

temperature. Experiments have taught us that the eggs of *Cucumaria*, which float near the surface, are so much affected by the surface-temperature of the coast-water in summer, that they are destroyed before a single larva is hatched, and it follows that the existence of this form in the littoral zone of the boreal region depends upon its period of reproduction being in the coldest months of the year; this is probably true also of *Echinaster*. Again, in the case of another arctic-boreal species, *Hippolyte gaimardi*, which along the west coast of Norway lives only in the littoral zone, the eggs develop during the cold months of the year, and the young are hatched in April. On the other hand, the lobster and the oyster, which are typical boreal forms inhabiting the littoral zone, have their period of reproduction in the months between June and August.¹ It must be admitted, however, that too few researches have been made upon which to base any general conclusions, and that the conditions in arctic tracts are quite unknown.²

Eurythermal forms.

Little is known as yet regarding the power of withstanding variations of temperature in different species, though most of the littoral animals, which are eurythermal and exposed to extreme variations, are astonishingly hardy. The Swedish zoologist Aurivillius has found, from observations made on the coast of Bohuslän in Sweden, that the barnacle (*Balanus balanoides*), the periwinkle (*Littorina littorea*), the sandgaper (*Mya*), the cockle (*Cardium*), and the lugworm (*Arenicola*) are able to endure for a considerable period a temperature below freezing point, and that the barnacle after being quite a long time in the ice had actually got vigorous young.³ Other littoral forms can protect themselves by descending into deeper water or by burrowing downwards into the mud. Still we cannot expect every species to be equally hardy, and wholesale destruction sometimes takes place under specially unfavourable circumstances, as, for instance, when the ice lasts too long or when the bottom freezes to too great a depth. That many of our littoral animals are able to live in boreo-arctic areas at a

¹ The German naturalists Samter and Weltner have published an interesting account of several arctic survival forms in North German lakes, illustrating their mode of life and reproduction. One crustacean, *Mysis relicta*, lives during the summer in the depths of cold lakes, and migrates landwards during autumn and winter, reproduction chiefly taking place at a temperature of 3° C. With another crustacean survival-form, *Pontoporeia affinis*, also, reproduction takes place in winter at temperatures varying between 0° and 7° C.

² It will be interesting to find out whether the boreal forms which penetrate into boreo-arctic areas with high temperatures for a short portion of the year have a short period of reproduction there, seeing that farther south their reproduction is known to extend over several months.

³ Aurivillius, "Littoralfaunans förhållande vid tiden för hafvets islågning," *Öfvers. Kgl. Vet. Akad. Förhandl.*, 1895.