B I O L O G Y

Microbial Life on Surtsey

by
T.D. Brock
Dept. of Bacteriology
Indiana University
Bloomington, Indiana, U.S.A.

1. Introduction.

I visited Iceland during the dates July 25 through August 6, 1965, under sponsorship of the Surtsey-Iceland Research Committee. The purposes of my visit were threefold: 1) to look for early signs of microbial life on Surtsey, especially in marine bacteria of the genus Leucothrix; 2) to study Leucothrix mucor on the coasts of Iceland itself; and 3) to study thermal algae and bacteria in Icelandic hot springs. Although my time was limited, I was able to accomplish most of these goals.

2. Surtsey.

The new eruption altered the possibilities for work on Surtsey, so that my work here was limited. However, I was able to make a number of general observations which may be of some interest in the developing biology of Surtsey.

a) The primary requirement for the development of life is a source of energy. Energy on Surtsey is available in the form of light, but since photosynthetic plants have not developed yet, this source is not being used. Energy is also available on Surtsey in the form of organic substances which are being contributed by the excrement of birds and by materials drifting onto the beach. These materials are obviously secondary sources of energy, and their utilization on Surtsey would not be expected to be different from their utilization elsewhere, thus I did not think it particularly interesting to study microorganisms attacking these things. The contribution of organic matter from these sources should not be underestimated. Literally

hundreds of gulls and terns were seen roosting on Surtsey, and on one cliff on the South West side of the island, the rocks were almost white from excrement. The amount of material drifting ashore is also quite high, and I made a large list in about an hour, as seen in Table 1.

Table 1

List of materials drifting onto Surtsey which could serve as energy sources for living organisms

Kelp fronds
Gull feathers
Large tree stumps and logs
Lumber in the form of boards
Board with attached barnacles
Bottles with attached barnacles
Orange peels
Plastic net floaters
Egg carton
Orange crate
Wooden Barrel
Pieces of rope
Dead animals

Other items found on the beach which were nonorganic included: light bulb, metal float, empty bottle, glass fishing float.

The point of making the above list is to emphasize that for a considerable length of time the main influence on the development of life on Surtsey will come from secondary sources which arrive accidentally. For a self-contained ecosystem, the development of photosynthetic plants will be essential. At the moment, several factors will probably inhibit extensive development of terrestrial plants: 1) The continuing accumulation of ash, covering up any plants which take root; 2) the very porous nature of the rock and volcanic ash, restricting water-holding capacity; 3) the very salty nature of the rock and ash, preventing the development of non-halophytic plants. This last point might not be appreciated, but I observed on the South West side of the island that water which had leached through the soil and was dripping down in overhanging caves far above the zone of wave action was very salty, much more so than sea water.

Some organic matter might be created right in the volcano, from termally catalyzed reactions, using inorganic carbon compounds such as CO_2 as primary carbon source. Although probably not important quantitatively, the nature and composition of such materials would be of interest in relation to ideas on the origin of life. However, it would be essential to collect material directly from the eruption, since once the material reached the ground it could be contaminated by birds, etc.

The lagoon in Surtsey has a salinity of sea water, and the water can be inferred to be derived from the sea since I saw a metal fishing float and a bottle in the lagoon which undoubtedly came from the sea during a high water interval. At present this lagoon does not have a high biological development, but if it remains it should become productive, since it is shallow. My pH measurement on lagoon water was 7.25, which is a little low for sea water, so that I assume acidic materials from the volcano are present.

The ultimate biological development of Surtsey will probably be similar to the other islands in the Vestmannaeyjar. Since none of these islands have what would be considered a lush terrestrial vegetation, it is unlikely that Surtsey will be otherwise. Clearly it will be the marine vegetation which will be most highly developed. At present, there are no sea weeds on the rocks of Surtsey. It will be of great interest to follow the development of sea weeds on these rocks throughout the next few years, and this, to my mind, should be the major effect of the biological research.

3. Leucothrix mucor on Icelandic sea coasts.

My earlier work had shown that L. mucor occurred as an epiphyte in temperate waters on sea weeds growing on exposed coasts where there was much wave action. The hydrographic conditions of Iceland suggested that L. mucor would be common here, and this prediction turned out to be true. I isolated several new strains in pure culture from material

collected at Cape Reykjanes and along the coast near Reykjavik. In addition, I set up a number of radioautographic experiments which provided quantitative data on the growth rate of L. mucor directly in nature.

The results of this work have been incorporated into a paper: The habitat of Leucothrix mucor, a widespread marine organism, which has been submitted to the journal Limnology and Oceanography.

4. Work on Icelandic hot springs.

I had worked earlier on hot springs of Yellowstone and I found the opportunity to study the Icelandic hot springs very rewarding. In Iceland I visited springs at Hveragerdi, Geysir, Cape Reykjanes, and Reykjadals River by Reykholt. Quantitative studies were done in only one spring, and are found in the report: Temperature Optima for Algal Development in Yellowstone and Iceland Hot Springs.

In general, biological development is less extensive in Iceland than in Yellowstone springs, for reasons that are not completely known. As far as I can tell from the literature, I am the only person who has tried to compare springs from the two sources on a quantitative basis. The higher pH of the Icelandic springs may explain their poorer biological development.

The sea water hot spring at Cape Reykjanes, which is unique in the world, was completely devoid of biological development. The pH of this spring was around 5.0, which is low for sea water, and this may be responsible for its sterility. This spring should be studied further.

I was interested to observe the extent of commercialization of Icelandic hot springs. I expect to prepare in the near future an analysis of the potentialities of hot springs for biological productivity. I would hope, however, that at least some of the Icelandic hot springs could be protected from exploitation, since they are in many ways unique. The use of soap in the Geysir springs, which I observed

directly, is undoubtedly responsible for the lack of algal growth in many of the springs in this group. Good conservation ideals on a tourist attraction of the significance of Geysir would require a complete lack of human disturbance.