mental error the maximum tetanic tension developed by a single muscle fiber is the same at all temperatures between 4°C and 22°C.

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References and Note

1. These experiments were reported at a symposium at Edgewood Arsenal, 6–7 Oct. 1952. The report was mimeographed in Chemical Corps Medical Laboratories, Special Report No. 27 (1953), p. 10. The study was aided by contract NR 113-099 between the Office of Naval Research and the Medical College of Virginia.
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17 December 1954.

Marking of Shrimp

Interest has been shown by the U.S. Fish and Wildlife Service in sponsoring research to find a means to tag shrimp effectively for growth, migration studies, and definition of stocks. According to the proposal the tags should fulfill these conditions:

> . . . (*a*) will not impede the natural movements of the shrimp, (*b*) will not cause abrasion, lesions in, or otherwise damage any tissue of the shrimp, (*c*) will offer minimum opportunity for the entry of parasitic fungi or other pathogens into the tissues of the shrimp, (*d*) will not attract predators, (*e*) will persist throughout the life of the shrimp regardless of age at which mark or tag is imposed or attached, (*f*) can be easily detected and identified by untrained workers in the fishery, both ashore and at sea.

Some preliminary investigations of the usefulness of vital staining for this purpose were made at the Marine Laboratory of the Oceanographic Institute, Florida State University, during October 1954. The shrimp (*Penaeus setiferus*) were captured in Alligator Harbor and the adjacent Gulf of Mexico with a shrimp try net and a minnow seine. They were transported to outside tanks, 10 ft in diameter, supplied with running seawater. The shrimp were fed at infrequent intervals with bits of shrimp, fish, and crabs. A 2-ml insulin-type syringe with a No. 25 needle ½ in. in length was used. Several different colored inks and stains prepared for histological purposes were used in the preliminary experiments. The injections were made by piercing the shell in the posterior abdominal segment. Except when almost immediate death occurred, the stain spread throughout the animal almost instantaneously, presumably via the blood vascular system.

The majority of the stains killed the animals, either immediately or within several hours. Neutral red and methyl blue did not kill the shrimp but, because of the temporary nature of the coloring, were not considered satisfactory. With these two stains, color could be detected only in the branchial chamber after a few hours (concentrated in the gills) and had disappeared altogether within 24 hr. Fast green was very successful. Less than 5 percent mortality was experienced if the animals were handled carefully and not too much stain was injected. It was estimated that about 0.2 ml of the solution was injected into the animal, and the color was still plainly visible after a period of more than 60 days. Mortality was about the same (about 15 percent) in the injected animals as in the controls kept in the same tank. The majority of the animals shed at least once. After shedding, the stain became concentrated in the branchial area but was still very noticeable, especially when contrasted with the control.

These preliminary data satisfy conditions *a, c,* and *f*. Condition *b*, "will not cause abrasions, lesions in or otherwise damage any tissue of the shrimp," is not fulfilled, although it is thought that the damage to the tissue was slight, certainly less than that caused by attachment of a metal or plastic tag. It will not be known whether condition *d*, "will not attract predators," is fulfilled until controlled experiments are performed with marked and unmarked shrimp. It is not yet known whether the color will persist throughout life to fulfill condition *e*.

These findings are reported with the thought that other workers who are interested in marking shrimp may profit by them. It is planned to continue the investigations in the spring when shrimp will again be locally available.

It is felt that if the stains are prepared carefully so that isotonic solutions are made and toxic substances are not used for carriers, this method of marking will prove effective. This method is certainly faster and more economical than tagging with metal or plastic and probably will cause less mortality. It has great possibilities if several contrasting colors can be found, both for marking in several localities in one year to study migration and also for the succeeding year. Because of the short life span of the shrimp the same colors could be used over again, at least within 2 yr.

One difficulty with this method is that individual records cannot be kept and hence, although it is valuable for migration studies, it will not be as suitable for growth studies. However, great numbers of shrimp could be marked in a very short period, and if only shrimp of a restricted size interval were marked with a single color, the growth under natural conditions could be determined when the shrimp were recaptured.

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Contribution No. 27, Oceanographic Institute,
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16 December 1954.