

# Chapter I

## Light and the Ancient Greeks

In this small volume I will attempt to describe the history of microscopy as well as introduce you to the functions of microscopes from early times to the ultra sophisticated techniques of the most modern laboratory. In order to do this I will describe some history of the earliest observations of effects of light and how magnification of small objects developed. In doing this you will be introduced to many new terms which I will try to explain as well as show how they were observed. Since this is a history of microscopy I will get ahead of the story to explain that the term “microscope” was coined in 1624 in Italy by members of the first Accademia Dei Lincei a group which included Galileo who is credited with being one of the early scientific users of the microscope. The word itself is derived from two Greek words small and to view.

Getting back to the Greeks there is a passage from that comic author Aristophanes (who lived in the 4th century B.C.) that describes globules of glass being sold in the grocery shops of Athens. They were called “burning spheres”. This may be the earliest mention of applied optics.

To learn about magnification one must look to a few simple principles of optics. Light always travels in straight lines. It seems obvious to us and has been taught since the time of Euclid around 300 B.C. Euclid has been called the founder of the science of optics.

If you put a small stick in a glass of water it appears bent (Figure I-1). This seems peculiar since we know light travels in straight lines but it is clear that it can also appear bent as when you look at a stick dipped into a pond or the stirrer in your afternoon

cocktail. This bending is called refraction and it occurs whenever light shines into a medium where it travels at a different velocity. An analogy is a line of equally spaced soldiers marching across a field and reaching a ploughed area.

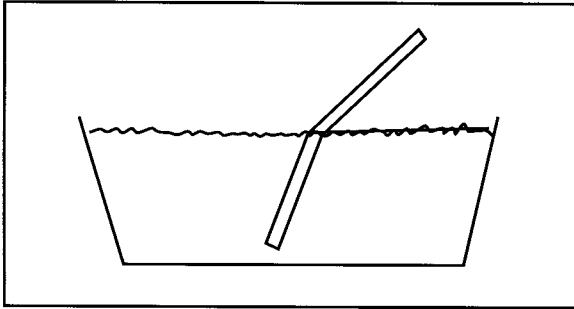


Figure I-1. Apparent bending of stick in water.

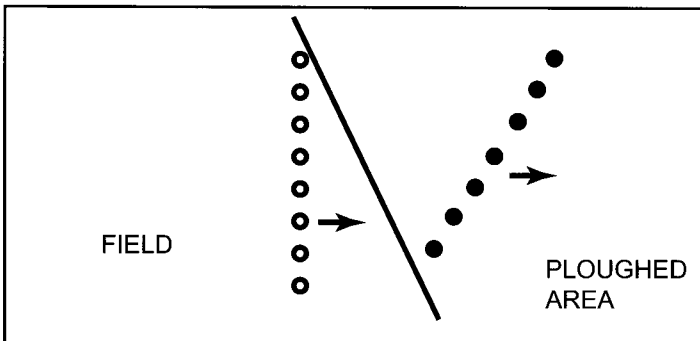


Figure I-2. Changing direction of a line of soldiers moving into a ploughed field.

The first soldier reaching the ploughed area slows down. The next one does also but if the soldiers maintain a straight line their directions will change as the wave front of a light beam does when it passes into a material of different density which changes its velocity (Figure I-2). This is the refraction caused by a difference in speed.

Effectively if a beam passes from a lower to a higher density medium it will be bent toward the normal (this is a line perpendicular to the surface.) (Figure I-3).

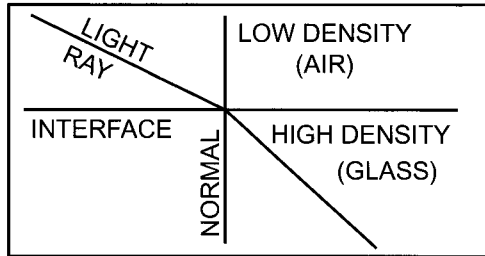


Figure I-3. Changing direction of a light ray moving into a dense medium.

As the sketch shows (Figure I-4), when a beam of light enters glass from air it changes directions. If the glass surface is curved then the further along the surface the light beam passes through the greater will be the angle that it is bent. This is basically how a lens works.

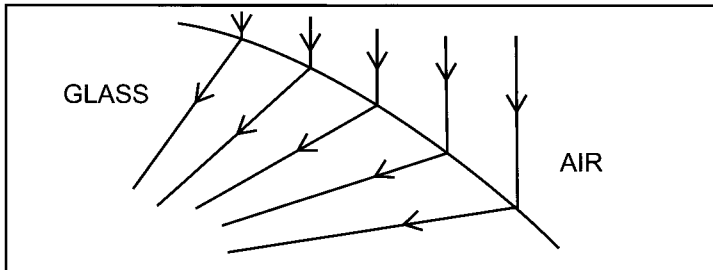


Figure I-4. Bending of light rays at a curved glass surface.

The first real lens is still a mystery but a discovery was made at Nimrod in the seventeenth century by Lanyard of a “polished” plano-convex piece of rock crystal which could be dated no later than 721-705 B.C. This was believed to be a magnifying lens of sorts.

Later examination showed it to be cloudy so it would not have very good optical properties and the “convex” surface is really the worn results of many irregular ground facets, so that it was probably an object of jewelry separated from its finding. Many older bits of polished glass or semi precious stone exist in museums but upon close examination they are usually remnants of jewelry.

There is a story in Pliny referring to a concave emerald used by the Emperor Nero to watch gladiator contests. Maybe it was the first monocle and could have helped his old-age myopia or maybe just eased his eyes from the noonday Roman sunshine.

After a hiatus of twelve centuries spectacles were “reinvented” around 1280 in Florence Italy. Credit was taken by a man named Amati who died in 1317 and had carved on his tomb credit for the invention that he only shared with a few of his close friends.