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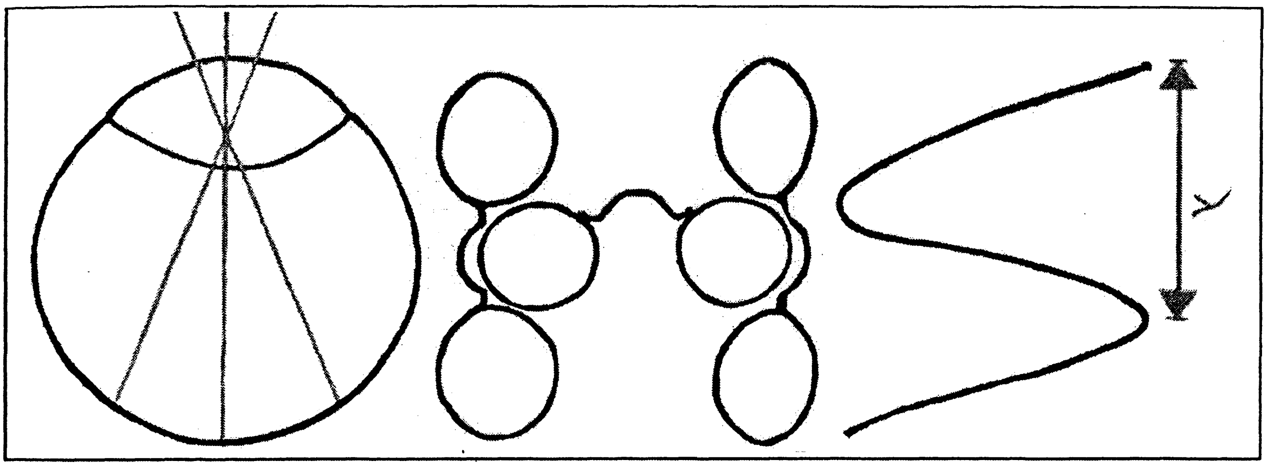

Official Publication of the Optometric Historical Society

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 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

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"History is the Light on the Path to (the) Future": The Burnt City, and the First Known Artificial Eye

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The Burnt City (What was the original name?)

Iran is much in the news today, but that is not the topic of this discussion. Tucked into a rather obscure corner of Iran near its border with Afghanistan, not far (ca 56 km) from the city of Zabol, and a modest distance north of the Iran-Pakistan border, lies an ancient and not-well-known ruin of a *major ancient city/civilization*. It was "one of the largest cities at the dawn of the urban era". Today this site is known as "The Burnt City" (see Fig. 1, this location was estimated by the author (black dot)). There are a number of Arabic/Iranian transliterations of this name (the Burnt City) given to this one-time center, e.g., Shahr-i Sokhteh. In various reports this name appears as Shahr-i (or Shahr-e), and Sokhteh (or Soukhteh, Sookhteh, Sukhteh, or Sokhta). Let us stay with the literal translation of this Arabic phrase, "The Burnt City". This area was apparently also known as "The civilization of the Hirmond River zone".[12,13] A new interesting discovery in the remains of this city/area, *the first known artificial eye*, is the topic of this discussion.

This archaeological study area has been under investigation by archaeologists since about 1915, when it was first studied by British archaeologist, Sir Aurel Stein.[16] The current "dig" in this intriguing area of Sistan-Baluchistan Province in South-Eastern Iran is in its tenth year. The Burnt City is in the Sistan Desert near to the Helmand or Hirmand River which has its origin in Afghanistan. The writer encountered the latter spelling for the name of this river in a number of documents of Iranian origin. The ruins of The Burnt City lie about 400 miles inland from the Gulf of Oman to the South.

This community was apparently a major early center of civilization about 5200 years ago (3200 BC) and lasted about 1100 years (until about 2100 BC). It was a major cultural route between the east and west of Asia. This city was burned to the ground at least three times before it was finally deserted, thus, the appellation of "The Burnt City".[5,12] The writer found no reference to the original name of this community.

One of a number of reports on this ancient center, written by an able journalist, Ms. Nastaran Zafar Ardalan contains the statement, "History is the Light on the Path to ['the'... *addition by JME*] Future". It is taken from a block heading to the right side of this author's paper on the world wide web.[12] It is not clear if this quotation originates with this individual, or if it originates with the organization which reports this article, The Circle of Ancient Iranian Studies.[12] This same statement could just as readily serve the Optometric Historical Society.

Figure 1. This is a blown up section of a now rather old map of Iran (1969). It includes the area of the "The Burnt City". A small black dot/marker has been added by the author. It is intended to indicate the approximate site of these ruins (author's judgment) and it is located near an apparent bifurcation of the residua of the Helmand/Hirmond River in the region of Hamun-i-Helmand. The map was taken from p. 67, *The Hammond Medallion World Atlas*, Hammond, Inc., Maplewood, NJ, p. 67, 1969, Library of Congress Catalog Number Map 66-31. The border opposite the town/city of Zabol is that of Iran and Afghanistan. This site is also located rather near to the modern Afghanistan/Pakistan border with Iran (visible on this map segment). The body of water to the south is the Gulf of Oman (at the bottom of figure).

There are valuable figures included in the article by Nastaran Zafar Ardalan.[12] One figure localizes the site of the ruins from an aerial photograph (Fig. 2); a second figure designates map-like residential areas within the city, industrial zones, and a massive cemetery containing an estimated 40,000 graves(!) (Fig. 3), and a third illustration shows the partially unearthed and reconstituted center of this ancient city (Fig. 4). *Surprisingly, no defensive walls or structures have been found in the rather sizeable Burnt City.* This major city (vast?) urban center clearly developed a unique civilization for its time; it was a major source for manufacture and trade within Greater Iran including ancient Elam.[18-21] Apparently there was also extensive trade with areas of modern Iraq (Mesopotamia) , Kuwait, Bahrain, Oman, and the Islands of the Persian Gulf, as well as Egypt to the West, Eastern and Northeastern Central Asia, and part of modern Pakistan, e.g., Quetta. There is also evidence of ancient roads, etc. Apparently, it served as "meeting point of great civilizations of Mesopotamia, India and China".[16]

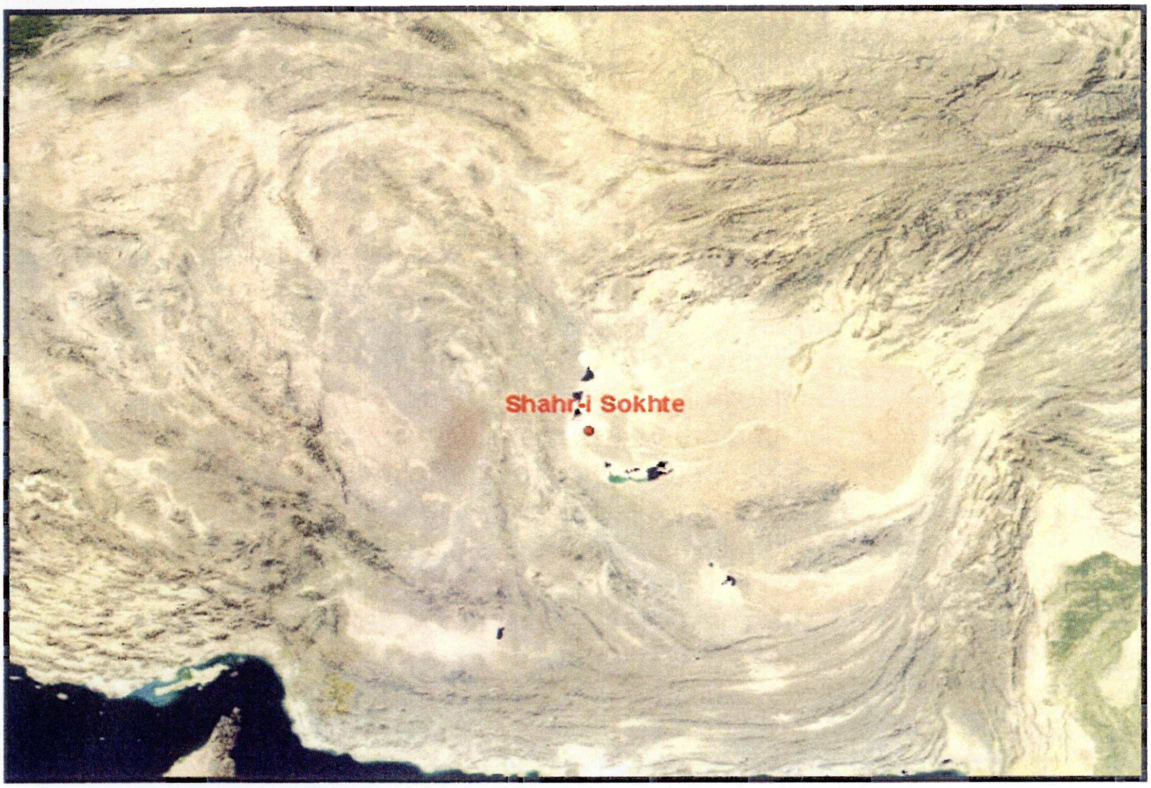

Figure 2. This aerial photo of the border area of South-Eastern Iran includes and locates properly The Burnt City. This figure is reproduced from a paper by the journalist, Ms. Nastaran Zafar Ardalan, Reference 12. This figure is reproduced with the kind permission of the publisher, "The Circle of Ancient Iranian Studies (CAIS) - www.cais-soas.com".

In this community, advances were made in development of manufactured pottery and clay figurines, textiles, jewelry, inlaid works, seals, flint drills, other stone tools, metallurgy, etc. There were painters, potters, jewelers, shepherds, farmers, weavers, carpenters, and other craftsmen. The oldest known backgammon game(s) with dice have been located there (manufactured locally or imported from India?), along with a number of quality textiles and pottery including some with artistic figures in animation (apparently a first).[15] This site was also the early source of caraway seeds.[12,13] Fine pieces of jewelry (some constructed less than one mm thick) have been found. Jewels made of lapis lazuli (obtained from Afghanistan) and other fine and semiprecious stones have been located, as well as works in gold, silver, etc. Apparently, thousands of lapis lazuli beads (finished and unfinished) were produced there for markets in Mesopotamia and Egypt.[12,13] The lapis lazuli had been imported to The Burnt City from a considerable distance away in Afghanistan and perhaps to the North of Iran as well. It has been suggested that the city had approximately 70 villages "active in agriculture and production of clay works" in the Helmand/Hirmand River zone.[12,13] Based on a skull recovered from a 13 year old girl exhibiting hydrocephalus, it is claimed that brain surgery existed at this site in advance of Egyptian development of such skills.[12,13] Thus, one can readily argue that this indeed was a major city/center in its time. One article termed it *the* regional capital for a millennium.[17]

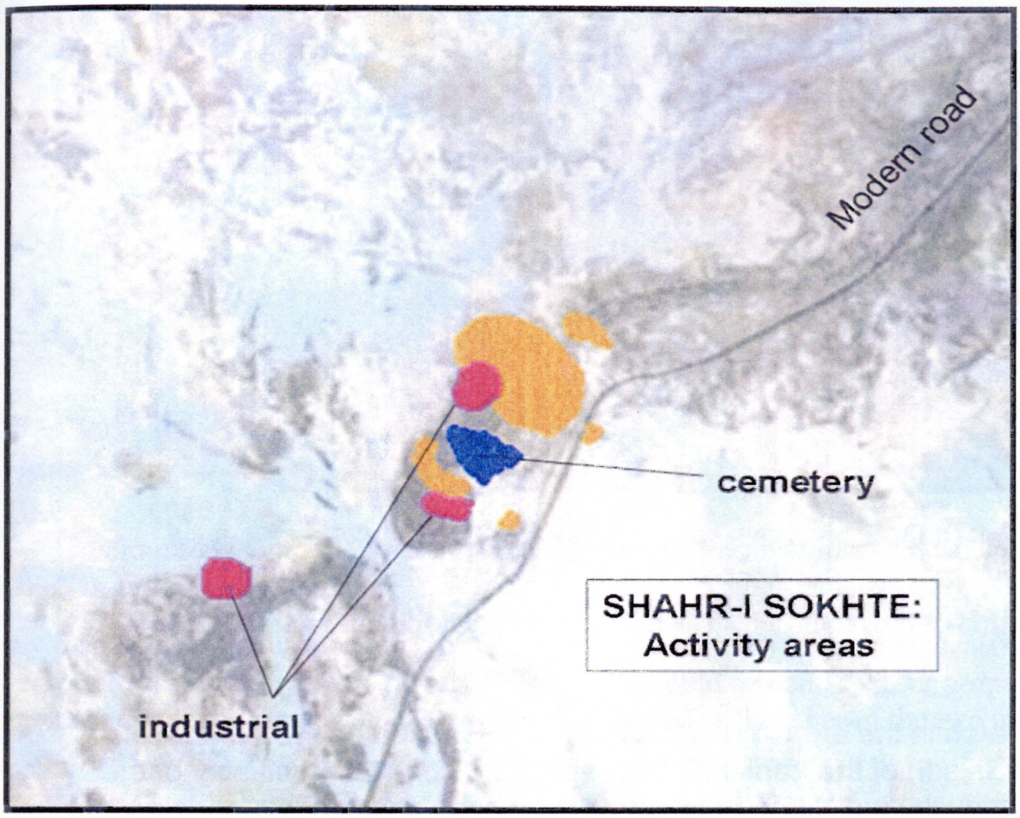

Figure 3. This is a map-like overlay of the area containing The Burnt City. Built up areas are shown as well as the massive cemetery, and industrial areas. Reproduced from a paper by the journalist, Ms. Nastaran Zafar Ardalan, Reference 12. This figure is reproduced with the kind permission of the publisher, "The Circle of Ancient Iranian Studies (CAIS) - www.cais-soas.com".

Much has been learned by excavating a number of graves, and items contained within them, in the enormous cemetery area of The Burnt City. Life expectancy there was rather short. Men died between the ages of 26 to 53, and women died between 26 to 46 years of age.[12,13]

Figure 4. Here we see the reconstituted central area of The Burnt City. Reproduced from a paper by the journalist, Ms. Nastaran Zafar Ardalan, Reference 12. This figure is reproduced with the kind permission of the publisher, "The Circle of Ancient Iranian Studies (CAIS) - www.cais-soas.com".

Overall research in the area in recent years has been led by Prof. Mansour Sayyed Sajjadi (or Sajadi) of the Iranian Group, and Prof. Lorenzo Costantini of the Italian Group. From such digs, it has been found that these early people apparently believed in an after-life. Dishes, water, and other basic items were placed in the graves of the deceased for use when they were resurrected or awakened. It is pointed out that garlic has often been found in these graves. This same tradition was used by Indo-European tribes to expel "wicked spirits" from their homes, and presumably it served a similar purpose for the deceased.[12,13] There is no definitive information as to what happened to the numerous people of this ancient community when the city was deserted, nor do we know from whence they came originally. Apparently, the Hirmand/Helmand River was drying up in this area and had changed its course significantly. It is probable that this might have made the area untenable or less tenable for continued settlement.

Artificial Eye

In a recent dig at "The Burnt City", skeletal remains were found of a *much taller than average* woman (height between 5 foot, 10 inches to 6 feet, or *circa* 180 cm), age 25-30 years. An artificial eye was found *retained within the socket of the left eye in her skull* (Fig. 5). Her remains were dated between 2900-2800 BC (almost 5000 years ago). These remains were found in Grave #6705 of The Burnt City's cemetery. And a quality hand mirror was found in this grave near her skeletal remains.

Figure 5. This figure shows the artificial eye still lying within the skull of the woman who wore it. The skull was found at her grave in The Burnt City. An imprint of the attached thread(s) is apparently visible in the bone structure near or at the rim of the orbit. This fact suggests that this artificial eye was in use for some considerable time period by this woman. This figure is reproduced from Reference 7; it is not clear who should be contacted for proper expression of appreciation. One assumes it has origin with one and/or the other of the two archaeological groups at the dig.

Because of her height, and physiognomy (see below), it is hypothesized the woman might have arrived in The Burnt City from Arabia (or elsewhere). The *hemispherical artificial eye structure was just over one inch in diameter* and was made of "bitumen". Bitumen, a lightweight material, is defined (ancient usage in Asia Minor)[3] as being a form of asphalt. In another article, it states that considering the specific gravity of the artificial eye, this particular eye structure most probably was composed of natural tar mixed with animal fat. Dr. Sajjadi (or Dr. Sajadi) is cited as making this statement - although he is also quoted as saying further study is needed.[6,8]

The surface of the artifical eye was inscribed with a pattern of radial (and other) lines (Fig. 6) inlaid with gold (residues were found on the artificial eye). And apparently the surface of the artificial eye was also covered by a thin layer of gold. The inscribed lines contained gold inlay, and radiated "like rays of light" from the edge of an also well delineated, round "pupillary zone" (Fig. 6). There is also evidence of white paint residue (a painted sclera). It is not clear, was there a thin layer of gold with over-painted areas, or were these two separate areas? Apparently there were also over-laid thin gold (*ca* ½ mm wide) "capillaries" on the "sclera". In addition to the round pupillary area, was there an iris zone? "There were some parallel lines around the pupil forming a diamond shape", quoting Dr. Sajjadi. Might these have been an intended iris?[8]

Figure 6. This is a photograph of the oldest known artificial eye. The incised grooves in "the bitumen" are readily visible. In the original, there are remnants of gold overlay, of white "scleral" paint overlay, and of gold applied to the incised areas. One can also see the holes near the rim which held the thread (gold and/or fiber) which was used to help secure the position of the artificial eye within the lady's left orbit and which was wrapped/tied about her head. The "eye" is rotated approximately 90 degrees from its position in Fig. 5. This figure is reproduced from Reference 8. This figure has been broadly reproduced in the press, and it is assumed that it has origin with the Iranian and/or Italian archaeological team at the dig.

There were two holes drilled through the bitumen (about 180 degrees apart near the rim of the artificial eye) to which were attached a thread-like string or chain made of gold(?) or possibly of fiber. These strings were wrapped about the head as we might attach an eye-patch today. The artificial eye had been worn or contained *within* the orbital cavity for some period of time, because evidence of an imprint of the string or fiber cord had worn into the orbital bone or orbital ridge (Fig. 5).[2] And, there was evidence of an abscess which had formed under the superior rim of the orbit and inside the socket of this woman (Fig. 5).[8] One assumes the eye structure, worn under the lid, had to be removed for cleaning and probably for sleep.

Near to the skeletal remains there was found "an ornate bronze hand mirror apparently used by the woman to check her 'startling appearance'".[2] One would think this was a wealthy, perhaps powerful, woman of high status. It is hypothesized she "had occult powers and could see into the future".[2] Professor Costantini said that the eye was clearly not intended to mimic a real eye, but had a special purpose. He felt it must have glittered spectacularly, conferring upon the woman a mysterious and supernatural gaze."[2] It was suggested she might have been a soothsayer, seer, or oracle.

No cause of death of this woman has been determined. And, the reason she lost vision in her left eye is not known. Can we assume the left eye had been removed?

Was preparation of the remaining orbital tissues necessary in order to receive the rather sizeable artificial eye within her orbit?

There is no record of an earlier artificial eye structure. Was this the very first artificial eye? One wonders? The first-known lenses (found in Egypt ca 2575-2551 BC, i.e., at the beginning of the Fourth Dynasty of the Old Kingdom, reign of Snefru), were just too mature in form, too refined in quality, and too complex in design to be the very first lenses.[1] This simulated artificial eye-structure is not a primitive design, but rather it is a rather mature/elegant one. It must have been employed successfully given evidence of extended usage found in the orbit. It may have been brought to The Burnt City from a prior location by this obviously un-common, very tall, and undoubtedly striking lady. She was said to have a high sloping forehead, a "determined" jutting chin, and dark skin. Her cranial configuration suggested to the archaeological team that she might have been of Africanoid origin. Some writers proposed she might have come from Arabia.[e.g., 5]

It is not clear whether the artificial eye was (or was not) fabricated in The Burnt City. There is quite a discussion on this point.[11] Dr. Sajjadi argues that it was fabricated in The Burnt City! He does admit she may not have had origin within The Burnt City because of her physical characteristics (height, etc.). He suggests she may have migrated from one of the southern provinces of Persia, or perhaps from Arabia.[5] Sajjadi argues strongly that the eye structure was made locally. That is, he postulates that the usage of tar in the artificial eyeball, and proficiency of jewelers in The Burnt City during ancient times argues strongly for local construction.[2] Assuming there is no further evidence on this set of issues, this writer feels this issue is really not yet resolved.

So saying, this woman must have had quite a presence, and created quite a sensation! It is interesting that this eye structure is dated earlier than the first known lens,[1] but well after the introduction of the earliest known mirrors which occurred between 6000-5000 BC in Çatal Höyük in Anatolia located in modern Turkey.[e.g., 1] And it is noteworthy that this rather special lady had a quality mirror (for her time). The archaeological team at The Burnt City mentioned the possible use of this mirror as a compliment to this lady's eye care, to adjustment of the artificial eye, etc. Many aspects of this historic find are rather fascinating!

References

There is much repetition in some of these citations. For a quick read/start, the writer suggests reading citations 2, 12, and possibly 4. Then read the remaining key sources. Other details *do emerge* when reading these research and news reports, but the yield is limited in a number of these citations.

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8. Sadigh, Soudabeh. Ancient artifical eyeball found in Burnt City presented in Rome.
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Five Eighteenth and Nineteenth Century Books Significant in Vision Science Selected from the Collection of the Lilly Library at Indiana University

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Abstract

This paper discusses five eighteenth and nineteenth century books selected from the collection of the Lilly Library at Indiana University in Bloomington, Indiana. The five were selected because they all contained at least some material of significance in clinical vision science (some contained a broad range of scientific topics) and they were all important publications in their time. The authors of the books, in alphabetical order, were Frans Cornelis Donders, Joseph Priestley, William Charles Wells, Charles Wheatstone, and Thomas Young.

Key words: *binocular vision, history of vision science, ocular accommodation*

The Lilly Library, located on the Bloomington campus of Indiana University, houses rare books, manuscripts, and pieces of music to serve as a cultural and research resource for scholars and the public. It was opened in 1960, having been made possible by the donation in 1956 of the library of Josiah Kirby Lilly, Jr., former president and chairman of the board of Eli Lilly and Company.

The five books discussed in this paper were selected for containing material of significance in clinical vision science and for being considered important in their time. Some of these also contain discussion of a broad range of other topics. They will be presented in alphabetical order by author.

Frans Cornelis Donders. On the Anomalies of Accommodation and Refraction of the Eye, With a Preliminary Essay on Physiological Dioptrics. London: The New Sydenham Society, 1864.

Frans Cornelis Donders (1818-1889) was born in Tilburg, Holland. He studied medicine in Utrecht, and later, in 1840, received the M.D. degree from Leiden University. He was for a time a military medical officer. In 1842, he returned to the University of Utrecht, where he would stay for the rest of his career, teaching, doing research, writing, editing journals, and practicing medicine. Starting in about 1852, Donders practiced mostly in ophthalmology.

Due to acclaimed papers on spectacles and refraction published in 1858 and 1860 and a monograph on astigmatism published in 1862, Donders was asked to write a book on refraction by the New Sydenham Society of London.[1] The result was the 635-page *On the Anomalies of Accommodation and Refraction of the Eye*, published in 1864. It was translated from Donders' Dutch manuscript by William Daniel Moore. In a translator's notice in the front matter of the book, Moore noted that Donders' "accurate knowledge of English" helped him "avoid any serious misconceptions of his meaning." The book was first published in English and later in other languages. It was an immediate success and was lauded for its clarity, depth, insight, and sound application of experimental findings to clinical practice. Ophthalmology historian Daniel Albert stated that "this brilliant creation by a man of genius ...was literally a triumph for nineteenth-century science and medicine....Conceptually it is as grand as Virchow's *Cellular Pathology*, and in its detailed observation is on a par with Darwin's *Origin of Species*.[2] (p. 142)

The book devotes a brief introduction and four chapters (the 170-page "General Part") to background information on accommodation, ocular optics, refraction, and spectacles. In his discussion of ocular accommodation, he presents a graphical method of showing accommodation and convergence ranges and the relation between accommodation and convergence.

Pages 171 to 627 (the "Special Part") are divided into five chapters on anomalies of refraction and three chapters on anomalies of accommodation. Separate chapters are devoted to hyperopia (farsightedness), myopia, and astigmatism. These chapters consider the definitions, classifications, diagnosis, causes, typical changes, symptoms, associated findings, and treatment of each of these conditions.

Donders authored more than 340 publications, mostly on physiology and ophthalmology.[3] *On the Anomalies of Accommodation and Refraction of the Eye* was his best known work. Hirschberg called Donders the "greatest genius of Holland of the 19th century" and said that Donders "influenced the entire scientific world, not only by his publications, but also orally in the lecture hall and in the laboratory."[4] Donders was the recipient of many awards and memorials from ophthalmological and other organizations. A statue of him stands in Utrecht and his likeness was featured on a Dutch postage stamp.

Joseph Priestley. The History and Present State of Discoveries relating to Vision, Light, and Colours. London: Printed for J. Johnson, 1772.

Joseph Priestley (1733-1804), a native of England, was a theologian, teacher, and scientist, who was important in the British Enlightenment. The books, pamphlets, and papers in journals that he authored numbered over 150, and included books on theology, politics, grammar, education, history, and science.[5] In his theological and political writings, Priestley advocated unitarianism and reform in government and theology. In science, he is best known for isolation and identification of oxygen and six other gases. Priestley was employed most of his life as a minister or teacher. He was an ordained minister, and he received an LL.D. from the University of Edinburgh in 1764. He was elected Fellow of the Royal Society in 1766.

His ability as a teacher led his friends to encourage him to prepare surveys of the sciences. His first book in that series was *The History and Present State of Electricity, With Original Experiments*, published in 1767. It was a success, leading him to publish *A Familiar Introduction to the Theory and Practice of Perspective* in 1770, and *The History and Present State of Discoveries relating to Vision, Light, and Colours* (often referred to simply as *History of Optics*) in 1772. The *History of Optics* was not financially successful and was, as a result, the last of what Priestley had envisioned as a long series of books covering all of the sciences. *History of Optics* was not highly original, but it was a comprehensive and up-to-date survey of the field.[6] It would be another 150 years before there was another English language work on the history of optics and vision science.[7]

In *History of Optics*, Priestley communicated the science of vision and optics by presenting a historical chronicle of discoveries. The book was divided into six periods: revival of learning Europe (pp. 1-28); discoveries from the revival of learning in Europe to the time of Snell and Descartes (pp. 29-96); discoveries of Descartes and his contemporaries (pp. 97-130); Descartes to Newton (pp. 131-237); discoveries of Newton (pp. 238-354); and since the time of Newton (pp. 355-783); followed by a section of additions (pp. 784-812). The coverage of vision was comprehensive, with discussion of after images, pupillary function, accommodation, strabismus, presbyopia, visual acuity, perceived position and distance, perception of motion, structure of the eye, and other topics.

In the preface to the book, Priestley explains his use of the historical method: "In order to facilitate the achievement of all the branches of useful science, two things seem to be principally requisite. The first is, an historical account of their rise, progress, and present state; and the second, an easy channel of communication for all new discoveries. Without the former of these helps, a person every way qualified for extending the bounds of science, labours under great disadvantage…" (p. i)

Priestley's favorable stance toward the Americans, support for the French Revolution, and uncompromising calls for theological reform led to the destruction of much of his house, library, and laboratory in mob violence in 1791. In 1794, Priestley emigrated to the United States and spent the remainder of his days in Pennsylvania. He was well received in America, and he counted Benjamin Franklin and Thomas Jefferson among his friends.

William Charles Wells. An Essay Upon Single Vision With Two Eyes Together with Experiments and Observations on Several Other Subjects in Optics. London: Printed for T. Cadell, 1792.

William Charles Wells (1757-1817) was one of the foremost scientists of his time, but his work has been largely overlooked and forgotten, leading vision science historian Nicholas Wade to write a book about Wells and his work and to title the book *Destined for Distinguished Oblivion.*[8] Wells' best known work on vision was his 1792 book *An Essay Upon Single Vision With Two Eyes – Together with Experiments and Observations on Several Other Subjects in Optics.* The book deals largely with binocular vision, but also, as the subtitle suggests, with other topics, such as eye movements, ocular accommodation, visual acuity, and visually-related vertigo.

The portion of the book that can be identified as being the essay on single vision is divided into three parts. Part I (pages 1-33) discusses previous theories of binocular vision. Wells primarily considers the work of Robert Smith and Thomas Reid, but also the writings of Galen, Alhazen, Briggs, Jurin, and Porterfield, among others. Part II (pages 33-62) presents results and interpretations of his experiments on perceived visual direction and binocular vision. Part III (pages 63-84) deals with the relation of his binocular vision theories to eye movements and various visual phenomena. The remainder of the book is on "several other topics in optics" as stated in the sub-title. It is divided into four "articles." The first article (pages 85-105) concerns visual orientation and perception of motion. The second article (pages 106-115) considers eye movements and visual persistence. Topics in the third article (pages 116-131) are ocular accommodation and convergence. In the fourth article (pages 131-144), the subject of visual acuity is discussed.

Perhaps the most notable work in Wells' book is his experimentation to develop theories of perception of visual direction. He provided evidence that perceived visual direction of an object was determined not only by stimulation of the eyes, but also by information from eye position. Present-day authors have praised Wells for his "elegant experiments,"[9] the "originality of his experiments," and his "elegant summary of observations."[10] Wells' book did not contain any illustrations or diagrams. It has been suggested that the lack of explanatory illustrations could explain the subsequent neglect of Wells' work on binocular vision and visual direction.[11]

William Charles Wells was born in 1757 in South Carolina, the second son of immigrants from Scotland.[12] His sister was the writer Helen Wells (1761?-1824). Wells' father sent him to school in Scotland in 1768. In 1771, Wells returned to South Carolina and served as an apprentice to a physician and botanist. Due to the influence of his loyalist father, Wells returned to Britain in 1775 where he resumed his studies. He completed the M.D. degree at Edinburgh in 1780. He was elected a Fellow of the Royal Society in 1793. He practiced as a physician in London for a number of years, but did not achieve financial success. Wells apparently had an irascible nature, but had a circle of loyal friends. Wells died in 1817 in London.

Another work by Wells, *An Essay on Dew and Several Appearances Connected with It*, published in 1814, was recognized by the Rumford medal from the Royal Society of London. In 1818, a posthumous compilation of some of his works was published. It bore the long title and sub-title, *Two Essays; One Upon Single Vision with Two Eyes; The Other on Dew. A Letter to the Right Hon. Lloyd, Lord Kenyon and An Account of a Female of the White Race of Mankind, Part of Whose Skin Resembles that of a Negro; With Some Observations on the Causes of the Differences in Colour and Form Between the White and Negro Races of Men*. The portion of the book subtitled *An Account...*presents a case which led Wells to postulate a form of natural selection, which, like his work on vision, has been largely forgotten. Also included in that book were memoirs which Wells dictated to a friend in his last year of life.

Charles Wheatstone. The Scientific Papers of Sir Charles Wheatstone. London: Published by the Physical Society of London, 1879.

Charles Wheatstone (1802-1875) was born in England into a family of musical instrument makers and dealers. He did not have formal education in science, but his scientific curiosity was stimulated by wanting to understand the acoustical properties of music.[13] While in the music business, he experimented on sound and worked on musical inventions, such as the concertina. Wheatstone became interested in vision when he experimented on the visual representation of acoustical phenomena, and he invented the kaleidophone, a toy which made visible the vibrations of glass rods that produced sound.[14]

This book was published posthumously and is a compilation of some of Wheatstone's best known works. It contains various commentaries and papers on optics and two major papers on vision, *Contributions to the Physiology of Vision, Part I* (published in 1838 in the *Philosophical Transactions*) and *Part II* (published in 1852). The sub-title on both papers was *On some remarkable, and hitherto unobserved, Phenomena of Binocular Vision*. In Part I, he describes his invention of the mirror stereoscope: "These inconveniences are removed by the instrument I am about to describe; the two pictures (or rather their reflected images) are placed in it at the true concourse of the optic axes, the focal adaptation of the eye preserves its usual adjustment, the appearance of lateral images is entirely avoided, and a large field of view for each eye is obtained. The frequent reference I shall have occasion to make to this instrument, will render it convenient to give it a specific name; I therefore propose that it be called a Stereoscope, to indicate its property of representing solid figures." (p. 230)

Other topics of works in this book include sound, wind instruments, audition, electricity, telegraphy, rotation of the earth, mathematics, gyroscopes, and cryptography. Wheatstone is best known for his experiments and inventions in electricity and telegraphy. In the field of electricity, Wheatstone studied the velocity of electrical transmission in wires, experimentally verified Ohm's Law, invented the rheostat, and did work on electrical recording devices. Wheatstone collaborated with

William Fothergill Cooke in the development of telegraphy. They obtained their first patent in 1837, and Wheatstone's subsequent efforts made the telegraph a practical working device. Although Wheatstone is not best known for his work in vision, Wade noted that "Brewster and Wheatstone were the two most consistent students of vision writing in Britain during the period from about 1820 to 1860."[15] (p. 301)

In 1834, Wheatstone was appointed professor of experimental physics at King's College in London, but he apparently did little lecturing after 1840. It is said that he "was an indifferent teacher because of an almost morbid timidity in the presence of an audience. On a one-to-one basis, however, he was an excellent tutor, and there are testimonies to his eloquence in such circumstances."[16] Among the many scientific honors that Wheatstone received were becoming a fellow of the Royal Society in 1836 and being knighted in 1868.

Thomas Young. A Course of Lectures on Natural Philosophy and the Mechanical Arts. London: Printed for Joseph Johnson, 1807.

Thomas Young (1773-1829), born at Milverton, England, was a gifted scientist, physician, and linguist. Young was inspired to become a physician by his mother's uncle Richard Brocklesby, who later left him a substantial inheritance.[17] Young studied medicine in London, Edinburgh, and Göttingen, where he was awarded the doctor of physic in 1796, and then at Cambridge, where he received the M.B. in 1803 and the M.D. in 1808. He became a Fellow of the Royal College of Physicians in 1809. Young's remarkable intellectual talents manifested themselves early, as he learned numerous languages and read widely in his youth.[18] He presented his first paper (on the mechanism of ocular accommodation) to the Royal Society before his twentieth birthday, and he was elected Fellow of the Royal Society in 1794 at the age of twenty-one.

In 1801, Young was appointed Professor of Natural Philosophy at the Royal Institution. In 1802 and 1803, he gave an extensive series of lectures there. Biographers Wood and Oldham said that "Of the lectures as an intellectual achievement it is impossible to speak too highly.... for their immense scope, their grasp of the subjects and their originality they are quite unique in the history of Natural Philosophy or Physics."[19] (p. 124) In 1807, the lectures and other material were published in two volumes under the title *A Course of Lectures on Natural Philosophy and the Mechanical Arts*.

Volume I was devoted to the lectures and divided into three parts with twenty lectures in each: Mechanics, Hydrodynamics, and Physics. He not only provided a comprehensive review, but also presented a number of new discoveries and ideas, such as the interference of light from his double slit experiment, the modulus of elasticity, and the use of the term energy. There were six lectures regarding optics and vision: On the theory of optics (p. 408), On optical instruments (p. 420), On physical optics (p. 434), On vision (p. 447), On the nature of light and colours (p. 457), and On the history of optics (p. 472).

Volume II contains a reference list of about 20,000 publications from the ancient Greeks up to about 1805 and reprints of several original papers. Among the reprinted articles are his 1793 paper given to the Royal Society and his 1803 paper *On the Mechanism of the Eye*. Included among the topics in the latter paper were his discovery of astigmatism and an early discussion of his trichromatic theory of color vision.

It has been said that Young's *Lectures on Natural Philosophy* "contained the detailed study and explication of a range of natural phenomena so broad that it would have established Young's fame in many fields at once, had he been unknown to that moment."[20] (p. 116) Biographer Andrew Robinson expressed his admiration for versatile people, but noted that Thomas Young, "for sheer range of expertise, beats them all. Not only did he make pioneering contributions to physics (the wave theory of light) and engineering (the modulus of elasticity), to physiology (the mechanism of vision) and to Egyptology (decipherment of hieroglyphics), but he was also a distinguished physician, a major scholar of ancient Greek, a phenomenal linguist, and an authoritative writer on all manner of subjects, from carpentry and music to life insurance and ocean tides."[21] Young died of progressive heart disease about a month before his 56th birthday.

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The Refraction Letter, a Periodical Published Monthly from 1973 to 1976

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Optometric Historical Society member Byron Newman sent me a copy of the January, 1974 issue of *The Refraction Letter*, in which he had authored an article. In his cover letter, Byron suggested that it might be of interest to *Hindsight* readers. Byron's article was titled "Add a measurement." The title refers to an additional recording he makes on the rotary prism fusional vergence ranges. He asks patients to not only report blur, break, and recovery, but also if they should happen to notice any discomfort or pulling sensation during the testing. He gave the example of a recording of 2/8/10/8 indicating discomfort with 2 prism diopters, blur with 8 prism diopters, break with 10 prism diopters, and recovery with 8 prism diopters. If discomfort is reported simultaneously with blurring or doubling, recordings are made as usual (for example, 8/10/8), and the word that the patient used to indicate the sensation, such as "pain", "strain", or "bothers", is recorded. Byron suggested that the additional measurement helped him identify patients who might not be completely comfortable with their new spectacles and who might benefit from vision therapy to improve visual motor skills.

Also in the January, 1974 issue of *The Refraction Letter,* there was an article by long-time OHS member James R. Gregg on a binocular balance method; a four paragraph "One man's opinion" by Morrison Smither, O.D., of Suffolk, Virginia; an article by Owen Belmont, M.D., of Philadelphia, on aspects of pediatric examinations; and an article on induced prism in bifocals by George A. Levi, M.D., of Fayetteville, North Carolina. A subtitle given below *The Refraction Letter* on the first page was *A Monthly Informational Service for the Eye Care Professions from Bausch & Lomb.* On the third page of the four page publication were the statements that it was published on the last Monday of each month and that the annual subscription fee was $6.

Wanting to see what else I could learn about *The Refraction Letter,* I consulted the library catalog, WorldCat. I found that five libraries were listed as having *The Refraction Letter,* including our own Optometry Library here at Indiana University. The exact holdings for four of the five libraries were given, and at all four, the holdings started with issue 1 and ended with issue 40. So I believe we can assume that publication ceased with issue 40.

Examining the copies in our library, I found that issue 1 was published in September, 1973, and issue 40 was published in December, 1976, one issue per month. There were author and subject indexes published after issues 13 and 24. A comprehensive subject index covering all of the first 36 issues was also published. There were four pages per issue, with each issue containing three to six short practical articles and commentaries. Pages were not numbered and volume numbers were not used. There were three holes in the margin so that copies could be kept in a three ring binder.

An interesting feature of *The Refraction Letter* was that at the end of each article there was a reproduction of the autograph of the author. The authors included approximately equal numbers of optometrists and ophthalmologists. I recognized the names of a number of the authors as being respected practitioners and educators. Topics of the articles included refraction methods, ophthalmic optics, refractive errors, binocular vision, accommodation, contact lenses, low vision, and patient communication.

Book Review: Doctor's Franklin's Medicine

Doctor's Franklin's Medicine. Stanley Finger. Philadelphia: University of Pennsylvania, 2006. xiii + 379 pages. ISBN-13: 978-0-8122-3913-3. ISBN-10: 0-8122-3913-X. Hardcover, $39.95.

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Due to his wide-ranging friendships, his work as a statesman, publisher, and writer, his concern for good health, and his curiosity, Benjamin Franklin (1706-1790) was a major influence on 18th century medicine. Franklin sought to find practical solutions to common diseases and public health problems. As stated by the book's author, "...what the most famous American of his day brought to the international medical community were some well thought out solutions....he had a large network of influential followers and dedicated admirers who looked upon him as a leader when it came to applying experimental natural philosophy to medicine..." (p. 173)

Poor Richard's Almanac was started in 1733. Readers at the time expected medical astrology in almanacs, so Franklin included it, but realizing that astrology was losing favor among the educated, he used it for humor. The almanac dispensed medical advice, hygiene recommendations, and news about cures for various common ailments. It promoted moderation in food, drink, and habits, often through aphorisms such as his famous "Early to bed and early to rise, makes a man health, wealthy, and wise."

Paintings of Franklin often show him as an overweight man in sedentary activities such as reading and writing. However, he saw daily exercise as important for health. He was an expert swimmer and published a treatise on swimming. Even as an old man, having difficulty walking due to gout and a bladder stone, he talked in correspondence about lifting "dumb-bells."

Franklin was among the first to recommend inoculation to prevent smallpox and he collected statistics to show its effectiveness. Franklin's ties to medicine were involved in his work in forming the Library Company (a circulating subscription library), the American Philosophical Society, and the Pennsylvania Hospital. Franklin did experiments on the effects of electricity, and the publication of some of his correspondence on electricity in monograph form helped make him world famous. He became convinced that electricity did not yield a permanent reversal of paralysis of stroke, but he thought that it might have some value in certain mental disorders.

While in England, Franklin developed close relationships with several eminent British physicians. Franklin greatly respected work at the medical school in Edinburgh, Scotland. He arranged for various young American physicians to visit and study in

Edinburgh. The first American medical school was established in Philadelphia based on the Scottish example upon their return to America.

Franklin advocated breathing fresh air and he did not believe, counter to the prevailing thought at the time, that colds were due to exposure to cold and wet environments. His concern with fresh air led him to study how fireplaces could be improved to remove smoke from inside the house and to invent a new fireplace.

The author observed that Franklin's "...abhorrence of dogmatism, empirical orientation, and passion for systematically collecting new facts...gave Franklin's medicine its relatively modern look in comparison to the speculations of many of his contemporaries." (p. 328) An example of Franklin designing an experiment was his work showing the falseness of Mesmerism. His observations on lead poisoning shared in correspondence with English physician George Baker helped Baker produce a landmark 1767 essay on the topic.

Twelve pages in the book were devoted to visual aids and Franklin's reputed invention of bifocals. On the matter of Franklin's priority in their invention, the author states: "...his idea of combining lenses to correct two visual defects at once seemed to originate with him....Exactly when Franklin had the idea for bifocals is not known, but they first appeared on his nose while he was in France struggling to read lips while also attending to his food or the written word. The first indication that we have to suggest that he was having bifocals made comes from a note dated 1779." In the section on bifocals, the author cites Franklin's writings and papers as well as publications of Charles Letocha and John Levene (misspelled in the book as Levine).

The author, Stanley Finger, is Professor of Psychology at Washington University in St. Louis. He has written previously on the history of medicine, one of his other books being *Origins of Neuroscience.* He serves as senior editor of the *Journal of the History of the Neurosciences.*

The book is divided into four parts: (1) The Colonist and Medicine, (2) Medicine in Great Britain, (3) Le Docteur in France, and (4) Old Age. These four parts are preceded by an introduction entitled Benjamin Franklin's Enlightened Medicine and followed by an epilogue entitled Franklin's Medical Legacy. The reference notes indicate that extensive use was made of Franklin's writings and papers as well as numerous scholarly publications on Franklin and 18th century medicine. I found this book to be enjoyable to read. It was also very informative on Franklin's contributions to medical science and public health, and on the medical atmosphere and popular health beliefs of the 18th century.

Death Notice: J. William Rosenthal

Optometric Historical Society member J. William Rosenthal passed away on June 28, 2007. Dr. Rosenthal (1922-2007) was a gracious gentleman, Board certified ophthalmologist, collector of spectacles and ophthalmic antiques, and scholar of ophthalmic history. He held the M.D. degree from Tulane University (1945) and M.S. and D.Sc. (1956) degrees from the University of Pennsylvania. He was a Fellow of the American College of Surgeons, the International College of Surgeons, the Royal Society of Medicine, and the French Ophthalmological Society. He engaged in the practice of ophthalmology in New Orleans from 1951 to 2004.

In the realm of ophthalmic history, Dr. Rosenthal is perhaps best known for his vast collection of spectacles and ophthalmic antiques and for his comprehensive 530-page book *Spectacles and Other Vision Aids: A History and Guide to Collecting*, published in 1996. Items from his collections can be found in museums in Chicago, New Orleans, San Francisco, Iowa City, and Washington, DC. He was Curator of Spectacles for the American Academy of Ophthalmology Museum of Vision, the 2002 Snyder Lecturer to the Cogan Ophthalmic History Society, Founder and Curator of the Jonas W. Rosenthal, M.D., Memorial Ophthalmology Museum at Tulane University, and the first President of the Ocular Heritage Society. He was a consultant to the Smithsonian Institution, and a member of the Board of Trustees of the American Optical Company Museum in Southbridge, Massachusetts. He gave a talk to the Optometric Historical Society when the American Academy of Optometry met in New Orleans.

The following obituary appeared in the New Orleans Times-Picayune, June 29-30, 2007:

Dr. J. William Rosenthal died at his residence on Thursday, June 28, 2007, at the age of 84. A native and life long resident of New Orleans, LA. Son of the late Marjorie Oppenheimer Rosenthal and Dr. Jonas W. Rosenthal. Husband of Beth Wright Bloch and by first marriage the late Harriet Stern Rosenthal. Father of Paul Rosenthal of Baton Rouge, LA and the late Susan Rosenthal Farrell, (Dr. James Farrell). Step-father of Ann Bloch Kern (Stephen Kern) and Dr. Ted Bloch, III. Grandfather of Elizabeth and Whitney Farrell, Ben and Will Rosenthal. Step-grandfather of Michelle Kern Sisco (Kenneth Sisco) and Scott Kern. Great-grandfather of Drew Sisco. Relatives and friends of the family are invited to attend the Funeral from Temple Sinai, 6227 St. Charles Ave., on Sunday, July 1, 2007 at 11:00 AM. Visitation from 10:00 AM until 11:00 AM at Temple Sinai. Rabbi Edward Paul Cohen Officiating. Interment in Dispersed of Judah Cemetery (N. Anthony at Iberville). Kindly omit flowers. Memorials to Touro Infirmary, 1401 Foucher St., New Orleans, LA or the Foundation of the American Academy of Ophthalmology, (General Fund), 655 Beach St., San Francisco, California, 94109-1336. Arrangements by Tharp-Sontheimer-Tharp, 1600 N. Causeway, Metairie, LA 70001.