



NO.

MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 234

PHOSPHORESCENCE IN THE OCEAN

by

W. A. Clemens

1938

58931



FISHERIES RESEARCH BOARD
OF CANADA

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Phosphorescence in the ocean is a widespread phenomenon and is caused by the emission of light by the living substances therein. It is suggested as being merely the transforming of potential energy in the form of food into kinetic energy in the form of light. In many cases it is not of recognizable use to the organism. In others it may be protective e.g. fish emit light to frighten their enemies away. The pale glow resembles the light emitted by phosphorus and for a long time it was suspected to be due to this element. From that connection, it gained the name "Phosphorescence". That this is a fallacy is evident since phosphorus and its compounds are known to be poisonous and would cause death even if present in very small amounts.

The process is certainly due to the oxidation of substances secreted by the animal probably due to the action of oxygen on the fats, oils and such compounds in the living cells. Since oxygen is a necessary adjunct, the phenomenon occurs usually on the top of the water. It will also occur when wind causes ripples on the ocean surface or when the prow or propellers of a boat churn it up. When a fisherman's net or other gear disturbs the surface, the same result will be produced.

The colour produced by different organisms varies. Green is often observed (brittle stars and annelid worms). This colour with blue predominate in marine organisms although red is sometimes observed.

Norwegian fishermen recognized two kinds of phosphorescence - "Dead" - resembling the stars in a clear sky, millions of small almost invisible points emitting a scintillating light, now decreasing, now increasing in intensity:- "Fish" - appearing like great bubbles of light suddenly flaring up as if a dull electric lamp had been turned on and off. Both types are caused by living organisms. The first type is merely the result of light emission from innumerable small microscopic organisms. The second is produced by larger

animals such as fish and squids, rushing through the water, sometimes by the impetus of their movements causing all the small phosphorescent organisms to flare up intensely in response to the irritation produced.

The power of emitting light is found in most groups of marine animals beginning with the bacteria. In animals the power is always attributed to certain structures which represent almost all conceivable forms of glands from simple skin (epithelial) structures to complicated tubular or lobular organs. These organs secrete a slimy luminous substance. As a rule a layer of black pigment is arranged around the gland to act as a reflector. Very often the light is projected through a lens-shaped structure. The organs therefore often resemble minute eyes and have been mistaken for such. As we go ^{up} through the animal kingdom the organs become more and more complex.

Although no particular study has been made of the subject in British Columbia, it is felt that most of the displays seen by the fishermen are the result of light emission in the lower animals. Great displays are attributable to those small, microscopic animals Marine Bacteria many of which are phosphorescent. As the larger animals move through the water, they disturb these forms which emit light. Fishes may also appear to be lighted up due to the presence of large numbers of these forms on their bodies.

One of the commonest phosphorescent forms which occurs in great abundance belongs to the group known as the Protozoa. Its name Noctiluca is derived from the property which it has of lighting up. Other members of the same group of one-celled microscopic animals common in our waters also emit light. The famed Gonyaulax which has recently been reported as an agent in shell fish poisoning is phosphorescent.

In the Coelenterata or jelly fish family we see the beginnings of localization of the luminescent organs. In these the whole surface may appear

bright but the brightest areas are along the radial canals. The sea pens may also emit light on occasion.

Marine Worms are also found to have luminous organs on the numerous lateral processes of the body. Two of our local genera may have the lighting habit (Tomopterus and Chaetopterus).

In the Crustacea or crab family the phenomenon is widespread. The copepods or water fleas, small microscopic forms possess the habit. The Euphasiacea or the family to which the "red feed" of our spring salmon belongs may have luminous organs on the appendages of the thorax and the abdomen. Some deep sea Decapods (Prawns) have luminous secretions at the base of the antennae and other eye-like organs all over the body.

Amongst the mollusc family, the squid genus, Rossia is known to show phosphorescence through the secretion of a glandular organ on the ventral side of the body behind the funnel. This light shines through a transparent covering and gives a green colour.

Amongst the fish, luminescent organs are very highly developed. Frequently they appear on the ventral surface and on the anterior part of the body and the head. These organs seem to be a specialization of the skin glands which excrete a fluid which becomes luminescent through slow oxidation. The essential part is a collection of gland cells but to these may be added blood vessels and nerves as well as a protecting membrane and iris-like diaphragm. Reflectors and lenses also occur. They may be recognition marks, attractors for prey etc. From the association with the eyes and the ability to send light downwards and forwards in certain fish they may actually serve as lanterns in the depths.

Example - Chauliodes macouni - Viper fish. Long thin peculiarly shaped with two rows of luminous dots along side.

Nautichthys - Midshipman - buttons, etc.

In conclusion it should be stated that phosphorescence in the ocean as recognized by the fishermen is not the result of electric sparks caused by the friction of salt particles in the sea but merely the result of the ability of a large number of animals to emit light under certain conditions. When one considers the number of animals which have this power it is not surprising that the well known light displays occur in sea water. In general although the larger forms have luminescent organisms, most of the effect is the result of the smaller more minute forms especially the small one-celled Noctiluca. Disturbing the water in the dark will stimulate the phenomenon if the animals are present.