HINDSIGHT
Journal of Optometry History

July, 2009
Volume 40, Number 3

Official Publication of the Optometric Historical Society

Hindsight: Journal of Optometry History publishes material on the history of optometry and related topics. As the official publication of the Optometric Historical Society, Hindsight: Journal of Optometry History supports the purposes and functions of the Optometric Historical Society.

The purposes of the Optometric Historical Society, according to its by-laws, are:
- to encourage the collection and preservation of materials relating to the history of optometry,
- to assist in securing and documenting the recollections of those who participated in the development of optometry,
- to encourage and assist in the care of archives of optometric interest,
- to identify and mark sites, landmarks, monuments, and structures of significance in optometric development, and
- to shed honor and recognition on persons, groups, and agencies making notable contributions toward the goals of the society.

The official publication of the Optometric Historical Society, published quarterly since its beginning, was previously titled:
Newsletter of the Optometric Historical Society, 1970-1991 (volumes 1-22), and
Hindsight: Newsletter of the Optometric Historical Society, 1992-2006 (volumes 23-37).
Hindsight: Journal of Optometry History began in 2007 with volume 38, number 1.

On the cover: The drawing represents OHS for Optometric Historical Society: the O an elementary schematic of an eye, the H three intersecting pairs of spectacles, and the S a representation of a light wave with the Greek letter lambda indicating one wavelength. The drawing artist was Diane Goss.

OHS website: www.opt.indiana.edu/ohs/opthohiso.html

HINDSIGHT: Journal of Optometry History
July, 2009
Volume 40, Number 3

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Instructions to Authors

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Material submitted for publication should be sent to the editor: David A. Goss, School of Optometry, Indiana University, Bloomington, IN 47405; dgoss@indiana.edu. Material may be submitted by postal service or by email, although the preferred mode of reception of submissions is a Word document in an email attachment.

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Journal articles:
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Section in a single author book:
Hofstetter HW. Optometry: Professional, Economic, and Legal Aspects. St. Louis: Mosby, 1948:17-35.

Chapter in a multi-author volume:
Penisten DK. Eyes and vision in North American Indiana cultures: An historical perspective on traditional medicine and mythology. In: Goss DA, Edmondson LL, eds. Eye and Vision Conditions in the American Indian. Yukon, OK; Pueblo Publishing, 1990:186-190.

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Bennett I. The story behind Optometric Management magazine. Hindsight: J Optom Hist 2007;38:17-22.

If footnotes or notes on additional (minor) details are used, they should be marked in the text with superscript lower case letters starting with a and continuing in alphabetical order. The notes themselves should be the last section of the paper. The heading for the section should be Notes.

Rays of Light and the Hands of God: A Fascinating Egyptian Application!

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Abstract

One of the most charming and perhaps naive bits of our optical history is associated with the early history of rays-of-light. A few years ago, the writer wrote about an ancient artificial eye found in Iran (circa 3000 years BCE/BC, or 5000 years Before the Present or BP). On this artificial eye, made of a bitumen, there were inscribed more than one set of designs. Included was a geometric grid of light-rays (at 45° intervals) which were either entering into, or perhaps emanating from the eye pupil. That feature carried with it highly meaningful theoretical issues which will be briefly discussed. These rays also raised (for the writer) the question: What is the oldest known display of light-rays, an early, important, and integral feature of optical science? As it turned out, this artificial eye is the oldest known example of rays-of-light the writer can locate!

When addressing this history, the writer encountered an application of rays-of-light in Egypt which was both remarkable and quite unique! That is, JME refers here to the rather brief period of time centered upon the "Armana Period" (circa 1350-1333 BCE/BC) [please note: there is some current discussion as to the correctness of these dates]. This occurred during Dynasty XVIII, New Kingdom, of Egypt. During that Period, Egypt was ruled by Pharaoh Amenhotep IV, who married the very beautiful Queen Nefertiti. He changed his name to Pharaoh Akhenaten; moved his capital to a new city, Armana; and created a new (rather short-lasting) monotheistic religion (the first such set of beliefs?). During that time period, "the one God, "the Sun God Ra"; "the Aten"; or "the Aton" was the focus of religious belief of many individuals led by the Pharaoh. This God was symbolically represented by a round-sun-disc. And for some years, the associated light-rays took on special significance and unique forms! Each ray-of-light portrayed had at its end a very small hand (!), and many of these delicate individual hands are seen bearing an ankh (a symbol of life, or of sustained life), or a tool, or another symbol of religious significance. Thus, during this brief time period and for some time afterward, rays-of-light symbolized a means of communication, so to speak, between the Sun God and a supplicant.

Introduction; Early Representations of Rays of Light

A.E.E. McKenzie states in *A Second Course of Light,* Cambridge University Press, Cambridge, 1962, "The first step in the scientific study of light was the representation of light by straight lines."[1] In this same book, this author also notes properly that in 300 BCE Euclid wrote "Light travels in straight lines called 'rays'."[1]

Most all of us are aware of the utilization of light rays quite early by a number of distinguished ancient Greek, Roman, and Arabic scholars.[2-5] But few of us realize that rays-of-light, *per se*, preceded applications such as the above mentioned uses by quite a long period of time!

Surprisingly, the earliest representations of light-rays found by the speaker is a set associated with one of the oldest known artificial eyes![6-8] The recent discovery of that artificial eye has been assigned a date of circa 3000 BCE/BC, or 5000 years BP (before the present), by a fine Italian-Iranian archaeological team currently active at "The Burnt City" in Iran.(Fig. 1)[6,7] This very extensive set of ruins is located in a desert region very near to the Eastern border of Iran with Afghanistan/Pakistan.

That artificial eye was found *in situ* (= *in place,* or, *in its original place*), within the left orbit of a very tall woman's skull when her body was exhumed at "The Burnt City". She died at an age between 25-30 years. The true name of this very large and active community, now abandoned, is not known. Obviously, The Burnt City had been burned (in fact, more than once!), and, surprisingly, this long-lasting major center never had any protective walls.[6,7]

Because this woman was so very tall (5 foot 10 inches to 6 feet tall) relative to the then local population, and had an Africanoid skull, it is suggested that she (and possibly her artificial eye!) may have had origin elsewhere? The "Iranian" artificial eye is seen in Fig. 1. As many of JME's readers have learned, amazingly there is also an artificial eye which has been found (in modern Spain) which is about 2000 years older than the Iranian one![8] That is, it is dated about 7000 years BP. In the Spanish-area case, these dwellers were in transition from hunter-gatherers to a more modern form of agricultural society. The older/earlier ancient body found with an artificial eye *in situ* was found at the Cingle del Mas Nou i Cava Fosca dig site located near to the city/province of Castellòn on the East Coast of Spain.[8] That earlier artificial eye does not exhibit a pattern of rays of light.

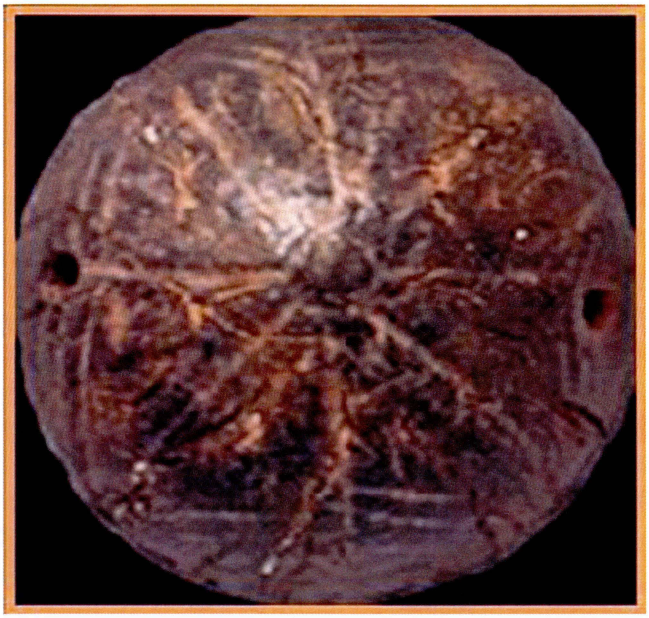

Figure 1. This is a photograph of an ancient Iranian artificial eye found rather recently in "The Burnt City", Iran (see below). It is made of a "bitumen" (a resinous and/or tar-like substance), with the possible addition of some animal fat. This artificial eye was apparently worn under the woman's eyelids, and was well decorated (!). It had been covered by a thin layer of gold and was also partially painted. It had two holes drilled to accept ties to help locate and/or to contain this prosthesis within this lady's orbit. *Please note the inscribed "ray-like" pattern which takes origin at the border of the eye pupil, and is represented geometrically by radial lines drawn at approximately 45° intervals.* Figure reproduced courtesy of C.I.A.S. Fine gold-wire lined these incisures.

In Fig. 1, the geometric pattern of "rays" about the eye pupil may be either entering or exiting the eye pupil as drawn! It is not clear if this inscribed pattern expresses an early "intromission theory" (a luminous effluence resulting in vision is conveyed from *the visible object seen to the eye* of the viewer).[2-4] Or, alternatively, there is also an "extramission theory" of visual function (wherein "some process" *was initiated from within the eye* and was transmitted to the object seen in space, where that object was detected.[2-4] The latter argument is implied (even today!) in the familiar concept of the ages-old "evil eye", and associated attempts made to "ward off the evil eye". As examples of the latter, this set of beliefs manifests itself in the wearing of, and/or the placement of a horn-like object (a small phallic symbol) in some cultures on a necklace about the neck of a new-born infant in order to ward off the evil eye. Similarly, in Mediterranean cultures, and across South Asia, it is not at all rare to see elderly ladies selling various amulets or other items to ward off the evil eye. And, one still encounters "eyes" painted on the prows of (generally middle to small size) ships both to guide the vessel, and also to ward off the evil eye! In the latter case, today, these are most often seen on fishing boats, or barges, etc. Such symbols were widely used in olden times. The writer has seen such vessels in use, and in maritime museum collections in Italy, scattered around the Mediterranean Sea, and all across Southern Asia.

One wonders whether the person who fabricated the "Iranian" artificial eye (for want of a better term) had any such notions, or if this sort of question was even considered at that time? That is, one cannot reject the possibility that these rays were merely decorative features on the Iranian artificial eye.

But, if there was a deeper meaning as to their presence, it is important to realize that the debate between the two alternatives mentioned above went on for a very long time period of time![3,4] As but one of many examples, millennia later Aristotle and Plato argued from different sides on this debate. And, separately, for some time period it was thought that the eye lens was the seat of the visual detection. Etc. It was Ibn al-Haytham (or Alhazen or Alhacen) who definitively proved scientifically that the intromission theory was the mechanism by which we experience vision.[3,4] And importantly, it was Ibn al-Haytham who (for his work on his topic) was designated by the New York Times newspaper at the end of the 20th Century (or perhaps during the first days of the new millennium) for having written the most important research paper of the *past millennium*(!). This recognition/award was given for the question addressed, its definitive answer, and for his use of well-defined (and appropriate) scientific methods in addressing this problem.

Many years after Alhazen, at the beginning of the 17th century CE (AD), it was Johannes Kepler who pulled a whole set of issues together.[2-4] Included was Kepler's understanding that luminous stimuli having origin external to the eye served to excite the visual process; that images formed on the retina are responsible for vision; and that the retina serves as the sensory receptive surface of the eye. This fascinating history was well described and written by Prof. David C. Lindberg in his fine dissertation at the U. of Chicago, published in 1976 (and he further expanded upon this set of topics later).[3,4]

Egypt's Unique Light-Rays!

During the "Armana Period" in Egypt,[5] rays of light were often employed as representations of the Sun's rays - but as you will see shortly, with a fascinating difference! *At their terminations, each of these rays had attached at its end a very tiny hand! And, often each of these hands carried objects such as ankhs (symbols of life, or continued life), hammers, etc.* In this context, one might think of these as "the hands (and perhaps tools) of the then Sun God, "the Aten"![9-11]

In the Egyptian canon, the important Sun God, "Ra", is commonly depicted by a round sun-disc.[9-12] The writer has had good advice on this matter from "Al Berens" hebsed@comcast.net, and he, in turn, asked Dr. A. Dodson aidan.dodson@bristol.ac.uk to comment further.[13] Apparently, the sun disc as a symbol came into broad use during the 11th and 12th Dynasties during the Middle Kingdom, 2040-1781 BCE, but was popularized particularly by Pharaoh Thutmosis IV, XVIII Dynasty, New Kingdom, 1397-1387 BCE.[13] JME notes that frequently this disk-symbol was represented as having broad wing-like lateral projections attached to it. During "the (later) Armana period", light-rays were commonly portrayed as emanating from the sun disc, *per se.* Examples will be shown below. These commonly occurred during of the Reign of Pharaoh Amenhotep IV, who, as noted, changed his name to Akhenaten (Eighteenth Dynasty, New Kingdom, 1350-1333 BCE).[5,9-11] Note, there may be some revision as to dates of his reign...this is being actively reviewed). Interestingly, the Guidebook of the Egyptian Museum in Cairo (p. 134, 2001)[5] notes that the process of political and religious reform that characterized Akhenaton's term as Pharaoh actually completed transformations started some years earlier by Pharaoh/Queen Hapshepsut (Eighteenth Dynasty, New Kingdom, 1479-1458 BCE).

Akhenaton decreed there was only one God, and that was the Sun God, "the Aten" or "the Aton".[9-12] In turn, the Pharaoh was raised to a position of special importance as this God's "indispensable guarantor". Thus, effectively, during his reign, there was created an early monotheistic religious movement in Egypt! *The God Aten was the physical manifestation of the Sun God "Ra"*. Pharaoh Akhenaton also moved his capital south to a new center on the Nile River, termed Armana. His wife was the renowned and very beautiful Queen Nefertiti.

The powerful Egyptian Priesthood and much of the populace, with a long history of polytheism, resisted this major change in their long-standing religion. As a result, this new religious belief had only a rather limited time period of use.[5] As noted, there is active debate as to the precise years when Amenhotep IV/Akhenhaten ruled,[5] and whether, at first, he participated in co-regency with Pharaoh Amenhotep III (his older brother), etc.[14] The Egyptian Museum in Cairo Guidebook, 2001,[7] gives as Amenhotep IV/Akhenhaten's reign the years 1350-1333 BCE, others suggest 1341-1324 BCE, etc.[5,9-12] For example, see A.K. Eyma <ayma@tip.nl>, 22 May 09, 10:58 AM. [This e-mail site, maintained by Mr. Eyma, is a reliable source for discussion of developments in ancient Egyptian history, and recent discoveries in Egyptian archaeology, anthropology, etc.]

The writer consulted the (National) Library of the Physical Society (USA), and a number of fine Egyptologists, and he cannot find evidence for depictions of light rays portrayed in Egypt, *per se*, prior to the reign of Pharaoh Akhenaten. So saying, individuals have suggested to him that they may have existed before that time period.

There are depictions of well-developed sun and light rays in the tomb of Vizier Ramose who had served Pharaoh Amenhotep III.[14] That Pharaoh ruled from 1391-1353 BCE (dates listed in the recent Kosloff article in KMT, a good journal of Egyptian history and archaeology), and according to the Cairo Museum Guidebook, Amenhotep III ruled from 1387-1350 BCE.[5] A Vizier was a high-ranking Minister of State.[14] There is also evidence of changes which were made on illustrative wall scenes(!) found in Vizier Ramose's tomb (see below) after Amenhotep IV succeeded his brother as ruler.[14] For a further discussion of changes made in existing *bas reliefs*, etc., in the transition from Amenhotep III to Amenhotep IV and to the latter's transformation to Akhenaten, see, Arielle P. Kosloff. What the Workmanship in Ramose's Tomb (TT55) Tells Us About It's History. KMT, Vol. 20, Spring, 2009, pp. 40-49. So saying, this is not the topic of this paper.[14]

The presence of the small hands associated with each of the light rays was apparently associated with the reign of Amenhotep IV/Akhenaten [based on a comment made in a message from Dr. Dodson].[13] He suggested this may have occurred in association with the elevation of the Sun God "Ra" to "the Aten", i.e., to the one God, monotheistic status.

Representations of Light Rays from Vizier Ramose's Tomb (TT55) in Thebes, etc.

Key points for the reader can be appreciated by viewing the fine quality figures presented in the recent Kosloff article.[14] Some of her figures from KMT are used in this paper here numbered Figures 2 to 4. Added figures applicable to this discussion are Figures 5 to 7.

Figure 2. This is a "Windows of Appearances Scene", circa 1340 BCE/BC (see Kosloff, p. 46).[14] Each of these figures was selected by JME for the fine sun (representing the Aten) and light-ray patterns. Note the small hands at the ends of each of these light-rays, and the fact that many of the hands hold defined objects. Reproduced with permission of the author.

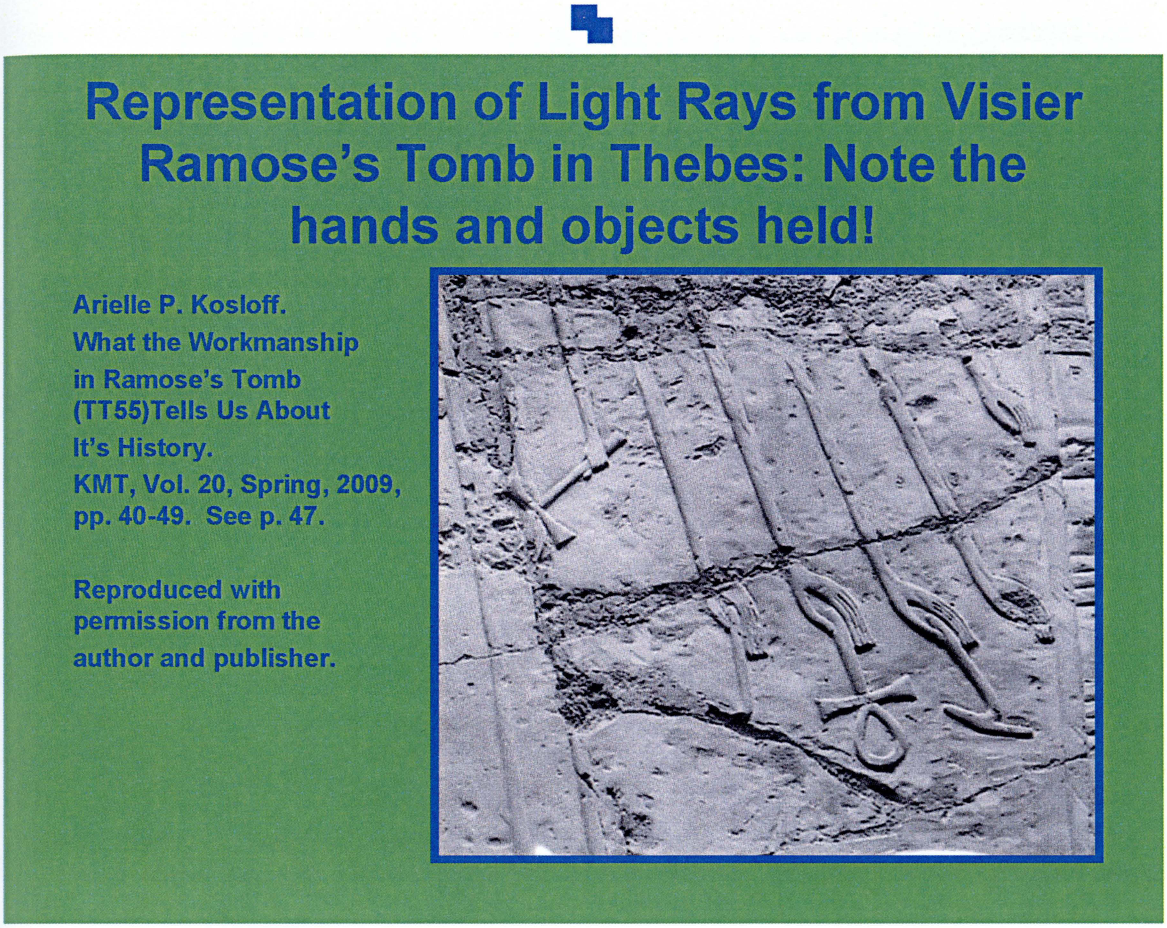

Figure 3. In this figure, the lower right-hand portion of Fig. 2 has been enlarged. Here, we observe the items held by the individual hands at the ends of the light-rays. Note the ankh symbol and a number of different tools. See Kosloff p. 47.[14] Reproduced with permission of the author.

Figure 4. Here we see an illustration on a stone block originating at Armana which is now in the Metropolitan Museum of Art in New York City.[14] This appears to be a representation of Akhenaten(?) who is busy catching a duck. The point here is that frequently one finds an *ankh* [defined as a "tau cross with a loop at its top"] located near the nose of an individual (as in this example). Here, the ankh (a symbol of life) can be thought of as characterizing the granting of life, or as sustaining life, or as offering ongoing/enduring life. See Kosloff. KMT p. 48.[14] Reproduced with permission of the author.

Egypt; Armana: Pharaoh Akhenaten & Queen Nefertiti With Three of Their Children. Note: the Sun Disc; Rays of Light, Ankhs, etc.

Rolf Krauss. Nefertiti's Final Secret. KMT, 20(2,summer): pp. 18-28 (this photo: p. 21), 2009.

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Figure 5. This is a wall scene showing Pharaoh Akhenaten and Queen Nefertiti with three of their children. Note the sun disk, the rays of light, the location of the ankhs. One wonders if the "double ankhs shown" were intended here symbolically to be extending life to the Pharaoh and the child he is holding, and similarly to Nefertiti and the child she is holding; or if two-each were intended for both Akhenaten and Nefertiti. [see Rolf Krauss. *Nefertiti's Final Secret.* KMT, 20(2, Summer): pp. 18-28, see p. 21, 2009.][15] Published with permission of the author and publisher.

In Figure 5, two of the hands on rays, each with an ankh, are placed near the noses of both Pharaoh Akhenaten and Queen Nefertiti.[14] It may be that the second ankh in each case is meant to have been associated with the child each of them is holding(?). One of these three young children (unidentified) is the future mother of their grandson, Pharaoh Tutankhamen ("King Tut"). Note, the new religious beliefs imposed by Pharaoh Akhenaten had largely been dropped by the end of Pharaoh Tutankamen's reign. [see Rolf Krauss. *Nefertiti's Final Secret.* KMT, 20(2, Summer): pp. 18-28, see p. 21, 2009.][15]

Armana:

Akhenaten and The Royal Family Sacrificing To The Sun-God Aten

Paul Johnson. The Civilization of Ancient Egypt. Harper Collins Publishers, New York, 1999, p. 62.

ISBN 0-06-019434-0

Figure 6. This drawing of a scene at Armana been taken from P. Johnson. *The Civilization of Ancient Egypt*, Harper Collins, NY, 1999, p. 62.[11] Here, Pharaoh Akhenaten and the royal family are sacrificing to the Sun-God, "the Aten". Reproduced with permission of the author.

Meanings Of the Sun's "Rays"

For those interested in the meanings of, and the symbolism to ancient Egyptians of the Sun God and the associated rays of light, e.g., during the Armana Period, the writer refers the reader to the book: Jan Assmann, *Egyptian Solar Religion in the New Kingdom*, Kegan, Paul, International, London and New York, 1995.[9] As one good example, see page 81 in Reference 9:

> "You have made heavens remote,
> so that you can ascend to it
> and see all that you have created,
> you who are the unique one,
> but millions of lives are in you
> for you to animate them,
> for the breath of life to their nostrils
> is the sight of your rays."

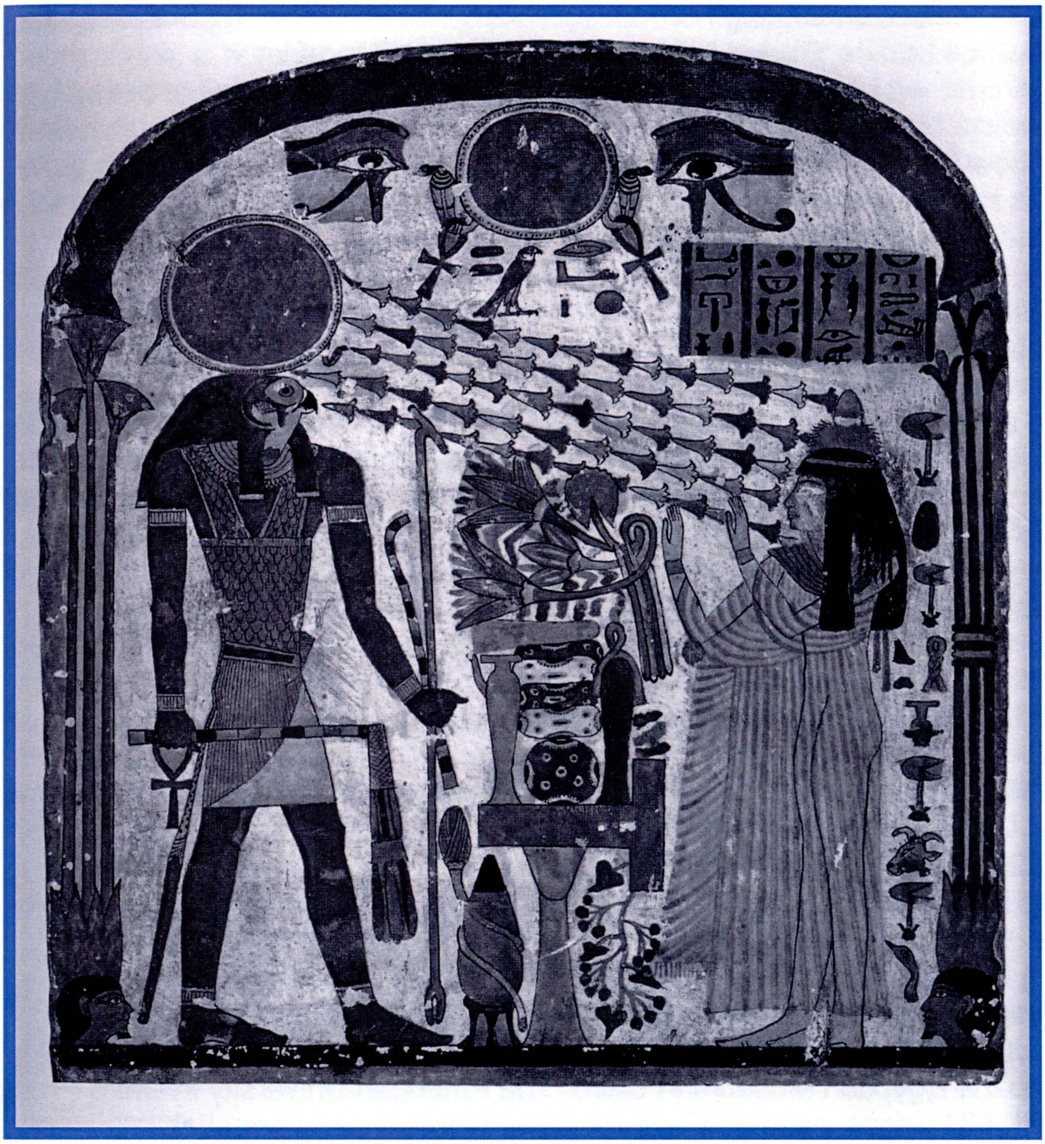

Figure 7. This illustration was created in the 22nd Dynasty, in the Third Intermediate Period, Egypt, a few hundred years *after* the Armana Period. Here, "a lady named Taperet [is] shown worshipping and making offerings to the falcon-headed Sun God Ra. She receives, in return, sun rays shown as flowers of many colors." (Thebes, Dynasty XXII, circa 945-718 BCE). This illustration is a frontspiece[12] taken from the book, Stephen Quirke, *The Cult of Ra; Sun Worship in Ancient Egypt*, Thames and Hudson, 2001. This figure is reproduced with permission of the author, the publisher, and Museum Le Louvre, Paris.

A Version of Light-Rays in Egypt A Number of Years After the Armana Period.

Included for the reader's interest (Fig. 7)[11] is an unusual and different form of light-ray pattern which appeared quite a number of *years* after the light-ray patterns of the Armana Period. Here, light-rays are shown as *parallel* streams of multicolored flowers! In fact one of these rays is shown coming from the forehead located below the Sun Disc.[11] This item is found at Le Louvre, Paris.

In Closing

No matter how one looks at this interesting period in the history of optics, it is quite unique, in fact, it is rather imaginative. Pharaoh Akhenatan's monotheism challenged long-established polytheistic religious beliefs, which, in turn, had existed for more than a millennium. Thus, his ideas were clearly not appreciated by many members of the Egyptian public as well as by quite a number of powerful Priests associated with the hierarchy of Egypt.

Clearly the ancients appreciated the fact that light (or light-rays) traveled essentially in a straight line. Virtually all of us, from time to time, when watching floating clouds in the sky, have experienced seeing ray-like beams/projections of light from the sun pass through clouds. The writer had little doubt that the ever-observant ancients did as well. And, mankind has always sought to ascribe meanings to, or to seek an orderly understanding of the events encountered in the World.

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5. Alessandro Bongioanni A, Croce MS, eds. Photos by Araldo de Luca. The Illustrated Guide to the Egyptian Museum in Cairo. The American University in Cairo Press, Cairo, Egypt. 2001, 631 pages, see pp. 17-19 for dates of rulers and Dynasties.

6. Enoch JM. The Burnt City and the First Known Artificial Eye. (a) Presented at the April 12, 2008, meeting of the Ocular Heritage Society. This paper has appeared in the 25th Annual Society Proceedings, 2008, Dr. John Tull, Organizer; (b) This article also appeared in The Proceedings of the Cogan Ophthalmic History Society, 2008, pp. 95-1, and (c.) Hindsight: J Optom Hist 2008; 38:58-67. Obviously, now this is no longer the first known artificial eye.

7. Enoch JM. The Burnt City and the First Known Artificial Eye. Presented as a public lecture in behalf of the School of Optometry of La Universitat Polytècnica de Catalunya at 7:00 PM, June 25, 2008 at the Cosmo Caixa, Barcelona, Catalonia, Spain.

8. Enoch JM. A Mesolithic (Middle Stone Age!) Spanish Artificial Eye: This Technology is 7000 Years Old! Presented at the Cogan Ophthalmic History Society meeting, March 28, 2009, Pittsburgh, (3/28-29/2009). Published in the 2009 Proceedings of the 22nd Annual Cogan Ophthalmic History Society, pp. 71-86. A similar, but modestly different talk appeared in Hindsight: J Optom Hist 2009; 40: 47-62. In each of these publications, a number of figures were reproduced in color. Great appreciation is expressed to Prof. Carme Pujoles for her substantial help/and her sharing of her superb materials! In no sense does JME mean to preempt her reports of her research findings.

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13. Sanders K, Dodson A. Sunset: The end of the Armana Period. Cartouche 2009;15(4): 2-4.

14. Kosloff AP. What the Workmanship in Ramose's Tomb (TT55) Tells Us About Its History. KMT, Spring, 2009;20: 40-49.

15. Krauss R. Nefertiti's final secret. KMT Summer, 2009;20(2):18-28. Note: This paper discusses the apparent forgery of a well-known stela (Cairo Museum #44865) attributed to the Armana period. Comparisons are made between this and other known examples of such objects, errors are displayed. Individuals including a former Curator of the Armana Collection and Director of the Cairo Museum Mohamed Seleh mosaleh2000@yahoo.com challenge Krauss' argument (see e-mail distributed by EEF on June 28, 2009, 7:15:44 AM).

A Note on Eighteenth Century London Optician James Ayscough and his Booklet *A Short Account of the Eye and Nature of Vision*

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Abstract

This paper presents a biographical sketch of eighteenth century London optician James Ayscough, who invented double-hinged temples and advocated tinted lenses. In 1750, Ayscough published a booklet entitled A Short Account of the Nature and Uses of Spectacles. It went through several editions from 1750 to 1760. The contents of the third edition (1754) of the booklet are discussed.

Key words: *James Ayscough, history of optometry, optometry books.*

London optician James Ayscough (1719?-1762?) was the son of a clergyman. It appears that Ayscough's father died at a young age, leaving the family in poor economic circumstances.[1] In 1732, he was apprenticed to London optician James Mann II, in a business which had been started by James Mann I in about 1690.[2] Ayscough was a business partner with James Mann II from about 1740 to 1747, after which he operated his own business.[1] The location of his business when he set up on his own, Ludgate Street, was a fashionable street in mid-eighteenth century London, suggesting that he must have profited significantly during his association with Mann.[1]

In 1752, Ayscough was Master of the Worshipful Company of Spectacle Makers.[3] Also in 1752, he invented frames with temples which were hinged not only with the front, but also along the temples themselves. Thus the temple could fold in against itself as well as against the front of the frame.[4,5] Corson[6] noted that spectacles with the double-hinged temples "became extremely popular and appear more often than any other kind in paintings, prints, and caricatures of the period."

Ayscough is sometimes credited with the invention of sunglasses.[7,8] He advocated tinted lenses, but it doesn't appear that he did so for the purpose of sun protection.[8] He instead thought that clear lenses allowed too much glare. Rosenthal[9] observed that the double hinged temples developed by Ayscough became very popular, but the light green tinted lenses that he advocated were not well accepted.

An undated trade card identified Ayscough as an optician.[10] It showed him as making and selling spectacles, reading glasses, and concave glasses. He also sold microscopes, reflecting telescopes, refracting telescopes, prisms, camera obscuras, optical machines, barometers, thermometers, and many other instruments. That trade card also identified his shop as "the original shop for crown glass spectacles."[10] In 1750, one of his advertisements for spectacles annoyed some of his fellow opticians because it implied that his use of crown glass made for exclusive and superior lenses.[2] In 1756, he placed several advertisements criticizing Benjamin Martin's "Visual Glasses," often referred to as Martin's Margins. He declared that Martin was not the inventor and that Martin used inferior glass. It appears that Martin did not respond in print and he continued to advertise his Visual Glasses for at least several more months.[2,11]

A trade card for Mann and Ayscough Opticians said that they "Make and sell, Wholesale and Retail, the finest Chrystal Spectacles, ground upon Brass Tools (approved by the Royal Society and the greatest mathematicians) set in Gold, Silver, Tortoiseshell, Horn, Leather, and all manner of ways that are most convenient and beautiful. Also curious Reading Glasses of Rock Chrystal, or the whitest Flint, contrived to turn into Cases of various Kinds, to be carried in the Pocket without Trouble or Damage. Likewise Spectacles of true Venetian Green Glass. They make Concaves for Myops or Short-sighted Persons, which are so nicely adapted to every degree of short-sightedness, and by so regular a Method, that Persons, after being once fitted, may at all times be furnished with them (though at ever so great a distance) as exact as if present."[12]

Ayscough apparently had significant skill in lens grinding because he made an achromatic telescope objective sometime in the 1740s or 1750s.[13] In addition to his optical work, he made barometers and meteorological instruments.[1]

In 1750, Ayscough published a booklet entitled *A Short Account of the Nature and Uses of Spectacles – In which is recommended a Kind of Glass for Spectacles preferable to any hitherto made use of for that Purpose.* It was sixteen pages in length.[14] It was expanded in 1752 and retitled *A Short Account of the Eye and Nature of Vision, Chiefly designed to Illustrate the Use and Advantage of Spectacles, Wherein is laid down Rules for chusing Glasses proper for remedying all the different Defects of Sight.* A third edition was published in 1754 with the same title except the word is was changed to are. The third edition is 26 pages in length. WorldCat, the online library catalog, indicates that fourth, fifth, and sixth editions were published in 1755, 1757, and 1760, respectively. A French translation was published in 1754. WorldCat also shows two booklets on microscopes by James Mann and James Ayscough, one undated and twenty pages long and the other published in about 1750 and sixteen pages long. In 1755 to 1756, Ayscough wrote a monthly series of articles on meteorology for *The Gentleman's Magazine*.[1]

Third Edition of *A Short Account of the Eye and Nature of Vision*

A copy of the third edition of Ayscough's booklet was examined. On page 1, Ayscough states that it was written for lay persons "to illustrate the Use of Spectacles for helping defective Eyes, and to instruct People labouring under these Disadvantages how to judge the Nature of their Infirmity, and to learn them how to apply a proper Remedy..." In the opening pages, he says that he will not attempt a description of the anatomy of the eye or of the process of vision. Rather he speaks in glowing terms of the wonder of vision and of the impossibility of understanding it completely. He says: "Such is the Organ of the first, the noblest, the most elegant of all our Senses: It is on the Retina that are painted all the

Glories of the Heavens, and Beauties of this lower World; it is by Means of this Organ we contemplate the stupendous Worlds of its Creator..." (page 5)

On pages 7 to 9, he discusses focus of light by a convex lens and uses the camera obscura as an analogy to image formation by the eye. On pages 10 to 11, he notes that eyes that do not refract light enough are helped by a convex lens and those that refract light too much are aided by a concave lens. On pages 11 to 12, he states that the use of the eyes affects their refractive status: "A bad Form may be acquired by looking much, either at very remote, or too near objects: In the former Case we flatten the Eye a little, and in the latter we draw it up into a more Convex Form, to see distinctly: In Time the Eye will acquire either Conformation, and retain a fixed Form, too flat or too globular for Objects at a moderate Distance."

"This is confirmed every Day, in the Case of Engravers, Watchmakers, Chasers, etc. who by frequently forcing their Eyes into too Convex a Figure in order to see minute Objects, at last have their Eyes settled to that Configuration, and so become short-sighted, especially if they are used to these Employments when young, while the Coats of the Eye are tender and pliable." (page 12)

Among the signs indicating a need for spectacles is the situation in which persons "find themselves obliged to hold a Book at a greater Distance." (page 14) Ayscough's advice for choosing proper power reading spectacles is to "hold a small Print at the Distance at which you was used to see distinctly when your Eyes were good, which with most People is about Ten or Twelve Inches; then chuse a Pair of Spectacles of such a Degree of Convexity, as renders the Letters as plain as they used to appear before your Sight was defective: If you chuse them too young, i.e. not Convex enough, they will scarce remedy the Defect; and you will not see distinctly, unless the Print is so far off, that the Letter will appear rather too small to be read. If you chuse them too old, i.e. too Convex, you will then be obliged to flatten the Eye to compensate their over-great Convexity, and therby be in Danger of increasing the Defect." (page 15) In the case of "short-sighted Persons, the best Way is to look through a Concave Lens at some distant Object; and the least Concave of all the Glasses, through which you can see distinctly, is the best." (page 15)

If an individual does not have the opportunity to choose between a number of spectacle lenses, he can "take a common Print, and move it to and from the Eye, 'till he sees distinctly, then measure exactly that Distance, (from the Eye to the Paper) and by sending an Account thereof to a proper Workman, they may be fitted to a sufficient Degree of Exactness." (page 16)

Ayscough noted that imperfections in glasses could arise from poor workmanship or inadequate materials. To find distortions in a spectacle lens, he recommended viewing a grid pattern. He also suggested that: "To discover the Veins in Convex Glasses, place a Candle from you about the Distance of Five or Six Yards, then looking through the Glass, move it from the Eye, till you find it full of light, and then will be seen every Vein and Speck in it. These Veins always distort Objects; but Specks, which are only opake Spots, intercept but an inconsiderable Part of the Light, doing no other Damage. At the same Time you will easily see if there be any Fault in the Polish." (page 19)

Ayscough recommended colored lenses: "...common white Glass gives an offensive glaring Light, very prejudicial to the Eyes; and on that Account green and blue Glass have been advised..." (page 19) However, he noted that the lenses can be too dark for some uses, and as a consequence he recommended a light green tint. He suggested that the glass material used to make those lenses was also more free of "Veins". He noted that the better quality of those lenses made them more expensive, but "the Difference of the Price is such a Trifle in Comparison to their superior Qualifications." (page 22)

An advertisement at the end of the text of the booklet proclaims that Ayscough had a large assortment of frames, including "some double-jointed Frames, entirely of a new Contrivance, being an exceeding great Improvement, seeing they obviate all the Objections made to the common Spring-Spectacles, as they neither press upon the Nose nor the Temples; the Complaint against these being the Pressure they cause on that Place, which stops the Circulation of the Blood, and thereby occasions to many People violent Head-Aches." The advertisement also stated that he sold "All Sorts of Optical, Mathematical, and Philosophical Instruments; particularly, Refracting Telescopes..." and Barometers.

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Australian Optometry Journal Celebrates 90th Anniversary and Puts Most of its Back Issues Online

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The journal *Clinical and Experimental Optometry*, a publication of Optometrists Association Australia, recently completed its ninetieth year of publication.[1] Its back issues from 1934 to the present are now available free of charge online at www3.interscience.wiley.com/journal.118487520/home.[2] Collin[1] noted that the origins of *Clinical and Experimental Optometry* predated those of *Optometry and Vision Science* in the United States and of *Ophthalmic and Physiological Optics* in the United Kingdom.

The beginnings of *Clinical and Experimental Optometry* can be traced back to the publication of *The Commonwealth Optometrist* in 1919.[2] The title was changed to *Australasian Journal of Optometry* in December of 1929 and then to *Australian Journal of Optometry* in 1959. The change in title to *Clinical and Experimental Optometry* occurred in 1986.

The availability of this journal online provides a potentially significant resource for historical study. The older issues are of historical interest, and this journal has also published articles on historical topics. The website at the URL noted above contains a search function. When I went to Advanced Search and searched for history of optometry and *Clinical and Experimental Optometry* I got 119 results. Many of the results were obtained because they dealt in some way with case history, but there were also a significant number of articles on historical topics.

A regular feature of this journal in recent years has been a series of profiles of notable optometrists and vision scientists. By searching at the website I was able to find 29 such profiles. Most of the profiles are of living persons, but exceptions include Ernst Goetz, who was the first Australian optometrist to fit contact lenses,[3] and William G. Kett, who was editor of the journal from 1920 to 1962.[4] The profiles, of course, center around persons from Australia and the surrounding region, but optometrists who have spent most of their careers in North America, such as Theodore Grosvenor, George Woo, and Anthony Adams, have also been profiled.[5-7]

The goal of the *Clinical and Experimental Optometry* Editorial Board is to continue to add back issues to the online file.[2] They have not been able to locate copies of the journal for 1919 (volume 1), 1924 (volume 6), or 1927 to 1930 (volumes 10 to 13). They have asked that anyone with access to those volumes who would be willing to make them available for scanning, contact the *Clinical and Experimental Optometry* editor at cxo.editor@optometrists.asn.au.

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Book Review: The Long Route to the Invention of the Telescope

The Long Route to the Invention of the Telescope. Rolf Willach. Philadelphia: American Philosophical Society, 2008. ix + 116 pages. ISBN 978-1-60618-985-6. Softcover, $35.

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Contrary to what the title might suggest, most of this book deals with the history of spectacle lenses. The author hypothesizes that spectacle lenses were used to make the first telescopes and thus the development of spectacle lenses was part of the long route to the invention of the telescope. The author is an optical engineer who performed optical and physical analyses of numerous early lenses, with emphasis on spectacle lenses, and examined existing documentary evidence concerning lens making.

The author observed that reading stones placed on text were known for some time before the invention of spectacles. Reading stones were usually 10 to 40 diopters in power, much higher than needed in spectacles for presbyopia. Obstacles to the invention of spectacles included the fact that the making of rock crystal lenses was very time consuming and required extensive skill. Glass may not been a reasonable alternative until the late thirteenth century due to the color and bubbles in the glass. Furthermore, in the thirteenth century, technology to grind lenses of predictable power was not available. The inability to reliably make two lenses of matching power stood in the way of making spectacles.

Willach's examination of early glass spectacle lenses showed that the convex surfaces of plano-convex lenses had not been ground but the plano surfaces had been ground. This led him to suggest that the first mass produced glass lenses were made by producing a bubble of glass. Then circular blanks were cut out. The concave surface of the blank was ground flat to make a plano-convex lens. Willach states that "This ingenious idea of blowing glass balls in order to make identical lenses that could be worn in pairs in front of both eyes was the birth of spectacles." (page 54) His optical examination of these lenses showed that they would have been of insufficient optical quality to make a telescope.

An improvement in the manufacturing process occurred in late fifteenth century Nuremberg when moulds were used to produce the flat surface. Then grinding was done to produce a convex surface on one side. This initially led to better optical quality of the lenses. However, the quality of lenses declined when the pressures to quickly produce cheap lenses resulted in less attention to the quality of the moulds.

Lenses made in the sixteenth century were ground on both sides. Willach examined 57 lenses made between 1500 and the first few decades of the seventeenth century. They ranged in power from +1 to +6 diopters and varied greatly in optical quality. A common problem with old lenses, including the better ones made in the sixteenth century, was increasing power toward the edge of the lenses. The author hypothesized that what made the invention of the telescope possible in the early seventeenth century was not only better quality lenses but also the use of a 10 mm diaphragm with the objective lens. Such a diaphragm has been found in all surviving early seventeenth century telescopes, and it would eliminate the effects of the distortions in the outer parts of the lenses of that era.

In the last chapter before a closing summary chapter, the author expresses "no doubt" that the person who should get credit for the invention of the telescope is Hans Lipperhey. "He was clearly the first inventor who convincingly demonstrated a real instrument." (page 98)

This is a very interesting book that represents the culmination of some outstanding original historical research. It is recommended to anyone seeking to learn more about the history of spectacle lenses or telescopes. The book includes a three page section of reference notes and a three page further reading list. The author studied physics, mathematics, and astronomy at the University of Bern in Switzerland and the University of Göttingen in Germany. He previously worked in the Department of Physics in the Institute of Astronomy in Bern. He is now self-employed working on the development of electronic and optical sensor procedures.

Book Review: Newton

Newton. Peter Ackroyd. New York: Doubleday, 2006. xi + 176 pages. ISBN-13: 978-0-385-50799-8. ISBN-10: 0-385-50799-2. Hardcover, $21.95.

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This book provides an overview of the life and accomplishments of Isaac Newton (1642-1727), as well as his quirks, such as his insecurity and his autocratic and quarrelsome nature. His insecurity and abhorrence of criticism led to delays of years in publication of some of his work. The book covers his disputes with Robert Hooke, astronomer John Flamsteed, and mathematician Gottfried Wilhelm Leibniz. It also notes some of his friendships.

Newton's laws of motion, work in optics, theory of gravity, and development of calculus are well known. Less known is the extent of his studies in theology and alchemy. The following paragraph illustrates the depth of his theological investigations, as well as aspects of his personality: "Newton's study of the Old Testament was, as was to be expected, rigorous and thorough. He had more than thirty different versions or translations of the Bible. He learned Hebrew in order to study the original texts of the prophets. He began a notebook in which he schematised his study, with headings such as "Incarnatio" and 'Deus Pater.' He amassed a huge library of biblical and patristic literature. He read all the authorities of previous centuries, and assimilated the most modern texts of seventeenth-century theology in his desire for true knowledge. He wished to become the master of his subject, as he had previously become the master of optics and the master of mathematics. At his death he left a manuscript on biblical matters, incomplete, of some 850 pages as well as a mass of assorted papers and notes." (page 57)

An anecdote concerning his years at Cambridge gives further insight into his nature: "In his Cambridge enclave and retreat he walked in his garden where, according to one of his assistants, he could not bear the sight or presence of any weeds. This was part of his drive towards order, neatness, and perfection. He kept a box filled with guineas by the window, as a deliberate test of the honesty of those who worked for him. He liked eating roast apples in winter, and one of his most unlikely letters is concerned with the proper making of cider. He gave money to the new library in his college, now universally known as the Wren Library, and was consulted by other colleges on various technical matters. He was in other words the image of a respectable and reclusive professor." (page 66)

In addition to some of his scientific and other studies, there is also coverage of his later work at the Mint and the Royal Society. Ackroyd describes some of the habits of Newton late in life as follows: "His habits were temperate in old age, with a breakfast of bread and butter with orange tea. He drank water principally, and had some of the instincts of a vegetarian. He refused to eat black pudding because it was made with blood, and would not eat rabbits because they had been strangled. It is worth noting here that he was well known for his charity; he helped various members of his own family, but he also distributed money to strangers who wrote him 'begging letters.' This charitableness is of course consonant with his Christian beliefs, and he was now a rich man, but it helps to modify the impression of a distant and authoritarian figure." (pages 157-158)

The author Peter Ackroyd has published numerous fiction and non-fiction books. His biographies address mostly literary figures, such as Shakespeare, Dickens, and T.S. Eliot. This little book (19 cm high x 14 cm wide) is part of the Ackroyd's Brief Lives series, the other subjects in which are Chaucer, Edgar Allan Poe, and English painter J.M.W. Turner. This book's 176 pages include a six page index and a two page list of selected readings.

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