CHAPTER 4. METHOD FOR DETERMINING HARMONIC COLORATIONS AS PERCEIVED BY MESSIAEN

The principal aim of the chapter is to determine the basis for quantifying music-color correspondences, as perceived by Messiaen. Although Messiaen described only colorations of chords, his synesthetic response depended upon a complex and elaborate system of relationships that resided fundamentally at the level of pitch class (pc). In studying Messiaen's descriptions of harmonic colorations, there is strong evidence that each of the twelve pcs corresponded to a base color. It is my contention that within a sounding chord, the base colors of the constituent pcs interacted and evoked a resultant harmonic coloration.

The chapter begins by determining the base colors of the twelve pcs. The mechanics of harmonic coloration are then analyzed, demonstrating how for Messiaen individual pc colors within a chord interacted and evoked a harmonic coloration. The chapter concludes with the presentation of a method for determining unknown colorations (i.e., colorations of chords that Messiaen did not describe in his writings). The method begins with the analysis of a chord's pc colors. Following proposed guidelines, adjacent pc colors within a chord are grouped into zones, the resultant harmonic coloration comprising a set of discrete zones of color. The testimony of a color-language synesthete supports such a method:

> Consonants, when thought of by themselves, are of a purplish black; but when I think of a whole word, the color of the consonants tends towards the color of the vowels. For example, in the word "Tuesday," when I think of each letter separately, the consonants are purplish black, *u* is a light dove color, *e* is a pale emerald green, and *a* is yellow; but when I think of the whole word together, the first part is a light gray-green, and the latter part yellow.[1]

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1. Sir Francis Galton, "Colour Associations," *Synaesthesia: Classic and Contemporary Readings*, ed. Simon Baron-Cohen and John E. Harrison (Oxford: Blackwell Publishers, Ltd, 1997), 45. Galton does not specify the stimulus for the subject's synesthesia (i.e., whether the stimulus is aural or visual). For my purposes, the nature of the subject's stimulus is irrelevant; I simply seek to illustrate how the elements of a stimulus may interact.

For this particular synesthete, letters correspond to base colors. When the synesthete thinks of a word, the base colors of the word's constituent letters fuse into separate zones of color—the word "Tuesday" evoking two zones of color. Analogously, for Messiaen, the base colors of a chord's constituent pcs fused into separate zones of color.[2]

Like all synesthetic percepts, photisms are generic, appearing as crude forms rather than recognizable pictures; they also vary in shape, size and coloration.[3] In his writings, Messiaen tended to list the colors within a harmonic coloration "from high to low." The expression "from high to low" refers to the position of discrete colors within a photism. The pitches and colors of a chord comprise two homologous series; the colors correspond to the chord's constituent pitches. Colors described as "high" were evoked by pitches in the upper part of the chord and likewise were perceived in the upper part of the photism; colors described as "low" were evoked by pitches in the lower part of the chord and likewise were perceived in the lower part of the photism. When determining unknown harmonic colorations, a visual model in the form of horizontal stacks of discrete colors—similar to a spectrum—can be devised. Although synesthetic perceptions are idiosyncratic, testimony by my subject LH supports such a model:

> They [the colors] stack on top of each other, but do not have definite beginnings and endings. It is almost like a rainbow effect, but they do not create a new color where they join. They just blend—like impressionistic painting, no definite line [of demarcation] where the new color starts. So if

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2. Throughout the coloristic analyses in the remainder of this dissertation, following the practice of Messiaen, the word "and" is used to signify either that two colors appear together, either in the same zone or in two overlapping zones. Commas differentiate zones.

3. The most rigorous research into photisms has been conducted by University of Chicago neuroscientist Heinrich Klüver, who studied people who experienced mescaline-induced synesthesia. During the 1920s, Klüver interviewed dozens of people who had taken mescaline and even went so far as to take the drug himself. Klüver categorized the various shapes of photisms into four fundamental types, which he called "form constants": grating and honeycombs, tunnels and cones, cobwebs, and spirals. Heinrich Klüver, "Mescal Visions and Eiditic Vision," *American Journal of Psychology* 37 (1926), 502–515. See also, Heinrich Klüver, *Mescal and Mechanisms of Hallucination* (Chicago: University of Chicago Press, 1966). Cytowic suggests a further classification of "movement constants": rotation, pulsation, oscillation, and concentric movement. Richard E. Cytowic, *Synesthesia: A Union of the Senses*, second edition (Cambridge: MIT Press, 2002), 177–178.

> I have an F-major chord, the colors from bottom to top are: purple [F♮], yellow [A♮], tomato red [C♮]. If the chord is in first inversion, the yellow would be on the bottom.[4]

In the model proposed in the dissertation, zones constitute areas of discrete color within a harmonic coloration; however, as will be shown, zones sometimes overlap or nest within one another.

Determining the base colors of Messiaen's pcs

Messiaen sometimes indicated the coloristic effect of a single pc within a description of harmonic coloration. Such descriptions provide tantalizing clues regarding the correspondence between pitch class (pc) and color. On at least four occasions, Messiaen described C♮ as white.[5] He generally described A♮ as either pale blue or deep blue; from this, one might assign A♮ a base color of blue.[6] The pc B♮ evoked an array of colors from pink to violet: "red," "red, pink," "pink," and "red, violet;" B♮ possibly had a base color of red.[7] Descriptions for G♯/A♭ include "red," "gold," "brownish orange," and "light, clear brown"; the base color for G♯/A♭ seems to be a hue of red, perhaps a brownish red.[8] For other pcs, Messiaen's descriptions are contradictory. For example, C♯/D♭ evoked both "glowing red" and "greenish-black tarnish;" these descriptions are contradictory, because red and green are complementary colors.[9] The pc G♮ evoked both "yellow" and "white,"

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4. Interview with LH, January 15, 2002.

5. Olivier Messiaen, *Traité de rythme, de couleur, et d'ornithologie*, 7 vols. (Paris: Alphonse Leduc et Cie, 1992), V/1, 357; 457; V/2, 513; 514.

6. Descriptions of "pale blue" stem from Messiaen, *Traité*, V/1, 466; 354; V/2, 514; 513–514. A description of "deep blue" stems from *Traité*, V/2, 514.

7. Descriptions of "red" stem from Messiaen, *Traité*, V/1, 469; V/1, 470; V/1, 465; V/1, 466. Descriptions of "red, pink" stem from *Traité*, V/1, 465; 466. Descriptions of "pink" stem from *Traité*, V/1, 470; V/1, 466. A description of "red, violet" stems from *Traité*, V/1, 465.

8. Descriptions of "red" stem from Messiaen, *Traité*, V/1, 461; 469; 465. A description of "gold" stems from *Traité*, V/1, 354. A description of "brownish orange" stems from *Traité*, V/2, 567. A description of "light, clear brown" stems from *Traité*, V/1, 461.

9. Messiaen, *Traité*, V/1, 461; *Traité*, V/2, 567.

but perhaps the white could actually be an off-white, cream, or very pale shade of yellow.[10] The pc E♮ seems to have evoked dissimilar colors: red, yellow ("gold"), and blue.[11] Regarding A♯/B♭, descriptions of "violet" and "red" can be reconciled (because violet contains red), but a description of "pale green" is disparate.[12]

Of course, the above correspondences only represent a preliminary measure towards establishing Messiaen's pitch-color correspondences. A more accurate list of pc colors can be established through two related analytical procedures. The first procedure involves selecting a color and analyzing the pc content of chords that evoked that color; the aim of the procedure is to determine which pc most frequently was present when that color was evoked. Conversely, the second procedure involves selecting a pc and analyzing the coloration of chords that contain that pc; the aim is to determine which color was most frequently evoked when that pc was present. The two procedures are illustrated through an examination of Messiaen's analysis of his orchestral work *Sept Haïkaï*.[13] In the analysis, Messiaen presented several chords invented for the work and described their respective colorations, listing the colors "from high to low." The initial thirteen chords of the analysis and their descriptions are presented in Example 4.1.

The first procedure for determining pc-colors is illustrated through the examination of chords that contain yellow. By examining chords that contain yellow, one can determine to which pc yellow corresponds. Among chords 1–13, seven chords contain "yellow" in their description: 1 (at the "top" of the description), 8 (near the "bottom" of the

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10. A description of "yellow" can be found in Messiaen, *Traité*, V/1, 462. A description of "white" can be found in *Traité*, V/1, 465.

11. A description of E-natural as "red" can be found in Messiaen, *Traité*, V/1, 469. A description of E-natural as "pink" can be found in *Traité*, V/1, 466. A description of E-natural as scintillating gold" can be found in *Traité*, V/1, 466. Descriptions of E-natural as "pale blue can be found in *Traité*, V/1, 470; 355; 470. A description of E-natural as "blue" can be found in *Traité*, V/2, 514.

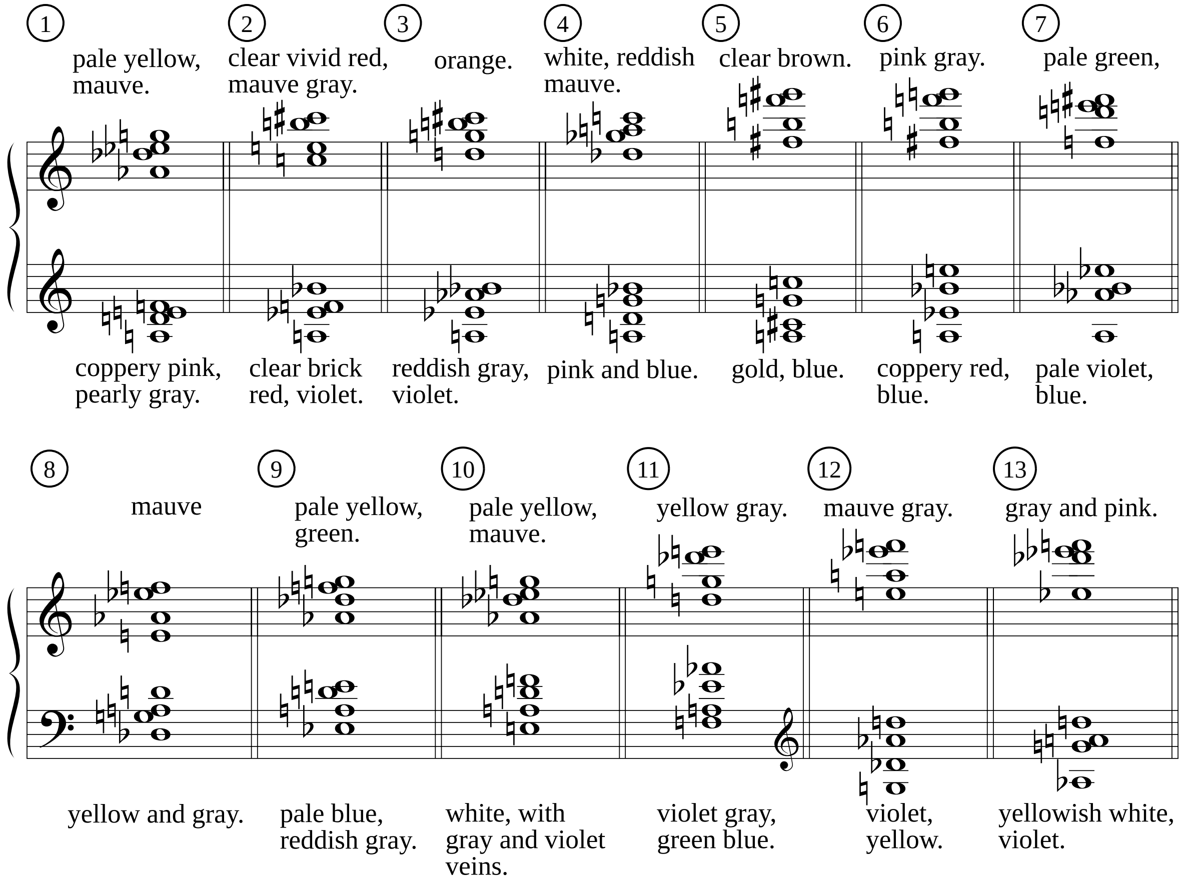
12. A description of "violet" can be found in Messiaen, *Traité*, V/1, 456. A description of "pale green" can be found in *Traité*, V/1, 461; 357–358. Descriptions of "red" can be found in *Traité*, V/2, 513.

13. Messiaen, *Traité*, 464–467.

description), 9 (at the "top" of the description), 10 (at the "top" of the description), 11 (at the "top" of the description), 12 (at the "bottom" of the description), and 13 (in the "interior" of the description). Seven pcs are common to all seven chords: G♮, D♮, A♮, F♮, A♭, D♭, and E♭; E♮ is present in six of the seven chords. (The other four pcs are absent in these chords.) Comparing the location of the color yellow within each description to the pcs in each chord, it seems that the color yellow most closely corresponds to G♮. Chords 1, 9 and 10 contain G♮ at the top of the chord and yellow at the top of the description; chord 12 contains G♮ at the bottom, with yellow likewise at the bottom of the description. Chords 8 and 13 contain G♮ in the interior of the chord and yellow in the interior of the description. Chord 11 contains G♮ in the upper part of the chord (the pitches of which evoke "yellow gray"). The list of pc colors given earlier in the chapter (which recounts Messiaen's descriptions of G♮ as "white" and "yellow") is consistent with the conclusion that G♮ evoked yellow. (Also, of the remaining chords, most of those that contain the pc G♮ but do not evoke yellow do evoke a yellowish hue. In chord 3, the pc G♮ seems to correspond to the color "orange" in the description; likewise, in chord 5, the pc G♮ corresponds to the color "gold.")

A second procedure for determining pc-colors is used in the examination of chords that contain the pc A♮. The aim of the procedure is to determine the most likely base color for A♮. In Example 4.1, A♮ is the lowest note in chords 1–7. The "lowest" colors of chords 1–7 are, respectively, "pearly gray," "violet," "violet," "blue," "blue," "blue," and "blue." The most common color is blue, which occurs in a pure form in four out of seven chords; violet, which contains blue, occurs in two chords. The "pearly gray" in the first chord could be interpreted as a very pale (practically colorless) dull blue. Therefore, it is plausible that the base color of A♮ is blue. The list of pc colors given earlier in this chapter (which suggests that A♮ evoked "pale blue, white," "pale blue" or "deep blue") reinforces the conclusion that the base color of A♮ is blue.

Example 4.1. Thirteen chords and their colors, from *Traité de rythme,* V/2, pp. 464–465.



The preceding procedures, applied to all of Messiaen's published descriptions of harmonic colorations, provide evidence for the following pitch-color correspondences:

C♮	clear
C♯/D♭	blue green
D♮	gray green
D♯/E♭	violet
E♮	gray blue
F♮	copper (red/green)
F♯/G♭	sparkle
G♮	yellow
G♯/A♭	violet
A♮	blue
A♯/B♭	violet
B♮	deep red

Most pcs correspond to a single color, but a few are equivocal. For example, C♯/D♭ (blue green), D♮ (gray green), and E♮ (gray blue) could evoke either of two colors. Within the context of a single chord, the colors of these pitches tend to align with the colors of neighboring pitches. For example, C♯/D♭ (blue green) would evoke blue when adjacent to A♮ (blue), but would evoke green when adjacent to F♮ (copper green). The base hue of F♮ is "copper"; depending on context, it evoked either copper red or copper green. If its neighbors evoked neither red nor green, the default color of F♮ was green. The pcs C♮ and F♯ were colorless.[14] I choose to relate C♮ to "clear," despite the fact that Messiaen described C♮ as "white" on a few occasions; I find much more compelling evidence that the presence of C♮ resulted in a more translucent coloration, rather than a paler coloration. The next section of the dissertation demonstrates how these base colors interacted and evoked resultant harmonic colorations.

Mechanics of harmonic coloration

In Messiaen's case, a harmonic coloration did not consist of a set of one-to-one correspondences between a chord's pcs and the respective colors of those pcs. Because harmonic coloration contain fewer colors than pcs, one may infer that the colors evoked by certain pcs either fused or did not appear. However, synesthetically perceived colors do not blend in the same way as do pigments. Color is not an immutable physical property of objects; color exists in the mind, and the perception of color is a complex neural phenomenon. For synesthetes—who experience color in a special way—color can exist independent of vision. Synesthetic perception of color seems to exist as a phenomenon

14. Cytowic has found that for certain synesthetes, not all elements of a stimulus (e.g., pitches, numbers, letters of the alphabet) evoke colors. Cytowic, *Synesthesia*, 36. My subject AF reported that for her C-natural evoked no color and is "like an empty space, like a hole in your mind." Personal interview with AF, January 9, 2002.

distinct from visual perception. My subject LH explained that while her synesthetic colors are simultaneous and homotopic, they remain distinct:

> Colors definitely do *not* mix (such as yellow and blue mixing to produce green). Rather, one color may feel “closer”—sort of like looking at two screens, one behind the other. And even though one may sense blue “behind” the yellow, the colors do not mix.[15]

Otto Ortmann, a physiologist, pianist, and former director of Peabody Conservatory, studied descriptions of pitches and dyads perceived by his subject D, an adolescent girl with color-music synesthesia.[16] In D’s perception of dyads—whose constituent pitches evoked a single, discrete color when heard individually—certain colors fused, while others did not. In other words, some dyads evoked one color (the two constituent colors fusing), while others evoked two colors (the two colors co-existing without fusing). Ortmann hypothesized that synesthetic fusion of color was related to the order of colors within the visible spectrum (red–orange–yellow–green–blue–violet). When the respective colors of a dyad’s constituent pitches lay adjacent to one another in the visible spectrum, fusion occurred, and a single color was evoked; when the two colors were not adjacent, fusion did not occur, and two colors were evoked. For example, the colors of C3 (“beautiful red”) and F3 (“very pretty orange”) fused into one color, “red-orange,” because red and orange lie adjacent in the visible spectrum. The colors of C3 (“beautiful red”) and E3 (“yellow”) did not fuse; they evoked “red and yellow,” because red and yellow do not lie adjacent in the visible spectrum.[17] Example 4.2 shows a colored-pencil drawing of a photism by Ortmann’s subject D.[18] The stimulus was the dyad C4–D4, played on the piano. For D, the pitch C4 evoked “red, nearing pink” and D4 evoked “green.” Because the two colors

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15. Interview with LH, January 16, 2002.

16. Otto Ortmann, “Theories of Synesthesia in the Light of a Case of Color-Hearing,” *Human Biology* V/2 (1933), 155–211.

17. Ortmann, “Theories of Synesthesia,” 186–190.

18. Ortmann, “Theories of Synesthesia,” plate 1.

are not adjacent in the visible spectrum, they did not fuse, and appeared in her photism as non-blending swirls. In her drawing, color-boundaries are clearly demarcated, with no actual fusion where colors meet.

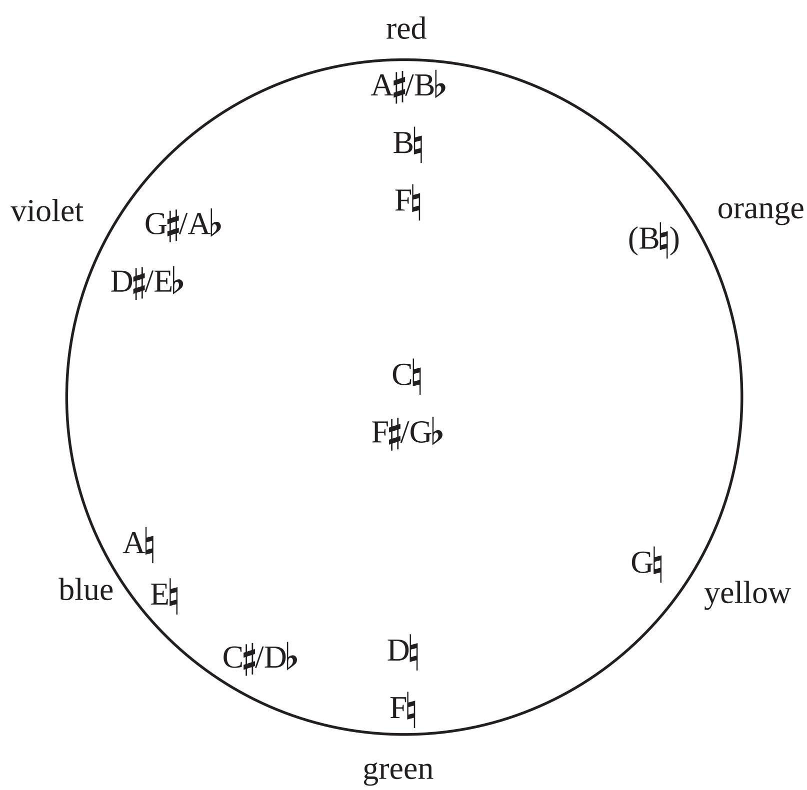
Example 4.2. Graphic depiction of photism evoked by
the dyad C4–D4, as perceived by Otto Ortmann's subject D.

On the whole, Ortmann's theory seems consistent with Messiaen's descriptions; however, it does not account for a possible fusion of red and violet—two colors which did seem to fuse for Messiaen.[19] Since red and violet lie at opposite ends of the visible spectrum, an alternate color series is needed, one that retains the order of colors within the spectrum but also places red and violet adjacent to one another. Example 4.3 illustrates a circular model that satisfies these criteria. The colors of the visible spectrum are represented in a continuum, beginning at the top of the wheel (at red) and proceeding clockwise (to violet); red and violet are now adjacent. In Example 4.3, Messiaen's ten colored pcs are positioned next to their respective colors; the pcs C♮ and F♯/G♭, which are

19. For Ortmann's subject D, red and violet fused, but not consistently. For example, the colors of C3 ("beautiful red") and A3 ("pretty purple") fused into one color, "red-violet;" the colors of A3 ("pretty purple") and C4 ("red, nearing pink") did not fuse, and evoked two colors, "purple and red." Ortmann, "Theories of Synesthesia," 186–187.

colorless and can fuse with any pc, are placed at the center of the circle. Within a chord, pc colors fuse with one another depending on their adjacent positions within the color-wheel. For example, the colors of E♮ (blue) and B♭ (red) would not fuse, because they are not adjacent in the wheel; however, the colors of E♮ (blue) and A♭ (violet) fused (and evoked blue violet), and the colors of B♭ (red) and A♭ (violet) fused (and evoked red violet).

Example 4.3. Color-wheel, with Messiaen's pc colors.



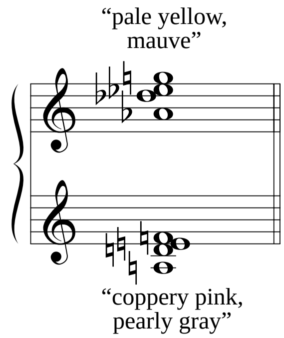
The color-wheel represents some anomalies regarding Messiaen's pitch-color correspondences. First, C♯/D♭ (blue green) is located between blue and green. The pc C♯/D♭ typically fuses with either blue pitches (E♮, A♮) or green pitches (D♮, F♮); less commonly, it fuses with violet pitches (G♯/A♭, D♯/E♭) or yellow pitches (G♮). Second, since the base color of F♮ (copper) is equivocal, it is placed at both red and green. Third, although the base color of B♮ is red, it would sometimes fuse with G♮ (yellow) and evoke orange. The placement of a parenthetic B♮ at "orange" within the color-wheel serves as a reminder of the pitch's equivocal identity. Last, despite its inclusion within the color wheel, G♮ (yellow) is somewhat inert and tends not to fuse with other colors.

The pcs C♮ (clear) and F♯ (crystal) are both colorless, and may affect any other color. C♮ clarifies other colors, making them appear somewhat translucent. F♯ causes other colors to sparkle, often resulting in gem-like quality. For example, Messiaen almost always described the tetrachord A♮–C♯–E♮–F♯ as "intense sapphire blue."[20] The pcs A♮ (blue), C♯ (blue green, but here assuming its blue identity) and E♮ (pale blue) fused into a zone of blue, while F♯ contributed a sparkling, gem-like ("sapphire") quality.

Applying the method to chords that Messiaen has already described illustrates its precision. Example 4.4 shows a coloristic analysis of the first chord of Example 4.1 (from earlier in the chapter). Messiaen described the chord's coloration as "pale yellow, mauve, coppery pink, pearly gray." In the example, the chord's pc colors are listed in a column to the immediate right of the chord. In the second column, the colors are grouped into four zones, corresponding to the four colors in Messiaen's description; for pcs with equivocal base colors, the color that is most similar to its neighbors is selected. In the lower system, the four pitch-class zones are aligned with the four colors in Messiaen's description; the colors within each zone are adjacent on the color-wheel. The yellow of the G♮ evoked "pale yellow," due to its high register. The blue of the D♭ fused with the violets of E♭ and A♭ to evoke "mauve" (a violet-like color). The F♮ (which has an equivocal identify and can evoke either green or red) here evoked a coppery pink. The grays and blues of E♮, D♮, and A♮ fused to evoke "pearly gray" (like mother-of-pearl, with swirls of gray, silver, and dull blue).

20. Olivier Messiaen, *Conférence de Kyoto*, (Paris: Alphonse Leduc, 1988), 8; Olivier Messiaen, *Musique et couleur: nouveau entretiens avec Claude Samuel* (Paris: Pierre Belfond, 1986), 69; Messiaen, *Traité*, III, 87; V/1, 354.

Example 4.4. Coloristic analysis of chord 1, from analysis of *Sept Haïkaï*, *Traité de rythme*, V/2, pp. 464–465.



pc-colors:

G♮–yellow
E♭–violet
D♭–blue green
A♭–violet
F♮–copper
E♮–gray blue
D♮–gray green
A♮–blue

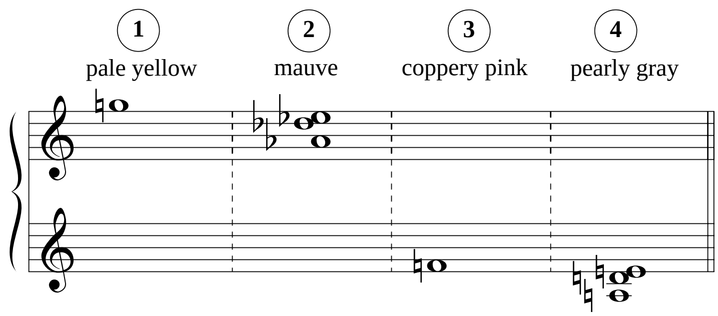
pc-colors, zoned:

G♮–yellow — 1

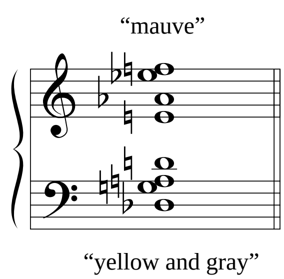
E♭–violet
D♭–blue
A♭–violet — 2

F♮–red — 3

E♮–gray
D♮–gray
A♮–blue — 4



Example 4.5. Coloristic analysis of chord 8, from analysis of *Sept Haïkaï*, *Traité de rythme*, V/2, pp. 464–465.



pc-colors:

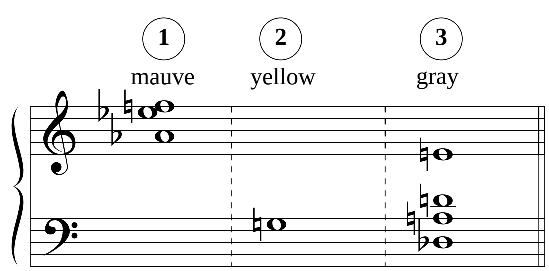
F♮–copper
E♭–violet
A♭–violet
E♮–gray blue
D♮–gray green
A♮–blue
G♮–yellow
D♭–blue green

pc-colors, zoned:

F♮– red
E♭–violet
A♭–violet — 1

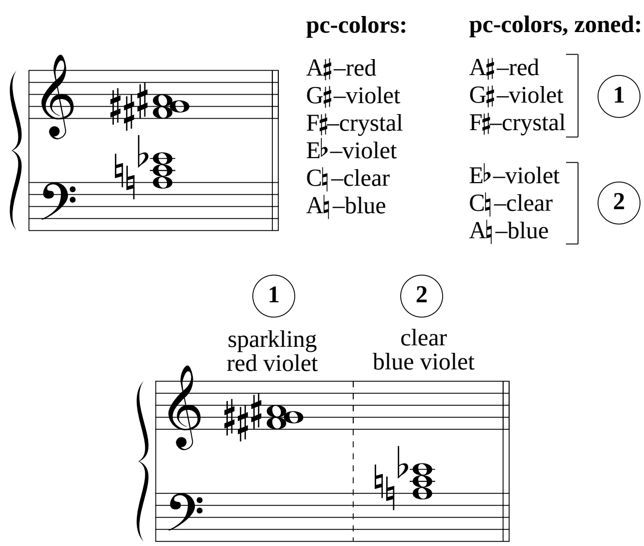
G♮–yellow — 2

E♮–gray
D♮–gray
A♮–blue
D♭–blue green — 3



Example 4.5 demonstrates how a zone may appear within another zone, using chord 8 from Example 4.1. Messiaen described the upper part of the chord as “mauve.” The lower part of the chord evoked “yellow and gray;” since in the description these two colors are not separated by a comma, I infer Messiaen meant that the lower part of the chord evoked two overlapping zones, rather than two adjacent zones. In the example, the chord’s pc colors are listed in a column to the immediate right of the chord; in the second column, the pc colors are separated into the chord’s three zones. In the uppermost zone, F♮ (equivocal, either red or green) is overwhelmed by the colors of its neighbors E♭ (violet) and A♭ (violet) and assumes its red identity; the zone as a whole evoked mauve. The pc G♮ (yellow) constituted its own zone of yellow, enveloped by the larger zone of gray that was evoked by the fusion of E♮ (gray), D♮ (gray), A♮ (blue) and D♭ (blue green). This example also illustrates the inert character of G♮—how it tends not to fuse with other pcs.

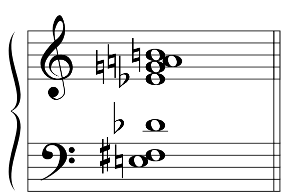
Example 4.6. Coloristic analysis of “Apparition du Christ glorieux,” phrase 2, chord 6.



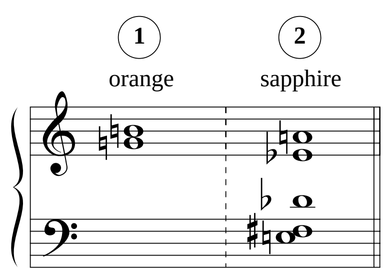
The method described here is most useful when applied to chords of unknown coloration. Example 4.6 is drawn from “Apparition du Christ glorieux” (the first movement of *Éclairs sur l'Au-Delà*). The chord's pc colors are listed in the first column, and grouped into zones in the second column. In the upper part of the chord, A♯ (red) and G♯ (violet) fuse into a zone of red violet; the F♯ (crystal) gives the zone a sparkling, gem-like quality. In the lower part of the chord, A♮ (blue) and E♭ (violet) fuse into a zone of blue violet; C♮ (clear) likely provided a clarity to the zone. The chord as a whole evoked the coloration "sparkling red violet, clear blue violet."

Example 4.7 shows a chord from "Apparition du Christ glorieux" that has overlapping zones. The chord's pc colors are listed in the first column, and grouped into zones in the second column. In the upper zone, the B♮ assumes its orange identity and fuses with G♮ (yellow) to evoke orange. The pcs in the lower zone fuse to evoke a blue coloration; the F♯ (crystal) provides the zone with a gem-like quality, resulting in "sapphire." Since the chord's two zones overlap somewhat, in the description of chord's coloration the two component colors are separated by an "and" instead of a comma. The chord as a whole evoked the coloration "orange and sapphire."

Example 4.7. Coloristic analysis of "Apparition du Christ glorieux," phrase 8, chord 10.



pc-colors:	**pc-colors, zoned:**	
B♮–red	B♮–orange	1
A♮–blue	G♮–yellow	
G♮–yellow		
E♭–gray blue	A♮–blue	2
D♭–blue green	E♭–blue	
F♯–crystal	D♭–blue	
E♮–gray blue	F♯–crystal	
	E♮–blue	



Summary

The chapter offers a predictive method by which one can ascertain the coloration of a chord for which Messiaen never gave a description. First, base colors of the twelve pcs were suggested. Then, extending the research and theories of Otto Ortmann, a topographic model of Messiaen's pc-color correspondences was presented.[21] The model is based on Messiaen's own testimony, and is supported by testimony of other synesthetes. The model allows us to provide a complete coloristic analysis of a work or passage of *musique colorée*.

21. Topographical models of pc-networks have become popular among music theory researchers. See, for example, Richard Cohn, "A Tetrahedral Graph of Tetrachordal Voice-Leading Space," *Music Theory Online* 9/4 (October, 2003). However, whereas Cohn's tetrehedral model offers a tool for an unspecified repertoire, the dissertation's circular model offers a tool for a specific repertoire.