

only, namely, a faint continuous blue light on the belly. Mechanical stimulation, however, caused a wave of luminescence to spread rapidly from the point stimulated to other parts of the body bearing luminous organs, the contour of the fish being outlined with light after a comparatively powerful stimulus.

The simple organs, which consist of gland cells only, and which are found thickly strewn in the dermis of the back and belly, only show a short luminescence immediately after stimulation, and the same applies to the complex, flask-shaped organs, equipped with lens and reflector, found near the eyes and in two rows near the ventral line of the belly. The latter, however, remain luminescent somewhat longer, though even then for a few seconds only. The continuous light on the belly is unaffected by stimulation, and SKOWRON considers it probably due to the cup-shaped organs which occur in groups of four or five on the mid-line of the belly.

As the fish becomes moribund, the continuous light is the first to disappear. The other organs can still be made to respond to powerful stimuli, the organs on the lower jaw and at the base of the tail retaining this faculty longest. The organs of a dead specimen cannot be made to luminesce, even when removed from the fish and triturated in suitable media.

Luminescence in fishes (apart from those whose luminescence is due to symbiotic bacteria, and those, such as Macrurids, which have open, slime-secreting glands) is of two types, namely, continuous, and intermittent. In *Chauliodus*, both types are found, the continuous light, independent of stimulation, from the cup-shaped organs on the belly, the intermittent light from all the other luminous organs, on stimulation. Dr. SKOWRON considers that the continuous light is not due to loss of control, due to approaching death, but may be either a response to a rhythmic stimulus, or a long-continued response to an earlier stimulation.

As to the means of control of luminescence, Dr. SKOWRON considers that it is due neither to hormones (as appears to be the case in *Porichthys*) nor to the varying supply of oxygen brought to the glands. He found that section of the spine instantly and irreversibly extinguished luminescence; and, remembering the slightness of the stimulus required, the spread of the response from the point of stimulus to other organs all over the body, and the short duration of response, he infers that control is due directly to the nervous system, notwithstanding BRAUER's failure to find many nerves supplying these organs.

Dr. SKOWRON's paper is interesting and important, but it leaves us as far as ever from an understanding of the purpose of these enigmatic, though widely-spread, and often highly complex, organs.

C. F. H.

K. STRUVE und W. KAIRIES. Die chemische Zusammensetzung einiger als Fischnahrung wichtiger wirbelloser Bodentiere der Nordsee. Wissenschaftliche Meeresuntersuchungen. N. F., Band XVII, Abt. Helgoland, Heft 2, Abh. 6. Kiel, 1930.

A logical sequel to a study of the nature of the food of fishes is an examination of the food value of that food. In this paper, the results of

chemical analyses of the following animals, which are used as food by fish, are given: *Nucula nucleus*, *Venus ovata*, *Tellina baltica*, *Ophiura albida*, *Echinoceyamus pusillus*, *Orchestia littorea*, *Podocerus falcatus* and *Nerine fuliginosa*. The material after measurement was cleaned, weighed and dried at 105° to constant weight. Elementary analyses for C, H, and N were made and the quantity and composition of the ash found. Fat was determined by the Soxhlet extraction method and in certain cases analyses were made for calcium and chitin. From the analyses the quantity of protein, fat and carbohydrate, which are most important as food, can be calculated. These are recorded as percentages of the fresh material so that with either known numbers and sizes, or better, known weight, the quantity of the different nutritive substances can be calculated.

The work is necessarily of a preliminary nature for it is most probable that there will be important seasonal changes in the composition of the different animals, affecting their food values. In addition, the work should form a background to a study of the availability of the nutritive substances for fish. So far, enough information is not available to enable us to compare the different fish foods from the point of view of nutrition with safety, but with an extension of the work, this should become possible.

A. P. O.

- A. WILLER. Untersuchungen über das Wachstum bei Fischen. II, III, IV. Weitere Untersuchungen über den Einfluss äusserer Faktoren auf das Wachstum der Bachforellenbrut. Zeit. f. Fischerei. Bd. 26, S. 565—606. Berlin, 1928.

The eggs of the trout are normally incubated in water rich in oxygen and in the absence of light. The author shows that a diminution in the pressure of oxygen equivalent to about one third of its normal value markedly delays the rate of development and is liable to produce high mortality. If the amount of oxygen per litre of water falls to 1.7 c.c., the larvae die within the first month after hatching. When eggs are incubated in an oxygen-rich water and exposed to light, the effects on development are similar to those produced by a diminished oxygen supply, although the effect of light is more obvious during the early stages of development than during the later stages. The effects of diminished oxygen and of light are additive.

It seems to us that, since growing fish do not appear to use more oxygen per gram per hour than fish which are not growing, the effect of oxygen lack on the growth rate must be of a secondary nature and be dependent on a general disturbance of metabolic activity. It would be of interest to know how far the rate of development of the eggs is dependent on the amount of oxygen available for absorption from the environment.

J. G.

- A. WILLER, W. QUEDNAU und A. KELLER. Untersuchungen über das Wachstum von Fischen. V. Untersuchungen über den Einfluss des Alters der Elterntiere auf das Wachstum der Bachforellenbrut. Zeit. f. Fischerei. Bd. 38, S. 167—188. Berlin, 1930.

The absolute size of the offspring from the eggs of a female trout is independent of the age of the male fish from which the spermatozoa are