excavated material from the Limon channel being pumped onto the site of the dam, where the water will run off, leaving the solids compacted into a firm, impermeable mass. Moreover, before this pumping process commences, the surface of the valley over the area to be covered by the dam will be entirely cleared of its vegetation and top soil, until, at a depth of eight to twelve feet, the clean sand and silt is everywhere laid bare.

All things considered, while we fully appreciate the conservatism which led the majority of the consulting board to reject the Gatun dam proposal, we think that the success of the San Leandro dam, the Wachusett reservoir dyke, and of a dam of pure sand which has proved successful at Jeypore, India, coupled with the elaborate experiments made by the Commission to establish the impermeability of the material upon which the Gatun dam is to be built, to say nothing of the willingness of some of our foremost hydraulic engineers to stake their own reputation and the interests of the people of the United States upon the venture, fully justify the Canal Commission and the President in their acceptance of a high-level lock canal.

MIKKELSEN'S ARCTIC EXPEDITION.

In the Arctic Ocean there lies a group of islands which is known to geographers as the Parry Archipelago. The most extreme western lands of this group are the two large islands called Banks Land and Prince Patrick Island. Lying to the west of this archipelago, discovered over half a century ago by one of the Franklin search parties, lies the great unexplored Arctic Ocean, undoubtedly the largest unknown area in the frigid zone.

For the purpose of exploring Beaufort Sea, the most southern part of this ice-covered ocean, and for the purpose of mapping islands which are supposed to exist there, Capt. Ejnar Mikkelsen has left with an expedition fitted out by the Royal Geographical Society of England and the American Geographic Society.

There is reason for believing that Capt. Mikkelsen's expedition will be crowned, if not with complete success, at least with sufficient success to repay the time, trouble, and money which have been expended in his behalf. Although he may fail completely in exploring the entire region, he should at least succeed in plotting the formation of the continental shelf, in other words, that part of the sea floor extending from the edge of the continent at depths of from 600 to 1,000 feet before the bottom suddenly drops.

That such a shelf does exist most geographers are certain. They base their belief on the experiences of previous expeditions. Shallow waters caused the "Jeannette" to drift for two years in a course which took her far west and but little north. The "Fram" was also carried west but far to the north, simply because she floated over the ocean in regions where there were no lands to set up currents that prevented her from drifting in that direction.

Unknown lands probably arise from the continental shelf, and impede the free movement of the currents. Hence the drifting of the "Jeannette" and other vessels. If Capt. Mikkelsen succeeds in definitely fixing the outlines of this shelf and its position, his expedition will be considered eminently successful.

In the hope of discovering the lands which project from the shelf, Capt. Mikkelsen will make long sledge journeys westward from Banks Land over Beaufort Sea, skirting well within the continental shelf. Actual exploration, however, will not begin until the spring of 1908.

THE MOTH AND THE FLAME.

Why does a moth fly toward a flame? Because it is inquisitive, was the rather puerile answer given by the great Romanes. Because of some inexplicable inherited instinct, was the reason advanced by other naturalists. Because it is the nature of the insect, was a third and equally unsatisfactory reply. One reason was as good as another, but that of Romanes undoubtedly carried off the popular palm. Perhaps we owe it to him that the moth and the flame have pointed many a moral and adorned many a sad tale of curiosity tragically satisfied.

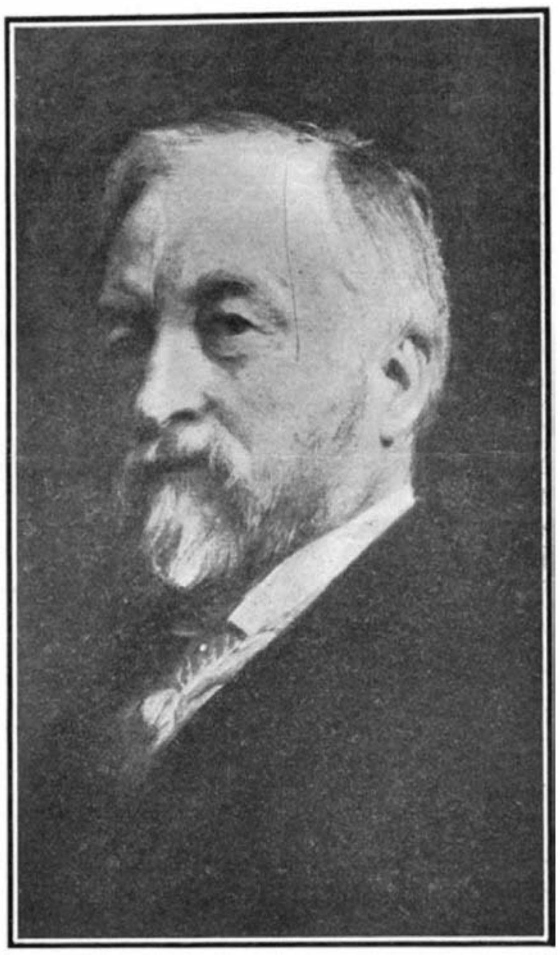
The investigations of Prof. Jacques Loeb bid fair to relieve the moth of the moral burden that has rested on his wings. Prof. Loeb has proved very conclusively that a moth, in common with many insects, flies toward a flame for the same reason that some plants turn their leaves toward the light. "Heliotropism" is the awesome name in which this tendency of plants and animals rejoices.

It happens that there are two kinds of heliotropism. If your moth or bug flies toward the light, it is positively heliotropic; if, like the earthworm, it shrinks from the glare, it is negatively heliotropic. Plants, too, may be classified into these divisions. Just as some flowers open only by day and others only by night, so some moths fly only by day and others only by night.

The results of Prof. Loeb's experiments explain with astonishing simplicity the causes of a June bug's merry antics as well as the apparently aimless movements of squirming, new-born vermin. Insects, it seems, move in the direction of the light rays that fall upon them. Change the position of the light, and the insect changes his course likewise. But the light must be of a certain intensity to produce a very marked effect. Suppose that in your experiments you exposed your bug to diffused light. He would move toward the light, to be sure; but he would creep toward it rather leisurely. Expose him to a bright glare, however, and he will hasten toward it with cheerful rapidity. That is why winged insects flutter gayly about in direct sunlight. Curiously enough, the influence of light is limited by atmospheric temperature.

From the circumstance that insects tend to arrange themselves and to move in the direction of light, it would almost follow that their structure must have something to do with their heliotropism. And such Prof. Loeb's experiments prove to be the case. The head of an insect is much more sensitive than the tail. Here the omnipresent skeptic will probably remark that an insect sees with his head and not with his tail, and that Romanes may be right after all. But such notoriously blind animals as the earthworm and other eyeless creatures are far more responsive to light at the head than at the tail. The mere possession of sight cannot, therefore, account for the earthworm's avoidance of light or for the moth's apparent liking for it.

Sometimes it happens that an insect is stimulated by light only at certain periods of its existence. In winged ants, for example, the period coincides with the time of the nuptial flight; in plant lice, with the appearance of wings; and in some larvæ, when full growth has been attained. Occasionally a caterpillar may crawl toward a flame, while the butterfly to which it gives rise may be repelled by light.



S. P. Langley

What is the cause of this curious effect? It must be confessed that science can give no satisfactory explanation. We might just as well ask, What is the cause of gravitation? The phenomenon is exactly the same as that which is produced in plant life. And that, in animals, it cannot be due to the nervous system is evident from the fact that leaves and branches have no nerves.

To be paralyzed by light, to be confined to a certain path, or to be incarcerated in an impalpable luminous prison would seem a serious limitation in the search for food. Yet it so happens that heliotropism may actually assist an insect in its struggle for existence. Certain caterpillars just after they are hatched, and when they are ravenously hungry, are compelled by the mechanical effect of light to crawl to the tips of branches, where they find their first nourishment in tender buds. After their first meal, the caterpillars lose much of their sensitiveness to light. Their heliotropism explains what has heretofore been vaguely attributed to instinct. Prof. Loeb even ventures the suggestion that the periodic migrations of many animals, such as those of birds of passage, may also be explained in part by heliotropic irritability.

SAMUEL PIERPONT LANGLEY.

With the death of Prof. Samuel P. Langley on February 27 there has passed away not only one of the most distinguished American workers in the field of pure science, but a physicist of world-wide reputation.

Prof. Langley was born in Roxbury, Mass., on August 22, 1834. Although astronomy was the study which most attracted him, even from his boyhood days, he drifted into the profession of civil engineering, where his mathematical taste found employment and likewise his manual dexterity. He soon gave up civil engineering for the allied profession of architecture. For seven years he worked patiently and then decided to abandon the profession. With no certain plans for the future he began to take up the study of astronomy in earnest. After a brief visit to European countries he obtained a position at the observatory at Cambridge, and was thus launched in his life work at the age of thirty. After a brief service at Cambridge, and at Annapolis, he became director of the Allegheny Observatory.

When Prof. Langley went to Pittsburg in 1867 he found there only an observatory in name. The equipment was inadequate, the endowment small. It was imperatively necessary that some means should be found whereby the work could be carried on. It was from the very poverty of the Allegheny Observatory that the greatest results came. In order to obtain money, Langley inaugurated "time-service systems" on a scale never before attempted. He first began by regulating the clocks of the Pennsylvania Central and other railroads associated with it, a system then comprising over 2,500 miles of railroad east and west of Pittsburg and along which 300 telegraph offices were located. Accurate time signals were communicated twice daily to each of these offices. Eventually some 8,000 miles of railway were run by this single Allegheny Observatory clock. The present system by which the railroad system of the whole continent is regulated may be said to be an outgrowth of that developed nearly forty years ago at Allegheny by Prof. Langley. The income thus derived was applied exclusively to the uses of the observatory.

In the course of two or three years the observatory affairs had prospered to such an extent that original work could be undertaken. Langley's first work was a laborious and minute study of the sun's disk, which study he completed in 1873. He revealed the true character of the "granules" upon its disk, discovered that the polarization of the corona is radial, and gave us the first complete account of the structure of a sun spot. A detailed study of the distribution of heat on the solar surface, begun in 1870, resulted in the previously unknown thermochroic action in the solar atmosphere, by reason of which, owing to the difference in wave length, it transmits heat more readily than light.

This early work upon solar heat was accomplished with the aid of the thermopile, an instrument not sufficiently sensitive for the more minute work which it was his desire to undertake. He invented a new instrument which he called the bolometer—a thermometer of almost infinite tenuity, which measured radiant heat with an accuracy that has never been excelled. In its more recent forms the instrument can detect differences of temperature amounting to no more than the one-millionth part of a degree on an ordinary thermometer.

In the hands of Langley, the bolometer demonstrated experimentally that the maximum heat in the normal spectrum lies in the orange and not in the infra-red spectrum, as commonly supposed. Before the invention of the bolometer the distribution of heat in the spectrum was almost entirely unknown. In the course of three years' patient work, however, Langley completed a map of the principal lines of the heat spectrum and thereby furnished new material for a study of the interaction of solar heat and terrestrial atmosphere. What Kirchhoff did for the upper rays of the spectrum Langley accomplished for the lower spectrum.

One important result of all these bolometric investigations was the discovery that the earth's atmosphere acted with selective absorption to a remarkable degree, keeping back an immense proportion of blue and green, so that which was originally the strongest became, when it reached us, the weakest of all, and what was originally weak became relatively strong. The action of the atmosphere is just the converse of that of an ordinary sieve, or like that of a sieve which should keep back small particles analogous to the short wave lengths (blue and green) and allow freely to pass the larger ones (the dark heat rays). Langley, therefore, proved that white is not the sum of all radiations as we used to be taught, but that it resembles pure original sunlight less than the electric beam which has come to us through reddish-colored glasses resembles the original brightness.

An expedition to the top of Mount Whitney resulted in the discovery of an entirely unsuspected extension of the solar spectrum; in a calculation of the relative intensity of the different rays of the sun before they

(*Continued on page* 211.)