1785
The University of Georgia

Department of Computer Science

January 23, 2015

Dr. David Shipley, Chair of the Executive Committee University Council

School of Law, 323 Rusk Hall, CAMPUS

Dear Dr. Shipley,

On 11/172014, the Faculty Affairs Committee approved and voted to forward the following two agenda items:

1. Suggested revision to *UGA Guidelines for Appointment, Promotion and Tenure*, p 28, 29, section On Promotion/Tenure-Unit Review as follows:

   Replace:

   "Absentee ballots received after the meeting begins will be disregarded."

   By

   "Absentee ballots should be brought to the meeting and be counted as the rest of the other ballots". (see Attachment 1).

2. Change the name of "Distinguished Research Professor" to "John and Joseph LeConte Distinguished Research Professor" at UGA (see Attachment 2, Attachment 3, Attachment4)

to the Executive Committee of University Council for consideration and placement on the February 18, 2015 Council agenda.

If you have questions concerning this item, please feel free to contact me by e-mail at thiab@cs.uga.edu

Regards,

Thiab Taha, Chair of the Faculty Affairs Committee

Tel: 706 542 3455

Office of the Vice President for Research at the university of georgia

Distinguished Research Professorship Guidelines

Program Snapshot

Title Distinguished Research Professorship

Purpose The appointment of Distinguished Research Professors at The University of Georgia is intended to recognize a sustained and continuing record of outstanding research or other creative, scholarly accomplishments *and* to provide the impetus for continuing high achievement.

Deadlines Nominations should be submitted to the appropriate dean or director by the College/Center's set deadline to be reviewed for approval. Endorsed nominations should be forwarded to the Vice President for Research by November 14. In the cases where November 14 falls on a weekend day, nominations will be accepted through 5:00 p.m. that following Monday.

Eligibility Nominees must be at least ten years beyond the date of the terminal academic degree and must have the endorsement of the appropriate department head, dean, or director.

Amounts A one-time permanent increase in base salary of $7,000, a $5,000 account each year for a 5-year period to be used in any appropriate way to support scholarship, and a framed certificate. Title retentions are not accompanied by new funding.

Questions? Please email questions to ovprip@uga.edu.

Program Description

The appointment of Distinguished Research Professors at The University of Georgia is intended to recognize a sustained record of outstanding research or other creative, scholarly accomplishments and to provide the impetus for continuing high achievement. The title of Distinguished Research Professor will be awarded to those individuals who are academicians recognized for creative and original contributions to knowledge and whose work promises to continue to foster significant new creativity in the theoretical or applied sectors of the discipline, affirmable by metrics appropriate to the discipline and recognition as national and/or international leaders in that discipline. Distinguished Research Professors are expected to serve the University as do all faculty by contributing to the research, instruction, and/or service missions. The specific responsibilities of the individual holding this title will be determined by the department head and the dean of the appropriate school or college.

Eligibility Criteria

All nominees must be at least ten years beyond the date of the terminal academic degree and must have the endorsement of the appropriate department head and dean.

The individual being recognized is expected to be currently active and to demonstrate the potential for continued excellence in scholarly activity. In this sense, the Distinguished Research Professorship is *not* meant to be a "lifetime achievement award."

The award of the title of Distinguished Research Professor is a University-wide honor. Accordingly, there will be no limit on the number of individuals from any department or other academic unit who might simultaneously hold this title.

The candidate must hold the rank of Professor. The awarded or retained title is held until retirement or resignation from the professorial ranks. Retired faculty members who have been rehired are not eligible, even if they held the title prior to retirement.

Budget/Funding

Each Distinguished Research Professor will receive a one-time permanent increase in base salary of $7,000 in addition to a $5,000 account each year for a period of five years to be used in any appropriate way to support scholarship. Distinguished Research Professors will normally retain the contract appropriate to the discipline and college (i.e., 9-month or 12-month contract).

Retention of the title is not accompanied by new funding.

Nomination Procedures and Documentation

An individual may be nominated for a Distinguished Research Professorship by: 1) a group of at least five tenured faculty members (which can include the department head, director or dean but is not required to), **OR** 2) by the department head, dean, or director. In any case, the nomination must include evidence that it is approved by the department head and the dean/director. For example, if the unit head and dean/director are not part of the original nominating group include a cover letter stating their approval.

It will be the responsibility of the nominator(s) to assemble a full dossier on the nominee, including documentation of the nominee's extraordinary reputation among a broad segment of professional colleagues and evidence of past and expectation of continuing performance. If the dossier does not follow the format outlined here, it is subject to return without review.

The dossier should contain:

- Cover sheet (please use the Distinguished Research Professorship Cover Sheet Form: http://research.uga.edu/docs/forms/iga/pdf/DRP-Application.pdf)
- Cover letter from the nominator(s) (3 pages maximum),
- The nominee's curriculum vitae,
- Four external letters from individuals with distinguished reputations in the area of specialization who can objectively evaluate the nominee's creative and scholarly contributions (please do not include more than four letters),
- Reviewer's Qualifications Sheet describing the reputation of the reviewers that qualifies them to comment
- Evidence that the nomination is endorsed by the relevant department head and dean/director (for example, a cover letter stating the endorsement if the department head and dean/director are not part of the original nominating group).

Please submit the items listed above as a single PDF file via email to ovprip@uga.edu. No paper submissions allowed.

Please name the nomination file as [Last Name]_[First Name]_DRP. For example, the nomination for John Smith for Distinguished Research Professor would be named as "Smith_John_DRP." Please label all separate attachments clearly.

Nomination Deadlines

All nominations should be submitted to the appropriate dean or director by the College/Center's set deadline for approval. Endorsed nominations should then be forwarded to the Vice President for Research no later than November 14. In the cases where November 14 falls on a weekend day, nominations will be accepted through 5:00 p.m. that following Monday.

Evaluation Criteria and Procedures

The nomination dossier will be submitted to the dean/director of the college or school or center. The dean/director, by a review process that is demonstrably objective and representative of the college/school, will determine which nominations will be submitted to the Vice President for Research. There is no limit to the number of nominations submitted by any department/school/college/center/institute.

The OVPR Distinguished Research Professor Review Committee will evaluate the nominees, and no more than five nominees will normally be recommended for Distinguished Research Professorships each year. Recommendations endorsed by the Vice President for Research will be forwarded through the Senior Vice President for Academic Affairs and Provost to the President of the University for approval. The Board of Regents is informed of the appointments. Public announcement of the awards is made at the spring Research Awards Banquet.

Award Procedures and Conditions

Awards are presented annually. However, if there is a lack of outstanding candidates, an award may not be granted.

Retention of Title

Current Distinguished Research Professors in the fifth year of their appointment may apply to retain the title for an additional five years. A dossier identical to the one described above for initial nomination must be supplied, EXCLUDING external assessments but INCLUDING department head/dean/director endorsement.

A retention of title dossier should include:

1. Cover sheet (please use the Distinguished Research Professorship Cover Sheet Form: http://www.ovpr.uga.edu/docs/forms/iga/DRP-Application.pdf),
2. Cover letter from the nominators (3 pages maximum),
3. Nominee's curriculum vitae,
4. Evidence that the nomination is endorsed by the unit head and dean/director

The OVPR Research Advisory Council will evaluate these applications using the same criteria used to evaluate initial nominations. As with initial appointments, recommendations endorsed by the Vice President for Research will be forwarded through the Senior Vice President for Academic Affairs and Provost to the President of the University for approval and The Board of Regents will be informed of the approved retentions. The title may be retained, subject to these approvals, provided there is clear evidence of continuing outstanding research or creative, scholarly activities.

OVPR strongly supports diversity in all its programs. We encourage nominations of women and underrepresented minorities for these awards.

BIOGRAPHICAL MEMOIR

OF

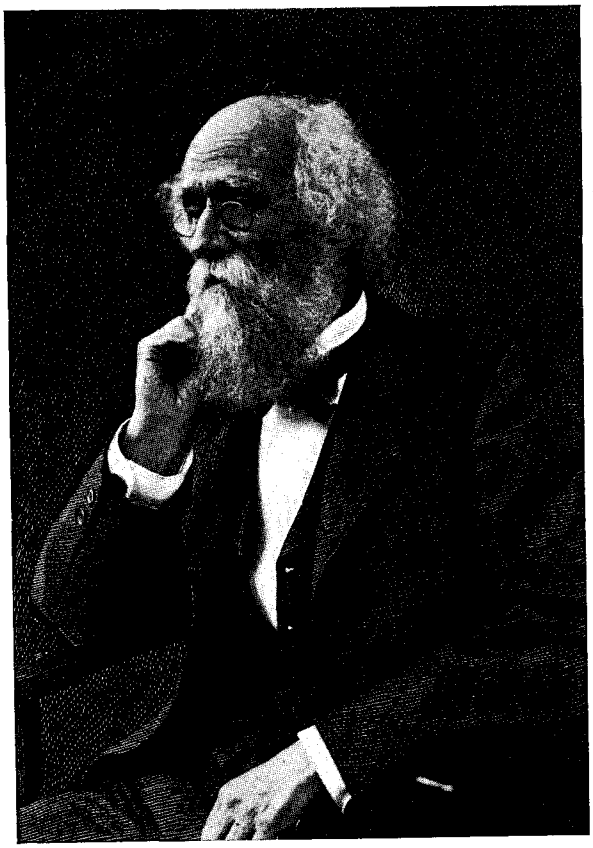
JOSEPH LE CONTE.

1823-1901.

BY

EUGENE W. HILGARD.

READ BEFORE THE NATIONAL ACADEMY OF SCIENCES
APRIL 18, 1907.



J. LeConte

PREFATORY NOTE.

In writing the memoir of the life and scientific work of Dr. Joseph Le Conte, it has seemed to me proper and best to follow, so far as practicable, his autobiography, in which the facts, events, and motives are presented by himself in their proper connection and order, better than could be done by any one else. In the abridgment of his text I have purposely striven to retain in a great measure his own mode of diction and expression, considering it desirable that he should appear essentially in the light in which he viewed himself; and that the somewhat exceptional mode of mental growth of a man so highly gifted, under conditions now fast becoming extinct, should be succinctly put on record in connection with the discussion of his broad scientific work, to which is due the length of this paper. The writer's long-continued and close personal relations with the subject of this memoir have afforded some side-lights which do not so clearly appear in Le Conte's published writings, and it gives him pleasure to fulfill herewith a promise mutually made as to the service the survivor should render to his friend.

E. W. Hilgard.

Berkeley, California, *March*, 1907.

BIOGRAPHICAL MEMOIR OF JOSEPH LE CONTE.

DESCENT OF THE LE CONTE FAMILY.

The distinction achieved by several of the members of the Le Conte family renders it interesting to trace their origin as far back as possible, particularly in the interest of the question of the heredity of mental and intellectual traits.

Owing doubtless to the dissensions of the times during the persecution of the Huguenots under Louis XIV, Guillaume, the ancestor of the American Le Contes, adopted the name of his mother, of the house of the Barons de Nonant, in Normandy. His paternal name has not been traced by the family. There is a tradition that he was warned of impending danger by King Louis himself. He fled to Holland, from where he joined the great Stadholder, William of Orange, in the invasion of England. He subsequently also served with distinction in the English war for the conquest of Ireland, and in 1698 emigrated to America, whither two cousins of the Nonant line had preceded him. Like many other Huguenots, he settled at New Rochelle, New York, where at that time we find domiciled also another group of Le Contes or Le Comtes, apparently unrelated.

In 1701 Guillaume married Marguerite de Valleau, of Martinique. The report that he married twice appears to be unfounded. Both died of yellow fever in 1710. Three children were born of this marriage, viz., Guillaume, Pierre, and Esther, of whom the latter probably died in childhood. Guillaume the younger married Elise Anne Beslie, of New Rochelle, by whom he had one child, a daughter, from whom descended Mother Seton, the founder of the Sisters of Charity in this country, and the late Archbishop Bayley, of Baltimore.

The second son of Guillaume the elder, Dr. Pierre Le Conte, who lived in New Jersey, married twice. His second wife was Valeria Eatton (related to the Biddle, Baird, and Berrien

families), by whom he had five children—William, John Eatton, Margaret, Thomas, and Pierre. William became a lawyer and took a prominent part in the Revolutionary struggle in Georgia, whither he, as well as Thomas and Pierre the younger, had moved. The latter two never married.

John Eatton, from whom all subsequent Le Contes are descended, was born in 1739, and died in New Jersey in 1822. He spent his summers in New York and his winters on his plantation, "Woodmanston," in Liberty county, Georgia. Like his brother William, he was accounted a "malignant" and rebel. In 1776 he married Jane Sloane, of New York, by whom he had three sons. The eldest, William, died unmarried. Louis, born in 1782, went to Georgia and there married Anne Quarterman, who became the mother of John and of Joseph Le Conte, the subject of this sketch. John Eatton, the third son, became a major in the U. S. Corps of Topographical Engineers, and married Ann Lawrence, who became the mother of John L. Le Conte, the distinguished entomologist.

Louis, the father of Joseph Le Conte, born in New Jersey in 1782, was educated in New York, graduating at Columbia College when only seventeen years old. He studied medicine under Dr. Hosack for some time, but is not known to have graduated as a physician, his main object being probably to practice on his own plantation. He was, however, called "doctor."

Louis Le Conte was a remarkable man, and his influence on the characters and life pursuits of his sons was so great that *his* life and character must be briefly considered. He lived on the "Woodmanston" plantation in Liberty county, Georgia. The region had been settled by a community of English Puritans, who originally founded Dorchester, Massachusetts; they were very moral and somewhat clannish and exclusive, so that when Louis came among them he was considered an outsider; but eventually, after his marriage with one of the members of the exclusive set, the warmest mutual relations were established. He was greatly interested in scientific pursuits, especially chemistry and botany; and in the then unexplored field by which he was surrounded he identified the described species and discovered many new plants, but never named or published them, and

freely gave his material to his scientific friends. His beautiful garden became known all over the United States and brought many visitors, who were hospitably entertained. His botanical insight disliked the mechanical arrangement of the Linnean system, so that he always referred his plants to their natural relationships. He was also a skillful mathematician. Aside from these intellectual pursuits, he attended personally to the management of his large plantation, with 200 slaves, whom he regarded as a heavy responsibility and constantly strove to control by religious and moral instruction, for which special "praise-houses" were established in the community. The negroes were greatly attached to him and proud of calling him "master." He also exerted himself in behalf of the instruction and general betterment of the condition of the white "crackers" inhabiting the pine woods some distance away. Though not a member of any particular church, his benevolence and charity made him universally beloved and respected.

It was under these influences, to which was doubtless added the inheritance of their mother's highly artistic temperament, together with natural surroundings of great beauty and scientific interest, in which the children were free to roam at will, that their characters and temperaments were shaped.

The issue of Louis' marriage were four sons and three daughters, of whom one died in infancy. The other six children grew up to marry and have children of their own. The mother, however, died early (in 1826), so that her direct influence upon Joseph could have been but slight; but her death prostrated the father, who remained plunged in gloom for years, until by the marriage of the elder children, William and Jane, grandchildren came to dispel, in a measure, the cloud of sadness. But the intervening period of sorrow had greatly impressed its seriousness upon the children and influenced their temperaments.

BOYHOOD AND COLLEGE EDUCATION OF JOSEPH LE CONTE.

Joseph Le Conte was born February 26, 1823, being the fifth child and the youngest son. With his three brothers, of whom Lewis was the nearest to him in age, he was accustomed to range the woods, fields, and swamps of the region freely, in quest of game, fish, and specimens of natural history, upon which the

father then commented instructively. Joseph became a good marksman, fisherman, swimmer, and athlete; in the latter accomplishment he afterwards greatly excelled. Of necessity, playthings, marbles, bows and arrows, canoes, and even rudimentary firearms, were made by the boys themselves. Joseph's formal schooling was scanty, in a country school supported by a few families and which was constantly changing teachers; but among the latter there was for two years Alexander H. Stephens, subsequently United States Senator and Vice-President of the Southern Confederacy, with whom he maintained a lifelong friendship. His imagination was much excited by the tales told and accounts given by imported negroes, of things in their native land, and of border warfare in which they had participated.

His country schooling and boy life ended in December, 1838, when, as he was about to go to college at the age of not quite 16 years, his father died from accidental blood-poisoning, at the age of 55 years. This event, which he had always put away from himself as almost impossible, stunned and dazed him; but, in obedience to his father's expressed wishes, he left home a week afterward, with his brothers John and Lewis, for the college at Athens, Georgia, 300 miles away; he up to that time having never been more than eight miles away from home. It was a week's journey, mostly by stage, and brought him in contact with an unfamiliar world—not very attractive to him, for he suffered severely from nostalgia for several months. The temptations usually supposed to beset young students entering college seem to have been no temptations to him; all coarseness and vulgarity merely repelled him, and he simply and naturally kept away from them and their devotees. During the first year he received a letter from his eldest brother, William, a deeply religious man of the old orthodox type and his legal guardian. This letter "alluded with distress and doubt to their father's dying outside of the pale of any church" and vehemently urged upon Joseph the necessity of "fleeing from the wrath to come." This letter greatly distressed and impressed him, and at a religious "revival" he and his brothers, with many other students, joined the Presbyterian Church, although the church at Midway was of the Puritan-Congregationalist faith; but they concluded that the Presbyterian was "good enough" for them.

He refers to this as a great crisis in his life, having experienced a sudden, almost miraculous conversion, followed by great joy and relief. He says that "the change was a sense of the deliverance from the fear of death and the hereafter—not the establishment of a new relation, but the discovery of the true relation existing." But his elder brother's admonition that he might feel it his duty to become a minister of the gospel did not prevail, and he remarks that "one may be a preacher of righteousness in more ways than one."

Although a member of one of the college literary societies, he never became a good debater; but he greatly delighted in the society of refined women, and entertained toward women in general a romantic feeling, as toward superior beings, which he declares to be "the greatest of all safeguards for the purity of young men."

Le Conte does not attribute to himself any unusual diligence in study while in college; yet he was both a junior and senior orator, the titles of his addresses being "True Greatness" and "Love of Truth, the Highest Incentive to Effort." The manuscripts of these efforts he afterwards destroyed because dissatisfied with them. "The skillful putting together of commonplaces of literature into a brilliant patchwork" he states he could never do, and that "the ability to write anything of value came late," and not until he "had independent thoughts of his own."

During his college course at Athens the natural-history sciences were almost wholly neglected, these being but feebly represented in the faculty. Charles F. McCay seems to have impressed him as the only strong man in the faculty, he representing mathematics and physics.

Le Conte's college life was uneventful, not even accompanied by the usual "pranks." His vacations were passed at the old plantation or with his brother William, at Cedar Hill, where he renewed his old sports of hunting, fishing, &c. In January, 1841, that brother died—"the second great affliction I have suffered by death."

POSTGRADUATE STUDIES AND TRAVELS.

Le Conte and his brother Lewis graduated from the Athens College in August, 1841. Their sister Anne having graduated about the same time, the three agreed to make a tour of the Northern States. During this first excursion into the outer world, they visited first the city of Washington, with the magnificence of whose buildings and monuments they were greatly impressed, as also by the oratory of Webster, Calhoun, and Clay in Congress. After a week at the capital they visited Baltimore, Philadelphia, Boston, and Cambridge, returning via New York, where there was a family reunion, their married sister, Jane, and their brother John, lately married, gathering at the house of their uncle, John Eaton Le Conte, the father of John Lawrence, the entomologist, the latter then but sixteen years of age. Returning in November, all stayed during winter at Woodmanston plantation, with their sister Jane. On this occasion Joseph become acquainted with John T. Nisbet, the uncle of his future wife. Hunting, fishing, and excursions occupied their time. In spring and summer more extended excursions were made, from Macon and Athens into the mountains of Georgia. Thereafter Joseph began the study of medicine under Dr. Charles West, at Macon, until the beginning of winter, which he again passed at the old plantation, riding, hunting, and fishing in company with his cousin, John L., who had come on a visit which was greatly enjoyed by both.

About this time the great comet of 1843 appeared, and greatly impressed him. This summer he first met his future wife at the house of his friend Nisbet, but at that time he was not permanently impressed; in fact, another fair face held his attention just then.

Le Conte now determined to take up medical studies in New York, and attended the winter course (1843-1844) of four months at the College of Physicians and Surgeons. Among his instructors were Dr. Torrey and Dr. Lewis Sayre. He characterizes the course as a period of regular cram and hard work, such as, it will be noted, had not fallen to his lot during any of his previous rather care-free life.

It was doubtless the taste for outdoor and more or less physically strenuous life that led him to undertake, in company with his cousin, John L., an excursion to the then Far West, the headwaters of the Mississippi, via Niagara, Buffalo, Detroit, and the Great Lakes. This trip he considers as a very important phase in his development, as it attracted his attention permanently to the great geological features passing before him, and gave renewed and definite direction to his subsequent chief work. Hence some space must be given to its discussion.

His comments on the conditions then prevalent in what are now some of the chief centers of commercial and industrial activity are very interesting. Buffalo and Detroit were then small towns, with little indication of their future greatness; the University of Michigan was in its beginnings. At Detroit, where they passed a week in pleasant company, they were persuaded to visit the Lake Superior country, to which they proceeded by the regular steamer via Lakes Huron and Michigan, stopping at Fort Mackinac and at Chicago, then a budding city of 5,000 inhabitants. At Mackinac they first saw birch-bark canoes, which, upside down, were serving as sleeping quarters for the Indians. Captain Scott, the commander of the fort and a noted hunter of the time, to whom they had letters of introduction, entertained them hospitably and introduced them to some of the salient features of the Far West. From Mackinac they went by canoe to Sault Ste. Marie, having provided themselves with buffalo robes at a cost of one dollar each. At the Sault they met Colonel Gratiot, who was on the way from St. Louis with a party of miners to explore the copper mines at Keweenah Point. The Le Contes were invited to join the party, and passed three delightful weeks at Eagle Harbor, which town they thus helped to found, taking an active part in the building of log cabins, and hunting and fishing between-times. The copper mines do not seem to have attracted Joseph Le Conte's special attention at the time.

From Eagle Harbor they again took sailing vessel to La Pointe, then an Indian agents' station and also that of the American Fur Company. Here they found a camp of about 300 Indians, whose pagan Sunday services they attended in the

afternoon, after taking part in a Christian service in the morning. Le Conte graphically describes this Indian ceremony.

At La Pointe they made arrangements for their trip to the headwaters of the Mississippi, which was to be made by canoe up the St. Louis River, thence by portage across to the headwaters of the Mississippi, which they were to descend to Fort Snelling. The crew of the 24-foot birch-bark canoe, hired from the Fur Company's agent, consisted of two Canadian voyageurs, with whom their verbal communication was somewhat difficult. Their agreement was for forty days and they provisioned themselves accordingly.

They started on July 8, passing through the group of Apostle Islands, whose wave-worn rock caverns they explored, camping one night. They then skirted the south shore to the mouth of the Bois Brulé River, and thence crossed over to the north shore, which they desired to see, and after camping there over night proceeded to the mouth of the St. Louis River, the present site of the city of Duluth. Next day began the voyage up the river, passing numerous Indian villages. While in camp at the Dalles of the St. Louis, where a long portage had to be made, Le Conte surprised a crowd of visiting Indians by swimming the rapids repeatedly; but although they cheered him, his invitation to them to join him in the exploit was not accepted. He comments on the effects of training in man as compared with animals, and his belief that "blood will tell" in physical man as well as in beasts. Farther up the river they were much annoyed by mosquitoes and "brulos," a minute sand-fly. Le Conte notes that instead of getting to drier country as they ascended to greater elevation, the ground grew marshy and dotted with shallow lakelets. A portage of a few miles then carried them to the waters of the Mississippi, and they descended to Sandy Lake, where there was an Indian agency, where they refitted for the descent of the Mississippi. Here also Le Conte raced with an Indian boy in swimming and diving, the Indian beating him in the latter art.

The voyage down the river was uneventful; Indians were frequently met and their villages used for night camps, but only one white man was seen down to the Falls of St. Anthony, a distance of between four and five hundred miles. Reaching the

falls at noon one day, they drew the canoe up on a beach at the very spot where Minneapolis was founded five years later. There was then a single log cabin, owned by a white trader. Le Conte examined with much interest the structure of the gorge below the falls, the rapids of which they "shot" in their canoe, and he even then compared the gorge to that of Niagara, as being formed by the recession of the falls from the escarpment at Fort Snelling; but, as he failed to publish these observations, the priority fell to others.

After a week's pleasant stay at Fort Snelling, during which they visited what is now known as Minnehaha Falls, on the origin of which in connection with the Falls of St. Anthony Le Conte commented at the time, they took the steamer down the river to Galena, where they stopped to examine the lead mines, also visiting Dubuque. Le Conte mentions passing a small village named St. Paul, and also Nauvoo, where the Mormon excitement connected with the killing of Joseph and Hyrum Smith was then at its height. On reaching St. Louis they found their stock of money exhausted, and had to borrow funds to enable them to return east by boat to Pittsburg, and thence by rail to New York.

At New York he resumed his medical studies—"the old grind," as he expresses it. During this time and until his graduation, in April, 1845, he became acquainted with many distinguished men, among them Giraud, Bell, Baird, and especially Audubon, whom he frequently visited at his residence, 10 miles out of the city, together with his brother John; greatly enjoying the intercourse and often boating on the river with the sons, John and Victor.

Though graduated as a physician, Le Conte did not intend to practice as such, but considered the medical course as being (at that time) the best preparation for a scientific career. His reading of the "Vestiges of Creation" about this time was his first introduction to the subject of evolution.

Going south shortly after graduation, and while making a round of visits to relatives and friends, he made a large collection of birds, which he afterwards presented to the Smithsonian Institution. Returning from a series of excursions to the mountains of Georgia in November, he planned to make a

tour through Florida on horseback with his cousin, Lewis Jones, to study the geology and natural history of that region, then little known; but this trip was brought to naught by complication with an affair of the heart, he having again met Miss Bessie Nisbet, his future wife, this constituting the second great crisis in his life. The following year seems to have been spent altogether in visits and excursions, among these one to Yonah and to Stone Mountain, returning in September to Liberty county. There he finally became engaged to Miss Nisbet, whom he married in January, 1847. The following year was also devoted to excursions and travel, with riding, hunting, swimming, &c.

Shortly after the birth of his first child, in December, 1847, Le Conte was taken with a severe attack of measles while on a visit at Savannah. Getting up too early in the impatience to return to his wife and child, his recovery was slow and tedious, and it was several years before he recovered his usual vigorous health.

But now, having assumed the responsibilities of a father of a family, he felt that it was time to terminate the free-and-easy, pleasurable life he thus far led, and he concluded that he must become "a worker in the social hive," without, however, regretting the time spent in his former pursuits, feeling that they had had a rounding and broadening effect. Not wishing to seclude his family on the plantation, he settled, to practice medicine, at Macon, Georgia, and so continued for two years and a half (to July, 1850), deriving but a very moderate income from his profession and enjoying more the instruction of a few students. He became conscious that he had not yet found his proper place in life, his taste being altogether scientific. In 1849 he read his first paper before the Georgia State Medical Society, its title being "The Science of Medicine." But he felt unhappy, as though he were wasting his life. Finally, in the spring of 1850, his cousin, Lewis Jones, visited Macon and told him of his purpose to become a pupil of Louis Agassiz, who had been appointed professor of Geology and Zoölogy at Harvard. He at once joined in this plan, the purpose being to make special preparation for the teaching of these subjects, in which he had become strongly interested through the works of Richard Owen,

especially that on the Archetype and Homologies of the Vertebrate System.

He left with much regret the circle of genial friends he and his wife had made at Macon, and in August 1850 arrived at Cambridge, where he took a dwelling-house on the Campus.

The regular session at Harvard did not open till October, but as he and his friend had come only to study with Agassiz and the latter was at home, they went right to work. "The first task Agassiz set us was very characteristic of the man. He thought awhile, then pulled out a drawer containing from 500 to 1,000 separate valves of Unio, and said: 'Pair these valves and classify into species; names no matter; separate the species.' Then he left us alone, very severely alone." They worked zealously for weeks, with an occasional silent visit from the professor. When they reported that they had done the best they could, he examined their work carefully and expressed himself much pleased, remarking to a visitor that they had just correctly amended the classification of Lea, the great authority on these shells. The same system of instruction was continued, but as they progressed their teacher became more communicative and engaged them in most interesting talks on biological philosophy.

Le Conte comments enthusiastically on Agassiz as a great teacher—one of those who are greater than all their visible results, in that their personality is magnetic and their spirit and enthusiasm contagious. To his fifteen months' intimate association with Agassiz for eight or ten hours daily, in all his excursions with Hall in the fossiliferous areas of New York, and along the shores of Massachusetts and Florida in zoölogical research, he ascribes much of the direction and success of his later work.

The exploration of the Florida coral reefs with Agassiz was especially fruitful, and he dwells upon it at length. He was most reluctant to leave his family, but, his wife urging him not to miss the opportunity, they started on the first of January, 1851. The work was undertaken at the request of Superintendent A. D. Bache, of the Coast Survey, for the investigation of the laws of the growth of coral reefs, which render navigation in the waters of southern Florida very hazardous to shipping. Le Conte and Agassiz' son Alexander, then sixteen, went as assist-

ants, the expenses being borne by the Government. They left Cambridge in a snowstorm, but during most of the six days of the voyage to Key West they sailed in summer seas, with excellent opportunities for observing marine life, from sharks to the exquisite Physalias and growths of corals.

They worked incessantly, "sometimes visiting the reefs in a Government steamer, sometimes exploring the Everglades in one direction, sometimes the Dry Tortugas in another—always observing, noting, and gathering specimens. Sometimes for several days we would be out all day on the reefs collecting, generally waist-deep in the water; then for several days we would study our specimens with the microscope, draw, and pack away. In the evenings we would gather in Agassiz' room and discuss the day's work and the conclusions to be drawn therefrom. I never saw any one work like Agassiz; for fourteen hours a day he would work under high pressure, smoking furiously all the time. The harder he worked, the faster he consumed cigars." They were greatly helped in their collecting by the sailors and 'longshore population, three or four hundred of whom took part in the task, and were greatly pleased when Agassiz manifested "almost childish glee" at some new discovery of theirs.

Longer excursions were made by the party on board a Coast Survey steamer commanded by Captain (subsequently Admiral) John Rodgers, and in a sailing vessel commanded by Captain Frye. In the latter they visited the Marquesas and the Dry Tortugas. From the latter point he was detailed by Agassiz, with Dr. Jones, to explore a small island ten miles away, where the vessel was becalmed for two days. Le Conte enjoyed the leisure time by bathing and diving in the clear warm water, gathering Gorgonias and sponges from the sea-bottom. Going back to the fort in a boat, he noted the killing of the new growths of the Madrepore corals on which the boat grounded, as a result of the annual depression of the water level; thus furnishing a basis for the determination of the age of coral reefs and islands. On his arrival at the fort he found that Agassiz had made the same observation during his absence, on reefs of Macandrina.

The evenings on the steamer around the dining-table Le Conte

mentions as specially enjoyable, as there were on board several scientific men connected with the Coast Survey, among whom he mentions J. E. Hilgard and Count Pourtalès. On one occasion Agassiz expressed himself quite forcibly regarding the intolerance of society in America, he having experienced the effects of the *odium theologicum* on account of his views on the diversity of the origin of man; and he commended Austria as the country where a man of science could utter his views most freely, so long as he let politics alone.

The party left Key West for Cambridge after a stay of six weeks, passing from summer to winter in the course of a few days.

The main scientific results of this expedition were published by Agassiz in the Report of the Coast Survey for 1851; some extensions of the same were by Le Conte himself read at the meeting of the American Association for the Advancement of Science in 1856, and published in the Proceedings of that body, and also in the American Journal of Science for January, 1857. This publication Le Conte considers to have been his first really scientific paper.

The rest of the year was passed at Cambridge in study, as before, only even more earnestly. In addition to zoölogy and geology, Le Conte took a course of botany under Asa Gray. He and Jones still had the advantage of having Agassiz almost to themselves, some wealthy New York youths who joined the class finding themselves out of their depth and leaving very soon. In May the two friends went with Agassiz to study the New York Paleozoic in the Catskill and Mohawk region, this being the first field work in geology done by Le Conte.

In June, Agassiz suggested that the two students should take degrees at the Lawrence Scientific School, which was then in its first year and for which it was desired to make a showing. Although already possessed of three degrees, Le Conte concluded to take another under the auspices of Agassiz, and took as the subject of his thesis the Homologies of the Radiata. Upon this thesis he bestowed a great deal of thought and work. He was examined on it by Agassiz, and also publicly by him and Wyman on zoölogy and geology. Thus Joseph Le Conte, Lewis Jones, David A. Wells, and John D. Runkle formed the first graduating

class of the Lawrence Scientific School, and probably the first strictly postgraduate class in the United States. Le Conte's thesis, however, never reached publication, the manuscript being destroyed in the burning of Columbia, South Carolina, at the end of Sherman's raid.

Le Conte, however, did not stop at graduation. He continued work in Agassiz' laboratory and excursions, or by himself. The "galaxy of stars" then at Harvard was so attractive and stimulating that he hesitated to leave. There were Agassiz, Guyot, Wyman, Gray, Peirce, Longfellow, Holmes, Felton, Emerson, and also Richard Dana, whom he met three times daily at meals. Moreover, Boston being near by, afforded an opportunity for hearing and seeing the great artists of the time, such as Jenny Lind, Parodi, and others, and of attending the meetings of scientific bodies.

Le Conte designates as the third critical mental period of his life the fifteen months of his study with Louis Agassiz, and here discusses briefly the points (more elaborately presented later, in a memorial address made at San Francisco) in which Agassiz' methods of study were novel and epoch-making in the natural sciences. The new departure most widely recognized is his demonstration of the stupendous agency of glaciers in shaping the present surface of the earth; but more fundamental than this achievement is the introduction of the study of nature itself in the development of the organic world, instead of mere laboratory experimentation. The latter method is all right for inorganic nature, but in the development of organized beings experimentation introduces abnormal factors, and the observation of nature itself is first in order.

"There are three subordinate series or methods leading to similar results; these are the natural-history series, the embryonic series, and the geological or palæontological series. By the first method Cuvier and his colaborers perfected comparison in the natural-history series, laying the foundation of scientific zoölogy; Agassiz and von Baer extended the method of comparison into the embryonic and geological series and into the relation of the three series to each other. Agassiz' work and Agassiz' method prepared the whole ground for the modern doctrine of evolution, only his was an evolution not by organic

forces acting within, but according to an intelligent plan from *without*—an evolution not by transmutation of species, but by substitution of one created species for another." But he regarded the cause of evolution as being beyond the domain of science and all attempts at a causal theory as being at least premature.

Le Conte adds that Agassiz' work and method are the only foundation of the possible scientific sociology, and that in this case also three different series, corresponding to those in the lower natural organic world, can be worked out. The first series is that exhibited in different nations and races in various stages, as now existing in different places; the second, that showing the various stages in the advance of one and the same nation from barbarism to civilization, corresponding to the embryonic series; and, third, that exhibiting the slow onward progress of the whole human race through the several ages now recognized. He mentions Herbert Spencer as having taken the lead in this line of investigation.

COLLEGE AND UNIVERSITY CAREER OF LE CONTE.

Leaving Cambridge after fifteen months of residence and study, Le Conte, after paying a visit to his uncle at New York, in October took the steamer for Savannah. On arriving he learned of the accidental death of his eldest brother, Lewis. After some months passed at the plantation, Le Conte received a call to a professorship of "the Sciences" at Oglethorpe University, at Midway, Georgia. He was to teach all the sciences except astronomy, and all for a thousand dollars. But he concluded that he must now begin his life-work and accepted, teaching mechanics, physics, chemistry, geology, and botany. Zoölogy, for which he had specially prepared himself, was no part of the curriculum, and, moreover, there was no laboratory, so the work was almost wholly intellectual; but he felt that he made a successful teacher.

The previous year his cousin, Lewis Jones, had been appointed professor of geology and natural history at the University of Georgia, at Athens—a position Le Conte had also desired—with double the salary. Jones did not get along well with the president, and after holding the chair for a year resigned in

disgust. John Le Conte being also a professor at Athens, Joseph wrote to him and found to his disappointment that *French* was to be superadded to the duties of the chair. However, as he read French with ease, he concluded to "qualify himself" by taking lessons in speaking from a good native French teacher. He was elected to the complex chair in December, 1852, and began his duties in January following. A French teacher being elected after six months, he was able thereafter to restrict himself to geology and botany, with a Monday-morning class in natural theology. This latter class he enjoyed, as it gave him the opportunity to bring out the general laws of animal structure as evidence of a divine plan; otherwise zoölogy formed no part of his subjects, and to this he did not object, as the colleges were not at that time prepared for the teaching as practiced by Agassiz. Altogether, with his brother John, McCay, and later Leroy Brown and C. S. Venable as his colleagues, he was well pleased with his situation at Athens.

During the long winter vacation of 1854 Le Conte went to Philadelphia with his family, and there met many prominent men, among others Lea, Phillips, Elwin, and John Fraser. The latter one evening brought with him a then new instrument, the stereoscope, showing its effects and elucidating the theory of Wheatstone, which attributes the result to a mental (subjective) combination of the two images. Le Conte noted that when he looked at the distant lines of the images the nearer ones appeared doubled, and *vice versa*, proving that the effect is a physical one; and he so stated to the company assembled. They, however, thought him a very forward and disputatious young man for daring to dissent from Wheatstone. He did not publish his conclusions, which were a year after brought out by Brücke in Germany.

Going afterwards to Cambridge, they were invited by Agassiz to stay at his house, where they passed a delightful week, meeting also many distinguished men.

During the four years Le Conte remained at Athens (1852 to 1856) he published a number of papers, popular, scientific, educational, and philosophical. The most important of these was that "On the Agency of the Gulf Stream in the Formation of

the Peninsula of Florida," based on his own and Agassiz' observations, which created marked interest.

Between 1854 and 1856 administrative difficulties led to the resignation of several of the best men of the faculty of the Athens institution and the final removal of all by the board of trustees. Le Conte immediately applied for the professorship of chemistry and geology in the College of South Carolina, then vacant. He was elected, and assumed the duties of the chair in January, 1857. He thus again became the colleague of his brother John and of McCay, who had become president. In this position he remained until, after the Civil War, he was called to California.

In the interval between his resignation from the University of Georgia and removal to Columbia, he was invited by Prof. Joseph Henry to deliver six lectures at the Smithsonian Institution. Three of these were on "Coral Reefs" and three on "Coal." The latter were subsequently written out by him and published in the Smithsonian Report for 1857. They excited a good deal of interest and were translated and published in French. He there brought out some views on the affinities of Gymnosperms, which anticipated by thirty years the same brought out later by Lester Ward and Engler.

The work at the South Carolina College was very exacting at the time and gave no opportunity for original work, he having also had to take a class in mathematics. Shortly there occurred a cataclysm similar to that at Athens, ending likewise in a wholesale resignation of the faculty, of whom, however, the two Le Contes and one other were immediately reëlected by the trustees. The college was thus disbanded in May, leaving four months vacant until the regular opening in October. Most of this time was passed by Le Conte and his family at the Virginia Springs, where they met many of the faculty of the University of Virginia, among whom Le Conte mentions McGuffy as specially interesting. In August both Le Contes went to Montreal, to the meeting of the American Association for the Advancement of Science, at which the writer of this memoir first became acquainted with them. Joseph Le Conte mentions as the prominent event of that meeting the reading by James Hall, the retiring president, of a paper on "The Formation of Moun-

tain Chains by Sedimentation," containing a new and very important idea, but imperfectly set forth, so as to be hardly understood, although it forms the basis of our present views.

Most of the former faculty of the South Carolina institution having been reëlected in September, a little later Judge A. B. Longstreet was elected president. Their success of the year before having made the students somewhat turbulent, another strenuous period was foreseen and realized, resulting in the suspension of nearly half the students for one term. Most of these subsequently returned under rigid conditions, and Le Conte comments upon the rigid sense of honor and veracity that manifested itself among the students on all these occasions.

Stimulated by the intellectual and social surroundings in Columbia, where he met daily such men as Dr. Thornwell, Dr. Palmer, Wm. C. Preston, Wade Hampton, and others, he wrote between 1857 and 1860 many articles, mostly of literary and philosophical nature, such as "The Place of Geology in a Course of Education," "The Relation of Morphology to Fine Art," "The General Principles of a Liberal Education," "Female Education," "The Relation of School, College, and University to One Another and to Active Life," "The Relation of Biology to Sociology," and "The Nature and Uses of Fine Art." The first four of these were given as addresses before academic audiences; the others, put into a drawer for the time, were subsequently published in various reviews and magazines.

In pure science he wrote and read at the meeting of the American Association for the Advancement of Science, 1859, his original paper on "The Correlation of Physical, Chemical, and Vital Force and the Conservation of Force in Vital Phenomena." This paper created great interest among scientific men at the time; it was widely republished, both in America and in European Journals, and also in the International Scientific Series.

During a summer vacation spent in the mountains of North Carolina, Le Conte met Langdon Chevis, a planter on the South Carolina coast, who, having read the "Vestiges of Creation," heartily endorsed the origin of species by transmutation of those previously existing, while Le Conte held Agassiz' view of creation according to a preordained plan. Chevis combated so successfully Le Conte's objections as to make a strong impression on his mind, in advance of the publication of Darwin's book on

the subject; but Chevis did not think of publishing his views, which, as Le Conte remarks, was a general habit in the old South and prevented him, as well, from publishing, first, a number of observations subsequently brought out by others.

He refers with much admiration to Donati's comet of 1859, but did not, like not a few people both in and out of the South, suspect in it the forerunner of the civil commotion then impending.

WAR EXPERIENCES.

Le Conte devotes 50 pages of his autobiography to the events of the Civil War and the graphic relation of his personal experiences in connection with it, which were both extensive and exciting. Of these experiences a short outline only can, of course, be given here.

Like a great many thoughtful men in the South, especially those not in political life, Le Conte was at first exceedingly reluctant to join in a movement which foreshadowed the disruption of the Union; doubtless the more as from his personal knowledge of the North he must have been fully aware of the futility of the prediction and assertions made by the professional agitators for secession, that "the Northern mudsills have no stomachs for fighting," and that "one Southerner can whip three Yankees any time." Had the dreadful conflict which resulted been generally foreseen, these agitators would not have had such easy work in carrying the masses with them. But, as Le Conte says, it came to be a spiritual contagion, and the final result was enthusiastic unanimity of sentiment throughout the South, with a few honest exceptions. Le Conte characterizes as absurd the designation of the Civil War as the "War of the Rebellion." It was a war between two fully organized States, which was honestly fought out to a finish and the result frankly accepted. But "to us it was literally a life-and-death struggle for national existence, and doubtless the feeling was equally honest and earnest on the other side." In this spirit Le Conte took up and participated in the contest so far as in him lay, and his war experiences are highly interesting reading.

The South Carolina College went on quietly during 1860-1861, but in the spring of the latter year the siege of Fort

Sumter caused a large number of students to leave college to join the army; nevertheless the college exercises went on. In the spring of 1862 the increasing stress of the war left the college with only 40 or 50 students. In June, 1862, after the seven-days battles in Virginia, there came a call for all men above eighteen years, and perforce the college was disbanded, all the students volunteering. Both the brothers Le Conte went on to Richmond to help nurse the sick and wounded, among whom was a brother of Joseph's wife. He himself took the typhoid fever. After three weeks' illness he and his brother-in-law returned to Columbia.

While the professors' salaries were continued, they proved woefully inadequate, on account of the depreciation of the Confederate currency; so they had to complement them by outside work. In October, 1862, Le Conte was appointed one of the arbitrators to determine the right of the Confederate Government to the niter caves in the several States, and sat on the case in Atlanta for three weeks. In 1863, during the height of the conflict, he wrote the paper on "The Nature and Uses of the Fine Arts;" but, anxious to render some effective service, he took the position of chemist to a large manufactory of medicines for the army, which was established in the suburbs of Columbia, and so continued for eighteen months. In 1864 he was appointed chemist of the Niter and Mining Bureau, with the rank and pay of major. Under this mandate he explored in summer all the niter caves and beds in the Gulf States of the States west of Mississippi, as well as the iron mines and furnaces at Shelbyville, Alabama. Returning to Columbia in September, he sent a report to the chief of the Niter Bureau at Richmond.

At this time Sherman's army was moving from Chattanooga towards Atlanta and the coast. Le Conte's widowed sister and family and one of his own daughters being then on a plantation near Halifax, south of Savannah, he set out to rescue them; but within ten miles of Savannah he had to turn back to Columbia, whence, by a detour of 850 miles to southward, he again attempted to reach his sister. After many delays from hostile parties and natural difficulties, he finally reached her house one morning; but, as it was clearly impossible to escape in wagons, he started out with his daughter on an old, broken-down horse

abandoned by the Federals, lent him by a negro. They soon found themselves cut off, and after hiding in the woods for some time and having several narrow escapes from capture, they were advised by a negro that several wagons had come from the Confederate lines under a flag of truce to carry away the ladies. As all, however, could not go at once, Le Conte had to return for his sister later, the entire party to meet at Macon. This trip proved an arduous one. At Macon they were materially assisted by a young man in Confederate uniform, who seemed to know everybody in both armies. Leaving the party at Augusta, he said he would meet them again at Columbia, "whither the Federal army was sure to go." They finally reached Columbia, nearly two months after Le Conte had started out on his voyage of rescue.

The situation at Columbia being very precarious under the rapid advance of Sherman's army and the bitterness entertained by the Federals toward the "cradle of secession," Le Conte received orders from Richmond to ship the chemical laboratory to that place. A universal panic prevailed and the departure of army trains put him on guard in respect to his family; and the young man who had previously traveled with them was on hand, as promised, and advised them to save at once what they specially valued. And so lecture notes, manuscripts, &c., went off with the belongings of the Niter Bureau. The two Le Conte brothers, being Confederate officers, could not remain without being taken and treated as prisoners of war. Under the distant booming of Sherman's guns, they started with five heavily loaded wagons, accompanied and greatly handicapped by twenty-two negroes and their families and the deep mud caused by the rains. They were finally discovered by Federals, who, after rifling all their trunks and packages, set the remnants on fire and watched them burn. At this juncture John Le Conte, finding it impossible to escape with his son, who was just convalescing from a serious illness, gave himself up. Ultimately Joseph and Captain Green, their traveling companion, learned from the negroes that several parties were searching for them, and therefore concluded to escape during the night. Walking rapidly and silently towards Columbia, they soon heard Federals galloping on their trail and quickly hid behind a "worm" fence,

the other side of which was presently selected by the searching party for a rest. But after half an hour they left on the back trail.

After several days of hiding in the pine woods, they finally heard that the Federals had left Columbia, and with other returning fugitives they took the road to the city.

Entering Columbia, Le Conte found all along the main street a heap of ruins, but the college buildings had been spared. At his home he found all living and well, but much exhausted by the terrible experience they had undergone in the burning of the city, although not a soldier had crossed their threshold. So the goods they laboriously carried off and lost would have been safe in the house. The mysterious young man had slept in the basement, and had authoritatively protected the house. Whether he was a Confederate or a Federal spy, or both, was never made quite clear.

The first year following the end of the war was a trying one. For a week the family lived on provisions that had been saved from the sack of the city by the negroes that lived on their lot. Then for a while they drew rations from the city, and gradually supplies came in from the country. At one time Le Conte obtained from the Federal commander permission to go down the river on an abandoned flatboat to obtain corn for the city from the plantations below, and brought back several thousand bushels, of which one hundred was allowed him as a perquisite for himself and his brother John. Everybody of course wore "homespun," or soldiers' clothes picked up from the hospitals.

Worse than these privations was the "reconstruction" period which followed, with negro domination, aggravated by "carpet-bag" officials and their swarms of predatory followers. Of this period Le Conte forbears to speak in detail.

Having lost everything but his land in the war, the resumption of college work in 1866 greatly relieved him by the salary being also revived. Instruction in the college was now made as "practical" as possible, he himself supplementing his chemistry course with short courses on pharmacy and agriculture. Meanwhile Le Conte also resumed his outside scientific activity. In 1866-1867 he gave six lectures on "Coal and Petroleum" in the Peabody Institute at Baltimore and wrote three papers on the

"Adjustments of the Eye," "Rotation of the Eye on the Optic Axis," and "The Horopter." These were published first in the American Journal of Science and in the Philosophical Magazine, and subsequently, with nine additional articles, were embodied in the volume "Sight" of the International Scientific Series, in 1880 and 1897.

A measurably satisfactory political and social condition existed until the establishment of the permanent "civil" government, which became more and more intolerable until, in 1876, by an uprising of the people, good government was restored; but in the meantime a good many of the best men emigrated to escape the intolerable misgovernment, and the two Le Contes themselves thought of trying their fortunes with Maximilian of Mexico. Just then they heard of the organization of the University of California and applied for positions there. Both were elected in November and December, 1868, and moved to California the following year.

LIFE AND WORK IN CALIFORNIA.

Leaving Columbia after thirteen years of service, Joseph Le Conte took his family to California on the transcontinental railroad, then newly opened, and was met at Oakland by his brother John, who had preceded him and was acting as president pending the election of a permanent incumbent by the regents. Both entered on their active duties on September 20, 1869, with a total of 38 students in attendance. At the university, which was then located in Oakland, Joseph Le Conte's lectures were on geology, zoölogy, and botany.

He was greatly impressed and interested by the novelty of the country and climate and the busy, active population; and in order to become acquainted he frequently lectured publicly, thus altogether finding his intellectual activity stimulated to the highest degree. At the Mechanics' Institute of San Francisco he gave about twenty lectures on various scientific subjects, and at Oakland on Sundays he spoke on the "Relations of Science to Religion," a subject which continued prominent in his mind to the last. The stenographic report of the Oakland lectures formed the basis of his first book ("Religion and Science"), published by the Appletons not long afterwards.

Geology had now become his favorite department, but as the understanding of the geology of a new country requires more time and travel than he was able to bestow upon it, his scientific activity continued specially in the line of binocular vision. He thus followed up his first paper on the subject, written in reply to the papers of Claparède and Helmholtz, by three others published in the American Journal of Science in 1871, the last ("On the Theory of Binocular Relief") being also published in the Archives des Sciences. It gave rise to discussions with Pictet and Tyndall, in which, according to the present state of the subject, Le Conte's views were fully sustained.

During the summer vacation of 1870 he, in company with Prof. Frank Soulé and eight students of the university, undertook a six weeks' camping trip in the Sierra Nevada, which he considers almost an era in his life. It was made in the roughest style, without even a tent, each man carrying his bedding, &c., behind his saddle. They visited the Yosemite, the High Sierra, Lake Mono and the neighboring volcanoes, and Lake Tahoe. The trip was thoroughly enjoyed by all, and the opportunity afforded him for the study of mountain structure and origin formed the basis for ten or eleven papers subsequently published by Le Conte. A narrative of this expedition was published in 1875, under the title "A Journal of Ramblings through the High Sierra," which attracted much attention and, being soon out of print, was republished in 1890 by the Sierra Club of San Francisco.

The summer vacation of 1871 was utilized by him for a trip through Oregon, Washington, and British Columbia, observing systematically the many important geological features of that region; these observations he supplemented by a trip, taken more leisurely, in 1873, to eastern Oregon, including the Columbia and Deschutes rivers and the John Day region. These explorations gave him the material for what he considers one of his most important papers, that on "The Great Lava Flood of the West and the Age and Structure of the Cascade Mountains." This paper made known for the first time the enormous extent of what is probably the greatest continuous eruptive sheet in the world, and gave its beginning as probably at the end of the Miocene.

During the fall of 1872, after his return from the second trip to the Yosemite, Louis Agassiz visited him in Oakland, having come around Cape Horn in the Coast Survey steamer *Hassler*. This visit was of course a great enjoyment to Le Conte. Agassiz died in Cambridge a year later, and Le Conte made one of the memorial addresses before the Academy of Sciences in San Francisco, as already stated.

During the summer vacation of 1874 he, with his family, spent some time at Lake Tahoe, and availed himself of the opportunity to study the tracks of ancient glaciers in the region, with their moraines and lakelets. The results of these observations were given in a paper "On Some of the Ancient Glaciers of the Sierra Nevada," published in the American Journal of Science in 1875. He also at that time visited the Comstock Lode, which formed the basis of four or five papers subsequently published.

In the fall of 1874 he, with others of the university faculty, took up residence at Berkeley, the permanent site of the institution, then consisting of a few houses, but at the time of his death, in 1901, a town of 15,000 inhabitants; which number has now (1906) at least doubled. He always greatly admired and enjoyed the site of the university and town.

During the summer vacation of 1875 he again, with a party of university men, camped in the High Sierra. Their plan had been to go, via Yosemite, Lake Mono, and Lake Owen, over the Kearsarge Pass and down the Kings River Cañon; but an accident to himself prevented Le Conte from going beyond Lake Mono. There he made detailed studies of the volcanic phenomena, the results of which were afterwards published in the American Journal of Science in a paper "On the Extinct Volcanoes about Lake Mono and Their Relations to the Glacial Drift." During this year he was elected to membership in the National Academy of Sciences.

The most important paper written by him in 1876 was "On the Evidences of Horizontal Crushing in the Formation of the Coast Ranges of California." The striking contrast between the structure and details of the origin of the Sierra Nevada and the Coast Range was always a favorite topic with him, and he used to cite the latter as an irrefragable proof that, whatever differ-

ence of opinion there might be as to the *cause* of the horizontal pressure, no one seeing the phenomena shown in the Coast Range strata, even within a short distance of the University of California, could question the fact that they could not be explained by forces acting in any other way.

An address on "The True Idea of a University," made during this year, at commencement, and subsequently republished in the Princeton *Review* and the University of California *Chronicle* in modified form, is characteristic of Le Conte's ideals in respect to the means and methods for the best and highest intellectual and moral development, so far as this can be accomplished by secular education.

Shortly after the writer's arrival at the university, in spring 1875, Le Conte asked his opinion as to the need and likelihood of success of a text-book of geology which should embody dynamic geology as its chief feature, instead of being in the main historic, as was then the case with Dana's large book. Having experienced, while teaching at the University of Michigan, the great need of such a work, the writer strongly urged upon Le Conte the publication of such a book, which he had already begun to write and subsequently pushed vigorously toward completion; so that in 1876, when he went east to visit the Centennial Exposition, he entered upon negotiations with the Appletons for its publication. At Philadelphia he was especially interested in the inspection and trial of the telephones, then newly invented, especially that of Bell; which occurred in the presence of Lord Kelvin, the Emperor and Empress of Brazil, and other distinguished men. He subsequently, on his return to Berkeley, gave a lecture to the students and faculty of the university, in which he explained the principles and action of the Bell telephone, exciting great interest.

Upon the completion of the manuscript of the "Elements of Geology" he, in April, 1877, sent it on to the Appletons, who agreed to publish it provided that he would personally superintend the making of the engravings and the printing. He went to New York in May and worked very hard for three months. By August all was done except the proof-reading of the last half, which was done by him at Berkeley. The book was published in January, 1878, and was from the beginning very suc-

cessful. It has remained a standard college and university text-book ever since, and has gone through four editions, revised by himself, the last in 1902. It has since Le Conte's death been revised and supplemented so as to include the latest researches, by Prof. H. Leroy Fairchild, of Rochester. Its original character has, however, been faithfully preserved, and it remains probably the most widely used text-book of geology in the English language; for, although no written treatise could even approximately represent the eminently "live" lectures which the book embodies, yet, in so far as this is possible, the style reflects everywhere the intensity and geniality which made Le Conte's lectures so deservedly popular, both with the students and the public. His courses always varied from year to year, never becoming stereotyped, but always fresh and newly interesting, even to those who had heard the same subjects treated by him before; and he always prepared himself fully for each lecture. In this personal intensity lay the secret of his great popularity and influence with his students, and he states emphatically the principle, now at last becoming widely accepted by the American universities, "that investigation should never be separated from teaching, as many propose; for not only is one a better teacher for being an investigator, but also a better investigator for being a teacher. We never know any subject perfectly until we teach it." To his intense interest in his subject, and in his students, Le Conte attributes most of his success in teaching, which in the course of time became so great that there was no lecture-room in the university sufficiently large to hold his audiences. These came from all the nine "colleges" into which the university differentiated in the course of time, with the twenty-four hundred students actually present at Berkeley at the time of his death, in 1901, as against the thirty-five in 1873. Le Conte alludes regretfully to the diminished efficiency of instruction resulting from this enormous increase, occurring simultaneously all over the United States, but without a corresponding increase in the means available for instruction, and rendering personal contact and influence of instructors with the students very difficult.

Among the influences which kept up his wide, active interest in many directions, he mentions among his colleagues Hilgard,

Moses, and Howison, the latter especially, with whom he differed quite radically in many points, especially as regards the scientific as contradistinguished from the metaphysical standpoint in philosophy. He justly attributes a great intellectual stimulus to the Philosophical Union established by Howison in the university, where he with others frequently held ardent discussions on philosophical subjects. Another strong stimulus was, and is today, the "Berkeley Club," founded in 1873 by President D. C. Gilman, and which Le Conte considers an ideal club for intellectual stimulation and broadening; consisting, as it does, not only of university men of all departments of knowledge, but embracing also educated men of all pursuits, professions, and opinions. It is, as he says, a club of diverse spirits, where we may get, directly and without much labor, the best results of thought in other departments. It is therefore, within its membership, a powerful promoter of broadness as against the modern tendency to excessive, narrow, and premature specialization, which Le Conte considers as one of the prime evils of modern intellectual, and specially of scientific, life, productive of prejudice, self-conceit, and lack of sympathy between diverse pursuits. "The Berkeley Club combines the best features of both social and intellectual clubs, there being a fortnightly dinner, and after that a paper by some member (in rotation) and a general discussion thereon." It was doubtless this continual friction with diverse opinions that led him to decline special affiliation with any of the existing denominational churches, though tolerant and sympathetic toward all and contributing habitually to several of their number.

It was in this attitude of mind, gradually matured during the thirty years of his residence in California, that the greater part of his intellectual and scientific work, of which the enumeration and discussion follows, was done.

A summary historic recital of his chief activities during his life in California must suffice, in order to leave room for a fuller connected discussion of his most important writings.

In 1877 he wrote one of his most important papers, "On the Critical Periods in the History of the Earth, and the Quaternary as Such a Period." This idea had long been in his mind, and it was subsequently greatly enlarged by his discussion of the

Ozarkian or Sierran era of elevation and erosion, published in 1900. These are discussed later. In the same year he wrote his first discussion of the "Glycogenic Function of the Liver and Its Relation to Vital Force and Vital Heat," which was expanded in subsequent publications and finally summarized also in his book on the "Comparative Physiology and Morphology of Animals," issued in 1900.

In 1878 he wrote a paper in reply to Captain Dutton's criticism of his "Contractional Theory of Mountain Formation," which he explained more fully. In the summer of this year he took his family on a camping trip to the Yosemite Valley and Calaveras Grove.

The summer of 1879 he devoted to an extended but rather pleasure tour with his wife to Oregon, Washington, and British Columbia, and examined the Carbon River coal fields.

Among the scientific papers written by him in 1880, a very active year, was one on "The Old River Beds of California," which further illustrated his views on the critical events of the Quaternary era. Others were on "The Genesis of Sex," "The Effect of Mixture of Races on Human Progress," and on "The Laws of Ocular Motion," the latter being afterwards made a portion of his book on "Sight," written in the same year. He also made a trip to the South.

In 1881 he made only a short trip to study the formation of cinnabar veins at the Sulphur Bank, which he saw in actual progress and discussed in a paper published in 1882. In the summer of the last-named year he also made another trip to the Yosemite, and while there heard of the discovery of the Carson Footprints, which he examined, together with the Steamboat Springs of Nevada. He determined the footprints as those of animals of late Tertiary age.

Spending the summer vacation of 1883 near San Bernardino, he made observations on the old river beds of the Sierra Madre, showing there also a post-Tertiary elevation of the mountains. His paper on this "Rejuvenation of the Sierra" was not published till 1886.

In 1884, after having in New York superintended the publication of his "Compend of Geology," he again visited the South. During this and the following year he wrote many short papers,

but the work of chief interest was his excursion with Captain Dutton, of the United States Geological Survey, first to Mount Shasta, and then to Oregon, to the lava fields and Crater Lake, in the old crater of the exploded Mount Mazama, whose lava they found quite different from that of the lava fields proper. They also examined Klamath Lake and its origin in a fault. Le Conte greatly admired the scenery and was deeply interested in the geological problems offered in that region. On his return he immediately began to write out his views, thus confirmed, on the "Post-Tertiary Elevation of the Sierra," which was read before the National Academy of Sciences in 1886.

In the summer of 1887 he made a trip to the lava fields of Modoc and northward, via Reno, and Pyramid and Winnemucca lakes, which he recognized as remnants of the former great continental twin lake, Lahontan. He also visited Surprise Valley and determined its character as representing a fault scarp. Later in the same year he wrote a paper on the "Flora of the Islands of the California Coast in Relation to Changes in Physical Geography," emphasizing the origin and effect of the deep channels separating them from the mainland.

In May, 1888, he gave the inaugural address at the transfer of the Lick Observatory, then just completed, into the custody of the University of California. During the succeeding summer vacation he, with his family, once more visited South Carolina.

During the summer vacation of 1889 he undertook an extended trip into the Sierra Nevada, entering via Yosemite Valley, Tuolumne Meadows, Mono Pass, Mono Lake, &c., ground already familiar to him, but nevertheless greatly enjoyed, in company with his son Joseph (who subsequently became a most expert mountaineer) and other University men. At this time, in crossing the hot San Joaquin Valley, he for the first time felt a waning of his physical endurance.

In 1890 Le Conte suffered a great shock and loss in the death of his brother John, with whom he had been more or less associated and linked in close friendship throughout his life. He wrote for the National Academy of Sciences, of which both brothers were members, the memoir of the life of John Le Conte.

The years 1890 and 1891 were a period of great intellectual

and scientific activity for Le Conte, involving the publication of numerous papers, both philosophical and scientific, as well as the revision and republication of previous works. He was elected president of the American Association for the Advancement of Science after thirty years' absence from its meetings. He was also made vice-president of the American committee of the International Geologic Congress, which met at Washington at the same time, and in the unexpected absence of the president, Newberry, he presided at the meetings of the Congress, and therefore had to make an address of welcome to the visiting geologists. The subject of this address, which he had to prepare within two days, was "The American Continent as a Geological Field," and in it he called the attention of the foreign members specially to the greater simplicity of geologic phenomena in the United States as compared with Europe, qualifying the American geologic field to serve as a prototype rather than the more complex European conditions, as had heretofore been done. Here he made numerous interesting acquaintances, which were to serve him greatly in a subsequent visit to Europe.

Having subsequently superintended at New York the fourth edition of his "Elements of Geology," he visited his relatives in the South, stopping afterwards at Washington, where he lectured before the Philosophical Society on "The Relation of Philosophy to Psychology and to Physiology." Subsequently, in New York, he lectured on "The Race Problem in the South"—a thorny subject at the time—which he afterwards elaborated more fully in a volume entitled "Man and the State."

The regents of the university having given Le Conte a year's leave of absence with full salary, he determined now to fulfill his wish, long entertained, of visiting Europe. He sailed in February, 1892, from New York to Genoa, with his wife and youngest daughter, Caroline. It was a great event to him and was thoroughly enjoyed. From Genoa, Rome was visited, then Naples, whose bay he compares to that of San Francisco, whose general scenery he considers quite equal, but lacking the clear blue water and the pebbly beaches as well as the historic setting. After visiting the usual points of interest, they went north, via Rome, to Florence, Venice, Milan; thence, via the St. Gotthard Pass and Luzerne, to Zürich, where he visited the university;

thence to Heidelberg and down the Rhine, which, apart from its historic castles and cities, he found less striking than the Columbia, the Fraser, or even the Hudson. After a few days at Cologne they went to Paris, where he enjoyed specially the many distinguished men he met, mentioning Gaudry, Boule, De Margerie, Daubrée, Barrois, and others. Professor Javal, the ophthalmologist of the Sorbonne, told him that where he (Le Conte) differed with Helmholtz in matters relating to sight, Le Conte was, in his opinion, altogether right.

From Paris they went to England, where Le Conte was specially delighted to hear his native tongue again. They were mostly the guests of Mr. De Friese, a former student at the University of California. Among the many interesting men he met were Professor Prestwich, whose guest he was for some days, Sir Archibald Geikie, Professor Judd, and others; and after attending a meeting of the Geological Society he was invited to a dinner, at which he met, among others, Sir John Lubbock, who showed him much attention. Sir Andrew Clark asked him immediately whether he was the author of the book on "Evolution in Its Relation to Religious Thought," which he had carefully read and annotated. Cambridge and Oxford gave him the most enjoyable experiences. Prof. McK. Hughes entertained him for several days at Cambridge, and Professor Romanes, with whom Le Conte had corresponded, invited him to his house at Oxford. It appeared, again, that Romanes had also been especially impressed with the book on "Evolution and Religious Thought."

After a much-enjoyed tour through Scotland and short stay in Ireland, where they visited the Lakes of Killarney, they went, via Cork and Queenstown, to New York; thence, after presiding at the meeting of the American Association for the Advancement of Science, at Rochester, Le Conte returned directly to California.

In winter of 1892-1893 he visited southern California, lecturing at several points.

On the 26th of February 1893, being his seventieth birthday, the Academic Senate of the University of California gave him a dinner in the Maple Room of the Palace Hotel, San Francisco. In June of the same year, being quite unwell, he visited the Yosemite Valley, and, thinking it was probably the last time he

would see it, he took leave of the familiar cliffs and water-falls. He, however, saw it several times afterwards. In August he went to Madison, Wisconsin, to give his address as retiring president of the American Geological Society. His subject was the important paper on "Mountain Origin," subsequently published in several journals.

At the beginning of the year 1894 occurred the Midwinter Exposition at San Francisco, where he addressed one of the congresses on "The Theory of Evolution and Social Progress," which paper was subsequently published in *The Monist*. He again spent the summer in the Yosemite Valley, but this time at the hotel, and then, in August, attended the meeting of the American Association for the Advancement of Science, at Brooklyn, New York. He shortly after became a member of the American Institute of Mining Engineers, in recognition of his paper on "Posepny's Genesis of Ore Deposits."

In 1895 he attended the meeting of the American Educational Association at Denver, giving an address on "The Effect of the Theory of Evolution upon Education," published in the proceedings of that meeting. In this year he also, after participating in the discussions of the "Concept of God" by the Philosophical Union of the University of California, wrote the summary of his address, which was finally, with those of Howison, Royce, and Mezes, published in a book by the Macmillans. He also wrote, by invitation, a memoir of the life of J. D. Dana, which was read at the meeting of the Geological Society of America and subsequently published as a bulletin, and also in Dr. Gilman's "Life of Dana."

In January, 1896, he gave up his undergraduate classes, which had become excessively large, and thenceforth gave mainly graduate courses in geology and comparative physiology. This change he greatly regretted, for he enjoyed the undergraduate teaching; but the revision of examination papers became too irksome.

In this year the students began to take notice of his birthday, which until his death was manifested by decorating his room and lecture-table and by the giving of some valuable present, among which was a portrait of Agassiz. Even when, in 1901, he was absent in Georgia, he received a congratulatory telegram from

the students; and for a number of years after his death, formal memorial exercises were held on that day.

The year 1896 was a very prolific one with him, his first paper being on "The Relations of Biology to Philosophy." This paper was read at a number of philosophical meetings at the East also, and subsequently published, without his permission, and with many misprints, in *The Arena*. Later he wrote an article entitled "From Animal to Man," published in *The Monist*. In summer he attended the meeting of the American Association for the Advancement of Science at Buffalo, and presided over that of the Geological Society of America, which was notable because it was in honor of the sixtieth anniversary of Prof. James Hall's activity on the geology of the State of New York. Le Conte delivered one of the addresses, which was subsequently published in *Science*.

After supervising the new editions of his "Elements of Geology" and his book on "Sight," he early in September sailed for England. The special object of this trip was to attend the Liverpool meeting of the British Association for the Advancement of Science, to which he had been specially invited. Here he met many old friends and made a number of new ones—among others, Herbert Spencer, who invited him to luncheon; also Mr. Carnegie, who invited him to the privileges of the Athenæum, in London.

Le Conte's stay in England was brief, as he was to be present at the sesquicentennial celebration of the College of New Jersey, on changing its title to that of Princeton University. Here the title of LL. D. was again conferred upon him, and esteemed by him a distinguished honor.

After the celebration he visited Harvard University as the guest of his former pupil, Josiah Royce, and spent a fortnight among many old friends, including Mrs. Agassiz, Alexander Agassiz, Mrs. Asa Gray, and James Peirce; dining also with a "Berkeley colony" of twenty or more former students.

After attending the meeting of the National Academy at New York, in November, he presided at the meeting of the Geological Society in December. At the latter meeting he gave an address on "Crust Movements and Their Causes," which was printed

as a bulletin of the society and also in the Report of the Regents of the Smithsonian Institution for 1896.

Immediately after this meeting he joined his wife and daughter in the South, and celebrated his golden wedding at the house of his elder daughter, at Scottsboro, only two miles from Midway, where the marriage originally took place. All the children and grandchildren, with many other friends, attended the happy occasion, which was still further enlivened by numerous telegrams, presents, and congratulations from the regents and faculty of the University of California, and other distant friends. Subsequently, on his return to California, a public reception was given him and Mrs. Le Conte by the alumni of the university, with the presentation of a golden loving-cup, at the Hopkins Art Institute; followed later by a dinner given by the faculty.

The summer vacation of 1897 he again passed in the Yosemite Valley, his son and daughter camping. He also made an excursion to Clouds Rest and the Little Yosemite, and he once more thought it would probably be the last time that he should see these wonders.

In 1898 he published a new and revised edition of the "Compend of Geology" and on Charter Day delivered an address on "The True Idea of a University," subsequently printed in the *University Chronicle*. He also contributed to the Philosophical Union's discussions on "The Will to Believe," and a paper on "The Religious Significance of Science."

During 1899 he wrote and published in the *Journal of Geology* what he himself regards as one of his most important geological papers, on "The Ozarkian and Its Significance in Theoretical Geology," which discusses the important unconformities and erosions due to extended oscillations of the continent at the beginning of the Quaternary era.

In January and February, 1900, he published, in the *Popular Science Monthly*, a popular article entitled "A Century of Geology," wherein he traces the evolution of geologic thought during the nineteenth century; illustrating strikingly its development from mere infancy to the commanding position it now occupies among the natural sciences, notably its influence upon general scientific as well as philosophical and religious thought;

overcoming one after another the various phrases of opposition by the invincible logic of its facts and logical inferences therefrom, and later substituting for the cataclysmic theories entertained at first, the conception by Lyell of slow and measured agencies, as observed today; which was in its turn modified by the recognition of "critical periods" occurring from time to time, when changes were rapid and intense.

Feeling in good health and spirits, despite his 77 years, and yearning once more for the High Sierra, he joined a camping tour undertaken by his son Joseph into the Kings River Cañon. He was in camp for six weeks, part of the time at an altitude of 11,000 feet and once at 12,000, he being in perfect health all the time and greatly enjoying himself. An account of this trip was published by him in the October number of *Sunset,* 1900.

Having again been given leave of absence for one year by the regents, in order that he might attend the congresses of the natural sciences which were to meet at Paris at the close of the century, he made preparations to go, but gave it up on account of the ill health of his daughter Caroline. In September, nevertheless, he went to New York with his wife to cross the Atlantic, but was himself taken ill with the grippe and had to relinquish the voyage. He then went South, to his elder daughter's home, soon recovered, and spent the winter among his children and grandchildren. He still hoped to go to Europe in the spring, but his wife yearned for home, and they returned to Berkeley in March. As his son was to marry in June, he finally relinquished the European trip.

After the wedding, which was also attended by his eldest daughter, Mrs. Davis, long a resident of South Carolina, he determined to revisit the Yosemite Valley in company with Mrs. Davis, who had never seen it. Mrs. Le Conte was anxious about the effect of the trip upon his reduced strength, but her objections were overcome by his enthusiasm and ardent wishes, and so he left home in June, 1901, for his eleventh visit to the wonderful valley, via Wawona and the Mariposa Grove. On July 3 he arrived at Camp Curry, the rendezvous of the Sierra Club, somewhat fatigued, but joyous and enthusiastic as ever.

Professor Frank Soulé, of the University of California, one of his companions on this trip, as he had been thirty-one years be-

fore, thus describes the events of these last days of Le Conte's life:

"He spent the next two days driving around the valley with his daughter and her friends, in walking to objects near at hand, or, during intervals of rest, in chatting with his numerous friends and the strangers who insisted on meeting him. He was geniality and hospitality personified, a Southern gentleman of the old school, and undoubtedly his physical strength was thus severely overtaxed during these two days. The history of his earlier trips, his hypothesis of the formation of the valley, and geological questions innumerable, were all gone over patiently for the edification of his ever-gathering listeners. But nature gave out at last. On the evening of July 5 the sad words were whispered around camp that 'dear Dr. Joe is very ill.' He was in great physical pain, caused by *angina pectoris*, but his daughter and their intimate friends did everything possible throughout the night to alleviate his sufferings. In the morning he seemed to be resting comfortably, so much so that his physician left his bedside to procure additional medicine from the hotel. At 10 a. m. Dr. Le Conte turned on his left side. His watchful daughter at once noticed a great change coming over his face, and said, 'Do not lie on your left side, father; you know it is not good for you.' He smiled and uttered his last words in life, 'It does not matter, daughter.' In five minutes he was dead.

"Only 24 hours previously he had visited with his party the picturesque Vernal Falls, and while there had good-humoredly consented to be photographed, affording the last picture of him ever taken."

Scores of friends quickly gathered, and university students and graduates prepared his casket, bound it upon the stage-coach, and covered it with laurels and pines. Thus Joseph Le Conte set out on his last return from the valley, escorted by his daughter and one friend.

The funeral, which took place on July 13, was a remarkable manifestation of the respect and affection in which he was held, not only by all connected with the University of California, but also by the people of the surrounding cities and of the State at large. Many came from long distances to pay this last tribute of respect to Joseph Le Conte; the regents, faculties, and

students of the university, where all exercises had been suspended for the day, and a long line of carriages formed an imposing procession, accompanying the body to Mountain View Cemetery, near Oakland, where it was interred alongside of his brother John. A few months later the grave was marked with a large granite boulder procured by the Sierra Club from the vicinity of the camp where he died, in the Yosemite Valley.

On August 21 following, at the opening of the academic year, memorial exercises were held in the presence of a large audience in the hall of the Harmon Gymnasium, addresses being delivered by members of the faculty, alumni, and students. Memorial ceremonies still continue to be observed annually, at the University, on February 26, Joseph Le Conte's birthday, at the foot of a venerable oak dedicated to the two brothers by the students.

Joseph Le Conte is survived by his wife, three daughters, and one son.

Digest of Joseph Le Conte's Major Writings.

1. SCIENTIFIC PUBLICATIONS.

A. Geological.

Le Conte's first geological paper after his arrival in California was evidently suggested by his observations in the Sierra Nevada and the Coast Range, in 1870 and the next succeeding years. His "Theory of the Formation of the Great Features of the Earth's Surface," published in the *American Journal of Science* in November, 1872, outlines essentially the views which he presented more elaborately in later papers on related subjects, notably in his "Reply to the Criticisms of T. S. Hunt" on the above paper (1873), and later in that on "Evidences of Horizontal Crushing in the Formation of the Coast Range of California" (1876). In the first of the above papers he formulates into a definite theory the ideas theretofore advanced by Herschell, Scrope, Lyell, Hunt, and Hall, viz., the solidity of the earth's interior and the aqueo-igneous fusion of the deeply buried sediments by the rise of the geo-isotherms. At this point Le Conte adds the important suggestion that such fusion created lines or belts of weakness, which, with the effect of secular

contraction of the earth, caused the formation of mountain chains within the zones of greatest thickness, and their complex folding by lateral pressure and upswelling. Hunt's reclamations of priority are discussed in the second paper, together with clear formulations of the essentials of his views, and their correlation with the occurrence of fissure eruptions and volcanoes in connection with such chains. He also calls attention to the impossibility of supposing the Appalachian plateau to have been formed as a convexity, that form being necessarily a subsequent result of an extended ("epeirogenic") upheaval. He sums up by the formulation of his theory of mountain formation as follows: Accumulation of lines of thick sediments where subsidence occurs; rise of geo-isotherms, causing aqueo-igneous softening, which determines lines of weakness and yielding; then crushing horizontally and swelling up vertically forms the mountain chain. But when once the yielding begins, mechanical energy is changed into heat, which may thus be increased to any extent and produce true igneous fusion. In the last-mentioned effect he, with J. D. Dana, accepts the views of Robert Mallet. In subsequent papers as well as in his book on the "Elements of Geology," he of course completes this theory by reference to the resultant fissure eruptions, followed by the establishment of volcanoes as the remnant of the energy of fissure eruptions, and the final erosion into the present forms of mountain chains; but he admits his inability to account for the local oscillations of level, which are so obvious in the past and are still in progress.

In his paper on the "Formation of the Coast Range of California" (1876) he illustrates, and fortifies by many observations and examples, his previous conclusions. He discusses specially his observations of the numerous rounded and elongated, flattened concretions of the cleavage surfaces of shales, evidently originally clay pellets, which have experienced the effects of lateral pressure and corresponding vertical upswelling. He shows that every 2½ to 3 feet of original horizontal strata were here compressed into one foot, with corresponding vertical upswelling. Slaty cleavage was here not produced at right angles to the pressure, owing to the coarseness of materials; but in the foothill slates of the Sierra Nevada the slaty cleavage is nearly throughout parallel to the stratification.

He also refers to the criticism made by Dana, that he (Le Conte) underestimates the amount of elevation caused by plications, and claims that on the supposition of a solid earth, the elevation by compression will be the same with as without folding, and that if fissure eruptions occur, the same will be true.

Le Conte's paper "On the Great Lava-Flood of the Northwest, and the Structure and Age of the Cascade Mountains," written in 1874, after his second exploration of that region, adds important illustration and corroboration to some of the points previously made by him. In his two explorations he conclusively established the enormous extent and thickness of the Northwestern eruptive sheet, and the beginning of its extrusion toward or at the end of the Miocene. He concludes that while a low range may have been formed synchronously with the Sierra Nevada, in Triasso-jurassic times, it was subsequently overflowed and submerged by the great lava-flow, causing the striking contrast between the jagged summit-lines of the Sierra and the almost level, plateau-like crest of the Cascades, varied only by the volcanic cones superimposed upon it. As to the mode of formation of the great eruptive sheet, he accentuates the fact that inasmuch as mountain ranges are admittedly formed as the result of lateral crushing and vertical upswelling, it is natural that when the stress occurs after a protracted solidification of the crust, fissures must be formed and the sub-mountain liquid or viscous matter, probably formed by local crushing, must be squeezed out. He also calls attention to the difference in the physical condition of the great eruptive sheet and the vesicular lavas erupted by the succeeding volcanoes, in which steam and other gases act as a *vis a tergo*. He agrees with Dana as to the inverse ratio between folded mountain chains and fissure eruptions.

These papers of Le Conte and those published by Dana in volumes 4 and 5 of the *Journal of Science* form a remarkable body of important discussions of mountain-making. While differing in some details and in mode of statement, the essential points of the two sets of papers are in agreement, and both turn to the contraction of the globe as the necessary moving force for the lateral crushing which is in evidence everywhere.

In a later paper (1878) Le Conte replies elaborately to criticisms made by Dutton, combating the contraction of the earth by cooling as an agency in mountain-making. Later papers on the same subject appeared in the *Philosophical Magazine* (1888), in the *American Geologist* (1889), and in the presidential address delivered by him before the American Association for the Advancement of Science, 1893. The views there given are those embodied in the last edition of his "Elements of Geology," revised by himself in 1902, and do not materially differ from those quoted above.

Le Conte considers as one of his most important geological papers that on "Critical Periods in the History of the Earth and their Relation to Evolution; and on the Quaternary as Such a Period," published in 1877. It is the most comprehensive and probably the most widely interesting of his single papers, comprehending as it does the geological, geo-physical, paleontological, and evolutionary points of view, including the preëminent significence of the advent of man upon earth. It is at this time the more interesting as, by an unconscious reaction toward Agassiz' contentions, he is lead to anticipate the modern theory of "Mutation" in connection with evolution, designating the process as "the fact of paroxysmal movement of organic evolution." An organism, he says, may be regarded as being under the influence of two opposing forces, the one—heredity, rigidity of type—conservative; the other, the pressure of changing environment and conditions, aided possibly by an inherent tendency toward change. The latter may for some time accumulate but make little impression, but finally, the resistance giving way, the organic form breaks up into a number of fantastic sports, which are at once seized upon by natural selection. If for the word "sports" we substitute "mutations," we have the essentials of De Vries' views and observations, in which natural selection also soon eliminates a number of non-viable mutations.

The critical periods he discusses are those characterized by unconformities in the geological series, which he considers as marking changes in the rate of evolution, "periods when the forces of change are active, instead of potential" as in times when conformable rocks are being made. The critical periods

are periods of lost records, because they were continental; and the farther back we go in geological and human history, the longer are the gaps and the more irrecoverable the records. The first and the greatest observable break is that between the Archean and the Paleozoic. The former ends with merely protozoan life, hardly yet differentiated into fauna and flora. The primordial record opens with a varied and already highly organized fauna, including an enormous evolutionary interval. The next general unconformity occurs between the Paleozoic and Mesozoic, "the most sweeping change in the forms of organisms that has ever occurred in the history of the earth, even though partly bridged by the Permian."

Far less in time and in sweeping character is the lost interval between the Mesozoic and the Cenozoic, the Cretaceous and the Tertiary. Here conformity is not uncommon, but the break in the continuity of the fauna is very great all over the world; the relatively short interval and the great change from the crest of saurian development ending the Cretaceous, and the great mammalian evolution in the Tertiary, is so great that it can only be explained by migration from where marsupial forms had existed even from Jurassic times. The disappearance of the Cretaceous ocean and its replacement by great lakes in the Basin region was doubtless a powerful agency in bringing about these changes in America.

The early Quaternary was also to a marked degree a continental period, one of great and widespread oscillations, upheaval, downsinking and reëlevation, with unconformities on a grand scale. He discusses this interval specially in a paper published in 1899, "On the Ozarkian and its Significance in Theoretical Geology," emphasizing particularly the important unconformities and protracted and incisive erosional activity marking the interval of time between the latest Tertiary and the earliest Quaternary; when during extended continental elevations there were formed the deep and abrupt cañons of the Ozark range, the sculpturing of the coastal plain of the Gulf States, prior as well as subsequent to the Lafayette epoch; the formation of the now submerged river channels of the Atlantic coast, and, greatest of all, the excavation of the present river channels of the Sierra Nevada and of the inner cañon of the Colorado. Le Conte esti-

mates that this erosional interval must have been quite as long, and probably longer, than the Glacial Epoch itself. There were thus great changes in physical geography, permitting intercontinental migration of mammals and forcing the retreat of organic forms adapted to temperate and warm climates southward, both on land and sea; with a subsequent return of arctic forms northward and upon mountains, where they were left stranded in isolation. The disappearance of the great Pliocene mediterranean lake separating eastern from western America likewise brought about or permitted important changes. Yet great as these changes were, they are incomparably less than those of previous critical periods, in which not species but genera, families, and even orders appeared and disappeared. The conclusion is that the previous critical periods or lost intervals were far longer than the whole Quaternary, or that the rate of evolution was far more rapid in those earlier times.

In view of all the facts, Le Conte claims that the Quaternary, as a critical period, should be considered as separating the Cenozoic from the Present, or Psychozoic, or Age of Man. "Not that man was not in existence in the early Quaternary, just as fishes existed before the Age of Fishes. It is the *culmination* of a fauna or flora, not their first beginnings, that should be considered as characterizing an 'age.'"

Next in importance to the above papers of wide scope and interest stands that on "The Old River Beds of California," which was written by him as the result of an exploration of the Yuba River and its hydraulic mines (1880). It suggested to him the important idea of a rejuvenation of the Sierra Nevada at the end of the Tertiary—a topic which is more fully elaborated in his "Elements of Geology," pages 591 to 593.

His paper "On Some of the Ancient Glaciers of the Sierra Nevada" was based upon his observations, first made in 1874, near Lake Tahoe, which he subsequently supplemented elsewhere in the Sierra Nevada; convincing himself, among other things, of the former occupancy of the Yosemite Valley by a glacier, which Whitney had at first believed, but afterwards rejected. Le Conte bases his conclusions upon the general forms of the rocky sides of the valley and the characteristic lake-meadows marking the retreat of the glacier, even though moraines and

scorings are not much in evidence. The rapid weathering of the Yosemite granites would inevitably obliterate the latter in a relatively short time. Investigations made since in other parts of the Sierra have clearly proven the former presence of numerous glaciers of vast extent in the principal valleys of the Sierra, and Le Conte, as well as the writer, thinks that there is good evidence that even the Coast Range was at one time glaciated.

In 1881 he, in company with Professor Rising, of the University of California, made a special examination of the "Sulphur Banks" quicksilver mines, where he saw cinnabar vein-formation in actual progress. These observations were discussed in a paper published in 1882 in the American Journal of Science. In that year he also made another trip to the Yosemite Valley, and while there heard of the discovery of the "Carson Footprints," which he examined, together with the Steamboat Springs of Nevada. He determined the footprints to be those of animals of late Tertiary age. The results of these investigations were published in 1883.

B. Biological Writings.

Le Conte's book on "Sight," first published in 1881 and again in 1897, as volume 31 of the International Scientific Series, by the Appletons, is perhaps the most striking illustration of the accuracy of his habit of observation, and the best refutation of the criticism made of his geological work by sticklers for specialization, viz., that he failed to show himself a good field geologist. Undoubtedly his bent of mind lay rather in the direction of generalizations from facts, whether observed by himself or others; but when he needed additional facts for his purposes, no one was more apt and ingenious in devising and carrying out the needful experiments and observations. The power and faculty of generalization is infinitely more rare and fruitful than that of narrow specialization, but it nowise impairs, necessarily, that of accurate observation. It is when superficial knowledge attempts generalization that discredit does and should attach to it.

As regards vision, he was specially qualified by the possession of excellent, strong, and normal eyes, which lasted unimpaired to the last; enabling him, with the aid of persistent practice, to execute with little difficulty experiments that had failed with

others, and the failure of which had been made the basis of incorrect interpretations of the phenomena of binocular vision especially. Thus, at his first view of the stereoscope devised by Wheatstone he at once perceived the incorrectness of Wheatstone's subjective interpretation of the stereoscopic effect, being enabled to see the real and the phantom images simultaneously by simple change in the adjustment of the eyes. His book contains a wealth of experiments easily executed by persons with normal eyes, and most convincing in their results, yet difficult or impossible to some persons, especially to those not accustomed to close objective perception and analysis thereof.

Accepting the correctness of the experimental results as given by Le Conte—and, so far as the writer is aware, they have not been successfully controverted in any material points—the clearness, simplicity, and cogency with which he presents even the most intricate phenomena and principles of vision are remarkable. Unlike many other treatises on subjects admitting of a strictly mathematical presentation, such as is given in most treatises on optics, Le Conte abstains as much as possible from the introduction of mathematical formulæ, which are after all only the graphic expression of truths or principles that can be formulated in words; even though the exact quantitative relations require the mathematical form for their expression. Le Conte himself considers his work on vision as among the best and most important he has done.

Any detailed discussion of the points wherein Le Conte has modified or changed or added to the definitions and explanations of previous writers would be out of place here, but among the most prominent may be mentioned his explanation of stereoscopic vision in connection with the true theory of binocular perspective; of the true nature of the horopter; the demonstration of certain fundamental physical phenomena in binocular vision, and the devising of a new mode of diagrammatic representation based thereupon. Also the explanation, for the first time, of certain peculiarities of phantom planes.

In the book "Outlines of the Comparative Physiology and Morphology of Animals," Le Conte's point of view of broad culture as the proper precursor to specialization and minute analysis is prominently exemplified. The book, which embodies

much of his other biological work, represents what might be called his as well as his students' favorite course, the one which more than any other attracted his audience and which, so far from discouraging concurrent or subsequent detailed work on their part, served conspicuously to attract students to special higher courses by the lively interest created in their minds—interest such as setting them down at once to a dissecting-table or museum case would never have brought about or sustained. The bearing of their subjects of study upon familiar living, moving objects and their correlations is ever that which interests pupils most, from childhood to maturity, and such interest is the best basis for earnest effort and success. The book serves admirably to avoid "the serious danger that . . . in microscopic clearness but narrowness of our knowledge we lose that general view of the whole, which alone gives significance to *any* knowledge."

The method of treatment also is peculiarly well adapted to the sustaining of interest throughout. Instead of the iron-clad academic consistency which has led some of our text-book writers in botany, for instance, to begin with the nearly invisible microscopic domain of unicellular organisms, because of the simplicity of structure, Le Conte throughout begins with the best-known though most complex form—man—and then uses the simplifications found in descending to the lower organisms to elucidate the complex structures and functions in the higher animals, for each organ or functional complex. This method may not conform to the latest doctrines in the matter of instruction, but it was notably and conspicuously successful in accomplishing the essential prime objects of all instruction. The interest was increased by the final summary of evolutional development in the subject of each chapter or functional subdivision. Just as the evolutional idea when broached by Darwin brought about a quick revival of interest where previously there had been fatigue from the multitude of dead, dissociated facts accumulated by investigators in the biological sciences, so the same idea is most fruitful in creating and fostering the interest of pupils under instruction in universities or even high schools.

As is natural, the subjects of sight and of the glycogenic functions of the liver, on which Le Conte had made special investi-

gations, are given great prominence, and the presentation of the subject first named is perhaps the most lucid and cogent that can be given within the space allowed by the plan of the book. The discussion of the kidneys and liver and their functions, in the chapter on "Katabolism," are among the most interesting in their suggestiveness. There is manifest throughout an evident relish of the subject, traceable to his "first love" in studying under Agassiz.

C. Philosophical Writings.

As may be seen from the list of his writings given at the end of this memoir, Le Conte dwelt and wrote frequently, almost throughout his life, upon philosophical subjects. These writings he fortunately gathered into permanent forms in later years, so that his views may be considered as quite fully represented in them. It would be of interest to follow through those papers the gradual development and change of his ideas in this direction; but to do so lies beyond the scope of this memoir. In his two books, "Religion and Science," 1873 (reprinted in 1902), and "Evolution and its Relation to Religious Thought," 1888 (second edition, revised, 1892), Le Conte summarizes his discussions and views on these subjects, in which he felt the deepest interest. Hence an analysis of these books perhaps gives a better insight into his mental attitude than any other part of his works.

In these discussions he has, probably more than any other man, contributed toward the formation of a sane public sentiment, and to the removal of unfounded prejudices against the doctrine of evolution from the minds of well-meaning persons. His fundamental thesis and deep conviction was that, under a correct interpretation of both, there cannot be any contradiction between the Book of Nature and the Book of Revelation. His consistent vindication of the claims of our spiritual nature as against the materialistic doctrines secured for him, himself a scientist of distinction, a respectful hearing where mere scholastic discussion or dogmatic assertion, indulged in about equally on both sides, produced little or no impression, thus leaving the conflicting opinions unchanged.

Of the two books mentioned, the last-named, in which the fruitful idea of evolution is the keynote, is doubtless the one

which, coming just at the right time, had the widest influence, evolution being then the topic foremost in the public mind, and the contested sign of the times. The former book, however, had rendered important service in preparing the ground for the subsequent discussion, the importance of which is evidenced by the publication of many magazine articles and several books by distinguished scholars, both in America and abroad.

The attitude taken by Le Conte in his book on "Religion and Science" may be thus summarized from his own diction:

The whole universe of space and time, the whole external world, is so much of the Divine thought as has been realized by the Divine will. The scientific study of nature not only cannot destroy, but does not even diminish, the mystery of existence; it only increases our sense of the awfulness and grandeur of its mystery.

Claiming the constant immanence of God in nature, and that nature itself is a divine revelation, and reveals also very clearly the close connection of the spirit of man with the animating principle of brutes, through this with the vital principle of plants, and through this, again, with the physical and chemical forces of nature, he claims that the general forces of nature are an effluence from the Divine Person; that this diffused Divine energy throughout all time individuated itself more and more, until finally it assumed complete individuality, or separate entity or personality, in man; that throughout all geological time spirit remained, as it were, in embryo, gradually developing within the womb of Nature until it came to birth in man, and became capable of independent life. This idea of complete spiritual individuality includes every other characteristic of man—self-consciousness, free will or free agency, moral nature, moral responsibility, immortality, which he considers convertible terms. Probation, he says, is the necessary result of man's free agency. External nature is a revelation of the Deity, but it is not so clear as to compel faith in all men; it is, however, so related to his nature that it becomes a touchstone of his moral character. It depends entirely upon the temper in which man approaches the study of nature, what his free will chooses to find there, whether he sees in it a living God or only a dead mechanism. The universality and invariability of law in every realm of nature, extending even

to the inner realm of consciousness, does not annihilate the free will of man; it only limits it to its legitimate domain.

The word "evolution" occurs repeatedly in this book, but without any special emphasis. As stated by himself, Le Conte was at that time and for a number of years afterward, only a "reluctant evolutionist," the result of his training under Louis Agassiz.

In "Evolution and its Relation to Religious Thought"* Le Conte enlarges upon the detail, illustrations, and proofs of the views given in the former book, but without materially changing his fundamental concepts. The first of the three parts of the book discusses evolution in general, followed by a chapter showing the fundamental rôle of Louis Agassiz in laying the basis of the doctrine, although refusing to follow it out to its necessary consequences. Part second deals with the evidences of the truth of evolution, with a wealth of illustrative examples, presenting again the three series mentioned in earlier papers, viz., the natural-history series, the embryonic or ontogenic series, and the geological or paleontological series, each in their most forcibly convincing features; laying great stress upon the light shed on the entire subject by geographical distribution. These presentations of facts are preliminary to the third part of the book, which treats more directly of the "Relation of Evolution to Religious Thought."

Recognizing that the actual effect on human life is, or ought to be, an important element in our estimate of the truth of any doctrine, Le Conte states as postulates three processes—the cognition of external phenomena through the senses; the elaboration of these facts by the intellect, constituting knowledge; and the outgoing of this knowledge into the world as right or wise conduct. All three are equally important and necessary. Scientific workers are apt to consider only the first and second as necessary; metaphysicians only the second and third. From these omissions arises largely the so-called conflict between religion and science. In disregard of the first postulate, the cry of "wolf" has been raised at the enunciation of each one of the fundamental laws of nature now universally recognized. It has been so likewise with the law of evolution, and the alarm has

* The writing of this book was originally suggested to Le Conte by Henry Ward Beecher.

been proved as groundless as in the other cases. Evolution according to law has no bearing upon materialism, any more than has the law of gravitation; it simply defines the *manner* in which contrary to preconceived notions, the development of nature has actually occurred. The bar to the speedy settlement of this conflict is pride of opinion, self-conceit, dogmatism. The last is not merely on the theological side; modern materialism has outdone the theologian in this respect; but the theologian will of necessity have to change his base so as no longer to pin essential religious truth to unessential, merely dogmatic traditions.

According to Le Conte's view, the phenomena of nature are naught else than objectified modes of divine thought; the forces of nature naught else than different forms of one omnipresent divine energy or will; the laws of nature naught else than the regular modes of operation of the divine will, invariable because God is unchangeable. Science is the systematic knowledge of these divine thoughts and ways—a system of natural theology. According to this view, there is no real efficient force but spirit, and no real independent existence but God.

"It may indeed be that we cannot live and work in the constantly realized presence of the Infinite; that in our practical life and scientific work we shall continue to think of natural forces as efficient agents; but this attitude of mind, like our work-clothes, must be put aside when we return home to our inner, higher life, religious and philosophical."

Le Conte proceeds to enforce and illustrate this view quite elaborately, coming back to and vindicating the somewhat discredited term "vital force," or principle, as fully justified by its representing a distinct form of force.

"Nature, through the whole geological history of the earth, was gestative mother of the spirit, which, after its long embryonic development, came to birth and independent life and immortality in man. . . . Without spirit-immortality this beautiful cosmos, which has been developing into increasing beauty for so many millions of years, when its evolution is completed, would be precisely as if it never had been, an idiot tale signifying nothing. . . . If man's spirit were made out-of-hand, why all this elaborate preparation by evolution of the organic kingdom?"

Answering the objection that the views advanced imply panthe-

ism, Le Conte says that this can only happen through the one-sided pursuit of purely scientific or material lines of reasoning, as against the spiritual. No one can form a clear conception as to how immanence of the Deity in nature is consistent with a divine personality; yet we must accept both, because we are irresistibly led to each of these by different lines of thought. We must accept immanence without pantheism, and personality without anthropomorphism. Our own self-conscious personality behind brain phenomena compels us to accept consciousness, will, thought, personality behind nature. By a necessary law of thought this concept gradually expands without limit, until it reaches the thought of an Infinite Person. Just as in the case of time and space, we are compelled to recognize, without understanding, their illimitableness.

In discussing the two views of man's relation to nature—the one, that he alone, having an immortal spirit, is immeasurably removed from the animal world; the other, that he is merely the highest member of the order of primates, which includes the apes—Le Conte admits the measurable justification of both, the first from the psychical, the second from the structural point of view; the two views are not irreconcilable. Observing physical and chemical brain-changes, no matter how closely associated with mental or even localized activities, we are still as remote as ever from knowing *how* such changes bring about consciousness, thought, emotion. There is doubtless a relation between physical and psychic phenomena, but *not* in the same sense in which we use these terms in physical science. And we cannot bridge the gap between the animal and man without in the end logically attributing an immortal spirit to plants also and incurring a *reductio ad absurdum*. Le Conte believes that the spirit of man was developed out of the *anima* or conscious principle of animals, and this again out of the lower forms of life-force, and this in its turn out of the physical and chemical forces of nature; and that at a certain stage in this development, viz., with man, it acquired the property of immortality, precisely as now, in the individual history of each man, it progressively acquires the capacity of abstract thought. This rise to a higher plane he manifestly considers as occurring somewhat like the "mutations" now well known and accredited, and also quite unexplained.

"With every new birth of the universal energy into a higher plane, there appear new, unexpected, and to previous experience wholly unimaginable properties and powers. Why may not immortality be one of these?"

It is evident that the idea of a causal nexus between successive phenomena is a primary conception, and therefore ineradicable and certain. In childhood and in the uncultured races, external forces take the form of a personal will residing in each object (fetichism). The next form is that of several personal wills controlling each the phenomena of a different department of nature (polytheism). Finally, in the highest stage of culture, it takes the form of one personal will controlling the phenomena of the whole cosmos (monotheism), anthropomorphic to the unscientific mind. "But anthropomorphism has been driven from one department to the other by science and evolution, and to those folowing this line of thought alone, the phenomena of nature are relegated to forces inherent in matter, and the material forces are made to invade even the realm of consciousness and reduce this also to material laws. But a rational philosophy admits these two antithetic views and strives to reconcile and combine them. This reconciliation, so far as it is possible for us, is found *in a personal will immanent in nature and determining directly all its phenomena.*"

The idea of the *causal* nexus also determines that of *design;* adaptation of means to ends is in our experience the result of thought, and we cannot conceive it to result otherwise. It is impossible to conceive of adaptive structure without assuming intelligence as the cause. The effect of science cannot be to destroy this primary conception, which is ineradicable, but can only exalt and purify our conceptions of the Designer.

Le Conte finally considers the relation of evolution to the problem of evil. External, physical evil prevails throughout the animal kingdom, as evidenced in the struggle for existence. It is there a condition of effective evolution, and might be considered a good in disguise. But organic evolution, completed in man, was transferred to a higher plane, and continues as social evolution. Unconscious material evolution according to necessary law is transformed into psychical evolution, a conscious voluntary progress toward a recognized goal and according to a

freer law. But the fundamental conditions of evolution have not changed; man is surrounded on every side with what at first seems to him an evil natural environment, against which he must ever struggle, or perish. What is the only conceivable remedy? It is knowledge of the laws of nature, and thereby acquisition of power over nature. But increasing knowledge and power mean progressive elevation in the scale of psychical being also. The evil of physical disease can also be controlled by knowledge, the achievement of which also serves to elevate the plane of the mind. Thus, altogether, may we not generalize and say that physical evil is good in its general effect?

As to moral evil, the case is not so clear. Yet the course of human development, whether individual or racial, is from *innocence*, a pre-established harmony of spiritual activities, to *virtue*, self-established, through more or less discord and conflict. Here again, knowledge of the laws of God and obedience thereto is the remedy—the will to know and the effort to obey them. We cannot conceive of a moral being without freedom to choose; we cannot conceive of virtue without a successful conflict with solicitations to debasement. It is because these solicitations are so strong, and often overcome us, that we regard these themselves as essential evil, instead of our weak surrender to them. All evil consists in the dominance of the lower over the higher. True virtue consists, not in the extirpation of the lower, which means asceticism, but in its subjection to the higher, for the higher is nourished by its connection with the more robust lower; and the lower is purified, refined, and glorified by its connection with the diviner higher, and by this mutual connection the whole plane of being is elevated. It is only by action and reaction of all parts of our complex nature that true virtue is attained.

Le Conte's early view of the older methods of metaphysics, formed as the result of reading many philosophical books, may be thus formulated: "Metaphysics ever strives after ultimate truth, which is unattainable, and of course fails . . . deludes us with promises of absolute knowledge, food for the gods; cheats us with gilded apples full of ashes. It is indeed only mental activity, and will continue to be so until scientific methods are adopted by metaphysicians."

It will be seen, however, that later he abated somewhat the

rigor of his disapproval and actively participated in the discussions of noted metaphysicians. These discussions were largely oral, and occurred in the meetings of the Philosophical Union at the University of California; a limited number of them passed into print in permanent form. Among these the most interesting is the book containing the discussion between Royce, Howison, Le Conte, and Mezes on "The Conception of God." Le Conte's latest (printed, but not published) discussion is a paper entitled "Evolutional Idealism," giving his view of the relations between God, nature, and man, and his conception of the ether as the substratum upon which the human spirit is developed, and from which, after death, may be derived the spiritual body, which he postulates as the condition of *personal* immortality and without which a perceptionless spirit—mere disembodied thought without personality—would seem to be offered us. There appear from this to be three kinds of "substance"—gross matter, ethereal matter or ether, and energy, *i. e.*, spirit. The ether is indissolubly associated with all forms of energy, such as light, electricity, heat, chemism. Life is a form of energy, so the ether is also the life-bearer. Now spirit is just essential energy itself, and therefore the ether must be associated with spirit; so it is also the spirit-bearer. Life and spirit differ from all lower forms of energy in being individuated, *i. e.*, endowed with self-activity. All three substances are progressively individuated in evolution: Energy completely individuated is created spirit; the ether, the energy-bearer, individuated, would be the ethereal (or spiritual) body; gross matter, as external vestment or habitation, is individuated into the live material body. The latter completes its organization in animals; but the ethereal body completes its organization only in man, *pari passu* with the individuation of spirit.

The material body is the matrix for the organization of the ethereal one; the brain seems to be the womb in which the ether becomes organized into the ethereal body. This organization, however, remains incomplete until, in man, the coöperation of self consciousness and free will begins.

"All this," he adds, "may seem but a sort of refined materialism. Not so. On the contrary, it is consistent with the most thoroughgoing idealism, for both gross matter and the ether are

but manifestations of the Divine Spirit in the self-conditioning forms of his consciousness called time and space—are but different grades of a downward effluence from the Divine Person; an effluence which again rises, by progressive organization in connection with the corresponding individuation of a finite portion of Divine Energy, to the plane of the spirit from which it came. The whole universe of created being is thus an evolutional series, every term of which is a form of the energy of SPIRIT."

Howison* comments thus, in part, upon the "Evolutional Idealism" of Le Conte, as set forth in the preceding abstracts:

"I confess that by the lucid force of Dr. Le Conte's reasonings and the great beauty of his conclusions I am constantly tempted to yield him my entire assent. It is only by the low murmurs of half-suppressed conviction that I am roused from this state of fascination to take up again the task of rigid thought. But . . . I will say that the stability of his system depends, I think, upon two things: First, whether it supplies sufficient proof that the Immanent Energy which is the cause of evolution is indeed a Cosmic Consciousness; second, whether, if real, having—as it must have—the attribute of immanence in nature, it is compatible with the freedom and the personal immortality at which the system aims." In discussing these two points, Howison further says: "As regards the first of these questions, I feel bound to say that the proof offered for the Cosmic Consciousness seems to me insufficient," going on to state his reasons for this opinion. On the second question, he says: "I cannot see how a Cosmic Consciousness, with its intrinsic immanence in nature, can be reconciled with true freedom at all; and its consistency with an immortality truly personal is to me beset with obscure alternatives, between which either the certainty or else the value of the life to come vanishes away."

Both these positions are extendedly argued by Howison in the sequel, and still farther in the volume of essays separately published by him under the general title "The Limits of Evolution." In the first of these he dwells with special emphasis upon the "unbridgeable gaps" which, he claims, exist between inorganic and organic nature and between the natural and spiritual

*The Conception of God, p. 115.

worlds, interrupting the continuity of evolution; and he undertakes to show that there is a farther break between physiological and logical genesis.

Royce says: "I must frankly confess that . . . I have never been able to give to this doctrine (of evolution), justly central as it is in the world of recent empirical science, the far-reaching, the philosophical, the universal significance which Le Conte still attributes to this aspect of reality. Evolution is, to me, not a process in the light of which we can learn much either concerning the Absolute, or concerning the relation of the eternal to the temporal world."

It is, of course, beyond the province of this memoir to attempt the settlement of such an issue as this between Le Conte and these critics, whom he himself considered well qualified for their task. Le Conte at all events was in no wise disconcerted by their contentions. In the introduction to "The Conception of God" he authorized the editor to say, in his behalf, that he "came out of the whole discussion, with its objections to his own system on all hands, without feeling that he must retract or materially alter the propositions which give it a distinguishing character." The writer of this memoir may add that in conversation with him, Le Conte repeatedly said that in the farther coöperative progress of science and philosophy, the alleged gaps would be sure to disappear.

LE CONTE'S OWN ESTIMATE OF HIS LIFE-WORK.

In concluding his autobiography, Le Conte gives the following summary estimate of his life-work:

"And now, looking back on a long life of incessant activity, what have I done of value to the world? what have I added to human thought? what influences for good may I hope to leave behind me?

"I. In science, touching only the most important points:

"(*a*) My paper in 1859 on 'The Correlation of Physical, Chemical and Vital Force' gave, I think, both impulse and greater definiteness to scientific thought on that subject. Carpenter in the last edition of his Physiology gives me credit for a distinct advance in this subject.

"(*b*) My researches on the phenomena of binocular vision I

am sure did clear up thought in this field. I claim, and have generally been accorded, the credit of several original thoughts, which have remained a permanent possession of science: (1) The demonstration of the real nature of the Horopter; (2) the demonstration of the true nature of the theory of binocular perspective; (3) the demonstration of certain fundamental physical phenomena in binocular vision, and the devising of a new mode of diagrammatic representation based thereon. These phenomena had been observed by some, but not understood; their explanation had been hinted at by others, but not clearly brought out: (4) the explanation, for the first time, of certain peculiarities of phantom planes.

"(*c*) In geology, I believe some real, substantial advance was made in my series of papers (1) on the structure and origin of mountain ranges; (2) on the genesis of metalliferous veins; (3) especially in that on critical periods in the history of the earth; (4) on the demonstration of the Ozarkian or, better, the Sierran epoch as one of great importance in the history of the earth. I might mention several others that are of prime importance, but I am willing to stand by these.*

"(*d*) In biology, my views on glycogeny, although not yet certain, have undoubtedly contributed to clearness of scientific thought on that important subject.

"II. In philosophy:

"I look back with especial pleasure on my writings on evolution. I lay no claim to the discovery of new facts bearing on the theory of evolution, but only to have cleared up its nature and scope, and especially to have shown its true relations to religious thought. It is well to stop a moment to show the rôles of different thinkers in the advance of this subject. Leaving out of consideration mere vague philosophic speculations, like those of the ancient philosophers, and of Swedenborg in more modern times, I would say that the rôle of Lamarck was to introduce evolution as a scientific theory; that of Darwin, to present the theory in

*Le Conte's omission to mention in the above list his important exploration and delimitation of the "Great Lava Flood of the Northwest" and the "Structure and Age of the Cascade Mountains" is characteristic of his slight regard for mere detail work as against the philosophical discussions and conclusions based thereon.

such wise as to make it acceptable to and accepted by the scientific mind; that of Huxley, to fight the battles of evolution and to win its acceptance by the intelligent popular mind; that of Spencer, to generalize it into a universal law of nature, thus making it a philosophy as well as a scientific theory. Finally it was left to American thinkers to show that a materialistic implication is unwarranted; that evolution is entirely consistent with a rational theism and with other fundamental religious beliefs. My own work has been chiefly in this direction. In my lectures in 1872 on 'Religion and Science' I might be called a reluctant evolutionist; yet even then, in the sixteenth chapter of the book, I tried to show the mode of origin of the spirit of man from the psyche of animals by a process of evolution. In a few years, however, I was an evolutionist, thorough and enthusiastic. Enthusiastic not only because it is true, and all truth is the image of God in the human reason, but also because of all laws of nature it is by far the most religious—that is, in accord with religious philosophic thought. It is, indeed, great tidings of joy which shall be to all peoples. Woe is me if I preach not the gospel! Literally, it can be shown that all the apparently irreligious and materialistic implications of science are reversed by this last child of science, or rather this daughter of the marriage of science and philosophy. During all my life I have striven earnestly to show this; my book on 'Evolution and Its Relation to Religious Thought' is the embodiment of the result of these strivings, although I believe that if I wrote it again I could add much to the argument. I began this line of thought in 1871, and believe, and therefore claim, that I was the pioneer in the reaction against the materialistic and irreligious implication of the doctrine of evolution. I look with greater pleasure on this than on anything else that I have done. At first I suffered some, but not much, obloquy on the part of the extreme orthodox people; but I have lived to see this pass away, and all intelligent clergymen coming to my position.

"All, or nearly all, of my philosophic writings are more or less connected with the doctrine of evolution, and I regard these as among the most important of my writings. Indeed, one of my friends thinks that the best and most permanent that I have done is in the domain of philosophy rather than in that of sci-

ence proper. But he is a philosopher; perhaps my scientific friends think differently."

It would be of interest to quote, as corollaries to Le Conte's estimate of his own work, given above, from some of the numerous obituary articles published in magazines and periodicals shortly after his death; but to do so would exceed the limits of this memoir. Among them may be specially mentioned those written by several of his colleagues: Professors T. R. Bacon,* S. B. Christy,† A. C. Lawson,* and J. C. Merriam;* Chas. M. Bakewell,* of Yale, and Josiah Royce,‡ of Harvard. That of the latter, formerly Le Conte's pupil, is one of the most interesting and is in part as follows:

"His wealth of knowledge, his instinct for order and lucidity of reflection, have indeed always remained my hopelessly distant ideal. I believe in the world's unity, and by indirect proof feel sure of it; but the world of facts will never seem to my unaided thought as perfect and as clearly visible a union of the one and many of harmonious principles and of multitudinous empirical illustrations as it seemed to me while I listened to his lectures."

All these articles alike bear witness to Le Conte's intellectual greatness and the lovableness of his character.

Space forbids further quotations from others. The writer's own estimate,* written under the first impression of the news of Le Conte's death, summarizes the views still held by him:

"The death of Dr. Joseph Le Conte removes one of the foremost thinkers and scientific men of the time; one whose writings and modes of thought have influenced the progress of science, and of scientific as well as popular opinion, throughout the civilized world. He was prominent in the now fast-thinning ranks of those who, like Louis Agassiz, J. D. Dana, and Asa Gray, in the New, and Lyell, Oersted, Darwin, and Wallace, in the Old World, thought and found it not only possible, but necessary, to be something more than specialists in one domain of science, in order to understand its full meanings and bearings upon other branches and its place in the world-plan. Le Conte never

*University of California Magazine, September, 1901.

†Trans. Am. Inst. of Mining Engineers, Mexican meeting, November, 1901.

‡International Monthly, September, 1901.

doubted the existence of such a plan, and he looked upon nature reverently as one part of its manifestations; but without undervaluing for a moment the other, the spiritual part, which is now so commonly cast aside as a mere 'property of matter in an advanced state of evolution;' while, on the other hand, there are still those who claim to evolve its nature from their inner consciousness, independently of observed phenomena. Le Conte's early education and experience as a physician laid the foundations of the broad knowledge which later made him equally at home in the purely physical sciences and in the biological field. While his geological writings are, perhaps, best known to the American public through the wide use made of his books on that subject, both in universities and in the secondary schools, his early and warm advocacy of the doctrine of evolution has probably served most to make him known and appreciated in the Old World, where he was warmly welcomed and honored in scientific assemblies, among the foremost men.

"It is sometimes said that those who undertake to generalize in science are apt to be unable to make accurate observations themselves. While this is true in some cases, it was certainly otherwise in that of Le Conte. His scientific writings and special papers show an eminent capacity for close observation; yet his glance was always upon the bearings of what he saw, upon general problems rather than upon the minor details of each field of view, which he was quite content to leave to others. At the same time, he had the true scientific spirit, in the absence of all dogmatism and the readiness at all times to consider candidly any observations or opinions at variance with his previous conclusions. He considered the cultivation of the spirit of truthfulness, candor, and readiness to revise one's opinions and conclusions as constituting one of the strongest claims of natural science as an educational factor, in contradistinction to the acceptance of mere opinions and precedents that is so common a result of exclusive literary and philosophical study. The personal gentleness for which he was so well known and beloved was deeply grounded in the absence of any claim to infallibility for himself.

"It is not easy to overestimate the influence he has exerted in rectifying the popular idea that the doctrine of evolution

necessarily tends to materialism, if not atheism—a misconception of its true import which is unfortunately still shared by the extremists both on the scientific and religious side.

"As shown above in the discussion of his philosophical views, Le Conte held that, so far from this, it inculcates the highest ideal of an intelligent world-plan; and he staunchly maintained not only its compatibility with Christian religious belief, but that, by elevating nature into the realm of teleologic thought and aspiration, it offers a much higher point of view than could be derived from any of the 'orthodox' views of the method of creation. This part of his influence will, perhaps, be most missed in the present state and tendency of scientific thought; particularly among the younger men of science, whose eagerness to specialize prematurely almost inevitably tends to prevent such catholicity of views and encyclopedic knowledge as characterized Dr. Le Conte.

"It was Le Conte through whom the University of California first became known to the outside world as a school and center of science on the western border of the continent; and for a number of years he almost alone kept it in view of the world of science. His presence and connection with the University was largely instrumental in attracting to it other men who otherwise would have hesitated to emigrate from their eastern homes to what was then the outskirts of civilization; and his ceaseless scientific activity acted as a strong stimulus both to his colleagues and to the students coming under his instruction, whose affection and esteem remained with him through life. He preferred this kind of activity to the more ambitious prospects that were many times open to him; he shrank from anything that would force him from the ideal world in which he lived into active contact with executive or administrative functions. His modesty and simplicity survived, unscathed, the applause and laudations bestowed upon him, and his strong will and cheerful disposition carried him up to a mature age in undiminished mental vigor, despite an apparently frail body.

"His death brings heavy loss to his university and to the world of thought at large, in which he occupied so high and exceptional a position."

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MEMOIR

OF

JOHN LE CONTE.

1818-1891.

BY

JOSEPH LE CONTE.

READ BEFORE THE NATIONAL ACADEMY, APRIL, 1894.

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 spec-

trum—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 con-

tagious 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

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Memo:- Prof John LeConte also compiled a Catalog of the Fauna and Flora of Georgia in May 1849. The lists of Birds and of Coleoptherous 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

From a copy in Cattell.

H. F. Gonier
Nashville, Tenn. 10-24-1933.