

**Studies on Colorimetry, the Stiles-Crawford Effects I & II,
and Fiber Optics Properties in the Laboratory of Walter Stanley Stiles
at the National Physical Laboratory, Teddington**

**Jay M. Enoch
School of Optometry
University of California at Berkeley, USA**

Abstract

The author had the good fortune to spend much of 1959-1960 as a post-doctoral fellow in the laboratory of Walter Stanley Stiles, OBE, FRS. While there, he had opportunity to reassemble partially, to realign, and to re-calibrate a meaningful part of the "Trichromator" after some modifications in design had been made (prior to his arrival).

Further, while this magnificent instrument was designed primarily for studies of color matching and for conduct of Stiles' two-color increment threshold experiments, it was also not difficult to adapt the instrument for studies of the Stiles-Crawford Effect I [SCE I] (the directional sensitivity of the retina, i.e., perceived luminance as a function of entrance pupil beam entry position here assessed for selected wavelengths), and Stiles-Crawford Effect II [SCE II] (the effects of directional sensitivity of the retina upon perceived hue and saturation). While at Teddington, Enoch participated in broadly-based studies of color matching, increment threshold studies, and experiments on SCE I and SCE II. He served as both experimenter and subject and worked closely with WS Stiles and his assistants Pamela Fowler, and Jeanne Vigil. Both Stiles (briefly) and JM Birch also served as subjects during this time period. Resultant research was published in Enoch, JM & Stiles, WS, *Optica Acta* **8(4)**, 329-357, 1961.

Separately, at NPL, the author was also studied fine single and double glass fiber-optics elements (kindly provided by Elias Snitzer, American Optical Corp, Southbridge, Massachusetts, USA) with diameters and index of refraction ratios similar to the core/cladding ratios of photoreceptors in vertebrate species. This work served as precursor for comments made in an Addendum to the Enoch & Stiles paper, and as a model for design of early experiments on waveguide modal patterns in vertebrate photoreceptors, including human, see Enoch, JM, *J Opt Soc Am* **50(10)**, 1025-1026, 1960; *Science* **133 (# 3461)**, 353-1354, 1961; *Am J Ophthalmol* **51(Part II)**, 1107-1118, 1961. Katherine Tansley and Brian Crawford showed Enoch how to construct ring chambers needed to hold/view retinal specimens.

An added research apparatus was assembled by Enoch under direction of Stiles in preparation for the visit of Profs Robert Boynton and Mitsuo Ikeda. A recent conversation with Robert Boynton indicated the design of this instrument was later altered.

Good interactions were had with GBBM Sutherland (Director), Brian H Crawford, JM Birch, Frank JJ Clarke, David Palmer, and a number of others at NPL. While there, Enoch had opportunity to meet J Guild (then retired), and FZ Young (and to hear his discussion of, and to see his demonstration of experiments of Thomas Young at the Royal Institution). Enoch visited laboratories and libraries at the Institute of Ophthalmology in London (e.g., Sir Stewart Duke-Elder, Robert Weale, Katherine Tansley, H Dartnall, etc.), as well as the Cambridge University Physiological Laboratories (William Rushton, Alan L Hodgkin, Fergus Campbell, Giles Brindley, Horace Barlow, etc.), Imperial College (WD Wright), University of Redding (RW Ditchburn, DH Fender), Royal College of Surgeons (Arnold Sorsby, and there, Hamilton Hartridge), etc.

Clearly, this was a period of time when quite a number of physicists were active in colorimetry, lighting research, radiometry and photometry, as well as in other aspects of psychophysics. And there were many distinguished scholars active in physiology and in other scientific endeavors. These individuals brought very special skills to their research, and this, in turn, enriched interdisciplinary, or what today might be termed translational research.

Enoch will describe his experiences at the laboratory and with individuals with whom he interacted. He will discuss an interesting statement made by WS Stiles during data analysis. Stiles noted that JME's color-matching data sets most closely matched the defined CIE observer of any set of data that had been obtained to that date, except possibly for one test point in the blue-green part of the spectrum.

One of the great delights experienced by Enoch during his stay at Teddington was having had opportunity to read carefully the voluminous correspondence of WS Stiles and W Rushton over a lengthy time period. They clearly were close friends. Each taught the other, and one appreciated the results of this in their individual research. It is very unfortunate that this fascinating correspondence seems to have been lost. Enoch called this material to the special attention of Prof M Alpern when he wrote the obituary of Stiles for the Royal Society of London, but these records were nowhere to be found.

Additionally, alignment, calibration and experimental skills learned at NPL have proven to be of great value. At NPL such techniques reached a level of quality which Enoch has sought to emulate throughout his career. WS Stiles and BH Crawford were indeed worthy teachers!