MEMOIR

OF

JOHN LE CONTE.

1818-1891.

BY

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BIOGRAPHICAL MEMOIR OF JOHN LE CONTE.

John Le Conte was born on a plantation in Liberty county, Georgia, December 4, 1818. As his family name indicates, he was of French Huguenot descent. His earliest American ancestor, Guillaume Le Conte, left his native city of Rouen soon after the revocation of the edict of Nantes, 1685, and in consequence thereof, and after a brief stay in Holland and in England, came to America and settled in the vicinity of New York. A full account of his ancestry has already been given in the biography of his cousin, John Lawrence Le Conte (Biogr. Mem., vol. ii, p. 263), and need not be repeated here. But his immediate parentage and the conditions under which he was born and educated had so important a bearing on his character and life-work that it cannot be passed over without brief mention. It is much to be regretted that we know so little of the boyhood of distinguished men, for this is the character-forming period of life.

Louis Le Conte, the father of John, was the elder brother of Major John Eatton Le Conte, so well known in the history of American science. He was born August 4, 1782, it is believed in Shrewsbury, N. J., but lived and received his early education in the city of New York, and was graduated in Columbia College in 1800, at the early age of eighteen. After graduation he studied medicine with the celebrated Dr. Hosack, but, it is believed, never graduated in that profession. He certainly, however, acquired great knowledge and skill in medicine, which was of great importance to him subsequently on his Georgia plantation. About 1810 he removed to Liberty county, Georgia, to take possession of a large property in land and negroes left him by his father, John.

Liberty county was originally settled by a colony of English Puritans, who have left their strong impress on the character of the people of that county even to the present day. A more intelligent and moral community I have never seen. It received its name of Liberty in recognition of the fact that it was the first colony in Georgia to raise the flag of independence on the breaking out of the war of the Revolution, in 1776.

Louis Le Conte married Ann Quarterman, a maiden of this colony. Of the seven children, four sons and three daughters, the issue of this marriage, John was the fourth child and the second son. His father, Louis, lived on his plantation and devoted himself entirely to the care and management of his large property and to the passionate pursuit of science in nearly all departments, but especially in those of chemistry and botany, in both of which his knowledge was both extensive and accurate. The large attic of his plantation-house was fitted up as a chemical laboratory, in which he carried on researches daily. I well remember what a privilege it was to us boys to be permitted sometimes to be present, and with what silent awe and tiptoe steps we, especially John, followed him about and watched these mysterious experiments.

His devotion to botany was even, if possible, still more intense. A large area of several acres of enclosed premises was devoted to the maintenance of a botanical and floral garden, widely known at that time as one of the best in the United States, and often visited by botanists, both American and foreign. Far removed from any city (Savannah was near forty miles distant), this garden was used only for scientific study and refined enjoyment. It was the never-ceasing delight of the children. The tenderest memories cluster around it, especially about the image of our father in his daily walks there after breakfast, sipping his last cup of coffee, enjoying its beauty, planning improvements, and directing the labor of the old negro gardener, "Daddy Dick." It is, alas, in ruins now, but some of the grand camelia japonica trees, of which there were eight or ten, still remain. I said "trees," for in December, 1891, I visited the old place and measured some of these. The largest, a double white, measured fifty-four inches in girth; ten inches from the ground where the first branches came off. In bygone days I have seen at least one thousand pure white blossoms five inches in diameter and double to the center on it at once.

To supply this garden he made many excursions, often with visiting botanists or collectors, sometimes lasting several days, and always returning laden with botanical treasures. As evidence of his keen perception of the true affinities of plants, it is noteworthy that although the Linnean system was at that time universally used, yet even at this early day he always spoke of the affinities of plants in terms of their natural orders.

Nor was he neglectful of other departments of science. This was well shown in the composition of his large library of scientific books and periodicals. In fact, his love of nature was so spontaneous and passionate that it could not but extend in all directions. Mathematics, astronomy, physics, geology, and zoölogy alike engaged his attention. I remember well the intense enthusiasm with which he read Lyell's Principles of Geology when first published. I remember, too, his delight in working out the most complex mathematical puzzles; such, for example, as magic squares. The boys were all ardent gunners, but under his influence we never failed to observe carefully what we shot. Every new form of bird or beast was brought home in triumph to be determined in name and affinities by him.

Nor was he wanting in kinds of culture other than scientific. His training in Latin, for example, was so thorough that he read it at sight almost as readily as English.

It is easy to see from the above sketch that Louis Le Conte was one of a type of scholars now almost extinct. Such simple, disinterested love of truth for its own sake, such open-eyed, yet thoughtful, observation in all directions, such keen insight, such passionate love of nature, and all combined with such utter forgetfulness of self and absence of any ambition or vanity of reputation. Those who knew him best, but especially his brother, Major John Le Conte, affirmed that he made many important discoveries in both chemistry and botany, yet he never published a line, but freely gave away his new things in the latter science to his many correspondents in New York.

Here, then, until his death, in 1838, he lived his simple, quiet life of intellectual culture and beneficent activity, administering the affairs of an estate with two hundred slaves with firmness and kindness, daily directing their labor, visiting the sick, and caring for the old. His medical knowledge was of inestimable value to him now, not only on his own place, but to the poor of the surrounding country, who were unable to pay for medical service. His plantation was on the borders of the pine barrens of McIntosh county, inhabited only by a shiftless class of "Pine Knockers." For twenty miles about, in pure charity, he visited these people in their sickness; and in chronic cases; even bringing their children to his own house, as the only hope of their recovery. In order to diminish their sense of dependence and to cultivate in them, if possible, a sense of self-respect he sometimes required of them in return some light work, as picking of cotton or gathering of corn. He was looked up to by these poor people as a being of another order from themselves.

It is easy to imagine the passionate love, the reverence, approaching to fear and even to worship, with which he inspired his children. The effect of such a life and such a character on young John is simply inestimable. To the day of his death John looked back on his father with the greatest love and reverence and upon his influence as the greatest of all influences in forming his character; and, indeed, of all the children John most resembled his father.

I have dwelt somewhat on the life and character of Louis Le Conte, not only because of its paramount influence on his children, especially John, but also because such a life and such a character ought not to go wholly unrecorded.

Liberty county at that time abounded in game of all kinds and its waters swarmed with fish. The mother died early (John was then eight years old), and the boys were left wholly in the care of the father. His theory of the education of boys was to give as much freedom as was at all consistent with safety. He allowed us the free use of fire-arms, but early impressed upon us the habit of careful handling. All the boys were, of course, passionately fond of field sports of all kinds. Indeed, life on a plantation in the South at that time was a very paradise for boys. Not only the unlimited hunting, fishing, swimming, &c., but all the multitudinous farm operations required at that early time, the tanning, the shoemaking, the blacksmithing, the carpentering, the picking, ginning, and packing of cotton, the reaping, threshing, winnowing, and beating of rice, and the machinery required for all these operations, were a constant source of delight and culture to the boys.

It was amid such intellectual and moral influences, amid such country sports and plantation operations, that John Le Conte received his first impressions of life, and under such he grew up until his seventeenth year, when he went to college. This was in 1835.

His early education, received at a neighborhood school, supported by four or five families, was irregular and desultory in the extreme, the teachers, as was common at that time in country schools at the South, changing almost every year. He was fortunate, however, in having as teacher during the last two years, and therefore in immediate preparation for his college course, no less a man than Alexander H. Stephens, afterwards the distinguished lawyer and statesman.

His collegiate education was received in Franklin College, University of Georgia, located at Athens, where he was graduated with high honor in 1838, and immediately thereafter commenced the study of medicine, the only profession at that time open to a man of scientific tastes and habits. He received his degree of doctor of medicine from the College of Physicians and Surgeons, New York, in 1841. At that time he greatly desired and fully intended to complete his medical education in Paris, but this intention was frustrated by the death of his eldest brother, William, by which it became his duty to administer on the estate of the younger children. His education, therefore, was wholly American. He never crossed the Atlantic. Soon after his graduation in medicine he married Eleanor Josephine Graham, a lady of Scotch descent, with whom he became acquainted in New York during his studies there. Of the three children, the issue of this marriage, only one, L. Julian Le Conte, assistant engineer in charge of Oakland harbor, survives.

Unless we except the early influence of his father, no other influence so greatly affected the whole course of his life as that of his wife. Mrs. John Le Conte was a woman of rare intelligence, spirit, and vivacity and of great force of character, united with queenly beauty and great social influence. He never undertook any enterprise or made any change of life without her advice and counsel. Their mutual devotion was as perfect as human devotion can be, and continued with ever-increasing strength to the very end. If he had lived but two months longer they would have celebrated their golden wedding. He was looking forward to this happy event with eager delight only a few days before his death. The moral effect of such a wedded life who can estimate? Surely it is the most powerful of all influences in ennobling and purifying human character. If character is formed in childhood, it is ripened and refined by a happy wedded life.

As usual in men of science, his life was uneventful in the ordinary sense of the word. His main achievements were in the inner world of thought rather than in the outer world of action. After graduating in medicine he settled in Savannah, and there practiced his profession with moderate success, though still keeping up his pure scientific studies; for it was during this period that he made some very important experiments on the alligator to determine the seat of consciousness and volition in the lower vertebrates. Of the great significance of these experiments we shall speak later.

In 1846, after about four years' practice of his profession in Savannah, he was called to take the chair of physics and chemistry in his Alma Mater, Franklin College, University of Georgia, and there he continued to teach for nine years. He had now at last found his true field of activity and entered upon it with the greatest enthusiasm. As may be anticipated, therefore, he never returned to the practice of medicine, but devoted himself unremittingly to teaching, investigating, and writing on his favorite subjects during the rest of his life—*i. e.*, for forty-five years.

In 1855 he resigned his place in Franklin College to take the chair of chemistry in the College of Physicians and Surgeons, New York, and lectured there on that subject during the winter of 1855–'56; but physics rather than chemistry was his favorite department, and therefore in the summer of 1856 he accepted a call to the chair of physics in the South Carolina College at Columbia. This chair he held until his final move to California, in 1869.

Meanwhile, in 1862, the demands of the terrible war then in progress for soldiers was so severe and sweeping that the college was broken up for want of students. Le Conte was now appointed by the Confederate government superintendent of the extensive niter works established at Columbia, S. C., with the rank and pay of major, although he never donned the uniform. He retained this place until the end of the war, and during the closing scenes and the march of Sherman through the State he suffered many hardships in the vain attempt to save the property of the Confederate government in his charge. It was during this period of turmoil and anxiety that some of his most important papers were written—papers of pure abstract science—in strange contrast with the furious political storm then raging.

The issue of the war swept clean away all that he owned as property, and the utterly disorganized and prostrate condition of the South left no place for men of scientific tastes and student habits. Therefore, after several years of vain struggle to revive the college and place it again on a firm basis, he was compelled to seek elsewhere for a field of activity. The legislature of California had just then (1868) chartered a State university. It was not yet organized. Some one of experience and reputation was needed for that purpose. He was elected in 1868 to the chair of physics and urged to come at once to assist the regents in the work of organization of the university. He went in March, 1869, and the university opened in September of the same year.

During the six months immediately preceding the opening of the new university he was in constant consultation with the regents concerning the organization of its various courses. During the first year after its opening he acted as its president and directed its policy, though continuing still to hold and to perform the duties of the chair of physics. The combined duties of these two positions, however, proving too onerous and his own tastes being stronger in the direction of abstract science, rather than of administrative detail, at the end of the year he withdrew from the presidency to concentrate his energies on the work of his chair. In 1875, on the resignation of President Gilman, he was again asked to act as president, and in 1876 he was elected full president, though still retaining his chair, the duties of which were, however, now lightened by the appointment of an assistant. In 1881 he again and finally resigned the presidency, but retained the physical chair, which he continued to hold up to the time of his death.

Such is a brief history of his connection with the University of California. It is seen that about one-half of his whole life as a teacher was spent in her service. This institution was planted by his hand and grew up under his eye and largely under his guidance. It opened in 1869 with thirty-eight students, eight professors, and an income of about $30,000. Today it has about twelve hundred students, one hundred and fifty teachers of different grades in all the departments, and an income of about $350,000. In 1869 it opened as a traditional college of letters and the mere beginnings of a college of agriculture. Today there are some twelve to fourteen colleges, literary, philosophical, and professional. It is everywhere recognized as one of the great universities of our country. There can be no doubt that its remarkable growth and especially its high character for thoroughness is largely the result of his wise course in organization, his wisdom and firmness in guidance, and his wide reputation as a scholar and a man of science. More than any other man he was *the father of the university*. The strong hold which he had taken on the respect, the reverence, and the love of his colleagues, his pupils, the community, and the State, a reverence and love all the deeper for its quietness, was abundantly shown on the occasion of his death. Such an outburst of universal feeling is seldom shown on the death of any man, especially one so retiring as he. It was the spontaneous homage of a whole people to his character and to his great influence in elevating the whole plane of education in the State.

Scientific Work.

Of his scientific work it is difficult to give any adequate account within the limits of a short memoir; it was so many sided. Although his chief delight was in physics, and in early times, under the influence of his medical studies, also physiology, yet he was not a specialist in the narrow sense in which that term is now used, for, like his father, his mind ranged and his interest extended over the whole realm of nature, though doubtless concentrated on certain departments, especially physics. Thus he fully retained his intellectual perspective—*i. e.*, the perception of the relation of the different departments of nature and the different kinds of truth to one another, so apt to be lost by the mere specialist. His wonderful memory, his methodical manner of reading and recording, and his clearness of physical conceptions gave him a fullness and wideness and yet an accuracy of knowledge rarely attained. Even in my own department of geology, especially when it bordered on physics, I constantly consulted him, with the greatest confidence. In a word, whenever clearness of thought and accuracy of statement on almost any scientific study was required, I instinctively turned to him as I would to a cyclopedia. Verily, the type of physicists to which he belonged can hardly be said to exist any longer. Such men as Newton, Thomas Young, Sir John Hershell, and Wheatstone, in England; as Arago and Laplace, in France, and Benjamin Franklin and Joseph Henry, in this country, were his models. He inherited something of his father's indifference to reputation. At least he had little of the eager desire to rush prematurely into print, too common at the present time. He investigated and pondered long before he wrote, and elaborated his manuscript, both as to matter and as to literary form, with care, often retaining them for years before publication. The amount of his published work, therefore, bore no proportion to the abundance of his knowledge and the wealth of his original thought. Besides his numerous contributions to scientific periodicals, he had commenced during the war and had nearly finished a complete treatise on physics, in which were embodied his wide knowledge and long experience in teaching, but unfortunately this was destroyed during the burning of

Columbia, in February, 1865. On coming to California he commenced again to write it, but the multitudinous details of administrative work left him no time to finish it. A fragment of some hundred pages of manuscript still exists among his papers.

During his long scientific career of just fifty years he published more than one hundred papers, a list of the most important of which are appended. Among these I select for brief analysis a few of value, so great that they have, I believe, distinctly affected the course of scientific progress.

1. *Experiments on the Seat of Volition in the Alligator.* Published in the New York Journal of Medical Science, 1845–'46.

The usual view, up to that time, was (and indeed to some extent still is) that the cerebrum alone is the seat of consciousness and volition, and that the function of the spinal cord is wholly reflex. The object of these experiments was to show, and they did, in fact, very clearly show, undoubted *purposive action* or conduct in the *decapitated alligator* on the application of appropriate stimulation to various parts of the body. The irresistible conclusion was that consciousness and volition are not confined to the cerebrum in the alligator; that the voluntary and reflex functions are not so widely separated and strictly localized in the lower verterbrates as they are in man, but, on the contrary, that these two widely distinct functions overlap and are both widely diffused in the nervous centers of these animals.

Some late physiologists, indeed, would explain these phenomena differently. Recognizing what seems deliberate purposive action in decapitated frogs, they have gone to the other extreme. Instead of extending volition in an obscure form to the spinal cord they would take it away even from the brain. They say that all so-called voluntary purposive action is merely automatic, and even man himself is only a *conscious automaton.* The answer to this is plain. There are, indeed, many conscious automatic actions in man, as, for example, breathing, swallowing, &c.; but there is a wide distinction between these and those we call voluntary.

The true explanation of deliberate purposive action in decapitated reptiles and amphibians is that given in Le Conte's paper and stated above. These experiments were an early illustration of the general law now well recognized that differentiation, specialization, and localization of functions increase with ascent in the scale of organisms; that functions which are quite distinctly separated and localized in the higher animals are more and more diffused and merged into one another as we go down the scale. Volition and automatism, for example, are not only less distinct as functions in an alligator than they are in man, but they are less localized, the one in the brain, the other in the spinal cord. They are, in fact, widely diffused throughout the nerve centers. It was an early and admirable examble of the application of the comparative method in physiology and a proof of its fertility.

2. "*On the Exudation of Ice from the Stems of certain Plants and on the Protrusion of Icy Columns from certain Soils.*" Phil. Mag., 1850.

Curious curling, silky ice-ribbons, looking like bands of fibrous gypsum, exuding from the dead stems of plants near their base are phenomena characteristic of certain annuals common on the coast of Georgia, and therefore familiar to the keen observation of Le Conte from early boyhood. These curling ice-ribbons had been described by others, but had not been explained. The key to the explanation of these he found in the study of the much more widely occurring phenomenon of the protrusion of silky, fibrous transversely striated ice-columns from certain soils, especially and in the greatest perfection from the residual red-clay soils of the Piedmont region of the southern Atlantic States, where they are often five inches in length. The true explanation of both is first given in this paper.

The explanation may be briefly summarized as follows: The necessary conditions are (1) *a firm, yet porous, soil.* This is eminently the case in the residual red-clay soils of the South. (2.) Through this soil water constantly rises and freezes only at the very surface, and thus the ground is kept warm and moist and unfrozen, even in the coldest weather, by the ascending water. If the ground freezes the whole process stops.

Now, imagine a multitude of fine capillary tubes terminating at the surface and water rising and freezing only at the very surface. Each tube would become trumpet-shaped at the mouth by the expansion of the water in the act of freezing and the consequent condensation of the clay between. Freezing and expansion in this trumpet-shaped mouth would produce a sudden infinitesimal jump of the ice upward. This in its turn would draw up the water from below and again fill the trumpet-shaped mouth, and the same operation would be repeated indefinitely. The capillary fibers cohering give rise to the silky, fibrous columns; the paroxysmal upward jumping gives rise to the transverse ridging of each fiber and thus to the transverse striation of the columns. The phenomenon is so curious and so beautiful that it attracts attention everywhere, and it is remarkable that no explanation had before been attempted.

The explanation of the curling, silky ice-ribbons exuding from the stems of plants is precisely the same. Here the wood pores take the place of the earth pores. Here, also, if the stem freezes the process stops. The flat ribbon shape is given by the protrusion of the ice through fissures in the bark.

3. "*The Influence of Musical Sound on the Flame of a Gas-jet.*" Am. Jour. and Phil. Mag., 1858.

This was the first notice and explanation of the beautiful phenomenon of sensitive flames now so familiar to physicists. The explanation is so well known that it need not be introduced here.

The importance of this discovery cannot be overestimated, for it was not only the discovery of a new and beautiful phenomenon, but it introduced a new method of research, which, in the hands of Barrett, Tyndall, Koenig, and others, has revolutionized the science of acoustics. By means of this marvelously delicate test of gaseous vibrations refraction and diffraction and interference of sound waves are easily demonstrated. Complex sound waves are analyzed and their components rendered visible. The analogy of sound and light is thus made clear and the wave theory of light itself placed on a surer basis.

4. *The Adequacy of Laplace's Explanation to account for the Discrepancy between the Computed and Observed Velocity of Sound in Air and Gases.* Philosophical Magazine, January, 1864.

This paper was written in 1861, during the war between the States, at a time, therefore, when the author was cut off by the blockade from communication with the scientific world. It was held in the hope of an opportunity of publication, which, however, did not come until 1864.

There is a slight discrepancy between the observed and calculated velocity of sound in air and gases, the former being slightly in excess. Laplace explained this by the increased elasticity due to the heat generated by compression at the wave crest. This increased elasticity by heat of condensation is not compensated for by any opposite effect of the cold of rarefaction at the wave trough, as might at first be supposed. On the contrary, the two causes coöperate, and their effects must be added, the propagating force, so far as this cause is concerned, being the difference of elasticities of crest and trough. Many physicists held that this explanation was inadequate; that the cause was not sufficient to produce the effect, and therefore that the whole theory of the propagation of sound waves needed complete revision. Several papers had about this time appeared in the Philosophical Magazine, especially one by Earnshaw, to prove this inadequacy. This paper of Le Conte aimed to show, by calculations based on the latest and most reliable experimental data of Regnault and others, the complete adequacy of Laplace's explanations. The paper showed complete mastery of the whole subject, both as to the physical principles and to the previous literature, and received the warmest commendations of Sir William Thomson (now Lord Kelvin), Tyndall, and others eminent in physics. It called out several replies, but it is believed that the conclusions will stand the test of time.

In July, 1876, being one of a party of men of science specially invited to examine the first telephones, then on exhibition at the World's Fair at Philadelphia, I there met Sir William Thomson. On being introduced he immediately asked me if I was the author of "that remarkable paper on sound," of which he again expressed his warm admiration. On replying in the negative I could not but observe a shade of disappointment flit across his face.

5. "*Sound Shadows in Water.*" American Journal, 1881, and Philosophical Magazine, 1882.

This was an account and a discussion of results obtained during an experimental investigation carried on at his suggestion by his son, L. Julian Le Conte, assistant engineer, in charge of improvements in the harbor of San Francisco. Rincon rock, a sunken ledge obstructing the landing along a portion of the water front, was being removed by blasting with dynamite. This afforded an excellent opportunity of experimentally verifying the theoretical cause of the difference between sound shadows and light shadows.

Light shadows are sharply defined geometric projections of the object. Sound shadows, on the contrary, are so blurred on their edges that their limits cannot usually be determined with certainty. The reason of the difference is the extreme shortness of the waves in the one case and their great comparative length in the other. The character of the shadows in the two cases has been accurately calculated, but experimental verification for sound waves of different lengths was still wanting, although it was known in a general way that the shadows of acute sounds were sharper than those of grave sounds. Dr. Le Conte's experiments were on shadows made by subaqueous explosions of nitro-glycerine. The sound waves made by such explosions are admirably adapted for the purpose for two reasons. First, because they were subaqueous. Water carries short sound waves better and farther than long waves and better than air. Colladon's experiments on Lake Geneva had already shown that of the many waves of different lengths made by striking a bell under the water only the shortest were carried to any considerable distance. The sharp click of the hammer was heard much farther than the musical sound. A second reason is because the extreme suddenness of nitro-glycerine explosion generates waves of almost inconceivable shortness. The shadows of such waves ought by theory to be exceptionally sharp, and such by experiment was found to be a fact. Stout glass bottles exposed to the direct action of these waves at a distance of fifty or more feet were invariably shattered, while behind an obstacle, such as a pier or pile, even at a considerable distance behind it and near the edge of the geometric shadow, they were completely protected. Thick glass rods behind an obstacle one foot in diameter and twelve feet away from it were sharply broken on each side at the margin of the geometric shadow, the length of the unbroken part being exactly equal to the diameter of the obstacle.

6. *Physical Studies of Lake Tahoe.* Overland Monthly, 1883 and 1884.

Although published in a literary periodical and therefore written in somewhat popular style, this is really a scientific paper of great importance. It is, in fact, a perfect model of what a popular scientific article ought to be, for it is simple in style and yet thoroughly scientific in matter; it is perfectly intelligible to the educated public and yet of deepest interest to the expert physicist as a real contribution to science. The paper is an exhaustive discussion of all the most interesting questions connected with mountain lakes in general, and this one in particular as the finest of all examples of such lakes. Among the questions discussed are depth, distribution of temperature, color, and rythmic oscillations of level or sèiche, &c.; but its chief value consists in its admirable discussion of the blue and green color of pure water and the blue color of the sky. We will therefore confine our analysis to this point alone.

He had long been intensely interested in the beautiful investigations of Tyndall on the blue color of the sky and of Soret on the blue and green color of the waters of Lake Geneva, but the explanation was still unsatisfactory; further investigations were needed. He had already himself, in 1860, published some observations on the marvelous transparency of the water of Silver spring, in Florida, probably the most transparent water in the world. (Proc. A. A. A. S., 1860; Am. Jour., 1861.) But the water of this wonderful pool was not deep enough (about forty feet) to bring out color. Except, perhaps, the Mediterranean, there is no water so well adapted for this purpose as that of Lake Tahoe. Its depth (1,645 feet, as determined by Le Conte) is far greater, its water far purer (the limit of visibility about double), and therefore the splendor of its blue color far finer than that of Lake Geneva.

Dr. Le Conte's observations on Lake Tahoe were made in 1873 while spending his summer vacation on the lake, but the investigations were continued in his laboratory by experiments on the *effect* of transmission of light through long tubes filled with distilled and with natural waters respectively on the color of the emergent beam. The final results were not published until 1883, although reached and embodied at least five years earlier. In the meantime Soret had been carrying on similar investigations on Lake Geneva. These were published partly in 1878, but mainly in 1884. The results of the two investigations were nearly identical, although wholly independent of each other.

Le Conte's paper was an exhaustive discussion of the whole subject of colored media of all kinds and the cause of color in each case. The general result of the experimentation and subsequent discussion was that the blue color of water is due partly to *selective absorption*—greater for the *red* end than the blue end of the spectrum—with diffuse *molecular reflection* of the unabsorbed blue rays, and partly to *selective reflection* from suspended particles, which, if small enough, reflects mainly the blue rays. In absolutely pure distilled water only the first cause operates and water is blue as blue glass is blue; in natural water, on the contrary, the second is the main cause.

This view, arrived at independently by Soret and Le Conte, completely explains all the phenomena of the color of mountain lakes, of the ocean, and of the sky. For example:

Blue Color.—It follows from the above that if the water is pure enough, the suspended particles are small enough, and the lake is deep enough so that *all* the light that comes to the eye is from internal reflection, *the color will be blue*, and the splendor of the blue will be in proportion to the purity of the water and the smallness of the suspended particles.

Green Color.—The green colors of natural waters are of such various shades, depending on admixture of sediments, color of bottom, and nature of dissolved organic matter, that each case must be investigated for itself. I shall speak, therefore, only of the green color of the purest mountain lakes.

Let it be remembered, then, that of the two causes of blue color mentioned above the first—*i. e., selective absorption*—would give blue, both by reflected and by transmitted light; but the second or main cause—*i. e., selective reflection*—would by itself produce more or less completely complimentary yellow or orange by transmitted light; but as the two causes are always combined in natural waters, the real color of transmitted light in the case of purest natural water was found by Le Conte's experiments to be yellowish orange to yellowish green.

Let it be remembered again that the green color of purest and deepest mountain lakes is found only on the margin, where the water is shallow, but not too shallow, and that it is especially splendid when the bottom is white sand, and therefore a good reflector. Now, suppose we have a moderate depth of twenty to thirty feet and a white bottom, the light reflected from suspended particles, as already seen, would be blue, while the light going through, striking the bottom and reflected back to the eye, would be yellow or greenish yellow. The combination of this with the blue of selective reflection would make various shades of green, according to the depth of the water.

This paper, although characterized by Soret as "un beau memoire," yet, on account of its having been published in a literary periodical, was not as widely known among scientific men as it deserved. It is for this reason I have given a fuller analysis.

Many other papers might be mentioned as almost equally deserving of attention, but space and time forbid. Among the last of his investigations were those on *capillarity*, a subject admittedly one of the most obscure and refined in physics, requiring both clearness of physical conceptions and mathematical skill, and for that very reason having a great charm for him. Thus he continued, though with slowly decreasing energy, to work and perform every duty up to a few days of his death. As he walked to and from his daily duties his slender figure, bowed form, and abundant snowy hair and beard, like an aureole about his noble head and benignant face, will long remain in the memory of his friends as the outward visible expression of one of the noblest and purest of human spirits.

In June, 1889, his strength visibly failing, he was given a year's leave of absence for travel, recreation, and sorely needed rest. Unfortunately, on the eve of his intended departure for Europe, where he expected to visit personally his many correspondents, his wife was prostrated with protracted illness. For nearly a year he scarcely left her bedside, and only his tender, unremitting care nursed her back to life and comparative health. The opportunity of recreation was lost. Unrefreshed at the beginning of the session, August, 1890, he took up again the burden of duties, and would have been able to bear it to the end of the session, when it was arranged he would be permanently relieved, but an attack of la grippe easily overcome his weakened frame, and after an illness of a few days he died, April 29, 1891.

Character.

It does not, perhaps, become me, who stood so near to him, to speak at any length of his character; but one trait I cannot pass over, for it was bound up with his whole intellectual and moral nature. His simple love and earnest seeking of objective truth had, as it were, burned in through the intellectual and into the moral nature of the man, intensifying his inherited love of truthfulness. His life-long habit of implicit reliance on unchanging natural law served to increase to a passionate degree his native integrity. Truth he loved and even worshiped as the image of God in the human reason, and truthfulness he honored as the very basis of human character. Therefore next to his devotedness in nearest human relations, and indeed closely bound up with this, was his absolute transparent truthfulness and his utter scorn of the least approach to falseness in word or deed or any indirectness in methods of attaining a moral end. His first public address in an official capacity as president, in Oakland, and also his last, in Berkeley, was on this subject.

But I dare not speak further on the subject of his innermost character. Perhaps my relations with him were too close, my view of him too near, to see well the general effect. The beating heart may make unsteady the hand that would draw a true picture. Let those speak, therefore, who loved him and yet stood a little farther away. I cannot do better than quote from a memorial drawn up by a committee of his colleagues on the occasion of his death.

"Admirable as were the scientific powers of our associate and distinguished as were their results, it was even more in the general temper and spirit of his mind and life that we found his chief attraction. He was, indeed, wholly and purely of scientific spirit and scientific habit. He literally lived and breathed in an atmosphere of scientific thought, and yet, as much as this disinterested scientific spirit attracted our attention and won our admiration, it was rather the moral traits of our friend that constituted his eminent worth and drew forth our warmest admiration and love. Seldom has a man exhibited a more unvarying and entire disinterestedness. We can truly say that he seemed to us utterly destitute of what are called ulterior motives. He loved truth and truthfulness supremely. Fealty to all truth, whether scientific or philosophical, theological or æsthetic, and fealty to all persons were not so much qualities of him as sum and substance of the man. He was simplicity and ingenuousness embodied. He was sympathetic, generous, tender, brave, and the soul of honor. It is not for us to invade the sacred precincts of his more intimate relations of home and kindred, but what he was there was evident enough, even to those who saw him from afar."

And, again, one of his colleagues who has known him longest, Martin Kellogg, now president of the university, writing of him in the Overland Monthly, says :

"And so we commend our loved colleague to our young men for the scholarly breadth of his culture, as well as for its completeness in his own department of science.

"But he had yet stronger hold on the admiration of his friends and the veneration of his pupils. It is the nobleness of his character. Scholar and scientist might be less important to some, but no one could fail to recognize in him the Christian gentleman and nobleman. This gave him commanding influence in the community, in the State, and in all the States in which he had lived. Among all the men connected with our educational interests no one could have a larger circle of sincere mourners. He was so gentle and genial, so learned in science, so highly reputed for his work and its published results, so self-poised in his judgments, so catholic in his recognition of all higher interests, so honored in the esteem of his colleagues, so beloved by many successive generations of students, that a great void is left by his departure. His memory receives such tributes of praise as are given to few men in all our wide land—eulogies won by a long life of beneficent activity and of rare purity and loftiness of character."

The Le Conte Memorial Fellowship, with endowment of $10,000, established by the alumni of the university soon after his death, and a bronze bust of him as he appeared draped in presidental robes, given also by the alumni and now in the library of the university, are testimonials of the love and veneration in which his memory is held by them.

In looking over what I have said of his character I perceive that it is incomplete; that one side is wholly unrepresented. The cause of this is plain. In my own case the sense of irreparable personal loss and in the case of his colleagues the recency of his death at the time they wrote has tinged the picture with a too somber hue. The effect of the whole, therefore, may seem sad. If so, this is a reflection of the feelings of his friends, not of his own nature. Next to his devotedness to persons and to truth his most pronounced characteristic was his warm, genial, sunny temperament. This was conspicuous on all occasions and to every one, but especially to visitors under his own roof. Those who saw him there felt at once instinctively the hearty hospitality of an ideal home. They will remember his kindly cheerfulness, his playful humor, and his contagious laughter; in a word, his full enjoyment of happiness in conferring happiness. He doubly enjoyed every pleasure in sharing it with a friend. Indeed, such enjoyment of life was but the necessary complement of his truthfulness, his genuineness, his heart-soundness, his unostentatious righteousness.

His colleagues have loved to hold him up to themselves as an example to imitate and to the young men as an ideal to follow. May we not also hold him up to men of science, especially in these days of extreme and sometimes narrow specialization, in these days of profitable science and often of science for profit? May we not hold him up to scientific men of our country as the embodiment of the broadest, the truest, the most disinterested spirit of science?

A PARTIAL LIST OF HIS SCIENTIFIC PAPERS.

1. "Case of Carcinoma of the Stomach." ("New York Medical Gazette," 1842.)

2. "On the Mechanism of Vomiting." ("New York Lancet," 1842.)

3. "On Carcinoma in General and Cancer of the Stomach." (*Ibid.*, 1842.)

4. "On the Explanation of the Difference in Size of the Male and Female Urinary Bladder." (*Ibid.*, 1842.)

5. "An Essay on the Origin of Syphilis." ("New York Journal of Medical and Collateral Sciences," 1844.)

6. "Remarks on Cases of Inflamed Knee-joint." (*Ibid.*, 1844.)

7. "Extraordinary Effects of a Stroke of Lightning, Singular Phenomena." (*Ibid.*, 1844.)

8. "Observations on Geophagy." ("Southern Medical and Surgical Journal," 1845.)

9. "Experiments Illustrating the Seat of Volition in the Alligator, or Crocodilus Lucius of Cuvier, with Strictures on the Reflex Theory." ("New York Journal of Medical and Collateral Sciences," 1845 and 1846.)

10. "Statistical Researches on Cancer." ("Southern Medical and Surgical Journal," 1846.)

11. "On the Quarantine Regulations at Savannah, Ga." ("New York Journal of Medical and Collateral Sciences," 1846.)

12. "Remarks on the Physiology of the Voice." ("Southern Medical and Surgical Journal," 1846.)

13. "Dr. Bennet Dowler's Contributions to the Natural History of the Alligator." (*Ibid.*, 1847.)

14. "On Sulphuric Ether." (*Ibid.*, 1847.)

15. "The Philosophy of Medicine, an Address." (*Ibid.*, 1849.)

16. "Observations on a Remarkable Exudation of Ice from the Stems of Vegetables, and on a Singular Protrusion of Icy Columns from certain kinds of Earth during Frosty Weather." ("Proceedings of the American Association for the Advancement of Science," 1850; "Philosophical Magazine," 1850.)

17. "Observations on the Freezing of Vegetables and on the Causes which enable some Plants to endure the Action of Extreme Cold." ("American Journal of Science," 1852; also "Proceedings of the American Association for the Advancement of Science," 1853.)

18. "On the Venomous Serpents of Georgia." ("Southern Medical and Surgical Journal," 1853.)

19. "On the Descent of Glaciers." ("American Journal of Science," 1855.)

20. "Review of Lieutenant M. F. Maury's Work on the 'Physical Geography of the Sea.'" ("Southern Quarterly Review," 1856.)

21. "The Mechanical Agencies of Heat." (*Ibid.*, 1856.)

22. "Influence of the Study of the Physical Sciences on the Imaginative Faculties." An Inaugural Address, delivered December 1, 1857 (Columbia, S. C., 1858).

23. "Preliminary Researches on the alleged Influence of Solar Light on the Process of Combustion." ("American Journal of Science," 1857; also "Proceedings of the American Association for the Advancement of Science," 1857, and "Philosophical Magazine," 1858.)

24. "On the Influence of Musical Sounds on the Flame of a Jet of Coal Gas." ("American Journal of Science," 1858; "Philosophical Magazine," 1858.)

25. "On the Optical Phenomena presented by the Silver Spring in Marion County, Florida (U. S.)" ("American Journal of Science," 1861; also "Proceedings of the American Association for the Advancement of Science," 1860).

26. "On the Adequacy of Laplace's Explanation to Account for the Discrepancy between Computed and the Observed Velocity of Sound in Air and Gases." ("Philosophical Magazine," 1864.)

27. "Limiting Velocity of Meteoric Stones reaching the Surface of the Earth." ("Nature," 1871.)

28. "Vital Statistics, Illustrated by the Laws of Mortality from Cancer." ("Western Lancet," 1872.)

29. "Heat Generated by Meteoric Stones in Traversing the Atmosphere." ("Nature," 1872.)

30. "The Nebular Hypothesis." ("Popular Science Monthly," 1873.)

31. Articles on "Bonanza," "Comstock Lode," and "Death Valley," in Johnson's Cyclopædia, vol. iv, appendix, 1876.

32. "Mars and His Moons." ("Popular Science Monthly," 1879.)

33. "Origin and Distribution of Lakes; Meteorology of the Pacific Coast." ("Mining and Scientific Press" and Supplement, 1880–'81.)

34. "Influence of Modern Methods of Popularizing Science." ("Berkeleyan," 1882.)

35. "Sound Shadows in Water." ("American Journal of Science," 1882; also "Philosophical Magazine," 1882.)

36. "Origin of Jointed Structures in Undisturbed Clay and Marl Deposits." "American Journal of Science," 1882.)

37. "Apparent Attractions and Repulsions of Small Floating Bodies." ("American Journal of Science," 1882; also "Philosophical Magazine," 1882.)

38. "Amount of Carbon Dioxide in the Atmosphere." ("Philosophical Magazine," 1882.)

39. "Physical Studies of Lake Tahoe." ("Overland Monthly," three papers, 1883, 1884.)

40. "The Part Played by Accident in Discoveries." ("Berkeleyan," 1884.)

41. "Horizontal Motions of Small Floating Bodies in Relation to the Validity and Postulates of the Theory of Capillarity." ("American Journal of Science," 1884; also "Journal de Physique," 1885.)

42. "Criticism of Bassnett's Theory of the Sun." ("Overland Monthly," 1885.)

43. "The Evidence of the Senses." ("North American Review," 1885.)

44. "The Metric System." ("Overland Monthly," 1885.)

45. "Thought Transference." (*Ibid.*, 1885.)

46. "Barometer Exposure." ("Science," 1886.)

47. "Electrical Phenomena on a Mountain." (*Ibid.*, 1887.)

48. "Standing Tiptoe, a Mechanical Problem." (*Ibid.*, 1887.)

49. "Vital Statistics and the True Coefficient of Mortality, illustrated by Cancer." ("Tenth Biennial Report of the State Board of Health of California," 1888.)

50. "The Decadence of Truthfulness." (1889.)

SOME MINOR CONTRIBUTIONS.

51. "On a Topographical Survey of the State of South Carolina." ("Lieber's Third Annual Report on Geological Survey of South Carolina," 1859.)

52. "Table of Physical Constants." ("Smithsonian Report," 1878.)

53. "Limiting Velocity of Meteoric Stones reaching the Earth." ("Nature," vol. iv, 1878.)

54. "Expansion of Glass by Heat." ("Nature," 1880.)

55. "Ice Crystals." ("Nature," 1880.)

56. "Solid Ice at High Temperatures." ("Nature," 1880.)

57. "On the Space Protected by Lightning Conductors." ("Nature," 1881.)

58. "The True Coefficient of Mortality." ("Nature," 1881.)

59. "Photography of Diffraction Rings." ("Nature," 1881.)

60. "Apparent Attraction of Small Floating Bodies." ("Science," 1883.)

61. "Thermal Belts in North Carolina." ("Science," 1883.)

62. "Hydrogen Whistles." Showing the error of Galton. ("Nature," 1883.)

63. "Sun's Radiation and Geological Time." ("Science," 1883.)

64. "Solar Constants." ("Science," 1883.)

65. "Upper Glow of the Skies in Relation to Halos and Coronæ." ("Science," 1884.)

66. "Remarkable Sunsets." ("Nature," 1884.)

67. "Velocity of Atmospheric Waves from Krakatoa." ("Science," 1884.)

68. "Points on Lightning Rods." ("Science," 1884.)

69. "Do Young Snakes Take Refuge in the Stomach of the Mother?" ("Nature," 1886.)

70. "Flooding of Sahara." ("Science," 1886.)

71. "Deepest Fresh-water Lake in America." ("Science," 1886.)

72. "Lightning Flashes: Their Direction Undeterminable by the Eye." ("Nature," 1887.)

73. "Noctilucous Clouds." ("Nature," 1889.)

74. "Relation of the High Schools to the University." ("Berkeleyan," 1877.)

75. "Importance of Unity in the Methods of Instruction in the Public Schools." ("California Teacher," 1885.)

76. "Igneous Meteors." ("Mining and Scientific Press." Supplement, 1879.)

77. "Qualifications of Teachers in the Primary Schools." ("Pacific School and Home Journal," 1887.)

78. "The Part Played by Accident in Discoveries in Science." ("Berkeleyan," 1884.)

79. "Review of Bassnett's Theory of the Sun." ("Overland Monthly," 1885.)

80. "Review of Arthur Kimball's Physical Properties of Gases." ("Overland Monthly," 1890.)

81. "Review of Robert Thurston's Heat as a Form of Energy." ("Overland Monthly," 1891.) This last was published a few days after

Memo:- Prof John LeConte also compiled a Catalog of the Fauna and Flora of Georgia in May 1849. The lists of Birds and of Coleoptera Insects were prepared by himself while the lists of other forms were contributed by other specialists, presumably under his editorship.

The above catalog will be found as an appendix to "Statistics of the State of Georgia," by George White / Savannah / 1849

whom a copy was sent.

A. F. Ganier
Nashville, Tenn. 10-24-1933.