

## NOTES AND MEMORANDA.

**Colour-changes in *Cottus bubalis*.**—On May 10th a specimen of this fish, of a brilliant carmine-red colour, was brought to the Laboratory. It had been caught in a lobster-pot in deep water. The ground colour was a very vivid carmine-red, and this was interrupted at places by black, white, and yellow markings. The black markings were distributed as follows :—There were streaks and bands on the head, a pair of irregular blotchings at the sides of the first dorsal fin, another pair at the sides of the second dorsal, and a pair at the base of the tail, also a pair of black patches on the bases of the pectorals. The white marks were opaque, and had a chalky appearance: there was a pair of these in the sides of the body opposite the first dorsal, and a pair of large patches on the sides of the first dorsal fin itself; there was a similar arrangement of white patches in the region of the second dorsal, and a patch on the middle of each pectoral, also a small white spot on the middle of the dorsal side of the head, and another at the dorsal part of each pectoral. Yellow bands alternated with red along the rays of the pectoral fins.

This specimen was placed in one of the table tanks in the Laboratory; at the bottom of the tank was coarse yellow gravel, while the sides were of black slate, and there were one or two large dark stones in the tank, behind which the fish usually concealed itself. The tank is very dimly illuminated.

On June 24th I examined the specimen, and found it was deep black all over the back and sides with the exception of the white markings, which were unaltered; there was not a trace of red about it. The ventral surface was of course light throughout the experiment.

I then placed the specimen in a pan painted red and strongly illuminated. In a day or two the colour was much lighter, having become a slightly yellowish brown without any red tinge. But the specimen died from accidental stoppage of the circulation in the pan before further observations could be made.

The ordinary specimens of the shore are black or dark brown on

the back, the sides being spotted or blotched with the same colour, while there are light markings similar in position to the white markings in the specimen described above, but yellow in colour, with brown spots scattered over them.

The occurrence of red specimens is mentioned by Day, who describes a male specimen of a brilliant carmine colour with white markings. My specimen was a female, so that the colour has nothing to do with sex. We have received several other specimens of the same red colour, but only the one above described has been yet subjected to careful observation.

It is evident from the above that the red colour is not permanent, so that red specimens do not represent a colour variety; the red colouration is evidently a temporary condition due to the action of light. Whether an ordinary shore specimen can be made to turn red by being exposed to light reflected from red surroundings has not yet been proved, but it has been shown that a red specimen soon loses its peculiar colour under the conditions above described. At the same time the change is not very rapid; in the above case it occupied more than a month. It seems probable that the red colour in nature is determined by the fact that the fish lives among red seaweeds. Probably in this case there is no alteration in the quantities of the differently coloured pigments in the skin, but merely an alteration in the expansion and contraction of the differently coloured chromatophores.—J. T. CUNNINGHAM.

**Palæmonetes varians in Plymouth.**—The estuary of the river Plym is connected, especially upon its left (eastern) side, with a number of small tributaries, whose waters are, even at their mouths, of very low density. In many of these tributaries *Palæmonetes varians* abounds. I have examined especially a large number of individuals from a stream which runs through Saltram Park, in the water of which I have found variations in density ranging from 1·010 to 1·018. From the position of the stream it is improbable that its density is ever much greater than 1·018, though a continuous rain might possibly reduce its specific gravity to a limit below 1·010.

The variability of the adult individuals from Saltram is very great. The following statement of variations observed in the characters of the rostrum will show how enormously the variations in this race exceed those indicated by the current diagnoses of the species.

Among 915 individuals of both sexes—

The apex was simple in 432 cases.

The apex was bifid in 483 „

One dorsal tooth only was present in	2 cases.
Two dorsal teeth only were	18 „
Three „	123 „
Four „	372 „
Five „	349 „
Six „	50 „
Seven „	1 case.
Ventral teeth were absent in	3 cases.
One ventral tooth present in	276 „
Two ventral teeth „	630 „
Three „	6 „

The range of variation being so considerable, it is evidently unprofitable to compare this race with the published accounts, which are based on examination of ten or a dozen specimens of other races. Such a comparison will therefore be deferred until it is possible to obtain an extended series of observations, from which a fuller knowledge of the diagnostic characters and range of variation of the species may be obtained.

The development of *Palæmonetes* has been shown by P. Mayer,\* Boas,† and others to present a series of interesting variations. The races which inhabit those countries surrounding the Mediterranean—and which are found almost exclusively in fresh water—exhibit, as is well known, a more abbreviated development than the races of Northern Europe, which inhabit exclusively waters containing at least some admixture of salt.

It is curious that the attempt to grow the southern forms in salt water has not been successful.

In June last several gravid females were taken from the stream at Saltram, whose specific gravity was then 1.010, and placed in an aquarium in the Laboratory at Plymouth. The density of the water was diminished by 0.001 daily, so that in ten days it became quite fresh. The adult individuals fed freely, and seemed in no way disturbed by the change of density, while the eggs hatched in due course.

The larvæ at hatching were about 4 mm. long; the rostrum was in some cases, though not in others, provided with a single basal spine.

The inner ramus of the second antenna was unsegmented. The mandible was provided with biting teeth, but was not bifid. The exopodite of the second maxilla was large; and the four endites (of which the distal was divided) were provided with well-developed

\* Mitth. Zool. Sta. Neap., Bd. ii, p. 196.

† Spengel's Zoologische Jahrbücher, iv, p. 793.

biting hairs. The maxillipeds were well developed, each having a large exopodite, used in swimming; while the five thoracic legs existed as mere buds, the first four being already bifid, but remaining folded beneath the thorax.

The larvæ moulted three or four times before attaining a proper "mysis" condition. After attaining this condition they were accidentally killed. They fed freely from a few hours after hatching during their whole lives.

The eggs from the abdomen of the mother measured rather less than 1 mm. in long diameter, and each female carried about 150.

The only difference between the larva here described and that shown by Boas to be characteristic of the northern salt-water form of *Palæmonetes* lies in the occasional presence, in the Plymouth larva, of the single rostral spine; and the facts above mentioned as to the variability of the adult rostrum may perhaps be considered to deprive this single difference of any great importance.

We have, therefore, in Plymouth a race of *Palæmonetes* which, while approximating in its habits to the races of Southern Europe, retains, in its development at least, a complete resemblance to those northern forms from which it is probably descended.

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