## Introduction

Colorful Neotropical parrots were amongst the first and most frequent exotic animals to be imported by Europeans from the "New World" of the Americas, becoming key figures in what would become known as the Columbian exchange.[1] They were the first animals Columbus reported seeing upon making landfall in 1492; he would subsequently capture and bring a number back with him to Europe to present to King Ferdinand and Queen Isabella of Spain.[2] As increasing numbers of these exotic birds were ferried across the ocean to became featured residents of royal aviaries, prized pets of wealthy individuals, and specimens in natural history collections and museums, so, too, were more and more of them depicted in various media.[3] There is thus a plethora of parrots to be found in the visual record of early modern Europe.[4]

Unfortunately, the pressures of colonization and exploitation have taken a heavy toll on both bird populations and their native habitats. Parrots (Psittaciformes) have the unfortunate distinction of being the avian order with both the overall highest proportion of endangered species and the greatest total number.[5] Neotropical parrots have suffered especially heavy losses, including multiple extinctions; in the West Indies alone, one study estimated that as many as 50-60 species of endemic parrots across three genera were once extant, whereas just 12

[1] It is fully recognized that "New World" and "Old World" are inherently problematic terms and are thus used sparingly and always within the context of European perception. Unfortunately, these terms are embedded even in ornithology (e.g., New World Parrots and Old World Parrots), and are thus difficult to completely avoid. "America" and "The Americas" are used as preferred alternatives to refer to the totality of the region encompassing North America, Central America, South America, and the Caribbean; "Neotropics" specifically refers to the biogeographical region consisting of the tropical terrestrial habitats of Central America, South America, and the Caribbean. "Columbian exchange" refers to the transatlantic biological exchange which developed between Europe, West Africa, and the Americas post-1492, including wild and domesticated animals, wild and cultivated plants, and disease.

[2] For an overview of early explorers' encounters with and exportations of parrots, see Bruce Thomas Boehrer, *Parrot Culture: Our 2500-Year-Long Fascination with the World's Most Talkative Bird* (Philadelphia: University of Pennsylvania Press, 2004), especially Chapter 3.

[3] Richard Verdi and Barber Institute of Fine Arts (Birmingham), *The Parrot in Art: From Dürer to Elizabeth Butterworth* (London: Scala Publishers, 2007); Boehrer, *Parrot Culture*, Chapter 3.

[4] The term "early modern Europe" generally refers to the late 15th through the end of the 18th centuries, with exact demarcation of beginning and end dates varying according to discipline and context. For the purposes of this study, the period commences with Columbus' first voyage in 1492 and extends into the 19th century.

[5] Boehrer, 152.

species from two genera survive today.[6] The reason scholars remain uncertain over the exact numbers is that physical evidence exists for only a handful; for the rest, they must rely on interpreting evidence gleaned from the historical record.[7]

It is for these reasons that the visual record of early modern Europe is of particular interest to psittacologists.[8] There has been an ongoing effort to locate and identify images of Neotropical parrots embedded in this record, with the classification of many remaining unsettled in the scholarship. Proper identification of these images can be valuable data for reconstructing historical biogeography and transatlantic trade; especially compelling is the potential of certain "mystery parrots" in the visual record to support the existence of those still unconfirmed taxa, which may have gone extinct.

However, it is important for those engaged in this sort of scholarship to recognize the potential pitfalls of trying to assert positive identifications through these centuries-old images. As parrots are amongst the most colorfully diverse taxa of birds on the planet, often, plumage color is a key diagnostic factor in making an identification; and yet, there are a variety of reasons why the colors of any one individual's image may not be enough to confirm its scientific classification.[9] This is further complicated by the fact that color photography did not yet exist during the period in question, leaving a visual record of only artworks and print illustration to examine. Reading colors, as recorded in these images, must be approached with caution and with an interdisciplinary knowledge of both the science and art of color.

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[6] Matthew I. Williams and David W. Steadman, "The Historic and Prehistoric Distribution of Parrots (Psittacidae) in the West Indies," In *Biogeography of the West Indies: Patterns and Perspectives*, ed. Charles A. Woods and Florence E. Sergile (Boca Raton: CRC Press, 2001), 175-189.

[7] While some scholars have subsequently questioned if the 50-60 figure is too high, most seem to agree there has been significant species loss in the region. This consensus, in turn, fuels the continued interest in identifying these "lost" species, including efforts to identify parrots in art.

[8] Psittacologists are ornithologists who specialize in the study of parrots. "Psittacine" is another term for parrot, derived from Latin; the scientific name of the parrot order Psittaciformes essentially translates to "parrot-shaped," and the root can be found in number of other scientific names and associated terms.

[9] While color remains an important visual identification factor across taxa in modern ornithology, it is best considered in conjunction with morphological features; however, Kleiter notes that color was an even more important independent factor to the natural historians of the early modern period: "knowledge about unknown bird species initially depended heavily on the description of their feather colour…colour was one of the most distinctive features used to determine a bird species until the eighteenth century." Christine Kleiter, "Birds, Colour, and Feet: A 'Naïf Portrait' of the Brazilian Tanager in Pierre Belon's *L'Histoire de la Nature des Oyseaux*," *Journal of the Lucas Graduate Conference: Animals (Un)tamed: Human-Animal Encounters in Science, Art, and Literature*," issue 8 (2020): 9.

## Literature Review

### *Uneven Coverage of the Visual Record*

The pre-photographic visual record of fauna exists in two broadly defined spheres, consisting of natural history and scientific illustration, and works of fine and applied art.[10] The former is intimately linked to the birth and development of modern scientific fields of natural history and zoology, with ornithology boasting an especially rich tradition.[11] Furthermore, these works were often published, and thus, along with other forms of print illustration, were able to circulate widely in their time and still exist in multiple copies today. As such, this type of visual record has been generally well-covered in the literature, including for parrots.

In contrast, works of art outside print media generally exist as unique entities, which may, at best, have been manually copied by a few others, and thus these images were often not known beyond those with direct knowledge of that art in its time.[12] While in modern times, many of these have been digitized online and/or photographed and published, knowledge of their existence remains less widespread, with much still unexamined in scholarship. At least two recent papers have commented on the potential of such art to yield valuable natural history data about Neotropical parrots. As James W. Wiley and Guy M. Kirwan observe:

> **[A] potential source of valuable information on West Indian macaws may lie in art museums, especially in Europe.** Many parrot owners included macaws within formal portraits that hang on gallery walls. Macaws were considered prestige symbols, especially in the Renaissance, and often appear in the background or alongside their owners. Although often stylised, some depictions approximate species suggested for the West

[10] Although there has been an increasing recognition of the inherent intersectionality of science and art in general, and especially with regards to the study of zoological images, it can be generally observed that such scholarship has traditionally been focused more on either a "scientific" or "artistic" orientation, and this has impacted how parrot images have been studied. This study will therefore refer to these entrenched delineations, even while generally arguing against them in favor of a more holistic scholarly lens.

[11] See Roger J. Lederer, *The Art of the Bird: The History of Ornithological Art Through Forty Artists* (Chicago: University of Chicago Press, 2019), and Michael Thimann, "Image and Objectivity in Early Modern Ornithology," in *Images Take Flight: Feather Art in Mexico and Europe (1400-1700)* (Florence: Hirmer Publishers, 2015), 241-249.

[12] Angelica Groom, "Early Modern Natural Science as an Agent for Change in Naturalist Painting: Jacopo Ligozzi's Zoological Illustrations as a Case Study," in *Knowing Nature in Early Modern Europe* (Oxfordshire: Routledge, 2015), 139-163. It should also be recognized that some works of applied art were produced in larger quantities and thus could enjoy wider circulation and recognition similar to print media (e.g., manufactured ceramic plates and figurines).

> Indies. As Cooper & Armitage (2013) have suggested, examination of such art could prove a fertile field….[13]

Here are Joanne H. Cooper and Philip L. Armitage's referred-to remarks:

> Exotic and expensive, parrots were commonly featured in paintings of the 1500s and 1600s…. **Evidence of parrots from the art record appears somewhat overlooked, despite its potential significance in revealing early ornithological records in Europe**…. Information on trade in New World parrots seems more abundant in literature, though there is considerably more to be gleaned from historic art concerning contemporary knowledge of exotic species.[14]

Cooper and Armitage go on to report that they were recently asked by a seller to identify a colorful parrot in an illustration by Dutch artist Herman Henstenburgh (1667–1726), which had never formally been classified (Fig. 1). The well-rendered plumage colors and pattern allowed it to be confidently identified as a Sun Parakeet (*Aratinga soltitialis*), a Neotropical species which they note did not appear in formal ornithological literature until the 1730s, "but was clearly known to merchants decades earlier."[15] This provides a perfect example of how natural history data may be hidden in plain sight in works of art.

*Individual Studies*

In addition to the two papers quoted above, a review of recent literature turned up a handful of other papers which focus on identifying one or more extinct Neotropical parrots, including hypothetical extinct species, and make at least some reference to color images in the visual record as evidence.[16] Of these, a pair of 2016

[13] James W. Wiley and Guy M. Kirwan, "The Extinct Macaws of the West Indies with Special Reference to Cuban Macaw, *Ara tricolor*," *Bulletin of the British Ornithologists' Club* 133, no. 2 (2013): 149.

[14] Joanne H. Cooper and Philip L. Armitage, "A Parrot of the Caribbean? A Remarkable Find from a 17th Century Spanish Shipwreck," *Bulletin of the British Ornithologists' Club* (2013): 55-56.

[15] Cooper and Armitage, "A Parrot in the Caribbean," 56.

[16] In addition to the two papers discussed here, see also Storrs L. Olson and Edgar J. Maíz López, "New Evidence of *Ara autochthones* from an Archeological Site in Puerto Rico: A Valid Species of West Indian Macaw of Unknown Geographical Origin (Aves: Psittacidae)," *Caribbean Journal of Science* 44, no. 2 (2008): 215-222; Samuel T. Turvey, "A New Historical Record of Macaws on Jamaica," *Archives of Natural History* 37, no. 2 (2010): 348-351; and Monica Gala and Arnaud Lenoble, "Evidence of the Former Existence of an Endemic Macaw in Guadeloupe, Lesser Antilles," *Journal of Ornithology* 156, no. 4 (2015): 1061-1066.

studies are noteworthy for their specific attention to colors in the fine art record. The first is by Nelson Papavero and Dante Martins Teixeira, who focus on identifying images of endangered and extinct Blue Macaws (*Anodorhynchus* and *Cyanopsitta* spp.) in European art.[17] As this species complex is named for their unique trait of almost entirely blue plumage, that color is used as a key identification factor. They also provide an overview of the earliest known European depictions of some other species of Neotropical parrots.

Meanwhile, Marco Masseti and Cecilia Veracini's study of the zoomorphic iconography of Piri Reis' (1465-1553) famous 1513 world map gives considerable attention to the red, green, white, and black parrot icons used to denote Caribbean islands (Fig. 2).[18] Although this map originates from the Ottoman Empire, the authors cite evidence that it was likely drawn from a lost original of Columbus. In further noting that the inscription references explorer reports of observing parrots in these same four colors, the authors suggest the possibility that these may have represented real-life species now lost to the natural history record, rather than the usual assumption of just being imaginatively colored decorative icons. Of particular interest to the present study is the connection made between these parrot icons and a pair of mystery parrots from early eighteenth-century paintings with similar color combinations, which appear drawn from life (Figs. 3a, 3b). As the identity of both birds remains unresolved, the implication is that their images may well also represent lost species and thus should be further investigated.

*Monographs*

A historiographic review of extinct bird compendiums finds a series of texts which draw upon the visual record, including at least some examination of non-published works of art. Each of these texts builds upon the previous ones, often citing and responding to earlier identifications. Walter Rothchild's 1907 text *Extinct Birds* laid the foundation for the species list in the beginning of the twentieth century by collecting and revising the flurry of ornithological activity from the previous century, during which many of the still-debated hypothetical taxa were erected.[19] By the middle of the century, James Cowan Greenway's *Extinct and Vanishing Birds of the World* could offer some new evidence and critical review of

[17] Nelson Papavero and Dante Martins Teixeira, "Um Breve Histórico das Araras do Gênero Anodorhynchus Spix, 1824 (Aves, Psittaciformes," *Arquivos de Zoologia* 47, no. 1 (2016): 1-32.

[18] Marco Masseti and Cecilia Veracini, "The Zoomorphic Representations of the Pîrî Reis Map (1513)," *Anthropozoologica* 51, no. 1 (2016): 41-54.

[19] Walter Rothchild, *Extinct Birds* (London: Hutchinson, 1907).

Rothchild's earlier classifications.[20] Errol Fuller then wrapped up the twentieth century and launched the scholarship into the twenty first century with his book *Extinct Birds*, including providing thoughtful criticism of how reliable the previously cited artistic evidence is, from the point of view of a working wildlife artist himself.[21] Julian P. Hume is also a trained artist in addition to a scientist, and likewise includes his own observations on the reliability of the artistic evidence as part of his *Extinct Birds* encyclopedia, currently considered the definitive standard reference on the subject.[22] Joseph M. Forshaw's *Vanished and Vanishing Parrots: Profiling Extinct and Endangered Species* is contemporaneous with Hume's work, but as the title suggests it focuses on parrots, and as such, provides additional depth of detail relevant to this taxon.[23] Through these successive works, we can follow the evolution of thought on which extinct Neotropical parrot species are generally accepted as having once lived and which are still debated as hypothetical, and how the available visual evidence has been viewed and interpreted.

Bruce Boehrer's superb monograph *Parrot Culture: Our 2500-Year-Long Fascination with the World's Most Talkative Bird* traces the history of parrots in human culture from ancient to modern times, including their history in art and visual culture. There is also ample coverage of the period covered in the present study, including discussion of the first European contact with Neotropical parrots and their subsequent importation into Europe as part of the Columbian exchange. Boehrer covers several famous works of art which include parrots, while also providing insightful commentary on how working with live birds versus dead specimens impacted the scientific accuracy of images. While he also examines issues related to biogeography and extinction at length, there is no discussion specific to mining the visual record for evidence of extinct taxa.

Likewise, the 2007 exhibition catalog *The Parrot in Art: From Dürer to Elizabeth Butterworth*, while providing a useful history of parrots depicted in fine art, does not specifically connect this to scientific study. Of course, numerous other books exist on the general subjects of ornithological illustration and birds in art, but these respective works rarely delve into linking the two spheres.[24] A notable

[20] James Cowan Greenway, *Extinct and Vanishing Birds of the World* (New York: Dover Publications, 1967).

[21] Errol Fuller, *Extinct Birds*, Revised ed. (Ithaca: Cornell University Press, 2001).

[22] Julian P. Hume, *Extinct Birds*, 2nd ed. (New York: Bloomsbury Natural History, 2017).

[23] Joseph M. Forshaw, *Vanished and Vanishing Parrots: Profiling Extinct and Endangered Species* (Ithaca: Cornell University Press, 2017).

[24] See for example Lederer, *The Art of the Bird*, and Caroline Bugler, *The Bird in Art* (New York: Merrell Publishing, 2012).


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exception is Christine Jackson's *Bird Paintings*, a two-volume catalog of European bird paintings from the fifteenth through eighteenth centuries.[25] As an ornithologist, Jackson brings a level scientific knowledge rarely seen in art historical scholarship to provide proper identifications of the birds in each work, including many parrots. Jackson also offers keen observations on how, for much of the early modern period, working artists often were ahead of their naturalist-scientist contemporaries, both in terms of access to live exotic specimens and skill in depicting them.

### *Cataloging Projects*

One final area of emergent scholarship which is worth following is the systematic cataloging of avian taxa in art museums and other collections of art. To date, at least four major projects have been completed, each including valuable scientific identifications of Neotropical parrots. These include the Museo del Prado in Madrid; the Raphael Rooms of the Vatican Loggia; the Rijksmuseum in Amsterdam; and the collective oeuvre of early modern Dutch and Flemish still life painting.[26] Searching through these annotated collections, one can find both examples of parrots being identified by the recorded colors and ones whose identifications remain uncertain and could benefit from additional scholarly input.

## Summary of the State of the Field, Purpose of the Present Study, and Research Methodology

Overall, it can be observed that most scholarship related to Neotropical parrots in early modern European art is focused on either natural history or art history and, likewise, viewed through an either primarily scientific or artistic lens. This, in turn, means that each scholarly sphere may be reading and interpreting the all-important clues of color in fundamentally different ways. While a few sources, such as those noted above, do make a point of integrating these views, the disconnect so prevalent elsewhere is often only mentioned in passing and is rarely elaborated on beyond the offering of a few general caveats. This paper therefore aims to produce a more thorough list of scientific and artistic variables which should be considered when reading color clues to identify Neotropical parrots in early modern European art, including explanations and illustrated examples of these factors, which scholars from across fields can then refer to.

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[25] Christine E. Jackson, *Bird Painting*, 2 vols (New York: Antique Collectors Club Limited, 1994).

[26] Cano, Joaquín Gómez Cano, Gerardo Orellana Escudero, and Juan Varela Simo, *Las Aves en el Museo del Prado* (Madrid: SEO/Birdlife and Red Eléctrica de España, 2010); Giulia Caneva and Giuseppe M. Capaneto, eds, *Raffaello e l'immagine della natura* (Milan: Silvana Editoriale, 2011); Rijksmuseum, "Rijksstudio – Birds," https://www.rijksmuseum.nl/en/rijksstudio/subjects/birds; RKD – Netherlands Institute for Art History, The Segal Still-Life Project, https://rkd.nl/en/projects-publications/projects/519-the-segal-still-life-project; Sam Segal and Klara Alen, *Dutch and Flemish Flower Pieces: Paintings, Drawings and Prints up to the Nineteenth Century* (Leiden: Brill, 2020).

*Methodology*

Natural history scholarship is often focused on quantitative data extraction, related to species identification and biogeography. Meanwhile, art history scholarship is often focused on qualitative interpretation, related to subjects such as iconographic meaning and artistic intent. However, the current question of making identifications through color clues is best addressed through a holistic view of the evidence, which gives equal consideration to both the science and art of color. Scientific analysis can elucidate color variations of both biological and artistic pigments; art historical analysis can help determine the reliability of an artist's rendering of color.

This study has therefore utilized a mixed-methods approach. Quantitative data on biological pigmentation and species identification in parrots was collected, along with quantitative data on artistic media and pigments. Qualitative analysis relating to art and artists was also compiled. This research was then synthesized to generate a checklist of essential biological and artistic factors to consider when attempting to make identifications. These findings are presented below.

## Results and Analysis

*Biological Considerations*

### Understanding Parrot Color Biology

To properly use color as a diagnostic factor in identification, it is important to have a basic understanding of the various ways parrots produce and express these colors.[27] Parrot color is generated through two primary mechanisms –biological pigments and structural colors. These colors, in turn, not only vary between species, but can also vary within a single species for a number of reasons, as discussed below. The sheer number of color variations, both natural and bred, present within this taxon can make identification of individual images inherently difficult; it is therefore important to keep in mind that an unrecognized color pattern in any one individual bird image may not, in and of itself, represent an extinct species.

### Biological Pigments

Parrots possess two main classes of biological pigments (Fig. 4a). The first are melanins, one of the most common pigments in nature and the same pigment responsible for our own variety of skin and hair colors. As with humans, these melanins are primarily responsible for a range of blacks, greys, and browns in birds, as well as some ruddy reds and sandy yellows. The second group of pigments are known as psittacofulvins. These pigments are unique to parrots and are responsible for a range of bright reds, oranges, yellows, and pinks. In most other birds, these

[27] See Geoffrey E. Hill and Kevin J. McGraw, eds, *Bird Coloration* (Boston: Harvard University Press, 2006). This is currently considered the standard scientific reference in the field. This two-volume work provides detailed discussion and quantitative data on multiple aspects of bird coloration relevant to the present study, including the unique aspects of parrot plumage color. Unless otherwise noted, the information provided in this section is supported by this text.

colors are produced by carotenoids, a different class of pigments, which are obtained through diet; in contrast, parrots synthesize their own psittacofulvins.[28] This means that these colors are generally more consistent and reliable in parrots than in other birds, where they may vary more by type and quality of diet.

**Structural Color**

No form of blue is known to exist as a pigment in bird feathers; in fact, amongst all the vertebrates natural blue external body pigment has only ever been confirmed in two closely related species of dragonet fish (*Synchiropus spp.*).[29] This means that even the bluest blue bird you have ever seen is not really blue at all – an unsettling fact which can be confirmed by taking a single blue feather and backlighting it, revealing a feather which is usually just a dull grey.[30] The blue we usually see is therefore not a biological pigment, but rather, the result of the feather's particular structure refracting light just the right way to bounce back blue to our eyes, similar to why the sky and ocean also appear blue at times (Fig. 4b).

Similarly, green as a feather pigment is incredibly rare in birds, known in only a handful of taxa.[31] And yet, green is by far the most common color present across the Psittaciformes. In this case, a combination of pigment and structure is usually at play, as blue structural color is overlaid with yellow psittacofulvins to produce a green effect.[32] Deep purples are often created in a similar color-mixing way, with blue structural color and red psittacofulvins.

A second type of structural color is iridescence, as can be observed in the scintillating feathers of male peacocks and hummingbirds. Here, the feather structure is bending light in such a way as to produce a shimmering effect, which

[28] Other notable exceptions include Penguins (Spheniscidae), who synthesize their own unique yellow pigments (spheniscin), and Turacos (Musophagidae), who synthesize unique red pigments (turacin). As noted below, Turacos are double exceptional for also being amongst the very few birds with a biological green pigment (turacoverdin, again unique to them).

[29] Joseph T. Bagnara, Philip J. Fernandez, and Royozo Fujii, "On the Blue Coloration of Vertebrates," *Pigment Cell Research* 20, no. 1 (2007), 14-26. Note this only refers to external body pigmentation; bird eggshells are known to have additional biological pigments, including biliverdin, which can give a blue hue.

[30] The dull grey present in the feather is melanin, which as previously described is a biological pigment, but in this case is also part of the structural color plan.

[31] These include the porphyrin-based greens of the Northern Jacana (*Jacana spinosa*), Blood Pheasant (*Ithaginis cruentus*), Crested Wood-Partridge (*Rollulus rouloul*), Eider Ducks (*Somateria* spp.), and Pygmy Geese (*Nettapus* spp.), as well as the previously mentioned turacoverdin greens of Turacos. As with blue, eggshells are again a different story, as biliverdin can also give a green hue to these.

[32] In some cases, an olive-green hue may also be produced through a grizzled combination of black and yellow pigments.

can also change color, depending on viewing angle (Fig. 4c). Even in the case of non-iridescent structural colors, there can be variation, depending on the type and intensity of light source. This means that the blues and greens of parrots may not always be perceived the same in different environments – and therefore not recorded the same way by different artists.

**Interspecific and Intraspecific Variation**

We can use color to help identify parrots because of naturally occurring interspecific variation – that is, variation between species. However, intraspecific variation, or variation within the same species, can also occur. While conspicuous sexual dichromatism is uncommon amongst parrots, it is not unheard of, and in fact in some cases can be quite extreme, as with the Eclectus Parrot (*Eclectus roratus*) (Fig. 5).[33] The striking color difference between males and females of this Australasian parrot led Europeans to initially mistake them for two separate species.[34] Likewise, juvenile birds may have different color patterns than adults, and adults may have different colors between seasons. Each of these variables of sex, age, and seasonal molt need to be taken into consideration when attempting to identify a potentially new taxon from a single specimen or visual record.

**Morphs and Mutations**

Perhaps the trickiest forms of intraspecific variation, which have caused the most confusion to casual birders and ornithologists alike, are color morphs and mutations. Polymorphism is found in varying degrees in different bird taxa; it is, for example, well known in the Hawks (Accipitridae) in the form of light and dark morphs of some species. Just as human populations can have natural variations in skin, hair, and eye color, so too can these bird populations exhibit more than one common color phenotype. However, the Psittaciformes have one of the lowest recorded rates of polymorphism, exhibited in only about 1% of species (Fig. 6).[35] There is thus less concern about color morphs causing confusion in the visual record for parrots than most other avian orders.

Unfortunately, the same cannot be said for color mutations. As with all other birds, parrots can exhibit a range of genetic mutations, which can alter the

[33] Mathew L. Berg and Andrew TD Bennett, "The Evolution of Plumage Colouration in Parrots: A Review," *Emu-Austral Ornithology* 110, no. 1 (2010): 10-20. "Sexual dichromatism" refers to a discernable difference in color between males and females.

[34] Joseph M. Forshaw, *Parrots of the World* (Princeton: Princeton University Press, 2010).

[35] Paolo Galeotti, Diego Rubolini, Peter O. Dunn, and Mauro Fasola, "Colour Polymorphism in Birds: Causes and Functions," *Journal of Evolutionary Biology* 16, no. 4 (2003): 635-646.

expression of their color in various ways.[36] These include melanin-based mutations where all or part of a bird appear lighter or darker than usual, including the extremes of all white (some forms of leucism and albinism/hypomelanism) and all black (hypermelanism) (Fig. 7a). Similar to carotenoid pigments in other birds, parrot psittacofulvins can also exhibit mutations leading to abnormal amounts of yellow (xanthism/axanthism) or red (erythrism) (Fig. 7b). Mutations which impact melanin and/or other structural components of feathers can also alter the expression of blue and/or iridescence; likewise, the expression of green can be altered by mutations impacting the yellow pigment and/or blue structural color layers (Fig. 8a). Further complicating the matter of morphs and mutations is the fact that, in addition to the kinds naturally present in the wild gene pool, humans have exploited these genetics through selective breeding in captivity to produce an even greater variety of color combinations in aviculture (Fig. 8b).[37]

Consider the case of the "George Edwards Parrot" (Fig. 9). The identity of this Jamaican parrot, known only from this single 1764 watercolor by British ornithologist George Edwards (1694-1773), has long been debated. While some have suggested it may represent a now-extinct Neotropical species, others argue that it is more likely just an aberrant individual with an erythristic color mutation.[38] Without the original specimen to examine, and without any other similar physical specimens or images to connect it to, the true identify of this parrot may forever remain a mystery.

**Hybridization**

A similar problem is presented by the existence of hybrids. Hybridization is relatively common in parrots, with numerous types documented in both nature and captivity (including standardized breeds which circulate in the pet trade).[39] In

[36] Hein Van Grouw is a recognized authority on color aberrations in birds and has written extensively on the subject; see especially Hein Van Grouw, "What Colour is That Bird," British Birds 106 (2013): 17-29, which encapsulates his previous work and provides an all-in-one reference for identifying avian color mutations.

[37] For an overview of color mutation genetics in both wild and captive populations see Terry Martins, *A Guide to Colour Mutations and Genetics in Parrots* (Queensland: ABK Publications, 2002).

[38] See Fuller, *Extinct Birds*, and Julian P. Hume and Hein van Grouw, "Colour Aberrations in Extinct and Endangered Birds," *Bulletin of the British Ornithologists' Club* 134, no. 3 (2014): 168-193.

[39] Eugene M. McCarthy, *Handbook of Avian Hybrids of the World* (Oxford: Oxford University Press, 2006); Serge Dumont, Bird Hybrids Database, 2003-2020, http://www.bird-hybrids.com/introduction_en.php.

addition, parrots have one of the highest rates of intergeneric hybridization.[40] Furthermore, while infertility is common amongst hybrids in general, there are a number of parrot hybrids which have proven fertile, which has resulted in cases of secondary or even tertiary hybrid strains (Fig. 10).[41] Hybrids usually exhibit color patterns which are either intermediate between the two parents or a combination of color patterns from each parrot (Fig. 10).[42] For example, the parrot depicted in two separate paintings by Flemish artist Jan Davidsz de Heem (1606 - 1684), though often identified as either a Scarlet Macaw (*Ara macao*) or Green-winged Macaw (*Ara chloroptera*), could possibly be a hybrid of the two, known as a Ruby Macaw, based on the feather coloration depicted (Fig. 11).

**Understanding Parrot Biogeography**

Yet another factor which must be considered when attempting to identify Neotropical parrots is their biogeography, and especially, human interference with and uncertainty of their natural range and distribution. Europeans did not initiate the parrot trade, but rather entered an existing system of widespread regional trade amongst Indigenous Americans; parrots had long been transported from region to region on the mainland as well as shipped to the Caribbean islands.[43] This means that, when confronted with a bird image whose colors do not seem to match any known species in its presumed locale, that one must also consider the possibility that it was a transplanted bird, making it necessary to cross-reference it with all other known Neotropical parrots.

A further complication arises from the fact that the Americas were not the only "new world" for Europeans during this time, and exotic parrots were simultaneously being imported from Africa, Asia, and Australasia – and it was not always clear to those on the receiving end where their particular parrot had come from.[44] While some of the more popular imports are easily recognizable as endemic to only one region, such as the Macaws (*Ara* spp.) of the Americas and the Cockatoos (Cacatuidae) of Australasia, many other smaller parrots have similar

[40] "Intergeneric hybridization" refers to hybridizing across the genus level, which is a more distant relation than across species. See Peter R. Grant and B. Rosemary Grant, "Hybridization of Bird Species," *Science* 256, no. 5054 (1992), 193-197.

[41] McCarthy, *Handbook of Avian Hybrids of the World*, 121-142.

[42] McCarthy, 121-142.

[43] Marcy Norton, "Going to the Birds: Animals as Things and Beings in Early Modernity," In *Early Modern Things: Objects and Their Histories 1500-1800 [2nd Ed.]*, ed. Paula Findlen (Oxfordshire: Routledge, 2021), 53-83.

[44] Pamela H. Smith and Paula Findlen, "Commerce and the Representation of Nature in Art and Science," in *Merchants & Marvels. Commerce, Science, and Art in Early Modern Europe*, (Oxfordshire: Routledge, 2002), 1-25.

looking counterparts in other parts of the world.[45] It may therefore be necessary to consider the possibility that an unidentified parrot may not be from where its written record claims, and to consult global field guides accordingly. Furthermore, while a parrot's point of origin can sometimes be deduced from how its image was recorded in maps, travelogues, natural history texts, etc., parrots depicted in fine arts were often subjected to a more fanciful placement. It is not uncommon to find Neotropical parrots painted alongside birds from other parts of the world, and/or placed in foreign geographies, as in the case of the unidentified Macaw (probable *Ara* sp.) depicted alongside an African Grey Parrot (*Psittacus erithacus*) in the sixteenth century Florentine fresco *Tribute to Caesar* (Fig. 12).[46]

## *Artistic Considerations*

### Artistic Medium

Bird colors have been depicted via a variety of artistic media, including tempera, watercolor, oil, and ink. Each of these materials present with their own unique color qualities, including inherent differences in the range of colors available, hue and saturation, and level of detail achievable.[47] These factors should all be considered when reading these colors for identification purposes.

Just as biology is essential to understanding the colors of living birds, so too is chemistry essential to understanding the colors of artist pigments. Different pigments exhibit a wide range of susceptibility to fading and change, depending on their chemical makeup, which can be exacerbated by both time and environmental conditions.[48] For example, a pair of studies by David Saunders and Jo Kirby report that volatile red and lake yellow pigments were among the most common pigments

[45] See Forshaw, *Parrots of the World*.

[46] Here too we find another case of a mystery parrot whose exact identity remains uncertain – for a discussion of its possible identity see Marco Masseti, "New World and Other Exotic Animals in the Italian Renaissance: The Menageries of Lorenzo Il Magnifico and His Son, Pope Leo X," in *Naturalists in the Field*, ed. Arthur MacGregor, (Leiden: Brill, 2018), 40-75.

[47] For a detailed examination of different types and qualities of pigments, see National Gallery of Art, *Artists´ Pigments: A Handbook of Their History and Characteristics,* 4 vols (London: Archetype Publications, 2012), as well as the scholarship of John Gage, including *Color and Culture: Practice and Meaning from Antiquity to Abstraction* (Los Angeles: University of California Press, 2012); *Color and Meaning: Art, Science, and Symbolism* (Los Angeles: University of California Press, 2000); and *Colour in Art* (London: Thames & Hudson, 2006).

[48] See sources cited in previous footnote for general information in addition to the two specific case studies cited here.

in early modern European art, and that certain green pigments from this same time are also prone to degradation – all colors important for parrot identification.[49]

**Artistic Process**

In addition to considering the artistic medium used and its inherent chemical properties, it is also important to identify the artistic process used to create the image. Was the image both created and colored by the hand of single creator, such as an oil painting? Was the image printed from an artist's original and then hand-colored by others? Was it inked on a printing press? Each of these processes results in a different level of accuracy and reliability in terms of color.

For example, Jackson explains that hand-coloring of zoological illustrations was common throughout the early modern period, wherein the original artist's work would be used as a template for an outside workshop of artists to copy as they colored in individually printed texts – with varying degrees of skill and accuracy.[50] It is further noted that books were sometimes printed uncolored for the patron to color in themselves if desired, using the text descriptions as a guide. One such case is highlighted by Christine Kleiter, who investigates Pierre Belon's (1517–1564) illustration of the brilliant red Brazilian Tanager (*Ramphocelus bresilius*) in his *L'Histoire de la Nature des oyseaux* (1555).[51] A small portion of these books were hand colored, and the author reports that in the 11 colored versions tracked down of this image, "the colouring is not always homogenous throughout, and the quality of it varies;" it is further observed that one colorist, "seems to take the accentuation of the red too seriously and also colours the legs in red, although the text explicitly says that they should be black, along with the wings and tail" (Fig. 13).[52]

**Artist Degree of Separation from Original Specimen**

Related to the above is the idea of what relationship the individual(s) who created and colored the original image had to the bird it depicts. A first-hand observation of a live specimen would seem ideal; however, we know that relatively few artists had this degree of access and privilege.[53] Even those who did see the

[49] David Saunders and Jo Kirby, "Light-Induced Colour Changes in Red and Yellow Lake Pigments," *National Gallery Technical Bulletin* 15, no. 1 (1994): 79-97, and "Sixteenth-to Eighteenth-Century Green Colours in Landscape and Flower Paintings: Composition and Deterioration," *Studies in Conservation* 43, no. sup1 (1998): 155-159.

[50] Christine E. Jackson, "The Painting of Hand-Coloured Zoological Illustrations" and "The Materials and Methods of Hand-Colouring Zoological Illustrations," *Archives of Natural History* 38, no. 1 (2011): 36-64.

[51] Kleiter, "Birds, Colour, and Feet."

[52] Kleiter, 20-21.

[53] Groom, "Early Modern Natural Science."


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bird alive may not have created the image contemporaneously, but instead, worked from memory or study sheets. Working from a preserved specimen was a more common occurrence, especially amongst early scientists who, as noted above, rarely had direct access to royal menageries and other wealthy exotic pet owners that court artists did. As Boehrer also points out, taxidermy was still a crude science during much of this period, and specimens were often just legless skins stuffed and mounted in unnatural ways, with eyes missing or approximated with buttons.[54] Furthermore, depending on the age of the specimen and its condition, its colors may have faded.[55] Still others created images without the benefit of seeing the bird in any form, alive or dead; instead, they may have copied someone else's image, or created the image based upon a written or verbal description. For example, several of the parrot images in Rothchild's 1907 text were not painted based on actual specimens, but rather were reconstructions of hypothetical extinct species, based solely on sketchy descriptions from historical texts (Fig. 14).

**Artist Skill**

Individual artists clearly possess a wide range of skill in their ability to accurately render a real-life animal, and this includes those artists who depicted parrots. Knowing the history and reputation of a given artist can go a long way in determining the scientific reliability of any given parrot image created by their hand. For example, bird art became a genre unto itself in the Dutch Golden Age, with artists such as Melchior D'Hondecoeter (1636-1695) renowned for their lifelike portrayals of their avian subjects (Fig. 15).[56] Their art is noteworthy for both the number of birds (including parrots) depicted and the scientific accuracy of the depictions.[57] Jan Brueghel the Elder (1568-1625) is singled out by scholars as exemplary in this respect; it has been observed that he used his art to convey an up-to-date knowledge of bird species and exclusive access to living specimens, which rivaled or even surpassed the knowledge of contemporary ornithologists.[58] It is noted he did this by incorporating images of birds still new or not yet known to

[54] Boehrer, Chapter 4.

[55] For a discussion of how taxidermy bird specimens may experience color fading, see Stéphanie M. Doucet and Geoffrey E. Hill. "Do Museum Specimens Accurately Represent Wild Birds? A Case Study of Carotenoid, Melanin, and Structural Colours in Long-Tailed Manakins *Chiroxiphia linearis*," *Journal of Avian Biology* 40, no. 2 (2009), 146-156.

[56] Marrigje Rikken, *Melchior D'Hondecoeter: Bird Painter: [Exhibition, Rijksmuseum, Amsterdam, 27/05/2009-26/10/2009]* (Amsterdam: Rijksmuseum, 2008).

[57] See analyzed examples in Jackson, *Bird Painting*.

[58] See especially the scholarship of Arianne Faber Kolb and Marrigje Rikken listed in the bibliography for detailed analysis of the ornithological knowledge embedded in Brueghel's works.

science and depicting them in multiple poses, rather than a single profile common in widely copied pattern images (Fig. 16). His art thus presents an important resource in the search for parrots in the visual record, including possibly extinct species; in fact, at least one such find has been recently reported.[59]

**Artist Intent**

When it comes to the concept of image accuracy, scholars have observed that there came to be fundamentally different ideals which developed in natural history and scientific illustration versus fine art, leading to a divergence in representational styles between the two spheres.[60] Whereas the artist was often concerned with depicting an individual bird, the scientific illustrator was charged with depicting a typical representative of its species.[61] Therefore, in the former, we may find a depiction of a single subject which is more lifelike, but also more prone to depicting a case of nontypical coloration previously described (Fig. 11), whereas with the latter, we may find a constructed composite rendering, which nonetheless accurately maps out color patterns in such a way as to make its identification easy (Fig. 5). As Jackson notes, it was not until the nineteenth century that there was any concerted effort to reunite the ideals of art and science into a single ornithological illustration, exemplified by the works of John James Audubon (1785-1851) (Fig. 17), and specifically in the case of parrots, Edward Lear (1812-1888), who made a point of depicting of living birds when almost everyone else was painting dead specimens (Fig 18).[62]

Whether an image was meant to depict an individual bird or the usual appearance of a species in general is but one form of artistic intent which needs to be considered when evaluating an unidentified parrot image. Even before the flood of new exotic parrots from the "Age of Discovery" appeared on the continent, parrots already had a long history in the visual record of Europe. Though never a native bird in recorded history, a few species had been known and imported from

[59] For the report of a possibly undescribed parrot species in a Brueghel painting, see Paul J. Smith, "Sympathy in Eden. On *Paradise with The Fall of Man* by Rubens And Brueghel," in *Spirits Unseen: The Representation of Subtle Bodies in Early Modern European Culture* (Leiden: Brill, 2008), 211-244.

[60] Horst Bredekamp, Vera Dünkel, and Birgit Schneider, eds. *The Technical Image: A History of Styles in Scientific Imagery* (Chicago: University of Chicago Press, 2019); Thimann. "Image and Objectivity in Early Modern Ornithology;" Jackson, *Bird Painting*, vol. 2 introduction.

[61] Jackson, *Bird Painting*, vol. 2 introduction.

[62] Boehrer, 93-96. Even Audubon was usually working with dead specimens; his innovation was to use a system of wires to pose them based on his observations of living birds, and to depict dynamic action in natural environments.

parts of Asia and Africa since ancient times.[63] Those parrots became part of the language of artistic iconography, employed as decorative elements, map icons, symbols of exotica, and later, as religious symbolism, becoming associated with the Virgin Mary in particular.[64] When the first Neotropical parrots were observed by Europeans, they were clearly recognized as parrots; in fact, they were at first considered evidence that Columbus had in fact found a route to India, which was known for its parrots.[65] As such, they could be easily integrated into these existing iconographic systems.[66] However, it was soon realized that some taxa, especially the large multicolored Macaws, were quite different from any parrots ever known before, and thus, they also quickly developed their own symbolic meanings.[67] They became icons on maps of the Americas and symbols of the "New World" in general (Figs. 19, 20); their relative rarity and much-admired beauty also made them symbols of royalty and of conspicuous consumption for wealthy classes (Fig. 11).

What all of this leads to is the realization that it was not always the intent of the artist to accurately represent the form and colors of a real, living bird. Any parrot image outside the realm of strictly scientific illustration should therefore also be evaluated from an art historical perspective, to determine if the bird was meant to be purely imaginative or decorative or otherwise highly stylized; if it was meant to primarily serve as an icon, emblem, or symbol; if its colors were in any way altered or exaggerated for the purposes of color symbolism; and so on.

For example, consider the following case of two early European maps of the Americas. As noted by Wilma George's classic study of animals on maps, cartographers were often quick to incorporate images of newly discovered animals into maps, and this was no exception for Neotropical parrots.[68] We thus find the earliest known European artistic representation of Neotropical parrots in the Cantino Map of 1502 (Fig. 19). Here, we see three Scarlet Macaws (*Ara macao*) are used to designate Brazil, which had been dubbed "the land of the parrots" by the Portuguese soon after first landing on the coast of Brazil in 1500.[69] These

[63] Boehrer, Chapter 1.

[64] Boehrer, Chapters 1-2; Verdi, *The Parrot in Art*.

[65] Boehrer, 51.

[66] Boehrer, Chapter 3; Verdi, *The Parrot in Art*.

[67] Ibid.

[68] Wilma George, *Animals and Maps* (Berkeley: University of California Press, 1969), chapter III.

[69] Alida C. Metcalf, "Parrots and Trees," in *Mapping an Atlantic World, circa 1500* (Baltimore: Johns Hopkins University Press, 2020), 97; Boehrer, 51-2.

parrots, while somewhat cartoonishly drawn, are nonetheless easily recognizable from their well-marked plumage pattern. George also observes how these strikingly colored New World parrots were juxtaposed with the representations of duller African Grey Parrots (*Psittacus erithacus*) and Senegal Green Parrots (*Poicephalus senegalus*) across the ocean in Africa. Furthermore, Alida C. Metcalf comments that the way the illuminator "posed the birds in three different ways and paid attention to the curvature in their beaks, the holding of their heads, and the coloring of their feathers," suggests that these birds were able to be observed in real life, a scenario which Metcalf notes is entirely plausible, given that sailors had brought back live individuals to Lisbon from the 1500 Brazil expedition.[70]

Metcalf contrasts this with the four parrots used to denote Brazil on the Caverio Map from c.1506 (Fig. 20). It is observed that this group of is more stylized and less detailed than the previous group, as well as reduced in size, although certain features such as the curved beaks, individual poses, and red body feathers are retained. However, unlike the clearly articulated bright bands of color on the wings and tails of the earlier parrots, here, the colors are muted and less defined, with washed out tips which appear to have the faintest tinge of blue upon close examination. Metcalf suggests that it was far less likely that the Caverio mapmakers had yet seen live macaws in Genoa and that these parrots were instead simply lifted from the Cantino map as an iconographic device. This claim is bolstered by the fact that increasingly derived parrot icons continued to appear on maps of the Americas throughout the rest of the century. On the other hand, the lack of yellow banding on the wings could also have been a crude attempt to depict a second species of macaw, the Green-Winged Macaw (*Ara chloropterus*), which, despite the name, has mostly blue on its wings (Fig. 10). Unfortunately, in this case, the reliability of these parrot images is impacted by multiple factors previously discussed, including faded pigments, probable lack of direct observation, copying, and iconographic stylization, making this a poor choice upon which to base a real-life species identification. They therefore should not be taken as credible evidence that mostly red parrots with grey or bluish wings and tails once lived in Brazil!

## Suggestions for Further Studies and Conclusion

It is important to keep in mind that most of the hypothetical extinct taxa still contested today originated in the ornithological works of the nineteenth century, which, as Hume cautions, were often the result of overzealous taxonomists looking to have as many new species as possible credited to their name.[71] While some of the visual evidence they cited in doing so has ultimately been accepted as credible to modern ornithologists, others remain contentious when re-evaluated under modern criteria, such as described in this study. On the other hand, there is much

[70]Alida C. Metcalf, "Parrots and Trees," 95.

[71] Hume, *Extinct Birds*.

in the early modern European visual record which remains underexplored, especially in fine art, and thus there is potentially valuable evidence still waiting to be uncovered which could corroborate the existing evidence, or perhaps even present evidence of entirely unknown taxa. Even uncovering new images of already known taxa can be valuable data, as they can be utilized in the continuing effort to reconstruct historical biogeography and trace the origins and development of the Columbian exchange which was the catalyst for so much biodiversity loss.

Furthermore, the search for Neotropical parrot imagery should be extended into analyzing works in the Indigenous American visual record. As native species, parrots were part of the zoomorphic iconography of many Neotropical cultures, both before and after conquest; in addition, there is much physical evidence embedded in their elaborate featherwork pieces which remains poorly studied. It should be further noted that these problems and potential solutions are equally relevant to the study of parrots from not just the Neotropics, but also all the regions of Africa, Asia, and Australasia which Europe was also exploring – and subsequently exploiting – during this same period. This can be extrapolated even further into considerations of any number of other fauna and flora depicted in art for which the natural history record remains incomplete.[72]

The annotated list of caveats produced by this study is intended to emphasize how art historians and natural historians alike should cautiously approach the game of "historical birding" and how efforts to identify taxa in the visual record are best conducted through an informed interdisciplinary lens, especially when it comes to the subject of color. While it is certainly tempting to see an otherwise unidentifiable image of a parrot with plumage colors which match no known species as evidence of one of the "lost" species of the Neotropics, it is important to recognize the many variables at play which can result in the likeness of any one individual not being typical for its species. It is only through this careful consideration of both the art and science of color that images of Neotropical parrots imported into Europe can be properly read and evaluated for inclusion in the natural history record.

[72] For example, primatologists have taken a similar special interest in exploring the visual arts of early modern Europe beyond the realm of traditional natural history and scientific illustration. Their reasons are much the same; together, parrots and primates were by far the most common exotic animal exports of the Columbian exchange, and they likewise suffered similar population declines and extinctions because of this exploitation.

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## ILLUSTRATIONS

**Fig. 1:** Herman Henstenburgh, *A Sun Conure Parrot and a Yellow-Backed Oriole*, n.d. (artist active 1682-1726). This work was given its present title after species identification in Cooper and Armitage (2013).
RKD / Galerie Alexis Bordes, Paris
https://rkd.nl/explore/images/243397

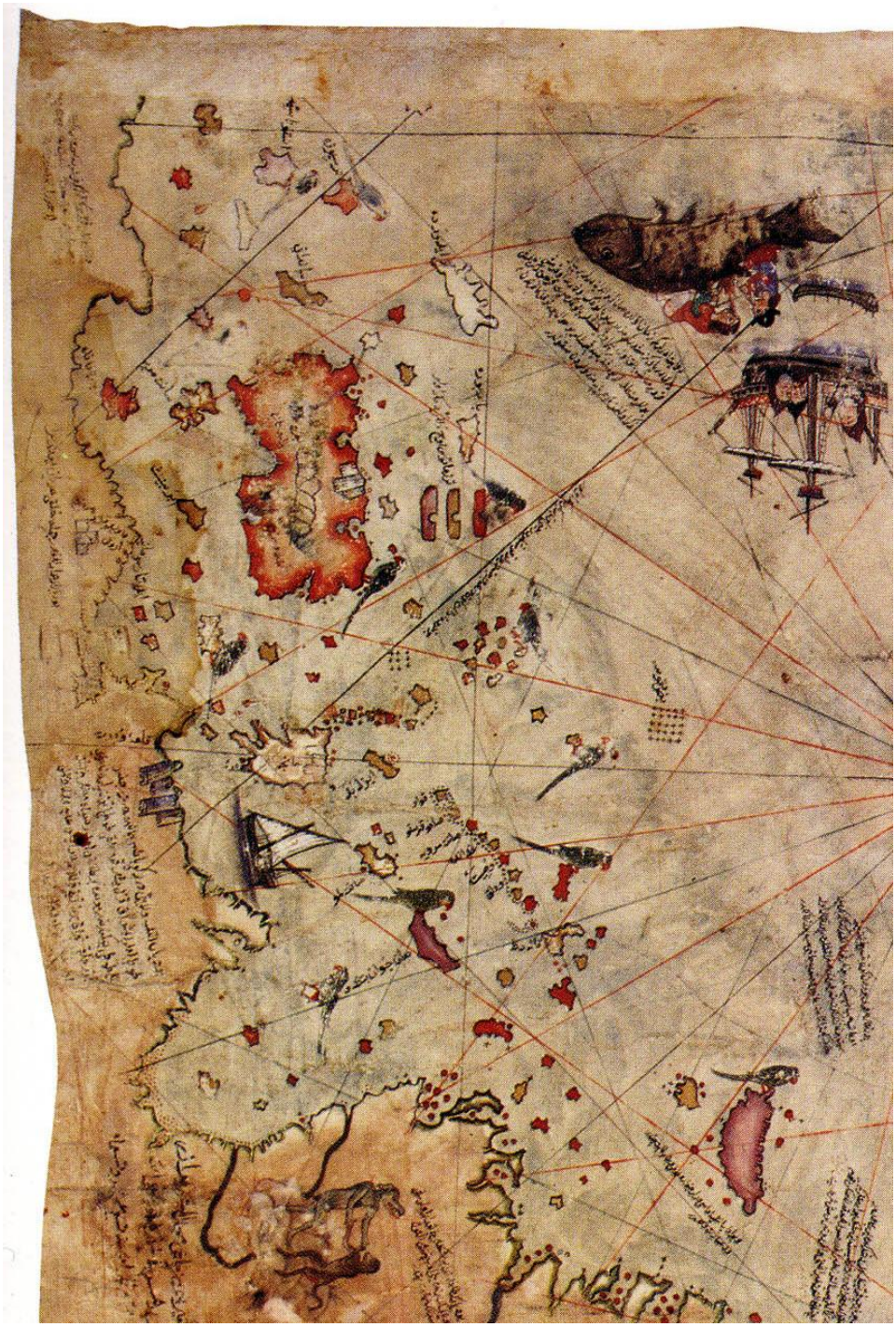


**Fig. 2:** Detail of parrot icons in upper left quadrant of the Piri Reis Map, 1513. Topkapı Palace, Istanbul, Turkey
https://commons.wikimedia.org/wiki/File:Piri_reis_world_map_01.jpg

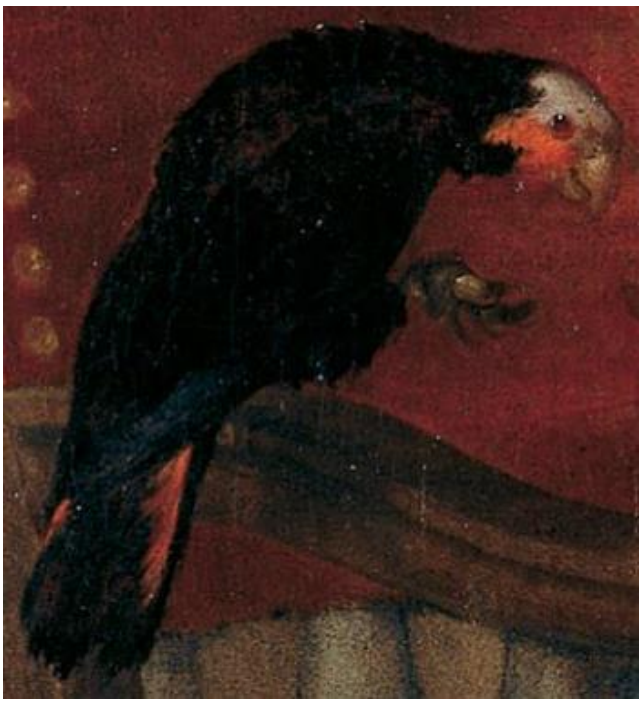
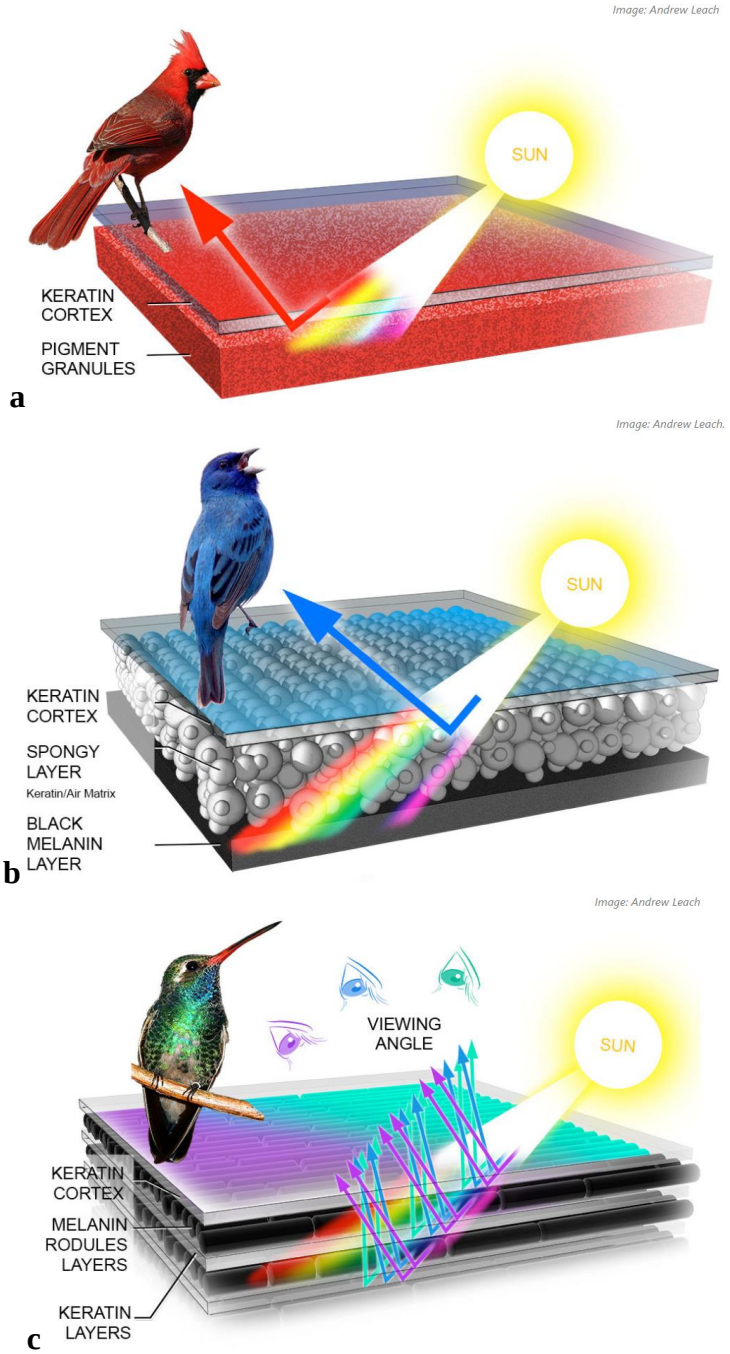


**Fig. 3a:** Detail of unidentified parrot in Anthony van Dyck, *Portrait of Paolina Adorno Brignole-Sale*, 1627.
Musei di Strada Nuova, Genova
https://artsandculture.google.com/asset/paolina-adorno-brignole-sale-anton-van-dyck/SwHpxHf-WFph0w

**Fig. 3b:** Detail of unidentified parrot in Bartholomeus van Bassen and Esaias van den Velde, *Renaissance Interior with Banqueters*, 1618/1622.
North Carolina Museum of Art, Raleigh
https://artsandculture.google.com/asset/renaissance-interior-with-banqueters/4AFf1S7jP-vDMQ




**Figs. 4a, 4b, 4c:** The optics of feather coloration via biological pigments, simple structural color, and iridescent structural color.
https://academy.allaboutbirds.org/how-birds-make-colorful-feathers/
(Cornell Lab of Ornithology)


**Fig. 5:** A male (green) and female (red) Eclectus Parrot (*Eclectus roratus*), an Australasian species which exhibits extreme sexual dichromatism. Illustration by W. M. Hart in John Gould, *The Birds of New Guinea and the Adjacent Papuan Islands*, Volume 5, 1875-1888, Plate 32. https://www.biodiversitylibrary.org/page/53881910 (BHL)

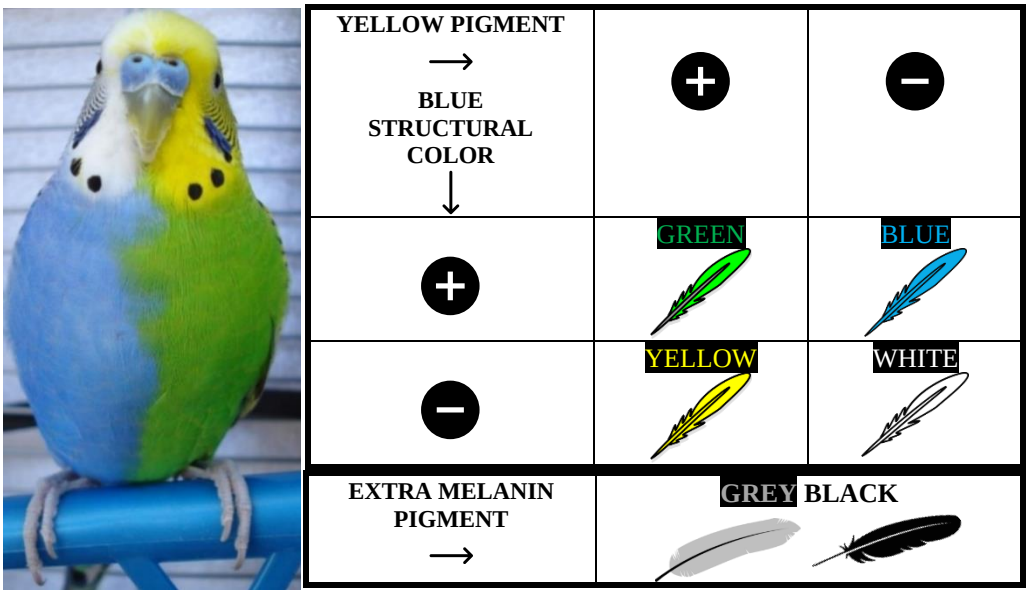

**Fig. 6:** A red (left) and melanistic (right) morph Stella's Lorkieet (*Charmosyna papou*), a rare example of a polymorphic parrot. https://www.biolib.cz/en/taxonimage/id417636/?taxonid=139551&type=1 (Iggino Van Bael)

**a**

**b**


**Fig. 7a:** A typical (bottom) and melanistic (top) Galah (*Eolophus roseicapilla*). https://www.facebook.com/groups/165239100496930/permalink/1160584320962398 (Hoss Bolenski)

**Fig. 7b:** A typical (left) and xanthic (right) Orange-winged Parrot (*Amazona amazonica*). https://www.avianreport.com/bird-xanthochromism/ (Avian Report)




**a**

**b**

**Fig. 8a:** A simplified version of color genetics in the Budgerigar Parakeet (*Melopsittacus undulatus*). Different feather colors are produced by different combinations of structural and biological color, as seen on "Twinzie," a pet with a rare half-sider mutation (a form of chimerism).
(chart by author; photo by Susan Dennis / cc-0
https://www.flickr.com/photos/23506271@N06/26690893991)

**Fig. 8b:** While in the wild the dominant color type is green and yellow with black, humans have exploited naturally occurring mutations via selective breeding to create numerous color varieties in aviculture.
https://commons.wikimedia.org/wiki/File:Melopsittacus_undulatus_flock.jpg
(Anna Saccheri / cc by-sa 2.0)

**Fig. 9:** "George Edwards Parrot," an unidentified parrot from Jamaica known only from this single 1764 watercolor and accompanying description by George Edwards; possibly a case of erythristic mutation.
https://commons.wikimedia.org/wiki/File:Jamaican_parrot.jpg

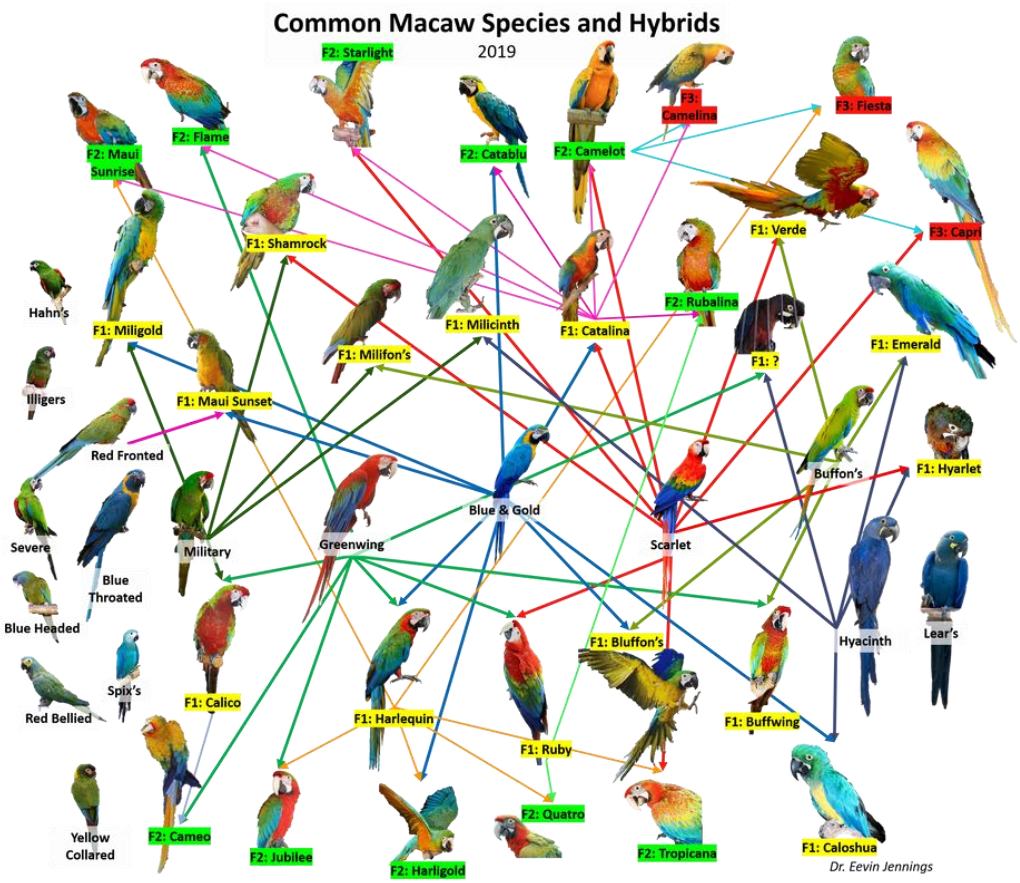



**Fig. 10:** A chart of hybrid Macaw breeds, including second and even third generation crosses as well as intergeneric crosses.
https://www.dreevin.com/misc-posts/macaw-species-and-hybrids
(Eevin Jennings)

**Fig. 11:** Two paintings by Jan Davidsz de Heem depicting what may be a hybrid macaw (Ruby Macaw?):
*Still Life with Parrots*, c. 1640s
The John & Mable Ringling Museum of Art, Sarasota, FL
https://emuseum.ringling.org/emuseum/objects/26827/still-life-with-parrots
*Still Life with a Parrot*, c. 1650s
Academy of Fine Arts, Vienna
https://library.artstor.org/#/asset/LESSING_ART_10310752593

**Figure 12:** Detail of unidentified Macaw (probable *Ara* sp.), along with an African Grey Parrot (*Psittacus erithacus*) and other unidentified birds in cage, in the *Tribute to Caesar* fresco by Andrea del Sarto, c. 1520, with additions by Alessandro Allori, 1578-82.
Salone, Villa Medicea, Poggio a Caiano, Italy
https://library.artstor.org/#/asset/SCALA_ARCHIVES_1039488774

DES OYSEAVX, PAR P. BELON. 319

ſon nid,comme auſsi la contenance ainſi que le Merle,& la couleur du plumage telle qu'à dit Ariſtote, auons facilement conclud, que c'eſt luy qu'Ariſtote à entendu pour la tierce eſpece de Merle. Soudain qu'on à laiſſé la montagne d'Ambrun,& qu'on eſt deuallé en la plaine,lon n'en trouue plus:& toutesfois eſtants lá hault il y en à ſi grande quantité,que les hoſtes feſtient les paſſans au lieu d'autre gibbier. On les trouue de meſme gouſt, qu'on fait noz Merles noirs, & viuent de telles viandes.

Du Merle de breſil.

CHAP. XXVII.

CEVX qui font le traffic de marchandiſes es terres neufues, ne perdent les occaſions de recouurer les ſingularitez, qu'ils pretendent vendre par deça: Car meſmemẽt ne pouuants apporter les oyſeaux de ce païs lá en vie dedens leurs vaiſſeaux, les eſchorchent pour en auoir les peaux: & principalement ceux qui ſont de plus belles couleurs, deſquels eſt celuy que deſcriuons maintenant, & duquel les mariniërs font leur profit,luy ayants donné le nom de Merle de breſil. Il n'eſt du tout ſi gros qu'vn Merle, ayant les plumes de tout le corps, excepté la queuë, & les ælles (qui ſont de fin noir) plus rouges, que n'eſt toute autre couleur rouge. Il eſt impoſsible que l'artifice humain puiſſe faire vne couleur rouge, qui n'en ſoit effacee, la mettant en comparaiſon de ſes plumes. Sa queuë eſt longue: ſes pieds, & iambes ſont noirs. Son bec eſt court de la façon de celuy d'vn Moyneau: ſes plumes rouges ſont noires à la racine. Il en ont peu aporter en vie iuſques en noz riuages. Lon en trouue pluſieurs peaux toutes entiëres, leſquelles lon pourroit conferer auec le portrait qu'en donnons, auſsi parfait, que ſi l'oyſeau eſtoit plain de vie.

*Merle de breſil.*

*Merle du breſil.*

*Deſcription du Merle de breſil.*

E iiii

Source gallica.bnf.fr / Bibliothèque nationale de France

**Fig. 13:** A hand-colored copy of Pierre Belon's "Du Merle de Bresil" (Brazilian Tanager, *Ramphocelus bresilius*) in *L'Histoire de la nature des oyseaux*, 1555, showing the legs and beak incorrectly colored red even though they are described as black in the text.
https://gallica.bnf.fr/ark:/12148/btv1b8608302w (Gallica-BnF)

**Fig. 14:** Hypothetical extinct parrot species illustrated in Rothchild's *Extinct Birds*, 1907, all created based solely upon descriptions in historical texts. From top left: Dominican Green-and-Yellow Macaw, Violet Macaw, Guadeloupe Amazon, Jamaican Red Macaw, Martinique Amazon, Martinique Macaw, and Red-headed Macaw.
https://www.biodiversitylibrary.org/item/148380 (BHL)

**Fig. 15:** Melchior d'Hondecoeter, *The Menagerie*, c. 1690, with birds from around the world depicted together.
Rijksmuseum, Amsterdam
https://www.rijksmuseum.nl/en/rijksstudio/artists/melchior-d-hondecoeter/objects#/SK-A-173,2

**Fig. 16:** Detail from Jan Brueghel the Elder, *The Entry of the Animals into Noah's Ark*, 1613, with two pairs of macaws (likely Scarlet Macaw, *Ara Macao*, and Blue-and-Gold Macaw, *Ara ararauna*) in different poses.
J. Paul Getty Museum, Los Angeles
https://library.artstor.org/#/asset/GETTY_GGMP_1031171951;prevRouteTS=1615780654871


**Fig. 17:** John James Audubon, *The Birds of America*, 1833, Plate 26, depicting the now extinct Carolina Parakeet (*Conuropsis carolinensis*). https://www.nga.gov/collection/art-object-page.32167.html (NGA)


**Fig. 18:** Edward Lear, *Illustrations of the Family of Psittacidae, or Parrots*, 1832, Plate 7, depicting a living Scarlet Macaw (*Ara Macao*). https://commons.wikimedia.org/wiki/File:Ara_macao_-painting_by_Edward_Lear.jpg (UW-Madison Libraries)


**Fig. 19:** Cantino Map of 1502, with details of "New World" Scarlet Macaws (*Ara macao*) in Brazil and "Old World" African Grey Parrots (*Psittacus erithacus*) and Senegal Green Parrots (*Poicephalus senegalus*) in West Africa. https://edl.beniculturali.it/beu/850013655 (Biblioteca Estense)

**Fig. 20:** Detail of four stylized macaws (likely *Ara* sp.) in Brazil on the Caverio Map, c. 1506.
https://gallica.bnf.fr/ark:/12148/btv1b550070757/f1.item (Gallica-BnF)