

## MARINE BACTERIOLOGY

GERHARD RHEINHEIMER\*

*Institut für Meereskunde an der Universität Kiel, Germany*

MARINE bacteriology deals with all groups of bacteria living in the sea, and with their functions. The marine bacterial flora mainly consists of slightly halophilic forms which need  $\text{Na}^+$  ions for the transport of nutrients into the cells. Their optimal salinities range from 20-40‰. Most of them are carbon heterotrophic organisms which feed on organic material. They could be found nearly everywhere in the marine environment: in sea water, in sediments, or in and on plants and animals—and in the littoral zone as well as in the deep sea. Their main function is the remineralisation of the organic matter which is produced by the phytoplankton and transformed in many ways by animals. Indeed there is hardly any organic compound of natural origin which could not be destructed by bacteria under favourable conditions. That means oxygen must be present and as well sufficient sources of nitrogen and phosphorus and in some cases also vitamins. The micro-organisms have a large oxygen consumption and they may cause a lack of oxygen in water bodies and sediments with relatively high nutrient contents. This could be found in the Indian Ocean in depths between 200 and 1000 m. In areas where oxygen has totally vanished denitrification and desulfurikation processes take place as happens mostly in polluted coastal areas but also in parts of the sea being isolated from an intensive water exchange with the oceans—as for example in the Black Sea. Thus the micro-organisms play a very important role in the cycle of elements. By destruction of the organic material they deliberate the plant nutrients ammonia, nitrate and phosphate and allow the manifold life in the sea as we know it today. But not only heterotrophic micro-organisms but also chemo-autotrophic bacteria are involved in remineralisation processes as the nitrofiors and some sulfur bacteria which transform ammonia via nitrite to nitrate, or hydrogensulfide to sulfate. Though the remineralisation of organic material is the main function of bacteria (and fungi) in the sea—micro-organisms however are very important in many other cases, too. Bacteria, fungi and virus are responsible for diseases of marine plants and animals. There are highly interesting symbioses—as those between luminous bacteria and different marine animals. Micro-organisms also play their role in the digestion of higher animals in the sea. Many processes of marine geology are influenced by micro-organisms—for example the formation of sediments and their diagenesis. The precipitation of calcium carbonate, iron or manganese compounds may be caused by bacteria, and also the formation of sulfur deposits and ores. Micro-organisms play the main role in the self-purification of polluted waters and sediments. Bacteria are responsible for fish spoilage, and the deterioration of nets, wood and concrete, and they may cause the corrosion of metals.

---

\* Key note address delivered at the Session on Marine Bacteriology at the 'Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin from January 12 to 18, 1971.

Marine microbiology started in the 1880 ties—only a couple of years after bacteriology has become a special discipline of natural sciences by the work of Louis Pasteur, Robert Koch and others. But in the following 4 decades it remained almost a domain of the surgeons especially those from research and navy vessels. In the 1920 ties the American scientist Claude E. ZoBell started with comprehensive investigations in the field of marine bacteriology and we may consider him the father of marine microbiology. With his many co-workers and students he did a lot of work in all fields of marine bacteriology and improved many methods in this discipline. His varying teams were engaged in bacteria counts in waters and sediments, with taxonomic, ecological and physiological work, and also dealt with problems of applied microbiology and geomicrobiology. ZoBell's book *Marine Microbiology* which was published in 1946 gives an impression of this work. It shows the great importance of bacteria and also of fungi for the biology and chemistry in the marine world.

In consequence more and more institutes of marine sciences established laboratories for marine microbiology, which are working mainly in the fields of microbial ecology, taxonomy and applied microbiology.

But most of the research work was done in the Atlantic and Pacific Oceans. So our knowledge of the microbiology of the Indian Ocean is still scarce. Some detailed work was done from coastal stations in India and South Africa—mainly on problems of hygiene and fish spoilage. But only on relatively few of the expeditions in the open Indian Ocean bacteriological research work was done.

So we need much more investigations in the fields of marine bacteriology in future, for the importance of bacteria for the marine biology and chemistry may hardly be underestimated. More co-operation between the microbiologists and the botanists, zoologists and chemists will help to improve the results of our research work and will give us the chance to increase the effect of marine sciences.