Inner Dialogue: James Talmage's Choice of Science as a Career, 1876-84

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James E. Talmage was born to be a scientist. When he arrived in Utah in 1876 at the age of fourteen, he was attending Brigham Young Academy within a few weeks. During the next eight years, he finished the complete course of the academy, taking virtually every grammar, academic, normal, and scientific class offered and receiving every certificate and diploma awarded. For the next four years, he continued to take classes, teaching part-time for one year, full-time for three, and building a reputation throughout Utah Territory as a talented lecturer. In the summer of 1882, as a young twenty-year-old, he journeyed east to South Bethlehem, Pennsylvania, to complete an intensive one-year course in analytical chemistry at Lehigh University. He moved to Baltimore a year later to continue his scientific studies at Johns Hopkins University, then rejoined the BYA faculty in 1884. His academic emphasis had been an unbroken line toward his chosen profession.

Perhaps Talmage's interest in science was first quickened by his grandfather, James Edward Talmage, an herbal doctor in the village of Ramsbury, Wiltshire, England.[1] Young James lived with his grandfather from three to five while attending infant school, and visited often in later years, sometimes just to walk in the woods and visit, sometimes for weeks and months while James attended school in Ramsbury.[2] Occasionally he traveled with the older

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[1] See *The Contributor* 16 (Feb. 1895), p. 229, based upon an interview with James E. Talmage. He also said that his father followed the herbal profession "afterward."

[2] Most biographical accounts written about him refer only to his attending infant school in Ramsbury and subsequently the National School in Hungerford. However, his "Notes on English History" (see Talmage Papers, Brigham Young University Library, Box 9 Folder 1; hereafter cited as Papers), which he copied over to use as the basis for a lecture at Brigham Young Academy were clearly labeled, "Ramsbury, Wilts, 1872." Add to this his statement that he attended school in Hungerford only intermittently between the ages of five and twelve.

man.[3] In 1874, shortly after graduating from the National School in Hungerford, Talmage and his grandfather toured Wiltshire and Berkshire. On this tour, as in their earlier tramps through the woods and along the streams closer to home, they undoubtedly looked for herbs. In such settings, the elder James taught James his first simple botany lessons, awakening a love for nature that never died.[4] James gathered, identified, and labeled a collection of botanical and mineralogical specimens which he took with him to Utah two years after his grandfather's death in 1874. Later, as the first curator of the museum collections of the Brigham Young Academy, he added his personal collection to the holdings.[5]

James Talmage's English schooling appears to have contributed little to stimulate his interest in science. He was taught religion, geography, English history, reading, writing, arithmetic, singing, and perhaps physical education in the form of cricket. The daily regimen at all levels above infant school was prescribed and strict (as was the discipline), including forty-five minutes for religion, hymn singing, and catechism.[6] History and geography stressed the greatness of English accomplishments and were designed to instill pride in the empire and its heroes — political, military, and economic. Geography students were required to know the minerals and principal coal fields of England, but that was as close to science as any part of the basic curriculum came. Memorization and recitation were emphasized. Examination questions asked for description or simple recall rather than analysis or independent thinking.[7] It is possible, though unlikely, that James also took courses in algebra, geometry, natural philosophy, natural sciences, political economy, physical geography, English literature, French, Latin, or German.[8]

This education, not directly relevant to science, taught him the indispensable skills of hard work, a sense of order, and self-discipline. He also became precise in the use of language and developed a retentive memory. Many of these traits were reinforced at home where he helped his parents manage the Bell Inn. Hungerford was a prosperous resort and market town on the main east-west thoroughfare between London and Bristol, about an hour away from London by train. In its shops, lecture hall, and library, and from the passage of travelers in and out of the Bell and other inns, there was much to develop the powers of observation necessary to a successful scientist. Thus, when young

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[3] *The Contributor* 16 (Feb. 1895): 229.

[4] See Papers, Journal, Vol. 2, 4 April and 12 Dec. 1881; and the preface of *First Book of Nature* (Salt Lake City, Utah: Geo. Q. Cannon & Sons Co., 1888). According to his son, Talmage frequently told his children stories of the elder James's influence. John R. Talmage, *The Talmage Story* (Salt Lake City, Utah: Bookcraft, 1972), p. 1–2.

[5] Ernest L. Wilkinson, ed., *Brigham Young University. The First One Hundred Years* (Provo, Utah: BYU Press, 1975) 1:169.

[6] The Hungerford National School had a boys cricket team. Whether James participated is not known. At Lehigh and Johns Hopkins he attended sporting events and made limited use of the gymnasium.

[7] See Examination Paper for Standard VI., Papers, Box 9 Folder 1.

[8] The decision to add any subject beyond religion, the three R's, singing and sewing for the girls was made by each local school.

James left England, though he had not yet consciously chosen to devote his life to science, the seeds had been planted.

The chief nurturer of the seeds was Brigham Young Academy's principal, Karl G. Maeser. Between August 1876 and June 1879, Talmage took about forty ten-week classes from Maeser ranging from arithmetic, rhetoric, and composition in the Grammar Department to natural philosophy, chemistry, and geology in the Academics Department.[9] In each class, Maeser did his best to carry out Brigham Young's admonition to teach nothing without the spirit. For example, he told his students in the "Theory of Teaching" that they must "introduce the subject [of religion] . . . wherever the opportunity offers"; and if the authorities prohibit a course in either theological or moral instruction, then "incidental instruction must be thrown in, for which numerous opportunities are presented. For instance, in the geography of South America the wide-awake teacher could instruct in regard to the history and travels of the Nephites and Lamanites. In the geography of the eastern states, the site of the burial of the plates etc." [10] In a similar spirit, Maeser taught Talmage about science and made science more attractive because he reinforced the spiritual mind-set Talmage had acquired in England.[11]

Maeser's first love was the art of teaching, and his greatest expertise was in the classics. However, he also had an adequate knowledge of the sciences.[12] With the proper textbook, he taught all of them at an elementary level.[13] Talmage's 1876 geography notes capture Maeser's typical mix of Mormon teachings and science and his tendency to oversimplify when teaching without a text (as he was in this instance):

THE CREATION

We have two sources by which we gain a knowledge of the creation viz. 1st Revelations in Scripture and 2nd by Geological discoveries. The 1st source viz Revelations in Scripture will be found in Genises (See Bible). We find there that God showed Moses six visions — I. He saw only mists huricanes & fearful commotion. II. Saw that the huricanes had ceased & also the waters had separated from the clouds, and rocks peeping out from the Oceans. III. He saw the rocks had been washed, powdered and decomposed which formed soil, which was green with small plants, & the waters had cooled off & had in them some small animals, IV. appeared as trees on the land with great animals in the water & in the air. V. He saw all kinds of monsters on land in water & in the air. VI. appeared to him in its perfect state with man in Garden of Eden. We cannot say how long a time elapsed between these great changes, but must have been millions of years. The Bible says God created the world in six days,

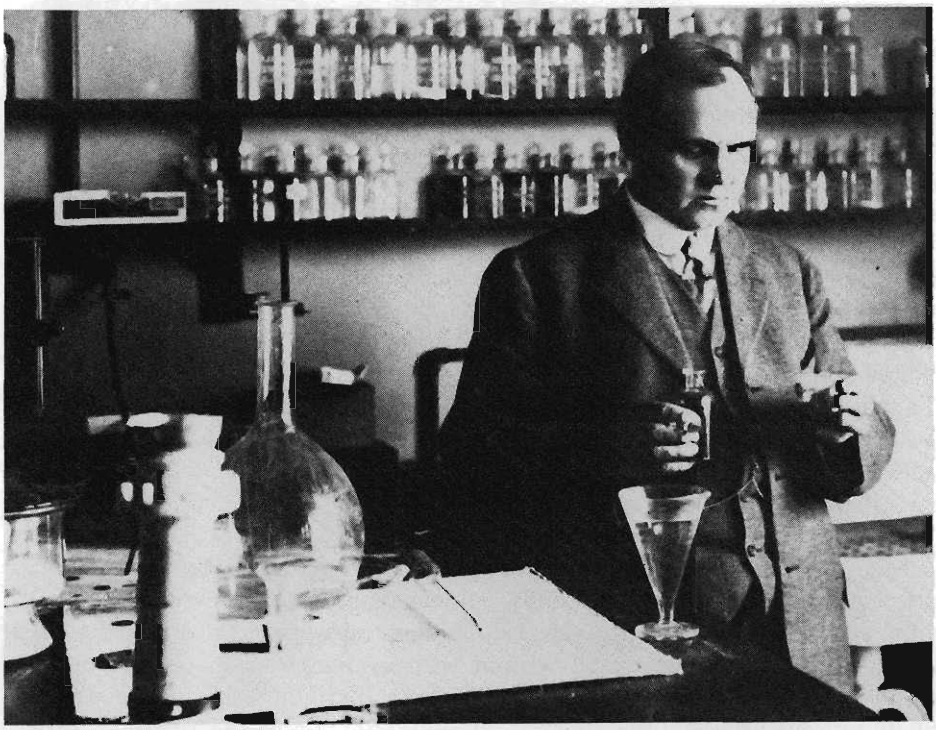
[9] For the number of classes Maeser taught, see Brigham Young University Archives, hereafter cited as UA, Register of Studies, which is not extant for the period of 1877–79, the Circulars, and the notes and examinations of Talmage in Papers, Boxes 9 and 10.

[10] Papers, Box 9 Folder 4, "Theory of Teaching," p. 41.

[11] *Talmage Story*, Ch. 1.

[12] BYU Centennial History 1:159; Douglas F. Tobler, "Karl G. Maeser's German Background, 1828–56; The Making of Zion's Teacher," *BYU Studies* 17 (Winter 1977): 155–75.

[13] Maeser taught his students that the teacher of primary and intermediate grades must have a thorough understanding of all the natural sciences even though "formally, in a common school these can claim no place." See Papers, Box 9 Folder 4, "Theory of Teaching," p. 93.



but this does not mean the time which we call days now, viz 24 hours it means simply 6 great periods. We also read of two creations spiritual & temporal. Whenever any Geological discoveries are made they verify the statements of the Bible though we must not take the Bible as a History it was never meant for it.[14]

In the Academic Department, to students planning to be teachers, Maeser stated that the aims of the natural sciences were:

1. To become acquainted with Nature.
2. To learn to utilize the elements of nature for the use and benefit of self and others.
3. To demonstrate the wisdom and goodness of the Creator.[15]

Maeser depended heavily upon "Steele's Series in the Natural Sciences" [16] in his lectures and examinations. Each volume reprinted a verse of scripture or a poetic verse about the Creator on the title page and there were abundant references to the "work of the Creator" throughout the text. They were also interestingly written, difficult enough to challenge the best students but simple

[14] Papers, Box 10 Folder 6, Geography Notes. Allowances must be made, of course, for any distortion of Maeser's teachings as they passed through Talmage's mind; however, all of Talmage's BYA notes are extremely valuable for the content of what Maeser actually taught in the early years as opposed to what he said ought to be taught in his 1898 *School and Fireside.*

[15] Papers, Box 9 Folder 4, "Theory of Teaching," p. 132.

[16] J. Dorman Steele, *Fourteen Weeks in Physics* (New York, Chicago, and New Orleans: A. S. Barnes & Company, 1878). Other titles in the series were physiology, zoology, chemistry, astronomy, and geology. Steele was an educator who achieved great success as a popularizer of science.

enough to be partially understood by the worst. There were regular encouragements to further reading for the eager students.

Maeser also encouraged interest in science outside the classroom. The earliest circulars of the academy spelled out plans for a museum and laboratory. In his term report of June 1877, Maeser reported on growth in the museum's botanical and mineral specimens, lamenting that they lacked organization and further lamenting the lack of a chemical laboratory and astronomical apparatus.[17] The museum or cabinet, established in October 1876, had grown from student/citizen donations and from at least one faculty-led field trip with twenty-one students to gather specimens from a nearby mountain.[18] Maeser and the other academy faculty used the specimens in their Pestalozzian "object-lesson" teaching. On 21 August 1878, Maeser appointed Talmage the first curator of the BYA Museum and added the laboratory as well, only a few pieces of equipment without a place to use them until October 1880. The honor probably reflects Talmage's interest, enthusiasm, and the donation of his personal collection.

During those first three years, Talmage learned a great deal of elementary science and developed increasing enthusiasm for it. By June 1879, he had taken courses in natural philosophy (physics), chemistry, physiology, astronomy, geology, and electricity. His examination answers in the sciences tended to be longer and more exact, written with assurance and accompanied by detailed drawings, while his test responses in other courses were merely adequate or very brief.[19] One algebra examination contains this response to two problems: "Absent when information covered." [20]

After he received his normal diploma in June 1879, Talmage began to teach full-time at the academy. His intellectual pace quickened and the pressures and influences in his life multiplied until he felt propelled toward a decision about his future in science. He taught his first science course, elementary physiology, in the spring of 1880. At that point Maeser had sufficient confidence in his student to recommend to a bishop and his wife that seventeen-year-old Talmage operate on their son, who had a bullet lodged in his thigh as a result of a hunting accident. Talmage and Maeser were boarding with them at the time on a tour of schools in southern Idaho, far from a doctor. Maeser's confidence was not misplaced. Talmage removed the bullet, the boy recovered nicely, and Talmage's self-confidence and interest in things scientific grew correspondingly.[21]

When Maeser informed Talmage that he would be teaching chemistry — along with two other science courses — in the fall of 1880, Talmage took a

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[17] UA, Register of Studies, June 1877.

[18] UA, 186 Folder M50 Vol. 1, p. 19.

[19] For example, compare the essay entitled, "What arguments have we that Joseph Smith was sent of God?," in Papers, Box 9 Folder 2, with "The Cotton Gin" and "The Microscope" in Papers, Box 9 Folder 3.

[20] Papers, Box 9 Folder 7.

[21] Journal, 28 July 1880.

three-week intensive course in qualitative analysis with Professor Thomas Hadley of Ogden. Hadley, an assayor, was an old friend of the Talmages who studied chemistry in England. He taught Talmage fundamental chemical analysis procedures and formulae. Neither Maeser nor George Coray, who had taught Talmage elementary experimental chemistry at BYA during 1879–80, had sufficient background in chemistry to supply this information, and Maeser supported Talmage's request to draw an advance on academy funds to complete the course.[22]

Until Talmage left for Lehigh, he taught virtually every science course offered at the academy. He also continued to teach penmanship, reading, grammar, Latin, and drawing — a total of eight classes during the first term in 1880, and ten during the second, plus the classes he took as a student. Apparently Maeser was not totally sympathetic with this desire to continue taking science classes while teaching full-time. Although he arranged Talmage's teaching schedule so his free periods coincided with the times the science classes were offered,[23] he did not reduce his teaching load or increase his salary despite Talmage's regular complaints that he was worth more money.[24] To his credit, however, especially in light of financial difficulties experienced by the academy in its early years, Maeser supported Talmage's growing demands for chemicals and scientific apparatus. Talmage records happily in his journal on 15 December 1881 that Maeser agreed to replace a new microscope because its magnification was not powerful enough for their needs. On January 21–22, 1882, after a successful public experiment by some of Talmage's students, he promptly requested another $150 worth of supplies while, as he put it in his journal, there was an "excess of good feeling" from Maeser and the board.

Without any lessening of the love and respect they felt for each other, the inevitable differences of the role shift from student to colleague began to develop. For example, to Maeser, education meant to draw out and cultivate "that contained in the mind, more than crowding new subjects continually into the mind." [25] In contrast, Talmage tried to learn everything he could about every subject he could with an emphasis on science. By early 1882, he proposed to take his insatiable appetite to the infidel and anti-Mormon east. Maeser could not approve. His aversion to eastern education was profound.[26] His concern for the spiritual safety of a beloved student must have been intensified by the academy's financial problems and his concern over the added cost of Talmage's activities.

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[22] Journal, August 1880; *Ogden Daily Junction* Aug. 23–24, 1880; Maeser to John Taylor, 23 July 1880, UA. Maeser correspondence, Box 1 Folder 2; U.S. Census for 1900, Utah, Salt Lake 3rd Precinct, Roll #1241684, 12 June, District 273, Sheet 12 page A; and Papers: Scientific Analysis in Box 10 Folder 2, Chemistry Tables in Box 9 Folder 8 and "Scraps" in Box 10 Folder 6.

[23] UA, Register of Studies, 1880–81.

[24] Journal, regular entries 1879–82, see e.g., 6 Nov. 1880, 17 June 1881, 25 Aug. 1881.

[25] Papers, Box 9 Folder 4, "Theory of Teaching," p. 7.

[26] BYU Centennial History 1: 215, 224.

However, Talmage found encouragement and financial support from other friends — probably George Coray and Joseph M. Tanner who encouraged him strongly after he was in the East and presumably earlier. Tanner, who wrote him regularly, was Talmage's immediate supervisor at the Academy, a man with an open and inquiring mind and a devotion to learning. Coray, the first person to teach and examine Talmage in the results of specific experiments, shared Talmage's interest in experimental science. Both Tanner and Coray would follow Talmage east, Coray to Cornell in 1883 and Tanner to Harvard in 1891.[27] Their combined financial support amounted to over half the cost of Talmage's year of study at Johns Hopkins University.[28]

Other supporters were Thomas Hadley and Joseph L. Barfoot, long-time curator of the Deseret Museum whom Talmage had met at the museum in February 1881. Thereafter they exchanged specimens and Barfoot helped Talmage with specimens at the BYA museum. Talmage credited Hadley and Barfoot with awakening his interest in nature.[29]

J. L. Townsend, a Payson pharmacist and taxidermist who also composed music and poetry, gave him a one-day course in taxidermy 4 April 1881; and Professor Richard A. Proctor, a famous English astronomer, gave public lectures in Salt Lake City, February 7–8, 1881, from which Talmage learned of the controversial theory about the birth, growth, decay, and death of worlds. On both occasions, he also commented in his journal about their personalities. He disliked Townsend's conceited nature (because it reminded him of his own conceit) and observed "that, though Prof. Proctor's theory is logical and fascinating, I am able clearly to see how he lacks that firmness, which one who has just claim by his Priesthood on the spirit of God will possess. Proctor says that the theory of the winding up scene being at hand is without foundation; that it is the 'Cracked-brain project of the nineteenth century;' as every century has been characterized by some such alarm. Prof. Proctor with us all will find out."

Interestingly enough, there is no direct evidence that either Maeser or Talmage were aware of the writings of Orson Pratt during Talmage's early years at the Academy. This is curious, for one would expect that Pratt, as the first Mormon scientist well-known to his own people, would have been one of Talmage's chief role models, not only as a scientist but also as a proponent of natural theology to which Talmage would later make significant contributions.

The encouragement of like-minded friends was important, but more important to Talmage was his appetite for information coupled with pressures from lecturing and teaching. Talmage combined full-time teaching with public lectures. Beginning with short talks before the BYA Polysophical Society, he soon began responding to invitations from bishops and youth groups all over Utah Valley and beyond. He spoke on a wide variety of topics including the Crusades, science and art, sketches from history, change, composition of water,

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[27] UA, biographical files for both men.

[28] Journal, 27 June 1884.

[29] See *The Contributor* 16 (Feb. 1895): 231.

sneezing, Milton's and Longfellow's poetry, the Norman Conquest (taken directly from his English schoolboy notes), electricity, language, how to teach the sciences, Roman history, the story of a rock, and the history of the earth.[30] Two favorites, which were repeated many times, were "Leisure Hours," which he once delivered to 400 people in Spanish Fork, and "Custom and Its Consequences," which he delivered to a "large congregation of young people" in Ogden and to packed tabernacles in St. George and Manti.[31] He was apparently an effective speaker even as a young man — he delivered Provo's Fourth of July oration in 1881[32] — but also seemed unwilling to refuse an invitation.

He felt insecure and inadequate when he began teaching science, though his classroom poise, dignity, and self-assurance covered such feelings. He completely reworked his class notes, rereading the texts, taking additional notes, and working at least partially through their bibliographies.[33] In the process, he first read British natural philosopher John Tyndall on sound and light and the *Manual of Geology* of U.S. geologist James Dwight Dana.[34] He rewrote his notes every night in preparation for the next day's lectures, getting by on four to five hours of sleep a night. Later he would confess that he had no inherent love for teaching,[35] a condition his feelings of inadequacy no doubt exacerbated.

His efforts in the classroom also seemed unappreciated. In late 1881, after a full year of teaching science, he lamented that the students seemed "to care for science but little" and that to many the very word was a "revolting name." [36] Not only did he feel wounded because of his love for the subject, but his continued teaching depended on student enrollment. Science courses were listed as optional and were not always well attended. If any of his courses were dropped, he would have been assigned to teach courses in other areas, thus losing preparation time for the science classes. Also, he needed the practical experience to get the advanced certificate, which in turn helped him obtain admission to Lehigh. He responded like a missionary, turning increasingly to classroom experimentation since his first year had taught him that "only experiments hold [the students'] attention." [37] Although he loved experimentation

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[30] Journal, frequent entries. See e.g., 29 Nov. 1878 (outline of lecture in pp. 479–84 of the volume in Box 9 Folder 5 of Papers) and 10 Feb. 1880 (outline in pp. 511–16 of volume in Box 9 Folder 5 of Papers).

[31] *Ogden Daily Junction*, 24 Aug. 1880 and Journal, 24 Aug. 1882.

[32] *Talmage Story*, p. 16.

[33] Papers, Box 10 Folder 3. See also Journal, 1 Sept. and 6 Nov. 1880; 17 June 1881.

[34] Papers, Box 9 Folder 5 and Box 10 Folder 3. It is not known which edition of Dana's manual Talmage used, either at BYA or later at Lehigh where he also used it in a class. If he used the 1874 edition, when Dana began to support evolution in much the same way Talmage subsequently did, then the likelihood of Dana having been an influence in helping to formulate the details of Talmage's stand is increased. See Bert James Loewenberg, "The Reaction of American Scientists to Darwinism," *American Historical Review* 38 (1932–33): 698–701.

[35] *The Contributor* 16 (Feb. 1895) p. 230.

[36] Journal, 14 Nov. 1881, 14 Dec. 1881.

[37] Journal, 14 Nov. 1881.

and his Pestalozzian training from Maeser emphasized object-teaching, he seemed to resent the students' unwillingness to perform the mental labor of understanding a scientific principle without experimentation.

Although a laboratory had been established in October 1880, the equipment was inadequate, and his brief sessions with Hadley and Coray in chemistry left him on his own for any other subject. Presumably, his usual procedure, possibly with Coray's help, was to unpack the apparatus (unless he had constructed it himself), set it up, and try the experiment following instructions and illustrations in the textbook and the directions which accompanied the apparatus.

In a journal entry on 22 August 1881, he characterized himself as "impetuous, rushing and energetic," which may have resulted in some of his more colorful classroom experiments. On one occasion, he and his assistant Daniel Harrington prepared to demonstrate the functioning of the lungs of a small animal to a physiology class. Harrington recorded, "Of course, before these things could be shown, the cat must be killed. Talmage held the gunny sack securely, as he thought, while I had the axe in the air. At this moment a small hole in the sack tore open and the cat broke out and ran wildly off into the lot." The cat was recaptured, fortunately for science if not the cat, and Talmage demonstrated the great expandibility of the lungs by inflating them with a small tube.[38]

A more spectacular experiment was more serious:

> I was lecturing upon the "Composition of Water" and demonstrating the various properties of Oxygen and Hydrogen. While exploding a mixture of the gases in a cylinder, the latter burst with such a concussion as to extinguish all lamps in the room excepting those held in the chandeliers.
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> My feelings were difficult to describe as I realized the probable extent of the consequences. A scare ensued among the audience, but soon abated. One young lady was struck on the left side of the forehead by a flying fragment of glass; when she discovered traces of blood she fainted very nicely and I changed at once my occupation from that of a public lecturer to an attendant physician. She recovered, however, when 'twas found that the large amount of blood filling the bowl from which I was bathing her head came from my own hand. Two pieces of glass had struck the index finger of my right hand, one fragment burying itself in the knuckle joint. Another young lady had been struck on the left shoulder, the fragment piercing the clothes and inflicting a severe gash. Beside these, four or five were robbed of traces of skin, and all were severely scared.
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> After the circumstance I went back and completed the lecture, which act, I believe, did much to lessen the fear of the audience. . . . Fatal results may have followed . . . I chide myself for one thing: that I did not insist on all keeping the back seats.[39]

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[38] UA, 317, Papers, Box 9 Folder 5.

[39] Journal, 7 Dec. 1881. Still other experiments robbed him of time and money, while adding to his frustrations. Between April 1 and 11, 1882, while studying electricity, he tried eight times on as many days to partially duplicate Franklin's experiment "to test the results of the electricity of the atmosphere." Journal, 1 April 1882. He procured or built and subsequently lost or ruined a total of six kites and one balloon before giving up.

Six months later, when he had learned to take a few precautions, he recorded:

> June 6, 1882. Experienced another accident in the course of experimenting. A small wooden powder mortar, to be fired by the passage of electricity called an "Electric Bomb," had recently been procured by the Academy; and as I was demonstrating before the Physics class in the small Laboratory the bomb burst with terrific force, demolishing the Leyden Jars placed alongside to accomplish the experiment, and shattering the whole instrument into splinters. Luckily I had opened the window & placed the whole on a board shelf on the outside. The force of course was directed right and left, and no one was hurt.

Such dramatic and unpredictable lectures, not unnaturally, increased attendance. One week after the oxygen explosion, on 14 December, he noted in his journal: "The room became so crowded as hardly to afford standing room, and the rostrum upon which I had placed my apparatus was literally besieged. Such a crowded room interfered with my machine to a certain extent. This is my usual luck, my experiments are generally highly satisfactory when I perform them alone . . ."

His expanding reputation as an expert also brought mixed feelings. He liked the attention and publicity but also knew how few Utahns knew enough science to recognize an expert. Even more unsettling than the flattery were occasional questions about his competence to teach some of the science courses which had arisen, according to his journal, before 10 June 1881, when, in an effort to stem such criticism, he wrote examinations for an advanced normal certificate in the natural sciences. The certificate attested to his theoretical knowledge and practical ability to teach after a year's experience. On 13 November 1881, his journal records his intention of spending three hours every evening in his tiny laboratory. He was nineteen years old.

The encouragement of key individuals, the expectations of his students and public, criticism, his own desire to know, and the diminishing opportunities to learn more at the academy made up a complex mixture pressuring him toward further academic study. He was certainly saving money with some definite object in mind. On 4 September 1882, according to his journal, he arrived at Lehigh with $420 from his savings after paying for the trip, a remarkable feat considering that his teaching salary for the previous three years had been $1200 out of which he had to live and buy chemicals, apparatus, and books. He also paid his father $40 per term beginning in 1880 to help pay back money advanced for school expenses.

Talmage's journal becomes more introspective in the summer of 1880 after his first year of full-time teaching. The alluring but unshaped future is a consistent theme. On 7 July 1880, while touring schools with Maeser, he took detailed notes on classroom facilities and teaching methods in case he decided to take up teaching as a profession. Other entries are suggestive:

> Sept. 1, 1880. I really do not approve of the plan of saying beforehand what one intends doing, . . .
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> Nov. 6, 1880. I do not like the vocation of teaching, that is, as a District School teacher, . . . Here in the Academy I am teaching all higher, scientific or philological branches; in order to do which I am necessitated to work up on the subjects myself,

thereby opening up to me a field of research which is almost as beneficial as regularly attending school. . . . I can see plainly that I will not be enabled to save the least means for a start in life. In fact cannot see my way clear for my future course.

Jan 24, 1881. Time passes so rapidly as hardly to be comprehended — half of the present school year gone already, and when I reflect thus I am spurred on to greater vigor in my researches and studies, realizing that such facilities will not last forever. . . . I reprove myself . . . for being so unsystematic in my course of study.

June 17, 1881. . . . if I would give way to selfish feelings I would today almost register a vow that I would not serve in the B. Y. Academy again unless I were well paid. . . . Then again I think and realize that the training I am receiving in teaching these higher branches benefits me as much, if not more than regular attendance at school would. Have been enabled to save nothing in the way of money during the year.

Nov. 13, 1881. I began to consider how my labors may be laid to greatest advantage during the coming winter months. . . . opportunities for study and research will not last long. I may be sent on a mission before winter or my occupation may be varied as to admit of but little time for private study.

Dec. 12, 1881. I want to do good among the young — probably lecture amongst the Improvement Associations, and encourage the study of nature. I have to give a first lecture on the subject of harmony between Geology and the Bible — a subject upon which so many of our people have mistaken ideas.

Increasingly explicit entries followed through the spring of 1882. Then, on 23 January 1882, he took a firmer but still tentative stand: "I have for myself harbored a vague idea of making an effort to raise sufficient means to pass a year in a prominent science school or college. . . . I may be counseled however to remain among my own people and as I hold myself as on neutral ground willing to follow counsel implicitly in this important step, I can only refer to such as a vague idea." This "vague idea" clearly referred to going away to school, not to learning more science, for twice in that same entry he writes that he is "desirous to follow scientific studies." On March 8 and 14, his future at the academy was cast in the conditional: "If I remain in charge of the Scientific Department," and "if I retain my position in the academy another year. . . ."

Finally, on 31 March, he wrote: "My desire to attend some leading institution for a time to train myself in scientific pursuits has been growing with me. A conversation with Bro. Maeser on the subject resulted in his heartily seconding my desires, and saying that he expected the project to be given me as a mission."

Maeser's enthusiasm was probably sincere, despite his deep-seated animosity toward eastern education. His suggestion that Talmage be called on a mission, though usual for the times, may have also been a protective attempt. He had been quite insistent that Talmage accompany him on his tour of northern Utah and southern Idaho schools in the summer of 1880 and again in 1881 through southern Utah, despite Talmage's reluctance.[40] He would have much preferred to remain in Provo and conduct experiments and study, but Maeser had extended the invitation in the form of a mission.[41] However, he made the best of

[40] Journal, 28 June 1881.

[41] Ibid., 17 June and 22 Aug. 1881.

both trips, taking notes, collecting specimens, making new friends with whom to exchange specimens, and cultivating his speaking ability.

Maeser may have intended Talmage to see the relative comfort of his position at BYA — and indeed Talmage came away convinced he did not want to teach in the district schools and haunted by the education needs of "his people." However, Talmage increasingly saw the mastery of higher science as his way of meeting those needs.

Possibly a key event in convincing Maeser that Talmage's faith could withstand an eastern education occurred on 8 March 1882, when Talmage used a newly acquired optical lantern and stereopticon slides to deliver an illustrated lecture to the Polysophical Society on "The History of the Earth." According to his script-like notes for the lecture (partially in shorthand), nineteen-year-old Talmage spoke warmly of the correctness and utility of the principle of uniformitarianism and proclaimed that studying the history of the earth as written in the rocks "cannot but lead us nearer the platform of God." Using time periods of undetermined length in place of days as Maeser had taught him, he matched the biblical account of the creation with the geological time scale, traced the history of the earth from its origins according to the nebular theory of Laplace up through the long pre-man period to the destructive glacial period which God had sent to bring "great and pleasing variety" to an earth that had known "comparative perfection" prior to that time. Then came man, "a new creation," being among other things the first among God's creatures who "reached toward the knowledge of himself and of his God." In ringing tones Talmage declared the reality of evolution which even "a glance at the past" will show and according to which "the simple forms have ever preceded the more complex." However, he noted that "the missing link between the form of man and that of the highest animal forms has never as yet been found." He closed by a reiteration of his central theme that science and religion were but separate paths of truth to the same God and that they were not in conflict: "This earth is but a great record, each continent but a page, each community but a paragraph, and each human being's body but a sentence." [42]

Maeser and the members of the academy board were so pleased that they asked him to repeat it on 15 March, which he did before a large and enthusiastic crowd. The views Talmage expressed were certainly not uncommon among the educated and the leaders of Mormon society at that time.[43] Although Maeser made a strong public statement against evolution in 1898, on that spring evening in 1882 he seems to have been at least partially convinced by the vision, eloquence, and stereopticon lantern, of young James Talmage. It was only two weeks later that Talmage had his conversation with Maeser about further study.

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[42] See original notes, partially in Pitman Shorthand, in Papers, Box 10 Folder 5. I am indebted to LaJean Purcell for the transcription of these notes.

[43] Davis Bitton, "Anti-Intellectualism in Mormon History" DIALOGUE: A JOURNAL OF MORMON THOUGHT 1 (Autumn 1966): 111–33, and John A. Widtsoe, *Joseph Smith as Scientist* (Salt Lake City: YMMIA General Board, 1908).

While he awaited the first school catalogs to see if he had admission deficiencies, he cautiously wrote on 12 April and 8 May, that he was training an assistant and a teacher to take his place, *if* he left. Privately he seems to have felt fewer reservations and resolved, "Shall begin at once," when he learned he had deficiencies in algebra and German. He firmly turned down two job offers, one on 20 April as principal of the St. George schools with a provision of special attention to the scientific branches, and another on 25 April when the Gunnison Sugar Committee tried to hire him for its chemical plant during the approaching sugar season.

On 15 May, Talmage had an interview with Church President John Taylor. In his journal he wrote, "Visited Prest. Taylor at his residence; explained to him my desires. He kept me in a long consultation, asking many questions as to the purposes of my desired trip, and closed by giving his decided advice that I proceed to some leading institution there to pursue a course of study in the Sciences. Returned to Provo in afternoon and reported at once my intended withdrawal to the Principal." This meeting was significant. Even though Talmage was seeking confirmation for his decision rather than advice on the best course of action, President Taylor's disapproval would have been a serious — possibly decisive — obstacle.

As spring wore into summer, Maeser's encouragement seemed to wane. On 16 June, Talmage recorded in his journal: "My intended withdrawal as reported to the Faculty and Board, was kept very quiet, no public notice of the same in any report being made. The Principal informed me that such were his instructions, but declined to give me his reasons."

On 23 June Talmage recorded that "the Principal still informs me that I am expected back at the Academy when I conclude my studies in the East." And finally, in a testimonial Maeser wrote on behalf of the board and the faculty and gave to Talmage on 25 August just prior to his departure, he stated that they had yielded "only reluctantly" to Talmage's request for release and that they hoped he would return to them "in due time still more qualified to assist . . . in the advancement of the educational interests of . . . [their] Mountain Home." [44]

Talmage had spent a hectic summer of experimentation and study in preparation for school, taking time out only to help his father hay and to dig up another human skeleton from a nearby canyon to add to one he already had transferred from the lake shore to the laboratory.[45] He spent his time studying, rather than earning more money so he would reap the greatest possible return for the time he spent in the East. He rejected the urgings that he attend medical school and felt relief when his stake president counseled him to stick with science. "Such meets my wishes," he recorded, and added:

> I have many times contemplated my probable destiny and mission in life without obtaining a satisfactory conclusion; but I have for some time past felt an intense desire

[44] Journal, 25 Aug. 1882. Cf Maeser's advice to Talmage to remain at Johns Hopkins if he could (Journal, 13 Feb. 1884) after the academy fire. Perhaps Maeser was less concerned about Talmage losing his faith after having corresponded with him during almost two years.

[45] Journal, 3 July and 7 Aug. 1882, 26 Oct. 1881.

> to become familiar with the walks of Science for the Sciences have to be redeemed from their present position of infidelity & skepticism. The idea has been a favorite one for my meditations of late, and has formed the theme of my public speaking. I conclude that this great mission has to be performed by the Priesthood of God, and to lay a single stone in such a work *is perhaps my mission in life.*[46]

He arrived at Lehigh College in South Bethlehem, Pennsylvania, on 4 September 1882, and like a man possessed, threw himself into his courses.[47] He took classes from leading men at both Lehigh and Johns Hopkins, copied the notes of professors and students for classes he could not take, and reviewed, studied, and audited classes so he could challenge lower-level courses by examination. He also spent long hours in the library reading Herbert Spencer and Charles Darwin, among others, and even longer hours in the laboratories exhilarated at performing virtually every experiment and analysis he had read about. In addition, he used every available opportunity to visit sites of scientific, cultural, and economic interest, collecting abundant specimens and on occasion conducting an experiment or two. Though he concentrated on chemistry, physiology and biology were strong seconds. He also took courses in geology, physics, mineralogy, metallurgy, astronomy, and botany.

In chemistry his interests ranged widely, benefiting from the industrial and agricultural emphasis at Lehigh and the organic and medical emphasis at Johns Hopkins. At Lehigh he took courses in agricultural and manufacturing chemistry, assaying, toxicology, and medical chemistry. At Johns Hopkins he took chemical physics, analytical chemistry, medical chemistry, the chemistry of the compounds of carbon, organic chemistry, and quantitative analysis. Students had to keep current with *Chemical News* and *The American Chemist*, which was co-edited by William H. Chandler of Lehigh, a man from whom Talmage heard a few lectures. At Johns Hopkins, Talmage records an invitation on 9 October 1883 to the regular meetings of the *Chemistry Journal*, a group organized to keep the faculty and upper level students aware of current research and writing. Both institutions were also interested in applied science and in the university's relationship with the industrial community. This concern led to some contract work, in which Talmage participated, and employment opportunities, both temporary and permanent, for students and graduates, some of which were offered to Talmage.

Laboratory work was his first and permanent love. After George Coray arrived in the East, he wrote to Talmage suggesting that they return to Utah after their schooling, pay off their debts, and "proceed to establish and build up a laboratory." Talmage replied that he could "make no promises for the future, though my heart's desire is to see a laboratory in Utah." [48]

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[46] Journal, 17 June 1882. Talmage's father is seldom mentioned in the journals, but he was among those who argued for medical school and also urged him to spend the summer studying.

[47] Information on Talmage's courses is drawn from numerous journal entries and class notes. In general, see Papers, Box 10 Folder 5 through Box 13 Folder 7 and Box 1 Folders 1–2.

[48] Journal, 24 Dec. 1883.

At Lehigh, Talmage gave a lecture entitled, "Chemistry and Life," based in part on his own laboratory research. In it he made the point that the term "organic chemistry" was a misnomer because any substance ceased to live when experimentation began. He reminded his audience that sometimes life must be sacrificed for the interests of science. Included in the lecture was a report on the amazing resistance of some animals, especially cats, to certain poisons that are deadly to man. Earlier, in his Toxical Analysis notebook he had entered the following:

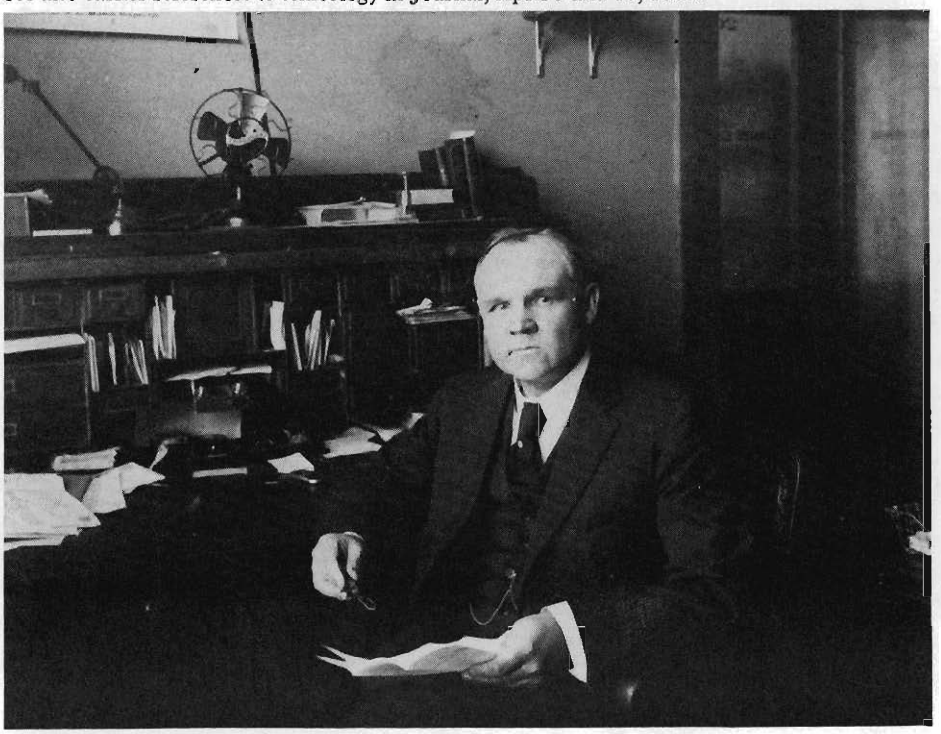
> Full-grown male cat
> Administered 0.3 grams white Arsenic (As_2O_3) April 10/'83 at 7:30 p.m.
> Second dose of 0.3 grm. at 9 p.m.
> Third dose, next morning at 10.
> Killed by force at 12:30.

Subsequently, he removed every organ for weighing, measuring, dissecting, and analyzing, recording the information in twelve pages of notes.[49]

During the summer of 1883, when he was preparing for Johns Hopkins by reading biology in the Lehigh library (including Herbert Spencer's *First Principles*) and gathering specimens, he went

> . . . fishing for frogs; caught a very large specimen and was anxious to preserve it for its skeleton entire. Did not know how to kill it there on the ground without torture,

[49] Journal, 26 April 1883 and Papers, Box 10 Folder 5, Box 11 Folder 6, "Analyses," pp. 3–15. Again, I am indebted to LeJean Purcell for transcribing the Pitman Shorthand. See also earlier references to toxicology in Journal, April 3 and 10, 1883.



unless by cutting off [its] head which would have spoiled the bones. So at a sudden gash I cut out its heart, liver, etc. The friend with me picked up the heart which was beating strongly; but as soon as I released the 'heartless' frog it turned off its back and took vigorous jumps for the water. Its leaps were 3–4 feet as measured. It saw us and tried to avoid us whenever we approached it; seemed entirely unhurt and continued its strong demonstrations for 1-1/2 minutes; having taken no less than 15 leaps in all directions; when I picked it up to prevent its getting into water; then it died suddenly.[50]

Such incidents reveal the depth of Talmage's commitment to laboratory work. For every student who has ever performed dissections in a biology course, an animal has to die. Since Talmage was a student in a time and place that lacked fully equipped laboratories, he early developed the habit of supplying his own specimens. The professionalism of his later career can only be fully understood in his student commitments.

Perhaps the best example of his commitment to experimentation occurred in the spring of 1884 while he was studying narcotics at Johns Hopkins. He recorded the following entries in his journal:

March 17. I have been engaged some time in the study of the effects of Narcotics upon the system, i.e. studying the same theoretically only. Today I found a gentleman who works in the same Laboratory as I, and who has for 2 years been addicted to the habit of eating Haschich or extract of *Cannabis Indica*. He was very willing to give me any data from his own experience; and gave me such.

March 18. . . . Three of us in the University have entered upon the study of the Narcotics in use.

March 21. The result of our work in research upon Narcotics has been tolerably satisfactory. We utilize my friend referred to above, with his Haschich eating experience — and find four or five others whom he knows have also an experience upon the subject. But the effects experienced by the different ones are so widely different that we can scarcely draw a conclusion. The opium habit is well explained by books, and the bad after effects of the same are sufficiently appalling to keep down experimentation upon the subject. But, the ill effects are reported very low in the Haschich or Hemp administration; and we have concluded to try effect of small dose upon ourselves

Of course, such a course is the proper one for the study of the effects of the drug, though I very much disliked the idea of doing such a thing, for as yet I have never known what it is to be narcotized either by tobacco, alcohol, or any drug. . . .

March 22. This being Saturday, was the day I selected to study practically the effects of Haschisch. This evening, after work and all was over, I took at 3 doses each an hour after the preceeding, 5 grains solid extract Cannabis Indica. At this writing — midnight — 5 hours since last dose, I have experienced no effect whatever. The effect is said to be widely different in different people.

March 23. Sunday. Spent quietly. Have had no result to be noted of my physiological experiment yesterday. . . .

April 5. . . . Took in all 15 grains. No effects.

April 6. Sunday. . . . Continued my experiment by taking 20 grains *Cannabis Indica* and the effect was felt in a not very agreeable way.

Talmage would lecture to the Brigham Young Academy faculty in September 1884 on "The Effects of the Narcotic Hashish on the Human System," but the

[50] Papers, Box 13 Folder 1, Journal, 1 Aug. 1883.

Faculty Minute Book does not record whether he mentioned the source of his information.

With an eye to the future, he shipped specimens home by the crateful. His journal records an incredible variety, including "the processes in the manufacture of tin cans," "the process of oil refining," and fossilized shark teeth, tobacco leaves, phosphates, lead, asbestos, zinc, iron, steel, chocolate, cork, fertilizer, rubber, ferns, minerals, vinegar, fossil shells and bones, pottery, paraffin, soap, candles, illuminating oil, iron ore, and even the complete skeleton of a monkey from the zoo in Druid Hill Park.

He also obtained an articulated human forearm, finger, some other bones, and a large piece of skin, from the university dissecting rooms with the aid of a student and the janitor. Although he disapproved of the callousness of the medical students and even the janitor, who apparently sold bones to the students regularly, he was even more surprised on 14 January 1884 when he was scraping the finger bones and preparing the skin for preservation. "A young gentleman of the University came to my room. . . . He is a classical scholar and I believe intends to study to become a Minister. Oh! the utter horror he expressed at what he saw me engaged in, was something intense. In fact, he could not rest in the room — was terrified. . . . He is 29 years of age and a fine scholar. What will not use and habit cause one to be?"

Perhaps most significant in its impact on Talmage was his opportunity to participate in original research at Johns Hopkins under the direction of Ira Remsen and Harmon N. Morse, both on the cutting edge of research in their fields. From 1872 on, Remsen wrote numerous books and papers covering a wide field of chemistry and was the founding editor of the *American Chemical Journal*, 1879–1913.

Harmon Northrop Morse, professor of inorganic chemistry, had published ten papers in the *American Chemical Journal* between 1880 and 1892 based on investigations conducted when Talmage was working in the laboratory. In addition, he invented equipment for reading gas volumes over water, determining the equivalents of metals, grading and calibrating liquid measuring apparatus, an electric furnace, and electric laboratory heating devices. Between Remsen and Morse, many original discoveries came out of the Johns Hopkins labs, including white phosphorous, saccharin, and a phenomenon that became known in the chemical world as Remsen's Law. Shortly before Talmage left Baltimore to return to Utah, he dejectedly described the work he had been doing with them:

> May 9 [1884]. . . . For nearly 3 months I have been engaged on a piece of original work in Chemistry — 'on the *oxidation of Cymene Sulphamide in alkaline solution*'. The labor has not been easy — great difficulty having been met in purifying the substances fit for analysis. Another line of investigation will have to be pursued: and the Professors told me today it would be impossible to do anything in less than another 3 months, and as the college closes in a month the subject would be better given up. I shall be unable to continue the labor at home for lack of material.

Despite Talmage's absorption in his studies, an odd theme of self-justification runs through his journals, a determination to prove that his choice

was correct and that Mormons could study in the East without losing their faith. Because his religious commitments meant that he was never totally free to follow his "selfish" interests in science, he frequently pondered how far he could go without being disloyal to his faith.[51] It is possible that had he been free, he would have rejected returning to Utah in a relatively short period of time without a degree.

From a practical standpoint, he was out of money by the spring of 1884, but he could easily have earned more in the East working as a chemist and, in fact, refused several job offers, one from the College of Western Maryland as a professor of chemistry which included an all-expense-paid year in residence as a student, to earn the necessary degree. At first he was tempted, even though chemistry was "but a minor study there anyway." Ultimately he declined, confiding in his journal that he did not value a degree so highly that he was willing to pay such a price in time. But, he did value a degree and had been willing to accept one from Western Maryland if they would confer it on the basis of June examinations.[52]

Another offer had come in the late summer of 1883, when he was attempting to decide whether to go to Johns Hopkins or stay at Lehigh. As money began to arrive for the next year of study from J. M. Tanner, George Coray, and members of the academy board, his mind turned strongly to home and his obligations there. Had Coray joined him at Lehigh, Talmage would almost surely have completed his degree there. When Coray went to Cornell instead and Maeser responded to Talmage's appeal for advice by telling him to make up his own mind after prayerful consideration, he made his final decision for Johns Hopkins but he felt "sadly alone" in the decision.[53] While he waited for classes to begin in Baltimore, he wrote three essays for Utah audiences, apparently to be used later and perhaps partly out of homesickness. In "Good for Nothing," he described how to the chemist there is no such thing as "dirt." It includes a moving passage about Adam being a great philosopher even though he lacked a college degree.[54]

He immersed himself as thoroughly in his studies at Johns Hopkins as he had at Lehigh. Then on 30 January 1884, he received word that Brigham Young Academy had burned to the ground. He was ready to begin his last term of schooling, but he was willing to leave for home immediately if called. Despite this prompt response, there are hints of ambiguity. A few weeks earlier he had written George Coray that "I . . . hope to come East again, when the cloud of debt will have passed off me." And one month after hearing about the fire, mentions "if" in connection with teaching again.[55]

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[51] Journal, see e.g., 9 Sept. 1883.

[52] Journal, 23 June and 8 July 1883; 28 March 1884. He also considered the possibility of approaching a North Carolina institution that would award a degree by academic record and examination; 2 May 1884.

[53] Journal, 17 Aug. 1883. See also 9 Sept. 1883.

[54] Papers, Box 12 Folder 9.

[55] Journal, 24 Dec. 1883, 29 Feb. 1884.

Apparently, however, Talmage never seriously considered staying longer. The Mormon or Utah question was a current issue. Talmage responded to dozens of inquiries about the Utah question, including at least two letters prompted by public lectures, each time defending his people and religion. He was offended in Baltimore by crime, drunkenness, poverty, and the practices of other churches. With the constant influence of letters from home telling of sick family members, giving him advice, sending news of the academy, and requesting assistance in procuring scientific apparatus, combined with other factors, it was nearly inevitable that he return home on schedule.

He could return home with the assurance that he had tested his choice in the big leagues of American science and that Mormons had nothing to fear from science. With rare exceptions, his professors had been warm, encouraging, and focused on the specific detailed facts of their science. He mentions Darwin only twice in the two years, on both occasions complaining about recent lectures on the subject by ignorant clergymen who were misrepresenting Darwin in particular and science in general.[56]

He returned as he had been instructed, "like a bee to the hive." [57] But he reentered with the firm intention of returning to the blossoms and nectar of science.

[56] Ibid., May 4 and 18, 1884; 16 March 1884.

[57] Ibid., 9 Sept. 1882; 9 Sept. 1883.