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Before Basic Color Terms

I. Introduction

In 1969, anthropologist Brent Berlin and linguist Paul Kay published *Basic Color Terms* – a groundbreaking study of the ways in which human beings acquire words to describe abstract color sensations. Drawing from interviews with subjects representing twenty language groups, as well as previously-reported data from another seventy-eight languages, Berlin and Kay concluded that all natural languages add color terms in a fixed and invariable order: first, black and white; then red; then yellow *or* green; then yellow *and* green; then blue; then brown; and finally, in varying order, orange, purple, gray and pink. Thus one could find languages – such as certain forms of Ndani, spoken in the Central Highlands of New Guinea – which had only two color terms: *mola* (white) and *mila* (black). One could also find languages such as Pomo – spoken among American Indians along the Pacific Coast of the United States – with only words for white (*tótokin*), black (*likolkokin*), and red (*tantakin*). And one could find languages like Mende – spoken along the Western coast of Africa – which only had terms for white (*kole*), black (*teli*), red (*kpou*) and green (*pune*). But one would never find a language in which there were only terms for white, black and *green* – that is, one in which "green" emerged as a linguistic concept before "red." To put it another way, in order to add color terms, languages had to progress through seven successive "stages" – Berlin and Kay enumerated seven – until they reached the maximum compliment of eleven basic color terms as found, perhaps unsurprisingly, in European and some Asian languages. These "stages" were, moreover, explicitly hierarchical – Berlin and Kay saw the number of color terms in a society's language as a sign of technological and social sophistication. The "elaboration of a color lexicon," they wrote, "is an evolutionary one accompanying, and perhaps a reflex of, increasing technological and cultural advancement."[1]

Berlin and Kay's study was a powerful entry in a long-running argument within the (principally) American anthropology and linguistics communities over the degree to which the structures of languages influence the cognition, behavior and perception of their speakers.

[1] Brent Berlin and Paul Kay, *Basic Color Terms,* Stanford, Calif. : Center for the Study of Language and Information, 1999, on pg 16

On the one side, so-called "linguistic relativists" followed a long tradition in ethnolinguistics – beginning with Franz Boas in the 1890s and extending through the 1950s in the work of Boas's student Edward Sapir, and Sapir's student, Benjamin Whorf – which saw language, cognition, and even sensory perception as fundamentally subject to the eddies and whorls of particular cultures.[2] Without a word for "green" in one's language – subscribers to the most extreme version of linguistic relativism believed –one really could not be said to perceive the color green. On the other side, beginning in earnest in the 1950s, psychologists such as Eric Lenneberg at Harvard University and linguists such as Noam Chomsky at MIT began to formulate the theory of a "universal grammar" – that is, the notion that language is a product of particular neuro-physical features of the brain, and therefore not a product of culture at all, but rather of biology. Against this backdrop, Berlin and Kay's study appeared to be a powerful affirmation of the "universalist" position. Citing Chomsky and Lenneberg among others, Berlin and Kay noted that

> [t]he study of the biological foundations of the most peculiarly and exclusively human set of behavioral abilities – language – is just beginning […] but sufficient evidence has already accumulated to show that such connections must exist for the linguistic realms of syntax and phonology. The findings reported here concerning the universality and evolution of basic color lexicon suggest that such connections are also to be found in the realm of semantics.[3]

That is, both the perception of color – and the naming of colors – must, to Berlin and Kay, have their roots in the universal neurophysiology of the human observer, rather than the vagaries of particular cultural construction.

In the forty years since its publication Berlin and Kay's thesis has generated vigorous debate. On the one hand, popularizers of the universalist position such as Harvard neuroscientist Steven Pinker point towards the study's broad base of data and robust reproducibility as evidence of its fundamental soundness.[4] Some years after the publication of *Basic Color Terms,* for instance, anthropologists such as Eleanor Rosch-Heider and D.C. Oliver replicated Berlin and Kay's results in studies of color naming and memory using the

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[2] The most famous exemplar of this outlook is in Benjamin Whorf, "The Relation of Habitual Thought and Behavior to Language," in *Language, Thought and Reality,* Cambridge: MIT Press, 1994, pp 134-159

[3] Berlin and Kay, *Basic Color Terms,* 1969, pp 109-110

[4] Steven Pinker, *The Language Instinct,* New York: William Morrow and Company, 1994, esp pp 61-64

same standardized color charts as Berlin and Kay as controls.[5] On the other hand, opponents of linguistic universalism criticize Berlin and Kay's methodology – questioning, among other things, the use of standardized color "chips" to stand for universals of color, and the procedure used by Berlin and Kay to decide exactly what terms count as "basic."[6]

For historians of science, the long-running debate between linguistic relativisists and determinists invites inquiry into the fundamental assumptions underpinning social-scientific studies of perception. Elsewhere I have charted the religious substrates of nineteenth century American experiments in psychophysics; the professional debates surrounding color blindness tests at the turn of the century; and the industrial, pedagogical and eugenic foundations of standardized color charts. In the following essay, adapted from a chapter of my dissertation, I wish to focus on the question of basic color terms. For Berlin and Kay, a color term qualifies as "basic" if, among other things, it is "psychologically salient for all informants" – that is, if all or most speakers of a language would agree that the term signifies the sensation to which it is attached; if it cannot be disassembled into smaller linguistic units (e.g. as would be the case with "greenish-yellow"); and if it does not require reference to a characteristically-colored object (e.g. leaf-colored).[7] In the following essay, I hope to show that the very notion of "basic" terms for colors was – for Americans at the turn of the century – a matter of considerable debate. Rather than automatically acquiring "psychological salience;" rather than having a sort of in-built linguistic unity; rather than automatically divorcing themselves from the world of concrete objects; the abstract color terms that Berlin and Kay see as basic and fundamental to all languages had to be laboriously constructed – for American speakers of English, in any case – between the end of the nineteenth century and the beginning of the twentieth.

To pursue this argument, I look at three particular instances of color-nomenclatural work around the turn of the century. In the mid 1880s, Robert Ridgway, an ornithologist at the Smithsonian Institution, attempted to devise a scientific nomenclature of colors for use by naturalists, based on tables of color terms carefully, if ambiguously, keyed to objects. A

[5] See, e.g. Eleanor Rosch Heider, "Universals in Color Naming and Memory," *Journal of Experimental Psychology,* 93, 1972, pp 10-20; and Eleanor Rosch Heider and D.C. Oliver, "The Structure of Color Space in Naming and Memory for Two Languages," *Cognitive Psychology,* 3, 1972, pp 337-354
[6] See, e.g. Arnold Henselmans, "The Munsell Constraint," in *Theories, Technologies, Instrumentalities of Color,* New York: University Press of America, 2002, pp 37-52; also J. van Brakel, "The Ignus Fatuus of Semantic Universalia: the case of color," *British Journal of the Philosophy of Science,* 45: 1994, pp 770-783; and Marshal Sahlins, "Colors and Cultures," *Semiotica*. 16:1, 1976, pp 1–22
[7] Berlin and Kay, *Basic Color Terms,* 1969, pp5-6

decade later, John Henry Pillsbury, a high school botany teacher, and Milton Bradley, a printer and board game magnate, looked to the solar spectrum to introduce standard terms for color in education and manufacture. And between 1892 and 1929, Columbia University psychologist and logician Christine Ladd Franklin mobilized color terms to argue for a unified theory of vision and mind. These works, I argue, offer three wildly different views as to what ought to constitute "basic color terms." The point is not to argue for either the veracity or impotence of Berlin and Kay's thesis – rather the point is to properly situate the very notion of "basic color terms" in historical context, as the product of the worries and anxieties of a culture just developing the sort of technological and social sophistication that Berlin and Kay hold to be a criterion for the highest attainment of basic color terms.

II. General Background

Color naming was more than an academic issue for nineteenth century Americans. On the one hand, developments in commercial manufacture and distribution such as aniline dyes, shop windows, and mail order catalogs allowed American consumers access to a flood of goods in bright new colors that seemed to defy description.[8] "Looking back on this year's riotous abundance" began an 1890 style piece the *New York Times*, "[…] the gamut of color embraces every shade heretofore conceived for feminine adornment, and not a few that were never before on sea, nor land – nor woman"[9] To define colors that had never before been seen required a correspondingly unprecedented degree of linguistic uncertainty. The *Times* poked fun at the ubiquity of the term "Eiffel Red," remarking, "[i]f any doubtful shade of red with a tone of lavender, lilac, pink, or brown is left undesignated it is unhesitatingly denominated Eiffel red, and so offered to the public who accept it with unquestioning faith. The original motif, if it may be so called, has been so far lost sight of that the true Eiffel red is as difficult to determine as the color of the tower itself."[10] Meanwhile, "The new red tinted with yellow," wrote the *Times,* "[…] though called by some Tomato red is better indicated by the yellow-red nasturtium."[11]

[8] For an excellent account of popular responses to the ostensible flood of new colors and color-generating technologies see William Leach, *Land of Desire: Merchants, Power, and the Rise of New American Culture,* New York: Vintage, 1993, pp 39-70
[9] "New Wool Goods," *New York Times,* Feb 9, 1890, on pg. 12
[10] "New Wool Goods," *New York Times,* Feb 9, 1890, on pg. 12
[11] "New Wool Goods," *New York Times,* Feb 9, 1890, on pg. 12

Some members of the public were, indeed, enthusiastic about the possibilities of new, indefinable colors, though others did not accept them with "unquestioning faith." On the one hand, in 1897, art critic Sadakichi Hartman – in between writing plays about the erotic adventures of Jesus Christ and the life of Confucius – penned a theatrical biography of Buddha in which the spiritual leader's enlightenment was to be dramatized by "a concert of self-radiant colors […] represented by pyrotechny, brought by chemistry, electricity and future light-producing sciences" and culminating in a "kaleidoscopical symphony of color effects constantly changing in elation and depression, velocity, intensity, variety and sentiment […] at last improvising an outburst of new colors, like ultra red and violet, for which optical instruments have first to be invented before the human eye can perceive and enjoy them."[12] On the other hand, Francis King, a gardener, was more reserved, following her British peer, Gertrude Jekyll, in decrying the "slip slop" of modern color naming conventions, in particular exemplified by colors like "mauve" which had only within her lifetime come into common use.[13] Indeed, in her volume, *Wood and Garden*, Jekyll warned her readers against color names both new and old, including "crimson" – which, she noted, "is a word to beware of; it covers such a wide extent of ground […] that one cannot know whether it stands for a rich blood colour or for a malignant magenta."[14] Magenta was "malignant," thought Jekyll, because it was a "new" color – the trade name of a novel aniline dye. In the same way, mauve – another aniline color –served as a symbol for historian Thomas Beer who, titled his 1928 book about the dissolution of American intellectual culture at the turn of the century *The Mauve Decade,* after a quip by the artists James McNeil Whistler that "'mauve is just pink trying to be purple.'"[15]

[12] Sadakichi Hartmann, "Buddha," New York, 1897, on pg 39-41. Thank you to Emily Gephart for pointing out Hartmann's chromatic fantasy. For a later and infinitely more nefandous fantasy of colors never before seen, impossible to comprehend, and possibly madness-inducing see also H.P. Lovecraft's 1927 short story, "The Colour Out of Space," in *H.P.Lovecraft: Complete and Unabridged*, New York: Barnes and Noble, 2008.
[13] Quoted in "Susan W. Lanman, "Colour in the Garden: 'Malignant Magenta,'" *Garden History,* 28: 2, Winter 2000, pp 209-221, on pg 214
[14] Jekyll, *Wood and Garden,* 224
[15] Thomas Beer, *The Mauve Decade,* New York: Alfred Knopf, 1926. Whistler is quoted only on the title page, which bears the legend, " '…Mr. Whistler said: "Mauve? Mauve is just pink trying to be purple…'" Beer's further references to mauve throughout the text are limited – the term is mentioned only twice – once in connection with prostitution, the other with money. Interestingly, Lewis Mumford takes a different chromatic tack in *The Brown Decades*, his 1931 history of reconstruction era society in the U.S. These years, for Mumford, are brown both because the dominant building materials of the decade were brown (brown stone, brown wood panels, brown paintings) and because the spirit of the American people was, for Mumford, brown – ambivalent, muddy, broken by war and greed. Both mauve and brown of course, stand with Mark Twain's "gilded" age as chromatic similes for folly, excess and shortsightedness with which

Scientists of many disciplines tended to view difficulties defining colors as a problem that science had wrought, in particular through the industrial production of intensely colored and highly versatile aniline dyes.[16] Ridgway, for instance, complained in 1885 that "the popular nomenclature of colors has of late years, especially since the introduction of aniline dyes and pigments, become involved in almost chaotic confusion through the coinage of a multitude of new names, many of them synonymous, and still more of them vague or variable in their meaning."[17] He excoriated color names such as "'Zulu,'" "'Crushed Strawberry,'" and "'Elephant's Breath'" as "nonsense" that was "invented at the caprice of the dyer" and unsuitable for any sort of "practical utility." Pillsbury, likewise, blamed aniline dyes and

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both period and subsequent commentators tarred the age. (See Lewis Mumford *The Brown Decades: a Study of the Arts in America, 1865-1895,* New York, Harcourt: Brace and Company, 1931; also Mark Twain, *The Gilded Age: A Tale of Today,* New York : Harper, 1915)

[16] Aniline dyes derived from coal tar – a viscous, brown byproduct of the process used in the nineteenth century to render coal into gas for lighting. Composed of a complicated array of carbon-based compounds, by the early 1820s, coal tar had attracted the fascination of a burgeoning generation of organic chemists because of the wide range of substances that could be derived through reactions between it and other chemicals. When treated with different reagents, coal tar yielded substances of potential greater commercial usefulness and scientific interest than the industrial sludge from which they derived. Phenols, for instance, were used as anti-microbial agents. Nitrobenzene held potential as a perfume base. And aniline – a derivative of nitrobenzene – had been known since the 1820s to yield brightly-colored precipitates under certain circumstances. Nevertheless, the high cost of distilling aniline from coal tar militated against commercial production of these agents as dyes. It wasn't until 1856, when William Perkins, a student at the Royal Academy of Chemistry, began to investigate industrial production of a vivid purplish dye that he had stumbled upon while attempting to synthesize quinine, that coal tar dyes began to appear to be viable commercial products. Within three years of the commercial production of the dye that Perkin called "Mauve," chemists in Britain had taken out twenty-nine patents on different aniline dyes – almost double the number of patents on natural dyes. (William J. Hornix, "From Process to Plant: Innovation in the Early Artificial Dye Industry," *the British Journal for the History of Science,* 25:1, March 1992, pp 65-90, on pg 69). By the 1880s, fuchsine, aniline blue, and Hofmann's violets – as well as newer coal-tar "azo" dyes like malachite green, London yellow and Congo Red – flooded the market, providing textile manufacturers and clothing designers with an even greater spectrum of fabrics and threads with which to ply their trade. The best technical account of the discovery and commercial development of aniline dyes is found in Anthony Travis, *The Rainbow Makers: the Origins of the Synthetic Dyestuffs Industry in Western Europe*, Bethlehem, London: Lehigh University Press, 1993. Amore popular but no less informative account is Simon Garfield's *Mauve: How one Man Invented a Color that Changed the World,* New York: Norton, 2001. Travis has also published numerous articles on particular aspects of the aniline dyes industries. See, for instance, Anthony Travis, "Perkin's Mauve: Ancestor of the Organic Chemical Industry," *Technology and Culture*, Vol. 31, No. 1, Jan., 1990, pp. 51-82; Anthony Travis, "Science's Powerful Companion: A. W. Hofmann's Investigation of Aniline Red and Its Derivatives," *The British Journal for the History of Science*, Vol. 25, No. 1, Mar. 1992, pp. 27-44; Anthony Travis, "From Manchester to Massachusetts via Mulhouse: The Transatlantic Voyage of Aniline Black," *Technology and Culture*, Vol. 35, No. 1 Jan, 1994, pp. 70-99; Anthony Travis, "Poisoned Groundwater and Contaminated Soil: The Tribulations and Trial of the First Major Manufacturer of Aniline Dyes," *Environmental History*, Vol. 2, No. 3, Jul., 1997, pp. 343-365. On some of the legal aspects of aniline dye production see Henk Van Den Belt, "Why Monopoly Failed: The Rise and Fall of Société La Fuchsine," *The British Journal for the History of Science*, Vol. 25, No. 1, Mar., 1992, pp. 45-63.)

[17] Robert Ridgeway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, & Co., 1886, on pg 26

trade color names for the general state of disarray in color nomenclature, and likewise singled out elephant's breath and crushed strawberry for particular abuse, asking, "What more absurd terms could one easily choose to express an intelligible conception?"[18] Pillsbury and Ridgway's frustration was not unfounded. Elephant's breath – though not an aniline color – was identified in the popular magazine *Judy* in 1874 as "a very beautiful shade of blue with a sort of mistiness about it;" in *American Naturalist* in 1880 as "a pale olive-green hue;" in 1887 as a variation on lavender; in 1907 as a "Cool Purple Grey;" and in 1918 as a very grey variant of green.[19]

But the ability precisely to describe sensations was more than a matter of commercial or even scientific utility – it was a mark of cultural sophistication. Primitive people did not name colors as did the "civilized," as Albert S. Gatschet, an ethnologist working for the United States Geological Survey, reported in his study of color terms in the Klamath, Dakota and Kalapua languages. For example, he wrote, the Modoc and Klamath Lake Indians of the Pacific Northwest (both of whom spoke varieties of Klamath) did not have words for the abstract notion of color, and used only a few names for particular abstract color sensations. Instead, colors in Klamath tended to retain strong associations with particular objects – for example, Gatschet wrote that, "[t]he Klamath language has two terms for green, one when applied to the color of the vegetals (kakd'kli), another when applied to garments and dress (tolalh'ptchi). Blue when said of beads is again another word than blue in flowers and blue in garments."[20] Indeed, Gatschet recalled Klamath speakers "qualifying certain objects of nature by their color and then calling them by the same attribute, even when their color has been altered." As an example of this phenomenon, Gatschet specified that "the name applied to the color of a quadruped may remain even when the animal has changed its color through the change of seasons."[21]

The ways that people used color terms, and the vocabularies available to them, moreover, indicated both individual mental ability as well as the sophistication of their culture. R.S. Woodworth, a psychologist at Columbia College who had studied the color perception of Filipinos at the 1904 St. Louis Exposition, wrote that the question was not

[18] J. H. Pillsbury, "A New Color Scheme," *Science*, Vol. 19, No. 473, Feb. 26, 1892, pg 114
[19] Deb Salisbury, *Elephant's Breath and London Smoke,* Neustadt, Canada: Five Rivers Chapmanry, 2009, on pg 75
[20] Albert S. Gatschet, "Adjectives of Color in Indian Languages," *the American Naturalist,* 13:8, Aug. 1879, pp 475-485, on pg. 483
[21] Albert S. Gatschet, "Adjectives of Color in Indian Languages," *the American Naturalist,* 13:8, Aug. 1879, pp 475-485, on pg. 484

whether "uncivilized" people *saw* differently from civilized, but rather "[w]hy should color nomenclature [of some languages] not be fairly adequate to the development of the color sense" – which Woodworth felt not to vary much across "normal eyes" observers in all cultures – "and why should it be so much further advanced among some peoples than others?"[22] The answer appeared to Woodworth almost banal. "We may fairly assume, with [psychologist Wilhelm] Wundt," he wrote, "that abstract color names are of relatively late introduction into any language, and that they are developed out of names for colored objects; so that the question is primarily regarding [the] hardening and dissociation of linguistic usage"[23] Colors tended to be abstracted in languages, Woodworth continued, in direct relation to their utility to speakers, as determined by the advancement of their culture. "Red" – as the color of blood, and ripe fruit – was an obvious candidate for early abstraction, as was yellow, a color used in conjunction with red, Woodworth speculated, for distinguishing the cattle upon which early agricultural civilizations depended for trade and subsistence. Blues and greens, meanwhile, tended not to be so necessary for "primitive" people, since blue and green were colors principally of the sky and of leaves – not items with particular utility for primitive people, and which therefore could be adequately described simply with nouns referring to the objects (this leaf, that sky, etc). It was only "[w]ith the introduction of green and blue paints and dyes," Woodworth concluded, that "these colors become important marks in distinguishing household objects; and it is probably owing to the use of pigments that names for green and blue have become stereotyped in European languages"[24] Woodworth's theory had legs. More than a half a century later, Berlin and Kay speculated – apropos of color term acquisition – that "to a group whose members have frequent occasion to contrast fine shades of leaf color and who possess no dyed fabrics, color-coded electrical wires, and so forth, it may not be worthwhile to rote-learn labels for gross perceptual discriminations such as green/blue, despite the psychological salience of such contrasts."[25] Color names, for Woodworth as much as Berlin and Kay, were a function of technological need.

[22] R.S. Woodworth, "The Puzzle of Color Vocabularies," *the Psychological Bulletin,* VII: 10, 15 Oct. 1910, pp 326-333, on pg 332-333

[23] R.S. Woodworth, "The Puzzle of Color Vocabularies," *the Psychological Bulletin,* VII: 10, 15 Oct. 1910, pp 326-333, on pg 332-333

[24] R.S. Woodworth, "The Puzzle of Color Vocabularies," *the Psychological Bulletin,* VII: 10, 15 Oct. 1910, pp 326-333, on pg 334

[25] Brent Berlin and Paul Kay, *Basic Color Terms,* Stanford, Calif. : Center for the Study of Language and Information, 1999, on pg 16

III. The Ornithologist

Among the earliest comprehensive attempts at systematic color notation in America was Robert Ridgeway's 1886 manual, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists*. Part field manual, part introductory textbook, and part mission statement, *A Nomenclature of Colors for Naturalists* was intended, as Ridgeway put it, "to supply a want much felt by the author during the course of his ornithological studies […]; namely a nomenclature of colors and a compendious dictionary of technical terms used in descriptive ornithology."[26] To accomplish these ends, Ridgeway stuffed his book with useful material: in its 200 pages, readers found diagrams of avian morphology; tables of feather types; illustrations of different egg shapes; a fifty-page glossary of ornithological terms; and even a printed ruler scored in French inches, English inches, and millimeters, along with several pages of handy conversion charts between the different types of measurements. The book also included color tables – pages and pages of rows of neatly painted squares of pigment, each painstakingly categorized, arranged, and named.

A prominent ornithologist, Ridgway's interest in color and naming – as well as birds – took root during a childhood in Mount Carmel, Illinois. The oldest child of "nature loving" parents, Ridgeway spent long hours in the forests around his house, where his father would point out the different species of avian fauna and identify them, often with made-up names: "the Towhee he called 'Ground Robin,'" remembered Ridgway, "the Wood Thrush was his 'Bell Bird' ; Gnatcatcher, 'Blue Wren' ; Yellow-breasted Chat, 'Yellow Mockingbird'; etc."[27] As Ridgeway grew older, his avidly collected these birds, though, one of his many correspondents recalled, the enthusiastic amateur naturalist had "no idea how to preserve a bird other than in a colored drawing" – a situation which sent Ridgeway to his father's pharmacy to mix his own watercolors.[28] In 1864, having sent one of his collection drawings to Washington, D.C. in an attempt to identify an unknown bird, Ridgway struck up a correspondence with the Smithsonian Institution's Assistant Secretary, Spencer Baird, who identified Ridgway's mystery bird as a purple finch.[29] Three years later, Baird hired Ridgway

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[26] Robert Ridgeway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, & Co., 1886, on pg 9.
[27] Harry Harris, "Robert Ridgeway," *The Condor,* XXX:1, Jan-Feb. 1928, pp 5-118 on pg 9
[28] Harry Harris, "Robert Ridgeway," *The Condor,* XXX:1, Jan-Feb. 1928, pp 5-118 on pg 12.
[29] Alexander Wetmore, "Biographical Memoir of Robert Ridgway," *National Academy of Sciences, Biographical Memoirs,* Volume XV, 1931, on pg 59

as a field zoologist, and Ridgway spent the rest of his life observing birds for the Smithsonian. By the time he was named the Smithsonian's first director of ornithology, in 1880, Ridgeway had overcome many of his boyhood obstacles – he was skilled at speaking about birds with scientific precision, and had learned how to preserve his specimens through taxidermy rather than watercolors – but questions of how precisely to denote the colors of the birds that he observed still preoccupied him.[30]

In one way, then, Ridgeway's *Nomenclature* can be seen as a gift to his boyhood self – a self-help manual for the aspiring ornithologist. But its key claim to scientific novelty was its treatment of colors. Naturalists, explained Ridgway, "demand a nomenclature which shall fix a standard for the numerous hues, tints, and shades which [...] now form part of the language of descriptive natural history" – and Ridgway's book was an attempt to deliver.[31] True, Ridgway continued, other authors had written about color – and he dutifully listed von Bezold and Rood among many others in his bibliography – but these books seemed to dismiss the exact nature of the relationship between color sensations and the words used to describe them as a matter beneath the scope of scientific inquiry. Ridgway complained, for instance, that von Bezold had dodged the question of color terms, and cited a remark made by the physicist in his *Theory of Colour in its Relation to Art and Industry* to the effect that "'the names of colors, as usually employed, have so little to do with the scientific or technical aspects of the subject that we are in reality dealing with the peculiarities of language.'"[32] For Ridgeway, though, it was precisely those "peculiarities of language" that demanded a "scientific and technical" intervention. Physicists and physiologists had ably explained the *causes* of color sensations, but had neglected to imbue them with any meaning. Ridgeway's goal was simply to provide a scientifically accurate but colloquially usable means by which

[30] Harry Harris, "Robert Ridgeway," *The Condor,* XXX:1, Jan-Feb. 1928, pp 5-118, on pg 13

[31] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, and Company, 1886, on pg 15

[32] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, and Company, 1886, on pg 15. Von Bezold had, in fact, acknowledged the problem of indefinite naming in the English translation of his work, urging readers to "pay special attention to those passages in which it has been attempted to define with scientific accuracy the somewhat loose terms in common use" (Wilhelm von Bezold, *Theory of Color in its Relation to Art and Industry,* S.R. Koehler, Trans, Boston: Prang, 1876, on pg vi). But readers desiring such definitions such as Ridgway could only have been disappointed to learn that in cases of fine discrimination, such as between lilac and purple, "we are in reality only dealing with peculiarities of language" – that is, precisely the problem that von Bezold's commitment to "scientific accuracy" was supposed to clear up (von Bezold, *Theory of Color,* on pg 99). In any case, while Ridgway did not accurately quote von Bezold, his argument still has substance.

naturalists and laypeople could identify the sensations that they experienced and convey them to other people.

How precisely, this was to be done, however, was unclear, and Ridgway attempted to organize and explain his color nomenclature around a number of scientifically inspired, but inconsistently applied conceits. For example, in order to begin systematically naming colors, Ridgeway first attempted to categorize them, following von Bezold by dividing all colors into two categories: "Pure colors of the solar spectrum," and "Impure colors, or those not found in the solar spectrum."[33] Red, for instance, would count as a pure color, while brown would be classed among the impure (it is not totally clear whether Ridgeway thought of white and black as colors per se, though he implied that they were absolute degrees of impure colors – i.e. maximally shaded or maximally lightened colors inevitably ended up as white or black. In this, it should be noted, he rejected von Bezold's suggestion that white and black belonged in a separate category of colors along with "gold" and "silver," since Ridgeway felt that gold and silver were, properly speaking, variants of yellow and white, respectively). The "pure" colors in turn could be divided into two tiers. Primary colors – "those not produced by mixture" – consisted of "red," "yellow," and "blue;" secondary colors were "those produced by the mixture of two primary colors" which Ridgeway notated as "orange (=red+yellow)," "Green (=yellow+blue)" and "Purple (=blue+red)." This same additive principle could be applied to the "impure colors," which Ridgeway divided into three classes– "shades," "tints," and "subdued colors" – all of which were some combination of primary or secondary colors and white or black. Thus Ridgway considered "olive" to be a shade of yellow, and notated it as "yellow+black."[34] By arranging his "pure" colors in an eighteen-fold "spectrum series" – i.e. a cycle of colors from red to purple divided into eighteen parts – and thinking of impure colors as additions of white or black to this series, Ridgeway could, in principle, sort all of his colors into distinct sets of like and unlike colors, allowing even ostensibly unmoored colors like "elephants breath" to find a berth in a stable system of nomenclature.

Realizing his system on the printed page, however, proved a good deal more problematic than theorizing the order of natural color. To explain his method for *producing* his swatches of color, Ridgway abandoned his categorization system without explanation,

[33] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, and Company, 1886, on pg 20
[34] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, and Company, 1886, on pg 21

and started again, this time noting that pigments and light mixed quite differently. Thus, even though he acknowledged that one of his primary colors ought to be *green*, and not yellow – at least according to psychophysical studies such as those of Rood and von Bezold – he was forced to reinstate yellow as a primary color, since certain yellow and blue pigments could combine to make a passable green on the printed page, but no known combinations of red and green pigment would made a viable yellow. Having cast his lot with the practicalities of printing rather than the ideal world of the psychophysical laboratory, he dismissed the eighteen-fold spectral divisions that he had explained at length in the opening pages of his treatise, and began to assemble his color reference samples on the basis of thirty six commercially available watercolors – half of which, Ridgeway explained, were selected from his personal collection of three hundred quality watercolors "for convenience, rather than because they are necessary."[35] Commercial colors of the same name, in turn, often varied considerably from maker to maker; the "Olive Green" of Winsor & Newton was not the same color as the "Olive Green" of Schoenfeld's, in spite of their homonymous designations. Indeed, it wasn't entirely clear that such synonymous names were really all that synonymous, since Ridgeway translated non-English names (like those given by the German maker Schoenfeld's) into English in his textual discussion of the qualities of different pigments, providing a handy table of color names cross-referenced in English, Italian, Norwegian and Danish, German, Spanish and Latin to aid his readers in back-translation.

Having explained his system both in terms of the logical order of colors and the practicalities of working in watercolors, Ridgeway then compiled tables of color samples mixed from different combinations of his thirty-six hues. He arranged his samples according to a rough sense of dominant spectral color – greens classed with greens, reds classed with reds, and so forth – although, as Ridgeway admitted, "in not a few cases it has been a difficult matter to decide upon which plate a certain [color] should be put, the decision being in some instances almost purely arbitrary."[36] Each plate contained up to twenty-one rectangles of color, some still bearing the brushstrokes of paint application, arrayed in neat grids. The rectangles were numbered and labeled, and keyed to recipes for the specific color cited. For instance, on plate VII, which appears to be devoted to orangey-red colors, item

[35] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists*, Boston: Little, Brown, and Company, 1886, on pg 27
[36] Robert Ridgway, A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists, Boston: Little, Brown, and Company, 1886, on pg 26

number 17, "Salmon Color," could be recreated with a combination of "scarlet vermilion +cadmium orange+white." Item number 9, "Poppy Red," was equivalent simply to "'Burgeois's "laque ponceau."'"[37] Ridgeway didn't give proportions of the particular colors to be used, but he did note, helpfully, that his was not a transitive addition: "'red + black," he remarked, "and 'black + red' imply very different relative proportions of the two colors; the former being *black* modified by admixture of a small quantity of red, the latter being *red* modified by the addition of a little black."[38] Specifically, "black + red" were the constituent parts of "seal brown;" while "red+black" equaled a "burnt carmine."

Beyond the specific recipes for different colors, however, Ridgeway's more general concerns about color names boiled down to the nature of the relationship between object and percept; words and things. As Ridgway explained:

> The selection of appropriate names for the colors depicted on the plates has been in some cases a matter of considerable difficulty. With regard to certain ones it may appear that the names adopted are not entirely satisfactory; but to forestall such criticism, it may be explained that the purpose of these plates is *not to show the color of the particular objects or substances which the names suggest, but to provide for the colors which it has seemed desirable to represent, appropriate or at least approximately appropriate names.* In other words, certain colors are selected for illustration, for which names must be provided; and when names that are exclusively pertinent or otherwise entirely satisfactory are not at hand, they must be looked up or invented. It should also be borne in mind that almost any object or substance varies more or less in color; and that therefore if the "orange," "lemon" or "chestnut" of the plates does not match exactly in color the particular orange, lemon or chestnut which one may compare it with, it may (or in fact does) correspond with other specimens. It is, in fact, only in the case of those colors which derive their names directly from pigments which represent them (as Paris green, orange-cadmium, vermillion, ultramarine blue, madder-brown, etc.) that we have absolute pertinence of names to color.[39]

[37] Robert Ridgeway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, & Co., 1886, on pg 34
[38] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists,* Boston: Little, Brown, and Company, 1886, on pg 36
[39] Robert Ridgway, *A Nomenclature of Colors for Naturalists and Compendium of Useful Knowledge for Ornithologists*, Boston: Little, Brown, and Company, 1886, pg 16

Far from "forestalling criticism," however, Ridgeway's explanation for his naming rationale raises only questions about what sorts of practical and epistemological duties Ridgeway felt to be included in the work of naming colors. For one thing, if Ridgway felt himself vulnerable on account of the "not entirely satisfactory" names that he chose for his colors, then what would constitute "satisfactory" names? What did names *do* and what were the necessary and sufficient conditions for a sign to properly match with its referent? For another thing, what did Ridgeway understand the nature of his color naming exercise to be? If the purpose of his colored plates was "*not to show the color of the particular objects or substances,"* then what did it matter if the sample of color on plate XIV labeled "lemon yellow" matched all lemons, some lemons, one particular lemon, or no lemons at all? (For that matter, how frequently did one encounter a stalk of broccoli that matched Ridgway's "Broccoli Brown"?). What were the brilliantly colored rectangles in his book representative of, anyway? Everyday objects? Chemicals? Birds? Sensations? Ideas?

In working through these questions, Ridgway looked to scientific precedent, and found a particularly compelling one in *Werner's Notation of Color,* a mineralogical text originally published in Edinburg 1814. Perhaps appropriately for a volume dealing with the ambiguities of naming, *Werner's Notation* was not, in fact, authored by the eponymous Werner, but by Patrick Syme – a Scottish flower illustrator and "painter to the Wernerian and Horticultural Societies."[40] Syme took the name and the basic material for his color nomenclature from the work of Prussian mineralogist Abraham Gottlob Werner, who had compiled eight "suites" of seventy-six color samples to assist his fellow "orycognosts" identifying the broad variety of colors characteristic of certain minerals.[41] The "green" suite, for instance, featured all those shades of green that Werner felt through examination of his own sensations to lie between yellow and blue, arranged by degrees from the yellowest ("siskin green") through the bluest ("verdigris green") with "emerald green" occupying the

[40] Robert Jameson, *A Treatise on the External, Chemical, and Physical Characters of Minerals,* Edinburg: Neill & Company, 1816, on pg 86

[41] Robert Jameson described Werner's system in depth in *A Treatise on the External, Chemical, and Physical Characters of Minerals,* Edinburg: Neill & Company, 1816, pp 55 – 89; on Werner's classification of minerals more generally – including his use of color suites in classifying minerals – see Thomas Thomson, "Some Observations in Answer to Mr. Chenevix's Attack upon Werner's Mineralogical Method," *Annals of Philosophy,* Vol 1: No 4, April 1813, pp. 241-258

middle position – thus allowing a mineralogist faced with an unknown green stone to, in theory, express a wide range of chromatic sensations.[42]

Syme faithfully reproduced Werner's system in his own text, while ironing out certain idiosyncrasies. For example, Werner had neglected to include purple and orange among his eight principle colors, instead classing their members within the "blue" and "yellow" suites – a decision that Syme overrode, noting that orange and purple "are as much entitled to the name of colours as green, grey, brown or any other composition colour."[43] Likewise, Syme felt compelled to add thirty-four colors to Werner's original seventy-six, while rearranging the placement of some colors in Werner's scheme and renaming others. In doing so, Syme felt he had usefully expanded Werner's system, assuring readers that his was more than just a book for mineralogists, or indeed men of science. As Syme explained, it was his intention to "remove the present confusion in the names of colours, and establish a standard that may be useful in general science" – if not, indeed, "as a general standard to refer to in the description of any object."[44]

For both Syme and Werner, colors were functions of things, and their conventions for naming and displaying colors reflected this relationship, albeit idiosyncratically. In his explanation of Werner's color tables, Robert Jameson, a Scottish mineralogist and one of Werner's translators, explained that "[t]he names of the colours are derived, 1st, From certain bodies in which they most commonly occur, as milk-white, siskin-green, liver-brown; 2d, From metallic substances, as silver-white, iron-black, and yellow-gold; 3d, From names used by painters, as indigo blue, verdigris-green, and azure-blue; 4th, From that colour in the composition which is next in quantity to the principal colour, as bluish-grey, yellowish-brown, &c.; and 5th, From the names of persons, as Isabella-yellow, now called cream yellow."[45] For his part, Syme, borrowing many of Werner's names, declined to specify his naming convention, but instead listed examples of each color as it appeared in the animal, vegetable, and mineral kingdoms. Although in many instances, Syme's names conformed to

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[42] Robert Jameson, *A Treatise on the External, Chemical, and Physical Characters of Minerals,* Edinburg: Neill & Company, 1816, on pg. 59

[43] Patrick Syme, *Werner's Nomenclature of Colours, with Additions, Arranged so as to Render it Highly Useful to the Arts and Sciences. Annexed to Which are Examples Selected from Well-known Objects in the Animal, Vegetable, and Mineral Kingdoms*, Edinburgh, W. Blackwood, 1814, on pg 7

[44] Patrick Syme, *Werner's Nomenclature of Colours, with Additions, Arranged so as to Render it Highly Useful to the Arts and Sciences. Annexed to Which are Examples Selected from Well-known Objects in the Animal, Vegetable, and Mineral Kingdoms*, Edinburgh, W. Blackwood, 1814, on pg 3 and on pg 1

[45] Robert Jameson, *A Treatise on the External, Chemical, and Physical Characters of Minerals,* Edinburg: Neill & Company, 1816, on pg 59

Werner's first rule that color names indicated characteristically colored objects, Syme's pairings of names and objects could prove idiosyncratic. For instance, the color that Syme called "plum purple" was, reasonably enough, closely identified with plums; "straw yellow," for its part, was the color of "oat straw." "Asparagus green," however, was not best found in asparagus plants, but rather in the "variegated horse-shoe geranium," while "lemon yellow" was, inexplicably, exemplified not by lemons, but by "shrubby goldylocks."[46] Syme's pairings of names and objects could veer from the fanciful to the disturbingly specific: "oil green," was to be found on "a nonpareil apple from the wall;" "Prussian blue" was exemplified by the "beauty spot on [the] wing of [a] mallard drake;" while the best exemplar of "bluish black" among members of the animal kingdom was the "largest black slug."[47] Both Syme and Werner, then, labored to make associations between specific colors and specific objects, though not consistently through names that linked the two.

Building upon the precedent set by Werner and dramatized through Syme, Ridgway preserved the strong association between the things that color terms named, and the color sensations that they described. For Ridgeway, colors were necessarily products or effects of things in the world; their names, therefore, ideally referenced those things – even if the things were chemicals, or familiar objects. Rather than attaching names to sensations, then, Ridgway's color nomenclature was, in a sense, a shortcut to matching colored object to colored object. That is, if a naturalist designated a bird (or part of a bird) as, for instance, "lemon yellow" according to Ridgway's system, he or she was necessarily making an association not between the bird and an abstract concept of a particular variety of yellow, but rather between a particular bird and a particular yellow lemon. In essence, by his own understanding of the weight that his color names bore, Ridgway's book was a shortcut to saying, "*this* bird is the same color as *that* lemon," rather than "this bird is lemon yellow."

Indeed, in his own ornithological practice, Ridgway maintained this equation between things in the world as colored objects, rather than the colors of things in the world abstracted into color chips. For example, in describing "A Singularly marked Specimen of Sphyracpicus Thyroideus" Ridgway referred to a species of Williamson's sapsucker (a type

[46] Patrick Syme, *Werner's Nomenclature of Colours, with Additions, Arranged so as to Render it Highly Useful to the Arts and Sciences. Annexed to Which are Examples Selected from Well-known Objects in the Animal, Vegetable, and Mineral Kingdoms*, Edinburgh, W. Blackwood, 1814, on pg 48
[47] Patrick Syme, *Werner's Nomenclature of Colours, with Additions, Arranged so as to Render it Highly Useful to the Arts and Sciences. Annexed to Which are Examples Selected from Well-known Objects in the Animal, Vegetable, and Mineral Kingdoms*, Edinburgh, W. Blackwood, 1814, on pg 23

of woodpecker) as being unusual for the "crimson-scarlet" marking upon its head – even though crimson-scarlet is not a color notated in *A Nomenclature of Colors*. This "red crown-patch" he continued, was similar in color to the cap adorning the Gila woodpecker, but was "more scarlet" in the case of the sapsucker; moreover the belly of the "unusual specimen," was "rather pale" for Californian examples of this species – interesting distinctions, but ones which would have little meaning to an individual who did not possess a strong sense of the coloration of Gila woodpeckers and Williamson's sapsuckers, even if they were equipped with a copy of Ridgway's nomenclature.[48] Similarly, when attempting to describe "two Abnormally Colored Specimens of the Bluebird," Ridgway mingled ostensible exactitude of his system with vernacular ambiguity. Although he could describe the typical coloration of a bluebird's throat plumage as "cinnamon colored" (corresponding to box number 20 on plate III of his *color notation*), for the more unusual colors Ridgway could only say that they were a "very rich uniform azure blue, almost precisely the same shade as in *S. arctica*, but even rather more greenish than in many examples of the latter species."[49] Again, as with the sapsuckers, Ridgway's descriptions do little to precisely name the unusual hues of the animals he's describing, at least according to his own color charts. Instead of finding the unusual colors of the birds on his color charts (perhaps among the greener shades of blue) he can do little better than to point his reader to "azure blue" (plate IX, box 15), then quickly redirect his reader to a "greenish" version of an azure blue bird, in this case, *S. arctica*, or the arctic bluebird.

Other naturalists appear to have been more rigorous in their use of Ridgway's color nomenclature. Amateur birder Frank L. Burns, in a monograph on flickers – another type of woodpecker – employed Ridgway's terminology with a gusto, writing that, among adult male flickers,

> "[t]he scapulars, wing-coverts and exposed secondaries are […] often as light as broccoli-brown; the bars vary only in width. The top of the head is occasionally washed with umber or tawny, and the nuchal crescent varies greatly in extent and in color from scarlet to vermilion. The sides of head, chin, throat and forebreast [vary] from drab through fawn, ecru-drab to vinaceous-cinnamon."

[48] Robert Ridgway, "A Singularly Marked Specimen of Sphyrapicus Thyroideus," *The Auk*, Vol. 4, No. 1, Jan., 1887, pp. 75-76
[49] Robert Ridgway, "On Two Abnormally Colored Specimens of the Bluebird (Sialia sialis)," *The Auk*, Vol. 3, No. 2 (Apr., 1886), pp. 282-283, on pg 282

Immature females of the flicker, he continued, had much the same color as the males, but

> "the feathers of the forehead and crown are usually tipped or mottled with scarlet vermilion, dragon's blood or brick-red, posteriorly fading to a rusty brown or burnt umber over the ashy-grey, which extends almost around the eye in some specimens."[50]

Similarly, naturalists Gerrit S. Miller, an assistant curator of mammals at the Smithsonian's United States National Museum, identified the markings of two Scarlet Tanager specimens as "gamboge-yellow" [51] –a common paint hue, as well as one of Ridgway's colors –and elsewhere he described the markings of the "adult female" great lizard cuckoo as "[h]air-brown on the back and head, fading to broccoli-brown on the neck, the feathers everywhere glossed with sage green."[52] Indeed, Miller found use for Ridgway's color names in his work with mammals as well as birds: a new species of rabbit was "a fine grizzle of reddish brown," which Miller qualified as "intermediate between the wood brown and russet of Ridgway;"[53] while a species of bat (Chiloycteris Mexicana) found in San Blas, Tepic, Mexico, had a back of "uniform brown, most closely resembling the broccoli-brown of Ridgway, "but darker and with a mixture of both hair-brown and drab [with] [u]nder parts wood-brown, much lighter than Ridgway's Plate III, fig. 19, the hairs distinctly dark slaty-brown at base."[54] Burns and Miller were only some of the earlier adopters of Ridgway's nomenclature. By the turn of the

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[50] Frank L. Burns, "A Monograph of the Flicker. (Colaptes auratus)," *The Wilson Bulletin*, Vol. 12, No. 2, Apr., 1900, pp. 1-83, on pp 70-71. Interestingly, Burns devoted a portion of his monograph to speculation about the different common names of the flicker – naming conventions that he described as "Descriptive, Onomato-poetic, [and] Misnomers" (5). Descriptive names captured something about the creature's manner or bearing – for example, among residents of Cape Cod the bird was known as the "fiddler," possibly on account of "the peculiar sew-saw motions indulged in by the males while courting the females during the early spring months." (6). Onomatopoetic terms were imitations of the bird's calls – such as "claype," as the bird was known in Western New York (5). Misnomers were simply misidentifications of the flicker with other birds' names, e.g. "golden winged woodcock," which the flicker was not, except among less discerning residents of Iowa (7). The term "flicker" itself Burns noted, might either be descriptive of the "the peculiar twinkling or flickering of the bright shafts when the wings open and close in flight;" or else onomatopoetic, deriving from the "*wicher"* sound of the bird's song (6). In general, Burns was opposed to naming creatures after their putative discoverers, finding "the servitude of the prefixed personal name" to be inferior to "[n]ames descriptive of form, flight, plumage, notes, habits, habitat, characteristics, etc., or of onomatopoetic origin," as long as the latter were "short and catchy" – as apt a summary of the problems of naming as any in the color literature (4).

[51] Gerrit S. Miller, Jr., "Some Abnormal Color Markings," *The Auk,* Vol. 14, No. 3 (Jul., 1897), pp. 275-278, on pg 277

[52] Gerrit S. Miller, Jr., "The Ground Cuckoo of Andros Island," *The Auk,* Vol. 11, No. 2 (Apr., 1894), pp. 164-165, on pg 164

[53]Gerrit S. Miller, Jr., "Descriptions of Six New American Rabbits," *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. 51, No. 2 (Apr. - Sep., 1899), pp. 380-390, on pg 383, and n.6

[54] Gerrit S. Miller, Jr., "Twenty New American Bats," *Proceedings of the Academy of Natural Sciences of Philadelphia*, Vol. 54, No. 2 (May - Sep., 1902), pp. 389-412 on pg 402

century, Ridgway's color names found use among mammologists, entomologists, and mycologists as well as his core constituency of ornithologists.[55]

Beyond its use by some zoologists and botanists, however, it wasn't clear how viable Ridgway's system was. On the one hand, a reviewer for the *American Naturalist* was very enthusiastic, writing, "[c]ould this nomenclature have a further introduction, and its terminology replace the meaningless terms like 'elephant's breath' etc. introduced into trade, it would have a very beneficial effect."[56] Others, however, had their doubts. While generally lauding Ridgeway's efforts, Joel Asaph Allen, who Ridgway had some years earlier recommended for a position as ornithologist of the American Museum of Natural History, was somewhat more measured in his appraisal, giving credit to Ridgway for taking on a "difficult task requiring […] skill as a colorist, combined with critical knowledge of the requirements of descriptive ornithology," but concluding that the color section of the book "fails by far, from the nature of the subject, to clear away all the difficulties, since the names of colors in current use are in many cases both vague and variable."[57] Ridgway's "broccoli brown" and "Terre verte Green," that is, did little to clear up either the vagueness or the variability of his color nomenclature. W. Hallock and R. Gordon, writers for the new *Standard Dictionary,* were more pointed, lampooning Ridgway's system (though not by name) as one which endeavored "to take an orange as a type of that color, and in like manner to let a lemon, an olive, etc. be the ultimate definition of those hues."[58] Such a system would inevitably come up short as a scientific nomenclature, concluded Hallock and Gordon, since any properly scientific system of color terminology had to do more than simply define the

[55] After Miller's work with bats, Portland, Oregon's Samuel N. Rhodes was an early adopter of Ridgway's nomenclature for use in describing mammals; see Samuel N. Rhoads, "Contributions to a Revision of the North American Beavers, Otters and Fishers," Transactions of the American Philosophical Society, New Series, Vol. 19, No. 3 (1898), pp. 417-439. For an early example of Ridgway's system in use in entomology -- particularly as used to describe butterflies -- see, e.g. James A. G. Rehn, "A Contribution to the Knowledge of the Acrididæ (Orthoptera) of Costa Rica," Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 57, (1905), pp. 400-454; and other articles from the period by Rhen. For an early example of Ridgway's use in mycology see Charles H. Peck, "New Species of Fungi," Bulletin of the Torrey Botanical Club, Vol. 22, No. 5 (May 15, 1895), pp. 198-211. Ridgway was, nevertheless, still most popular among ornithologists.

[56] "Ridgeway's Nomenclature of Colors," *American Naturalist,* Vol 21:2, February, 1887, pp 166-167, on pp. 166-167

[57] J.A. Allen, "Review: Ridgeway's Nomenclature of Colors and Ornithologists' Compendium," *the Auk,* 4:2, April 1887, pp152-153, on pg 153

[58] W. Hallock and R. Gordon, "Color Standards," *Science*, New Series, Vol. 6, No. 136 (Aug. 6, 1897), pp. 214-215, on pg 214

color of an object's surface "by saying that it resembles or differs to a certain extent from some other arbitrary surface."[59]

In 1909, Ridgway himself denounced his 1885 edition as "manifestly seriously defective in the inadequate number of colors represented, their unscientific arrangement, and the bad method of their reproduction" and revealed that he had been working for years on a revised edition to his system.[60] In 1912, he released a volume devoted exclusively to color names entitled *Color Standards and Color Nomenclature.*[61] As with its predecessor, *Color Standards* was written so that all "who may have occasion to write or speak of colors may do so with the certainty that there need be no question as to what particular tint, shade, or degree of grayness, of any color or hue is meant."[62] But unlike his 1885 edition, Ridgway revisited color science in earnest, struggling to arrange his new colors – which numbered over 1,000 – according to the standards of contemporary psychophysics. The cover of his book bore the imprint of a Maxwell disk with red, green, and violet sections to symbolize his attentiveness to scientific understandings of color; and, he wrote, he had spent the past twenty years compiling and exhaustive collection of "several thousand samples of named colors" that he found in commercial color books, painters' pigments, and manufactured items.[63] In so doing, Ridgway explained, he hoped to "standardize colors and color names, by elimination of the element of "personal equation" – that is, the subjective disagreement between observers as to what, precisely, color terms meant. Nevertheless, Ridgway still struggled with the nature of the color names he used, reprinting almost in its entirety his apologia from 1886 in the new edition (while expanding his musings on ideal lemons and chestnuts to include oranges and lilacs.) He helpfully listed his thousand new color terms in alphabetical order in the front of the book – and yet, for all of his extensive collecting, Ridgway was no closer to a settled understanding of what those terms meant.

PART IV. The Pastor and the Printer

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[59] W. Hallock and R. Gordon, "Color Standards," *Science*, New Series, Vol. 6, No. 136 (Aug. 6, 1897), pp. 214-215, on pg 214

[60] Robert Ridgway and H. B. Kaeding, "Correspondence," *The Condor,* Vol. 11, No. 6 (Nov. - Dec., 1909), pp. 210-211

[61] Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912

[62] Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912, on pg 1

[63] Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912, on pg 11

In producing his second edition, Ridgeway pronounced himself indebted to the work of an unlikely pair of collaborators, the botanist and Methodist minister, John Henry Pillsbury, and the board game tycoon and elementary school reformer, Milton Bradley. "The scientific arrangement of colors in this work," Ridgway explained, "is based essentially on the suggestions of Professor J.H. Pillsbury for a scheme of color standards," while Ridgway claimed to have "learned more, and learned it more easily," from Bradley's 1895 text, *Elementary Color,* "than from careful study of more elaborate and authoritative works on the subject."[64] Ridgway quoted Bradley's complaints on the imprecise nature of modifying terms for color as one of the motivating sources for revising his own terminology (to wit: "'Tint, Hue and Shade are employed so loosely by the public generally, even by those who claim to use English correctly, that neither word has a very definite meaning, although each is capable of being as accurately used as any other word in our every day vocabulary.'")[65] Indeed, he turned to the Milton Bradley company's assortments of colored papers when he compiled his color terms, and named two of the colors in his index "Bradley's Blue" and "Bradley's Violet" (Pillsbury did not get a color named for him in Ridgway's compendium, though "Rood's Blue," "Rood's Brown," "Rood's Lavender" and "Rood's Violet" all make an appearance.)

Bradley's fascination with color derived from both his commercial endeavors and a personal interest in educational reform. Born in 1836, Bradley grew up in Lowell, Massachusetts, where his father worked in the textile mills.[66] He briefly attended Harvard's Lawrence Scientific School, but was forced to drop out when his family moved to Connecticut. Shortly thereafter, Bradley left home for Springfield, Massachusetts, where he sought employment as a draftsman. Early in 1860, Bradley purchased a small lithograph press with the intention of starting a printing business, but in spite of an early success selling portraits of an beardless Abraham Lincoln – an item rendered passé when Lincoln grew a beard prior to his inauguration – subsequent sales were not forthcoming Later that year, an unemployed inventor approached Bradley with the idea for a board game, which Bradley

[64] Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912, pg 42
[65] Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912, pg 32
[66] There are two principle biographical accounts of Milton Bradley. *Milton Bradley, a Successful Man,* (New York, J. F. Tapley co., 1910) offers a number of recollections of Bradley and the Milton Bradley Company by friends and executives of the Bradley corporation, as well as some material by Bradley himself. James J.Shea's *It's All in the Game,* (New York, Putnam, 1960) is a longer and more extensively researched account of Bradley's life, authored by the president of the Milton Bradley corporation for the centennial of the company.

purchased, patented and produced; by 1861 "the Checkered Game of Life" was a runaway success, selling 40,000 copies in its first year and launching the Milton Bradley Company. On the success of the "Checkered Game of Life" and subsequent products – like "Games for Soldiers," which charitable organizations bought in large quantities to send to Union forces – Bradley expanded into other areas of production.[67] Inspired in 1868 after attending a lecture by educational reformer Elizabeth Peabody – as well as by some passionate badgering from his neighbor, a German music teacher named Edward Wiebe – Bradley became a committed advocate of what was then a novel program of "kindergarten" education.

Developed in the 1840s by the German teacher Friedrich Froebel, kindergarten (as Froebel saw it) emphasized a sort of sensual/scientific education involving the use of colorful learning implements called "gifts" – geometric shapes and patterns in bright colors, intended to introduce children to the fundamental elements of nature.[68] Working with Weibe and Peabody, Bradley set about retooling his Springfield factory to produce Froebel's unusual educational tools – "articles […]," recalled Bradley, "of such a character that the like of them had never before been seen in an American workshop."[69] In addition to wooden items, "many of the kindergartens occupations," recalled Bradley, "called for the use of colored papers, and here was a new and peculiar field of labor."[70] Bradley found commercially available pigments and papers to be indiscriminately identified and unreliably colored, prompting him to engage the study of color "on a scientific basis," in order to begin developing his own system of identifying and producing colors.[71] The result was a set of papers in ninety one different colors that Bradley thought met the standards of color science.

About John Henry Pillsbury, less can be said in detail. A man of many hats, Pillsbury was an ordained Methodist Episcopal minister, educator, botanist, and author of the 1893 textbook, *A Laboratory Guide for an Elementary Course in General Biology*; in later years he was the headmaster at a boy's school in Dedham, Massachusetts. Born in 1846, he graduated Wesleyan college in 1874, staying on for a master's degree which he earned in 1877. After teaching "natural science" in the High School in Springfield, Massachusetts

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[67] On "Games for Soldiers" see David Wallace Adams and Victor Edmonds, "Making Your Move: The Educational Significance of the American Board Game, 1832 to 1904," *History of Education Quarterly*, Vol. 17, No. 4, Winter, 1977, pp. 359-383, on pg 373

[68] Norman Brosterman's *Inventing Kindergarten*, (New York: H.N. Abrams, 1997) provides a thorough and well-illustrated history of Froebel's kindergarten philosophy, as well as his "gifts."

[69] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 32-33

[70] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 33

[71] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 33

between 1877 and 1881, he moved to Smith College between 1882 and 1894, where he taught "Plant Description and Analysis, Study of Types of Living Organisms, Systematic Botany, Vegetable Histology, Vegetable Physiology."[72] Although he may have known Ridgway through meetings of the American Society of Naturalists – of which both men were members – Pillsbury recalled that the problem of color nomenclature originally came to him as early as 1880 when he noticed that female students in his high school classes tended to use many more words to "express much smaller differences in color" when naming the colors of flowers than his male students. This tendency he took to be caused by the generally "fuller vocabularies" of women, rather than a surfeit color blindness among the men, but he also noted that, while they used more words to express what they were seeing, women also tended to be less accurate in their descriptions. This realization led Pillsbury to conclude that "[w]hat we most need is not a fuller vocabulary [in naming colors] but a more accurate use of the vocabulary we now possess" – a principle upon which he began to experience with color naming systems through the 1880s.[73]

It is not clear exactly when Bradley's and Pillsbury's paths crossed, nor is the precise nature and timetable of their collaboration easy to ascertain. Archival evidence relating to Pillsbury is limited to a smattering of items mostly pertaining to his botany work, while Bradley's papers – including his detailed diaries and carefully saved correspondence – went missing some time in the late 1960s, with only fragments of entries remaining through excerpts in secondary sources.[74] Extant published pieces, meanwhile – such as journal articles by Pillsbury and recollections by Bradley's associates – indicate some measure of crossed purposes and chronological confusion between the two men. For example, in articles published in scientific journals in the 1890s, Pillsbury emphasized that he first became interested in scientific color names in 1880s – a declaration consistent with his statement that

[72] Biographical information on Pillsbury is rather limited. See Lora Altine Woodbury Underhill, *The Descendants of Edward Small of New England and the Allied Families with Tracings of English Ancestry, vol. 1,* Cambridge: Riverside Press, 1910, on pg 124; F.W. Nicolson, *Alumni Record of Wesleyan University, Middletown, Conn.* Third Edition, 1881-3, Hartford, Conn.: The Case, Lockwood and Brainard Company, 1883, on pg 263; on Pillsbury's Smith College courses see: http://www.smith.edu/garden/Academics/courselist.html, last accessed 4/27/2011.
[73] J.H. Pillsbury, "On the Color Description of Flowers," *Botanical Gazette*, Vol. 19, No. 1, Jan., 1894, pp. 15-18, on pg 15
[74] On Bradley's diaries – as well as a nimble take on the meaning of "The Checkered Game of Life" – see Jill Lepore, "The Meaning of Life: What Milton Bradley Started," *The New Yorker,* 83:15, 21 May, 2007, pp 38 - 41. Although not concerned with Bradley's archive, David Wallace Adams and Victor Edmonds make much the same argument as Lepore about the meaning of "The Checkered Game of Life" vis-à-vis other board games in "Making Your Move: The Educational Significance of the American Board Game, 1832 to 1904," *History of Education Quarterly*, Vol. 17, No. 4, Winter, 1977, pp. 359-383

he came to his color work through his experiences teaching high school, which appear to have been concentrated between 1877 and 1881. However, while Pillsbury claimed in an article published in *Nature* in 1895 that he had experimentally identified the spectral wavelengths of his principle named-colors by 1884, thus cinching his nomenclatural system, this statement contradicted earlier remarks in an 1893 article in *Science* in which Pillsbury reported that he had only within the past year (i.e. 1892 or 1893) analyzed the spectral components of his color system through the loan of equipment in the physics laboratory at Wesleyan. As for Bradley's work with Pillsbury, Pillsbury in 1892 remembered that their collaboration had ensued about "twelve or thirteen years since" – that is, around 1879 or 1880. A close associate of Bradley's, however, remembered Bradley beginning his work in color science around 1887 – a date more consistent with the release of Bradley's colored paper series in the early 1890s, as well as the 1892-1895 publication dates of journal articles both by Pillsbury and Bradley.[75] Indeed, Bradley's biographers and Bradley himself mention collaboration in color work between Bradley and "scientists and teachers" in the Springfield school district around 1887 – indicating a possible time and place where Bradley and Pillsbury might have met over a similar interest in color nomenclature. But while Pillsbury made frequent mention of Bradley in his published work, Bradley acknowledged Pillsbury only once in writing, in an 1893 letter to *Science* in which he endeavored to distance himself from "any misapprehension of the claims" that Pillsbury had made for their color system.[76] It is possible, then, that Bradley and Pillsbury were both at work on the question of color names throughout the 1880s, but beginning in earnest in the 1890s, though it is equally possible that Pillsbury's recollections of thinking about color in the 1880s were an attempt to give retroactive precedence to his own work over color systems like those of Ridgway – or, for that matter, his own collaborator, Bradley. In any case, it is difficult to say with any certainty when, precisely, Bradley and Pillsbury began to work on their system, or precisely how they collaborated.

What is clear is that both Bradley and Pillsbury, like Ridgway, put a premium on precision in color naming. As Pillsbury lamented in 1895, although musical notes and geometrical forms could be notated in great detail – i.e. through notes and measurements, "for colour perceptions we have neither any well-defined concepts for those terms which

[75] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 44
[76] Milton Bradley, "The Color Question Again" *Science*, Vol. 19, No. 477, Mar. 25, 1892, pp. 175-176, on pg 175

have become well-established, nor any definitely and well-arranged system of colour terms for common use."[77] Bradley, for his part, struck a somewhat apocalyptic tone, lamenting that "geometrical forms have already been so definitely analyzed by the science of mathematics that if destroyed to-day these solids and surfaces could be reconstructed at any future time from written or printed directions. But suppose all material samples of color to be lost, it would be impossible by the ordinary system of color nomenclature to even approximately restore a single one from written or verbal descriptions."[78] Faced with the fantastic possibility of a cataclysmic and rather inexplicable loss of all colors, the need to accurately define and communicate colors through text that could be preserved and restored at will attained a high priority.

But unlike Ridgway, instead of basing their color terms in the names of objects and people, Bradley and Pillsbury advocated a more precise usage of a smaller number of abstract color terms. Gone were the fanciful "dragon's blood," "broccoli brown" and "isabelle" of Ridgway's abacadarius – terms which, along with the much-maligned "elephant's breath," Bradley found "meaningless," and Pillsbury felt to be simply "absurd."[79] Gone, too, were names based on popular pigments – even those such as "vermillion" and "ultramarine" which, although "used by many of our best authorities on colour," were nevertheless subject to a "wide range of variation."[80] Nor was there any place in the two men's system for commonplace color words like "olive, citrine, russet, &c.," which Pillsbury dismissed as "terms whose meaning has never reached any considerable degree of accuracy."[81] Pillsbury even gave the axe to indigo – a staple of optical discourse since Newton included it in his divisions of the spectrum in 1671 – on the grounds that "the always questionable indigo of the rainbow is no longer recognized as one of the distinct spectrum colors."[82]

Rather than "scouring the field of literature for fanciful and arbitrary names," as Bradley put it, he and Pillsbury advocated a systematic color nomenclature based on only six color terms – "red," "orange," "yellow," "green," "blue" and "violet," the latter of which Pillsbury favored over "purple" because he felt that, strictly speaking, "purple" indicated a

[77] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390
[78] Milton Bradley, *Elementary Color,* Springfield, MA: Milton Bradley Co., 1895, on pg 6
[79] Bradley quoted in James J.Shea's *It's All in the Game,* New York, Putnam, 1960, on pg. 25; J. H. Pillsbury, "A New Color Scheme," *Science*, Vol. 19, No. 473, Feb. 26, 1892, pg 114
[80] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390
[81] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390
[82] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390

combination of red and violet.[83] Along with black and white – which Bradley and Pillsbury termed "shade" and "tint," respectively – disks of these colors could be combined on a color wheel to represent any color sensation imaginable. The names of these combined colors, meanwhile, could be expressed as simple assemblies of the principle words for colors, or even an abbreviation of the terms. Thus a color that appeared to be an equal mixture of black and red could be notated as "red shade No. 1," or simply "R.S." A color between red and orange but leaning towards the latter would be Red Orange, or R.O.; a color between red and orange but leaning towards the former would be Orange Red or O.R. (Pillsbury and Bradley's abbreviation convention did not account for a color exactly between red and orange). By placing a slightly larger disk divided into 100 sections behind the colored sections, it was moreover easy to specify the exact percentages of the basic hues that constituted a specific color. Thus "Orange Red" might more specifically be called O.25 R.75, while a sample of a commercial color like "crushed strawberry," instead of being conventionally described as "a dull, slightly orangish pink," could, through comparison with a spinning disk bearing the correct standard colors in the correct proportions, be renotated as "R55, O5, W 27, N 11" – or 55% red, 5% orange, 27% white and 11% black.[84] "What a saving of confusion in the use of color names is thus gained," exclaimed Pillsbury, "we are hardly able to realize."[85]

In itself, Pillsbury and Bradley's idea was not especially novel. Colloquial English furnished roughly the same convention as their suggested nomenclature without the need of spinning disks. A color like that of a lime, for instance, might simply be described as "yellowish green" in everyday language, while a color like that of rust could be called "orangeish red." Moreover, two color systems similar to theirs already existed by the early 1890s. After reading an 1895 article by Pillsbury describing his and Bradley's color notation, Herbert Spencer, the British social scientist, wrote to *Nature* to say that he had already thought of a similar system, based on the compass, such that different combinations of red and blue might be notated as "red by blue, red-red-blue, red-blue by red, red-blue (purple); red-blue by blue; blue-red blue, [and] blue by red."[86] While allowing that his system didn't have the same degree of "scientific nicety of discrimination or naming" that Pillsbury's did,

[83] Bradley quoted in James J.Shea's *It's All in the Game,* New York, Putnam, 1960 on pg 123; J.H. Pillsbury, "On the Color Description of Flowers," *Botanical Gazette*, Vol. 19, No. 1, Jan., 1894, pp. 15-18, on pg 18
[84] J.H. Pillsbury, "The Nomenclature of Colours," *Nature,* 1360:53, 21 Nov, 1895, on pg 57
[85] J.H. Pillsbury, "The Nomenclature of Colours," *Nature,* 1360:53, 21 Nov, 1895, on pg 55
[86] Herbert Spencer, "The Nomenclature of Colours," *Nature,* 1348: 52, 29 Aug, 1895, pg 413

Spencer nevertheless remarked that "[v]ery possibly, or even probably, this idea has occurred to others, for it is a very obvious one."[87] Pillsbury himself affirmed Herbert's suspicion, writing in response that not only had he (Pillsbury) used the metaphor of a compass in an 1890 lecture given to the American Association for the Advancement of Science (again suggesting a much later date to Pillsbury's work than his own accounts), but that such a system had also been put to use by Louis Prang, a Boston-based printer and paper manufacturer, who used a nomenclature similar to his and Bradley's – "R RRO ORO O OYO YO YYO Y, &c," for example, to signify different colors between pure red and pure yellow.[88] Immediately below Pillsbury's response, the editors of *Nature* included a letter from Louis Prang himself, also claiming credit for a "system of colour nomenclature" that "corresponds almost precisely to the idea in Mr. Spencer's mind."[89] Whatever the originality of the idea, the editors of *Nature* concluded, they were "glad to see that the idea has been put into practice, and that, out of a chaos of colour-names, an intelligent system of nomenclature had been evolved."[90]

But Bradley and Pillsbury's system – the two men insisted – was of a different caliber than those proposed by Spencer and Prang. Rather than an essentially arbitrary allocation of color terms, it represented a color *standard,* fixed not to any object or pigment, but to precise points on the solar spectrum. "The wave theory of light," explained Pillsbury, "long ago established the fact that vibrations of an almost infinite variety of wave length in the luminiferous ether impinge upon the human retina and produce the effect which we call white light. From these [infinite combinations of wavelengths] we may select any wave-length we please, and giving it a name, have a colour as accurately fixed as any musical note or geometrical form."[91] The notion of dealing with color strictly as a physical phenomenon rather than as a quality of objects appears to have met with some resistance. "It has been urged in objection to the spectrum colors that they are not the colors of nature," wrote Pillsbury in 1893 – a criticism that he countered with the somewhat gnomic observation that, in fact, "nature has no other colors than those of the spectrum."[92] That is, from a physical perspective, all colors necessarily derived from the variable absorption and reflection of

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[87] Herbert Spencer, "The Nomenclature of Colours," *Nature,* 1348: 52, 29 Aug, 1895, pg 413
[88] J.H. Pillsbury, "The Nomenclature of Colours," *Nature,* 1360:53, 21 Nov, 1895, on pg 55
[89] Louis Prang, "The Nomenclature of Colours,", *Nature,* 1360:53, 21 Nov, 1895, pp 55-56, on pg 56
[90] Norman Lockyer?, "The Nomenclature of Colours,", *Nature,* 1360:53, 21 Nov, 1895, pp 55-56, on pg 56
[91] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390
[92] J. H. Pillsbury, "The Standard Color Scheme," *Science*, Vol. 21, No. 540, Jun. 9, 1893, pp. 310-311

different frequencies of solar light. Unlike objects – lemons, for instance, with their individual particularities –the wavelengths of light represented in the solar spectrum were, as Bradley stated, "unalterably fixed."[93] Thus, wrote Pillsbury, it was "possible to ascertain or relocate the [color] standard in any part of the world without any material representation of the color designated."[94]

Bradley and Pillsbury were pleased with their system – Bradley managed to include two of his pet projects in a single boast when he wrote in a memoir about "the immense improvement in one department of physics," that he had fostered, "growing out of the introduction of the kindergarten."[95] But Bradley and Pillsbury's system raised some important questions, too. First, even if spectral colors were the true "colors of nature," what warranted the selection of one wavelength in the nominally "red" band of the spectrum over another? Wasn't picking a wavelength, as Pillsbury had suggested, just as arbitrary as picking a colored object upon which to base one's color nomenclature? And second, what precise claim were Bradley and Pillsbury making about their colored disks? Were colored disks not just objects, rather like lemons, subject to greater or lesser deviation from a sensual norm?

To answer this first question, Pillsbury and Bradley relied on a panel of experts – a "small company of scientists and teachers," in Bradley's recollection; "six or eight persons well skilled in the use of colours," in Pillsbury's – who were invited to pinpoint the exact position of each of the six color terms on a large prismatic spectrum projected on a screen in the Springfield High School.[96] Among the assembled panel was the art educator Henry T. Bailey, soon to be named State Director of Drawing in Massachusetts, who later recalled being invited by Bradley into a "dark room, with its quivering spectrum of glory, ten feet long."[97] Somewhat to Pillsbury's surprise, correlating precise points in the spectrum with abstract colloquial color terms was a relatively straightforward task. Rather than expressing a wide range of opinion as to the best exemplar of red, orange, yellow, etc. in the spectrum, the panel exhibited a "very great unanimity of judgment" – suggesting to Pillsbury that abstract color terms did, in fact, signify something more universal than the subjective judgments of

[93] Bradley quoted in Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 34
[94] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390
[95] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 34
[96] Milton Bradley, *A Successful Man,* on pg 34; J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390
[97] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, on pg 32-33

individual viewers.[98] Indeed, this is what Ridgway meant in his 1912 *Nomenclature of Colors* when, following Pillsbury and Bradley, he described "Red, Orange, Yellow, Green, Blue and Violet" as the "psychologically distinct colors of the solar spectrum" – implying that the words indicated generally recognized and precisely defined sensations regardless of the material origins of those sensations.[99] Once identified as distinct and meaningful areas of the solar spectrum, Pillsbury set about cementing the definitions of his color words in terms of wavelengths, which he identified (in microns) as: Red .6587; Orange .6085; Yellow .5793; Green .5164; Blue .4695; Violet .4210.[100] Thus Bradley and Pillsbury could reasonably argue that their system was not "arbitrary" or subject to the vagaries of the "human equation" (as Ridgway had put it) but rather provided a physically precise concretization of meanings of abstract color terms in English.

The question of the ontological status of Bradley and Pillsbury's colored disks followed from their work in defining salient abstract color words in terms of spectral wavelength. Both Bradley and Pillsbury acknowledged that, speaking strictly according to the principles of psychophysics, only three colors – red, green, and a bluish purple – ought to be used as bases of a color system. Nevertheless, as Bradley explained, "[i]nstead of beginning with three primary colors seen in the spectrum we are content to select six." By choosing six colors "as they appear in the spectrum [and] making the best imitations of them possible with pigments," their system "practically bridge[d] the chasm between the science of color and the practice of color in the use of pigments."[101] That is, the physical basis of their system of color nomenclature was a conceit, to be sure, but one in which, as Bradley put it, each color term was "'definitely located in the solar spectrum by the wave length of each *material color* as matched in the spectrum.'"[102] To put it another way, the colored disks were a fiction, but one which closely enough approximated both the psychophysics of color mixing

[98] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390.
[99] Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912, on pg 19
[100] See, e.g. J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 390. On use of Wesleyan's physics lab, see J. H. Pillsbury, "The Standard Color Scheme," Science, Vol. 21, No. 540 (Jun. 9, 1893), pp. 310-311, on pg 310. The report for the American Association for the Advancement of Science's 1895 meeting lists Pillsbury's spectral value for green as ".4156" microns – probably a typo. See Pillsbury, "On Standard Colors," *Proceedings of the American Association for the Advancement of Science for the Forty-Fourth Meeting held at Springfield Mass,* Salem: Published by the Permanent Secretary, 1885, pp 58-59 on pg 59
[101] Milton Bradley, "The Color Question Again" *Science*, Vol. 19, No. 477, Mar. 25, 1892, pp. 175-176, on pg 175
[102] Milton Bradley Company, *Milton Bradley, a Successful Man,* New York, J. F. Tapley co., 1910, pg 40, italics added

and the conventional definition of abstract English color terms that Bradley felt they worked, themselves, as sorts of universal objects. In effect, Bradley and Pillsbury asked their viewers to believe that his disks were archetypical abstractions of the sensations referred to by color terms, rather than particular colored objects. Unlike Ridgway's color naming system, Bradley and Pillsbury's system was based on the idea that a color – like "crushed strawberry" – was ultimately a conglomeration of discrete sensations, rather than a representation of an actual macerated strawberry somewhere in the world. As such, the disks were not disks at all, but representatives of entangled pairs of names and sensations, rather than of sensations, names, and objects.

Bradley and Pillsbury further explained this profound reordering of the physical, sensual and nominal aspects of color perception in their discussions of the possible applications for their color system. For example, Pillsbury mused, imagine that "a firm dealing in large quantities of coloured material" wanted to manufacture a new color. "By the old method," Pillsbury explained, "they must find something as nearly like what is desired as possible, and then dictate the variations that are to be made." Equipped with colored disks corresponding to Bradley and Pillsbury's system, however (or even equipped with the means to produce colored disks of the associated spectral wavelength), the firm could simply compose the desired color on their color wheel, and then send the formula to their manufacturer, "who also has a set of the disks, and he 'sets up the colour' and then reproduces it in the material desired."[103] Indeed, if a salesperson were in doubt about what a customer wanted, could simply "tak[e] him to the colour wheel and ascertai[n] what the desired colour is," and then send the information on to his manufacturer. Rather than relying on comparisons with colored objects to compose a novel prospective color, that is, Bradley and Pillsbury's system dispensed with the need for particular colored objects in favor of precise terms for colors. Such a system, moreover, was well suited for pairing with modern technologies, dramatizing both its fantastic utility and eerie dissociation from the material world. "As a manufacturer of an extended line of colored papers," remarked Bradley,

> "I am constantly putting this proposed nomenclature to a severe test by ordering new colors by telephone. That is to say, we make the desired combinations on the wheel in our office and then telephone them to the factory, ten miles distant, where they are again made on the wheel and the papers are then manufactured to correspond with the

[103] J.H. Pillsbury, "A Scheme of Colour Standards," *Nature,* 22 Aug 1895, on pg 392

> results of these combinations. Under this plan we are liable to have occasion to 'telephone a color' frequently. In the same way we could cable colors to Europe should it be necessary."[104]

Not only did Bradley and Pillsbury conceive of color as distinct from colored *things* – color could, in fact, be decomposed into something as immaterial and impersonal as pulses of electricity creeping their way across the seabed, only to be reconstituted whole minutes and thousands of miles away.

Other than Bradley's professed usage of the color nomenclature to telephone color, there is little evidence that Bradley and Pillsbury's nomenclature was widely adopted. Although Pillsbury announced at the 1895 meeting of the American Association for the Advancement of Science that Hallock and Gordon, editors of the *Standard Dictionary,* had used his and Bradley's system when defining colors in their lexicon, Hallock and Gordon quickly penned a measured but firm rebuttal. While acknowledging that "the scientific method [for naming standard colors] would seem to be to choose from the spectrum itself and locate those colors ideally," Hallock and Gordon wondered if it was truly possible to accurately and consistently reproduce spectral colors with pigments. "Chromolithography can do wonders and can nearly match a spectrum color," they admitted. "The objection, however, to such working standards is that each lithographer, and indeed the same one at different times, will succeed to different degrees, so that a slight variation in color, luminosity and saturation is inevitable."[105] For this reason, Hallock and Gordon wrote, "we have no desire to belittle the work of Milton Bradley or Mr. Pillsbury, for they are doing much for the introduction of scientific methods into color study, but it did not seem best to us to attempt to define all colors [i.e. in composing the entries for colors in the *Standard Dictionary*], using only two colored discs at a time, and we do not believe that any lithographed surfaces should be adopted as ultimate standards, even though they may prove best adapted to educational purposes."[106] "No doubt Mr. Pillsbury regretted that his system was not adopted for the ' Standard Dictionary,'" they continued, "but that should not have induced him to insinuate

[104] Milton Bradley, "The Color Question Again" *Science*, Vol. 19, No. 477, Mar. 25, 1892, pp. 175-176, on pg 176

[105] W. Hallock and R. Gordon, "Color Standards," *Science*, New Series, Vol. 6, No. 136 (Aug. 6, 1897), pp. 214-215, on pg 214

[106] W. Hallock and R. Gordon, "Color Standards," *Science*, New Series, Vol. 6, No. 136 (Aug. 6, 1897), pp. 214-215, on pg 215

that we copied his system."[107] For the *Standard Dictionary,* Hallock and Gordon relied instead on the colors of common pigments – recapitulating the problems of Ridgway's nomenclature, but comfortably rooting their system in the material world.

Part V. The Logician

Although Bradley and Pillsbury felt that their color nomenclature definitively established the relationship between spectral colors and color names, others were not so sure. Particularly for scientists working in the emerging discipline of psychology, such as Christine Ladd Franklin, the linkages between the objective world, the sensing body, and the spoken word defied one-to-one correspondence. "The universe in which we find ourselves," she wrote in undated notes, "consists of three regions, the physical, the intracorpreal and the extracorporeal. Color phenomena, like other phenomenon of the conscious organism include in the first place the physical, in the last place the psychical, and in the middle place the physiological."[108] This, in itself, was not so different from the unspoken assumption made by Bradley and Pillsbury – as well as, for that matter, as psychophysicists such as Rood – that to understand vision, one had to take into account not only color as objectively defined by physics, but also the subjective physiological response of the observer. But how those objective stimuli and physiological responses came to be understood as singular experiences in "the last place" – that is, the "psychical" or the "extracorporeal" – was exceedingly difficult to discern. In notes entitled "Poor Nature!" Ladd Franklin lamented the "defective" connection between "prismatic colors" as studied by physicists in laboratories and colors as experienced in everyday life. "The color sensations," she wrote, "are in any case, a representation *in the consciousness* of the facts of an external world – a sad makeshift."[109] Unlike the conscious apprehension of sound – and in particular music, in which auditors could apparently discern and describe with effortless clarity distinct transitions between notes within an octave – the colors of the prism were vexingly hard to label with any sort of reliability. "The sense organ in color is acute enough to enable us to distinguish, in the visible spectrum, 150 different sensations," exclaimed Ladd Franklin. And yet, those "different sensations are for the most part merely

[107] W. Hallock and R. Gordon, "Color Standards," *Science*, New Series, Vol. 6, No. 136 (Aug. 6, 1897), pp. 214-215, on pg 215
[108] Christine Ladd Franklin, Undated Notes, Box 53: Folder: methodology, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.

[109] Christine Ladd Franklin, Undated Notes, Box 54: Folder: Prismatic Colors, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.

"blends" in different proportions [of "unitary" colors]."[110] Nature had perpetrated a fraud on sentient beings, Ladd Franklin continued, although the purpose was unclear. "Why this deception on the part of nature?" she wondered. "It can only be that, having started on a certain (chemical) plan for a physical and psychological representative of a non specific whole octave general band of a physical light she found nothing better to do than what she has done, defective as it is!"[111] The simple relationship implied by Bradley and Pillsbury, that is, between physical stimulus, sensual response, and conscious description, was far more muddled that they had assumed.

In order to untangle the "defective" relationship between stimulus, response and cognition, Ladd Franklin relied on "introspection" – a central technique of the so-called structuralist school of psychology, then enjoying a brief moment of popularity in the United States. Although practitioners argued as to the precise scope and methods of introspection, at its most basic introspective psychology consisted simply of "looking into our own minds and reporting what we there discover," as William James famously put it.[112] Just as psychophysics plumbed the associations between physical sensations and physiological responses, introspective psychologists probed the relationships between physiological responses and conscious thoughts. As such, the "physical," "intracorpreal," and "extracorporeal" regions of Ladd Franklin – while entwined in ways that defied simple correspondence between physical stimulus, physiological response, and cognitive perception – were not mutually exclusive areas of study. Indeed, physics was simply concerned with understanding the nature of the objective world as experienced and reported by the observer, while psychology was concerned with understanding the nature of the mind as experienced and reported by the observer. The only difference was that one field effaced the observer through abstract measurement; the made the observer its central object of study.[113] In an undated note marked "a faire," for example, Ladd Franklin described an introspective

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[110] Christine Ladd Franklin, Undated Notes, Box 54: Folder: Prismatic Colors, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.
[111] Box 54: Folder: Prismatic Colors, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.
[112] William James, *Principles of Psychology,* on pg 185
[113] See Boring, Edwin G. Boring, "A History of Introspection," *Psychological Bulletin,* 50: 3, May 1953, pp. 169 – 189, on pp 171-172. Deborah J. Coon writes about introspection an attempt to mirror methods of industrial production in "Standardizing the Subject: Experimental Psychologists, Introspection, and the Quest for a Techno scientific Ideal," *Technology and Culture*, Vol. 34, No. 4, Oct., 1993, pp. 757-783; see also Kurt Danziger, "The History of Introspection Reconsidered," *Journal of the History of the Behavioral Sciences* 16, 1980, pp. 241-62.

experiment to compare ocular discrimination in two [series] of color gradients: "get a long good bk-wh series, + by its side a long, good bk – gr series. Sit down before them and by introspection see if they are or are not similar series. [114] Different schools of psychologists set different parameters for acceptable technique – strict experimental psychologists in the vein of Wilhelm Wundt or Edward Titchener would question whether describing "similarity" was truly an introspective function, or a function of higher-order judgment – but in broad strokes, as the historian of psychology Edwin Boring put it, introspection was predicated upon the "belief that the description of the consciousness reveals complexes that are constituted of patterns of sensory elements."[115] It was these complexes – these deep structures of physical, physiological and psychical interactions – that the study of color promised to illuminate.

As such, for Ladd Franklin, the words used by people to describe colors were of central importance not for defining the properties of objects, but for defining the inner workings of the human mind. Rather than asking how properly to notate the millions of sensations that humans could discern, she instead asked why human beings could experience millions of colors but define only a very few? What did this fact – and the facts that were known about physiological and psychological responses to color – say about the relationship between sensation and cognition? And how ought this relationship be understood in a society based on the percepts of science?

Ladd Franklin arrived at her color science obliquely. Born in 1847 in Windsor, Connecticut, she grew up in what her biographers roundly describe as a well-off and progressive family.[116] Her mother and aunt were energetic advocates of women's rights; and her father, a successful businessman, was unusually supportive of his daughter's intellectual curiosity (though he did worry, in line with the thinking of the day, that excessive mental exertion might impair her physical and mental well-being).[117] Ladd Franklin recalled that

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114 Christine Ladd Franklin, Undated Notes, Box:50, Folder: Experiment to do re: vision, Christine Ladd Franklin Papers, Columbia University Library of Rare Books and Special Collections.

115 Edwin G. Boring, "A History of Introspection," *Psychological Bulletin,* 50: 3, May 1953, pp. 169 – 189, on pp 171-172

116 For biographical information on Ladd Franklin, see Laurel Furumoto, "Joining Separate Spheres: Christine Ladd-Franklin, Woman Scientist (1847-1930)," *American Psychologist,* February, 1992, pp 175-182; and Laurel Furumoto, "Christine Ladd-Franklin's Color Theory: Strategy for Claiming Scientific Authority?"*Annals of the New York Academy of Sciences*, Volume 727, October 1994, pp 91–100. For an account of Ladd Franklin's life from a fellow color scientist see Dorothea Jameson Hurvich, "Christine Ladd Franklin," Edward T. James, Janet Wilson James, Paul S. Boyer,eds., Cambridge: Belknap Press, 1971, pp. 354-356

117 Laurel Furumoto, "Joining Separate Spheres: Christine Ladd-Franklin, Woman Scientist (1847-1930)," *American Psychologist,* February, 1992, pp 175-182, on pg 179

when she was an undergraduate at Vassar between 1866 and 1869, women were denied access to the laboratory equipment necessary to study her principle interest, physics, so she turned to "the next best subject, mathematics, which could be carried on without any apparatus."[118] After finishing Vassar and teaching elementary school for nine years, she went on to graduate work in logic with Charles Peirce at Johns Hopkins University, publishing her thesis, "On the Algebra of Logic," in 1883 as part of a compendium of the works of Peirce's students.[119] While at Johns Hopkins, she became interested in the problem of the "horopter" – the geometrical form defining the field of binocular vision – publishing a study of the phenomenon in 1889.[120] Two years later, while accompanying her husband (also a mathematician) on a sabbatical in Germany, she pursued her vision work at the laboratory of George Elias Müller, an experimental psychologist known for his work in color and memory studies. Later that year, she traveled from Gottingen to Berlin to do further work in the laboratories of Helmholtz, where she worked with his disciple, Arthur König, on measuring the "basic sensations" (*Grundempfindungen*) of normal and color-blind vision.[121]

It was during this time in Germany that Ladd Franklin was first exposed to a wide-ranging scientific dispute between partisans of Helmholtz and followers of the German physiologist, Ewald Hering, over the nature of the functioning of the color sense. Helmholtz, as was well understood among physicists and physiologists alike in the United States and Europe, had proposed since the middle of the 1850s that all color sensations arose through the reactions of three sorts of cells in the retina of the observer, each sensitive to either red, green or blue light; the variable responses of these cells to different sorts of visual stimuli combined in the mind of the observer to yield the vast multiplicity of sensations that people experienced as color. In 1864, however, Ewald Hering, an German physiologist, challenged Helmholtz's theory, proposing that color sensations were not, in fact, the result of three retinal receptors each keyed to *one* color, but rather three receptors that reacted antagonistically to *paired sets* of colors, such that one kind of receptor responded to red/green; one responded to yellow/blue; and one to black/white. According to Hering, it was

[118] "Christine Ladd Franklin," *Biographical Cyclopedia of American Women,* Vol. 3. New York: Halvord Publication Co, 1928, pp. 135-141, on pg 136

[119] Christine Ladd Franklin, "On the Algebra of Logic," *Studies in Logic,* Charles S. Peirce, ed., Boston: Little, Brown and Company, 1883, pp. 17-61

[120] Christine Ladd Franklin, "The Experimental Determination of the Horopter," American Journal of Psychology, 1, 1889, on pp 99-111

[121] Arthur König, "Die Grundempfindungen in normalen und anomalen Farbsystemen und ihre Intensitätsvertheilung im Spectrum," *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, 1892, pp. 241-347

the variable responses of these three sorts of receptors as they oscillated between their "opponent" pairs – and not the simple combination of three sorts of fixed responses – that the brain of the observer combined to yield a sensation of color.

As historian R. Steven Turner points out, more was at stake than simply the precise mechanism by which color sensations manifested themselves – Helmholtz's and Hering's theories implied not only different physiological mechanisms, but also very different methodologies for understanding sensation, and very different models for thinking about human physiology.[122] Among many other arguments, Helmholtz's followers pointed to the increasingly precise and well-replicated experiments made in psychophysical laboratories with spinning disks and combinations of spectral light. These seemed incontrovertibly to prove that red, green and blue lights were the sole ingredients necessary to produce all color sensations, including non-colors such as white and black – the former of which was viewed as a state of maximal stimulation of all three varieties of receptor cells, while the latter was viewed as a state of non-sensation. Hering's theories appeared to Helmholtz and his supporters to be overly hypothetical and idealistic – founded on pie-in-the-sky speculation underpinned by flimsy evidence at best. Proponents of Hering's view countered that Helmholtz's model of vision was overly mechanistic and incomplete. On the one hand, it posited a human organism that simply experienced the world as a series of inputs and outputs, with none of the dynamism of Hering's notion of opponency, while on the other hand it dismissed phenomena that didn't fit its parameters as products of "the psychological," and therefore, by implication, the unknowable. If Hering's theory lacked the sort of physical rigor that Helmholtz's seemed to supply, Hering's partisans countered that Helmholtz's theory neither accounted for well-known aspects of perception such as the apparent impossibility of certain color combinations such as greenish-red or bluish-yellow (which Hering's supporters thought neutralized each other to form gray) nor did it properly account for its assertion that colors like white and black were, in fact, qualitatively different sensations from those like red and green. Although seldom rehearsed in the United States – where Helmholtz's domination was secure until at least the first World War – arguments

[122] Turner examines the dispute between Hering and Helmholtz from an STS "conflict studies" perspective, emphasizing that the Helmholtz-Hering controversy was not simply a matter of comparing facts, but of marshalling schools of allies for support. R. Steven Turner, *In the Eye's Mind: Vision and the Helmholtz-Hering Controversy*, Princeton, N.J.: Princeton University Press, 1994. A shorter version of Turner's basic argument can be found in R. Steven Turner, "Vision Studies in Germany: Helmholtz versus Hering," *Osiris*, Vol. 8, 1993, pp. 80-103

between the two factions remained vigorous in Europe throughout the nineteenth century and until Hering's death in 1918.

By the time of her year in Germany, arguments between the two factions were in full swing, giving Ladd Franklin ample opportunity to consider each theory with care, before pronouncing both sides guilty of committing "crime[s] against the spirit of science." Although over the next three decades she occasionally vacillated as to which side was the more heinous offender, her basic criticisms of both Helmholtz's and Hering's partisans remained consistent. Of Hering's followers, she fumed, "[a]lthough this great body of facts [about Helmholtz's trichromatic theory] is absolutely inexpugnable, although they involve a great mass of color mixing and of color mixture equations, carried out by instruments of absolute precision, repeated in laboratory after laboratory, and always with reconfirmation – although, I repeat, these facts are indubitable <u>facts</u>, the follows of Hering are obliged, by the terms of their theory, to shut their eyes to them."[123] Their "errors" she wrote, "consist in most sinful commissions" – they simply ignored experimental evidence which ran contrary to their theory. But Helmholtz and his followers were no less sinful. Although they could point to a great mass of experimental evidence to bolster their theory, they failed to look *beyond* their experiments to their own experiences of color. They failed, that is, to "introspect," and in doing so missed a very important fact about color sensations: according to Helmholtz's theory, yellow wasn't a primary color because it consisted of the optical combination of red and green light – a fact well-rehearsed in countless psychophysical experiments.[124] However, as evidenced by basic color terminology (at least in both English and German), human beings don't call yellow "reddish-green;" they call it "yellow" – that is, its own, singular name, suggesting to Ladd-Franklin that it was a "unitary" color or "unitary" sensation – a sensation with enough psychological salience to warrant a specific linguistic denomination.[125] Thus while both Helmholtz and Hering's theories accounted well for different *aspects* of color vision, neither could account for the total structure of visual experience as reported verbally by careful observers.

[123] Christine Ladd Franklin, Undated Notes, BOX 51: Folder: Color Triangle, Christine Ladd Franklin Papers, Columbia University Library of Rare Books and Special Collections.
[124] Christine Ladd Franklin, Undated Notes, Box 50: Folder Contra Hering, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.
[125] In fairness to Hering and his followers, Ladd Franklin later wrote that "[t]he theory of Hering […] is so vastly superior to the Young-Helmholtz theory, that until it has fully displaced that it is hardly desirable to discuss its demerits" (45)

Having diagnosed the deficiencies in the two dominant theories of color vision of nineteenth century science, Ladd-Franklin did not hesitate to propose her own, which she first read in 1892 at the International Congress of Experimental Psychology in London and published thereafter both in the *Proceedings* of the conference, and the American journal, *Science*.[126] The "development," "evolutionary," or "genetic" theory of color perception, as she variously called it, posited that rather than three different sorts of receptor cells with either singular or paired color responses, the evidence collected by both Helmholtz and Hering – when considered jointly – indicated that there was only one color-sensing *molecule* within the cells of the eye of the retina, which was responsible for generating all color sensations as well as sensations of light and dark. This molecule, she proposed, was responsible for rudimentary vision early in the evolution of the visual apparatus of living things, and slowly changed over time, developing different "decompositions" for different combinations of unitary colors. At first, the molecule was only capable of discharging one variety of its "exciting substance," albeit in varying degrees, thus producing graded sensations of light and dark. Later, the molecule underwent a transformation, causing it to disintegrate partially in blue light, and partially in yellow light – if struck by light of either wavelength, it would discharge its exciting substance to a degree matching the proportion of colored light; if struck by both blue and yellow light it would discharge as a degree of light or dark. Still later in its development, the yellow aspect of the molecule further decomposed so as to yield variable responses to red and green light. As with the decomposition of the original molecule into yellow and blue, so too, red and green light could either variably decompose the yellow aspect of the molecule into red or green sensations, or – if they struck the molecule in the correct proportions – would be experienced by the viewer as a yellow sensation. This was why color combinations like "greenish red" and "bluish yellow" couldn't exist – each color term in the pair constituted component parts of sequential decompositions of the specialized color-sensing molecule. But it also explained why red, green, and blue lights appeared to mix to produce white: red and green mixed to produce yellow, which, when combined in correct proportion with blue, decomposed the color sensing molecule in its most primitive fashion – yielding only a sensation of lightness or darkness. In this way, both the theories of Hering and of Helmholtz could be seen as special cases of a more

[126] Christine Ladd Franklin, "A New Theory of Light Sensation," *Science*, Vol. 22, No. 545 Jul. 14, 1893, pp. 18-19; Christine Ladd Franklin, "A New Theory of Light Sensation," *Proceedings of the International Congress of Experimental Psychology*, London, 1892, pp. 103-108

comprehensive theory – not wrong, precisely, but blind to the complete range of human color experience.

Ladd Franklin promoted her theory over the next thirty years in journals, public lectures, and classes at Johns Hopkins and Columbia College. Although the basic theory itself changed little she continually refined it and connected it with developments in other fields of vision science. Early on, she defined her four unitary colors as "sensations which are produced in their purity by, about, the wavelengths 576 mm, 505 mm, 470mm, and a colour a little less yellow than the red end of the spectrum" – wavelengths different from, but in the same range as – Pillsbury and Bradley's colors.[127] She triumphantly noted evidence by Spanish physician Ramon y Cajal that suggested that "cone" cells in the retina, responsible for sensations of color, were evolutionarily newer versions of "rod" cells in the retina, which gave rise to achromatic sensations of brightness.[128] Likewise, she approvingly cited an article by physiologist J.S. Burdon-Sanderson in *Nature* of 1893, which noted the presence of light-sensitive molecules even in microbes, suggesting that evidence of the most basic form of her light sensing molecule might still exist in primitive creatures (thought Ladd Franklin did not comment on Burdon Sanderson's proposal that, unless psychologists were content to "admit a deferred epigenesis of mind, we must look for psychical manifestations even among the lowest animals," since even the most rudimentary vision suggested a capacity for cognition).[129]

But the most critical proof of the viability of her theory was never provided by advances in photochemistry, but in language. "We have the terms yellow green, reddish yellow, bluish green, greenish blue, blue-green, green-blue and blush red &c.," she wrote, in an undated note, "But why not reddish green or greenish red? […] You may say that language is an accident – and doesn't decide things but not when the case is like this! [130] While psychophysicists like Rood and von Bezold considered the naming of colors to be incidental to understanding the ontology of color, for Ladd Franklin, color names were an important – perhaps the most important – piece of experimental data in revealing the

[127] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 8
[128] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 48
[129] J.S. Burdon-Sanderson, "Inaugural Address, British Association," *Nature,* 1245:48, 14 Sept. 1893, pp 464 – 472, on pg 470
[130] Christine Ladd Franklin, Undated Notes, Box 50: Folder: MS re Color Theory & Color Terms, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.

underlying nature of the color sense. The existence of "yellow" as a unitary color was not, for Ladd-Franklin, an accident of language, but rather a fact to be reckoned with – red and green could be observed to mix to produce yellow; but that mixture was not called red-green. "Try to introduce the word," Ladd Franklin challenged a lecture audience. "[A]dd some visible green to red [i.e. mix red and green lights,] say the word + teach the child: this, my love, is called a red-green, or a green red, whichever you like. He would <u>hate</u> you, for introducing a nasty trick into his science studies!"[131]

Similarly, the verbal reports made by individuals with monocular color blindness of the sensations they experienced though their color-blind eye compared with their normal eye, suggested to Ladd Franklin that her theory was more viable than the three color theory of vision. Following Helmholtz's trichromatic theory, Jeffries and Holmgren both believed that different forms of color blindness could be modeled by assuming that one of the three types of receptor cells in the retina of the observer lacked function. Thus they predicated their tests (Ch 2. Figure 6) on detecting cases of deficient red *or* green blindness (or much more rarely, blue blindness). But, Ladd Franklin noted, when one actually paid attention to the sensations as *reported* by those who were color blind in one eye, it became apparent abundantly clear that it was not sensations of red *or* green that were nullified, but rather sensations of red *and* green; or sensations of yellow *and* blue. Color blindness tended affect color pairs, rather than individual colors. But the dominance of Helmholtz's trichromatic theory induced the great majority of color blindness researchers to persist in modeling color blindness in terms of deficient red or green *cells*, and not in reports of paired nullification of red and green *sensations.* "There was absolutely no reason *except the theory* for affirming that the warm color of the defective person was either red or green;" wrote Ladd Franklin, "all that was known was that it occupied the that portion of the spectrum which, for the normal person, is occupied by red, yellow *and* green."[132] Thus rather than turning to the words used by color blind individuals to describe their sensations, physicians and physiologists who saw cases of red blindness and green blindness as proof of the success of Helmholtz's theory were guilty

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[131] Christine Ladd Franklin, Undated Notes, Box 50: Folder: MS re Color Theory & Color Terms, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.

[132] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 192

of "*infer[ing]* the sensations of the colour-blind from a theory which they have already adopted."[133]

It was important to note, however, that color terms for Ladd Franklin described states of mind, rather than objective physical facts. Light as denoted in terms of wavelength was not the same thing as the sensations that the observer experienced and described with terms like "red," "yellow," "green" and "blue." This did not necessarily mean that the different wavelengths she had earlier named did not correspond to primary color sensations. But the fact that these wavelengths *could* be described by color terms did not therefore indicate that the meaning of red *was* "light with a wavelength of 576 mm." Rather, as she put it "a single sensation, say, a grey-green-blue, can be excited by a thousand different combinations of electro-magnetic radiations – by a million, rather."[134] As such, color terms were best understood as reflecting the inner state of the observer, rather than an objective psychophysical reaction to light of a particular wavelength striking the eye and inducing the partial decomposition of the light-sensing molecule. Indeed, in keeping with the doctrines of introspection, Ladd Franklin proposed a bifurcated vocabulary for color, with terms like "erythogenic, xanthogenic, chlorogenic, cyanogenic and leucogenic" describing the objective quality of radiations that induced subjective sensations that observers described with the words "red," "yellow," "green," "blue" and "white," respectively. [135]

The difficulty with the introspective approach, as Ladd-Franklin's bifurcated terminology suggested, was that words not only revealed mental structures, but had the potential to create them. Scientists had to carefully police the words that sensations suggested, corrupted as they might be by ambiguities of meaning and signification. In a paper read at the American Psychological Association's 1914 meeting entitled, "A Corrected Color Terminology," Ladd-Franklin reproached her audience, writing, "the words orange and purple should never be admitted into scientific speech – non unitary colors should not be given unitary names. Just as there exist no unitary names for the yellow-greens and the blue-greens, so we should, in the other two series of color-blends, speak always of the red-blues

[133] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 193
[134] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 170
[135] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 171

and the red-yellows."[136] The problem with giving non-unitary colors unitary names, for Ladd Franklin, was that, in a sense, these names *made* colors into fundamental sensations that might not ordinarily be so. In an undated note to herself, Ladd-Franklin fretted about the nature of the color gray, writing that "[o]n account of its unitary name it is a far more unitary thing than it really is and far more unitary than it would be if [we] were always to call it (as we always call the blue-greens) a black-white."[137] In this instance, gray was *made* a more "unitary thing" by its name than Ladd Franklin supposed it be. That is, the name for the color short-circuited what she believed ought otherwise to be her introspective sense of the color. Further introspection, however, prompted Ladd-Franklin to reverse herself, writing later that "the ambiguous word *colour* should be used to include the colour grey (white)."[138] That is, gray was, in a sense, unitary, at least insofar as it was a special case of gray and white.

On the other hand, by dint of their guilelessness, subjects like children could – at least in the opinion of some psychologists – provide better introspective evidence than adults.[139] In a review the 1897 edition of of Joseph LeConte's *Sight, an Exposition of the Principles of Monocular and Binocular Vision,* Edward Scripture dismissed the theory of four unitary colors –LeConte had promoted, citing Ladd Franklin – reflecting that only those who consciously learned to see "violet" as a combination of "red" and "blue" would mentally decompose the color into its constituent parts – just as to children, "orange is as much a primary color as red is."[140] In defense of her theory, Ladd Franklin confronted Scripture with introspective evidence of her own – namely, an experience related by her own daughter at an age when she didn't know the word for purple. When one day viewing a "large a brilliantly

[136] Christine Ladd-Franklin, "A Corrected Color Terminology," *Psychological Bulletin,* Vol 11: no 2, Feb 15, 1914, pp 52-53, on pg 52
[137] Undated Note, BOX 54: Folder: Color Terms, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.
[138] Christine Ladd Franklin, "The Evolution Theory of the Colour-Sensations (the Ladd-Franklin Theory of Colours)" in *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929 pp 126-131, on pg 127
[139] The question of whether children (and their evolutionary corollaries, "savages," the "uncivilized," and "primitive" people) were viable subjects for introspective psychology was a matter of some debate. Following James McKeen Cattell at Columbia, James Mark Baldwin, editor of the *Dictionary of Philosophy and Psychology,* answered in the affirmative. More doctrinaire introspectionists, such as Edward Titchener of Cornell, thought that introspection, strictly speaking, ought to be limited to subjects who had been trained to introspect – a view which sparked an ugly disagreement between Baldwin and Titchener (see Boring, *Experimental Psychology,* pg 413 f 555). As a close correspondent of Baldwin's – as well as an antagonist of Titchener's (who refused to allow women into his elite club, "the Experimentalists) – Ladd Franklin seems to have cast her methodological lot with Cattell and Baldwin, rather than Titchener.
[140] Edward Scripture, "Review of Sight, an Exposition of the Principles of Monocular and Binocular Vision," *Psychological Review*. Vol 4(5), Sep 1897, pp. 543-545, on pg 545

lighted up surface of that color," the girl nevertheless gave it her full attention and, in Ladd Franklin's recollection, "said, in what we used to call her hypothetical tone of voice: 'B'u – Wed! – Wed! – B'u!" which Ladd Franklin interpreted to mean "'perhaps I should call this blue! – Perhaps I should call it red!"[141] To Ladd Franklin, the conclusion was clear: if purple had been a unitary color, like yellow, her daughter would not have been able disentangle its chromatic elements so easily. She would instead have struggled to find a word to describe a sensation that was unlike any other in her mind. The fact that her daughter had immediately tried to associate purple with its two component colors therefore spoke both to the non-unitary nature of purple, as well as to the fact of unitary red and blue. Thus, due to their lack of sophistication or artifice, children – both Scripture and Ladd Franklin agreed – could be trusted to reveal the true essence of color through the reporting of their sensations, although sophisticated observers might disagree on the interpretation of their reports. To complete the experiment, Ladd Franklin sardonically suggested that it would be necessary to find a child "brought up in an aesthetic atmosphere of nothing but blue-greens and green-yellows" in order to see whether, when presented with a swatch of pure green, the child recognized it as simply green, or as one of the hybrid colors that she had known.[142]

Her concern with the precision of color names was not, however, the same as that of Ridgeway, or Bradley and Pillsbury. That is, on the one hand, she scoffed at Hering's followers who spoke of basic colors as "hering red" or "hering green," remarking that they might as well speak of "hering crimson" and "hering peacock," so unscientific was their outlook.[143] In this instance, "crimson" and "peacock" stood, for Ladd Franklin, as the very apotheosis of unscientific color terminology. At the same time, commenting on the curious fact that non-unitary colors like "blue green" and "yellow green" were not named for similarly-colored objects – unlike "orange" and "violet," which bore the "plain names of the flower and the fruit which stand for them" – Ladd Franklin recommended "peacock" and "olive" respectively as terms that would fill the role. Though she admitted that olive – at least

[141] Christine Ladd-Franklin, "Color-Introspection on the Part of the Eskimo," *Psychological Review,* VIII: 4, July, 1901, pp 396 – 402, on pg 398
[142] Christine Ladd-Franklin, "Color-Introspection on the Part of the Eskimo," *Psychological Review,* VIII: 4, July, 1901, pp 396 – 402, on pg 398
[143] Christine Ladd Franklin, Undated Notes, Box 50: Folder: Lecture notes, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.

as it signified the fruit of the olive tree – was not exactly a yellow-green, Ladd Franklin shrugged, "there is no harm in changing its signification a little for scientific purposes."[144]

Moreover, in her one desultory attempt to create a "color terminology" of her own, Ladd Franklin appeared to be more interested in rehashing the structure of her development theory than in providing a comprehensive notation of sensations. A single page of sketchy, undated notes calls for a color terminology system based on "six visual sensations, or colour sensations": "one non-light sensation, or achroma, black" and "five light sensations" divided into one "achromatic light-sensation → achroma white" and "four chromatic light sensations" or "unitary colors": yellow, blue, red and green.[145] From these basic categories, non-unitary colors could be notated as combinations of unitary colors. Indeed, for quaternary color blends, "whenever the intensity of a colour (or color compound) becomes lost, black "jump[s] in. Thus," she concluded, "the colour of the bayberry is black-white-blue-green, or a gray-green-blue."[146] Unlike the color nomenclatures of Ridgway, or Bradley and Pillsbury, Ladd Franklin was more interested in discerning the *fact* of the component parts of complex colors rather than solidifying the exact proportions of components of each color, because the fact of component colors yielded truth about the facts of color vision, which in turn revealed the mental life of human beings.

Ladd Franklin's theory was respected by her peers, but not remembered. It never made the lasting impact that might have been expected from the serious interest given it on the part of influential physiologists and psychologists as well as her own constant advocacy of her ideas. Helmholtz himself responded favorably to her presentation of 1892, murmuring, "*ach [...] Frau Franklin – <u>die</u> versteht die Sache!*" (i.e. Mrs. Franklin understands the matter [of color]), while the influential physiologist William Henry Howell wrote in his 1901 *American Text-Book of Physiology* that Ladd-Franklin's theory was "in some respects more in harmony with recent observations in the physiology of vision" than any other.[147] By 1922, Deane B. Judd could write in the *Journal of the Optical Society of America* that her success

[144] Christine Ladd Franklin, *Colour and Colour Theories,* London: Kegan Paul, Trench, Trubner & Co, 1929, on pg 36
[145] Christine Ladd Franklin, Undated Notes, Box 50: Folder: Color Terminology, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.
[146] Christine Ladd Franklin, Undated Notes, Box 50: Folder: Color Terminology, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections.

[147] William Henry Howell, ed., *An American Text-Book of Physiology,* Vol 2., Philadelphia: W.B. Saunders & Company, 1901, on pg 337

in uniting Hering's and Helmholtz's models of color vision "is probably the basis for the increasingly wide acceptance which the Ladd-Franklin genetic theory of color is now enjoying."[148] And as late as 1940 – ten years after her death, *Optometric Weekly* listed Ladd-Franklin's theory alongside those of "Helmholtz [and] Herring [sic]" as being among "familiar color theories" that required greater explanation.[149] For all of this support, however, as historian Laurel Furumoto points out, Ladd Franklin labored without access to the resources and connections that allowed her male peers to train students and engage fully-fledged research programs. As a married woman – even a married woman with an extensive record of publication, connections with powerful scientists, and deep respect within the discipline – Ladd Franklin was denied professorships in psychology departments of Johns Hopkins or Columbia, where she had followed her husband. Forced instead to teach single classes, often for free, Ladd Franklin was able to promulgate her work only as a sideline to the main work of burgeoning psychology departments. Moreover, Ladd Franklin had limited access to the scientific societies that were fertile grounds for collaboration and mutual support. "The Experimentalists," for instance, an elite club founded in 1892 by E.B. Titchener for connecting those psychologists "who had arrived" with promising aspirants, strictly barred women from attending meetings – an attitude which Ladd Franklin excoriated as "'[s]o unconscientious, so immoral, – worse than that – so unscientific!"[150] The club eventually allowed women in 1929 – two years after Titchener's death, and a year before Ladd Franklin's. The inability to train students, cultivate junior faculty and inaugurate research programs left Ladd Franklin without the committed disciples (such as Müller was to Hering, or König to Helmholtz) necessary to reinforce and sustain her work after her death.

By the time of her death, Ladd-Franklin's color work had foundered on the shoals of disciplinary divides and shifts in research style. Reviewing Ladd Franklin's 1929 book, *Colour and Colour Theories* – a compendium of Ladd Franklin's papers, published the year before her death – Cornell psychologist Elise Murray wrote that, in spite of Ladd Franklin's valuable suggestions about the evolutionary roots of color vision, and her insistence on precise discrimination between objective stimulus and subjective sensations, the

> "laboratory psychologist is compelled to adjudge the postulates of Ladd-Franklin as little satisfactory as the discarded ones of Helmholtz. The explanations of color-

[148] Deane B. Judd, *J. Optical Society of America,* 1922, on pg 14
[149] "News," *Optometric Weekly,* vol 31: 5, 1940, on pg 804
[150] Quoted in Furumoto, 1992 on pg 97

> blindness discoverable in these pages are sketchy, involved, and little helpful. The psychological premises themselves on which the older theories are attacked and the superiority of the genetic hypothesis advanced are less compelling than in the nineties. Reliance upon the 'immediate deliverances of consciousness' in the selection of color 'primaries' fell away in the early nineteen-hundreds.[151]

Ladd Franklin herself in 1927 lamented the slackening of interest in her work, and in color in general, particularly among physicists, who she still considered to be viable audience, writing, "[a]t this time, when one daily expects exciting news from Schrödinger and Heisenberg, it is rather difficult to secure attention for such matters as color theories" – ironic, if only for the fact that Schrödinger had, in fact, published his own theories of color measurement in the 1920s.[152] Beginning in the 1950s, "zone" theories of color – in which color perception began to be seen as a combination of physical and mental processes – began to gain precedence as viable explanations of human color perception. As psychologist Gerald S. Wasserman has argued, although Ladd Franklin's was arguably the first serious attempt to produce a zone theory of color, the fact that she "expressed her ideas in terms of a hypothetical photochemistry which has not stood the test of time; critics focused on the auxiliary photochemical notions and largely ignored the genuine contribution of her theory" – that is, the attempt to think of color terms as descriptions of mentality independent from descriptions of objective physical stimulus.[153]

Part VI. Conclusion

In a certain sense, the story of attempts to attach definite names to color sensations according to the standards of science is a story of the failure of scientific reason. Ladd Franklin's efforts to define basic color sensations were rejected – or at least, subsumed into later theories of perception.[154] Bradley's system of color naming, as represented most closely in his system of

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[151] Elsie Murray "Review: Colour and Colour Theories by Christine Ladd-Franklin," *The American Journal of Psychology*, Vol. 41, No. 4, Oct., 1929, pp. 653-656

[152] Christine Ladd Franklin, "Mischance in the Science of Color," Box 50: Folder: Mischance in the Science of Color, Christine Ladd Franklin and Fabian Franklin Papers, Columbia University Library of Rare Books and Special Collections. For Schrödinger's theories see Erwin Schrödinger, "Theorie der Pigmente von größter Leuchtkraft," *Annalen der Physik*, 4:62, 1920, 603-622; Erwin Schrödinger, " Grundlinien einer Theorie der Farbenmetrik im Tagessehen," *Annalen der Physik*, (4), 63, 1920, 397-426; 427-456; 481-520, and Erwin Schrödinger, "Farbenmetrik," *Zeitschrift für Physik*, 1, 1920, 459-466

[153] Gerald Wasserman, "Color vision: an Historical introduction," New York: Wiley, 1978, on pg 113

[154] See, e.g. E. Murray, "Color Problems: The Divergent Outlook of Physicist and Psychologist," *The American Journal of Psychology,* Vol. 42, No. 1, Jan., 1930, pp. 117-127; and Dorothy Katzin and E.

educational colored papers was never less than a drag on the company's finances, and Bradley's successor discontinued them after Bradley died. Of all of the attempts at thinking about color names here described, Ridgway's – ridiculed by Hallock and Gordon as conflating objects with sensations; laughed at by Ladd-Franklin for being an affront to scientific reason ("if he only had the color triangle before him!!!" she jeered while reading his book) – was the most successful, at least in terms of common use. Ridgway persisted in using vague, colloquial nomenclatures for color, insisting in 1912 that "an expression of opinion […] from many naturalists and others," indicated a strong preference for evocative color names over more abstract conventions.[155] And while admitting that Ridgway used "very colorful language" in naming the colors in his 1912 edition (a curious recursion calling attention to the slipperiness of sensory terms), as Daniel Lewis, senior curator of science and technology at the Huntington museum, noted in 2008, "[e]veryone from stamp collectors to naturalists to chemists refers to 'Ridgway colors' to identify specific shades."[156]

Attempts to name colors according to the standards of science neither reassured Americans of their own modernity vis-à-vis "semi-civilized" peoples, nor did they lead Americans to place a greater stock in the veracity of their own basic sensations, nor, perhaps needless to say, did everyday people begin to speak with greater clarity about color names – though a whiff of the theme occasionally seeped into popular reporting. A *Los Angeles Times* style piece from 1929, for instance, began with the promise that "[a]lthough every manufacturer, every weave of materials, and one might say every retail establishment has a range of color names for its chosen product, still there are certain colors […] which may be recognized by their names, descriptive of the actual color." The article then went on to list under "the browns" "seal brown, also known as Afrique or merisand; witch brown, also known as autumn; chocolate, Philippine, capuchine brown, also known as peach stone; burnt siennt [sic], patio brown, also known as Barcelona; russet, red head. In a tone between brown and red," the article notes, "there is brandywine." The same went for "blue" ("navy or marine, independence, imperial, monet"); for "green," ("English green, bottle green, cucumber, new grass"); "yellow" ("nasturstium yellow, capucine gold, also known as curry;

Murray, "Instability in Color-Naming in Normal and Anomalous Observers," *The American Journal of Psychology,* Vol. 46, No. 4, Oct., 1934, pp. 611-620

155 Robert Ridgway, *Color Standards and Color Nomenclature,* Washington, D.C.: The Author, 1912, on pp 10-11

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egg yellow, tumeric, mais," and so forth until the article arrived at "black and white, ever present in feminine dress."[157] Thus, in a formal sense, anyway, the article made an attempt to simplify its color reporting in a manner not unlike Ridgway, filing its evocative color terms under simple, abstract headings, before concluding with black and white – Berlin and Kay's two most basic colors.

If anything, those who attempted to establish scientific nomenclatures between 1886 and 1929 induced their successors to throw in the towel. As A. Maerz and M. Rea Paul, authors of the 1930 *Dictionary of Color*, commented in the preface to their work, "[i]t is true that our present language of color is, to a certain extent, composed of words that are somewhat meaningless in themselves as color terms. This refers to such words as 'folly,' 'Westminster,' and 'elephant's breath'; they are lacking entirely in descriptive color value, *yet their continued use earns them a place among the accepted color terms that custom has decreed should compose our vocabulary*."[158] Rather than taking science (physics, physiology, psychology) as their guiding principle – the warrant that would overpower the arbitrariness of individual perception; overturn the vagaries of commerce, decoration and artifice; and elevate the primitive underpinnings of civilized sensation – Maerz and Paul turned to "custom" to justify their selection of color terms. Custom, in this case, wore down the precision edge of science.

But if they were failures of scientific reasoning, attempts to define color words scientifically were also exemplars of scientific imagination. They were fantasies of the possibilities of science; fantasies of how science could change everyday life on a fundamental level. Psychophysical studies and color blindness research had revealed vision as disturbingly unreliable – part of a sensorium unmoored by either a divine presence or a reliably shared sense of what things were like. The flood of ostensibly new, ever-changing colors in commerce, advertising and art – unable to be precisely named, or even, apparently, rationally described – had confirmed the worst fears of those who saw in modern society dissolution and drift. Against this drift, the mastery of concrete, basic terms was a salve. The idea of basic, standardized color vocabularies were in this sense the flip-side of Sadikichi Hartmann's fantasy about colors that had never before been seen, that needed new names like "ultra red" and "ultra violet." They held the hope that there was, in fact, order to be found

[157] "Brown Favorite Color," Los Angeles Times, Sep 11, 1929, pg. C12
[158] A. Maerz and M. Rea Paul, *A Dictionary of Color,* New York: McGraw-Hill Book Company, 1930, pg v. italics added

within the ostensible chaos, and that modern society was, in fact, superior to its alternatives. This fantasy, moreover, did not evaporate, even if attempts at colloquial nomenclature, did, over the course of the twentieth century, but simply shifted its discipline. It is precisely this notion of a rationally grounded, empirically accessible color sensation that survives, for instance, in the "basic color terms" of Berlin and Kay.