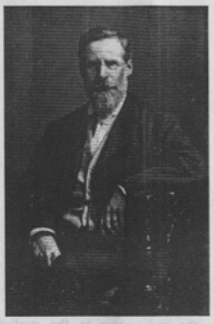
TARANG SCIENTIFIC INSTRUMENTS

Sir William Crookes



(1832-06-17)

Born	:	17 June 1832 London, England
Died	:	4 April 1919 London, England
Nationality	:	England
Fields	:	Physical chemistry Known for thallium

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THE WAY TOWARDS PRACTICAL SCIENCE

RADIOMETER

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DHARWAD
Phone : 0836-2775204
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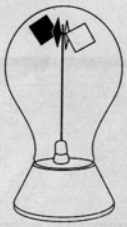
CROOKES RADIOMETER
Light Mill

Assembly :
Radiometer is made from a glass bulb from which much of air has been removed to form a partial vaccum in side the bulb on a low friction spindle is a rotor with 4 vertical light weight metal vanes spread equally around the axis. The vanes are polished or white on one side, black on the other side.



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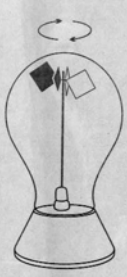
To do and observe :



Expose the radiometer to the sunlight or artificial light (60W bulb is enough). You will observe that the vanes turn with no apparent motive power, the dark sides retreating from radiation source and the light sides advancing.

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What is going on ?
When a radiant energy source is directed at radiometer, the radiometer becomes a heat engine. The operation of heat engine is based on difference in temperature that is converted to a mechanical output. In this case the black side of the vane becomes hotter than the other side, as radiant energy from a light source warms the black side by black body absorbing faster than the white side. The internal air molecules are heated up (i.e. experiences an increase in their speed) when they touch the backside of the vane. The gas molecules hitting the warmer side of the vane will pickup some of heat, bouncing off the vane with increased speed. Giving the molecule this extra boost effectively means that a minute pressure is increased on the vane. The imbalance of this effect between the warmer (black side) side and Cooler (white) side means the net pressure on the vane is equivalent to push on the black side and as a result the vanes spin round with black side trailing.

Followup :
1. Cooling the radiometer causes rotation in opposite direction
If you cool the glass quickly in the absence of a strong light source by placing ice on the glass or in the freezer with the door most of the way closed, it turns backwards (i.e. white sides are trailing). This demonstrates black body rotation from black sides of the vanes rather than black body absorption. It turns backwards because the black sides give off more heat and cool more quickly than the other side.

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