

## The Fourth Dimension and the Theology of Edwin Abbott Abbott

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Edwin Abbott Abbott wrote my favorite book, Flatland. Since it first appeared in 1884, it has been read by many generations of students, most often because, as was the case with me, it was suggested by a teacher who wanted to challenge a class to go beyond restricted ways of thinking.

It deals with one of the most mysterious aspects of mathematics, the idea of four or more dimensions, and as a high school student, that impressed me because it fit into what I was trying to understand about mystery in other areas, specifically in theology. As I followed up on the idea of mystery in those two subjects, I learned a good deal about both of them, and something about myself as well. I always tried to understand things. I loved to look at complicated relationships and figure out how they fit together. More and more I found myself preferring geometric ways of organizing ideas, both in mathematics and theology, and I appreciated learning about a book and an author who seemed to think about some of these things in similar ways.

In the Roman Catholic tradition in which I grew up and in which I still maintain my faith, people are fond of coming up with creeds and formularies. You have a lot of statements around which you can try to treat as axioms. In contrast to systems of mathematics, these theological axioms often seemed to me to be, if not contradictory, at least difficult to reconcile with one another. I felt that it was important to try to find ways of seeing that. I spent a lot of effort as a youth praying about that and trying to understand it. As a proper approach to mystery, I tried not to explain it, but to see how it fits together.

I got a chance as a sophomore at Notre Dame to write a term paper on any subject in theology that I wanted. I spent more time on my paper, "The Fourth Dimension and the Trinity," than I did on any other single thing that I did as an undergraduate. I was very proud of the fact that at the end there were twenty-five references in the bibliography. I thought in my naiveté that I had exhausted the subject (now my bibliography of the subject must include over a thousand items). In my paper, I used Flatland as my theme. I attempted to reconcile phenomena that looked very complicated in such a way that they were no longer a block to mental acceptance. I didn't prove anything, but it allowed me to move on.

I thought that Flatland was mostly a book about mathematics with a little bit of social satire. Little did I realize where that was going to take me! What follows is a collage of people and places and ideas to show you where an idea can take you if you follow the Spirit. It will involve not just ideas, because it is people that make it all work.

The book Flatland itself was written in 1884 by Edwin Abbott Abbott. At one time I thought that he wrote only one other book on the works of Pope, but in fact that was his father Edwin Abbott. My man Edwin Abbott Abbott wrote many more things. I wish that I had met him. I've come as close as it is possible to be to meeting someone

who was born exactly 100 years before I was. The frontispiece of Flatland gives a hint that Abbott was more “dimensional” than just someone who could write a little mathematical allegory. The Shakespearean quotations at the top and the bottom are a clue to the fact that in 1870 he wrote a book called A Shakespearean Grammar, which my Shakespearean friends tell me is still a quoted reference, one of the most important references on Shakespeare from the middle 19th century. For that book’s second edition, Abbott reports that he reread all of the plays of Shakespeare for the fourth time. Abbott loved words. He approached Shakespeare from the point of view of form criticism of the Classics. He was a classicist. He was a First at Cambridge in Classics. And he knew Latin, Greek, French, and German. He studied Hebrew and Aramaic as well so that he could apply the form criticism of his classical studies to the Bible and to Shakespeare. Form criticism was the key to a classical education in mid-Victorian England.

It is the dimensional analogy in Flatland which interests mathematicians, because it is a key to understanding so much of mathematics - the arithmetic, the analytic, and the geometric. Flatland’s protagonist, A Square, understands well Pointland, Lineland, and Flatland. At the end of the book, he vainly tries to recreate three-dimensional space while he is in prison for heresy and for having delusions. That should warn us all about what happens to prophets and teachers in this business.

Abbott himself was headmaster of a school. My favorite picture of him is an un-retouched one, leaving visible the shadows of his cheekbones. To be a headmaster of a school, you had to be ordained. He was a serious student of Theology. In the Classical Tripos at Cambridge he showed his ability in Mathematics, in Classics, and in Theology. Abbott saw his life’s work as making sense of Christianity in Victorian England. Each of us too must make sense of the major thrusts, the major pulls, the major challenges of the day in the light of our Christianity. We have trouble today understanding what the challenges were to faith in Victorian England. What was the context? Abbott wanted to have a religion that he could live in and that he could train his students to go on in. He was a teacher par excellence. For twenty-six years he was headmaster of the City of London School. He had no trouble accepting orders after graduating with a fellowship from St. John’s College. But he did have trouble maintaining orders, because his scholarship put him at variance with a number of people in his own Anglican Church, as well as with intellectuals of his day who had nothing to do with the Church. He maintained his convictions at great personal effort.

The school was moved by Abbott at the start of his headmastership to a place near Blackfriar’s Bridge in London. Today that building’s location is just a facade, and the City of London School has again been moved. I guess that that’s appropriate: its dimensionality has been reduced to two! Now the building is the London headquarters of the Chase Manhattan Bank. Maintained are the major room across the full width of the top of the building where Abbott as headmaster used to lead the prayers of the day.

Abbott also handled sixth form English, sixth form Theology, and just about every other subject at one time or another. In the headmaster’s office currently is a picture by Sir Herbert Herkomer of Abbott, given upon Abbott’s retirement (when he was a year older than what I am now). Abbott had been ill most of his life. He felt that he had only a few months left for scholarship, and wanted to devote that to devotional

writing. By the time that he was my age, he had written more than twenty books. He retired at age 52, lived 36 more years, and wrote twenty more books. Having as a hero someone who published a book a year while he was headmaster of a busy school, teaching every subject in the curriculum, is an ambitious goal! Abbott felt that he was neither young enough or old enough to be flattered by a portrait, but the Old Boys demanded a retirement picture.

The new City of London School is a wonderful facility, but as Prince Charles complained, it's squarely in front of St. Paul's right on the Thames River. They rescued most of plaques from the old school. The head porter currently is William Hallett. About 12 years ago I started talking to people like William about Abbott. A number of my contacts were in their 80's and 90's, so they have died now. I'm glad that I didn't wait. One of my missions is to complete a book on Abbott based on these investigations.

Robert Pitt Edkins made a big difference in Abbott's life. He was Abbott's high school mathematics teacher. A plaque for Edkins is in the new school. A crazy man according to all histories of the City of London School, he made people do problems that were so difficult that people hardly survived his course. Those that did survive went on to Cambridge and won all the prizes. Abbott, although planning on Classics and Theology, had before he left for Cambridge already finished Calculus and Differential Equations. The City of London School was a public day school. Many who went there returned home to work in their fathers' businesses. Others were funneled into the universities. They had an excellent record.

The Rev. Percival Gardner Smith was in his 90's when he helped me with my project. He came up to Cambridge in '06 and ultimately became the Chaplain of Jesus College, where he knew Edwin Abbott (the son of Edwin Abbott Abbott) who was a lecturer in Latin until his retirement in 1933. He owned a copy of Flatland given him by the son, shortly before he died in 1952. This copy is a first edition of Flatland, signed by the author, and including in the author's hand a few corrections in the margins which were made in the second edition. The introduction to the second edition claims that these were not the author's fault. For example, the compositor apparently changed "dodecagon" to "dodecahedron." One or two mistakes were clearly Abbott's fault, since they were in the drawings, which Abbott had drawn himself.

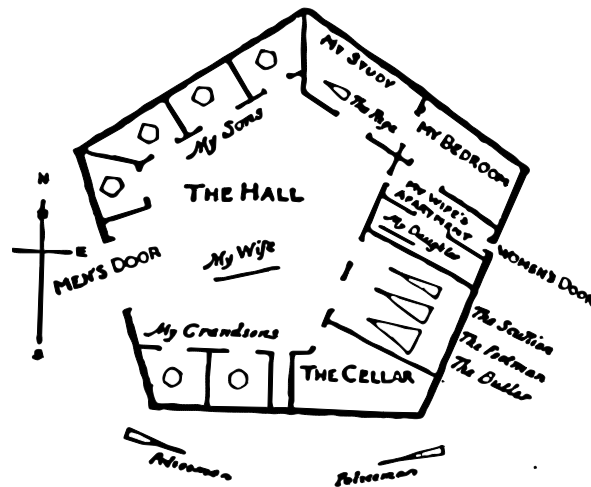
The first edition came out in October 1884 and was reviewed in November. The second edition came out in December because the first edition sold out immediately. The Rev. Gardner Smith willed his copy to Jesus College, which now understands its value.

Barbara Phillipson, who is 85, living in Finchley, is the granddaughter of two of Abbott's closest friends. Neither of Abbott's children had children, but there are many descendants of friends of Abbott's about. She has a house crammed with things. She never throws anything away. She helped me get pictures of the people today who are connected with Abbott, and to make those connections. For example, John Llewellyn Davies, the Broad Church minister who really led Abbott into the idea of an examined religion, was the grandfather of the "lost boys" of J. M. Barrie, which explains why both Abbott and Barrie were at the graveside of Davies. The whole fabric of Victorian England seems to be that of a small town, as though everyone lived in a suburb of

Harrisburg and ran into each other all the time at shopping malls.

Wellside, in Wellwalk, is where Edwin Abbott's house is. The owner of the house, Laurence Leonard, is a symphony conductor, his wife a concert pianist. He gave me permission to sleep overnight in Abbott's bedroom.

Here's a picture of A Square's house. This picture is not a floor plan of his house: it is his house. All the prepositions that we use to describe A Square going from one part



of his house to another - across, behind, between, in - do not make sense to us in the same way as they do to A Square. Prepositions are relational words. They are the most dimensional words of any language. Most of what I worried about when I was a boy was connected to words, because words used to describe theological mysteries did not mean the same thing when they talked about God as they did when they talked about human beings. The concept of place and time which frames all our actions in history is not the same when you are talking about Deity beyond space and time. Heaven is a state and a place, according to the words of the Bible, but it's not the same familiar kind of place or the same kind of state. How do we express the ineffable in words? The theologian and the mathematician share the same problem: the dimensional analogy is an attempt on the part of mathematicians to explain situations in which our words no longer mean the same thing. A Square faced this problem.

The social allegory of the first part of Flatland is often skimmed over by its readers. Either that happens or people become stuck there. Princeton University Press is interested in publishing a new edition of the book. There have been six new editions in the past ten years. They are distinguished by and large by their introductions. One of those introductions has helped us to understand the social allegory part. The social system of Victorian England was more rigid than in England now or in the United States. The state of life into which you were born determined what opportunities were open to you. In Flatland, the number of sides that you have determines where you are on the social ladder. (Last night, the 1883 reference to Galton interested me, because it seems as though Abbott may have quoted Galton at one point.) In Flatland, each succeeding generation has one extra side. The grandsons of A Square are hexagons. When you have so many sides that you are indistinguishable from a circle, you are treated as a

Philosopher-King, as nobility. But, as Abbott says, these higher classes become infertile. They make unwise marriages and their lines die out. Nature versus nurture was a live debate in Victorian England. It was thought that you could measure a prisoner's forearm bone to determine his base tendencies. You are ruled by your configuration. There was a Darwinian view of the evolution of social systems as well as of biology in that day. This affected Abbott's theology only in this respect. As a product of the liberal Broad Church movement, Abbott devoted a great deal of his life to education, which he saw as the key to breaking the barriers of this class system. Abbott was in a school which made scholarships available for either career - or university - oriented boys, regardless of race, color, or creed.

I shall have to explain in the new introduction to Flatland why it was not regardless of sex: boys only! Abbott was one of the leaders of the Women's Education Movement in Victorian England. He was regarded by the feminists of the day as an invaluable aid in their work to bring equal educational opportunity to women. They were frustrated by the reluctance of Oxford and Cambridge to help women recently admitted to the University to prepare for the University. The "separate but equal" mentality said that women should prepare the same way that men did, but there weren't any schools to help them prepare. Through the Headmaster's Conference and through the Teachers' Training Society, Abbott helped to build opportunities for women to prepare. He was a champion of women's rights. I get frustrated when people reading Flatland superficially call Abbott a sexist. Abbott used satire to describe his society, which pained him so much, a society which treated women as though they were only one-dimensional. It's a two-cultures allegory. Abbott's sentiments are very clear. He talks about rationalists and intuitionists. All the rational goes into the two-dimensional men; all the intuition goes into the women. He found this disjunction unacceptable, and he took it to its logical conclusion in satire. His protagonist was totally limited by his own view of the world. A Square's preconceptions had to be blasted away. They were - by his contact with a revelation of a higher order of existence.

Let's look now at Abbott's polygonal family tree. The Triangle, Edwin Abbott, father of Edwin Abbott Abbott, wrote a book on the works of Pope; his son wrote the introduction to that volume and helped him to compile it. Head of the Philological School, Abbott senior became a headmaster at age 18. (His son became headmaster at 26.) Abbott senior was then head boy of the school and was made provisional headmaster when the headmaster got sacked. He did such a good job that he stayed on for 40 years.

Another of Edwin Abbott Abbott's generation, Albert Vardy, was one of four boys who were good friends who took orders like Abbott. John Yates Paterson was the only fellow among Abbott's friends who didn't go into teaching. He became a lawyer instead. He was Barbara Phillipson's grandfather. William Steadman Aldis and Abbott were the two top boys at City of London School. They went to Cambridge together. They astounded Cambridge and the Earl of Clarendon, who was doing a report on education, by walking off with all the top prizes at Cambridge in one year. The Chancellor's Medal for tops in Classics, and Smith's Prize and Top the Wrangler in Mathematics went to two boys not from Winchester, Rugby, Eton, or Harrow. That was

enough of a scandal. That they were from the same school prompted the Earl of Clarendon to report that “There is a more robust education amongst the Middle Classes” and that they will take away from the “rightful” owners of the higher positions in society. Aldis was the best mathematician of his generation. But he could not get a job in England because he was a non-conformist. He didn’t subscribe to the Thirty-nine Articles. He taught instead at the University of Auckland in New Zealand. He and his wife were active in social reform, and they kept in touch with Abbott who was also active in social reform.

Howard Candler had eight children. Candler was the mathematics teacher of the group, Abbott's best friend, the “H. C.” to whom Abbott dedicated Flatland. He was the mathematics master at Uppingham School, north of London. He and Abbott corresponded every week for 25 years. As late as 1939, that correspondence existed, but it is lost now. There are references to them in 1939 in the history of Abbott’s school. I would love to find them. They would say a great deal about Abbott’s personal and theological development. Candler too was interested in mathematics, theology, and classics. He wrote a book called Groundwork of Belief. I'm sure that all the drafts of Flatland were shared back and forth. It helps to explain how Flatland is able to keep its tone through 100 pages without mathematical error. Candler kept Abbott honest.

Where did Abbott’s ideas come from? Charles Howard Hinton had some similar ideas (a man in whom in my colleague Rudy Rucker is interested). Hinton was the science master at Uppingham for a short period of time, 1881-85, while Abbott was writing Flatland. Hinton was thrown out of England for bigamy, and came to the U.S. to teach at Princeton. Hinton wrote an article, “The Fourth Dimension”, which appeared in 1880, and was then republished in the Cheltenham Ladies’ Gazette in 1883.

Abbott wrote three other novels before he wrote Flatland. They were written published pseudonymously. One was, Philochristus, Memoirs of a Disciple of Our Lord; another was, Onesimus, Memoirs of a Disciple of St. Paul. The first realized a project that Abbott had from the beginning. Abbott did not believe in miracles as popularly understood. He believed firmly in the supernatural. He believed firmly in the divinity of Christ. But he did not believe that Christ worked the kinds of miracles of feeding, of walking on water, or of withering fig trees. He did believe in miracles of healing, because they were easy to understand in terms of the kind of self-healing that can take place in the presence of a great power and encouragement. Abbott held this view for various reasons. Some of those reasons are important, some less so, because of the particular way in which miracles were interpreted in those days in non-biblical ways that Abbott could not accept. They weren’t taken historically. As a Classicist, Abbott knew the meaning of the words, and knew how the translation could be misleading. Abbott, in writing these two books, tried to recreate a non-miraculous Christianity, not to debunk or play down Christianity. He felt that Christ was more divine, more worthy of worship, more estimable, more to be followed, when you saw Him not in the context of miracles, but when you saw him in the context of the truth and beauty of His interior life, in the nature of His devotion to mankind. Abbott thought that the miracles got in the way; that is to say, Abbott felt that the rationalists of his day dismissed Christ too easily because they couldn't accept miracles. Abbott said that you could accept Christ fully as your Lord

and Savior without the miracles. He even tried to convince Bishops of the Church of this with very little success in the latter part of his life. Early in his life, he gave up public preaching because he really felt that he couldn't speak out about his understanding of these things. The boys whom he was teaching were likewise not ready for this sort of thing.

Abbott had a symbol which he developed of the "kernel and the husk" to help explain his views. In 1887 he wrote a book referring to Flatland as an example of the process by which you winnow away the husk. The beauty of Scripture comes wrapped in parables, in stories. The education of the individual and of the race is to remove gradually this hull, this husk, from the kernel. Later writers in Victorian England, and in Germany as well, picked up this metaphor. Abbott was looking at what we might call Natural Christianity. He thought that it was possible ultimately to give people this kernel of the truth of religion which they could hold onto no matter what onslaughts might come. Candler and Abbott ran into a number of temptations when they went to Cambridge. Later on when a lot of Abbott's students went on to Oxford to become top students there, their temptations were even stronger. The temptations were of four sorts, rather like four compass points. Abbott was trying to maintain a balanced position as a rationalist and supernaturalist as well. He was attacked on all sides. The social gospel people were not interested in this kind of theological worry. On the right in his own communion Anglicans were totally accepting of the Articles, and were not willing to hear of any deviation or modification of them. More seriously to the boys going off to college were the pulls not from the left or from the right, but from the north and from the south. T.H. Huxley, from the south, was an agnostic Darwinian. He led a lot of people into disbelieving in miracles. Abbott didn't want his students drawn down into the sediment of agnosticism.

Abbott was even more worried about their being drawn up into the airy superstitious world of Roman Catholicism. Abbott was very distrustful of Roman Catholics whom he thought perverted the message of Christianity by their incredulity. You can imagine who his demon was: John Henry Cardinal Newman. Abbott thought Newman was pretty good when Newman was an Anglican. Abbott wrote a two-volume work called The Anglican Career of Cardinal Newman. That was when Newman did his good work, according to Abbott. Abbott wrote another thing called Philomythus, an Antidote to Credulity. He wanted to call it A Grammar of Credulity as a direct attack of Newman's Grammar of Assent. He felt that "assent" really meant that Catholics had sold out to a wholehearted believe in any sort of miracle that anyone could come up with without ever asking what it meant. They accepted the form of the miracles without trying to understand the content. Abbott was very much concerned with the content.

The Honourable Peter Stanley Price, Q. C. Retired, one of the nephews of Abbott's wife, was willed a replica of a Greek chalice inscribed with "EAA-MEA July 1913", given to Abbott and his wife by their children for their 50th wedding anniversary (which happens to be exactly 100 years before mine). Abbott was married in 1863. Heptagon, Wilfred Vardy Candler, mathematician, in our own generation, whose grandfathers' names, Vardy and Candler, you by now recognize. He does mathematical economics, about which he's written a book.

Back to the Straight Lines. Wife Mary Abbott never went to college because she couldn't, but her daughter Mary went to Girton in 1891. The daughter was at the top of the Classics class in her second year, but according to a newspaper article from the time as a woman she was not eligible as were her father and her brother for the Chancellor's medal. In 1891 her father had just retired, so after two years she took off from school to nurse him through his "terminal" illness; of course it lasted 36 years!

Daughter Mary is the co-author with Abbott of his major project. He retired to devote his time to theology. He wrote over 20 books, some of them tracts like the one against Newman. In 1906 he wrote a book, Silanus, a Christian Philochristus had tried to take a look at Pharisaical Judaism as preparation for the Christian message; Onesimus looked at all the Greek philosophical positions and found them wanting. Abbott came back in the end to revelation. In Philochristus, the Pharisee meets Christ and gets a new View of Christianity; in Onesimus, the Pharisee meets Paul and gets a new view of Christianity; in Silanus, he gets a new view of Christianity from the philosophy of Epictetus. Abbott, the Classical scholar, wanted to see how all of the prevailing philosophies in society prepare people for the message of Christianity - how societies receive it; how they transmit it. In his retirement, Abbott wrote a 15-volume study of the New Testament called Diatessarica. His daughter Mary Abbott helped him with that, as well as with preparing a Johannine grammar which is still used today by New Testament scholars.

Abbott was ahead of his time in Biblical criticism. He wrote an article on the Gospels which ran to 50 pages for the Encyclopedia Britannica, 9th edition, in 1875. In this article he surveyed all modern scholarship on the authorship, meaning, and historicity of the Gospels, creating quite a furor, since he comes out at the end with his strange brand of spiritual, supernatural religion which believes in Christ's deity yet rejects miracles.

Abbott had some famous students. The Earl of Asquith, Prime Minister of England, in his biography credits the City of London School with giving him the opportunity to rise from the lower class. He credits Abbott as the primary influence in his education.

Another of Abbott's students was Granville Booth. Granville's father was William Booth, the founder of the Salvation Army, who wrote In Darkest England, describing the plight of the poor who lived right near Blackfriars Bridge. Granville went to the City of London School. He had a little trouble in one of the schools that he went to because people couldn't abide people who were a little different. In the City of London School he was accepted. He said that Abbott was the first person who recognized in him his inner light and encouraged him to follow it.

Abbott wrote a long report describing the kind of religion that he set up for the boys at the City of London School. It would teach them the essence of Christianity. They could take it from there. Abbott was opposed to proselytism. Oliver Gollancz, whose father was Sir Israel Gollancz, was one of Abbott's best students, a Shakespearean scholar who became a professor of English Literature at Cambridge. At a time when Jewish students were not welcome at schools that were preparing students for Oxford and



Cambridge, Oliver reports that his father was made to feel welcome and was encouraged by Abbott. Abbott had a broad, truly Christian understanding of trying to bring out the best of every person, trying to see each in his best light.

The concept that there is a higher order of existence that is known by revelation is very important to Abbott. Some people talk about Natural Religion as trying to intuit the higher order just from the nature of the world. In that sense then Abbott was a Revelationist. Mathematics, too, according to Abbott, is very Platonic. William Granville, the President of Gettysburg College who wrote the famous Calculus textbook, wrote a book called The Fourth Dimension and the Bible in 1922. His view in the introduction to that book is almost identical to Abbott's view: pure mathematics is known to God and revealed to men, like Sphere visiting from the fourth dimension, like some balloon being blown up and being allowed to shrink again.

Like Abbott, we have to consider the implications of having our three-dimensional world immersed in a four-dimensional world. Unlike Abbott, we mathematicians need to think of not just one but many possible four-dimensional worlds, not just a fourth spatial dimension, but definite metrics as well as indefinite ones, Euclidean as well as non-Euclidean spaces.

The Sphere in Flatland is another voice of Abbott the teacher, explaining to A Square that he really came from a higher dimension. The implications of that are tremendous. Abbott uses language in an important way: when A Square realizes that he is being visited from a creature of the Third Dimension, his language immediately shifts to religious language.

The Sphere can't understand. "Why do you talk to me that way?"

"Because you're a god."

"Why am I a god?"

"Because you can do all of the things that I associate with a god. You can touch my very insides; you can see everything; you can predict what I am going to do ahead of time. You have all power; you are not limited by time or by space. You know the whole scope of my existence. You must be a god."

The Sphere answers that question, and A Square receives it. Abbott wrote two other books, The Kernel and the Husk, to which I've referred, and The Spirit on the Waters, which have a long discussion on this portion of Flatland. The reason that Abbott wrote Flatland was to answer the question, "What properties does a being have that makes that being worthy of worship?" Why do we worship Christ? Not because of the power, not because of the miracles, not because of some things that any charlatan can do, some four-dimensional cutthroat coming down to amaze us. That would not mean that we should worship that being. We should worship a being because of his internal qualities. The key conversation in Flatland occurs when A Sphere finally realizes what is on the mind of A Square, why he confuses divinity with power. A Sphere says that the things that make a being worthy of worship are not just tricks to manipulate nature, but rather love, truth, loyalty, conviction and compassion. A Square says, "Wait a minute!

You're talking about the qualities of women!" The light dawns. Maybe there's something wrong with the disjunction in Victorian England. Maybe we have to bring these things back together: intuition and love along with the rational. The occupation of the saint, of the theologian, of the teacher is to bring those things back together. Abbott devoted his life to that.

Abbott's gravestone has on it a Celtic Cross, with a collection of knotted tori (see my cover for Martin Gardner's book), which in the 19th century was a symbol for transcendentalism. Sir Basil Blackwell was responsible for the 1926 republication of Flatland. He abhorred mathematics, but thought that Flatland was the best satire since Swift.

Cyril Stanley Smith, MIT Professor of Metallurgy, and philosopher-historian, owned a pre-publication copy of Flatland, dated October 1884, dedicated to Abbott's mathematician friend William Stedman Aldis, in memory of their school days. I own this book. I've willed it to Brown University. Smith sold it to me for \$100. He knew that it was worth more than that, but he knew that I would value it.

George Hunston Williams, Hollis Professor of Divinity at Harvard, teacher of Royal Rhodes, wrote on Victorian Christianity in 19th century novels. Flatland was one of his key sources. Two other good books on the fourth dimension are The Fourth Dimension Simply Explained, written in 1909 by my forbear Henry Parker Manning at Brown, and Sphereland by the Dutch writer Dionys Burger. Next year Dover Publications will reprint the former, and I'll be doing the introduction to it. Madeline L'Engle, in A Wrinkle in Time, explores also the relation between theology and dimensionality. I'm a consultant for the movie version of that book.

Salvador Dali's painting Corpus Hypercubus of Christ crucified on a hypercube, symbolizes the infinite folded down into the finite for our benefit. When I met Dali in 1976 I was surprised to learn that his image came out of the work of Ramn Lull, a polymath and mystic of the 12th-13th century. I had just heard about Lull when I sat in on a course in the Religious Studies Department at Brown on the history of the church in the 12th and 13th centuries in Spain and Italy, just on the side, having nothing to do with mathematics, so I thought. Dali loved to play visual tricks with his paintings, so that as we change our viewpoint different images come in and out of focus, so a picture of a woman looking out a window becomes a portrait of Abraham Lincoln, or a skull gives the illusion of a collection of monks praying. It reminds me of Abbott's work, From Illusion to Truth. We do not see things completely; we only see them in their illusions. Dali's final painting includes inflection points, and a swallowtail catastrophe, which forms the image of a chalice, once again combining mathematics and theology.

Follow your ideas. They will lead to places that you don't expect. You will see lots of illusions. Pay attention to those illusions, and beyond them you will come to truth.

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