HECTOR’S COLOUR-MUSIC CODE

1912–1913 PATENTS
AU1912003713 & GB191229615A

Hector stipulated the colours red, orange, yellow, green, blue, indigo and violet (ROYGBIV) to occupy the seven notes of a musical octave.

Isaac Newton had used these colours in “Opticks” of 1704, to fill the intervals of a scale starting on the note D. Hector named no particular musical scale in these patents.

While the patents awaited approval, an article on Hector in the Sydney Mail applied his ROYGBIV colour to a diatonic scale on A – the white notes A, B, C, D, E, F and G on a piano. An article in the Western Australian concurred.

Hector’s patents specified that low-pitched octaves were dark, and successively higher octaves were in lighter colours. Here; the beginning of the next highest octave on A’ is shown in a lighter shade of red.

The patents also specified ‘half tones’ for the sharps and flats, so that 12 differently coloured lights corresponded to the 12 semitones of an octave.

Seven different brightness levels were given in the patents, for successive octaves. They are indicated below over seven octaves, from the deepest dark notes to the lightest high notes.

Hector varied his scheme by spreading one spectrum over an entire keyboard, below. He mentioned red, orange, yellow, green, blue and violet, omitting the usual indigo.
HECTOR’S COLOUR-MUSIC CODE

1916–1917 PATENTS

AUSTRALIA AU1916001299 AU1916001412 AU1916001936
GREAT BRITAIN GB107380A GB107767A GB109263A
FRANCE FR485860A FR485928A FR486612A
UNITED STATES US1432553 US1432552 US1388706

Hector took out three additional patents in Australia on consecutive months of 1916. Each contained further details to mechanisms of his colour keyboard. In addition, the first two of these patents outlined a substantially different colour-music scheme. The Newtonian ROYGBIV was replaced by another array of colours, distributed differently. The spectrum(s) so formed were aligned to start on the musical note C, rather than on A as had been suggested in 1912. Hector described the new arrangement as a “tempered colour scale”.

In 1917, three similar patents applications were lodged in each of the other countries listed. There were some minor differences in the mechanisms described, but Hector’s new colour-music scheme appeared in all jurisdictions (with an additional scheme in one US patent).

PATENT AU1916001299

The first iteration of Hector’s new colour music took the form of a double rainbow spread across a keyboard. In the outer or upper bow, a spectrum runs from violet on the upper edge to red on the lower edge. The colours are reversed on the inner or lower bow; red is positioned on its upper edge, violet on the lower edge. Hector had the two spectrums meet symmetrically about middle C on a keyboard. The lowest notes had the darkest shade, the highest notes were lightest.

The main colours are unequal in extent, compared to Newton’s ROYGBIV – red occupies 15 semitones while yellow has only one. As a result, 30 shades of red range over 2.5 octaves, around middle C. Twelve different colours were named: red, red orange, orange, orange yellow, yellow, greenish yellow + yellowish green, green, blue green, cyan blue, blues, blue violet, and violet.

PATENT AU1916001412

Hector asserted his array of colours, of unequal proportions, was “well known”. He laid them out in a table with numerical values totaling 1000. The table, in fact, is taken from page 24 of “Modern Chromatics, with Application to Art and Industry”, by Ogden Rood, 1879. Hector proceeded to convert Rood’s values to parts per 48 (instead of per 1000), to apply the colours to 48 semitones over a four-octave span. (see page 7, below)
Rood’s colours were calculated from observing spectra from diffraction gratings, rather than the prisms of Newton. This method gave more accurate wavelength measures, expanding the red end rather than the violet. The divisions of colours and the names given them were, of course, subjective choices. (Rood’s theories had some influence on the Post-Impressionist painters, Seurat and Pissarro.)

Hector did acknowledge Rood once, in a US patent (US1432552), perhaps because Rood was an American professor of physics at Columbia University. What Hector fails to mention is that Rood severely criticized any attempt to equate colours to musical notes, outlining his reasons in many passages.

Patent AU1916001412 and its overseas equivalents gave several different schemes for applying Rood’s colours to a musical instrument. Applying 48 colour units to four octaves of an organ, Hector added another octave of pale violets and pinks to the treble. A further 24 notes extended the bass (using a sub-base stop), adding half a spectrum from violet to yellow green, darkening as the notes descended.

Hector noted his schemes could equally apply to a piano, a player piano, or even a dummy keyboard that produced colours only but no sound. He proceeded to employ Rood’s colours to a seven-octave instrument. A single spectrum could cover three, two or single octaves, with the final treble octave being white.

A further scheme was implied in a wiring diagram of US1432552 only. A simplified spectrum was used – red, orange, yellow, green, blue and violet. (The same variant colours appeared in Hector’s 1912 patent.) Two such spectra were symmetrically joined to form a double rainbow. White notes were added to the treble, dark ones to the bass, allowing 6 notes per colour.
HECTOR’S COLOUR-MUSIC CODE

1919–1922 PRESS REPORTS

“COLOUR MUSIC”, SEA, LAND AND AIR, October 1919
In the first half of the article, Miss Kae McDowell interviewed Hector on his ventures into colour music. Included was a quote from Hector on the nature of his colour-music code:

“Here we come to the undoubted relationship between sound and colour. Do, re, mi, fa, so, la, te, do.—in other words, c, d, e, f, a, b, c, says the musical octave. Red, orange, yellow, green, blue, indigo, violet, red, says the colour spectrum.”

Rood’s colours, used in Hector’s 1916 patents, are ignored. Instead, Newton’s ROYGBIV colours are listed, as they had been in the press in 1912. However, the colours were matched to a musical C scale, in line with patents of 1916, rather than the earlier A scale of 1912.

“COLOUR MUSIC”, SYDNEY MORNING HERALD, February 1922
Hector wrote a series of three lengthy articles for the newspaper in 1922. In the second of these he mentioned the ROYGBIV colours, attributed them to Newton, and stipulated, “half-tones of these colours give us the sharps and flats”. He later noted the same colour sequence appeared in nature, when metal is heated, and so on. The colour array is shown above, on a C scale, though Hector mentioned no specific music scale in his articles.

1930s LATE DEVELOPMENTS

“THE ART OF COLOUR MUSIC”, "The Sydney Mail", June 1935
Hector’s last patent gave red, orange, yellow, green, blue, violet and purple to sequential notes of a C scale. In 1922, he had noted a very similar code by William Watt in 1888.

Patent 1926002810 of 1926 described Hector’s colour-music code in general terms only, without new or specific details.

PATENT AU1937004075, 1937
Hector’s last patent gave red, orange, yellow, green, blue, violet and purple to sequential notes of a C scale. In 1922, he had noted a very similar code by William Watt in 1888.

Painters primaries and secondaries of red, orange, yellow, green, blue and purple were the basis for a different code. (Yellow-green on the note F gives a smoother transition.)
Hector drew a coloured keyboard on a science chart in c1925-30. (see Hector's science.pdf) It is unusually large, of 101 keys from low F on the left up to A on the right, encompassing 8 octaves and a major third. (A normal piano keyboard has 88 keys, from low A to high C, covering 7 octaves and a minor third.) A single spectrum is stretched end to end: it is different to similar schemes above, at the bottoms of pages 1, 2, and 3. The colours approximate the Newtonian ROYGBIV, except there seem to be two greens, one with a yellowish cast, the other more blue. All are allowed about an octave each, with indigo (deep blue) expanded a few notes. This way, the full range is coloured.

In 1912, while waiting for his first patent to be ratified, Hector came across “Colour-Music”, a book containing similar ideas to his own. He exchanged letters with the author, A W Rimington, a professor of painting and sculpture in London, and Hector pointed out several times in the press how their inventions were independently conceived though very alike.

Rimington divided the spectrum into twelve colours, mathematically spaced equally according to their frequencies. It differs from ROYGBIV – four varieties of green are named between yellow and indigo, for instance. Usually Rimington contained the colours within a single octave, but the spectrum could be spread over five or six octaves for effect, by simply pulling out a stop on his colour organ. Here, he has the colours occupying four octaves. “Colour-Music: the art of mobile colour”, A W Rimington, Hutchinson & Co, London, 1912 https://archive.org/details/colouartof00rimi

Hector may have influenced by Rimington in his 1916 patents, when he first defined a colour-music code precisely. They both spread the spectrum across several octaves, in a variety of ways, and defined colour spaces mathematically. Both departed from the colour names of Newton, Rimington selecting his own and Hector relying on those of Ogden Rood.

Hector also contacted the Sydney painter Roi de Mestre (Roy De Maistre) who, with Roland Wakelin, mounted an exhibition called “Colour in Art” in 1919. They theorized a colour music of ROYGBIV colours aligned to a white-note scale on A. The press ascribed the same coding to Hector in 1912, though by 1916 he had moved to a code based on the C scale. De Maistre denied Hector influenced his scheme. A competent musician, he may have had reason to prefer A, since A forms the relative minor to C major (as well as taking alphabetical preference). In any case, he revived his scheme for several paintings in the 1930s.
Thomas Young provided the first calculations of colour wavelengths in 1801, using measures for colours of thin plates taken from Newton’s “Opticks” (though Newton himself denied colour any wave motion). He noted that, “The whole visible spectrum appears to be comprised within the ratio of three to five, which is that of a major sixth in music”. He went on to say, “If a chord sounding the tenor c, could be continually bisected 40 times, and should then vibrate, it would afford a yellow green light: this being denoted by c, the extreme red would be a, and the blue d”. Here, Young suggests a scale equivalent to the spectrum, starting on A but the colours end on F# before an octave is reached.

Due to limitations of the retina, Young concluded, “it appears that any attempt, to produce a musical effect from colours, must be unsuccessful, or at least that nothing more than a very simple melody could be imitated by them”.


Young used Newton’s colour names, ROYGBIV, as would John Herschell and others. But Hermann von Helmholtz, in his “Handbook of Physiological Optics” of 1856, noted “Newton’s division into seven principal colours was perfectly arbitrary from the beginning and deliberately founded on the musical analogies”. He noted Young limited the spectrum to a span of a major sixth, musically, and postulated a similar code. With yellow on C, A landed on red and a violet F# set the upper limit. Helmholtz decried any attempt to manipulate the spectrum mathematically, forcing it to cover an octave. “In the author's opinion, therefore, this comparison between music and colour must be abandoned.” “Helmholtz's Treatise on Physiological Optics”, 3rd edition (1866), Vol II, The Optical Society of America, trans. J P C Southall, 1924, pp 76-118 https://vlp.mpiwg-berlin.mpg.de/library/data/lit39650?

Some reputable scientists, John Tyndall included, continued to approximate the spectrum to an octave. But several colour-music codes did not allow the spectrum could stretch to a musical octave if wavelengths were strictly compared. The seventh note was then supplied with another colour, often a dim violet or darkness for ultraviolet. Most codes ignored Newton’s scale on D and those of Young and Helmholtz on A. The C major scale, which gained musical priority towards the end of the end of the 17th century, was preferred.

The scientist W F Barrett made a wavelength comparison of colour and pitch in 1870. Starting with ROYGBIV and a C scale, he was obliged to compress blue and indigo onto the one note, G, and his colours ended with violet on A, a major 6th above C.

"Light and Sound; an examination of their reputed analogy, showing the oneness of colour and music as a physical basis", W F Barrett, Quarterly Journal of Science 1, 1870, pp 1–16 https://archive.org/details/quarterlyjournal71870lond
HECTOR’S COLOUR-MUSIC CODE

Hector payed homage to Newton’s ROYGBIV, particularly in the press, though these were in the nature of conventional references and varied somewhat in practice. He was more attentive to the niceties of science when dividing up colours in his first two patents of 1916.

(To be continued)

Then, Hector relied on Ogden Rood’s “Modern Chromatics” of 1879. Rood rejected Newton’s spectrum as coming from a prism. The glass compressed the reds and enlarged the blues and violet, so he opted for more ‘normal’ spectral colours from a diffraction grating. He explicitly rejected indigo (as had Bezold) as too green for the position next to violet that Newton had given it. Rood opted for 12 main colour names, giving each a proportion of the length of a spectrum.

Hector adapted Rood’s figures to fit the 48 semitones within four octaves. (Though the 12 colour names could easily have been allocated to the 12 semitones of an octave, their differing proportions made this impossible.) Rood had made it clear that “colour does not even extend over one octave”. In several passages he argued cogently against colour music, and his rational, scientific approach is spelled out in his Preface:

"For the explanation of these facts, the theory of Thomas Young, as modified and set forth by Helmholtz and Maxwell, has been consistently adhered to. The whole class of musical theories, as well as that of Field, have been discarded, for reasons that are set forth in the text."

"Modern chromatics, with applications to art and industry", Ogden N Rood, D Appleton & Co, N.Y., 1879, Ch II, “Production of Color by Dispersion”, pp 17-29; pp 303-4
http://lcweb2.loc.gov/service/gdc/scd0001/2010/20100701001mo.pdf

A B Hector, STRINGS OF A PIANO, c1925-30, Mitchell Library, State Library of NSW
The drawing on page 7, above, shows the harp of a piano, a cast iron frame holding the high-tension strings. Bass strings are in front, running from top left diagonally down; treble strings are behind them, slanting the opposite way. The piano could be a small one, with a span of 7 octaves (85 keys) or a little more. The unusual half-wheel, lower right, suggests webbing used to reinforce the iron frame; I have been unable to trace such a design. From photos, Hector appears to have owned a Rönisch upright grand, iron framed, with 88 keys. Since he was not a musician, it is possible his instrument was a pianola. Using piano rolls and pumping foot pedals, Hector could make music himself, to trigger his coloured light display. From 1902, many Rönisches indeed had pneumatic player mechanisms installed by Ludwig Hupfeld; they proved so popular he was able buy out the company in 1918.

Hector has carefully coloured between the strings in a repeating spectral pattern. Assuming he intended ROYGBIV colours and a C major music scale, the notes A and C would recur as shown. Such a colour-music code was reported in the press in 1919, and variants on single-octave codes were mentioned. It is even possible Hector is reprising his earliest code, of 1912, with ROYGBIV starting on A. (The Cs superimposed on the drawing would become As, Cs would move to yellow, and the As shown would be Fs.)

This is not the elaborate code of Hector’s mid-War patents. Their uneven colours, based on Rood’s spectrum, are smoothed out; the spectra progress regularly, without reversing direction in imitation of a double rainbow; and each spectrum is confined within the bounds of a single musical octave, no more, no less.
HECTOR’S COLOUR-MUSIC CODE

Hector transferred his colour-music code to musical notation on one of his drawings (page 8, above). The score is hard to read in the photograph, though the note C is mostly red, E flat an orange-red, and A flat a dark blue. The key is A flat major. It could well be Hector has used ROYGBIV colours, aligned to a C scale. This piece might be played on a colour-coded instrument such as the piano on page 7, above. Presumably, Hector has transcribed the music from a printed score and his unusually small note-heads and leger lines point up unfamiliarity with musical conventions. His score is rewritten, as best I can, below. It is surprisingly logical and sounds like a popular song.

![Image of musical notation]

Colour-coded notation is not unusual as a teaching device. There is a notion that colour helps students learn to read and play music more easily than relying on the black-and-white of manuscripts and the keyboard itself. There are many courses on the internet that supply coloured stickers for the keys of a piano (or notes on a guitar), as well as written music printed in related colours. Toy pianos and xylophones are made as well, with coloured keys in a spectral sequence. A survey of patents reveals similar ideas, dating back as far as the 1870s.

Some patents from the mid-1920s use colour-music codes similar to Hector’s. Later examples, around 2000, employ ROYGBIV colours as well, aligned to either A or C scales. But the most common colours used in educational schemes omit indigo, retaining the painter’s primaries and secondaries (ROYGBV), the 7th colour most often being pink or brown. Almost as often, particular colours are not specified. They can be randomly distributed across the keys, the main idea being to make each note visually distinctive.

In his writing, Hector clearly outlined the merit to this approach: “...the use of colour in the teaching of music is of the very first value from an educational point of view, and, considering that education is largely a question of training the senses and leading them through one association to another, there are almost Infinite possibilities in the use of colour In the schools.”


In the same article, Hector mentions experiments by Kemp-Prossor on colour in the treatment of hospital patients. The Sydney painter De Maistre had applied those principles in colouring the rooms of shell-shocked patients returning from World War I. In performance, Hector nuanced his colours by obscuring them through muslin veils and behind plants and stage props. Previously, Rimington had blended his projected colours on a screen. In 1894, Joseph Grave objecting to “converging, combining, blending or super-imposing” colours; he claimed to have lodged his colour organ patent prior to that of Rimington, issued the previous year.

Hector made a similar claim to originality regarding Rimington’s book. (page 5, above)

Hector, Grave and Rimington all had dummy versions of their instruments, designed to play colours but no sound while accompanying live music, a stage production, and so on. Hector certainly knew of Rimington’s plan in 1914, to play the colours written into the score for Alexander Scriabin's "Prometheus: Poem of Fire". At his own colour-music concerts, Hector may have played music by Handel, Haydn, Beethoven, Mozart, or Melba, if only on a piano roll. Sometimes, there was a live performer to stimulate the colour display; Mr. Hume played Handel in 1912, while the composer Edward Page performed his own compositions in 1950. Perhaps Hector intended the latter, as one of those “composers in our midst in Sidney actively engaged on colour compositions”.