

Institute for Christian Teaching
Education Department of Seventh-day Adventists

**SPIRITUAL LESSONS FROM THE PROPERTIES OF LIGHT:
A PHYSICIST PERSPECTIVE**

by

Priscilla Pilly
University of the Southern Caribbean
Trinidad, West Indies

**704-12 Institute for Christian Teaching
12501 Old Columbia Pike
Silver Spring, MD 20904 USA**

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Introduction

The purpose of this essay is to appreciate God's design in the creation of light. God said, "Let there be light." Only God knows how many details are hidden in this one small sentence. Whenever I teach my students about light, I always try to combine my faith with the lesson that I am going to teach. In the process, I also begin to appreciate more of God's love for us. As humans we have a limited knowledge, and therefore we cannot fully comprehend God's infinite wisdom. After many discoveries by scientists, we are now able to understand very little about the light that came into existence when God made the pronouncement on that first day of creation.

The student body that sit in my class consists of a heterogeneous mixture of three conflicting ideologies. The first type which holds a premodernistic philosophy believes that Scripture is given by the inspiration of God; they believe that truth originates from God. In the second group we have students with a modernistic scientific mind – they believe in the method of collecting the data analysing then drawing conclusions out of it. In this case, the truth is established by looking at the figures and by interpreting the data. And the third group comprises of postmodern youth. This group of students has the I-concept. What they think and what they say is the truth. It is really challenging to teach this last group the Christian faith and by extension, Seventh-day Adventism. When I confront this type of students every day, I realized that I need to follow the teaching method of Christ. He taught them the heavenly principles by using parables. This method can be used in any area of physics and by any other educator. So I take topic of light and split it into different sections, and compare it with the basic biblical principles.

An approach to postmodernism

Modernism is a movement that expresses itself by reason and expressed itself fully through science. Newton and Bacon regarded physical reality as operating on the basis of natural laws. Modern science is empirical in methodology and rational in interpretation. The 20th century emphasized the application of scientific methodology to academic disciplines. In the process modernism has brought environmental degradation, totalitarianism in the name of science, global wars using the most advanced technology, and atomic destruction. Reactions over modernism resulted in the advent of postmodernism.

We find these types of people where ever we go. I don't have a problem with a student who has a pre - modern or modernistic views, but I find it more challenging to handle a postmodern youth. As an Adventist educator I don't reject their idealism. Instead, I can say and agree with the postmodernist that our knowledge is limited (Gary Land, 1996). As Paul said in I Corinthians 13: 12 "But now we see in a mirror, dimly but then face to face. Now I know in part, but then I shall know just as I also am known."

When a student comes to me with this type of ideology, I stand outside both modernism and postmodernism. I evaluate him critically and then identify the points of agreement where dialogue can begin. I Enter into dialogue with our post -modern friend knowing that our discourse is not inter- textual (to use postmodernist terminology) then try to built the discussion on faith in the God who revealed Himself to us through the Word and through His Son, Jesus Christ. As E. G. White wrote in her Letter²: "we need to fill the hearts and minds with the solemn and sacred truth for this time, dwell on the present truth, on Christ's coming. The Lord is coming very soon; we have only a little while in which to present the truth for this time – the truth that is to convert the souls." To present the truth to our students there must be diligent work, earnest prayer and faith to meet the needs of our students.

A brief History of the Nature of Light

The earliest scientific theories on the nature of light were proposed around the end of the 17th century in 1690 by Christian Huygens, (1629–95) a Dutch mathematician and physicist. He proposed a theory that explained light as a wave, which was discussed earlier. However, a rival theory was offered by Sir Isaac Newton (1642–1727), the English mathematician and natural philosopher (Physicist) who is considered by many the greatest scientist that ever lived. Newton, who had discovered the visible spectrum in 1666, held that light is composed of tiny particles, or corpuscles, emitted by luminous bodies. By combining this corpuscular theory with his laws of mechanics, he was able to explain many optical phenomena.

For more than 100 years, Newton's corpuscular theory of light was favoured over the wave theory. Finally, important experiments were done on the diffraction and interference of light by Thomas Young (1801) and A. J. Fresnel (1814–15) that could only be interpreted in terms of the wave theory. The polarization of light was still another phenomenon that could only be explained by the wave theory. Thus, in the 19th century the wave theory became the dominant theory of the nature of light.

The wave theory received additional support from the electromagnetic theory of James Clerk Maxwell (1864), who showed that electric and magnetic fields were propagated together and that their speed was identical with the speed of light. It thus became clear that visible light is a form of electromagnetic radiation, constituting only a small part of the electromagnetic spectrum. Maxwell's theory was confirmed experimentally with the discovery of radio waves by Heinrich Hertz in 1886.

Modern Theory of the Nature of Light

The electromagnetic theory, however, failed to account for the phenomenon of photoelectric effect, emission of electrons from a conductor by light incident on its surface. The solution to the problem was proposed by Einstein in 1905. Einstein extended the quantum theory and postulated that the energy in light beam, instead of being distributed through electric and magnetic fields of an electromagnetic wave was concentrated in bundles of energy called light quanta, or photon. The energy of each photon is directly proportional to its frequency.

With the development of the quantum theory of atomic and molecular structure by Niels Bohr and others, it became apparent that light and other forms of electromagnetic radiation are emitted and absorbed in connection with energy transitions of the particles of the substance radiating or absorbing the light. In these processes, the quantum, or particle, nature of light is more important than its wave nature. When the transmission of light is under consideration, however, the wave nature dominates over the particle nature. In 1924, Louis de Broglie showed that an analogous picture holds for particle behaviour, with moving particles having certain wavelike properties that govern their motion, so that there exists a complementarity between particles and waves known as particle-wave duality.

The present standpoint of physicists is to accept the fact light is dualistic in nature. The phenomenon of light propagation may be best explained by the wave theory, while the interaction of light with matter in the process of emission and absorption is a particle phenomenon.⁵

He is the light of the world. John 9: 5

The Holy Bible talks about light in different occasions. How do I explain this to my students? Mother Teresa was the mother of many poor people in India. Without thinking about the comforts of life, she served the blind, orphans, old people, the people who had no hope in life and she received the Nobel Peace prize. She became a light to the people in the city of Calcutta, India. There are many orphanages all over the

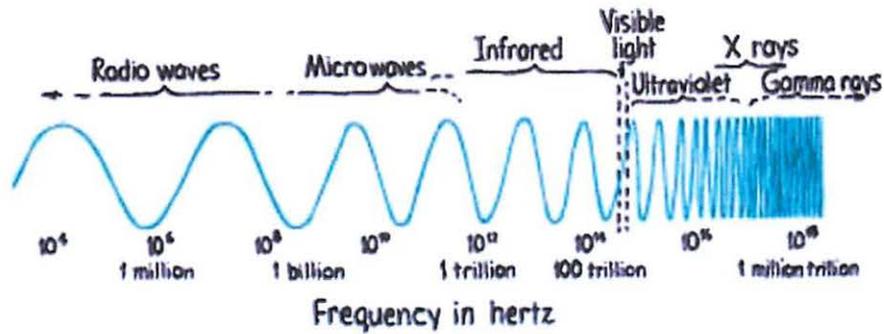
world. Similarly, Mahatma Gandhi became “father of the nation”, because he led the country to independence. As a result of his sacrifice, India is no more under the British colonial rule. It is a free democratic country.

Jesus, who was born to a virgin, also fed the hungry, clothed the naked, healed the sick, and resurrected the dead to life. His name is still remembered by many. In addition to that, he taught the lessons of life, and did many miracles; was crucified and risen from the dead and was ascended to heaven. Till today we have not seen anyone who was dead and resurrected and ascended to heaven in the entire history of the Earth. We called Mother Teresa as the light to the city of Calcutta, Mahatma Gandhi as the father of nation; so what do we call Jesus? He can for sure be called God still remembered not only for his great works, but for His sacrifice for the entire humanity. John 1:1 says” In the beginning was the word, and the word was with God, and the word was God.” In the same book it is written, He is the light of the world. John 9: 5 (NIV).

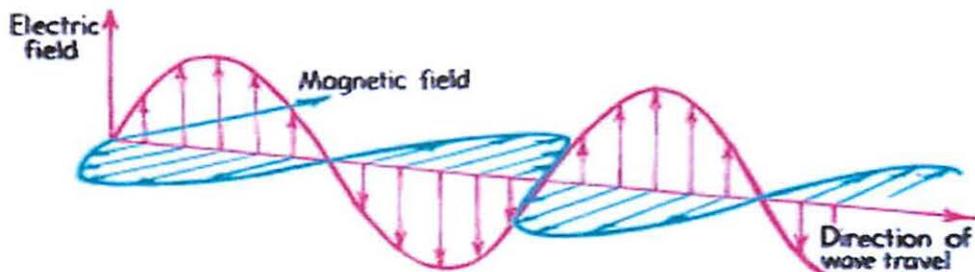
God is the source of light for the entire universe, including the humanity. He created the greater light “Sun” to rule the day and a lesser light to rule the night. (Gen 1:16) In the presence of sunlight, everything can be seen very clearly, As the sun shines equally on every one, God’s love shines on everyone of us. But those who accept him receives His light. Then they become the light of the world as it is written in the book of Matthew 5:14. You are the light of the world, a city that is set on a hill cannot be hidden.

What is Light?

The sun is the source of light for our planet Earth, emits electromagnetic radiation and an influx of charged particles, for the very survival of our planet. The sun emits enormous amount of energy, but only a fraction of energy that the earth intersects. Electromagnetic radiation comprises of a range of wavelengths, together we call it as electromagnetic spectrum.



As we see in the above diagram, electromagnetic spectrum comprises of radio waves through gamma rays in the increasing order of frequency. Light, which is the visible portion is only a very little portion of the entire electromagnetic spectrum. And our eye surprisingly is sensitive only to this visible part of the spectrum, which was created two days before the creation of man. Here I see the wisdom of God, when He created the Sun to give light in the day; it not only was made to give visible light, but also the invisible part of it. And the first man who was created in the image of God was able to see only the visible light. When these visible rays impinge on the retina of our eye, we see the objects around us.



When God created He not only created light but also other portions of the spectrum, which are useful to us. For example:

Radio waves are used in radio, T.V. communication systems.

Microwaves are used in radar, long distance wireless communication via satellites and in microwave ovens.

Infrared waves are used in green houses to keep the plans warm and in warfare to look through haze, fog or mist.

Visible light is for sensation of sight.

Ultraviolet light is used in detection of invisible writing, forged documents, finger prints and to preserve food stuffs.

X-rays reveal structures of inner atomic electron shells and crystals, help in medical diagnosis.

Gamma Rays provide information about structure of atomic nuclei.⁶

Revelation of God

Let me talk about vision. Vision is achieved when the eyes and brain work together to form pictures of the world around us. Vision begins with light rays bouncing off the surface of objects. These reflected light rays enter the eye and are transformed into electrical signals. Millions of signals per second leave the eye via the optic nerve and travel to the visual area of the brain. Brain cells then decode the signals into images, providing us with sight. God gave us eyesight with a purpose in our lives. He wants us to be able to discriminate good and evil, that we may enjoy life to the full.

John 5: 35 He was a burning and a shining lamp, and you are willing for a time to rejoice in his light.

Psalms 119:105 Thy word is a lamp unto my feet, and a light unto my path.

As stated in the Bible the ruler of this world has blinded his children but God reveals Himself to us in many ways. Our duty is to go to Him to get the light on vision. As the scripture says, a blind cannot lead another blind. So to help our friends we need to receive first a revelation of God. Acts 26: 18 To open their eyes, and to turn them from darkness to light and from the power of Satan unto God, that they may receive forgiveness of sins, and inheritance among them which are sanctified by faith that is in me.

2 Corinthians 4: 4 In whom the god of this world hath blinded the minds of them which believe not, lest the light of the glorious gospel of Christ, who is the image of God, should shine unto them.

2 Corinthians 4 : 6 For God, who commanded the light to shine out of darkness, hath shined in our hearts, to give the light of the knowledge of the glory of God in the face of Jesus Christ. Therefore It is our duty to take our students to the greater Light to reveal Him to them.

Light is only a small portion of the electromagnetic spectrum that we can sense with our natural senses. There is a lot to which we are being exposed, which passes through the eye and which we are not aware of. The eye is a very powerful sense organ. An estimation has been made that the eyes can be moved to focus on no less than 100,000 distinct points in the visual field. As a Christian educator, we need to pray that God to open the eyes of our students, so that may see the things they cannot see. This is the experience of conversion. Once they are changed they become the children of God. For this to take place we need to build confidence in ourselves first. We are like the sower who sows the seeds and waits for them to germinate. The moment one receives a revelation of God, he is a new person, because the light dispels the darkness that was once in him.

Properties of light

Light has two types of sources. God is the primary source. When we accept Christ we become the secondary source of light, that is we reflect the light of God that has been received. Without light everything around us would be in darkness. We also know that the sense of sight is very important to us for it provides us with the link to and information about the outside world. We can see an object in one of two ways: 1) the object may be a light source e.g. a light bulb, fire or a star and 2) an object where by light is reflected off of it for example, the moon. Light is also made of several different properties, such as:

Wave Properties

1. Reflection
2. Refraction
3. Diffraction
4. Interference

Particle Properties .

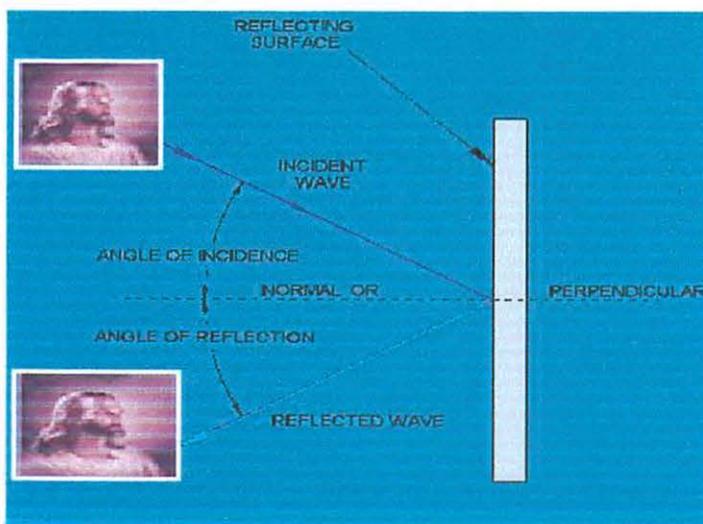
- 1 Photoelectric effect

Spiritual Lessons from the properties of Light

Now that we have several properties of light, we can now take a look at some scriptural references and examples from the scripture, and possibly link them to the properties of light.

a) Reflection of light.

We say light is reflected when it returned into the same medium from which it came. When a wave approaches a reflecting surface, such as a mirror, the wave that strikes the surface is called the incident wave, and the one that bounces back is called the reflected wave. The angle between the incident wave and the normal is called the angle of incidence. The angle between the reflected wave and the normal is called the angle of reflection.



If the surface of the mirror is smooth and polished, each reflected wave will be reflected back at the same angle as the incident wave. The path of the wave reflected from the surface forms an angle equal to the one formed by its path in reaching the medium. This conforms to the law of reflection which states: The angle of incidence is equal to the angle of reflection.

The amount of incident-wave energy that is reflected from a surface depends on the nature of the surface and the angle at which the wave strikes the surface. At any incident angle, a mirror reflects almost all of the wave energy, while a dull, black surface reflects very little.

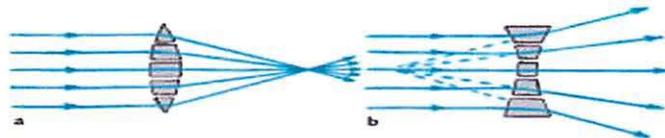
Matthew 5:16 In the same way, let your light shine before men, that they may see your good deeds and praise your Father in heaven . In letting our light shine before men, Jesus requires us to be smooth mirrors, so we may reflect His image exactly how the object (Jesus) is so others will see him instead of us. Also being a smooth mirror entails knowing him well and having a close connection with Him. If we don't have the connection, we will be just like a dark surface that does not reflect much light.

b) Refraction of light

Light bends in passing obliquely from one medium to another, we call the process refraction. Refraction occurs when light passes from either from air to glass or glass to water and so on.

Let me compare the our heart as the transparent medium or our willingness to obey Him, to a convex lens which converges light rays at the focal point called focus after refraction. Mark 3:15 And he had power to heal sickness. Matthew 10:8 Heal the sick, cleanse the lepers, raise the dead cast out devils; freely ye have received, freely give.

(a) A converging (b) A diverging lenses

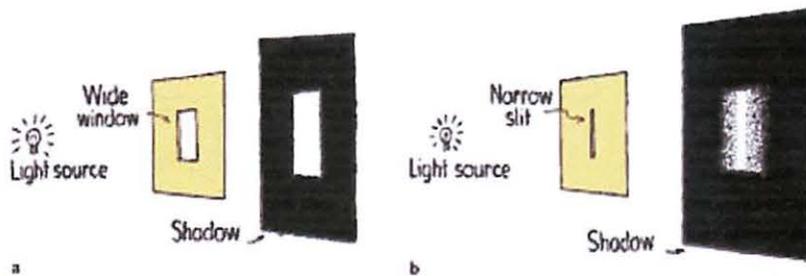


If we ask anything in the name of Jesus, according to His will he will grant us. In the book of Matthews, as it is written ask it will be given, seek ye shall find and knock it will be opened to you. So if we allow the Lord to work through us He will cleanse, heal, raise the dead etc.

When Jesus spoke to Lazarus, who was dead and buried for four days, his words penetrated through his body and he came out of the grave with the resurrected body. When we ask anything in His name, his word refracts through our heart or body which I took it as a converging lens focuses at a point and emerges out. Then his/her countenance manifests the changes that take place within their body.

c) Diffraction

Diffraction is the apparent bending of light waves around obstacles in its path. Let me consider the example of diffraction of light waves through a single slit. When light passes through an opening that is larger than the wavelength of light it casts a shadow such as that shown in Figure a. We see a rather sharp boundary between the light and dark areas of the shadow. But if the light through a thin razor slit in a piece of opaque cardboard, whose opening is much smaller or equal to the wave length of light, we see that the light diffracts figure b. The sharp boundary between the light and dark areas disappears, and the light spreads out like a fan to produce a bright area that fades into darkness without sharp edges. The light is diffracted.

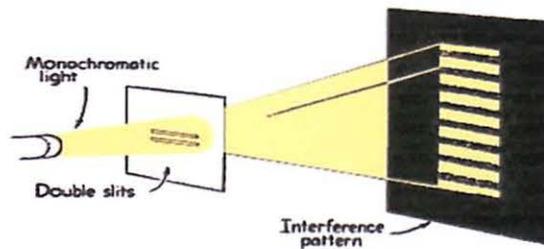


Diffraction is more pronounced when the opening, or aperture, or the barrier is similar in size to or smaller than the wavelength of the incoming wave. In the above diagram we see a light source and an illuminating slit.

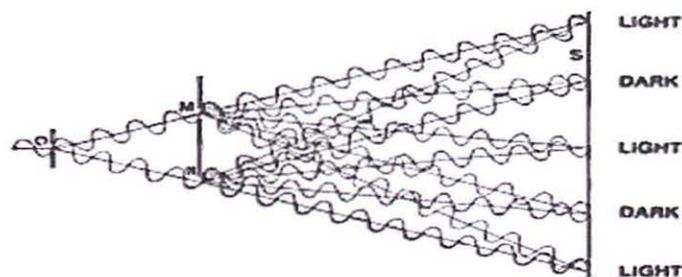
God is the source of light, he/she is the slit. A beautiful diffraction pattern can be seen only when the light width of the slit is comparable to the wavelength of light. God likes to see a beautiful pattern around us and this is possible only when our will coincides with the will of God.

d) Interference of light.

When two light waves of the same frequency travel simultaneously in the same direction then, due to their superposition, the resultant intensity of light at any point in space is different from the sum of intensities of the two waves. At some points the resultant intensity is maximum while at some other points it is minimum (nearly darkness). The re-distribution of light intensity due to superposition of two light waves is called interference of light.



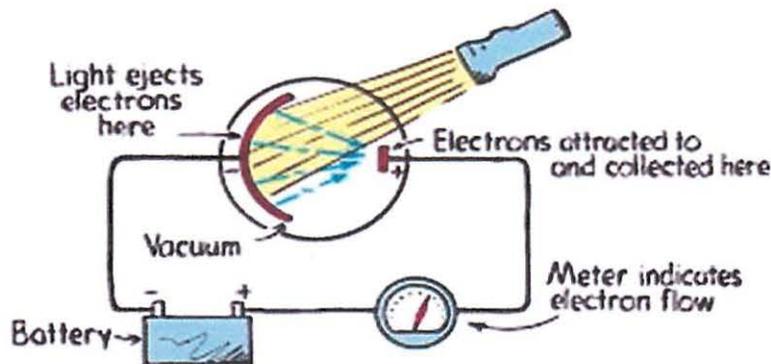
In the above diagram,⁷ we see a single source of light illuminating two slits. Light travels from these slits interfere and forms a pattern of alternate bright and dark fringes on the screen. In the diagram below, light or bright fringes are formed, when waves from both slits arrive in phase, dark fringes result from the overlapping of waves that is out of phase.



This analogy basically applies to family setup. Both the husband and wife are to be guided by one source of light or walk in unison then they both form a beautiful picture in their life. This type of life I call as a Christ-centered life. I call this as constructive interference. This is a very good principle for the stable families. If the husband and wife are guided by different sources of light or do not walk in unison, that family might not be stable. Because they always differ in their plans and goals, which ends up with conflict. This type of interference is called as destructive interference. We have many examples in the Bible, about a Christian home. Colossians 3: 18-19 talks about a Christian home. "Wives, submit to your own husbands, as is fitting in the Lord, Husbands, love your wives and do not be bitter toward them."

e) Photoelectric effect.

Photoelectric effect is the formation and liberation of electrically charged particles in matter when it is irradiated by light or other electromagnetic radiation. In photoelectric effect, electrons are liberated from the surface of a metallic conductor by absorbing energy from light shining on the metal's surface. The electrons emitted from the plate are attracted by the positive plate, so that circuit is completed and current flows. The effect is applied in the photoelectric cell, as shown below.



Acts 9: 3, 4 And as he journeyed he came near Damascus, and suddenly a light shone around him from heaven. Then he fell to the ground, and heard a voice saying to him, "Saul, Saul, why are you persecuting Me?" In these verses we

see the conversion of Saul to Paul, after a bright light shone on him from heaven. Conversion of a person takes place only when a greater power intersects us. The person is a completely a new person. He received energy from the living God that enabled him to go and preach the gentiles the good news of God. In the same way when God Calls us for his service, we will be able servants and instruments to serve others.

f) Dual nature of light

Jesus was called the Lord many times in all the gospels. He was called Lord by the disciples and also by the people. He was hungry, tempted by the Satan just like anyone of us. In the New Testament, the writers of the gospel referred Jesus as someone who lived in Palestine. Many times he was called as Lord by many. After he died they spoke about their experiences of the risen Christ as though he was divine. When Jesus was on this earth, he was fully human, but without yielding to the desires of the world, because He was in constant touch with His father8.

We too exhibit a dual nature in our lives. We are so fragile in our nature. Sometimes we try our best to obey God, but we also have times when we fall back to sin.

Ephesians 5:8 For you were once darkness, but now you are light in the Lord. Walk as children of light.

Ephesians 5: 13 But all things that are exposed and are made manifest by the light, for whatever makes manifest is light.

Ephesians 5: 14 Therefore He says: "Awake, you who sleep, arise from the dead, and Christ will give you light.

The Scriptures always give us comfort and strength, when we meditate them every day. So we need to remain firm on the promises of the Lord. Then whatever we do, wherever we go we will be victories. God is looking for this type people who remain faithful to him till the end.

Conclusion

As an educator, we impart knowledge to our students. But a Christian educator is more responsible not only to train them for this world but also to the world to come. As we have seen in this paper, the properties of light talks about our sinful nature and the salvation that was brought to us through the death and resurrection of Christ to see his image in us. In the process of reflecting God's image, God leads us with his mighty hand, and enable to pass through the trails and temptations. But He wants us to follow Him with a willing heart, by standing on His promises.

Light is visible to us and without light, we cannot think about our very existence, the same way without the Light of this Universe we can't survive. This we have to put into the minds of these young ones, because they will be our future leaders.

In this paper I made an attempt to teach the spiritual lessons from the properties of light, not only to our post modern man but also to everyone that we come across.

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