

methods of producing the like effects; and by experiment he discovered a mode of generating steam so effectual as to promise very great advantages to the inventor. To bring this invention to act on his former machinery, required some time, which was employed in perfecting it; several experiments were accordingly made, and in the end Mr. Rumsey's principles were proved to be good. During this time Mr. Arthur Donaldson, a very ingenious mechanic (whether from the strength of his own genius, or from hearing something of Mr. Rumsey's scheme, is not material in this dispute with Mr. Fitch to ascertain) took up the idea, and made several experiments, which fully proved that the reaction of a column of water, forced with rapidity from the stern of a boat, would propel her forward so as to answer the end required for navigation. Mr. Donaldson communicated his ideas and experiments to many gentlemen in Philadelphia, who were satisfied of his principles, but they doubted whether the size of a boiler, and the quantity of fuel necessary to keep it heated, would not occupy so large a part of the boat as to render her freight of no value: to reduce this to a certainty, gentlemen acquainted with Steam-engines in Europe, were consulted, and their opinions confirmed the doubts entertained, so that Mr. Donaldson gave up the idea of prosecuting his scheme. While Mr. Donaldson was employed in experiments, Mr. Fitch had applied to the assembly of Pennsylvania, for the exclusive privilege of navigating by the force of steam, and was opposed before a committee of the house by Mr. Donaldson, when Mr. Fitch claimed all possible modes, whether *invented or to be invented by himself or others*, of using steam for that purpose; and as Mr. Donaldson, before a report was made by the committee to the house, was convinced by his friends that no boiler *then known* would generate steam in a sufficient quantity and at a cheap rate, to answer the end, he declined his opposition, and a grant was made to Mr. Fitch, of the exclusive use of steam for navigation, in very large and comprehensive words. Since this grant Mr. Fitch, and a large company, who associated with him, have made many experiments to reduce their boat to practice; all of which were to apply the force of steam (generated in a large boiler, agreeably to the old practice long used in Europe) to the working a

number of paddles on the sides of the boat, the abortive events of which have been too public to need repetition.

[Those who wish to follow this controversy in detail will find these three rare pamphlets reprinted in full in "The Magazine of History with Notes and Queries," extra numbers 100 (1924), 122 (1926) and

139 (1928). Both inventors tried to obtain money to build boats for complete tests. They had the interest of most of the famous men of their time, but were unable to carry out their plans. Rumsey died broken-hearted, Fitch committed suicide. Yet both men had actually run their steam-propelled boats upstream on swift rivers. Thus the steamboat dates from the Eighteenth Century.]

Science News Letter, April 23, 1932

PHYSIOLOGY

## Scientist Traces Evolution Of Firefly Light Reaction

### Finds Special Ability Has Developed From One of Biochemical Processes Underlying Ordinary Respiration

ORGANISMS that shine in the dark, like fireflies, and the bacteria that cause the light of "punkwood" or "fox-fire," have evolved this special ability from one of the biochemical reactions that underlie ordinary respiration. Reasons in support of this view were presented before the opening session of the American Philosophical Society's annual meeting by Prof. E. Newton Harvey of Princeton University.

Prof. Harvey, who has been working on the problems of "living light" for many years, traced a close parallelism between the reaction of the glowing substance "luciferin" and oxygen, brought about by the enzym "luciferase," and the "hydrogen acceptor" mechanism involved in the oxidation of food substances to set free energy in common non-luminous forms. The outstanding difference between the two processes is that in ordinary oxidation the end-product is carbon dioxide, whereas in the light-producing reaction this substance is not set free. Instead, the oxygen involved seems to be tied to hydrogen atoms to form water, and the oxidized luciferin is later caused to lose its oxygen and thus be ready for use all over again.

Luminescence is a capacity possessed by many organisms scattered all over the evolutionary family tree; which leads Prof. Harvey to believe that the shift-over from ordinary respiration to the special case of luminescence has occurred many times, and is not confined to any one line of descent.

There are two main modes of luminescence; continuous glow, exhibited by bacteria, and intermittent glow, exhibited by practically all other organisms.

The intermittent type is the one most familiar to the majority of people; it is well exhibited by the common firefly. Intermittent luminescence ordinarily takes place only in response to a stimulus. It may serve an evolutionary end, such as scaring off enemies or attracting prospective mates. The anatomical mechanisms for its production are often quite complex.

The continuous glow of bacteria is emitted without stimulus and apparently serves no useful purpose to the organisms that display it. It seems to be produced simply by the secretion of luciferin within the bacterium's body, and the oxidation of this luciferin when it makes contact with the air.

Science News Letter, April 23, 1932

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The Science Service radio address next week will be on the subject of

**A WORLD OF PARASITES**

**Dr. Maurice Hall**

prominent parasitologist of the U. S. Department of Agriculture, will be the speaker.

**FRIDAY, APRIL 29**  
at 1:45 P. M., Eastern Standard Time

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