Chapter 1. The Young Ivy Leaguers

In the mid-nineteenth century, there were no "physics departments", no "graduate programs", and whatever research was done was pretty much up to the initiatives of the individual academicians, occasionally with funding from wealthy sponsors interested in the science. The roots of most university physics departments in America go to the relatively small number of professors of natural philosophy who taught alongside their colleagues in classical studies. Most of the action in physics in the early eighteen-hundreds was in Europe, where the experiments of Coulomb, Ampere and Faraday would provide the foundation for Maxwell's theory of electricity and magnetism. While the Americans Benjamin Franklin and Joseph Henry had made significant contributions in this area, most American physicists were teaching Newton's mechanics and studying its applications.

Some of the following information on Western Reserve's early teachers of physics comes from the Centennial History of CWRU by C. H. Cramer (Little Brown, 1976) and from a long article on the sciences at Western Reserve by Frederick Clayton Waite. It appeared in the Reserve Record (the newspaper of Western Reserve Academy) of 13 May 1938. Waite, a WRU professor emeritus of biology, later wrote a detailed history of the early years of the college: "Western Reserve University: the Hudson Years" *W. R. University Press 1943.*

Western Reserve College was founded in 1826 by a group of farmers and land developers in the area around Hudson, Ohio. The northeast corner of Ohio had been designated as the "Western Reserve of the State of Connecticut". According to Cramer: "Connecticut was given permission by Congress to reserve 3,500,000 acres in northeastern Ohio for the purposes of reimbursing those of its citizens who had suffered losses from British depredations during the Revolution." Moses Cleaveland, surveyor, had come out to the area in 1796 and left the settlement which bears his name (approximately). Ohio became a state in 1803 as large numbers of families from Connecticut traveled west to set up farms and towns. Some of their sons were sent back to Yale and other eastern universities. They soon saw the need to create a college closer to hand. "Reserve's" first graduating class, in 1830, consisted of four students. A section of a contemporary map of the Western Reserve is shown in **Fig. 1-1.**

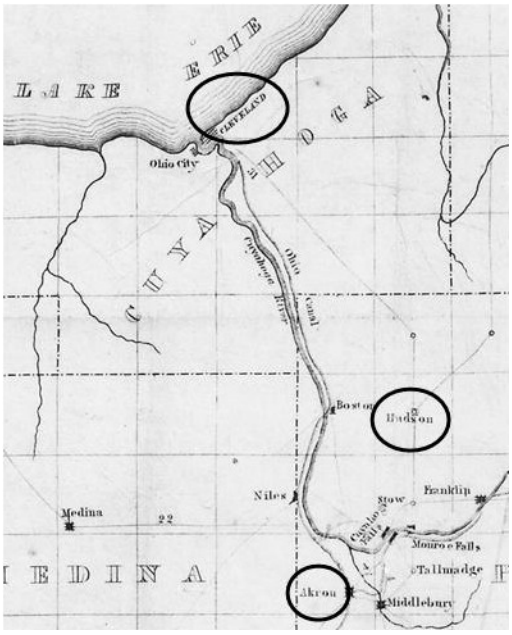

Fig. 1-1. An 1830 map showing the location of Hudson relative to Cleveland and Akron.

As was the case in the older Ivy League schools, most of the colleges established in this period were staffed by faculty trained in theology, philosophy, and the classics, and who were affiliated with a particular denominational group. Western Reserve College was founded by Congregationalist clergymen educated at Yale.

The first professor of physics at Western Reserve College was **Elizur Wright, Jr**, a twenty-five year old graduate of Yale who was hired in 1829. As the third member of the college faculty, he taught mathematics and natural philosophy. By 1832 the young professor had become preoccupied by the controversy between the abolitionists who favored immediate emancipation of the slaves and the colonizationists who argued for the return of slaves to Africa. This controversy was hotly argued by students, faculty, and trustees and the resulting publicity so negative that the survival of the college was at risk. Wright's frequent absences from campus as he lectured around the country in favor of abolition and the general commotion he caused on campus led to the trustees' requesting his resignation in 1833, before he had a chance to accomplish very much in the way of natural philosophy. Making his way back east to New York and then to Massachusetts, he continued his fight against slavery as editor of several emancipation journals. Wright used his rare understanding of mathematics to bring about the reform of the insurance industry in Massachusetts, eventually being known as the "friend of the widow". He was, until his death at age 81, continuously associated with the advancement of liberal causes. A good number among later professors of physics at CWRU would, in their own eras, emulate Wright in promoting social reform.

Filling in after his son's departure was **Elizur Wright**, **Sr**. (AB Yale 1781) who was one of the three founders of the college. The elder Wright clearly had better credentials for teaching than his son, having been ΦBK at Yale. He was an astute astronomical observer and expert in the fluxions of calculus. He was determined that the new college should succeed and was responsible for all of the science and mathematics courses for the next three years, without pay.

Loomis: astronomy on the frontier

In 1836, the second twenty-five year old Yale graduate to be made professor of natural philosophy and mathematics was **Elias Loomis**. (**Fig. 1-2)** He was appointed by President George Pierce who had come from Yale two years earlier. Loomis had established himself as a promising astronomer at Yale, where he was the first to determine the orbit of Halley's comet and to observe its return. Another experiment was done in collaboration with colleague Alexander Twining who was about 75 miles away at West Point, NY. Each measured the angular position in the sky of meteor trails, recording the time each appeared. They were thus able to estimate, by triangulation, the altitude of the luminous trajectories.

Loomis was sent by Western Reserve College to Paris and London to study the teaching of astronomy and to arrange for the purchase of a telescope and chronometer.

The $4000 appropriated for this purpose represented a very generous and ambitious move by the trustees. Loomis spent a year abroad and purchased top-of-the-line instruments: a transit-circle with a 2.7-inch lens and an equitorial telescope with a 3.3-inch lens, both bought from Troughton and Simms, and a clock purchased from Robert Molyneaux, all of London. The clock would provide a time standard at Western Reserve for over 50 years; its accuracy was better than 3 seconds per day.

Fig. 1-2.
Astronomer Loomis.

In a speech delivered at the college in August, 1838, on the importance of higher mathematics, the 27 year old professor described the impact of such astronomical measurements on world commerce. He explains with great admiration the work of Isaac Newton on the orbital motion of the moon, an analysis which took into consideration the gravitational effect of the sun: the first attack on the "three body problem". In his speech, Loomis went on to describe the mathematical analysis of comet appearances, explaining that science triumphs over ignorance (referring to the belief that comets were omens of earthly disasters), saying that we can through science "emancipate our race from the thralldom of superstition". He then outlined advances in the construction of ever better telescopes, and how the newly acquired telescope and chronometer which he had brought from Europe would bring important scientific work to America. Finally, having suitably prepared his audience, he arrives at his main point, a plea for monetary support for the construction and operating expenses for his observatory.

In this he was successful, for the trustees were convinced and provided the necessary funds. The excellent instruments were installed in the newly built observatory - the third such in the nation. Loomis was especially interested in the use of telescopic observations of the moon and stars in the determination of latitude and longitude.

This facility would play an important role in the practice of modern science at WRC. Loomis, over the course of the next six years, measured great numbers of occultations, lunar culminations and cometary orbits. In a series of articles in the Transactions of the American Philosophical Society, he reports the latitude and longitude of his observatory at Hudson as 41^{o} 14' 38.1" north and 5h 25m 39.5s west of Greenwich. (A tenth of a second is about ten feet.) This measurement provided the basis for subsequent wide-ranging surveys in the newly opened western territories.

With the most precise clock west of the Appalachians, Loomis arranged for a telegraphic signal to be sent daily at noon which rang a bell, thirty miles away, on Cleveland's Public Square. During this same period, Loomis compiled measurements made in 13 states east of the Mississippi of magnetic declination. This involved measuring the component of the earth's magnetic field perpendicular to the ground. ("Observations of the magnetic dip in the United States", American Philosophical Society, Philadelphia 1843] This work, and a later compilation of data on auroral displays, followed from his

interest in the shape of the earth's magnetic field. His aurora map appears on the NASA website at http://www-istp.gsfc.nasa.gov/ Education/wloomis.html

Loomis invents the weather map

Loomis is best known for his pioneering work in the science of meteorology. He was especially interested in how storms were structured and how they move. At the time there were conflicting theories for the direction of the winds associated with a storm: either rotational about the storm center or centripetal, toward the center. Loomis sent a paper to be read at the 1843 meeting of the American Philosophical Society in which he described his analysis of data collected over the course of a few days in 1836 at a large number of stations in the US and Canada. In an 1890 *American Journal of Science* memorial to Loomis, H. A. Newton describes Loomis' technique of presenting the data: "Professor Loomis drew on the map a series of lines of equal barometric pressure…. A series of maps representing the storm at successive intervals of twelve hours were thus constructed….A series of colors represented respectively the places where the sky was clear, overcast, rain or snow…A series of lines represented the places at which the temperature was at the normal, or 10 or 20 or 30 degrees above or below the normal. Arrows of proper direction and length represented the direction and intensity of the winds. These successive maps for the three or four days of the storm furnished to the eye all its phenomena in a simple and most effective manner." Loomis' map, as shown here in **Fig. 1-3**, appears on the Yale website:

http://love.geology.yale.edu/kgl/Dept_Information/History/loomis-map.gif

It was not until 1871 that the United States Signal Service began to provide weather maps following Loomis' design.

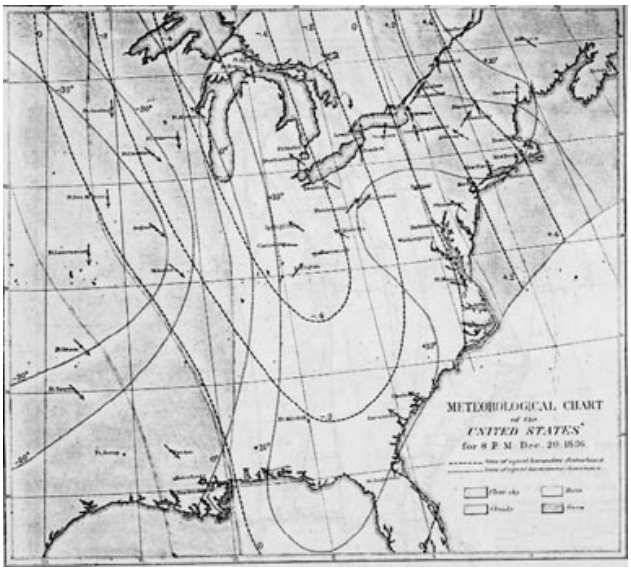

Fig. 1-3. Loomis' 1843 weathermap.

Loomis was in contact with other scientists interested in meteorology and the nature of storms. Some of his correspondence with William C. Redfield in New York (first president of the AAAS) and with James P. Espy in Philadelphia has been reproduced in a book by Nathan Reingold (*Science in Nineteenth-century America* Univ. of Chicago Press 1964). Here are two excerpts. One describes doing science on the frontier, the other makes one wonder if the writer were joking: Loomis to Redfield (Redfield papers, Yale University): "Being so far from New York, I find it difficult to obtain regular information from Europe. This is one of the greatest inconveniences of my position and I feel it sensibly. It takes a great while to get a box from New York, as it is very liable to be mis-sent or to be cast aside in some ware-house on the route." Espy to Loomis (Loomis papers, Yale University): "The

information which I have received concerning the chickens and turkies *(sic)* remaining alive after being stripped of their feathers in a tornado is verbal and I have no doubt of the fact though I cannot refer you to the authority by name."

It was about this time that the trustees approved the construction of a new and ample building. Funds for this new facility came from a gift of General Simon Perkins, one of the founders of the Western Reserve. The handsome three-story building, eventually called the "Athenaeum", would house lecture rooms and spaces for student organizations. It is here that chemist Morley would set up his teaching laboratories, as described in the next Chapter.

Loomis remained at Western Reserve until 1844, when he accepted a position at the University of the City of New York. He subsequently moved on to Yale in 1860. He is perhaps best known as the author of *A Treatise on Meteorology*, published by Harper and Bros., 1868.

Following Loomis in the position of Professor of Natural Philosophy was **James Nooney** (AB Yale 1838) who had served as professor of mathematics in the U.S. Navy – at a time when the teaching was done aboard ship. At Western Reserve, Nooney taught all the mathematics and physics courses from 1844 until 1848, when he left the college. For the next five years, rather grim ones on the economic side, there was no one on the faculty trained to teach physics. The college did eventually find another young Yale graduate, **Alfred Emerson**, AB 1834, who served from 1853 until 1856. I have not yet found evidence that these two young men had the opportunity to do any astronomical or other physics research. However, the Loomis astronomical observatory is featured each year in the Western Reserve catalogs until 1856.

Young and geomagnetism

During the 1850's there was a movement among American universities away from degrees based solely on the classics, philosophy, religion and literature and toward the study and application of the sciences. Henry Hitchcock (president of the college 1855-1871), himself an practicing clergyman, inaugurated an enhanced scientific program at Western Reserve. The first designation of "physics" in the college catalogue was in 1855. In 1856 Hitchcock hired **Charles Young**, a 22 year old graduate of Dartmouth, who took over mathematics, natural philosophy, and astronomy. **(Fig. 1-4)** Young continued the work of Loomis in meteorology and geomagnetism at Western Reserve. In fact, Loomis wrote to Young in 1859, asking him to repeat the magnetic declination measurements at Hudson in order to compare them with those which Loomis had made seventeen years earlier. Loomis published the

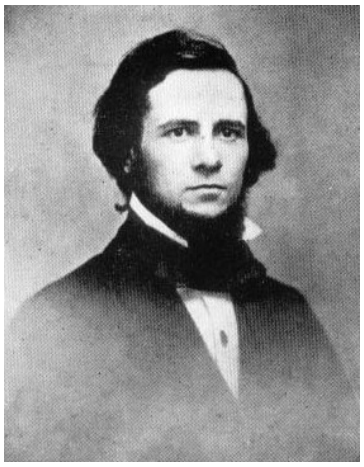

Fig. 1-4.
Charles Young.

results, claiming an increase in the dip angle by 14 minutes, evidence for the dynamic nature of the earth's magnetic field.

In 1862, the youthful Prof. Young was placed in charge of a company of student "soldiers" who served in the Union Army for a few months by guarding confederate prisoners. In this way, the college was spared the loss of most of its students to the draft. In 1865, Young was appointed the first Perkins Professor of Natural Philosophy and Astronomy. (This professorship, which ensured the continued teaching of physics at Western Reserve, was established with a gift of $5000 by Joseph Perkins in memory of his father, Simon. The Perkins Professorship continues to the present day; a list of its holders is included in Appendix F.) In spite of this honor, Young left Hudson the following year to return to the East after ten years at Western Reserve.

In later years at Dartmouth and Princeton, Young became a world authority on solar physics. Among his more important accomplishments was the measurement of the Doppler shift of spectral lines in light coming from opposite equatorial regions of the sun and consequently of the rate of solar rotation. His 1881 book, *The Sun*, and his 1898 introductory text on astronomy, *Lessons in Astronomy*, were used worldwide for more than fifty years. More on Young as a researcher and teacher can be found at the Princeton website:

(http://mondrian.princeton.edu/CampusWWW/Companion/young_charles.html).

Young died in Hanover, New Hampshire on January 3, 1908, a day of a total solar eclipse.

Physics in the Reserve: a beginning

Important aspects of the history of physics research at Western Reserve are the amounts and sources of funding that made it possible. In the early years, it was the enlightened trustees and the persevering presidents who sought out the dollars to be spent on salaries, buildings, and equipment. It was they who got the college through the difficult years of the 1830's and 40's. As commerce in northeast Ohio expanded exponentially, especially with the coming of the canals, the railroads and shipping on the Great Lakes, significant funding for professorships and memorial buildings became more available. The annual salary for a professor rose from $400 in 1829 to one thousand dollars in 1864.

There is a common element within this sequence of five young Ivy League teachers of natural philosophy: Wright, Loomis, Nooney, Emerson, Young. Each of them returned to the East after his stay in the Western Reserve. Almost as missionaries, they came to the Midwest to bring science to sons of farmers and land developers, and then left to pursue their various careers, having spent their allotted time on the American frontier.