

# THE POISON PUMP AND THE SPITTING FISH

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# 1 Abstract

In 1854, cholera broke out in a neighborhood of London. While people didn't yet understand how diseases spread, the pattern of this particular outbreak was so unusual it seemed to have a message, though no one could read it. Only the people in one area of town got sick; as time passed, more people got sick here, but no where else. All the people on a street would get sick, up to one particular address, and beyond that, most people were healthy. It was only when a doctor drew the appropriate map of the district (and used the "walking-distance" metric!) that an explanation appeared.

In Africa, the mouthbreeder fish gather in sandy bottoms of rivers to breed. The females wander around, but the males tend to stay in one place, hollowing out a sort of pit in the sand by taking a mouthful and spitting it away. The initially random configuration of male fish eventually takes on a fairly regular pattern, with each fish in the center of a roughly polygonal region.

These are two examples of the occurrence of Voronoi diagrams. In this talk, we will also consider the dual concept of Delaunay triangulations, ways of computing these objects, whether by hand or by computer. We will also look at Monte Carlo techniques for approximately computing Voronoi diagrams, which allows us to work in higher dimensional spaces. We will consider a special version of the Voronoi diagram, in which the points are allowed to rearrange themselves (like the African fish), resulting in a roughly hexagonal grid. We will consider applications in sampling, quadrature, and (non-uniform) mesh generation.