Mathematical Lives

Ada Lovelace

Programming the Future

Robert Black

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Prologue

The Enchantress of Number

It was like nothing the world had ever seen. The Great Exposition of 1851 brought the culture and industry of twenty-five nations to London's Hyde Park and put it all under the great glass roof of the Crystal Palace, a massive structure three times the size of St. Paul's Cathedral, built specifically for the event. The six million people who visited from the Exhibition's opening in May to its closing in October could wander through ten miles of exhibit aisles, seeing both natural and technological wonders from around the world. From France, there were magnificent tapestries, silks, and porcelain, along with the machines that made them. From India, there was the Koh-i-Noor (the largest known diamond at the time) and a throne made of carved ivory. And from the United States, there were daguerreotypes from photography pioneer Matthew Brady and revolvers from gun manufacturer Samuel Colt.

But the most spectacular exhibit of all—more popular even than the German tableaux of small stuffed kittens having tea—came from Britain itself. The Analytical Engine was a steam-powered mechanical thinking machine the

size of a locomotive engine. Its many thousands of gears, wheels, cogs, and levers could manipulate numbers of up to fifty decimal places, adding, subtracting, multiplying, and dividing them at a rate of one operation every four seconds. But the Analytical Engine was more than just an oversized calculator. It could be given complex instructions through sets of punched cards, and as it carried out those instructions, it could make its own decisions, determining on its own whether its task was complete.

The brilliant inventor who created this mechanical marvel could be found there almost every day, eager to explain his work to the curious crowds that gathered around it. And on many of those days, he was joined by his partner, who was almost as amazing as the Analytical Engine itself, for his partner was a woman from the British aristocracy—a countess, no less—whose mathematical ability had moved the inventor to call her "The Enchantress of Number." He may have built the Analytical Engine, but she was the one who wrote its instructions. The dreams she had for the machine stretched far beyond mere computation. She imagined it working on anything that could be expressed in terms of mathematical relationships—maybe even being able to compose its own music one day....

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Okay, *most* of that really happened, but not all of it. There *was* a Great Exposition in London in 1851, which *did* take place in an enormous glass and iron building called the Crystal Palace. Brady and Colt *were* there, as was the Koh-

i-Noor diamond and even the German stuffed kittens having tea (not to mention the world's first modern pay toilets). But there was no Analytical Engine on display, no giant steam-powered computer full of wheels and cogs and levers.

There were plans for such a machine, though. They had been created by Charles Babbage, one-time holder of Isaac Newton's former position at Cambridge University, who spent much of his life designing a series of mechanical computers but never raising enough money to build them. And he really did have an aristocratic female partner whom he called "The Enchantress of Number." Augusta Ada Byron King, Countess of Lovelace, had met Babbage in 1833, when she was still a teenager. She had already shown signs of being a skilled mathematician and was fascinated when Babbage showed her a demonstration model for one of his designs. It was the beginning of a friendship that lasted the rest of her life.

In 1842, an Italian military engineer published an article describing Babbage's Analytical Engine. Lovelace translated it for the British public and then added a series of explanatory notes that ran much longer than the original text. In those notes, she detailed a method that the Analytical Engine could use to calculate a set of values called Bernoulli Numbers. It was, effectively, an outline for the world's first computer program—written a century before the world's first computer was built.

Lovelace's translation and notes were her only published works, but in her sadly brief life, she exchanged ideas with Babbage and other great scientific minds of Victorian

Britain, all at a time when the idea of any woman, much less a countess, doing advanced mathematics was considered extraordinary.

Before we can tell her story, though, we first must get to know her parents, one of whom was extraordinary in some completely different ways.

Chapter One

Mad, Bad, and Dangerous to Know

In the early 1800s, there was no internet or social media, no television or movies or radio, not even recorded music of any kind. There were books, but only wealthy aristocrats and intellectuals bought, read, and discussed them. In Britain, reading wouldn't become popular among the middle class for a few more decades. In fact, more than a third of all men and half of all women couldn't read at all.

There were still celebrity entertainers, though, even if they were only known among the rich. Musicians could find success playing an instrument or singing opera, and dancers could dance in the ballet. Some novelists were becoming well-known, provided that they were men (women like Jane Austen had to publish anonymously). But the novel hadn't yet become as popular as the epic poem, a lengthy story told in verse, usually about a larger-than-life hero. People around the world had been writing epic poems since ancient times, and in 1812, perhaps the era's greatest epic poet—certainly its most infamous—exploded onto the scene.

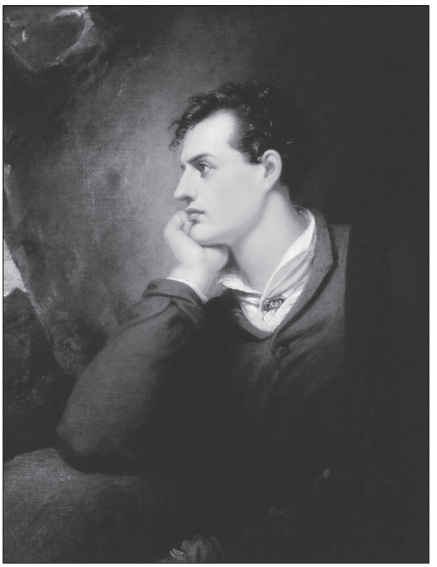
George Gordon Byron was the sixth Baron Byron of Rochdale, in the English northwest, which entitled him to

be called *Lord* Byron. He was only ten years old when he inherited that title in 1798, following the death of his great uncle. By age fifteen, he had begun writing poetry and falling passionately in love, the two pursuits that would carry him into history. During the next few years, he published a small book of poetry, followed by his first major work, an anonymous satire of literary critics, written as revenge on the reviewers who hadn't liked his poetry.

In July 1809, just months after turning twenty-one, Byron set out for a tour of the eastern Mediterranean, which was ruled by the Turkish Ottoman Empire. He was abroad for two years, spending much of that time in Athens, and he returned home with a broadened sense of the world and a collection of new poems inspired by his travels. One of them, *Childe Harold's Pilgrimage*, ran for two cantos of almost 100 stanzas each, telling the largely autobiographical story of a young man who, tired of an aimless life seeking nothing but pleasure, goes on a journey to search for something more meaningful. Byron felt anxious about putting his work in print, thinking he had revealed too much about himself in it, but within a few months, he had reached an agreement with a London publisher. *Childe Harold's Pilgrimage* first went on sale on March 10, 1812.

What happened next went beyond anyone's wildest expectations. The first 500 copies sold out in only three days. Within six months, 4,500 copies had been sold—a remarkable number at that time. Byron, who had enjoyed only modest success before, was an instant sensation. "I awoke one morning and found myself famous," he later

recalled. Suddenly, everyone wanted him as a guest at their next party or social gathering, and women across England wanted to be his lover. Byron was more than willing to accommodate both.



One of those women was Lady Caroline Lamb, wife of William Lamb, who one day would become prime minister and a trusted advisor to Queen Victoria. She was a writer herself and first wrote Byron an anonymous fan letter praising *Childe Harold*. But she was cool toward him when they met in person and came away describing him as "mad, bad, and dangerous to know," a description that has stuck with him to this day. Byron pursued her anyway, admiring her intelligence and the devotion she had to care for her son, who was probably autistic, when most wealthy families placed such children in institutions. Most irresistible of all, though, was the fact that she had rejected him. But the chase didn't take long. They were a couple within a few weeks.

The affair lasted through the summer, through poetry-reading, jealousies, and arguments. At first, the two were low-key enough about their relationship for society to tolerate them, but Byron soon became bored and began to pull away, and Lady Caroline responded with increasingly public emotional displays. As Byron looked for a way out of the relationship, he found an ally in Charles Lamb's mother-in-law, Elizabeth Milbanke Lamb, known formally as Lady Melbourne. Lady Melbourne arranged for Byron to begin a courtship with her niece, Anne Isabella Milbanke, known as Annabella.

Byron and Annabella had met in the spring as Byron was rocketing to fame, and like so many other women, Annabella was drawn to his charm and good looks. But unlike those other women, she saw someone noble and generous lurking behind his dangerous image. As a member of the House of Lords, he had spoken out against a bill that gave the

death penalty to a group of rioters in his home county. Two months later, he spoke out against Britain's official policy of discriminating against Catholics. Annabella wanted to do good in the world herself. If she could help Byron reform his ways, she wondered, might he become a suitable partner for her?

Lady Melbourne took full advantage of Annabella's infatuation, as did Byron. He saw her serious nature, her kindness, and her respectability as qualities he wanted in a wife. As Lady Melbourne both coaxed and tested him, he debated the possibility of marriage through the summer and into the fall. Then Lady Caroline wrote him an agitated letter from Ireland, where her husband had taken her, and that spurred him into action. He wrote to Lady Melbourne asking if Annabella would be interested in marrying him.

Despite her obvious interest, Annabella turned him down. The flattering letters that Lady Melbourne had chosen to pass along to her from Byron had made her feel as though he had too high an opinion of her—one that would surely crumble once they were together in daily life. Lady Melbourne was disappointed that her plans had failed, but within a few weeks, Byron was involved in another affair, so at least he was putting some distance between himself and Lady Caroline.

But that wasn't the end of the story. By the following spring, Annabella had come to regret her decision. She may not have wanted to marry Byron, but she still considered him a friend—one she didn't want to lose. In August, she sent him a letter suggesting that they begin writing to each other,

strictly as friends. Byron, who couldn't resist a woman trying to resist him, agreed, and so their correspondence began.

The arrangement lasted all of three months. By November, Annabella was telling one of her closest friends that becoming Byron's wife was "a thought too dear to be indulged." For almost another year, they wrote long letters to each other, sometimes drawing closer and other times pulling apart, before Byron finally proposed by letter in September 1814.

Annabella was clearly in love with Byron, but how did Byron feel? How did he view the engagement? Falling in love was never hard for him to do, so he surely felt something for her, but his letters to other people from that time reveal other priorities. Annabella was an heiress, something that Byron—who was almost always in debt, despite being a baron—mentioned often to one of his closest friends. He also saw having a wife as the key to controlling his impulses and reforming his ways. But as it turned out, at that very same time, those impulses had already drawn him into something that a wife couldn't solve.

They were married on January 2, 1815, after a rocky engagement that had seen Byron hesitate and delay several times. It was a sign of things to come. Entire books could be written about the Byron marriage—and, in fact, they have been. Byron's enduring fame and his long record of scandal have drawn the attention of writers and historians for more than two centuries, and Lady Byron—as Annabella was then called—led a noteworthy public life of her own. Some portrayed her as a victim of Byron's behavior. Others,

especially those wanting to defend Byron's reputation and his place in literary history, portrayed her as a villain. Her own account became romanticized over the years, but it was always regarded as truthful. The marriage lasted barely a year, but its consequences reverberated for much longer.

The couple didn't even reach their honeymoon destination before trouble began. While riding in their private carriage, Byron told Annabella that she shouldn't have married him and that he disliked her mother. The next morning, Annabella's wedding ring, passed down from Byron's late mother, fell into the fireplace, an incident that Byron took as a bad omen. In the weeks and months that followed, Byron discovered that his financial problems were as bad as ever, and he increasingly turned to alcohol to cope with them.

Annabella tried responding to her husband's behavior with patience and reason, but that only made him worse. Byron couldn't bear having a woman stand in his way over anything. When his antics couldn't provoke a reaction from her, he tried even harder to provoke one. Within a few months, he was flying into fits of raging temper at her so violently that friends and family began to fear for her safety. By that time, Annabella was pregnant with a child that Byron was certain would be a boy. It was not. On December 10, 1815, Annabella gave birth to a baby girl, Augusta Ada Byron, named for Byron's half-sister Augusta Leigh but always called by the name Ada.

What happened next isn't entirely clear, known to us only through conflicting accounts muddied by inflated rumors or massaged by London lawyers. We do know that on January

15, 1816, Annabella left the Byron home in the middle of the night, taking Ada and three servants with her. She went to her parents' home for what she believed would be a temporary separation. Evidence shows that she had been working with a lawyer to have Byron declared temporarily insane and that she expected a reunion with him after he was cured. But once news of the split reached British society, the gossip began to fly as people began sharing stories of Byron's past antics. Loudest of all was Caroline Lamb, who let loose with everything she had learned about Byron during their affair. Byron's own behavior didn't help. He changed his mind constantly about whether he even wanted to reconcile with Annabella, sometimes writing her a loving letter only to follow it promptly with an angry one.

Something that came out in the next two months convinced Annabella to make the separation permanent, and something convinced Byron to accept it. The strongest evidence is that Annabella found out about an affair that Byron had had with Augusta Leigh, his half-sister. There was no way the marriage could survive such a disgrace. Officially, they never divorced, but after Byron signed the formal separation document, he never saw Annabella or Ada again. On April 23, in a new carriage that he never paid for, Byron left his home—the contents of which were immediately seized by his creditors. The carriage took him to Dover, where he set sail for the European continent, never to return.

Annabella was left to rebuild her life and raise her daughter alone—and still in the public eye. As bad as Byron's

reputation had been damaged, the slightest misstep would damage her own even more. As it was, groups of strangers already stared at her when she went out in public. Two weeks after Byron's departure, Caroline Lamb published *Glenarvon*, an account of her relationship with him, barely disguised as a novel. Its depiction of Annabella as weak and boring offered her no help.

Byron never forgot about his daughter. Later that year, he published the third canto of *Childe Harold's Pilgrimage*, which he opened with this tribute:

> *Is thy face like thy mother's, my fair child!*
> *Ada! sole daughter of my house and heart?*
> *When last I saw thy young blue eyes they smiled,*
> *And then we parted,—not as now we part,*
> *But with a hope.—*
> *Awaking with a start,*
> *The waters heave around me; and on high*
> *The winds lift up their voices: I depart,*
> *Whither I know not; but the hour's gone by,*
> *When Albion's lessening shores could grieve or glad*
> *mine eye.*

Ada's own journey was just beginning.