

Figure 1 "Autobiography of Joseph LeConte", frontispiece

Joseph LeConte AB MD BS, 1823-1901

Fraser Muirhead

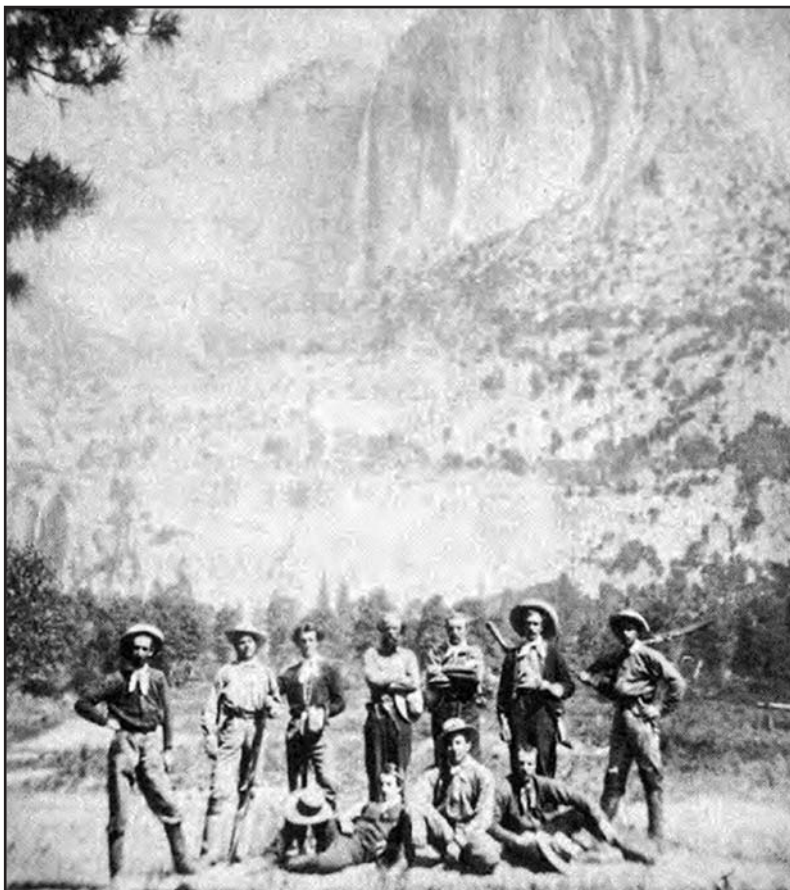


Figure Two:
LeConte's Ramblings Excursion Party 1870

Introduction

Although Joseph LeConte (1823-1901) is widely known as a geologist and conservationist, he is little recognized today for his work in other fields. Recently his long neglected work in physiologic optics has been revisited and evaluated. His family history, his early education, his experiences during the Civil War and Reconstruction, and his 30 year tenure at the University of California, so well described in his autobiography, provide a background for understanding his contributions.⁽¹⁾

Early Life

Joseph Le Conte was born to a well to do, pre-civil war, slave owning plantation family with a tradition of having scientific

flight of birds	genesis of sex
law of evolution of thought	saltpeter manufacture
human being as pack animals	idea of a university
domestic ducks that fly	star rays and blindness
problem of human flight	psychical relations man to animals
liver glycolysis	ptomaines, leucomaines and disease
nature of vowels	Plato's Doctrine of the Soul

Figure Three
A few subjects of LeConte's publications

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interests. Their plantation survives now as a national historical garden bearing no original buildings. He graduated from Franklin College (now part of the University of Georgia) in 1841 and went on to the College of Physicians and Surgeons in New York City where he and his older brother, John, graduated MD in 1845⁽²⁾.

After graduation he returned to the south to practice medicine for a couple of years before giving up medicine to start graduate school at Louis Agassiz' new Lawrence School of Science at Harvard, where LeConte had daily contact with Agassiz, Asa Gray, Richard Henry Dana and others. He studied mollusc taxonomy, the geology of the Catskill Mountains and the formation of the reefs of Florida. He returned to the South to an academic career at three colleges. During this period Joseph Henry, founder of the Smithsonian Institution, invited him to present two sets of lectures at the Institution, three on coal formation and three on the formation of the Florida coral reefs. The coal series was published in the Smithsonian Report of 1857 and later reprinted in French translation.

Civil War

After short service in the Confederate government as civilian in charge of medicine manufacture he became the chemist for the Niter and Mining Bureau. In the turmoil and confusion at the end of the war he and his family suffered major losses. At one point he hid under bushes for an entire day to escape being shot by Sherman's marauding forces.⁽³⁾ Sherman's troops burnt all his personal belongings including his Harvard thesis. Later the family gardened together with their ex-slaves to grow their own food.

The poverty and mismanagement of Reconstruction presented unbearable barrier to teaching and research. The expense of geologic exploration and associated instrumentation forced LeConte to abandon geology in favor of less expensive vision research. Northern antipathy to people who had served the Confederacy thwarted his hope of a position in a northern university. Northern friends suggested the new university at Berkeley as a possible alternative. His brother John and he applied and they became the first two faculty members of the University of California.⁽⁴⁾

California and University Career

In California he bloomed. He taught geology, botany, and natural history for over three decades. From the very beginning he was an extraordinarily popular professor. In his first year he made a very arduous journey with a group of students to Yosemite, recorded in his still in print book, "A Journal of Ramblings through the High Sierra of California by the University Excursion Party".

Lifelong friendship with John Muir, formed on that trip, led to his becoming a charter member of Muir's Sierra Club. His deep interest in the Sierra Nevada Mountains continued until he suddenly died camping in Yosemite. Two mountains, one in Tennessee and one in California, a glacier in Alaska, and a pass and waterfall in California are named after him, as are many schools and streets across California.

He became president of the American Association for the Advancement of Science and the American Geological Society. He was elected to the National Academy of Sciences, and represented the United States at the 1891 International Geological Congress. He was also vice-president of the American Committee for the Congress. Princeton University awarded him Ll. D. at its sesquicentennial. Of his 214 publications, 195 appeared during his California years. Their subjects varied incredibly, from vowels to sex, to human flight, to the evolution of thought, to human beings as pack animals, to liver glycolysis, to the flight of domestic ducks, the nature and uses of fine arts, and so on.

He published two geology textbooks, as well as books on race relations, evolution and religion. His "Elements of Geology" went through three revisions before his death and one other afterward and his "Compend of Geology" was revised once.

Vision Research

Evaluation of LeConte's vision research work is based his many articles and his very popular and generally highly regarded major work, "Sight: An Exposition of the Principles of Monocular and Binocular Vision", which was widely used as a textbook in university physiology and psychology courses in the

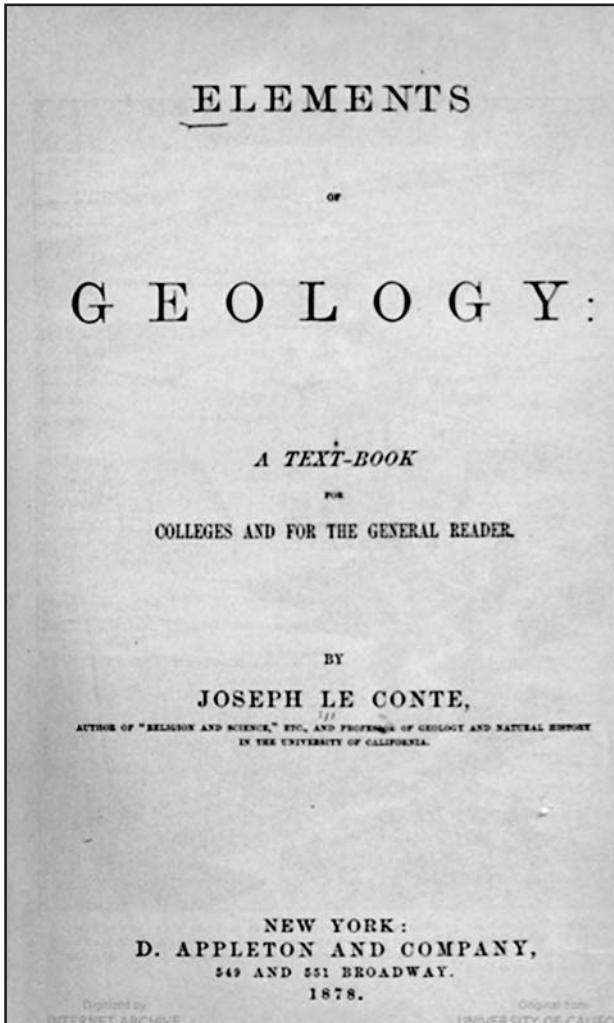


Figure Four
 "Elements of Geology", First Edition, 1878, Title Page

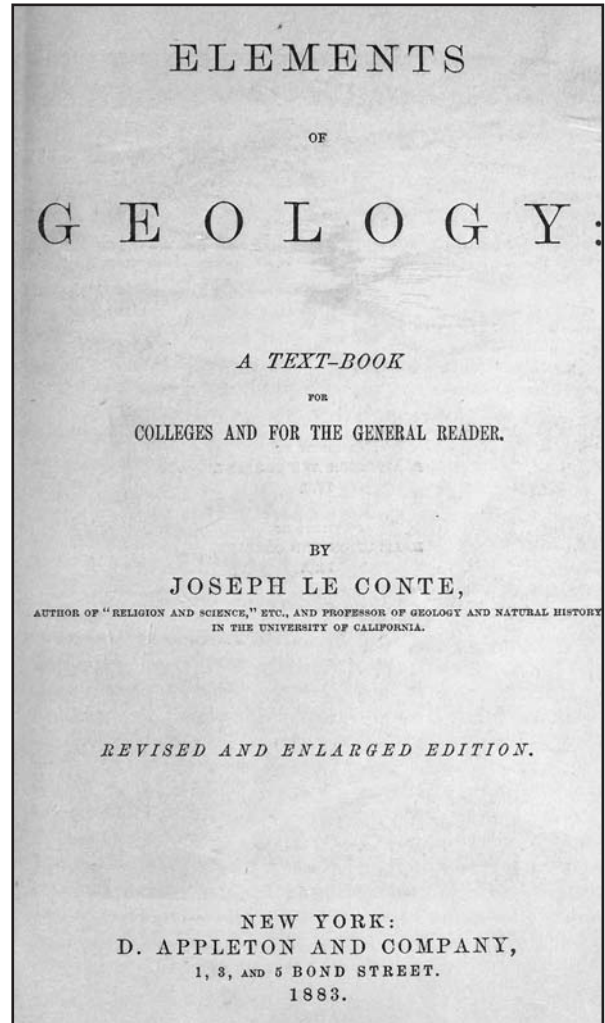


Figure Five
 "Elements of Geology", Second Edition, 1883, Title Page

decades before the turn of the century. It went through a second English edition in 1897 and a German edition appeared in 1883. William James, although he had reservations about the psychology coverage of the book, highly praised it.

After LeConte's death interest in the book lessened. Hermann von Helmholtz, who had cited LeConte 12 times in the 1896 edition of his "Handbuch der physiologischen Optik", made no mention of LeConte in later editions of the work.⁽⁵⁾ Julius Hirschberg included him in his "Geschichte der Augenheilkunde". third book, second section, *History of American Ophthalmologists of the 19th Century*, despite LeConte being neither an ophthalmologist nor even a practicing physician.⁽⁶⁾

Hirschberg wrote that LeConte was, "...relevant for ophthalmology (because of his publications about binocular vision....)". He continued, "Important also ...(is)... his 'Theory of Vision'...(Lehre vom Sehen)... because, there is no other book in English which in the popular language deals with this topic . LeConte's type of presentation is his own and his illustrations are largely original."⁽⁷⁾ Hirschberg noted that "Sight" was so little mentioned in America. By the time this volume of *Geschichte der Augenheilkunde*, was published (1915) LeConte's "Sight" was no longer widely in use.

Joseph LeConte is mentioned twice in the 1918 "American Encyclopedia and Dictionary of Ophthalmology". Charles Sheard

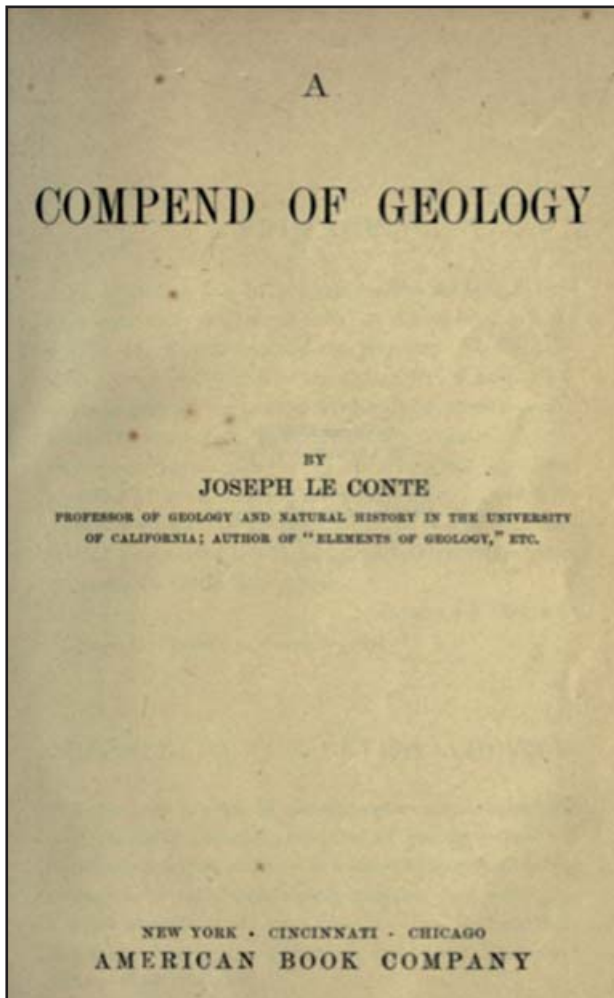


Figure Six,
"Compend of Geology", 1888, Title Page

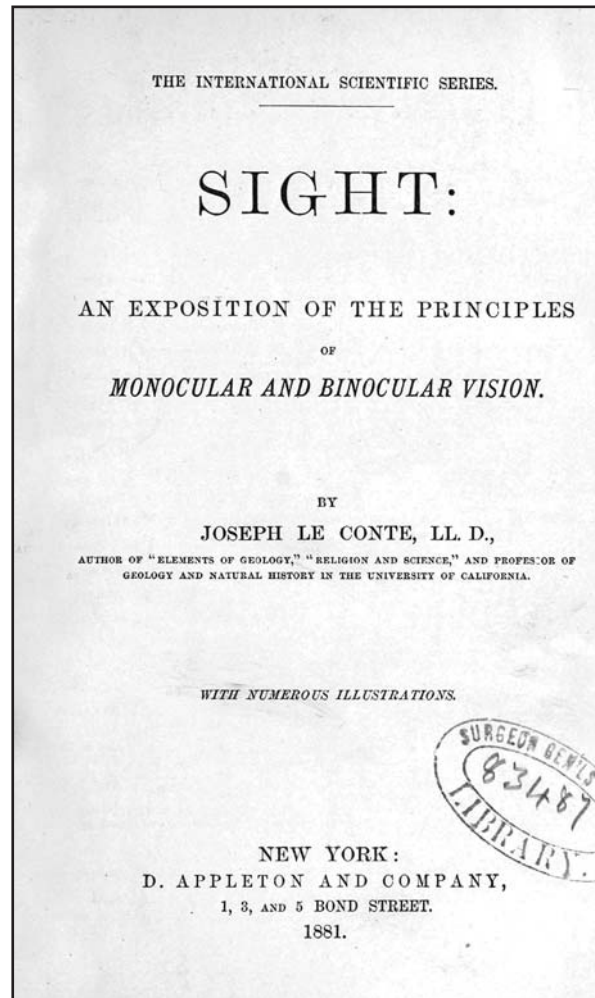


Figure Seven,
"Sight: An Exposition of the Principles of Monocular and Binocular Vision" , 1881 Edition Title Page

in his article, "Physiologic Optics", mentioned him four times.⁽⁸⁾ Dr. F. B. Eaton, mentioned "Sight" in his biographical article on LeConte⁽⁹⁾

LeConte had scant mention through the next decades. In 1968 Duke-Elder attributed the derivation of one of his diagrams (Figure Nine) to a diagram in LeConte's "Sight".⁽¹⁰⁾ Somewhat later Lester Stephens, LeConte's biographer and historian at LeConte's alma mater, suggested that LeConte be considered father of physiological optics in the United States.⁽¹¹⁾ He wrote that, "...LeConte deserves credit as the father of physiological optics in the United states.

He wrote the first textbook on optics in the Western Hemisphere, and by consensus of contemporary critics and the extent of its use.

Sight was an extremely influential work. Even today the book stands forth as a remarkably clear presentation of a complicated subject. It is marked by its lucid language, its reduction of complex phenomena to easily comprehensible explanations, its simple and distinct illustrations, and its experimental verification of visual phenomena. But long before he published his book on vision, he had pioneered a number of significant studies that directly advanced the science of optics,

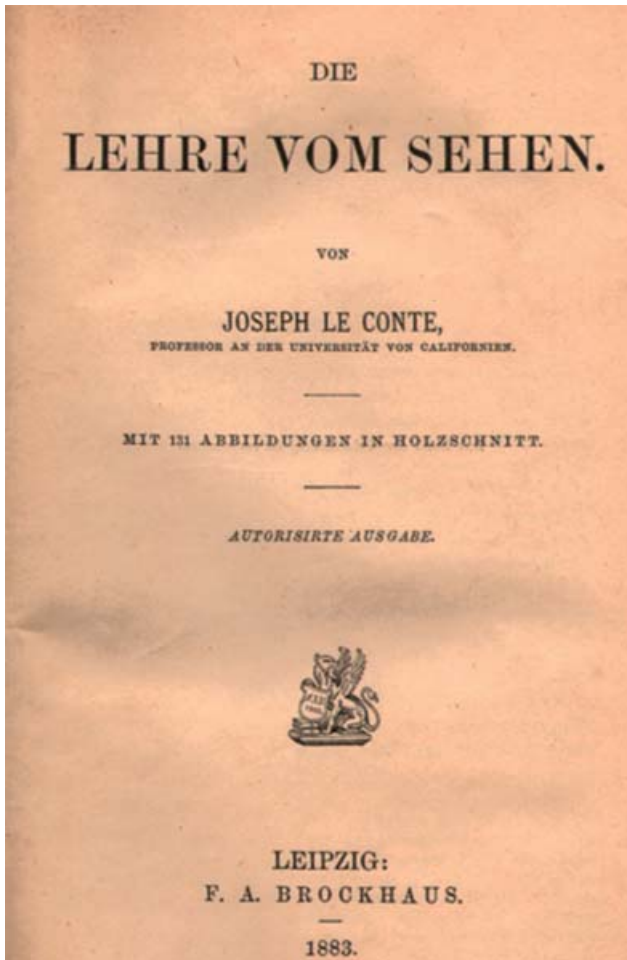


Figure Eight ,
"Die Lehre vom Sehen," 1883 Title Page courtesy Rich Behles,
Cordell Library of the University of Maryland

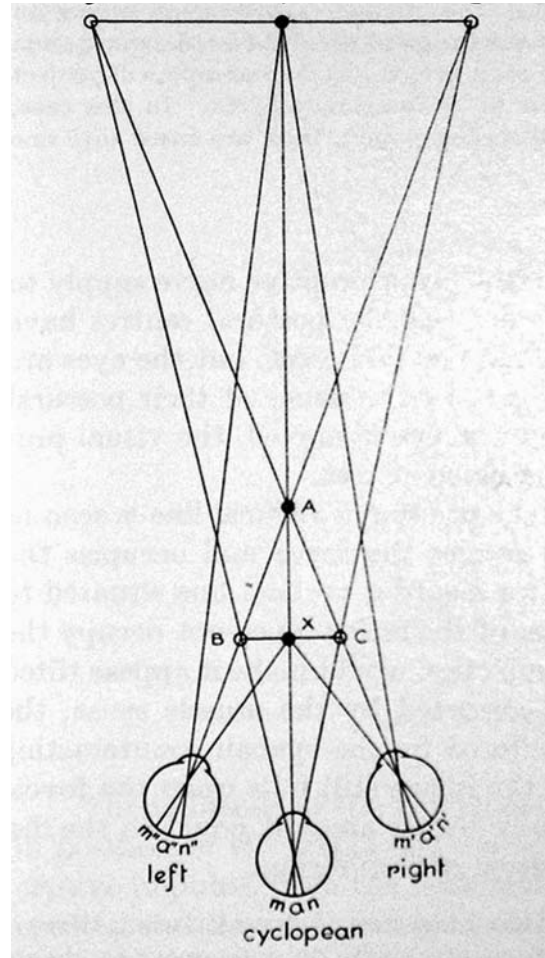


Figure Nine,
Stewart Duke-Elder, *System of Ophthalmology*,
Volume Four, 1968, fig 308

or at the very least either confirmed other studies through new experiments and observations or helped to clarify thought on disputed subjects. Thus, his research on accommodation, the nature of the horopter, and binocular relief added to contemporary knowledge of physiological optics, and his diagrammatic presentations greatly enhanced explanations of the phenomena of binocular vision."

Modern Analysis

Germany in the mid to late 19th century dominated vision research. The work of several long neglected English language researchers in the field of vision, William

Charles Wells, Joseph Towne, and Joseph LeConte, has a recently been the subject of extensive review and analysis.⁽¹²⁾

To visually locate an object in relation to oneself requires a reference point, the origin of view, variously known as egocenter, head center, center of visual direction, or cyclopean eye. In their monumental three volume work "Perceiving in Depth"⁽¹³⁾ Ian Howard and Brian Rogers wrote, "The concept of the cyclopean eye was proposed at approximately the same time by three authors, Towne, Hering, and LeConte". "The very similar observations of these three, taken together with Hering's, led to the idea that we locate an object in our binocular visual field in relation to

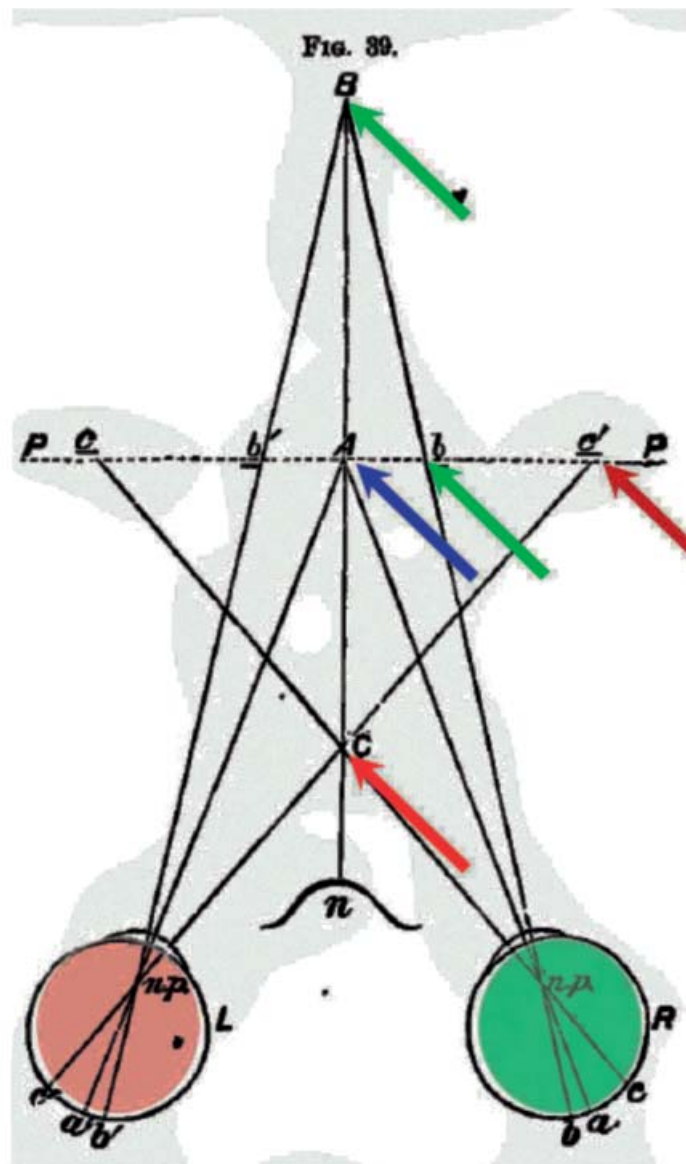


Figure Ten, Joseph LeConte, Sight: An Exposition of the Principles of Monocular and Binocular Vision 1897 Edition p. 115, Figure 39 modified by author

a point half way between our two eyes, to the cyclopean eye.”

From youth LeConte was interested in diplopia and binocular stereoscopic vision. This interest intensified after his first experience with Charles Wheatstone’s stereoscope at a party in Philadelphia in 1854. In 1838 Charles Wheatstone, describing his new invention the stereoscope, wrote, “... objects whose pictures do not fall on corresponding points of the two retinae may still appear single.”⁽¹⁴⁾

LeConte, in his account of this experience with the stereoscope, recalled that he had immediately stated that Wheatstone’s theory of binocular vision was false.⁽¹⁾ He wrote that, “... I had read carefully ... all ... published by Wheatstone.... His theory...was that when the images of two dissimilar pictures fall on the retinae ...the two dissimilar images are mentally fused into one, and appear as a real solid object I looked long ... at the stereoscopic effect, and then remarked, ‘Yes, it is very beautiful, but Wheatstone’s theory is not true; there is no mental fusion at all, for when I look at the farther lines of the united diagrams, the nearer ones are doubled, and when I look at the nearer lines, the farther ones are doubled, and furthermore, the stereoscopic effect is the result of this doubling”. Here LeConte used his remarkable ability, well honed since youth, to appreciate doubling of images of objects that do not lie in the fusional area.

This long known phenomenon, doubling of images not in the fusion area, is illustrated in Figure Ten (p.120). It shows that when both eyes are fixed on point A, lying in the fusional area, an object lying at C closer to the observer than A, when viewed unocularly appears to lie at small c’ or small c located on the other side of A. Thus objects nearer than fixation appear monocularly cross projected. Similarly an object B, located farther away from the eyes than fixation point A, will be perceived to remain on the same side of A as at small b and b’ when viewed monocularly; or to be projected monocularly uncrossed.

LeConte attributed stereoscopic binocular vision to the diplopia caused by the monocular crossing and uncrossings induced when the focus moves from beyond to in front of the object of regard.

In their analysis of this phenomenon using modern instrumentation, H. Ono, L. Lillakas and N. Wade⁽¹⁵⁾ wrote, “Modern experimental evidence supports LeConte’s idea that the information regarding ‘crossed’ and ‘uncrossed’ disparity is available to the visual and oculomotor system ... and stereoscopic depth can be seen with diplopia.” They continued, “Consistent with LeConte’s claim ... depth perception with diplopia is ‘direct’ (ie it is based on binocular disparity information and not on “eye-muscle proprioception” or on a “vergence drive signal”. They conclude that, “...today there are psychophysical experiments that confirm the existence of the perception of depth with diplopia, and there is a hypothesis that processing of second-order disparity is responsible. Moreover, there is physiological evidence for a depth mechanism that processes the second-order stereoscopic information. The observation of diplopia with depth perception, made over 150 years ago, is now receiving some attention.”

Conclusion

Joseph LeConte, long honored as a geologist and conservationist, had many other interests. Among these was physiologic optics, for which he was well known in his lifetime. After his death his work, along with that of two other English speaking researchers, was neglected for about a century. In midcentury Lester Stephens wrote that LeConte deserves credit as, “...the father of physiological optics in the United States”, He based this statement on the widespread use of his textbook, “Sight: An Exposition of the Principles of Monocular and Binocular Vision”, in educating future physiologists and psychologists in the latter part of the 19th century. LeConte’s contributions to physiological optics have recently been retrieved and analyzed using modern methods. Today he is being appreciated as one of several people who independently introduced the concept of “cyclopean eye”, introduced laws of visual direction, and proposed that binocular stereoscopic perception arises from diplopia.

Acknowledgements

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