12/15/16, Thurs., 7:30AM

"They're" doing the big-Kill LURE off of me today, please don't be conned, tricked into trusting anyone or anything, I am totally by myself and nonstop tortured without any human-level adult allowed anywhere near around to speak with me unless it's for their own entrapment, all the trappers are organized and all around me, the "invisible warfare" types, mixed all with drug addicts and paid-off broke people of all kinds, etc.

- 12/28, I ought to just keep a standard warning. Things are unsafe!

followed behind "to run a line of levels," that is, to measure the gains or losses in elevation for each segment of the proposed road. In the next four months, however, personnel would shift as the men trekked 230 miles west to the town of Bath, near Lake Erie, then reversed direction and added about another 100 miles on an alternative route from near Portland eastward to the village of Angelica. During the last leg of the main, westward trip, for want of a regular survey team, Henry would be forced to borrow a surveyor's compass and combine the surveying and leveling into a single, simplified operation under his personal direction. One crew member remaining through the expedition was Joseph's younger brother, twenty-two-year-old James. Although James started as a surveyor's flagman, he also acted as a targetman, leveled, and worked closely with his brother. Two of the crew, "sons of rich & influential men," tested Joseph's mettle when not only did they rebel against remaining in the field as winter weather set in but also routinely got drunk. Decades later, Rhees recorded Henry telling him that "he would have no drinking men on his party" and, consequently, "was obliged to dismiss them, thereby incurring their opposition & ill-will." The state's flawed system of meeting costs and payrolls also plagued Henry as the engineer leading the party. "I have experienced great inconvenience from want of funds," he wrote to Chief Engineer Campbell in mid-November, "and have been under the disagreeable necessity of borrowing from strangers."[14]

Henry also told Rhees that living and camping in the outdoors improved his health. Standing about five-feet-nine-inches and weighing about 130 pounds,[15] he had overindulged in his Albany studies and work, becoming "very delicate and threatened with consumption." But the outdoors "made a different man of him." Comments that he added to a series of leveling notebooks capture his day-by-day perceptions of this challenging yet restorative adventure. As the party traveled between the Delaware and Susquehanna Rivers, for example, he remarked not only that wolves were plentiful and frequently preyed on sheep but also that rattlesnakes were abundant and that his group had killed one about three and a half feet long. Moreover, determined to meet Campbell's deadline for submitting the survey's data, Henry kept his party working even as severe weather hit—the decision that vexed the two rebellious members of his crew. Near the village of Ellicottville in mid-November, he jotted in his notebook that "this day we leveled about 5 miles in a snowstorm." The bad weather persisted and near Franklinville he complained: "This is a most teidious day for Leveling[;] the Snow drifts and it is so cold that the ink freezes in our pens."

Asides in the notebooks also reveal that Henry broadened his knowledge of geology, topography, and agriculture as he gathered information crucial to deciding the physical and economic viability of the route. In a typical entry, about a new village in Tioga County, he recorded: "Land from the river valued at from 2 to 2 1/2 Dollars per acre a natural soil for wheat." He also used a few of his rare free moments to study sites of scientific interest. In the western part of the state, he first visited a "burning spring" and then went on to other "oil springs," concluding that the inflammable gas bubbling to the surfaces at both sites was "undoubtedly carburetted hydrogen." Henry even took note of remnants of American Indian life. He entered detailed descriptions of a conical hill "remarkable for the trace of an ancient fortification," supposedly "the last residence of the indians in these parts." He also recounted how local tribes could kill "40 deer in one forghtnight" by driving them between two brush-and-log fences arrayed in a "V" that extended two or three miles in each direction.

The expedition also expanded his awareness of daily life among white settlers in the New York outlands. He found it noteworthy that he had traveled 70 miles on one stretch without seeing a church and about 100 miles without meeting a carriage on springs; he added that the rough roads the crew had been following would have proved "fatal" to such a delicate carriage. Traveling through these remote areas, he encountered what he took to be quaint practices. In the region between the Delaware and Susquehanna Rivers, for instance, he recorded that locals still traveled in canoes and made a living by rafting timber down to Philadelphia when the rivers swelled after heavy rains. Despite the remoteness, he did receive a cordial reception. The families in the towns and villages along the route relished the prospect of a state road and, as Henry mentioned in a letter to Commissioner Hammond, treated the party "with the greatest kindness and respect." In fact, the leading citizens invited members of the party into their homes. Years later, Princeton student Cuyler recalled Henry saying that he had enjoyed this hospitality "mightily."[16]

The survey party completed its assignment by the last days of November and headed home, but Henry remained in the field two more weeks retracing the route "in order to make some additional notes." Finally returning to Albany on 15 December, he visited his mother briefly and, as instructed, rushed on the next day to Cherry Valley, about 60 miles to the west, to confer with Chief Engineer Campbell. The sleigh in which he was riding upset twice in the snow but the most disturbing part of the trip was when Campbell greeted him with the announcement that his set of measurements,

gathered at great expense to the state, was "worthless." Henry later told Rhees that at that moment, after five months in the field and a harrying sleigh ride, he was so flabbergasted and exhausted that Mrs. Campbell "thought he must be intoxicated." He returned to his room and slept for twelve hours. The next morning, with new resolve, he pressed Campbell on the details of the problem and discovered that an assistant whom he had fired had misreported some figures. Also, he realized that Campbell had made a mathematical mistake in analyzing the data. A forthright man, Campbell apologized on the spot and went on to befriend Henry. He relied on Henry for help in compiling the overall report of the road survey and even hired him to tutor his niece in mathematics. Meanwhile, for his party's component of the state project, Henry had the main responsibility for writing the report and compiling an associated atlas. This work eventually became part of the commissioners' official presentation to the state. Later, Henry would combine his report with fieldnotes from other surveys to prepare an introduction to the *Atlas of the State of New York*—a popular reference book compiled by a fellow surveyor and issued by the legislature in 1829. He also read a version of this introduction at a meeting of the Albany Institute and published it in their *Transactions* under the title "Topographical Sketch of the State of New-York, Designed Chiefly to Show the General Elevations and Depressions of Its Surface."[17]

In one of his leveling books, Henry remarked that "if no state road be constructed this survey will be of great advantage to the country in teaching the inhabitants to explore and awaken their attention to the subject." His comments proved prescient; the legislature never followed through to build the Great State Road. But results such as the *Atlas* did serve to encourage development in the southern counties. For Henry himself, the never-completed project paid handsomely in experience, reputation, and opportunities, not to mention money. Earning $3.50 per day, he ended with the sizable sum of $885.50 after laboring 253 days gathering data in the field and then processing it. However, as the fieldwork drew to a close, in letters to Beck and his cousin Stephen Alexander, Henry divulged that the main reward that he sought was approval of his work: "The last summer has been to me a season of peculiar interest although one of labour and trial. I have devoted myself exclusively to the duties of my office and if my labours should not prove as important as I wish they may, still I hope I have conducted myself so as to merit in some degree the approbation of the commissioners and not to disappoint the moderate expectations of my friends."[18]

This high-minded desire to fulfill the expectations of others, and thereby

was still with the tour. But the primary reason for his early departure and stage ride home was to expedite a pending visit to the United States Military Academy at West Point.

Henry was probably rushing to West Point, about 90 miles below Albany on the Hudson River, to arrive in time for a prearranged review of the military academy's science facilities and programs. With his own teaching assignment looming, he could profit from exposure to the military academy's technical offerings, which were among the best in the nation. The timing of the visit, which lasted for at least two weeks in June 1826, allowed him to be present during the annual, extended gathering of the school's board of visitors. He could thereby take advantage of the activities associated with the board's regular inspection of operations, including some social interactions; in a log of the trip, Henry recounted, for example, touring a nearby Revolutionary War fort and attending the formal dinner that the board held for the academic staff.[5]

Although he opened his log by reporting on an iron foundry near West Point, he concentrated on the teaching of chemistry. He recorded that the "chemical laboratory" was a room in which students sat behind a railing while the instructor used the other half of the room for displaying apparatus and performing demonstrations. While inspecting the laboratory, he found striking the professor's reliance on a particularly innovative instructional device: "One article very necasary in teaching chemestrys is found in this room viz a black board on which the student is taught the attomic theory and all algebraical formula in chemestry. Indeed it appears to be one of the principles of teaching in this institution that every thing as far as practical should be demonstrated on the black board. The student is even required to draw all articles of chemical aparatus & explain them in this way." For Henry, who in his younger days purportedly had made do with writing on a whitewashed wall with charcoal, the West Point blackboards seemed decidedly progressive.

Henry also noted particular teaching initiatives of the two instructors in charge of the overlapping fields of chemistry, mineralogy, and geology. Professor John Torrey and Assistant Professor Jonathan Prescott each broached a topic to which Henry himself would devote considerable attention during the next few years. Torrey alluded to making an improved version of a scale of chemical equivalents—a mechanical device, with sliding logarithmic scales, for finding weight relationships between basic elements and compounds. Within a year, Henry would be collaborating with his friend Lewis Beck on constructing and selling just such an improved version.

chemistry professor from Dartmouth College about to assume a post at the New York College of Physicians and Surgeons. Dana, a member of the board of visitors, detailed for Henry the type of battery to use and the size of magnetic needle necessary "so that the class might see every movement" in demonstrations involving electromagnetism.

West Point did not provide Henry's first exposure to electricity and magnetism. Perhaps his earliest formal contact occurred in Albany when initially enchanted by Gregory's *Popular Lectures on Experimental Philosophy, Astronomy, and Chemistry.* He certainly had become acquainted with the basics of the subjects by 1823 while assisting T. Romeyn Beck in his chemical lectures and investigations. But at the military academy in mid-1826, faced with the prospect of braving his own roomfuls of students needing to "see every movement," he was perhaps more attentive to details. This attentiveness continued after he left West Point and traveled fifty miles further south to New York City, an extension of his trip most likely intended for additional scholastic enrichment. On visiting the shop of an instrument maker, he transcribed detailed instructions for creating strong magnets. This artisan, who made and sold a variety of technical instruments, suggested a convenient way to produce a group of bar magnets by placing them in a circle and sweeping them all with a horseshoe magnet; Henry revealed that he had already been working with magnets when he noted that he had previously been using this technique. The instrument maker then offered advice on fashioning an exceptionally strong magnet, one capable of lifting at least 60 if not 150 pounds. "In making a powerfull magnet," Henry jotted in his log, along with the artisan's other instructions, "the shape should be a horse-shoe and each bar should be as thin as a saw blade, magnatised separately and united all the north poles together with screws or rivetts of lead." The concept of a "compound" horseshoe magnet—one that gained its strength from separate magnetic components—would be one that Henry would also extend in the next few years.

While in New York City, Henry spent an evening visiting "Peals museum in Broadway." This was a newly opened branch of painter Charles Willson Peales's main museum in Philadelphia, a popular and respected enterprise offering a distinctive mix of art and science. In later years, Henry recalled that "almost from childhood," he had wanted to visit the notable museum. The Broadway branch, run by Peales's son Rubens, juxtaposed three disparate displays or activities in three different rooms. In successive rooms, Henry viewed an exhibit featuring natural history, a collection of fine art paintings, and a chemistry demonstration. For the latter, on the evening Henry was

in the audience, "Mr. Peal exhibited a number of experiments with oxygen & hydrogen gases." Producing bright flames and loud explosions, the experiments evidently were engrossing. The Peale plan for mingling an arresting array of natural history, art, and scientific experiment would also resurface in Henry's coming years—but not for another two decades.[8]

When the Albany Academy's fall term opened in September 1826, the trustees held a formal ceremony to induct the new professor of mathematics and natural philosophy. In addition to the main event, which was Henry's own inaugural speech, one trustee offered welcoming remarks and another gave the concluding prayer. In his opening comments, reported afterward in the *Albany Argus and City Gazette,* Gideon Hawley encapsulated the trustees' philosophy toward Henry's area of mathematics and natural philosophy, a subdivision of the academy's "English department" rather than its more traditional "classical department." Hawley explained that, though the trustees valued classical training for traditional professional careers, "they cherish with peculiar favor" the English department, which is "best fitted to prepare the greatest number of pupils for the useful pursuits of active life." Hawley noted that this preference for practicality sprung from the trustees' belief that the academy should be responsive, as a local institution, to the needs of Albany's citizens.[9]

Hawley boasted that Henry's preparedness for his new position proved the Academy's effectiveness; after all, Henry had "received the greater part of [his] education under its instructors." Always an attentive student, Henry apparently had assimilated the academy's guiding pragmatic philosophy: the central theme of his inaugural speech was that mathematics and natural philosophy offer significant practical benefits in everyday life. Of course, this utilitarian message permeated early nineteenth-century views of science; Henry had also encountered it in books such as Gregory's *Popular Lectures* and Parkes's *Chemical Catechism.* Ultimately, the message reflected the persistence of seventeenth- and eighteenth-century ideas about science—particularly the Enlightenment trust in the power of humans to achieve progress by using reason to discern natural laws.

Henry structured his address around mathematics, first distinguishing between "pure" and "mixed" mathematics. The former is an abstract study without worldly connections, he remarked, and the latter entails applications to natural or social realms and gives rise to pursuits ranging from astronomy to surveying and political economy. Through a sketch of the history of mathematics—which he portrayed as a story of "progress towards its present

The students appreciated Henry's efforts. George Carpenter, a pupil from 1826 who later tutored at the academy, recalled: "In disposition he was most kind, in manners courteous and agreeable; his face was remarkably handsome, his finely chiseled features being lighted up with mild, blue eyes. He was a favorite with the pupils, always ready and willing to aid them in their studies, winning their esteem and affection." H. N. Smyth reminisced that Henry's willingness to help extended even to "a dull boy" such as himself, who was having trouble with Dr. Beck's course in English literature during the academic year 1830–31. "My composition was heart rending," he recollected, "and as they were submitted to and supervised by Doct. Beck little consideration for my short comings was extended. I had however the sympathy of Prof. Henry, who sat by me and aided me with ideas and phrasiology." As a young student, Smyth felt that Henry "was the realization of all that was manly, generous, sympathetic and kind as an instructor." Yet another student, Alexander Bradford, fondly remembered that Henry "rose with the sun to instruct his pupil, eager after knowledge." Local citizens also seemed to appreciate his public presentations. After Henry moved to Princeton, he told his new students an anecdote about his first, open Albany talk on galvanism. Though the talk had been "attended by a large Assembly of the Elite from Albany & its surroundings," a merchant friend in the audience nonplussed Henry. The merchant told him afterward that whereas the presentation was interesting and good, it contained "nothing especially new." A few weeks later, however, a lecture on the same topic by a traveling speaker from New York City completely enchanted the merchant. Henry recalled that his own talk conveyed the latest information clearly but with "little ornamental flourish"; in contrast, the visiting speaker gave an amateurish discourse but packaged it in eloquent language. "So young gentlemen," Henry reportedly advised his Princeton students, "you see if you would be considered *profound,* you must not be *too plain.*"[12]

Henry believed that the courses in his department contributed to the students' general mental development as well as fostered particular practical skills. That is, the courses not only embodied the principles of the psychological theory of faculties but also exemplified the precept of science's utility. Besides the offerings involving surveying and navigation, there was an entire course on "Technology, or the application of Mathematical and Mechanical Science to the Useful Arts." Furthermore, there was explicit instruction on architecture and civil engineering. At one time or another, Henry taught each of these subjects.[13]

Production of Cold by the Rarefaction of Air." As in all his lectures he devoted especial attention to the demonstrations, one of which on this occasion was noteworthy.

> One of these illustrations most strikingly illustrated the great reduction of temperature which takes place on the sudden rarefaction of condensed air. Half a pint of water was poured into a strong copper vessel of a globular form, and having a capacity of five gallons; a tube of one fourth of an inch caliber with a number of holes near the lower end, and a stopper attached to the other extremity, was firmly screwed into the neck of the vessel; the lower end of the tube was dipped into the water, but a number of the holes were above the surface of the liquid, so that a jet of air mingled with water might be drawn from the fountain. The apparatus was then charged with condensed air, by means of a powerful condensing pump, until the pressure was estimated at nine atmospheres. During the condensation the vessel became sensibly warm. After suffering the apparatus to cool down to the temperature of the room, the stopcock was opened; the air rushed out with great violence, carrying with it a quantity of water, which was instantly converted into snow. After a few seconds the tube became filled with ice, which almost entirely stopped the current of air. The neck of the vessel was then partially unscrewed, so as to allow the condensed air to rush out around the sides of the screw; in this state the temperature of the whole interior atmosphere was so much reduced as to freeze the remaining water in the vessel.[9]

No new theory was involved; indeed, it was only a more spectacular demonstration of the same law he had employed in his previous paper, but the younger members of the audience lived long enough to see the principle applied in commercial ice-making. Perhaps the most interesting feature about this demonstration was the unfavorable conditions under which it was performed. The night was unseasonably warm, the room was heated by a large stove situated near the lecturer, and a large audience filled the hall. This combination of circumstances drove the room temperature to nearly 80 degrees, a condition which caused Henry no small amount of perturbation over the success of the demonstration, but which must have greatly im-

[9] Albany Inst. *Trans.* Vol. I, pt. 2, p. 36.

pressed those members of the audience who realized his predicament.

Meanwhile, he was not neglecting the study of mathematics. He had now progressed to Lagrange's *Mécanique Analytique,* that great treatise in which the Frenchman so richly illuminated the study of mechanics, in which his differential equations gave to the subject a new generality and completeness. But Henry never became a mathematician.

Somehow, while engaged with his studies and while he assisted Dr. Beck, he found time to act as private tutor to Henry James, the lad who was to become the father of two famous sons, William James, the psychologist, and Henry James, the novelist. Joseph Henry was supposed to have been supervising a group of boys during the recreation period. As was a common practice, the boys were engaged in a game in which a ball soaked in turpentine figured. This ball was then set on fire. Through some mischance, the flaming ball set a hayloft on fire. Young James bravely beat out the flames with his feet before much damage was done, but in the action he suffered such burns that he had to have a leg amputated. He was unable to follow his studies at the Academy as a result of this injury, and was prepared for college by Joseph Henry. With some interruptions, the association of tutor and pupil was maintained after James had gone to Princeton.[10]

But Nature, no patron of genius, was exacting her toll for the strain to which Henry was subjecting himself in his studies. The ceaseless grind kept him too much indoors, which proved detrimental to his health. When it became apparent that he must relax his efforts, he was unexpectedly offered, through the influential Judge Conkling, a position as surveyor upon a projected new road between West Point and Lake Erie. The proposal of self-sustaining labor in a healthy outdoor occupation was exactly what Henry needed.

The route he had to follow extended from Kingston, near West Point, to Portland Harbor on Lake Erie. He threw himself wholeheartedly into the task, nor was it any easy task when winter came and the line had to be followed unwaveringly in deep snow over wild and rugged country, when the wind was sharp and cold. Nevertheless, he enjoyed the work and completed it with credit. Indeed, he had done so well that his friends sought to secure for him a place in the U.S. Corps of Civil Engineers, but it had been determined that all future vacancies in this Corps should be filled by West Point

[10] Rukeyser, M. *Willard Gibbs,* p. 109.

and the cost of shipping grain from the West by four-fifths. New York became the largest shipping center in the United States.

Though Henry had no part in these developments, he was now and then caught up in the mainstream of swift-moving events. A new road was projected between West Point and Lake Erie, and quite unexpectedly Henry was offered the job of surveying it.

What did he know of surveying? Ought he to take on work that would interrupt his studies? Still, the offer was tempting. Although his sinewy frame, strong constitution, and six-foot height hardly betrayed it, his health was beginning to show the effects of confinement in the laboratory and his long hours of study. Working out of doors offered a welcome change. Besides, the pay was good. As it turned out, this was the only job he was ever to have on which he could save a modest sum. He accepted the offer.

The work was hard and the terrain rugged. In winter it meant trudging through deep snow every foot of the way through unfamiliar country, but he stuck to the task. No one could ever say that Henry flinched from any job he undertook, and he applied himself to this one with his usual earnestness. In fact, he came to like the work of following the line to its completion. So well done was the job that he was recommended for a position with the U.S. Corps of Civil Engineers. Another offer, to supervise the construction of a canal in Ohio followed, and still another to manage a mine in Mexico.

Just when Henry was weighing these opportunities, Dr. Beck called to tell him of a vacancy in the Albany Academy. He had only to say "yes" and there was an appointment waiting for him as Professor of Mathematics and Natural Philosophy, as Physics was then called.

Once again Henry was forced to make an important decision. Ambitious and able men sought their futures in the developing industries, in railroads and commerce. Peter Cooper was envisioning a wheeled steam engine to run on rails. He was working on his *Tom Thumb,* the first railway locomotive. There were many opportunities offered in the development of the country's harbors and the improvement of its waterways. This was the era when young men of Henry's ability took leading places in the development of an expanding country.

Had Henry longed for wealth he could easily have turned his back on struggle and poverty, which had been his lot from early childhood. His surveying job paid him nearly $2,100, twice what he would get as a professor years later. Having succeeded in this work, he had paved the way for still more profitable jobs had he wished to take up the offers.

No doubt Henry had some help in arriving at his decision.

Room on second floor of Albany Academy, originally occupied by Joseph Henry