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The Last Man Who Knew Everything
Thomas Young, Anonymous Polymath
by
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Engineers who know of Thomas Young only from their use of Young's Modulus in strength of materials will likely be surprised that he was a medical doctor, proved the wave nature of light, deciphered the Rosetta Stone, and made many other discoveries in a variety of fields.

Egyptologists who recognize Champollion as the decipherer of the Rosetta Stone hieroglyphics may not know that Champollion relied on Young original deciphering of hieroglyphics published in an early *Encyclopedia Britannica*, and that it was Young who subsequently deciphered the demotic script of the Stone. As a child his classical tutor, John Hodgkin, taught him Greek calligraphy, which helped him immensely in deciphering ancient Greek texts of the Rosetta Stone and other inscriptions.

Physicists who recognize Young's wave theory of light which upset Newton's claim of light being composed of particles, may not realize that Young was the first to recognize the two-slit effect of light, was the first to use energy as a physics term, first to understand that energy of a moving body increase as the square of velocity, first to determine the diameter of a molecule, first to use surface tension to calculate molecular tension, first to create a modern view of heat as molecular motion instead of a flow of a caloric fluid into a body, and first to imagine a spectrum of radiation from ultraviolet to infrared(1). At a time when light waves were still assumed to be longitudinal waves (compression and expansion) like sound waves, Young was first to discover the process of polarization of light and deduced correctly that light must be transverse waves. Combined with Fresnel's work, the Young-Fresnel theory of light explained reflection, refraction, diffraction and polarization, displacing forever the particle theory of Newton.

Ophthalmologists may be surprised to know that Young did basic research in the human eye, creating a much improved optometer for measuring refractive states of the eye. Along the way he discovered the process known as *astigmatism* due to a deformation of the eyeball during accommodation, which was only given its name by William Whewell some 30 years later. Using rings on a compass, he measured the transverse diameter of his own eye as well as the distance from retina to cornea, and did this unaided by anyone else in his own apartment. He did careful experiments to establish that accommodation was due to a change in the shape of the lens of the eye. Young established the 3-color theory of color sight in 1802. The "man who knew everything" was truly a "Physician of Vision" as Chapter Five is titled.

Young wrote this next passage, which I find much to agree with:

> **[page 178, Young in a letter to Hudson Gurney, 1809] The longer a person has lived the less he gains by reading, and the more likely he is to forget what he has read and learnt of old; and the only remedy that I know is to write upon every subject that he wishes to understand, even if he burns what he has written.**

Writing about what one reads is something I do a lot. Writing is an aid to memory, which is exactly how writing became invented by human beings. At a point around the time of Homer, humans were losing their ability to see into the spiritual world to refresh their knowledge and invented writing as a way of recording information. When I finish reading a book a vague memory of its contents exists in my memory, but after I have completed writing a review of the book, the memory of its contents solidifies and my review becomes a quick way of refreshing in my mind what interested me in the book. Given the currency of the verb "burn" to mean "write into a memory storage device", Young's statement takes on new meaning, for indeed, my reviews after I write, like the one you are reading, are *burnt* into hard drives locally and on remote computers for the world to be able to read.

When I graduated in physics, I became aware that most of the work being done in physics was like adding a few decimal places onto to physical unit like the speed of light or the density of platinum, and none of that kind of work interested me. This passage by Einstein is a droll way of saying the same thing as I thought after college, as I was trying to decide on a course of life's work for myself. I did not want to work on refining someone's theory to prove how good it was; I want to be on forefront of innovation myself.

> **[page 183, Einstein] I have little patience for scientists who take a board of wood, look for its thinnest part, and drill a great number of holes when the drilling is easy.**

During a summer job at a Celotex factory I worked for several weeks drilling holes in acoustical tiles. Each tile was fed into my machine and my job was to pull the lever down until the large array of drills penetrated about a cm or so into the board. It was an easy enough job, but I learned an amazing lesson while filling in for the person who was on vacation. I was working next to an old man, and asked him how long he had been doing this job. "Thirty years" was his answer. I suddenly created an image of my doing this job for that long and I realized that could never happen for me. Recently during the financial collapse of mortgage banks, I was listening to a conversation among lawyers and one mentioned a lawyer who retired recently after working on a case for thirty years! One case. He started on the case when hired by some large law firm and when he retired the case was still under litigation. The similarity of the old man at the drill machine and the old lawyer with the one case are spookily similar. Scientists can create new hypotheses and theories can form from them or they can find easy places to work on existing planks in current theories. Young, whom I admire immensely, was of the former kind of scientist.

Scientists, true scientists, begin with a hypothesis which leads to experiments and if the experiments confirm the hypothesis over time, the hypothesis grows to be called a theory. In the passage below, Andrew Robinson explains and quotes Young's response to invectives about his work by reviewers in Edinburgh.

> **[page 117, 118] This debate continues even today, in that non-scientists generally imagine that scientists first do experiments and then look for hypotheses to explain the results, whereas in fact, normally, hypothesis determines experiment, which then acts as a check on the hypothesis. Young explains this cogently in his reply:**
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> > **[T]here are two general methods of communicating knowledge; the analytical, where we proceed from the examination of effects to the investigation of causes; the other synthetical, where we first lay down the causes, and deduce from them the particular effects. In the synthetical manner of explaining a new theory we necessarily begin by assuming principles, which ought, in such a case, to bear the modest name of**

> **hypotheses; and when we have compared their consequences with all the phenomena, and have shown that the agreement is perfect, we may justly change the temporary term hypothesis into theory. This mode of reasoning is sufficient to attach a value and importance to our theory, but it is not fully decisive with respect to its exclusive truth, since it has not been proved that no other hypothesis will agree with the facts. It is exactly in this manner that I have endeavored to proceed in my researches.**

Thomas Young may have known everything, but he wasn't right about everything, but neither was the author of this book. Robinson makes a common error in assuming that the ciliary fibers are muscles which compress the lens of the eye to alter its curvature. Here is his statement:

> **[page 38] The human eye does accommodate by changing the curvature of its lens. But he was wrong in considering the lens itself to be muscular. In fact, the ciliary muscles, a set of radial muscles that surround the rubbery, jelly-like, non-muscular lens, are what alter the curvature. The function of the ciliary muscles was not known in Young's time, and so he attributed muscularity to the lens itself.**

Young was wrong in that there are no muscles in the lenses itself. Robinson is wrong in implying that the ciliary muscles squeeze the lens to create a focus. There are tiny ligaments which pull the lens flat and the ciliary muscles must work against these ligaments to compress the lens. Reading something up close requires constant work by these muscles resulting in cramps of these muscles and a steady state of myopia, such as beset Thomas Young as his own calculations of his eyes proved.

> **[page 74] The near point of his own eye, after he had made the adjustment for the convex lens, turned out to be eight inches; the more short-sighted a person is, the nearer to the eye is his or her near point. In due course Young must have realized his myopia, because in his autobiographical sketch he writes: "He felt some inconvenience in society from being a little short sighted, and he used to attribute in part to this circumstance the mistake which he sometimes made respecting the impression produced by what he said or did, on the feelings of others." (It seems possible that the frequent cases of mistaken identity in the dramatics plots of plays and operas of Young's age were more convincing to audiences then than they are now, because many people were short-sighted and did not wear spectacles.)**

One can only wonder what kinds of physical ailments, symptoms, or limitations appear as plot devices in current movies. The movie "Rain Man" is one example of creative use of an autistic person as a plot element.

On a trip to the British Museum, I was hurrying to get to Lord Elgin's marbles when I skidded to a stop in front of a plexiglass case, and stared in awe. In front of me was the famous Rosetta Stone! I stood in awe as I walked slowly around the stone. It contained the key to deciphering the hieroglyphic language of ancient Egypt. It contain parallel translations in hieroglyphics, demotic script, and Greek. As I learned later, the three languages were the *fane* or religious language Egyptian hieroglyphics, the *pro-fane* or outside-the-temple demotic language of the *demos* or common people, and the language of commerce at the time, Greek. Scholar could read the Greek script and were amazed to find this statement on the Stone near the bottom: "This decree shall be inscribed on a stela of hard stone in sacred and native and Greek characters and set up in each of the first, second, and third temples beside the image of the ever-living king." (Page 151) The next step was to find the equivalent expression in the hieroglyphics to those in Greek, a daunting task for a language for which no known speakers had been living for many centuries. Thomas Young's familiarity with Greek from an early age and his close work with calligraphy in Greek gave him a head start in the deciphering process which those who followed him used to their advantage, often without crediting Young's work, especially by Champollion who ignored Young's pleas to relent in his monomania to receive *the* sole credit.

[page 220] Either Champollion had too much vanity to concede anything important to Young, or he had genuinely convinced himself, through his long years of obsession with ancient Egypt, that the crucial first steps were really taken by him — or perhaps there was an amalgam of both feelings in his mind. By sticking intransigently to his claim of sole authorship, he achieve his ambition and came to enjoy general acceptance as *the* decipherer of the Egyptian hieroglyphs. But in so doing he lost his good name. Young was right in his gentle warning: Champollion's personal reputation will forever be tainted by his hubris toward Young.

Several more items of Thomas Young's work: he became one of the first insurance doctors, he suggested that seismic waves due to earthquakes were similar to longitudinal sound waves of compression and expansion, and proposed correctly that "the elasticity of a solid must be proportional *not* simply to its density, as was known to true of elastic fluids, but to the square of its density." (Page 128)

The Jesuit priest Athanasius Kircher was called "the last man who knew everything" from which the title of this book apparently came. (Page 146) Young may not have known everything, but he certainly drank deep from the Pierian Spring as Alexander Pope wrote in Young's favorite passage as a young man (Page 18)

A little learning is a dangerous thing;
Drink deep, or taste not the Pierian Spring . . .

Pieria was the legendary home of the Muses on Mount Olympus and Thomas Young's deep draughts from this fountain of inspiration and intuition proved a boon for humanity, as he single-handedly in so many diverse ways bootstrapped science and industry into the modern age.

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Footnote 1. All these things and others, he described in the book, *Natural Philosophy*, in 1807.

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