. D. Birkhoff at Harvard University, receiving his Ph.D. in 1924. He returned to the Harvard faculty after six years at Bryn Mawr College. His publications include numerous research papers in analysis and two important monographs, The Laplace Transform and (jointly with I. I. Hirschman) The Convolution Transform. He is also the author of an influential textbook, Advanced Calculus.

Some Mathematical Reminiscences

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A Committee of the American Mathematical Society has asked me to record any memories I may have about the mathematics of the early twentieth century. This I now attempt, somewhat reluctantly since my fading nonagenarian memory is not easily jogged. It is true that I have had the good fortune to be taught by or to have had contacts with many of the mathematical giants of the era, and do remember them with admiration and affection. For example, a portrait of Maxime Bôcher hangs now above my desk.

At the risk of giving these reminiscences the appearance of a personal diary I must try to enliven my vision of the past by following some of my education step by step. Why did I choose Harvard? My father was a minister and former high school principal, and I think he would have liked to have me attend a religious college. As a student at Central High School of Harrisburg, Pennsylvania, I sat beside a man we called "Rusty." What college would he attend? Harvard. Why? Because "it is the best." Enough. I applied, took entrance exams, and was admitted; perhaps because I was valedictorian or perhaps because the entrance committee liked to keep a good geographical mix. (But Rusty went elsewhere.)

Accordingly, I arrived at the South Station, Boston, in late September, 1916, asked where Harvard was, took the subway to the last stop and found myself at Harvard Square. Disillusionment! College buildings were separated by two busy highways with stores and business buildings mixed in. True, some of the buildings and a campus, which I learned later to call "The Yard," were enclosed inside walls. But this did not fit my preconceived notions.

By mail I had been assigned living quarters in Standish Hall, a Freshman dormitory, now part of Winthrop House. I found my room on the top floor, where I had three room mates, each with a separate bedroom. The dining room was on the first floor. I do not remember the charge for board and room, but I think tuition was \$200. The food was sumptuous, elegantly served by waiters. These new dormitories on the Charles River were a project of President A. L. Lowell, who felt that students should be taught a proper life style. In any case I gained weight and almost lost my seat on a Standish crew, until I began reducing!

The two courses that I remember most clearly that year were Analytic Geometry under Bôcher and Inorganic Chemistry under E. P. Kohler. It was a novel experience and somewhat exciting to be using a text that the professor had written: Bôcher's *Analytic Geometry*. Perhaps I did not appreciate at the time that a world famous mathematician had condescended to take a Freshman class. But I came to admire him and to become enamored with the subject. Professor Kohler was also a master expositor who could make his subject live.

In my Sophomore year I was lucky again. I had Modern Geometry under Bôcher. In the first weeks he had us discovering properties of the ellipse from familiar ones for the circle by use of affine transformations. This was just a foretaste of the marvels to come. I think it was the influence of this course by this instructor that determined for me the choice of a career. In any case I determined to take any course Bôcher offered in later years. The same year I studied Calculus under another famous mathematician, teaching from his own text. Professor W. F. Osgood had a less inspiring style. I recall that he gave us good advice, ignored by most, on how to prepare a paper. You were to fold it down the middle, put a first draft on the right, corrections on the left. He used rubber finger caps to hold chalk. On the whole I would describe him as somewhat imperious.

Then came the war. I became a civilian computer in the range firing section at Aberdeen Proving Grounds. Oswald Veblen was in charge. I was bunked in barracks with Norbert Wiener and Philip Franklin. I learned a lot from these enthusiasts, but at times they inhibited sleep when they talked mathematics far into the night. On one occasion I hid the light bulb, hoping to induce earlier quiet. One of our jobs was to convert French range tables to American units, using hand operated calculators, which we called "crashers." Armistice enabled me to return to Harvard in the middle of a term. I recall that Wiener was distressed that he could not leave immediately. He was in uniform and subject to army regulations.

By taking extra work I was able to graduate with my class in 1920. But there were no more courses with Bôcher; he died in 1918. In Senior year I took Complex Variable, first term under W. C. Graustein, the second under E. B. Van Vleck, a visiting professor that term. Upon graduation I received

(with three other graduates) a Sheldon Traveling Fellowship. This enabled me to spend the next year in France, with one brief sojourn in Italy.

While in France I did not learn much mathematics. But I did at least come in contact, however remote, with some famous personages. I heard a lecture by Mme Curie and another by Emile Borel. I attended, irregularly, Goursat's *Cours d'Analyse*. If Osgood was imperious, Goursat was regal. An usher opened the door for his entrance and escorted him out at the close. He lectured in a vast amphitheatre, nearly filled (some said partly by street people who came in for warmth), and had absolutely no contact with his audience. Although I had taken many French courses in college I still had trouble following the lectures. It was only near the end of the year that I became at all at ease with the language.

Returning to Harvard in the fall of 1921 I was fortunate to be offered a half-time teaching fellowship, although I had neglected to make application at the proper time. This I held for two years, receiving a Masters degree in 1923. The following year I worked full time on a thesis under the direction of G. D. Birkhoff. He had proposed a problem connected with his own first published paper. This with further results on trigonometric interpolation comprised my thesis, and I received the Ph.D. in 1924. Of course I had taken several of Birkhoff's courses. His style of teaching was very different from Bôcher's. He presented a view of a research man at work. He would sometimes give the appearance of solving a problem for the first time, with no fear of being stuck, as stuck he sometimes was. But he would tackle the same problem at next lecture and eventually solve it. We learned by trying to understand. O. D. Kellogg was a more polished, if less memorable, lecturer. J. L. Walsh was more like a colleague, for he ate with a few of us teaching fellows in Memorial Hall. He could be very formal in class, very informal after hours. I recall one hot spring day when he gave his lecture on partial differential equations on the front steps of Jefferson Hall.

From 1924 to 1930 I taught at Bryn Mawr College, brought there by the efforts of Professor Anna Pell. When she remarried, to a Professor A. Wheeler and moved to Princeton, I became chairman of the mathematics department. In that position I tried to have G. Pólya, some of whose work I had studied and admired, join the department. But our offer was not sufficiently attractive and was rejected. It was only some years later that he came to this country.

During my stay at Bryn Mawr I was granted one year's leave of absence, assisted financially by a National Research Fellowship. The first part of the year was spent at the University of Chicago, where I had contact with G. A. Bliss and L. E. Dickson. The latter loved to play bridge at the Faculty Club after lunch, and I often joined the game. Next I went to the Rice Institute to study with S. Mandelbrojt, a visiting lecturer. I found him very stimulating, full of ideas. Under his guidance I published two notes, one with J. J. Gergen, in *Comptes Rendus*.

In 1930 I received a joint appointment from Harvard and Radcliffe, later developing into a full professorship at Harvard, when Harvard became truly coeducational. My first sabbatical, with the help of a Guggenheim Fellowship, was spent in Cambridge, England, 1935–1936. There I had the extreme good fortune to take three courses with G. H. Hardy in three successive terms. I had first met him while at Bryn Mawr, for he was a visiting lecturer at a neighboring college, and I heard him talk on an inequality of Hilbert. I proved a generalization of it, and Hardy had asked me to publish it. This I did in the *Journal of the London Mathematical Society*. The three topics in Hardy's courses were divergent series, Fourier series, and Fourier integrals. In the latter he proved, for example, Wiener's general Tauberian theorem. I had the feeling that Wiener's work was appreciated more in England than in America. That year I wrote the final chapters of my book, *The Laplace Transform*. At times Hardy would invite me to dine with him at high table in Trinity College, where I met A. S. Besicovitch, among other notables. I attended his course on Almost Periodic Functions. He was less inspiring than Hardy. Hardy liked bridge, and he often came to my digs for several rubbers with other visiting students.

In 1936 Hardy was a guest at Harvard. There he presented a fine lecture on Number Theory, now in the *Bulletin*. One small incident stands out in my memory. The hostess at the house where I stayed had permitted me to invite Hardy to dinner. In the course of the evening he had used his fountain pen while sitting on a gold colored sofa, leaving a nasty mark thereon. Our gracious hostess said that she would treasure that spot, reminding her of the great man's visit. My admiration of Hardy, always great, grew monotonically.

In 1939 Vera Ames became my bride. We had met at Professor Anna Pell Wheeler's summer cottage in the Adirondacks. Vera has a Ph.D. in mathematics from Bryn Mawr. She has taught part time at Tufts, Cambridge Junior College, University of Massachusetts, Boston and full time at U.C.L.A. in 1948–1949.

Two trips to Russia were memorable. The first, in 1935, was for an International Congress. M. H. Stone and I stopped on the way to tour Helsinki, Finland. There we were guests for dinner at the home of R. Nevanlinna. In Russia I had the pleasure of meeting Dimitri Shostakovich, the famous composer. Hassler Whitney had asked me to show him a new musical scale which he had invented. I found the musician's home without help of In-tourist. Communication was difficult, in German, but as I expected he was uninterested in a new musical scale, having become proficient in and even composed in the standard scale. But I was pleased to meet him beside his grand piano.

At another Congress in Moscow in 1966 I was told that I. I. Hirschman and I were due royalties on our book, *The Convolution Transform*, which had been translated into Russian (without our permission). We were each given

\$400 but were not allowed to take it out of Russia. Our train left next day, but we gave a dinner at our hotel for the E. R. Loves, from Australia, and the Lennart Carlesons, from Uppsala, Sweden. Also Vera bought a silver fox stole and a few nicknacks. It was fun to be forced to spend!

A few more mental images arise. On one occasion I prepared a lecture in jail. I had been invited one Sunday by J. D. Tamarkin for dinner and a symphony concert in Providence. I drove there, evidently too rapidly, and was apprehended in North Attleboro. I was indicted on the spot and put in jail. I called Tamarkin, who borrowed bail money from the Brown University treasurer, drove to jail and had me released. I have always supposed that my standing with my students was improved when they learned of this experience.

On another occasion Tamarkin called and asked me to drive him and his guest, L. Fejér, to Salem for a visit to the house of the seven gables. As we toured the secret passages Fejér always insisted on being last in line. We supposed that this was old world politeness, but when we returned to the car we learned the real reason. A smashed bag of lunch, with cherry juice in evidence, made it clear that his trousers were soiled, as well as the car seat. He said, "*Ich wusste dass ich nichts gemacht hatte.*"

I conclude with one sad memory involving G. D. Birkhoff. One spring evening during the war, May 12, 1944, when gasoline was severely rationed and driving restricted, we had invited guests to dinner at our home on Snake Hill, Belmont. Folks came by bus to Belmont and walked up the hill. Marjorie, concerned about promptness, walked ahead, allowing George to climb more slowly. Later he arrived in a police car with head slightly bruised. Evidently he had become faint and fallen. A neighbor had seen his plight and had called the police. He protested to us that he was all right and stayed with the rest. This episode may have indicated incipient heart weakness, for he died in his sleep exactly six months later.