Samuel Pierpont Langley, Secretary to the Smithsonian Institution, Honorary Fellow of the Royal Society of Edinburgh, 1902–6. By **Dr W. Peddie.**

Through the death of Samuel Pierpont Langley this Society has lost one of the most eminent of its distinguished Foreign Members, and Science has lost one of the great leaders who have placed America in the front rank of the nations which concern themselves with the advancement of knowledge. The announcement of his death came as a surprise; for, although he had passed the threescore-and-ten limit, his powers for work were so entirely untouched as to justify the hope that many years of useful labour still lay before him. The work which he actually performed was so colossal, and some of it so recent, that years may necessarily pass before all its results are fully made public.

Born at Roxbury, in Massachusetts, on the 22nd day of August 1834, Langley received his general education at Boston High School. Leaving the school in 1851, he took up the study of civil engineering and architecture, and subsequently practised these professions until he had succeeded in acquiring means which made him independent of routine work. From that time onwards his employments coincided more fully with his mental inclinations.

Astronomy had attracted him powerfully since the days of his childhood; so the years 1864 and 1865 found Langley visiting the chief observatories of Europe, and making acquaintance with its scientific societies, many of which were in subsequent years to bestow upon him their highest honours.

In 1865 he became assistant astronomer at Harvard College Observatory. In 1866 he was appointed assistant professor of mathematics at the United States Naval Academy. In 1867 he became director of the Alleghany Observatory at Pittsburg, a post which, along with the professorship of astronomy and physics at Pennsylvania, he held until, in 1887, he was appointed

Assistant Secretary, and soon afterwards Secretary, to the Smithsonian Institution. This connection continued uninterruptedly until his death on the 27th of February this year. The variety of his successful employments bears eloquent witness to the magnitude of his mental equipment: engineer, architect, mathematician, physicist, astronomer, and administrator by profession, he was also a successful writer, a student of art and of archæology.

The great characteristic of Langley's work is its pioneer nature. Problems of like type to problems already solved had no attraction for him. New problems which presented no special difficulty in their solution were passed by. The problem whose difficulties were such that others had failed to solve it, the problem whose difficulties were such that no other had attempted to attack it—these were the problems which Langley attacked and mastered; and his attack was conducted almost with impatience. He never sat down beforehand to perfect a method of procedure; he began at once on what he believed to be the likeliest lines, and perfected his method as he proceeded.

A subject which had once attracted Langley attracted him always. Questions arising in his earliest work appeared again in work which was uncompleted at the time of his death. All his investigations arose naturally, as all great investigations do, in the course of daily labour. It would serve no useful purpose to enumerate them here. It seems better that a mere indication of their nature and extent should be given, along with a fresh expression of this Society's appreciation thereof.

Between the years 1870 and 1877 Langley's attention was devoted to the question of the structure of the solar disc and the radiation of heat from its various portions. The results were published in a series of papers during that period. It is found that, the more perfect are the atmospheric conditions for observation, the more closely do present-day results agree with Langley's early drawings. The practical aim of all his work is well indicated by a paper, in that series, on the direct effect of sun-spots on terrestrial climates.

Another, and perhaps the most distinctive, branch of his work was that which dealt with the distribution of energy in the solar

spectrum. Finding the thermopile, which at that time was the most delicate instrument available for his object, far too sluggish in its indications, he devised the bolometer, an instrument which, to this day, has no superior, and only one equal, in such work. By its aid he pushed the investigation of the solar spectrum into previously unexplored regions in the infra-red radiations.

A natural extension of that work led to the mapping, by Langley and Very, of the lunar energy spectrum. This was a work of immensely greater difficulty, because of the slight difference between the temperatures of the source and of the surroundings of the instrument, and also because of atmospheric absorption. The results led to the conclusion that the temperature of the moon's surface is not much above 0° C.

A further extension was made to terrestrial sources of radiation, the mapping being pushed more than twice as far into the long wave-length region as had been found possible with solar radiation. In the process, the dispersive power of rock-salt was carefully determined.

In 1892 Langley immensely improved his bolometer by making it an automatic self-registering instrument, and the investigation of solar radiation was pushed as far into the infra-red region as it had been carried with terrestrial sources.

Another distinctively great piece of work was that on the effect of the earth's atmosphere in absorbing solar radiation, and on the determination of the solar constant. The value found for the constant must be regarded as at least a good first approximation.

After he became Director of the Smithsonian Institution, Langley founded the Smithsonian Astro-physical Observatory and arranged its work primarily for the purpose of determining the natural influences having a direct bearing on climate and life. A part of its work, not completed at the time of his death, dealt with the question whether or not the solar radiation was variable to an extent sufficient to affect the earth's climate, and whether or not the effects were predictable. The results already indicate an affirmative answer to the former part of the question.

Another line of work, in which the daring nature of Langley's attack on unsolved problems is well exhibited, is that on the problem of aerial navigation. His papers on *Experiments in*

Aerodynamics and the *Internal Work of the Wind* commanded wide attention. He made successful models of flying machines; and, although the launching of his actual airship was unattended by success, unimpeachable photographic evidence showed that the failure was not in the vessel but in the launching apparatus.

This Society cannot do other than endorse the strong simple words of the resolution come to by the representatives of the great Institution whose work he so long and so ably controlled —that the scientific world is indebted to Mr Langley for the invention of important apparatus and instruments of precision, for numerous additions to knowledge, more especially for his epoch-making investigations in solar physics, and for his efforts in placing the important subject of aerial navigation upon a scientific basis.