

Duel at Dawn: Heroes, Martyrs, and the Rise of Modern Mathematics

Reviewed by Daniel S. Silver

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Amir Alexander

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On those occasions when popular culture takes a moment to ponder mathematicians, the result is usually unpleasant. Mentally unstable, obsessive, and unfeeling are some of the traits seized upon by Hollywood blockbusters such as *A Beautiful Mind* and *Good Will Hunting*. Barbie dolls complain that “Math class is tough!” before being reluctantly pulled from store shelves. And magazine articles about Grigory Perelman, who recently solved the Poincaré conjecture, must begin by informing readers of the Russian mathematician’s eccentricity. But it wasn’t always like this. Thales of Miletus, who according to legend could calculate heights of pyramids and find distances of ships seen offshore using only pen and papyrus, was proclaimed one of the Seven Sages of Greece. Archimedes of Syracuse might have occasionally forgotten himself in the bathtub, but for centuries he was admired as the world’s greatest mathematician.

So what happened? Readers who wish to understand how mathematicians went from sage to security risk might begin by reading *Duel at Dawn* by Amir Alexander.

Alexander examines popular stories about mathematicians during the eighteenth and nineteenth centuries. That many combine exaggeration and fantasy is so much the better for the author,

Daniel S. Silver is professor of mathematics at the University of South Alabama. His email address is silver@jaguar1.usouthal.edu.



as they reveal contemporary attitudes about mathematicians. Jean d’Alembert, Évariste Galois, Augustin-Louis Cauchy, Niels Henrik Abel, and János Bolyai are the stars of *Duel at Dawn*. The storyline is clear: as mathematics became more abstract and independent of physical sciences, the popular image of mathematicians went from worldly to oth-

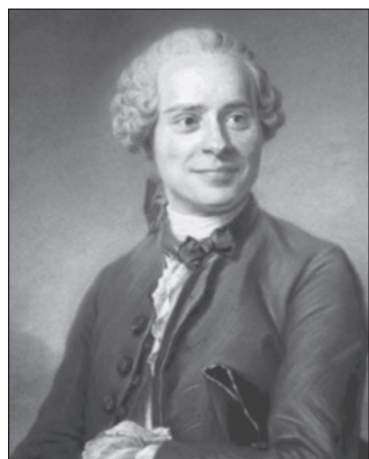
erworldly. As the Enlightenment yielded to the Romantic Era, the image of the natural savant gave way to that of the heroic misfit.

Jean le Rond d’Alembert is best remembered in mathematics for the ratio test, as well as for a classical mechanics principle and a wave operator that bear his name. He was the product of a Paris salon. Literally. His mother was Claudine Guérin de Tencin, a *salonnière* who invited guests regularly for witty and inspiring intercourse. His father, Chevalier Louis-Camus Destouches, a military officer, was one of her favorites. Mme de Tencin left their illegitimate offspring in an open box on the steps of a church. Destouches later arranged for the infant to be raised in the home of Mme Rousseau, the wife of a glazier. D’Alembert remained in her modest house until he was forty-eight years old, living a strange double life. Laboring invisibly on mathematics in his tiny bedroom during the morning hours, he would venture out in the afternoons in order to sparkle among intellectuals and aristocrats.

D'Alembert knew how to sparkle. Despite his unimpressive appearance and odd, high-pitched voice, he became a favorite at the salon of the Marquise du Deffand. His enthusiasm and naïveté, and his ability to mimic, charmed everyone. The Duchesse de Chaulnes expressed the view that d'Alembert was “only a child”, living in “eternal infancy”. The following story, found in Thomas Hankins’s biography of d'Alembert, is charming confirmation.

Since he frequently did not have enough to pay his cab fare, the Marquise de Créqui would take him for a drive in her coach and d'Alembert was so thrilled by the echo produced when the carriage went through the portals of the Louvre that the Marquise had to instruct the coachman to drive around five or six times to satisfy him.

It is a pity that the engraved portrait of d'Alembert reproduced in *Duel at Dawn* shows none of the playful spirit that one senses from Quentin de La Tour’s pastel portrait of the mathematician. (La Tour’s delightful portrait hangs in the Louvre Museum in Paris. It can also be easily found on the Web.) Nevertheless, Alexander brings



La Tour's portrait of Jean d'Alembert.

d'Alembert to life in his book. Readers who have never considered this forgotten mathematician will want to read more.

Did d'Alembert always act with an unstained spirit, as his legend would have us believe? Of course not. As Alexander tells us, d'Alembert sought honors and fought petty battles. It is the nature of the legend rather than the nature of the subject that is the concern of *Duel at Dawn*. What the legend tells us is that during the Enlightenment, when mathematics was firmly tethered to physical subjects, successful mathematicians were popularly imagined to be all-natural with

the ability to see reality clearly despite culture’s artificial ingredients.

Legend would have us also believe that the twenty-year-old Évariste Galois was cruelly ignored and spent the night before a fatal duel frantically writing the answer to an age-old question: under what conditions can an equation be solved? “I have not time. I have not time,” he scrawled in the margins. At least, that is how Eric Temple Bell’s *Men of Mathematics* told the story. As Tony Rothman made clear in “Genius and biographers: The fictionalization of Evariste Galois”, published in 1982 in *The American Mathematical Monthly*, Bell’s version

of events is reckless nonsense. Galois’s brilliance had been recognized by notable mathematicians, and his work had already appeared in print. Sadly, Galois was also emotionally troubled and gave the impression of being dangerously violent. On one occasion he publicly “toasted” the King with an open knife. On another he marched through the Paris streets heavily armed and wearing the uniform of the outlawed National Guard. Galois placed himself in perilous situations with the same enthusiasm that he brought to his mathematics. Rather than be shocked that he died so young, we should be impressed that he lived as long as he did.

Alexander’s portrait of the real Galois is entertaining but certainly not new. What is fresh is Alexander’s explanation of why Galois’s discoveries caused so little excitement at the time. The solutions of general quadratic polynomial equations had been known as early as the ninth century. A siege of seven centuries was needed before the general third- and fourth-degree equations surrendered to solution. The great polynomial war ended in 1824 when Abel proved that not every polynomial of higher degree can be solved in terms of radicals. Characterizing the polynomials that do was Galois’s contribution six years later.

If Abel’s theorem seemed strange to mathematicians who were concerned primarily with physical problems, then what Galois succeeded in doing must have seemed both alien and useless. Galois anticipated as much. In 1830, he wrote:

If you now give me an equation that you have chosen at your pleasure, and that you desire to know whether it is resolvable by radicals or not, I could do nothing but indicate to you the means of responding to your questions, without wishing to charge either myself or anyone with the task of doing it. In a word, the calculations are impractical.

Galois believed that future generations would see value in his work. “All that makes this theory beautiful, and in truth, difficult,” he wrote, “is that one has always to indicate the course of analysis and foresee its result without ever being able to perform the calculations.” One year later, he added: “I believe that the moment will come when the algebraic transformations foreseen by the analysts will find neither the time nor the place to be executed; at that point it will become necessary to be content with having foreseen them.”

The mathematics of Abel and Galois represents an evolutionary step of monumental importance. Problems about hanging chains and flowing heat would have to make room for more abstract concerns. As mathematicians wafted higher into the rarified realm of pure thought, the public would soon lose sight of them. The Romantic myth of the tragic hero, misunderstood and unappreciated,

would supplant the Enlightenment's myth of the natural child.

Alexander has risked becoming something of a tragic hero himself by including technical exposition in his book. Readers with little background might blame themselves for their lack of comprehension. Mathematicians might blame the author. A well-known theorem concerning equality of mixed partial derivatives, proved by Euler, is stated with insufficient hypothesis. Solvable groups, an essential ingredient in Galois's theory, are defined incorrectly. In other places, such as the description of John Wallis's attempted proof of the parallel postulate, sentences that are too informal cause confusion. Fortunately, the main points of *Duel at Dawn* don't rely on the mathematical digressions.

Was the tragic image of Galois applied to nineteenth century scientists generally? Alexander anticipates the question:

...one might still wonder whether the shift in the prevailing narrative was unique to mathematics or was shared with the other sciences. It is possible, after all, that just as mathematical imagery absorbed some of the dominant themes of High Romanticism, redefining what it meant to be a mathematician, so did other sciences.

Alexander dismisses the possibility by observing that it is difficult, perhaps impossible, to find a physical scientist of the Romantic era who was widely regarded as a misfit. Lord Kelvin, Hermann von Helmholtz, Ludwig Boltzmann, Charles Darwin, and James Clerk Maxwell, for example, had professional reputations that any scientist today would envy.

Mathematicians might have been the only scientists who acquired the popular label of heroic misfit, but *Duel at Dawn* can leave readers with the impression that most mathematicians wore the unhappy brand. Besides Galois, we find Abel and Bolyai offered as examples, and, arguably, Cauchy, too. Yet there were many well-known mathematicians in the nineteenth century who were seen as anything but misfits: Cayley, Dirichlet, Gauss, and Hamilton are just a few names that come to mind.

And there are plenty today. So why are sad tales of unstable mathematicians from Galois to Perelman so popular? *Duel at Dawn* suggests a reason. The public sees mathematicians as being like artists, preferring to live in a virtual world that bears little resemblance to what G. H. Hardy called "this stupidly constructed 'real' one". Such people cannot possibly be happy or sane.

Another reason, one not offered by Alexander, can be found in our public high schools. Few graduates have any knowledge of mathematics beyond computation. Fewer know what mathematicians do. The repercussions are felt in colleges and

universities, where good students are reluctant to major in mathematics and bad administrators are quick to characterize mathematics faculty as impractical or arrogant.

Duel at Dawn suffers from being repetitive. Its handful of main points are good ones, but they are met too often throughout the book. Also, the lack of a separate section for references might frustrate a serious reader. Nevertheless, *Duel at Dawn* offers a good starting point for anyone who wishes to understand some popular attitudes about mathematicians. The topic is important, especially for educators. And, I must admit, the stories are fun.



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