pound which is then concentrated by extraction in an organic solvent and measured photometrically. Salts interfere with the reaction, reducing the yield by a factor of 0.62 times that of distilled water so that standards must be run in deionized water and the results multiplied by a factor.

The nitrite test involves its linkage with sulfanilamide to form a diazo compound and then coupled to make a colored compound which can be measured as such. Nitrates are reduced with hydrazine sulfate to nitrites and measured photometrically.

High concentrations of ammonia in solution (more than a few ppm) varying according to species, must be avoided. Moderate and gradual loadings of marine organisms without over-feeding and a proper run-in period based upon the size of the initial inoculum of filter bacteria normally introduced with the higher organisms, should keep equilibrium volumes for ammonia as low as 0.055 ppm or less.

The length of the "run-in" period determined by other factors besides the size of the initial inoculum, include the effect of temperature on bacterial growth rates, the trace-element requirements of the bacteria, and the individual characteristics of the bacterial strain present.

Proper "breaking-in" of the aquarium will permit the culturing of even very delicate marine invertebrates without difficulty. Establishing the pH of the water at about 8.2, which is generally suitable for all marine animal organisms, will be maintained by aeration and by passage of the water through calcareous gravel in the filter bed.

To operate a closed or semi-closed system satisfactorily for an indefinite period, the water must be kept circulating at all times to allow for proper aeration and "purification." The specific gravity (1.025) of the water must be maintained. Temperatures must be maintained by a thermo-regulating device. Systems should never be overloaded with animals although maximum quantities as determined by laboratory checks of oxygen and ammonia content can be kept without difficulty. Only enough food should be added at any time to satisfy the hunger of the animals. Periodic laboratory checks of ammonia, nitrite, and nitrate should be carried out (Strickland and Parsons 1965). Approximately 25% of the water should be changed every four to six weeks as determined by laboratory nitrate checks to keep the nitrate level from getting too high. Not too much data are available as yet to allow the setting-up of a "permissible limits" scale for various animals but good management of the physico-chemical factors of closed systems should help to keep most marine animals alive for indefinite periods.

References

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Aquaria

Students in the elementary and secondary teacher education programs at Iowa State University, Ames, Iowa, have the opportunity now of learning about certain animal forms which geographical location has kept rather far away from the midwest. The Zoology and Entomology Department has had installed a series of self contained, temperature-controlled, constant-circulation salt water aquaria in which marine forms can be kept alive for long periods in conditions approaching those of the ocean. The manufacturer of the units refers to them as *Instant Oceans,* and sells the necessary natural salts for making up measured volumes of "ocean." The aquaria not only provide students who have never been to a marine laboratory a chance to see and study live salt-water forms of animals, but also make it possible for advanced students to work on special problems or do research on marine forms. The teaching in elementary zoology and invertebrate zoology has been particularly enhanced.