

## THE THRILL OF DISCOVERY<sup>1</sup>

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In the process of communicating to the student or the lay person, we often forget to point out why it is that scientists are involved in their esoteric explorations of the universe. As a result, the scientific endeavor is painted as being somewhat removed from “real life.” This unfortunate misconception can be remedied by discussing the thrill of discovery.

Scientists love to “boldly go where no man has gone before.”<sup>2</sup> The act of discovery produces a heady sensation akin to the thrill of victory for an athlete. The thrill may come as a surprise, as the result of a serendipitous turn of events, or may be experienced at the conclusion of a dedicated piece of research whose endpoint was always understood. In either case the joy is associated with the revelation of what was previously unknown or not understood. It is this joy that is the reward for the researcher.

Myth would have us picture Archimedes in his bathtub solving the problem of why objects float. He rushed into the street, naked, shouting “Eureka! I have found it!” Witnesses concluded that he had “lost it,” but the moral of the story is clear. This was his moment of joy that accompanied insight, a moment associated with the thrill of discovery.

Abraham Maslow, the psychologist, has described a “peak-experience” as “...the single most joyous, happiest, most blissful moment of your whole life.”<sup>3</sup> This is precisely how the astronomers I interviewed described the thrill of discovery. Comparison of the two phenomena suggests they are indistinguishable. Maslow described peak-experiences in the context of esoteric pursuits where a deep insight, a “discovery,” may sometimes even lead to the founding of a new religion. The scientist who has a profound insight cannot run outside, proclaim to all and sundry that he has “seen the light,” and then expect his colleagues to “believe.” He has to calm down and dispassionately report what he has just understood. It is his duty to communicate the essence of his discovery in order to show others that it was meaningful and adds to the fund of shared scientific knowledge.

The thrill of discovery can be experienced in a different context, as an astronomer/teacher once reminded me. “The first time it happened to me, even before it happened in my research career, was when I had to teach. Every time I understood another piece of what I had to teach, I felt elated.”

The thrill of discovery, of experiencing insight or understanding can propel someone into a state of ecstasy, euphoria, or elation that may last minutes, weeks, or

<sup>1</sup> An expanded version of this talk appears in *Interstellar Matters* (Springer Verlag, 1988).

<sup>2</sup> Star Trek.

<sup>3</sup> Maslow, Abraham H., “Music Education and Peak Experiences,” *Journal of Humanistic Psychology*, 2, 1962.

months. The memory lasts forever. Once someone has tasted the thrill of discovery, he/she will devote the rest of his/her life to the pursuit of more of the same, and be willing to do so with amazing dedication. Is this not a benign form of addiction?

A heartening fact for the student who has not had the experience is that achieving this thrill does not depend on having lots of qualifications, training, or even brilliance. It is given as a reward for curiosity.

An astronomer recalls a night when he was 12 years old. He was looking at Saturn through a small telescope. The night was partly cloudy and the planet appeared but briefly. As the child gazed upon the magnificent rings, he suddenly felt that he was the only person in the world who, in that very instant, was looking at Saturn. It matters not whether he really was; what matters is that he believed it. He described the sensation. "I suddenly felt one with the Earth and the universe. There was nothing else." A wave of elation and euphoria swept over him and decided his career. This was the peak-experience in full cry. "I knew then that I would become an astronomer, no matter what it took."

Maslow reported that peak-experiences have the characteristics traditionally associated with moments of deep religious insight, as culled from the recorded history of many creeds and faiths.<sup>4</sup> The great difference between the scientific endeavor and the esoteric tradition is what the experiencer does *after* having the sensation. For the esoteric and his followers it is enough for him to say that he has "seen the light." He does not have to prove anything to anyone. His followers need only believe. But the scientist must explain what the light has revealed. Otherwise the experience has no significance beyond the personal thrill induced. Scientists must find the words to enable them to report what it is they understood or discovered so that others may achieve an equivalent level of understanding. Thus science as a discipline moves forward, evolving through sharing, while religions and sects remain static, rooted in the words of a founder who did not have to "prove" anything to anyone.

An astronomer recently spent years analyzing data related to the structure of the spiral arms in the Milky Way. Day after day he worked at it. Then suddenly it happened! "One day I heard the Galaxy," he told me excitedly. "I hesitate to admit this, but I heard the music." He stared at me, wondering if I would think him crazy. "I could hear the music of the spiral arms. They have motion within them and I could hear it! It was an incredible feeling. I understood!" He confessed that it was the greatest moment of his life, could not tell his colleagues, and wasn't optimistic that anything as wonderful would ever happen to him again.

Then he had to confront the astronomer's next great challenge. After the elation wore off he had to write a report on his research. Today his neatly rational paper on the structure of the spiral arms rests between the covers of a journal in astronomical libraries throughout the world. The report makes no mention of his moment of profound insight, nor of the music.<sup>5</sup>

<sup>4</sup>Goble, Frank G. *The Third Force*. Grossman Publishers, 1962. New York.

<sup>5</sup>The reader will appreciate that most of these "confessions" were obtained with the promise not to reveal names, a sobering comment on our shared attitudes toward the conduct of scientific research and the image that researchers find they need to uphold even in the eyes of their peers. This topic surely deserves further, more formal, research.

Frank Goble noted that “the peak-experience may be brought on by many causes: listening to great music, a great athletic achievement, a good sexual experience, even dancing.”<sup>6</sup> And, we must add with considerable emphasis, by the thrill of scientific discovery, by the satisfaction of curiosity that accompanies understanding, by the completion of a piece of research. Seeking this feeling may be the strongest driving force behind the scientific endeavor, but it is never mentioned, because, as Maslow put it, the experience is intrinsically “unscientific.”

Recently, astronomers at the Naval Research Laboratory in Washington, D.C., reported the discovery of a fascinating new phenomenon. A dark, unseen, mass had moved in front of a distant quasar and interfered with the radio waves on their way to Earth. A few months later everything was back to normal. The moment of recognition of this phenomenon (called an extreme scattering event) is etched vividly in the mind of Dr. Ralph Fiedler. It was a moment that culminated months of hard work for him. “I was elated and ran screaming and shouting down the corridor,” he says, expressing a feeling to which many a researcher can relate. But his elation had to be tempered so that he and his colleagues could take up the challenge of explaining what had been observed. And when the explanation was found, the thrill returned; it was a little less intense perhaps, but still a delight. (The dark masses responsible for the phenomenon are suspected to be diffuse clouds of hot gas, having planetary dimensions, that are more numerous than stars in the galaxy.)

The discovery of a supernova, the explosive death of a star, has provided a rare thrill for only a handful of human beings in recorded history. Not since the times of Tycho Brahe in 1572 and Johannes Kepler in 1604 had anyone actually seen a supernova with the unaided eye; not until February 24, 1987, that is. On that night, at Las Campanas Observatory in Chile, astronomer Ian Shelton discovered a star in the act of exploding.

“I don’t think anything is going to replace that night of actually seeing it for the first time. That was memorable.” These were Shelton’s words on the *Nova* television program describing the discovery of Supernova 1987A.

The thrills and the rewards that accompany scientific research are personal and scientists have conspired mightily to keep this a secret. They have come to be pictured as slightly inhuman beings in white coats pursuing lofty goals for reasons no one understands. Yet they are human, and the truth is that scientists “get off” on what they do.

Everyone can experience the thrill of discovery, even if you don’t have a Ph.D. All you need do is exercise your curiosity and be willing to recognize that there are things in nature worth discovering for yourself. So why not say *yes* to curiosity? Embrace those moments when questions presents themselves. Seek solutions and find out how beautifully elegant the world of nature is. Prepare to enjoy the thrill, the “high” that is the reward. It could present you with the “single most joyous, happiest, most blissful” moment of your life.

<sup>6</sup>Goble, Frank G., *op. cit.*

## Discussion

C.R. Chambliss: *It is extremely important in introductory astronomy courses to discuss scientific methodology. What is science? How does the scientific method work? The pseudo-scientific natures of such topics as astrology and creationism should be explained. Important concepts such as the falsifiability of a theory should be carefully explained. A good scientific theory, of course, is one that is falsifiable (i.e., testable) but that has not been falsified.*

G.A. Carlson: *I share with my students a comment I read that a high percentage of Nobel prize winners and of science fiction writers in past decades were “turned on” by seeing Halley’s Comet in 1911.*

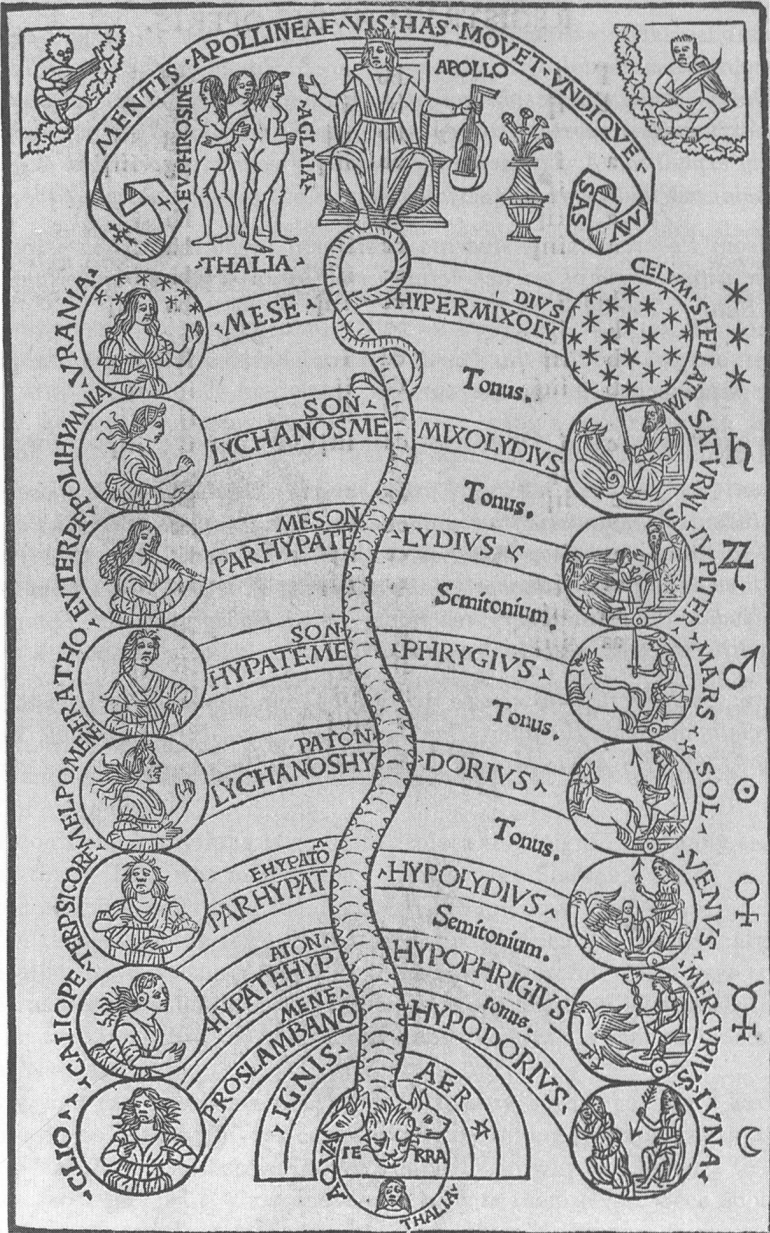
W. Osborn: *Do you feel that this “thrill of accomplishment” is one of the purposes of problem sets, such as in physics courses?*

G.L. Verschuur: *Absolutely. Or at least it should be. Too often this is forgotten.*

H. Shipman: *As you were talking, I asked myself, “how do I share these feelings with my students? Quotations from unnamed sources in a book just won’t do.” The American Institute of Physics (335 East 45th St., New York, N.Y. 10017) sells an audiotape, recorded at the telescope, of the discovery of optical pulses from the Crab pulsar, including the astronomers’ reactions: “It’s a bloody pulsar!!!” (Emphasis in the original.) This tape, and the few others like it, would be good sources.*

J. LoPresto: *Such excitement can be realized by beginning students with the use of a commercially available H $\alpha$  filter (DayStar Filter Corp., P.O. Box 1290, Pomona, California 91769, U.S.A.) to be used with small telescopes to observe the sun.*

PRACTICA MUSICÆ FRANCHINI GAFFORI LAVDENSIS.



*Music of the Spheres*, artist unknown; Title Page of *Practica Musicae*, by Franchino Gaffurio. Chapin Library of Rare Books, Williams College. Further information on page 433.