reflect the tastes and values of collectors and archivists, rather than those of practicing mathematicians and users of mathematics.

The library at West Point, though, stands more or less as it has grown over the last two hundred years. Books were usually added to the collection because somebody at West Point wanted to use them, and not because an archivist or a collector thought they belonged there. Moreover, West Point has enjoyed the luxury of space, so they have not discarded much. Consequently, the collection is a record of almost all the books that were important enough for somebody at West Point to read and use them between 1802 and 1915.

The account is enlivened by a number of informative anecdotes: what is apparently the first use of a blackboard in a mathematics class; how West Point’s first mathematics professor managed to get fired even before the Academy was officially founded; the stories of prolific textbook authors Charles Davies and A. E. “Stinky” Church; the stories of Sylvanus Thayer’s spectacular European shopping trips.

The bibliography was prepared with three motivations. First, it is part of a larger project to celebrate the 200th anniversary of the founding of the United States Military Academy at West Point in 1802. Second, it is a service to the community of mathematics historians to document the collection. Finally, it constitutes an invitation to scholars to use the fascinating collection of primary materials in the collections at West Point.

The work is far more interesting than an annotated bibliography ought to be.

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James Joseph Sylvester. Life and Work in Letters

Wherever the name of James Joseph Sylvester (1814–1897) is mentioned in a gathering of mathematicians who can read, it becomes clear that he is remembered as the man whose life made E. T. Bell’s *Men of Mathematics* memorable. He was one of Bell’s “Invariant Twins,” with a character that contrasted starkly with the downbeat reticence of the other, Arthur Cayley. As an English Jew who suffered all the educational disadvantages that this entailed in the early 19th century—he could study at Cambridge, even be adjudged Second Wrangler, and yet not take his degree—Sylvester no doubt compensated to some extent by his many extravagances, and so provided Bell with the colors for his palette. There was mathematical substance too to Sylvester’s life, and there are more ways of approaching it than by reading his mathematical writings alone. Karen Parshall’s approach is though his voluminous correspondence, known today through some 1200 letters. Of these, she selects 140, of which the most interesting concern the events of relatively short periods, first when he was hot on the trail of a theory of invariants, and second when he was getting to grips with the programming of education between 1876 and 1883 at the Johns Hopkins University. In an earlier brief and unhappy episode (1841) he had taught at the University of Virginia—in which capacity he is often described as America’s first Jewish professor. His career, however, took him to many other places and was certainly not the research sinecure that so
many have open to them today. For ten of his most fertile years he was actuary in a London insurance company. After that he was laden with teaching obligations in a post at the Woolwich Military Academy, a post from which he was forced to retire when the War Ministry lowered the retiring age to 55. His researches meant a great deal to him, in a way they did not to his more cosseted peers. He became bound up, perforce, with mathematics as propagated through international journals rather than through close scholarly affiliations—with a few notable exceptions, Cayley being the most important.

The inevitable tensions that ran through Sylvester’s life are all the more easily understood once we have his correspondence in hand. His disappointments, as he wrote on one occasion, he could bear with Christian fortitude—not an inappropriate expression, in view of the fact that the Christian churches were at the root of so many of them. But there are better things to be done with Sylvester’s life than comb it for repression and depression alone. His letters to Cayley and others, short as they usually are, bring his (and their) mathematics to life. Cayley is well represented here, but there were other mathematical friends in their circle. Take Salmon’s letter, for instance, in which he tells how he was so engrossed in Cayley’s discussion that he did not realize how they had walked round a church so that he was left heading back whence he had come. Salmon makes it clear that he learned much from the invariant twins, and gives chapter and verse. As he writes in one letter to Sylvester, “a great part of every one of your previous letters was unintelligible to me,” although he adds that matters have now improved. It is unfortunate that so many of Sylvester’s “unintelligible” letters are lost. One wonders just how much of Salmon’s difficulty had to do with the luxuriant vocabulary of evectants, intermutants, syzygies, Bézoutiants, commutants, and so forth. Did their algebra really all die with the dramatic reorientation navigated by Hilbert in the 1890s? No, of course not, but it was certainly submerged and camouflaged. Even Professor Parshall’s enthusiasm for the theorems they were generating seems to flag at times, for instance as she tells us how

The theory of intermutants or partial commutants provided Sylvester with another, somewhat less combinatorially daunting way of producing covariants, but the details need not concern us further. (P. 55)

While Sylvester’s work might now seem old-fashioned, there are touches of modernity at several points along its course. One fascinating remark, to a generation that is turning to the computerization of proof, is in a postscript to a letter on the theorem that every polar reciprocal of a curve is an evectant. In it Sylvester writes that “a machine might be made for grinding out this Polar Reciprocal,” and Parshall links this to a correspondence with Charles Babbage and a printed remark by Sylvester (1840) that he hoped “to get a machine made for working Sturm’s theorem, and indeed all problems of derivation.” He was a century ahead of his time when he offered his services to the government of the day. He claimed to have a sound knowledge of principles, of computing, and inventive power, and so to be able to save the country enormous sums of money. And yet a third dash of modernity is where, in a letter slipped in between one from Cayley (on aszygetic invariants) and one to Cayley from him (on expanding the products of powers of differential operators), Sylvester offers his hand in marriage to a renowned feminist of the time, Barbara Smith. It came to nothing, and he never married, but in any case, the lady was at the time somewhat committed to a third party.

Sylvester’s time at Woolwich did not put an end to his mathematical researches, and he continued to correspond with Cayley while combing foreign journals too for inspiration. But at Woolwich, the restraints he had experienced at the hands of English sectarianism were now replaced by others, reflecting the chain of military command. It must have been galling to have the Military Governor revise an
examination mark he gave to a cadet and to have his choice of textbooks overridden. As on a previous occasion, mindful of the power of the class system, he invoked the help of Lord Brougham. Where others might have turned to drink, Sylvester went on inventing names. No doubt it will be of help to those who deal in catalecticants to remember that the name was inspired by the iambicus trimeter catalecticus. After fifteen years at service to Woolwich he turned to poetry and the laws of verse before he was head-hunted by Johns Hopkins University in Baltimore.

Once he was across the Atlantic his culture shock was not helped by the loss of his papers in the move and the heat and humidity of the place. A salary substantially higher than that paid to professors at Yale and Harvard—and paid to him, at his insistence, in gold—helped to ease the pain. In due course he lost most of his homesickness, and by 1881 we hear him enthusing about the climate and rejoicing in good health. At Johns Hopkins he had the freedom to promote the untrammeled graduate research for which he had always pined, and his own work took on a new lease of life. There is an amusing letter to him from Salmon, sceptical about Oxford nonsense about the endowment of research. Salmon thought there could be no guarantee that the work would be forthcoming, but that at least one could squeeze some teaching out of the researcher. Sylvester fortunately had loftier ideals. As Halsted wrote, Baltimore was “made at once by this Euclid a new Alexandria,” and students were drawn there, not all of them male.

When he finally left for England in 1883 he gave a typically exuberant speech, peppered with well-meaning suggestions as to how the university might be improved. Moving to the Savilian chair in Oxford he gradually realized that the need for reform in the matter of research there was considerably greater than in Baltimore. But he was accepted, at least, as a part of an Establishment that he had long envied, and accepted in a way that would have been impossible when he was beginning his career. Still he corresponds with his old friend Cayley on a variety of subjects—for instance on Hamilton’s quaternions—and now he is better able to indulge an old love of socializing. He lived long enough to see aristocrats “manufactured wholesale,” as he put it, but it has to be said that he had always set a high value on high birth, so it is appropriate that this collection of letters should end with a Latin poem he sent to the editor of “The National Observer” in honor of Lord Rayleigh. Not just any old aristocrat, of course. Sylvester still had his standards.

This collection of letters is a mine of useful oddments, and it is only to be regretted that it does not include everything that is known to survive. Perhaps a supplementary edition on compact disc might one day be issued to supplement it. The device whereby Sylvester’s life is divided into sections, each with a short summary preface, is one that works well, and the few small editorial repetitions are easy to bear. Whereas other editors would have silently expanded or emended the originals, the editing is here reverential, added to which the footnotes make much use of DNB articles that are decidedly long in the tooth. There can be no doubt, however, that this collection of materials will make a very welcome addition to the Sylvester canon in the view of all who value the history of 19th-century mathematics and mathematical education.

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