

Review Article

Propounding Darktom Theory: Ophthalmologist Perspective

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Abstract: To propose that “darktom” is the basic unit of darkness. Major databases including National Library of Medicine, PubMed and Cochrane Library were used in the literature search conducted in English. Light and darkness are two extremes in luminous world. Darkness appears to be contained in every sealed hollow object, a default that requires no energy unlike visible light which is a fraction of the electromagnetic spectrum. The luminous world with two competing phenomena: darkness and light, is at mutually exclusive equilibrium in which the presence of one elicits the absence of the other.

Keywords: Light, Darkness, Darktom, Luminous

1. Introduction

The nature of light has been extensively studied and reported. On the other hand, little is known about darkness, a phenomenon that makes light impactful. Light attains relevance because there is darkness to displace and perhaps conquer. A seeing human eye is sensitive to darkness much as it is to light because a blind eye sees nothing, not darkness. Darkness is not useless to human existence. It provides a general time of rest and energization: plants recover from photosynthetic activities and the bleached photo pigments of the human eye also recover, allowing for a smooth transition during dark adaptation. Darkness and light at various times blend in a unique manner to provide contrast for our understanding of colours, shapes and sizes of materials and objects we interact with in our day to day activities. Therefore, darkness is as important as light for ophthalmologists, other eye care professionals and scientists to understand. Darkness is a relative term being largely dependent on the background luminance on which a new light source shines. A brighter light illuminates further an area already illuminated by a less bright light. This illumination continues to be appreciated by the human eyes until the brightest light within the visible and tolerable spectrum of the human eye shines. Currently, most visual field analyzers have a standard background luminance

of 31.5 apostilbs (asb) [1]. It is expected that at this background luminance, targets in form of light of varying degrees of brightness could still be recognized by eyes being examined.

It is the thrust of this article to propound a darktom theory to explain what happens to darkness when light appears. In other words, explaining where darkness vanishes to whenever light beckons. It is believed that, like its predecessors, work of this nature borne out of curiosity largely from asking questions, would provide some thoughts for minds asking similar questions and provide a broad knowledge base on which further studies could be built.

2. Defining Darkness

Darkness is perceived and defined differently based on training, beliefs, norms and cultures. In Physics, an object is said to be dark when it absorbs photons, causing it to appear dim compared to other objects. For example, matte black paint does not reflect much visible light and appears dark, whereas white paint reflects lots of light and appears bright [2]. Artists use darkness to emphasize and contrast the presence of light to create artistic impressions. Color paints are mixed together to

create darkness, because each color absorbs certain frequencies of light. Theoretically, mixing together the three primary colors, or the three secondary colors, will absorb all visible light and create black. In literature, darkness is used to connote the presence of shadows, evil, and foreboding while light is a harbinger of fortune and goodness [3].

In the religious circles, darkness and light are mentioned with darkness representing a place of torments, displeasures, and wickedness to those who violate the tenets of a Supreme Being. Light, on the contrary represents eternal bliss, godliness, immaculate cleanliness of a Celestial Being. Darkness is often taken as bad or evil while light connotes good. In a strict religious setting, darkness is hardly or sparingly mentioned as it could superstitiously spell doom to the offender. Nothing good is ever thought to be associated with darkness and may be partly responsible for paucity of empirical information on it. Only anecdotal resources abound on darkness largely influenced by fables handed down a family line, religious settings, or cultural lineage. Over the ages, scientific discoveries appeared to have impacted little on strongly held ideology on the phenomenon of darkness.

3. The Light Phenomenon

Visible light (wavelength, 400-700nm), an infinitesimal fraction of the electromagnetic spectrum, is an energy whose interaction with the retina gives a sensation of sight [1, 4]. Many theories swept across centuries in attempts to explain the nature of light [5-8]. Newton's corpuscular theory (1675), proposed that light consisted of tiny particles called corpuscles capable of undergoing reflection and refraction. Three years later, 1678, Huygens' wave theory came up and proposed that light moves in form of waves, with crests and troughs and could undergo interference and diffraction. Almost two centuries elapsed before Maxwell's electromagnetic theory (1873) came on board. Einstein's quantum theory (1905) addressed photoelectric effects of light which its predecessors ignored [5-9]. Put together, light possesses the characters of both waves and particles (dual-nature theory).

4. Photo-Chemical Reactions in the Dark

Retinal photoreceptors depolarize in scotopic conditions (dark environment). In the dark, cyclic Guanosine Monophosphate (cGMP) levels are high and keep cGMP-gated sodium channels open allowing a steady inward current, called the dark current. This dark current keeps the cell depolarized at about -40 mV. The depolarization of the cell membrane in scotopic conditions opens voltage-gated calcium channels. An increased intracellular concentration of Ca^{2+} causes release of excitatory glutamate into the synaptic cleft. In photopic conditions (lite environment), they hyperpolarize to a potential of -60mV. It is this 'switching off' that activates the next cell and sends an excitatory signal down the neural pathway to the visual cortex [10-12].

5. Darktom Phenomenon

The author is of strong opinion that darktoms exist, the aggregation of which causes visual perception of darkness. Darkness is unlikely to be a continuous phenomenon like a spreading sheet of blanket. Rather, it appears to be made up of individual units which are separable. This is akin to many things in nature of vast abundance that are made up of smaller units. For instance, oceans and thick clouds are made up of water droplets.

6. Discussion on Darktom Theory

Darktom is being proposed by this article to be the basic unit of darkness akin to the corpuscles Newton thought constituted light. It is being considered that darktoms are held together by strong forces called darktomic forces which can only be overcome by light corpuscles. The quantity of light emitted (luminous flux, measured in Lumen) and light emitted per unit solid area (luminous intensity, measured in Candela or Lumen per Steradian) determine the compactness of darktoms and consequently the density of darkness. The possibility is that there exists a state of absolute darkness when there is an absolute absence of light. If this exists in real life, darkness may both be seen by the eyes, as it currently is and in addition be felt by human sense of touch. In this scenario of absolute darkness, darktoms would have maximum compactness. And on other hand, there is the plausibility of another polar extreme of absolute light when all darktoms are separated by the longest possible inter-darktomic space and all darktoms can be said to exist at an infinite distance called "darktom ad infinitum"(DAI) or "darktom remotum" (DR). If this exists in reality, the brightness may be too unbearable to the human eyes.

Nature leaves no vacuum; hence the content of an enclosed hollow object by default is darkness (see figure 1).



Figure 1. Total darkness in an enclosed hollow space.

Depending on the size of a hollow object, darkness ranges from the minutest single darktom to the size of the universe we

live in. The earth's atmospheric space without the sun will be in utter darkness. Figure 2 below shows that darktoms close to the luminous object have increased inter-darktom spaces caused by wide separation from light corpuscles.

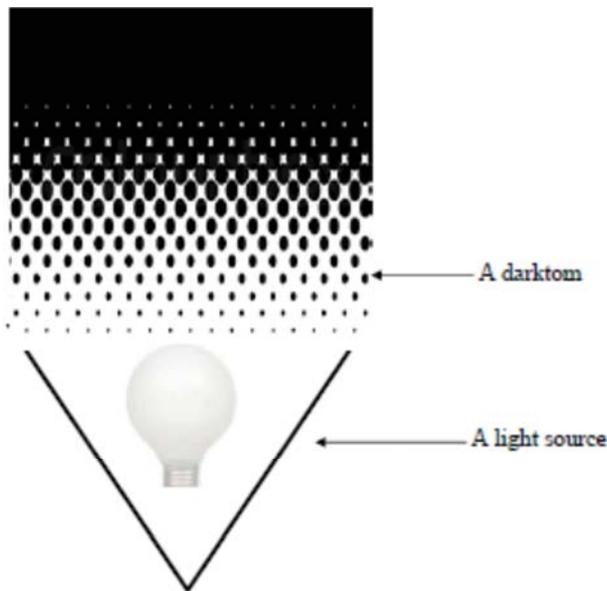


Figure 2. Inter-darktom spacing and darktomic density.

Therefore, there is increasing darktomic density away from a luminous object which results in imperceptible increasing darkness from a luminous object.

When light shines in the dark, it sculpts the shape of its source in the vast sea of darkness (see figure 3).



Figure 3. A candle light sculpting its shape in the dark.

This carved out shape of luminous object forms a zone of light dominance (ZLD), the perimeter of which peripherally displaced darktoms reside. ZLD is an illuminated island

within a vast sea of darkness. ZLD has increasing diatomic concentration (density) towards its periphery that blends imperceptibly to the unilluminated perimetric darktoms (see figure 4).



Figure 4. Increasing ZLD's perimetric darktomic density.

This perhaps explains why darkness returns at the same speed a luminous source is being taken away as against sound waves that produce delayed effect between the source of production and point of perception. Slower speed of transmission is an additional explanation for the disparity encountered in sound transmission. The logic is that darktoms are "hovering" around light and resurface at the instance of light disappearance.

Whereas the illumination produced by light is finite (ZLD), determined by the size and perhaps the intensity of the luminous object (luminous flux and luminous intensity), darkness is infinite, occupying an enclosed hollow object in its entirety. Bright light produces far-flung darktoms with its ZLD having longer radii. Dull light, on the other hand, has short ZLD radii. For instance, a candle light with 1 Candela of brightness produces short radii of ZLD that illuminates the immediate zone around the lighted candle stick. A fluorescent light of over a thousand Candelas illuminates a much larger ZLD.

It then means every light source has a darktomic radius (r^d) that is directly proportional to its luminous flux and luminous intensity (L^d) i.e. $r^d \propto L^d$. This translates to; $r^d = \phi \cdot L^d$. Where ϕ is an obstacle in the way of luminous object. ϕ is unity if no obstacle exists or the obstacle is completely transparent with zero illuminance.

It appears that the surfaces of darktoms have zero illuminance i.e. no reflectivity. Consequently, they do not reflect incident light and has no capacity to emit same (zero luminance). Interestingly, an opaque obstacle along the path of a light source, casts a shadow called silhouette, within the ZLD. A silhouette is an area of high darktomic concentration within a ZLD. A silhouette occurs when forcefully displaced darktoms by a luminous object are blocked by an obstructing opaque medium within a ZLD. The shape and direction of a silhouette is determined by the shape of the opaque medium and the angle at which it is being hit by light source

respectively. The density of the silhouette, on the other hand, is determined by the extent of obstruction of light rays by the obstacle which is a function of its opaqueness. It is thought that an opaque medium in the way of a projected light carves a silhouette that extends from the obstructing medium to darktom ad infinitum (DAI). This can be conceptualized as a bottomless darktom-filled groove, encapsulated in ZLD and stretches posterior to obstructing medium to DAI.

7. Conclusion

Darkness is not an indivisible spreading sheet but composed of densely populated darktoms only separable by a light source. The intensity of the light determines inter-darktom space and hence the extent of illumination experienced. By this theory, it is hoped an insight has been given and the existing knowledge on luminous world broadened to accommodate exploratory research for more discoveries.

8. Operational Definitions of Key Terms Used in the Text

Luminous flux: The total flow of light in all directions from a source and measured in lumen

Luminous intensity: Intensity of light emitted from a source measured as the flow of light per unit solid angle of space extending away from it, measured in Candela or Lumen per Steradian

Candela: The luminous intensity of a standard candle. In general sense, it connotes light reflected or emitted in only one direction and not the entire light leaving a surface in all directions.

Illuminance: When luminous flux is incident on a surface, the surface is said to be illuminated. It is measured in Lumen per square meter or Lux.

Luminance: It is the emitted light from an illuminated surface. Measured in Candela per square meter

Brightness: Sensation produced by a given illuminance on the retina.

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