

## Syntonic Phototherapy

Raymond L. Gottlieb, O.D., Ph.D.,<sup>1</sup> and Larry B. Wallace, O.D., Ph.D.<sup>2</sup>

**C**LINICAL AND BASIC research in the last decades showing the impact of light on cells, tissues, blood, circadian rhythms, and mood disorders has increased the acceptance of light as a healing agent. This article describes syntonic optometric phototherapy in hopes of stimulating interest and research to validate and expand its use. We are very grateful to Dr. Raymond Lanzafame, *PMLS*, Editor-in-Chief, for inviting us to write this guest editorial.

Syntonics uses noncoherent, nonpolarized, nonnarrow-band light delivered into the eyes to treat visual dysfunctions, brain injury, headache, strabismus, eye pathology, learning disability, and mood and developmental syndromes. Syntonics is a local and nonlocal therapy that is primarily neurologic in action and neurobehavioral in effect. The eyes permit direct, noninvasive application of light to the retinal blood supply and to nonvisual, retinal photoreceptors that signal circadian and other brain centers. Patients generally look at prescribed colors for 20 minutes/day, three to five treatments per week for 20 treatments. Visual field, pupil, and binocular testing, medical history, and current symptoms determine the syntonic filter prescription. Here we describe syntonic theory, equipment, clinical procedures, and outcomes by using neurorehabilitation of brain injury to illustrate syntonic phototherapy.

Syntonic optometry was conceived of in the 1920s by H. Riley Spitler, O.D., M.D. After studying the works of Pleasanton,<sup>1</sup> Pancoast,<sup>2</sup> Babbitt,<sup>3</sup> and Ghadiali,<sup>4</sup> Spitler began systematic experiments with rabbits raised in various light environments. By 1916, he began to investigate the therapeutic use of light through visual pathways via the eyes. Spitler worked with Carl Loeb, M.D., to develop Specific Light Therapy<sup>5</sup> and adapted this approach for optometrists by applying light directly into the eyes to treat visual problems. Spitler's central thesis, published as *The Syntonic Principle*, in 1941, concluded that chronic systemic, mental/emotional, and visual ailments were caused primarily by autonomic nervous and endocrine imbalance and that specific light frequencies shined into the eyes could stimulate or sedate autonomic and endocrine functioning to restore balance via direct retinal input to thalamic and hypothalamic regulatory centers, thereby correcting visual dysfunctions at their source. His model suggests that red, orange, and yellow light on the low-energy, long-wavelength side of the visible spectrum acts to stimulate the sympathetic nervous system, green (mid-spectrum) yields physiological balance, and blue and indigo (high energy, fast frequencies) activate the para-

sympathetic nervous system.<sup>6</sup> In 1933, convinced that his approach was clinically valid, Spitler founded the College of Syntonic Optometry. Membership grew to more than 1,000 optometrists before the start of the war. Spitler died in 1966. The college survived, and, buoyed by the clinical and basic-research findings from the international LLLT community, syntonics is gaining respect and influence in the eye-care professions.

Clinical and basic research in the last decades about the impact of light on cells, tissues, blood, circadian rhythms, and mood disorders has broadened the paradigm and increased the acceptance of light as a healing agent. (See review by Toshio Ohshiro.<sup>7</sup>) Recently, LLLT has been applied "as a neuro-restorative and/or neuro-protective therapy for the treatment of injury and diseases of the central nervous system."<sup>8</sup>

The application of LLLT for visual disorders has great potential. Russians treated myopic children with poor accommodation with a 2-mm spot of low-intensity red and infrared light on the limbal sclera for 6 minutes per eye on 10 consecutive days. Accommodative ranges measured 4 weeks after treatment were doubled, but for matched controls, remained unchanged. Three years later, the rate of myopic increase was 25% (-0.43D/year) that of the controls (-1.6D/year).<sup>9</sup> Others using similar transscleral treatments reduced symptoms of workers with extreme eye fatigue after long hours engaged in stressful visual tasks.<sup>10</sup> A similar approach was recently initiated to delay or reverse presbyopia.<sup>11</sup> Other, more-serious ocular pathologies have also been successfully treated with light. Injured corneas healed faster with infrared therapy.<sup>12</sup> In 2003, Janice Eells, et al.,<sup>13</sup> found that stimulating the retina with red and near infra-red light prevented retinal damage in methyl alcohol-poisoned mice. LLLT has shown great potential in the treatment of three of the leading causes of blindness: glaucoma, macular degeneration, and cataracts. This includes restoring vision in macular degeneration and cataract, and reducing intraocular pressure in normal and ocular hypertensive patients.<sup>14–16</sup>

The eye is the one place in the body in which blood is directly exposed to relatively unfiltered light. Light-sensitive blood constituents carry photic information and energy to affect far-off places in the brain and body.<sup>17</sup> Syntonic therapy directly irradiates the large volume of the blood circulating through the eye in the 20-min treatment. A well-known physiological effect of visible frequencies of light on blood is relaxation of blood vessel walls mediated by free NO.<sup>18</sup>

<sup>1</sup>Dean: College of Syntonic Optometry, Rochester, New York.

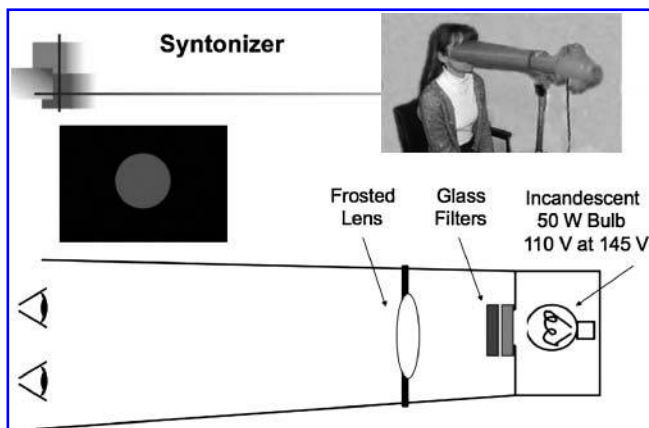
<sup>2</sup>Immediate Past President, Director of Education, College of Syntonic Optometry, Ithaca, New York.

Increasing blood flow in the tiny capillaries to reduce hypoxia might explain how syntonics is so successful at reversing functional symptoms after brain trauma. Hemoglobin is similar to chlorophyll in structure, and both are reversibly altered by light.<sup>19</sup> Other research has found that heme oxygenases are reversibly altered by specific wavelengths of visual light.<sup>20</sup> The heme oxygenases influence oxygen-carbon dioxide exchange, vasodilatation, neurotransmission, oxidation, inflammation, gene expression, and other basic physiologic functions.<sup>21</sup>

Clock mechanisms, sensitive to environmental light, have been identified in the brain as well as peripherally in organs, tissues, and cells throughout the body. Mounting evidence suggests the temporal ordering and phase relations of the multiple physiological rhythms are vital to the health and functioning of the organism. Syntonics may work through the eye by optimizing these rhythms. The recently discovered blue-sensitive cells in the inner layers of the retina, known as intrinsically photosensitive retinal ganglion cells, project via the retino-hypothalamic tract directly into the master circadian pacemaker of mammals, the suprachiasmatic nucleus. This controls a circadian brain network to maintain an oscillatory synchrony in the whole organism to maintain appropriate phase relations such as yearly seasonal changes in temperature, diet, procreation, and daylight (including color temperature and twilight length).<sup>22</sup>

### Syntonics Therapy

The traditional syntonics therapy device, the Syntonizer, uses a white-light source placed behind colored absorption filters focused by a frosted collimating lens. Patients look down a 50-cm tube at the 50-mm-diameter frosted lens that appears as a glowing dot of saturated color (Fig. 1).<sup>23</sup> The light can be steady or strobed. Early devices used carbon arc, but the light source after 1933 was incandescent. Today it uses a vibration-series 50-W, 115-V bulb (powered at 145 V to increase color temperature) that delivers 1.4 Lux at the eye (unfiltered). The glass filters mounted near the bulb are



**FIG. 1.** A patient taking a syntonics treatment. The details of the instrument are described in the text of the article. [Modified from Gottlieb, R.L. (2010). *Syntonics Phototherapy: Mechanisms for Low Light Therapy*. Proc. SPIE 7552, 75520N-1-9]

24 mm in diameter and range from 4 to 8 mm thick. Several newer devices use more-modern sources and other types of filters.

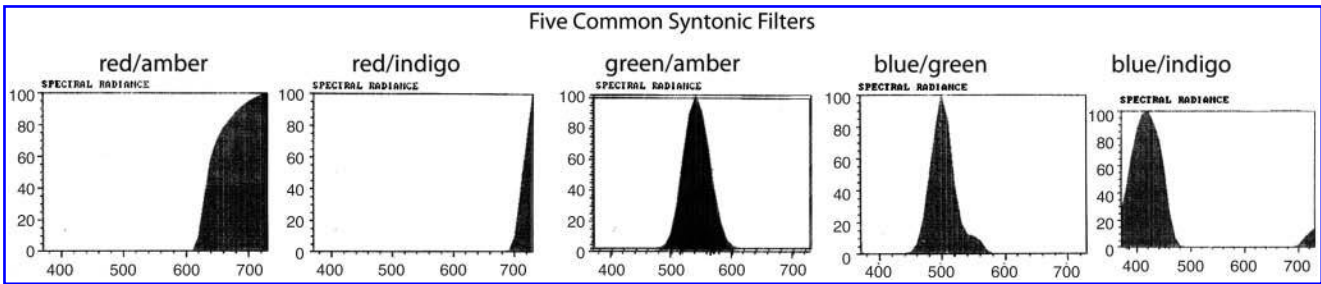
Thirteen different syntonics filters are available. Usually two filters are inserted in series, but single filters or three together are sometimes prescribed in various combinations. Treatments usually last 20 min. One filter pair is often used for the treatment, or sometimes two pairs will be prescribed for 10 min each. Syntonics filter prescriptions are based on the patient's medical history, symptoms, and clinical findings. If pathology is suspected, the patient is referred for neurologic or medical evaluation.

Success of treatment is determined by improvements in vision-test results, symptoms, behavior (mood/attitude, coping ability, and social/verbal skills), and performance (academic, vocational, athletic, and expressive). Progress is monitored after seven treatments, and the prescription is modified if necessary. The most common syntonics diagnostic and treatment protocols are organized as syndromes called "Lazy Eye" (amblyopia and strabismus); "Acute" (hypoxia and inflammation); "Emotional Fatigue" (heart and adrenal exhaustion); "Chronic" (metabolic and toxicity); and "Pain" are treated by using red/amber, green/amber, blue/green, red/indigo (deep red), and blue/indigo filter pairs, respectively. Figure 2 shows the spectral transmission for these.<sup>23</sup>

Pupil and visual-field measures are used to monitor progress and outcome of syntonics therapy. Normal pupils constrict and stay small under sustained light stimulation. Fatigued pupils constrict initially but quickly dilate in the sustained bright light. The severity of fatigue (sluggish response, short-latency redilation) correlates with reduced visual fields and autonomic nervous system imbalance. Visual fields record peripheral awareness as the patient fixates a central target with one eye occluded. Fixation is monitored as the practitioner moves a small target from the periphery toward the center and records responses. Blind areas due to retinal, visual pathway, or cortical damage can diagnose retinal degeneration and detachment, glaucoma, brain tumor, stroke, or head trauma. These are almost always permanent losses.

Functional field loss occurs in cases in which nerve tissue is not destroyed but is compromised because of poor oxygen, edema, or toxic or metabolic imbalance. Functional field constrictions do recover with syntonics treatment. Practitioners measure the central 60 degrees of the field by using a campimeter device (Fig. 3).<sup>23</sup> Generally the more tunneled the field, the poorer the child's learning, reading, social, and performance abilities. A substantial number of children with unexplained learning and emotional dysfunction have fields of less than 15 degrees in diameter and suffer needlessly. With appropriate syntonics treatment, pupil fatigue and field constrictions normalize, and symptoms disappear.

Syntonics phototherapy has been especially successful in treating traumatic brain injury, mild closed head injuries, postconcussive syndromes, surgical trauma, and cerebrovascular accidents. Brain injury can disrupt autonomic nervous balance, causing co-activation or co-inhibition of both the sympathetic and parasympathetic branches. This can lead to hyper- or hypoarousal of motor and emotional responses and frontal-limbic communication by causing implicit and explicit memory defects, motor stress, and loss of



**FIG. 2.** Spectral transmission curves of the five most commonly used syntonic filter combinations from left to right: RED/AMBER, "Lazy Eye" (amblyopia and strabismus); RED/INDIGO "Emotional Fatigue" (heart and adrenal exhaustion); GREEN/AMBER, "Chronic" (metabolic and toxicity); BLUE/GREEN "Acute" (hypoxia and inflammation); and BLUE/INDIGO "Pain." [Modified from Gottlieb, R.L. (2010). Syntonic phototherapy: mechanisms for low light therapy. Proc. SPIE 7552, 75520N-1-9]

emotional tone, resulting in maladaptive sequelae such as posttrauma syndrome, posttraumatic vision syndrome, temporomandibular joint problems (TMJ), and myofascial pain. Induced neurohormonal imbalance upsets the homeostasis of the brain stem, hippocampus, amygdala, pituitary, cerebellum, and brain lobes. Orbitofrontal trauma can lead to restricted emotional ranges and disrupt procedural memory.<sup>24</sup>

Syntonics has been found to be an essential part of a multidisciplinary hospital rehabilitation program. PT, OT, speech and psychotherapy all reported significant acceleration of recovery in their areas.

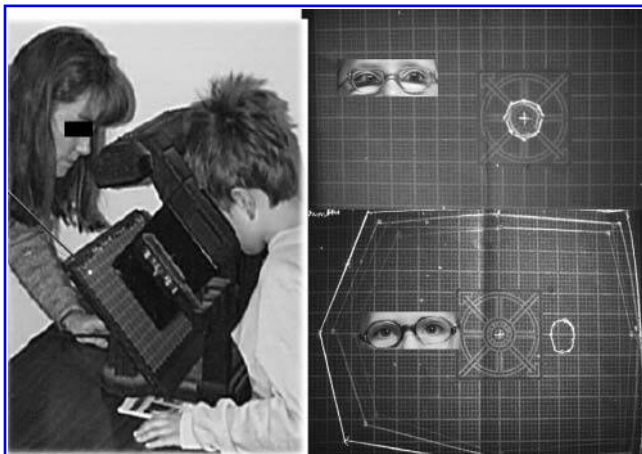
Postinjury autonomic imbalance strongly affects vision, resulting in loss of binocular and accommodative function, spatial distortions, attention, memory, and visual motor and visual field defects. A retrospective study of 46 unselected patients at Neuro-Rehab, a head trauma clinic in Rochester, New York, found that all 46 had visual anomalies. Forty had field defects, 39 had accommodative disorders, and 24 had

binocular and oculomotor deficiencies. Most were treated with indigo and blue/green light for a total of 75 treatments; 32 of the 40 with field defects had improvements of up to 500%, and all 46 showed improved visual function.<sup>25</sup> The downstream effects of phototherapy are becoming more evident in recent approaches in treating central nervous system injury and brain diseases such as Parkinson and Alzheimer.<sup>8</sup> The potential for photoneurorehabilitation shows great promise.

Mild brain injury is a leading cause of vision-related learning problems. Children are particularly susceptible to head injury, especially in the perinatal and prenatal periods. Syntonics has been highly successfully in treating children's visually related learning problems for 80 years. Three controlled studies by optometrists, Kaplan,<sup>26</sup> Liberman,<sup>27</sup> and Ingersol,<sup>28</sup> provide evidence that relatively short-term syntonic treatment can significantly improve visual skills, peripheral vision, memory, behavior, mood, general performance, and academic achievement.

They also confirm that children with learning problems have a functional reduction in their visual fields. The research validated the increase in peripheral vision and visual skills. These three studies found profound improvements in the children who used syntonic phototherapy compared with control subjects matched for age and academic success who did not. In Liberman's study, the syntonics group showed increases over the control group in standardized tests: visual field area of 2,916% versus 14%; visual memory (unrelated words) of 50 versus 13 months; visual memory (abstract symbols) of 21 versus 3 months; and auditory memory of 24 versus 15 months. Teachers and parents of students in the syntonics group reported better emotional recovery, less tension and hyperactivity, and greater ability to handle criticism and confrontation, as well as improvement in academic scores (75% of subjects) and handwriting (40%). Some subjects using methylphenidate (Ritalin) for hyperactivity were able to discontinue its use.

Syntonic optometry is an application of clinical phototherapy of which LLLT researchers and clinicians have been unaware despite its 80-year history. This is because syntonics has not been well researched; it came out of optometry and not medicine, and light therapy was outside the scientific/medical paradigm of its time. Spittler's conjectures, that chronic ocular and systemic disease is caused by imbalance of the autonomic nervous system, that syntonic



**FIG. 3.** Visual field being plotted on a Lloyds Campimeter with photos of a young, cross-eyed girl and her visual fields before (eyes crossed) and after (eyes straight) 20 syntonics phototherapy treatments. The initial visual field measured just 6 degrees, expanded to a full 60 degrees after. The small oval plotted in the After field is the "normal physiological blind spot." [Modified from Gottlieb, R.L. (2010). Syntonic phototherapy: mechanisms for low light therapy. Proc. SPIE 7552, 75520N-1-9.]

phototherapy restores health by rebalancing and toning the autonomic via ocular input, and that light from the blue side of the visible spectrum stimulates parasympathetic action, whereas the red side stimulates sympathetic, were based on the most up-to-date scientific findings of his time. Now, decades later, a growing body of research has provided solid evidence for light's role in modulating biologic actions.

Depending on its frequency and dose, light has been shown to influence circulation, cell respiration, and immune function by stimulating photosensitive elements in the blood, altering mitochondrial metabolism, triggering nonvisual eye-brain pathways to modulate circadian phase and amplitude, reverse depression, and improve sleep in Alzheimer patients, and more. The accelerating volume and quality of light research is changing the acceptance of light and color as a medical tool. It is time to reexamine Spittler's Syntonic Principle and to conduct appropriate clinical research on the efficacy of syntonic phototherapy.

Today, about 1,200 optometrists and a few ophthalmologists and psychologists practice syntonic phototherapy in the United States and other countries. The influence of syntonic theory and treatment has influenced and helped to develop numerous other color therapies around the world.<sup>29,30</sup> Syntonists have successfully treated many thousands of patients since 1933. The lives and health of children and adults with learning, reading, and attention disabilities, people suffering the effects after head trauma and stroke, retinal diseases, crossed eyes, headaches, and senility have been dramatically improved by syntonics when nothing else was helping. More information is available online at [www.syntonicphototherapy.com](http://www.syntonicphototherapy.com)

## References

- Pleasanton, A. (1871). *On the Influence of the Blue Color of the Sky in Developing Animal and Vegetable Life*. Philadelphia: Claxton, Remsen & Haffelfinger.
- Pancoast, S. (1877). *Blue and Red Light*. Philadelphia: J. M. Stoddart & Co.,
- Babbitt, E.D. (1878). *The Principles of Light and Color*. New York: Babbitt.
- Ghadiali, D.P. (1933). *Spectro-Chrome Metry Encyclopedia*. Malaga, NJ: Spectro-Chrome Institute.
- Loeb, C. (1939). *A Course in Specific Light Therapy*. Chicago: Actino Laboratories, Inc.
- Spittler, H.R. (1941). *The Syntonic Principle*. The College of Syntonic Optometry, Pueblo, Colorado (Available at [www.oepf.com](http://www.oepf.com)).
- Ohshiro, T. (2009) Light and life: a personal overview of development in the fields of photosurgery and phototherapy. *Photomed. Laser Surg.* 27, 1-2.
- Anders, J. (2009). The potential of light therapy for central nervous system injury and disease. *Photomed. Laser Surg.* 27, 379-380.
- Avetisov, E.S., Khoroshilova-Maslova, I.P., Anikina, E.B., Shapiro, E.I., and Gubkina, G.L. (1995). Applying lasers to accommodation disorders. *Laser Physics* 5, 917-921.
- Belkin, M., Lobko, V.V., Karu, T.I., and Letokhov, V.S. (1987). *Oftalmol. Zh.* 28, 108.
- Sweeney, C. (2009). To squint or to see the light. *New York Times*, January 1
- Belkin M., and Schwartz, M. (1994). Ophthalmic effects of low-energy laser irradiation. *Surv Ophthalmol* 39, 113-122.
- Eells, J.T., Henry, M.M., Summerfelt, P., et al. (2003) Therapeutic photobiomodulation for methanol-induced retinal toxicity. *Proc. Natl. Acad. Sci.* 100, 3439-3444.
- Ivanic, T., and Ivanic, B. (2008). Low-level laser therapy improves vision in patients with age-related macular degeneration. *Photomed. Laser Surg.* 26, 241-245.
- Kessel, K., Eskildsen, L., van der Poel, M., and Larsen, M. (2010). Non-invasive bleaching of the human lens by femtosecond laser photolysis. *PLoS One* 5, e9711.
- Ivancic, B., Hoque, N., and Ivancic, T. (2009). early diagnosis of ocular hypertension using a low intensity laser irradiation test. *Photomed. Laser Surg.* 27, 571-575.
- Dyson, M. (2010). Role of the circulation in the systemic effects of low-light therapy. mechanisms for low-light therapy V. Hamblin, M.R., et al., editors. *Proc. SPIE*, 7552, 9-15.
- Borisenko, G.G., Osipov, A.N., Kazarinov, K.D., and Vladimirov, Yua. (1997). Photochemical reactions of nitrosyl hemoglobin during exposure to low-power laser. *Biochemistry (Moscow)* 62, 661-774.
- Oren, D., and Terman, M. (1998). Tweaking the human circadian clock with light. *Science* 279, 333-334.
- Noguchi, M., Yoshida, T., and Kikuchi, G. (1981). Photo-reversal by monochromatic light of the carbon monoxide-inhibited heme degradation catalyzed by the reconstituted heme oxygenase system. *J. Biochem. (Tokyo)*. 90, 1671-1675.
- Maines, M.D. (1997). The heme oxygenase system. *Annu. Rev. Pharmacol. Toxicol.* 37, 517-554.
- Mendoza J., and Challet, E. (2009). Brain clocks: from the suprachiasmatic nuclei to a cerebral network. *Neuroscientist* 15, 477-488.
- Gottlieb, R.L. (2010). Syntonic phototherapy: mechanisms for low light therapy. *Proc. SPIE* 7552, 75520N-1-9
- Shore, A. (1994). *Affect Regulation in the Origin of Self: the Neurobiology of Emotional Development*. Hillsdale, N.J.: Lawrence Erlbaum.
- Wallace, L. (1992). Syntonics and Head Trauma. *J. Optometry. Phototherapy*, pp. 13-17 March.
- Kaplan, R. (1983). Changes in form visual fields in reading disabled children produced by syntonic stimulation. *Int. J. Biosocial Res.* 5, 20-33.
- Lieberman, J. (1986). The effects of syntonic colored light stimulation on certain visual and cognitive functions. *J. Optometric Vis. Dev.* 17, 14.
- Ingersoll, S. (1999). Syntonics as reading enhancement techniques at the Livingston Developmental Academy. *J. Optometric Phototherapy* March, pp. 22-30.
- Brailing, B., and Argyle, B. (eds.). (1996). *Light Years Ahead: The Illustrated Guide to Full Spectrum and Colored Light in Mind body Healing*. Tiburon, CA: Light Years Ahead Publishing.
- Liberman, J. (1991). *Light: Medicine of the Future*. Santa Fe: Bear & Co, Inc.

Address correspondence to:  
 Raymond L. Gottlieb, O.D., Ph.D.  
 336 Berkeley Street  
 Rochester, NY 14607-3311  
 E-mail: [raygottlieb@me.com](mailto:raygottlieb@me.com)

This article has been cited by: