Reports

Observation of Bioluminescence in the Atlantic Fish (Porichthys porosissimum)

The only North American shallow-water fishes which produce light belong to the genus *Porichthys* (family Batrachoididae). The fact that the Pacific species, *P. notatus,* will produce light is well known.

Greene (*1*) observed that *P. notatus,* when it was placed in an aquarium made alkaline with ammonia water, "exhibited a brilliant white light for about 20 minutes." Dean (*2*) stated that there were "few actual observations of living fishes." Greene and Greene (*3*) reported that *P. notatus* had a latent period of 8 to 10 seconds following stimulation and that the light lasted about 20 seconds. They also reported that adrenalin, when it was injected into the fish, activated the light-forming organs. Prosser *et al.* (*4*) stated that intermittent light of this type "is an intracellular phenomenon," but the exact mechanism is still not known. Hubbs and Schultz (*5*) gave a bibliography on this group of fishes. Harvey (*6*) states that little work additional to that of Greene and Greene has been done "chiefly due to lack of material."

There seem to be no reports of observations on light production in the Atlantic midshipman, *P. porosissimum.* Jordan and Evermann (*7*) reported that this species had been seen by fishermen "shining at night" but that they had been unable to verify the observation. The following observations were made at the Gulf Coast Research Laboratory on the night of 22 June 1957. The fish came from Mississippi Sound.

At 9 P.M., after the lights had been off for about 10 minutes, a faint glow appeared to move toward the water surface. Before the lights were turned off, one of the two midshipmen present had been cruising up and down and around the tank. There were several more short emissions of light lasting 5 to 10 seconds, but interrupted by variously longer periods of dark. One show of light was so intense that the rows of photophores on the ventral side, the row above the middle of the side, and the several rows on head and chest stood out sharply as bright lights for 15 or 20 seconds. After one or two faint emissions, nothing more could be seen even though the fish was picked up in the hand and released. The following night the aquarium was again observed for more than an hour; the fish was stimulated with the hand, but no light was seen. Except for the removal of one *Gobionellus hastatus* from the tank, conditions were essentially the same as they had been on the previous night. There was about 1 inch of white sand in the aquarium, which was 10 by 18 inches by 12 inches high. The aquarium contained two *Porichthys,* one *Hippocampus hudsonius,* and two shrimp (*Penaeus*). The salinity was 16.9 parts per thousand.

On 25 June a midshipman was placed in a liter of sea water to which about 5 ml of ammonia water had been added. The same photophores that showed brightly on the one spontaneous emission became bright to about the same intensity. The fish became very active during this time and was killed by the ammonia. After respiratory and other movements ceased, the light slowly diminished.

On 29 July tests were made to see whether other chemicals would stimulate light production. These chemicals were added slowly, a few milliliters at a time, to a gallon jar containing the fish in 1 liter of sea water which had a salinity of 26.2 parts per thousand and *p*H of 7.2.

Sodium hydroxide and ethyl alcohol were as effective as ammonia, but acetic acid failed to stimulate any visible light even though it was added until the fish had died. Light did not appear in the alcohol test until 50 ml of 95-percent alcohol had been added and the fish had lost almost all ability to move. The light continued to increase as alcohol up to 112 ml was added. In the NaOH test, maximum luminescence was reached after 73 ml of 1N solution of the alkali had been added and the *p*H had become 11.2.

Porichthys porosissimum is distributed from South Carolina to Uruguay and is found in shallow waters. It is not a particularly abundant fish, nor is it extremely rare. The only estimates of its general abundance were given by Gunter (*8*), who collected eight specimens from April to November 1941 among 78,000 fishes which were taken mostly by trawl from Texas bays. He found the species at salinities ranging from 10.3 to 35.8 parts per thousand. In Mississippi Sound the fish seems to be more abundant, and one to ten are taken in an hour's trawling. The fish is not at all delicate and exhibits the well-known toughness of the batrachoidids. It is a readily available source for workers studying the physiology of bioluminescence.

HURST H. SHOEMAKER*
Gulf Coast Research Laboratory, Ocean Springs, Mississippi

References and Notes

1. C. W. Greene, *J. Morphol.* 15, 667 (1899).
2. B. Dean, *A Bibliography of Fishes* (Am. Museum Nat. Hist., New York, 1923), vol. 3.
3. C. W. Greene and H. H. Greene, *Am. J. Physiol.* 70, 500 (1924).
4. C. L. Prosser *et al., Comparative Animal Physiology* (Saunders, Philadelphia, 1950).
5. C. L. Hubbs and L. P. Schultz, *Proc. U.S. Natl. Museum* 86, 473 (1939).
6. E. N. Harvey, *Bioluminescence* (Academic Press, New York, 1952).
7. D. S. Jordan and B. W. Evermann, *U.S. Natl. Museum Bull. No. 47* (1896–1900).
8. G. Gunter, *Publs. Inst. Marine Sci. Univ. Texas* 1, 1 (1945).

* Permanent address: Zoology Department, University of Illinois, Urbana.

5 August 1957

Tumor-Inhibiting Effects Derived from an Active Principle of Garlic (Allium sativum)

Extracts of garlic (*Allium sativum*) have been shown to contain a powerful bactericidal agent, allylthiosulfinic allyl ester (allicin) (*1, 2*). This compound is formed by the interaction of an enzyme and substrate present in garlic bulbs (*3*). The enzyme, alliinase, is liberated when the garlic bulb is crushed, and it acts on the substrate, S-allyl L-cysteine sulfoxide (alliin) as follows (*4*):

$$2\,R\text{—SO—CH}_2\text{—CH(NH}_2\text{)—COOH} \quad (\text{alliin})$$

$$\xrightarrow[\text{alliinase}]{+\,H_2O} R\text{—SO—S—}R + \quad (\text{allicin})$$

$$2\text{CH}_3\text{—CO—COOH} + 2\text{NH}_3$$

where

$$R \text{ is } \text{—CH}_2\text{—CH=CH}_2.$$

Wills (*5*) has shown that this reaction product inhibits many sulfhydryl (—SH) enzymes but that it does not affect many

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table *or* one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).