

various organisms, we must first of all become acquainted with the external conditions governing floating and sinking; mainly owing to the investigations of Chun and Ostwald our knowledge on this point has increased greatly in recent years.¹

First and foremost among these conditions is the specific gravity of ocean water. If an organism has the same specific gravity as the sea-water it floats, because, according to the law of Archimedes, it displaces a volume of water equal to its own weight. When the specific gravity of the organism is greater than that of the water it has a surplus gravity and may possibly sink. If nothing counteracts its sinking, the velocity will be proportionate to the value of the surplus gravity (equal to the specific gravity of the organism minus the specific gravity of the water).

Specific gravity of the water.

Experience shows, however, that all objects of the same specific gravity do not sink with equal velocity. Fine sand particles float much longer in water than large pebbles, although they have the same specific gravity. This is due to a property more or less peculiar to all liquids, called the viscosity or the internal friction of the liquid, but in a liquid with a definite viscosity objects sink with varying velocity, which depends on what has been termed the surface resistance of bodies.

Viscosity of the water.

An object has a great surface resistance, and sinks slowly, when its surface is large compared with its volume, and when its surface presents a large area at right angles to the direction of the sinking.

Surface resistance of bodies.

Surplus gravity and surface resistance are the two properties in sinking bodies which determine the velocity of their sinking. The greater their surplus gravity and the smaller their surface resistance the greater is the velocity of their sinking. High specific gravity and great viscosity of the water counteract the sinking and require lower specific gravity and less surface resistance on the part of the organisms in order to keep them floating.

We will first consider the two "external conditions," the specific gravity and the viscosity of the water, and then discuss the faculty of regulating the surplus gravity and surface resistance possessed by the organisms, enabling them to adapt themselves to their surroundings. The importance of the two elements, specific gravity and viscosity, anywhere in the ocean

¹ See, for instance, Chun's *Reisebericht (loc. cit.)*; W. Ostwald, "Theoretische Planktonstudien," *Zoologische Jahrbücher*, Abtg. Systematik, etc., Bd. 18, Jena 1903; "Zur Lehre vom Plankton," *Naturwissenschaftliche Wochenschrift*, N.F., Bd. 2, Jena, 1903.