MEMOIR

OF

JONATHAN HOMER LANE.

1819-1880.

BY

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READ BEFORE THE NATIONAL ACADEMY, APRIL, 1892.

BIOGRAPHICAL MEMOIR OF JONATHAN HOMER LANE.

Our late fellow-member, Jonathan Homer Lane, who died in the city of Washington May 3, 1880, was the eldest son of Mark and grandson of Joshua Lane, of the town of Strahan, in northern New Hampshire. His paternal grandmother's name was Tilton; his mother was Henrietta (Tenny) Lane, youngest child of Lieutenant John, who was a soldier of the Revolution, and Patience (Young) Tenny, of Bradford, Massachusetts.

The subject of this memoir was born at Genesee, Livingston county, New York, August 9, 1819. From the record of the class of 1846, Yale College, we learn that he attended school till but eight years old, his father being a farmer by no means well to do, and then, in the intervals of work (excepting three winters), enjoying only the instruction of his father and mother at home, notwithstanding which we find him later on engaged for nearly a year in teaching district schools. Obtaining the means of subsistence by teaching, our associate was enabled not only to enter Phillips' academy at Exeter, New Hampshire, in 1839, to prepare himself for college, but afterwards to enter Yale at the beginning of the sophomore year.

Possessing the qualities which distinguished him in after life, Mr. Lane during his college career rendered such assistance to many of his fellow-students from time to time in their studies in mathematics and natural science that they were not loth in after years to acknowledge to him their gratitude and sense of obligation.

After having been employed for a year as teacher at the seminary at Castleboro', Vermont, he was in 1847 appointed to a position in the Coast Survey, but on July 1, 1848, and on recommendation of Joseph Henry, he was appointed as assistant examiner in the Patent Office. On May 1, 1851, he was promoted to be principal examiner. He was thus honorably associated with the re-organization and development of this important bureau.

After ten years' service in the Patent Office "Mr. Lane was induced to withdraw," a step that is more exactly stated by his friend and colleague, Wm. B. Taylor, as follows: "In less than six months

"after the occupancy of the Interior Department by Jacob Thomp-
"son, of Mississippi, Judge Mason resigned office rather than per-
"mit either removals or appointments to be made in his bureau on
"grounds of political service. Within the same month (on Sep-
"tember 20, 1857) Mr. Lane was removed from his post of exam-
"iner in the Patent Office."

As an examiner Mr. Lane was laborious and thorough, cautious and critical, conscientious in the extreme. Of course he could not be popular with the exterior world of inventors, but it may safely be said that no patent approved and endorsed by him has ever been successfully contested.

Throughout his official career as examiner and subsequently he continued to enjoy the appreciation, confidence, and friendship of Professor Henry, who always took great pleasure in his intercourse and in drawing out from the reserved and rather silent student his views on abstruse or doubtful physical questions.

Both were original members of a scientific and social club organized at Washington (in 1857?), and which continued its pleasant and instructive meetings for some dozen years, until in 1871 it developed into the Philosophical Society of Washington.

Many memoirs and problems presented to the Smithsonian Institution in the course of its extended correspondence (whether for publication or for solution), especially if involving mathematical principles or discussions, were referred by Professor Henry to Mr. Lane for his consideration and report, in the confidence that his judgment would never be found wanting.

After leaving the Patent Office, in 1857, Mr. Lane opened an office in Washington for the prosecution of business as an expert and counsellor in patent cases, and continued in this pursuit for several years. During this time he still devoted his leisure to researches in physical science, and also to the development of several ingenious contrivances having a practical bearing, though mainly designed as adjuncts to scientific inquiry. Among these he himself has mentioned "A machine for instantly finding, one after another, the real roots of the higher equations by electric currents in a set of small induction coils, a pretty illustration of the law of induction of a current upon itself and a unique method of using logarithms." He also devised and brought to practical operation an electric governor or a "Machine for very exact, uniform motion, controlled by electro-magnetic break-circuit." Another contrivance of his, prob-

ably referable to about this epoch, was a "Visual telegraph, capable of transmitting to any visible distance and of expressing itself far more rapidly than the pen in common writing."

As he had given considerable attention to the mathematical theory of electric currents, he attempted to work out experimentally "the law of the induction of electric currents as regards distance;" also to determine "the relation of the force of induction of electric currents to the force of resistance in a specimen of copper wire conducting a current." He undertook the construction and arrangement of apparatus for the more exact determination of the quantitative relation between static electricity and voltaic electricity, but it is believed that these experiments were never carried through to a satisfactory conclusion.

Mr. W. B. Taylor states that "in 1859, at the request of Professor "Henry and under his suggestion, our colleague was led to under-"take a series of experiments on various points of scientific interest "relating to the conditions and special action of the Atlantic tele-"graph cable. Only a brief notice of this investigation occurs in "the report of Professor Henry to the Board of Regents of the Smith-"sonian Institution for 1859, and we know of no further notes or "papers detailing the results arrived at."

But legal business in Washington ceased to be profitable and an opportunity offered in the new petroleum fields of Venango county, Pennsylvania, to further both science and fortune: thither he went in 1860 or 1861, intent on pursuing both these objects.

It is interesting to note that so early as before entering Yale College he had speculated on the means of attaining a lower temperature for scientific purposes than had as yet been effected. This project, frequently recurring, was taken up in a practical form about the year 1865, during his residence in Pennsylvania, where he endeavored to have constructed a machine for effecting the condensation and rarefaction of air in large quantities. One of the objects more particularly in view in this research was to obtain, by investigating the conditions of successive compressions and expansions of gases, a closer determination of the absolute zero of temperature than was already reached.

In the spring of 1866, having realized, as he thought, a handsome sum from the sale of oil lands, he returned to Washington to devote himself to science and unfolded his project and its methods to his old friend Professor Henry, who undertook to forward his designs

by having apparatus specially constructed for his use by funds of the Smithsonian bequest devoted to researches of such a character. A series of experiments was made with a turbine specially designed by Mr. Lane and operated, under General Meigs' permission and direction, by the water-power of the Washington aqueduct mains. This work was based upon correct principles and must be considered as in the main successful, but Mr. Lane was too careful in attending to every detail or effective condition to be a rapid worker, and his fastidious desire for extreme accuracy led him to postpone the publication of results until much of the valuable work which he actually accomplished has, as is feared, come to be but imperfectly preserved. The failure of his banking firm sadly diminished his available funds and eventually caused the work to stop.

"In addition to the various activities thus imperfectly noticed he "occupied himself with an extension or modification of his visual "telegraph or semaphore, the object of which was to obtain 'A "visual method by which time can be compared between stations "from fifty to a hundred miles apart to one-thousandth of a second "and the comparison carried on over a line of such stations.'" Apparently this method is appropriate for ascertaining differences of longitude in geodetic surveys.

Another project on which he expended some thought was "a mechanism to be used on shipboard for holding the Drummond light, with its lens or parabolic reflector, so that its concentrated beam of parallel rays shall rest motionless upon any desired point, and so that it can be manipulated with as much facility as on land."

He also perfected at a later date an "improvement in the artificial mercury horizon, whereby ripples and undulations of the surface were effectually suppressed." This was invented for the use of the Office of Weights and Measures, in whose employ he then was, and a full description was published in the annual report of the Coast Survey for 1871, appendix 16. An early account of this apparatus was communicated to the American Association for the Advancement of Science at its meeting in Troy in 1870.

During the first few years after his return to Washington, viz., from 1866 to 1869, Mr. Lane's time was fully occupied with private business, and especially with the experiments on the mechanical production of low temperatures. During this period was composed his admirable memoir on the "Theoretical Temperature of the Sun," read before this Academy in April, 1869. On November 10, 1869,

Mr. Lane accepted a position under the Superintendent of the Coast Survey as "Verifier of standards in the Office of Weights and Measures." This was a peculiarly congenial position, and he retained it until his death, in 1880, not only rendering valuable service in the matter of detail with which he was charged, but originating general improvements and displaying here, as in every trust he held, both originality of thought and the most discriminating judgment. The Superintendent of the U. S. Geodetic and Coast Survey (our late fellow-member Julius E. Hilgard) on the occasion of announcing his death before the Philosophical Society of Washington thus expressed his estimate of the mental grasp and perspicacity of Mr. Lane: "The quality of Mr. Lane's mind was truly remarkable, being chiefly "characterized by an extraordinary precision of thought and logic, "and it was unfortunate that he lacked fluency of speech. Of the "quietest, most retiring disposition, he was personally known to but "few; diffident in manner and not given to many words, yet when "he did speak his rare logic was such as to carry conviction. In "his writings his clearness of mind became manifest; so lucid was "it and so fully were those qualities and soundness of precision "appreciated that his colaborers never thought an induction safe "until it had passed through the alembic of his criticism.

"His exceedingly generous disposition led him to devote a con-"siderable portion of his income to the assistance of two sisters and "a brother; and in order that he might extend to these all the "aid in his power he never married." *

From the nature of his occupations, in the Patent Office and in the Office of Weights and Measures, Mr. Lane was obliged to give much of his time to matters of office routine and detail, but he still found time to make many valuable experiments with expensive apparatus, the cost of which he himself defrayed, and also to publish a number of valuable and interesting memoirs in the domain of physics and of precise measurement. Valuable unpublished memoirs were also left by him. The high order of his mind is well shown in two important papers read before this Academy "On the Physical Constitution of the Sun" and "On the Determination of the Volume of a Sphere." His determination of the "Coefficient of Expansion of the British Standard Yard" was published after his death by the Coast and Geodetic Survey.

* Bulletin of the Phil. Soc. of Washington, May 8, 1880, vol. iii, p. 123.

An unpublished paper "On the Means of Measuring the Tidal Change in the Direction of the Plumb-line and the Tidal Deflection of the Earth's Crust" was finished in 1874. This shows that he was an early student of problems that are now being actively discussed. It seems likely that even at this late date this and other memoirs of Mr. Lane may be worthy of publication.

Mr. Lane's memoir of April, 1869, on the "Physical Constitution of the Sun" was published in June, 1870, under the title "On the Theoretical Temperature of the Sun," and its importance has been fully recognized by Peirce, Newcomb, Ball, William Thomson, Young, and others. In 1882 it was referred to by Newcomb and in 1887 by Thomson as demonstrating a paradox—namely, that the more heat a body loses the hotter it will become; but it must be confessed that no such paradoxical statement appears in the text of Mr. Lane's published memoir, and it should, perhaps, rather be referred to Prof. Benjamin Peirce, who in 1879 communicated to the American Academy certain propositions in cosmical physics (Proc. Am. Acad., XV, p. 201), among which the following occurs: "Gaseous bodies in the process of radiating light and heat condense and become hotter throughout their mass." (See also Peirce, "Ideality in the Physical Sciences," Boston, 1881, pp. 160–198.)

Mr. Lane's memoir accepts Helmholtz's theory of the meteoric origin of solar heat and the subsequent maintenance of the solar temperature and radiation by a process of slow gravitational condensation upon itself. He applies this theory to a gaseous sun as distinguished from the solid or liquid sun conceived of by former investigators and deduces the distribution of temperature, density, and pressure that must obtain throughout such a sphere of gravitating gas if it be in convective equilibrium. Although it may be possible to deduce from Mr. Lane's formulæ a demonstration of the extent to which the condensation due to cooling increases the mutual gravitation of the gaseous particles and produces heat that compensates for the heat lost by radiation, yet Mr. Lane does not do this, as he had in mind a different object. He deals only with a static condition and attempts to determine approximately the present temperature and density of the solar gas. It would seem as if he had effected a solution of the problems suggested by Sir William Thomson in 1862 in his essay "On the Age of the Sun's Heat," wherein he says: "Mutual gravitation between the different parts of the sun's contracting mass must do an amount of work which

cannot be calculated with certainty, only because the law of the sun's interior density is not known." And again: "There must be an approximate convective equilibrium of heat throughout the whole, if the whole is fluid." But we are not restricted to the hypothesis of convective equilibrium, and Mr. Lane states definitely the difficulties in the way of accepting simultaneously both this modified Helmholtz theory and the mechanical theory of heat of Clausius. He shows that either the solar gases must be very different from those that occur on the earth or else that our idea of the nature of heat must be modified, and concludes with the statement that "of course this difficulty does not present itself when we suppose that heat is not motion."

During the last few years of Mr. Lane's life he suffered much from illness. His death, on May 3, 1880, called forth many eloquent and earnest expressions of regard from those who knew him. The following tribute from his pastor, Dr. Byron H. Sunderland, is well worthy of preservation:

"Of the propriety, integrity, and simplicity of his life, of his exceeding conscientiousness and carefulness and his modest shrinking from all self-assertion or ostentation, we all well know. He was not what we should style a demonstrative man. He lived quietly within himself, and his life was engrossed in scientific pursuits.

"The nature and construction of his mind was purely mathematical. This was evident in the exactitude of his language, even in the most casual conversations and the most trivial subjects. His speech was slow, but exceedingly discriminating and perspicuous. This was the character of his mind and all his mental habitudes. I doubt if there ever was among scholars a more striking example of carefulness of expression in the use of terms to indicate the exact shade of thought he designed to convey.

"He was very slow in all his processes and would never deviate in his reasoning or his language from the precise mathematical cast in which all his conclusions were ultimately conceived.

"Such an intellectual nature must of necessity be connected with a moral disposition which would perceive at once the relation and fitness of moral truth to the highest needs of man; and this he did perceive and accept with the simplicity of a child. His was a mind never to be borne away by the mere power of enthusiasm or any undue excitement of emotion. He viewed everything in the calm,

clear light of the rational understanding, and only in this way could moral and religious truth impress him, and in this way it did profoundly impress him.

"For the last two or three years he has been battling with the bodily disease to which he has now at last succumbed; and, of course, his favorite studies and pursuits have been in a large measure interrupted, but his mind remained clear to the last. Only a day or two before he died he talked freely with me on the subject of the supernatural God and his own relations to a future life and the fitness of the 'Christian scheme' (as he termed it) to all the requirements of his nature, condition, and prospects. 'I rest upon it,' he said, 'as a moral certainty from its adaptability to give firmness and courage to face the future. It is wholly agreeable to me, and my repose is unshaken. Whether I am about to die now or that event be yet some way off I know not, but I trust the issue without hesitation or fear to Him who disposes all things in His own good pleasure.'"

PUBLICATIONS OF J. HOMER LANE.

1. On the law of electric conduction in metals.
Am. Jour. Sci., 1846 (2), I, 230–241.

2. Notice of a novel mode of discharging a Leyden battery, with an explanation of its theory.
Am. Jour. Sci., 1849 (2), VII, 418–419.

3. On the law of the induction of an electrical current upon itself and of electrical discharges in straight wires.
Proc. Am. Assoc. Adv. Sci. Charleston, 1850, III, 359–361.

4. On the law of the induction of an electric current upon itself when developed in a straight prismatic conductor, and of discharges of machine electricity through straight wires.
Am. Jour. Sci., 1851 (2), XI, 17–35.

5. A visual method of effecting a precise automatic comparison of time between distant stations.
Am. Jour. Sci., 1860 (2), XXIX, 43–49.

6. On a mode of employing instantaneous photography as a means for the accurate determination of the path and velocity of a shooting star, with a view to the determination of its orbit.
Am. Jour. Sci., 1860 (2), XX, 42–45.
Jour. Photogr. Soc., 1860, VI, 302–304.

7. On the physical constitution of the sun (*title only*).
Report Nat. Acad. Sci., Washington, April 15, 1869.

8. Report to Mr. Hilgard of observations on the total solar eclipse as observed at Des Moines, Iowa, August 7, 1869 (dated August 28, 1869).
Coast Survey Rep., 1869, 42, 167–169.

9. On observations of the eclipse of the sun made at Des Moines, Iowa, August 7, 1869. A report, dated August 28, 1869, to the Superintendent of the United States Naval Observatory.
Published in Astr. & Met. Obs. U. S. Naval Observatory, 1867, Append. II, 165–173.

10. On the theoretical temperature of the sun, under the hypothesis of a gaseous mass maintaining its volume by its internal heat and depending on the laws of gases as known to terrestrial experiments.
Am. Jour. Sci., 1870 (2), L, 57–74.

11. Description of a new form of mercurial horizon, in which the vibrations are speedily extinguished.

Proc. Am. Assoc. Adv. Sci., Troy, 1870, XIX, 59–61.

12. Report to Professor Benjamin Peirce, superintendent, on observations of the total solar eclipse observed at Catania, Sicily, on December 21, 1870.

Coast Survey Rep., 1870, 120–125.

13. Description of a new form of mercurial horizon [invented for the use of the Office of Weights and Measures, in the report of which its uses will be mentioned, but the description of the apparatus is given in the report of the Coast Survey].

Coast Survey Report, 1871, II, 181–192.

14. On the determination of the volume of a sphere (title only).

Proc. Nat. Acad. Sci., New York, October 30, 1873.

15. On the coefficient of expansion of the British standard yard, bar bronze No. 11, being a new discussion of the experiment of Sheepshanks and of Clarke.

Report C. and G. Survey, 1877, 148, 155–166.

(This is chapter IV of the report of J. E. Hilgard on the comparison of American and British standard yards, dated July 10, 1880, Append. XII, C. and G. Survey Report, 1877.)