

**AN INVESTIGATION  
OF TERRESTRIAL  
REFRACTION**

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An Investigation of Terrestrial Refraction by George Edward King

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**GEORGE EDWARD KING**

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BY

GEORGE EDWARD KING Ph. B.

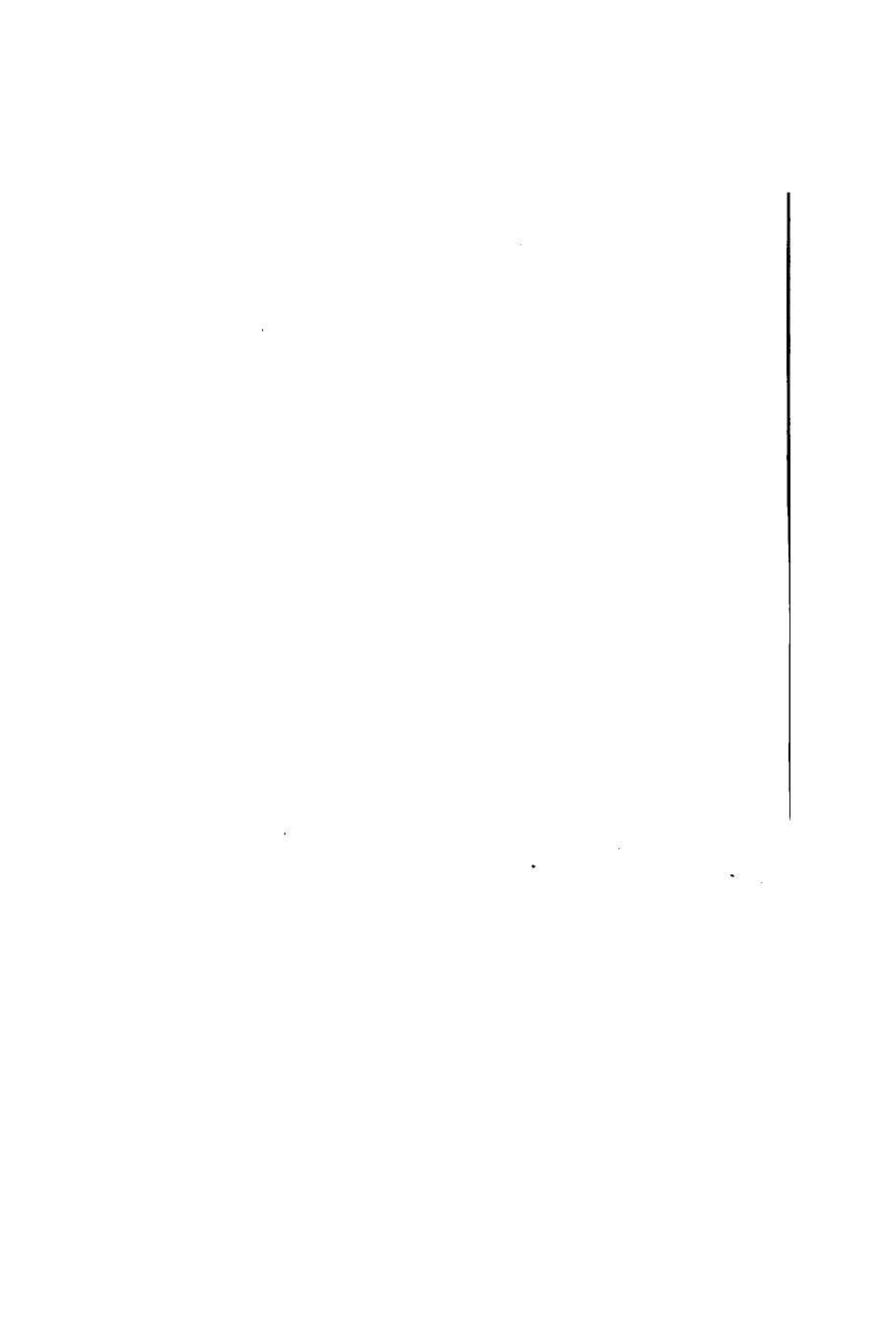
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AN INVESTIGATION OF TERRESTRIAL REFRACTION.

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The history of the subject of refraction bears with it considerable of antiquity, although we have no knowledge of when it first began to be studied; but undoubtedly from the earliest times men were familiar with the effect that water has upon a body as seen in or through it.

The earliest record of atmospheric refraction having been considered is that of Cleomedes, who lived about the time of the Emperor Augustus. He suggested that the sun may be seen while it is still a little below the horizon. He also, like Archimedes, was acquainted with the fact that an object, in the bottom of a vessel, just invisible when viewed at an oblique angle, may be made visible by filling the vessel with water.

Ptolemy measured angles of incidence and refraction but failed to discover the true law of refraction; which was discovered by Snell in 1619. He stated it thus:- For the same media the ratio of the cosecants of the angle of incidence and angle of refraction retains always the same value. A few years later Descartes gave us the form we use to-day, that is, "the

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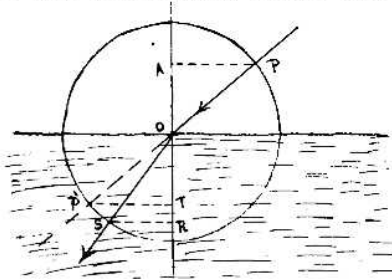
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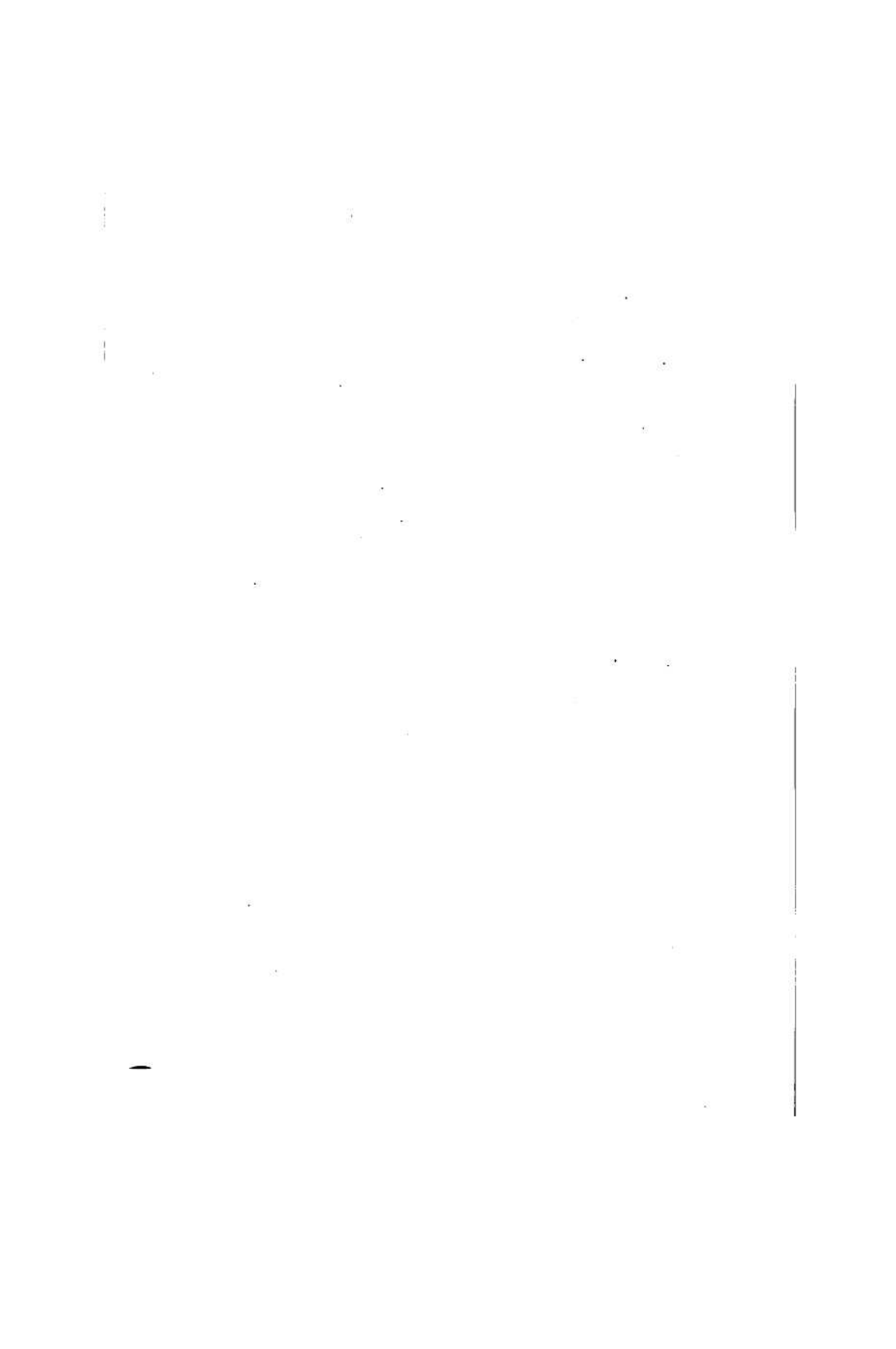


law of sines." Huygens was the first to elaborate the subject of atmospheric refraction according to the undulatory theory of light.

When a ray of light passes from one transparent medium to another, it undergoes a change of direction at the surface of separation; so that its course in the second medium makes an angle with its course in the first. This changing of direction is what is known as refraction. The phenomenon can be exhibited by partly immersing a stick in water in an oblique position, when it will present a broken appearance. The amount of this displacement varies with different media.



Snell's law can only be stated by reference to a geometrical figure or using the language of trigonometry. Let  $PO$  be a ray incident at  $O$  on the surface of separation of two media and let  $OS$  be its course after refraction. The angle  $POA$ , that is, the angle which the ray makes with the normal  $AR$  is called the angle of incidence and  $OSR$  is known as the



angle of refraction. With  $O$ , the point where the ray passes from one medium to the other, as a center describe a circle. Drop perpendiculars to the normal as  $PA$  or its equal  $P'T$  and  $SR$ . Then the law is that these perpendiculars will have a constant ratio. This ratio, with respect to a ray of light passing from a vacuum into any medium, is known as the index of refraction.

|                           |         |
|---------------------------|---------|
| The index for Air is..... | 1.0003. |
| Pure water is.....        | 1.336.  |
| Crown glass.....          | 1.545.  |
| Diamond.....              | 2.596.  |

The atmosphere may be regarded as a medium which varies continuously according to some given law. Or it may be said to be in concentric spherical strata with the center of the earth for the center of the spheres. The refractive index at any point may be regarded as a function of the co-ordinates of that point. Equating this function to a constant, we obtain the equation of a surface along which the refractive index is constant.

