However, in addition to being useful for demonstration purposes, this counter has further interesting properties.

The polythene counter can be made to operate for a considerable period of time without any high-voltage supply. The counter must first be irradiated by an x-ray machine while a voltage is applied equal to the normal operating voltage, but reversed in sign so that the case is positive. When the charging process is complete, and the high voltage is switched off, the counter will operate as usual due to the negative charge on the inner surface of the polythene. The pulse height decreases slowly, the rate of decrease depending on the gain in the counter, the energy and intensity of radiation. In the counter shown in Fig. 4 the gain fell from 10 000 to 2000 in 12 hr exposure to the natural cosmic ray background of 450 counts per minute.

The counter may be used as an integrating instrument for the measurement of total radiation over a certain time, by observing the fall in gain that occurs. Some information about the distribution of ionization along the counter may also be obtained, and in this respect the counter may be said to have a "memory" for radiation.

Physics and Physical Science in New Orleans, 1800–1860

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A survey of the early developments in physical science in New Orleans, with emphasis on the important contributions of John Leonard Riddell, Edward Hall Barton, Claudius Wistar Sears, and Caleb G. Forshey.

SCIENTIFIC thinking in New Orleans in the early years of the past century was primarily associated with three groups—traveling lecturers, local physicians, and a few faculty members of the University of Louisiana. During this period New Orleans was the center of a rich, agricultural region, and a busy port. There was much wealth and splendor, but also gambling, corruption, filth, and violence. Stabbings, garrotings, and duels were quite common. There was no sanitary water supply, most of the residents relying on rain water collected in cisterns. There was no sewerage system and refuse was allowed to accumulate in the mud streets. Characteristically, the native-born residents were quite content with their city, and no effort was made to correct these matters. Only visitors and those moving to New Orleans from other areas were concerned.

In spite of these shortcomings there was a genuine interest in things scientific. Three medical and scientific societies were organized before 1840. A museum was opened in 1819, another in 1825, and a third in 1836. There were organized discussion groups, meeting informally, for the exchange of ideas and experiences. It is not surprising that most of these were concerned with natural history or with medicine, since the region abounded in all sorts of specimens, and was visited periodically by epidemics of yellow fever and cholera.

The influence of the traveling lecturer was considerable. These men were not charlatans, but usually scientists of established reputation, who gave short courses of lectures. The earliest visitor of this type arrived in 1819, and gave a series on "Chemical and Physical Enquiries." There were lectures on microscopes and telescopes, courses in astronomy, geology, chemistry, meteorology, and natural philosophy, and in applied science. Dionysius Lardner, the Irish scientist, drew a large and interested audience for his lectures on physical and astronomical subjects in 1843. Benjamin Silliman gave his lectures on geology in 1845, and Benjamin Silliman, Jr. presented a course entitled the "Chemistry of Agriculture." The audience re-

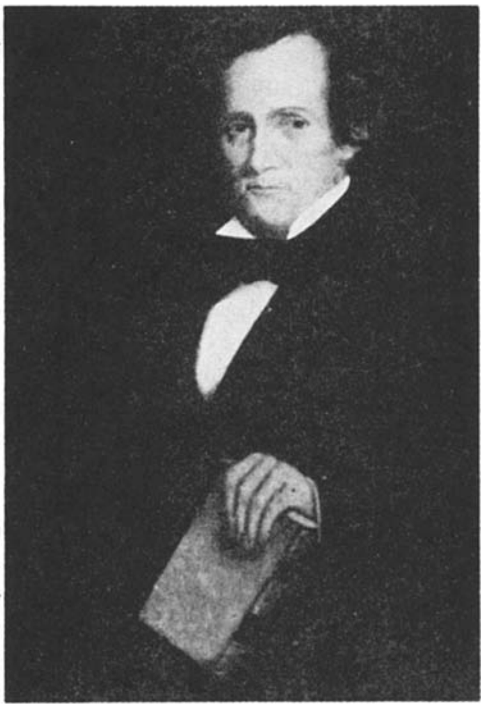


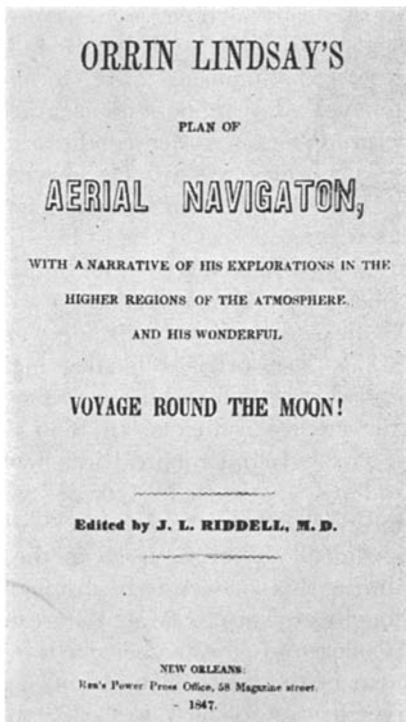
FIG. 1. John Leonard Riddell (from an oil painting in the Louisiana State Museum, New Orleans, Louisiana, courtesy of Lester Bridaham, Curator).

sponse was generally enthusiastic for all of the lecturers. The popularity of the travelers led to the establishment of the People's Lyceum, a monthly lecture series by local scientists, covering all fields of science. These lectures were supplemented by the occasional public meetings of the scientific societies. Physics, pure and applied, was not neglected in these lectures.[1,2]

One of the most popular lectures was given by Dr. John Leonard Riddell, whose portrait is shown in Fig. 1, on the subject of aerial navigation (1847). Riddell proposed a space ship to carry him to the moon, a ship made out of a metal which would be unaffected by gravitation. The lecture covered a description of the ship and of the instruments needed, a discussion of the necessary oxygen supply and of the changes in temperature to be encountered, and speculation on the possibility of collisions with meteorites. The lecture was published by popular demand.[3] (See Fig. 2.)

The local scholars were all physicians, sending their contributions to recognized journals such as the *American Journal of Science and Arts*, the *Boston Medical and Surgical Journal*, the *Western Journal of Medical and Physical Sciences*, and the like. Their writings were not confined to medicine, but embraced the physical and biological sciences. The *New Orleans Medical Journal* was established in 1844 and soon became the principal outlet for scientific writing. The name was changed to the *New Orleans Medical and Surgical Journal* after one year, but it contained many articles from the fields of physics, chemistry, botany, zoology, anthropology, geology, and meteorology. The editorial policy was summarized in the following statement[2]:

> It is far better, more practical to induce men to think, to investigate, to discover and then to apply.



ORRIN LINDSAY'S

PLAN OF

AERIAL NAVIGATON,

WITH A NARRATIVE OF HIS EXPLORATIONS IN THE HIGHER REGIONS OF THE ATMOSPHERE AND HIS WONDERFUL

VOYAGE ROUND THE MOON!

Edited by J. L. RIDDELL, M. D.

NEW ORLEANS:
Rea's Power Press Office, 58 Magazine street.
1847.

FIG. 2. Title page of Riddell's *Orrin Lindsay*, from photostat of copy in the New York Public Library.

[1] Thomas Cary Johnson, Jr., *Scientific Interests in the Old South* (Appleton-Century-Crofts, Inc., New York, 1936).

[2] Robert J. Usher, "Physician and scientist, 1850," New Orleans Med. Surg. J. **94**, 567-575 (1942).

[3] John Leonard Riddell, *Orrin Lindsay's Plan of Aerial Navigation* (Rea's Power Press, New Orleans, 1847).

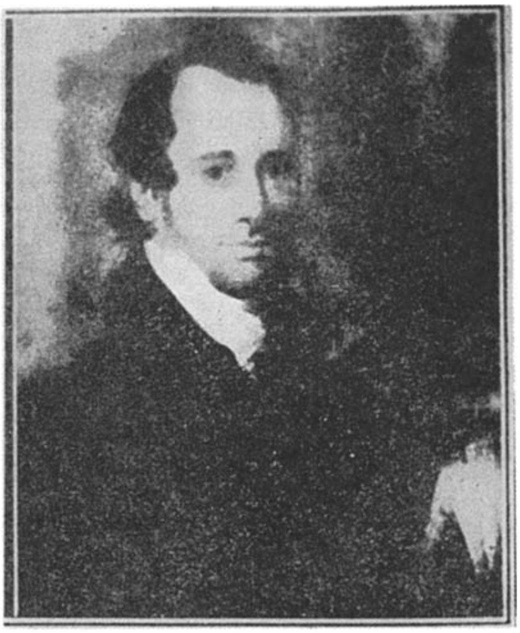


FIG. 3. Dr. Edward Hall Barton.

Several of the local physicians were amateur meteorologists. Of these Dr. Edward Hall Barton was the most distinguished (Fig. 3). For over twenty-five years Barton kept an accurate record of temperature and weather conditions, taking readings four times a day. He served as an official observer for the Smithsonian Institution. Barton used these observations in his studies on the relationship between weather and disease, with emphasis on yellow fever.

The Medical College of Louisiana was organized in 1834. The original faculty included a professor of chemistry in addition to the instructors in the medical subjects. In 1836 this post was filled by Dr. John Leonard Riddell, who held the chair until his death in 1865. It was John Leonard Riddell, chemist, physician, and botanist, who did all of the research in the field of physics during this early period,[4] although he was never thought of as a physicist. Later, when the Medical College of Louisiana became the Medical Department of the University of Louisiana, and the University established a Collegiate (Academic) Department, a professor of mathematics and natural philosophy was included. This post was filled from 1846 to 1860 by Claudius Wistar Sears (Fig. 4). Sears instituted instruction in physics, pure and applied. Since Riddell and Sears were responsible for most of the progress in physics, some details about these men and their work will be given.

Claudius Wistar Sears was a native of Massachusetts, born November 8, 1817. He was graduated from the United States Military Academy in 1841, and, after a brief period of active duty with the Army, became professor of mathematics at St. Thomas' Hall, an Episcopal preparatory school in Holly Springs, Mississippi. In addition to his professorship of mathematics and natural philosophy at the University of Louisiana Sears served as principal of the Preparatory School of the University, and for a time as Dean of the College.

To counterbalance the emphasis on Latin and Greek in the curriculum and in the entrance requirements of the University Sears built up a scientific program. He included algebra, geometry, plane and spherical trigonometry, analytic geometry, surveying, navigation, descriptive geometry, differential and integral calculus, astronomy, and two semesters of natural and experimental philosophy (physics), and a course

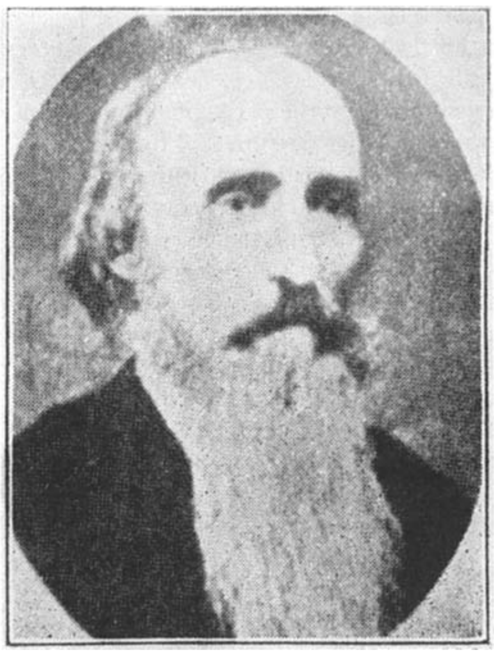


FIG. 4. Claudius W. Sears.

[4] John Leonard Riddell, *Diaries* (unpublished). On deposit in the Howard-Tilton Memorial Library, Tulane University.

in shades, shadows, and perspective. His course in natural and experimental philosophy, for juniors and seniors, treated in about six months the fundamentals of mechanics, hydraulics, hydrodynamics, acoustics, optics, electricity, magnetism, and chemistry. He also included the application of chemistry to the arts and to agriculture. This sequence has some resemblance to the general physics course of today, but it seems strange that no phase of heat or thermodynamics was presented.

In addition to the scientific program Sears offered a special curriculum for engineering students. The program omitted the usual Latin and Greek requirements for a degree, but added courses in masonry, strength of building materials, stone cutting, limes, cements, mortars, foundation and concrete works, framing, bridges, roads, railways, canals, aqueducts, viaducts, rivers, sea coast improvements, architecture and topographical engineering, and drawing.

According to our standards today Sears was carrying a tremendous teaching load, since he taught all of the courses mentioned. He was also burdened with his administrative duties. Fortunately, classes were small. The graduating class of 1851, for example, contained only fourteen students. Sears was a hard taskmaster. He believed in West Point methods, used the West Point textbooks and encouraged plenty of drill work and recitation. He was often cited for thoroughly indoctrinating his students into the principles of science. He was responsible for the inclusion of geology in the curriculum (1850).

Sears was elected to membership in the New Orleans Academy of Sciences in 1857. This indicated that he must have published at least three scientific papers, but no record of these exists today. Sears became a Brigadier-General in the Confederate Army, lost a leg in the Battle of Nashville, and afterward became professor of mathematics at the University of Mississippi, where he remained until his death on February 15, 1891.

In stark contrast to Sears we have the research physicist of the University of Louisiana—John Leonard Riddell. Although he was never officially connected in any way with physics or natural philosophy he did much work in the field. Riddell was born in Leyden, Massachusetts, February 20, 1807, the son of a poverty-stricken tenant farmer. He was graduated from Rensselaer School, Troy, New York, with the A.B. degree in 1829, and received the A.M. in 1832. Cincinnati Medical College granted him his M.D. degree in 1836.

Following an early career as a traveling lecturer in chemistry, as a botanist, and as a geologist, Riddell came to the Medical College of Louisiana in 1836 as professor of chemistry. His course in chemistry was a mixture of physics and chemistry, illustrated by simple but showy experiments. He considered natural science as divided into natural philosophy, natural history, and chemistry, and felt that it was impossible to draw a strict line of demarcation between them. He wrote:

> Natural philosophy investigates and explains the properties, motions and relations of material bodies without any regard to their inherent composition. It is the laws of nature, developed by Natural Philosophy, that poise the heavenly bodies and direct the distant planets in their trackless orbits through the regions of empty space . . . Natural philosophy explains the perceptible motions of natural bodies in mass, such as the momentum of falling bodies, the pressure of fluids and the force and effects of planetary attraction.—(Lecture at Meadville, Pennsylvania, 1832.)

Riddell's early work in physics consisted in constructing a modified barometer, studying showers of meteors, and speculating on atmospheric and terrestrial changes. All of these were published in brief reports.

In his notes on mechanics Riddell presented some unusual hypotheses. He discussed momentum and collision theory in the same terms we use today, but did not accept Newton's theory of gravitation. He propounded a radiant theory of gravitation, stating that the attraction of gravity is

> caused by the radiations of ethereal particles in all directions, having the power to impart their momentum to ponderable matter.

He believed that gravity was not material, that it was not abstract motion, nor was it momentum.

Riddell followed this theory with a symbolic formulation of matter, for particles of luminiferous ether and particles of gravitation-bearing ether, expressed in terms of a fraction of unity, indefinitely small. The formulation is cumbersome and incorrect, yet is carefully presented in several papers.[5] He was sharply criticized by Dr. Albert Welles Ely, a fellow physician, in the local newspapers, but always had a ready answer for his critic.[6] Riddell developed his theory of matter to account for four states: nebular matter, solids, liquids, and gases. He accepted the law of conservation of matter and believed that matter was composed of molecules, atoms, and an infinite number of smaller particles, held together by "lines of force," indeed our present-day concept presented many years before the discovery of our atomic particles.

Riddell was also an inventor of many pieces of apparatus. The binocular microscope (Fig. 5) was his outstanding contribution. This was reported to the Physico-Medical Society of New Orleans in 1852, and to the American Association for the Advancement of Science in 1853. He made several modifications of this instrument, and prepared special lenses and objectives for

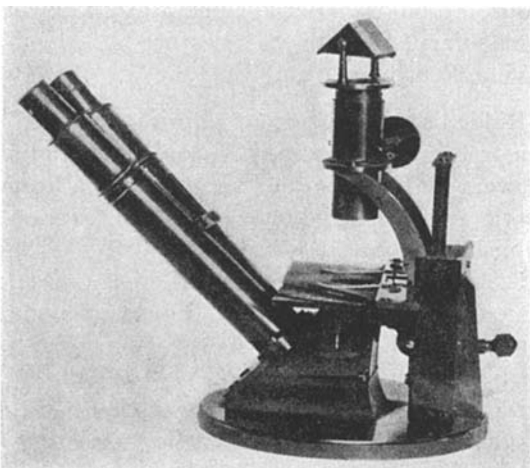


FIG. 5. Riddell's binocular microscope (photograph from Ohio State Archaeological and Historical Quarterly, Vol. 54, October–December, 1945).

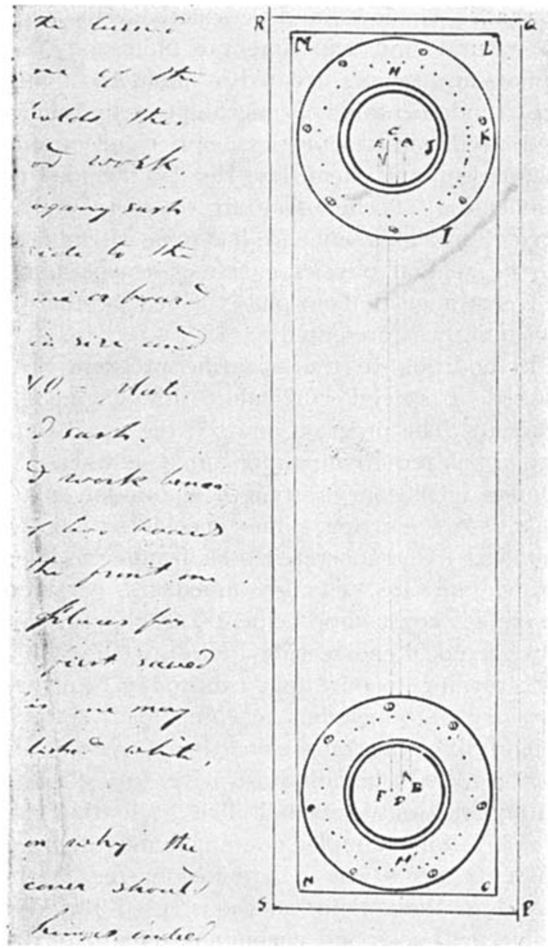


FIG. 6. Page from one of Riddell's diaries, showing one of his preliminary sketches for his "spirit clock."

his work. He constructed a "fish-rod" balance, used to determine the amount of nonvolatile matter in liquids which gave films too minute for an ordinary assay balance. He also designed a pocket compass and a spirit clock (Fig. 6).[7,8]

During the latter part of the 1850's Riddell's work was chiefly in the field of medicine. He later became postmaster of the City of New Orleans and was involved in politics during the period of occupation of the city during the Civil War. He died on October 7, 1865.

An interesting contribution to physical science

[5] John Leonard Riddell, "The probable constitution of matter," New Orleans Med. Surg. J. 2, 592–623 (1846).

[6] Albert Welles Ely, "An examination of the Riddellian philosophy," New Orleans Med. Surg. J. 3, 3–16 (1846).

[7] John Leonard Riddell, "On the binocular microscope," Proc. Am. Assn. Adv. Science 7, 16–23 (1853).

[8] John Leonard Riddell, "The binocular microscope," New Orleans Med. Surg. J. 9, 407–408 (1852).

FIG. 7. Caleb G. Forshey.

was made by Dr. Edward Hall Barton.[9,10] He proposed the air-conditioning of the entire city of New Orleans. He said that all buildings and even the streets up to a height of at least thirty feet could be kept at an even temperature of 75 degrees Fahrenheit throughout the summer months. His method employed the natural laws of physics as he knew them. He believed that evaporation was the obvious source of artificial refrigeration, and suggested

> the rarefaction and distribution of atmospheric air previously deprived of large portions of latent heat by mechanical condensation. Large reservoirs in the suburbs would contain the compressed and cooled air which would be released in houses and even in streets and open squares.

Barton denied that atmospheric air currents would carry away the cool air, stating that in every city in the South there was actually a stationary air pocket. His proposal preceded Joule's experiments by at least a year, and hence his calculations are not feasible today. It is interesting to note that Barton estimated that it would cost about $8.33 per building per year for air-conditioning.[2,11]

Another worker in applied physics was Caleb Goldsmith Forshey (Fig. 7). A native of Pennsylvania, educated at Kenyon College and the United States Military Academy, Forshey was a civil engineer and a student of science in its broadest sense. Following a survey of the delta of the Mississippi River he wrote the "Hydrometry and Physics of the Mississippi Delta" and later the "Physics of the Mississippi River." At one of the meetings of the New Orleans Academy of Sciences Forshey discussed the behavior of a flock of buzzards which he observed, the birds rising to a height of two miles with great velocity and no apparent motion of their wings. Forshey postulated that there was a column of air rushing upward, and that this had carried the birds along. This was, of course, correct, and an observation made later by others in experiments with gliders.[12]

Although some of the men mentioned in this paper are remembered primarily for their founding of the New Orleans Academy of Sciences in 1853, their real contribution was the establishment of a true scientific atmosphere in New Orleans, and a recognition of physics and physical science as an integral part of the culture of the old South.

[9] William D. Postell, "A review of Louisiana medical literature, 1796–1843, the formative years," Ann. Med. Hist. **3**, 207–218 (1942).

[10] William D. Postell, "Edward Hall Barton, sanitarian," Ann. Med. Hist. **4**, 370–381 (1942).

[11] Edward Hall Barton, Southern Quarterly Review (1842).

[12] Minutes of the New Orleans Academy of Sciences, July 11, 1853.

As a result of the many requests for summer employment, the Institute has again compiled a list of institutions which have indicated that they will welcome inquiries for summer employment, for the year 1957, from College Students studying physics and from High School Science Teachers. Further information may be obtained by writing to the PLACEMENT SERVICE, American Institute of Physics, 57 East 55th Street, New York 22, New York.