

Insights into the Materials and Techniques of James Castle

ABSTRACT

Identifying the materials of works of art and determining methods of execution through technical study deepens our understanding of an artist's body of work. Conservators, scientists and historians often have endeavored to identify the materials and techniques of mainstream artists and to develop precise language to articulate their findings. However, this approach rarely has been undertaken for self-taught artists, such as Boise, Idaho, native James Castle (1899–1977), who used primarily unconventional and found materials. This paper derives from the first detailed, systematic studies of Castle's art, which were undertaken for a 2008 retrospective of his work at the Philadelphia Museum of Art (Ash and Homolka 2008; Price et al. 2008). It discusses his work in terms of technical connoisseurship and the scientific investigation of his materials, which provided new insights into his artistic output and informed the lexicon that was developed to describe Castle's unique creations for the exhibition and accompanying catalogue.

INTRODUCTION

James Castle's art—drawings of soot and spit, complex constructions, idiosyncratic books, and whimsical color renderings—embodies a deeply personal vision and artistic language. Previous descriptions of his materials and techniques have been based on his family's limited recollections of watching him work¹ or on scholarly inference, but these descriptions are incomplete, since Castle—who could not hear, speak, or write—left no written records and rarely allowed visitors into his studio. Castle found his subjects in the everyday objects around him. His materials, too, were the stuff of daily life, and give us a glimpse of period life in rural Idaho: discarded packaging from the week's groceries, the homework papers of his nieces and nephew, soot from the



Fig. 1a. Ephemera from James Castle's studio; James Castle Collection and Archive; Courtesy of the J Crist Gallery, Boise, Idaho

wood-burning stove, and matchboxes—dozens of them—from decades of a family going about its daily routine. His family supported his artistic endeavors and saved his designs and other related materials left in his workroom following his death in 1977. Today, many of these items are maintained in archives at the J Crist Gallery in Boise, Idaho, and the Boise Art Museum (figs. 1a, 1b). In the jar lids and coffee cans that contain residual soot and color; in old candy boxes filled with wads of cotton, cloth, and colored tissue used for applying color; and in the oddly shaped wooden sticks employed as pens and the pocketknife used to sharpen them, an artist's palette unfolds. By sifting through these materials and closely examining the works of art, insights on Castle's techniques and clues to his working processes emerge.

The technical study of works of art, often essential to understanding an artist's output in historical context, involves identifying that artist's materials and determining the methods of execution. For someone like Castle, who worked primarily on or with paper, this is achieved through close visual examination of the physical qualities of his paints, inks, colorants, and supports, and by the identification of their constituents

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Fig. 1b. Whittled sticks and nails the artist used as drawing implements; James Castle Collection and Archive; Courtesy of the J Crist Gallery, Boise, Idaho

through scientific analysis. The instrumental techniques used in our study to characterize the materials found on Castle's works and in his studio were Fourier transform infrared microspectroscopy (MFTIR), gas chromatography mass spectrometry (GCMS), high-performance liquid chromatography with photodiode array detection (HPLC-PDA), laser desorption ionization mass spectrometry (LDMS), x-ray diffraction (XRD), and scanning and transmission electron microscopy (SEM, TEM) with energy dispersive spectroscopy (EDS). Castle's soot-and-spit drawing medium and colored media (pigments, dyes, and binder components) were among the materials examined.

CASTLE'S DRAWING MATERIALS

As stated above, the primary goal of our technical study was to identify Castle's materials and methods and to develop detailed and meaningful descriptions for the exhibition catalogue. Castle's drawings had been classified broadly as "soot and spit" or "colored pulp" and the gray-black soot lines and the washes and colors observed in them recur throughout his books, constructions, and collages. Close scrutiny of Castle's art, scientific analysis, and a consideration of his techniques within the context of traditional artistic practices have greatly enhanced our understanding of the artist's work. They also have helped to correct some misconceptions: perhaps most

importantly, the popular notion that he completely rejected conventional art materials.

Another goal of our study was to use our analytical results and the information gathered from visual examination of Castle's supports to help determine when Castle executed his works, since he did not sign or date them and no reliable chronology exists. It was thought that the wealth of commercial product packaging he used in his art might provide clues for the dating of certain pieces. It was also anticipated that some of the constituents of Castle's drawing media—particularly modern synthetic colorants and their dates of development and manufacture—could serve as markers to indicate the earliest possible dates for some works.

Drawing on Centuries-Old Traditions: Castle's Soot and Spit

Since antiquity, artists have relied on certain essential drawing materials. Carbon black and bistre, historically two of the most frequently used drawing inks, could be acquired easily or prepared by the artist in the studio. Carbon black ink traditionally was made from soot produced by burning candle wax, oils, resins, resinous woods, or the seeds of fruits (Watrous 1967). Bistre, a brown ink exhibiting a range of hues, was prepared by extracting the colored soluble tars from wood soot by boiling a mixture of soot in water (Watrous 1967). James Castle's development of his own wonderfully personal ink drawing medium utilizing stove soot links him to these centuries-old artistic practices. Oral accounts suggest that the soot was collected from the family's wood-burning

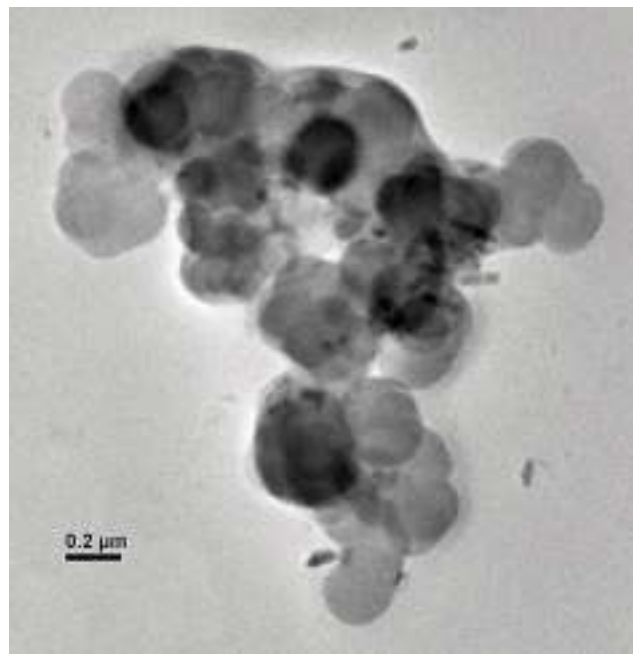


Fig. 2. Transmission electron micrograph of a black soot-and-spit ink sample showing particles with morphology characteristic of chimney soot

stove. Scientific analysis of samples of the ink from Castle's studio and individual works confirmed compositions and particle morphologies (fig. 2) consistent with soot produced by the incomplete burning of wood, rather than a commercial pigment. Furthermore, analysis determined variability in the soot composition that supports accounts that the source of the soot changed during his career when the family turned to other heating and cooking fuel sources (Harthorn 2005).²

While no one is sure exactly how Castle prepared his drawing ink, his niece Gerry Garrow and great-nephew Doug Wade have described how he would mix the soot with his own saliva in a jar lid and then load it onto a sharpened stick or other handmade implement for drawing.³ To ascertain whether these accounts were accurate, tests were conducted that confirmed the presence of enzymes indicative of human saliva in Castle's drawing ink. The ink was also replicated by mixing the fine particulate soot acquired from the artist's studio with saliva. No grinding of the soot was required, but it had to be worked up well with the fingertip or similar tool, as the somewhat greasy mixture that resulted resisted easy blending with the saliva. One advantage of Castle's choice of saliva may be explained by its surfactant properties and the presence of certain constituents (mucins) that functioned as lubricants. These most likely improved the working properties—such as smoothness of the homemade ink and controllability of application—and facilitated the dispersion of the soot particles, making it a more effective vehicle than water alone (Price et al. 2008). It also is worth noting that Castle was not alone as an artist in his use of saliva as a drawing medium; the self-taught Mexican artist Martin Ramirez (1895–1963), for example, reportedly used saliva in his colored drawings.

Bringing Color into the Picture

Although Castle is best known for his soot-and-spit renderings in a subtle range of gray and black tones, color appears in a fair number of his drawings. He used it, for example, to fill in forms or to provide distinct highlights within drawings in which soot and spit predominate. The soot itself also exhibits subtle tonal variations, ranging from warm brown in some works to cooler blue lines and washes in others.⁴ But it is Castle's bold full-color drawings executed on supports fashioned from wax-coated food cartons (figs. 3, 4) that are the most mystifying and challenging when it comes to discerning his sources of color and methods of application. These drawings often are referred to as "colored pulp" pieces, based on the misconception that the artist wet and pulped colored papers, and then applied and left the pulp on the drawing support (Yau 2000, 20);⁵ however, no evidence of this practice was observed in our study. Intense, bold colors often dominate in these works, but the exact design materials employed, as discussed below, were difficult to determine visually.



Fig. 3. Red "dream house" in color-block landscape, 3 1/2 x 6 3/4 in. (8.9 x 17.1 cm); Philadelphia Museum of Art, 2007-121-22; Gift of the James Castle Collection and Archive



Fig. 4. "Dream house" with yellow sidewalk, 5 1/2 x 7 3/4 in. (14 x 19.7 cm); James Castle Collection and Archive; Courtesy of the J Crist Gallery, Boise, Idaho

The materials retrieved from Castle's workroom offered clues to the colored works and a resource for further study. Among them were an unexpected variety of commercial art materials: jars of tempera paint, soft oil pastels (Townsend 1998),⁶ harder school-type chalks, colored pencils, and wax crayons, as well as brightly colored crepe paper.⁷ Equally significant was the discovery of numerous bunched and twisted wads of paper, cotton, or cotton wrapped in cloth, each wad saturated with soot or color (fig. 5).

Close observation of Castle's full-color works revealed that, rather than applying the pulp from colored tissue or crepe paper to the drawing surface and leaving it there, he used a method comparable to that employed in his soot-and-spit drawings. It appears that he either dampened and then squeezed liquid colorant from such papers into a container and then applied the color using his wads or sticks, or he rubbed the dampened colored paper directly onto the support surface. The wadded pieces of orange and red crepe papers (fig. 6a) that were found among Castle's studio



Fig. 5. Wads of paper, cotton, and cloth-wrapped cotton used by Castle to apply soot and spit or color to his drawings; James Castle Collection and Archive; Courtesy of the J Crist Gallery, Boise, Idaho

materials—well worn and depleted of color—are consistent with such use. Experiments were undertaken to extract the red color from an unused sample of Castle’s bright red crepe paper by wetting it with water and squeezing it by hand (fig. 6b). The resulting water-soluble dye was strikingly similar to the red color present in many of his works and could be applied with a stick in the same fashion as his soot ink. Instrumental analysis of the dyes from the wadded red crepe paper from Castle’s studio and the red ink from one of his hand-sewn books using HPLC-PDA showed a close correspondence of synthetic colorants in both. Each contained a mixture of the water-soluble dyes Rhodamine 6G, Crocein Scarlet 3BS, Ponceau G, and Eosin, supporting the idea that Castle indeed extracted colorants from papers to use in his artworks (Price et al. 2008).⁸

It quickly became apparent that the range of design materials Castle employed in his full-color works was far greater than originally suspected. In a number of drawings, including *“Dream house” with yellow sidewalk* (fig. 4), pigment particles were clearly visible under high magnification, suggesting that Castle’s palette may have included commercially manufactured paints in addition to his extracted colorants. This supposition was supported in part by the poster paints found in his studio (Arnold 1994),⁹ and his family’s recollections of



Fig. 6a. Red crepe paper and wadded red paper from Castle’s studio; Philadelphia Museum of Art, James Castle Study Collection, P2007-1-43, P2007-1-44; Gift of the James Castle Collection and Archive



Fig. 6b. Red colorant extracted from wet crepe paper

his use of watercolors of the dime store variety.¹⁰ Rather than working directly from the dry watercolor cakes, however, Castle was said to have dissolved them in a water dish or jar lid, which probably allowed him to employ application techniques similar to those used in his soot drawings.¹¹ Analysis by EDS and XRD of a sample of a leanly-bound, powdery green paint from one of Castle’s “dream house” pictures identified chromium oxide green, a pigment probably derived from watercolor or tempera paint (Price et al. 2008, 185).¹² A second such pigment, chrome yellow, was identified by LDMS on *“Dream house” with yellow sidewalk* (Kirby et al. 2009).¹³

As mentioned previously, among Castle’s belongings were commercially manufactured dry media such as chalks, oil pastels, and wax crayons.¹⁴ One set of chalks, Alphacolor from Weber Costello, showed remarkable visual similarity to the colors used in several of his full-color drawings. Evidence



Fig. 7. Detail of *Woman with wheel feet on street*, 4 1/2 x 7 in. (11.4 x 17.8 cm), showing scattered bits of waxy crayon with a distinct yellow flake evident at center; James Castle Collection and Archive; Courtesy of the J Crist Gallery, Boise, Idaho



Fig. 8. Detail of *Man in red between two giant chickens*, 5 3/8 x 9 1/2 in. (13.7 x 24.1 cm); Philadelphia Museum of Art, 2007-121-21; Gift of the James Castle Collection and Archive

of his use of wax crayons was observed, for example, in the drawing *Woman with wheel feet on street* (fig. 7), in the scattered bits of colored waxy material that likely crumbled off the crayon and adhered to the paper. Castle appears to have applied crayons to his works either dry or perhaps softened with a household solvent, and often in combination with

color washes from other sources. His use of wax crayon was confirmed by GCMS analysis and comparison of the waxy particles from his constructions and drawings with the Crayola- and Little Lulu-brand wax crayons from his studio. The waxy particles from the artworks were found to contain paraffin hydrocarbons and fatty acids in a composition indicative of crayon. In addition, evidence was found for his use of both crayon brands: the compositional profile of some particles matched that of the Crayola crayons, with a mixture of paraffin and stearine (mainly stearic and palmitic acids), while other particles matched the composition of the Little Lulu crayons (produced by the Milton Bradley company), with paraffin in combination with fatty acids suggestive of hydrogenated fish oil (myristic, palmitic, stearic, arachidic, and behenic acids) (Warth 1956; Ackman 1989).¹⁵ Interestingly, the Little Lulu crayons are labeled with a 1948 copyright by the Milton Bradley Company, indicating that Castle could not have used them on his drawings before that year.

In examining Castle's repertoire of found media, one unexpected discovery was that he used the common household product laundry bluing as a prominent colorant in his work.¹⁶ Laundry bluing is a concentrated, intensely blue commercial product used to optically "brighten" dingy or yellowed linens or other fabrics. Visual inspection of Castle's drawings revealed the recurrence of a particularly intense blue color. In one drawing that depicts four figures standing in a row, this blue appears in both crisp stick-applied lines and passages of wash. The artist used the same blue in one of his figure constructions, *Dresser-head girl with blue plaid dress and red hat* (fig. 9), to fill in broad areas of folded cardboard, creating a richly colored outer garment. Analysis of the blue from this work by MFTIR revealed the presence of Prussian blue, a common colorant used in commercial laundry bluing during the 20th century (Price et al. 2008).¹⁷ The blue pigment in laundry bluing was formulated with a starch or gum base, and starch was detected in the blue sample from Castle's construction, further supporting the identification of laundry bluing.¹⁸ The consistency and uniformity of the blue colorant in Castle's works also suggest a commercial source such as a bottled, pre-mixed liquid laundry bluing. Castle's use of this product was resourceful but not unique, since it has been used as a colorant in ethnographic objects and incorporated into the palettes of artists and other craftspeople worldwide (Odegaard and Crawford 1996). Moreover, laundry bluing was distributed widely during the 20th century and therefore would have been a readily available, inexpensive source of color among Castle's eclectic stock of materials.

Further visual examination of Castle's drawings and constructions revealed his occasional use of other commercially manufactured mediums, such as fiber-tipped and ballpoint pens, graphite pencils, and even green finger paint. Colored fiber-tipped pens, more commonly known by the brand name Magic Markers, often appear as discrete accents



Fig. 9. Castle figure constructions, including *Dresser-head girl with blue plaid dress and red hat* (fourth from left), 10 1/2 x 2 7/8 in. (26.7 x 7.3 cm); Philadelphia Museum of Art, 2007-121-4; Gift of the James Castle Collection and Archive. Other figures courtesy of the J Crist Gallery, Boise, Idaho

in Castle's constructions, placing the dates of such pieces at mid-20th century or later, when fiber-tipped markers gained use (Ellis and Yeh 1998).¹⁹ In addition, scientific analysis of Castle's colored media, as discussed above, revealed 22 colorants of the monoazo, disazo, xanthene, quinacridone, triarylcarbonium, phthalocyanine, cyanide, aluminosilicate, oxide, and chromate types. While many of the colorants detected were developed in the late 19th to early 20th centuries, four pigments—phthalocyanine blue, diarylide yellow, and quinacridone red and gold—were not marketed until the 1930s–50s and thus may serve as indicators of the earliest possible dates for works containing them (Price et al. 2008, 2011).²⁰ For example, Castle used quinacridone red, which was first marketed in 1958, on *Red "dream house" in color-block landscape* (fig. 3), and therefore he could not have completed the landscape before that date.

DRAWING IMPLEMENTS AND TECHNIQUES

Just as Castle's drawing media often were unconventional, so too were the tools he used for their application. No brushes were found among his possessions, nor is there any mention of their use in previous writings or in recorded family recollections, yet he applied his washes with skill and nuance. While only an occasional metal pen nib was found, throughout the boxes of his materials are carved wooden sticks that Castle used to deftly render his personal vision of Idaho life (fig. 1b). Artists always have selected their pens (quills, reeds, or metal nibs) for the distinctive quality of the line they deliver. Similarly, Castle individually carved sticks to produce the surprising variety of lines he desired. Round or flat sticks, wood slats, and rough twigs were cut, carved, and whittled—some to sharp points, others to a more gradual taper, and still others to mere stubs. Nails, too, are present, the heads and points also used to deliver color to the page. The most significant difference between Castle's stick application and the use of a traditional ink pen is that the tip of the

sharpened stick holds only a small amount of liquid medium, so he would have needed to continually re-dip it. Among his studio ephemera was a small scrap of paper on which he repeatedly wiped the end of his stick while in the process of drawing, perhaps to check the flow of liquid soot or to clear excess "ink" from the tip. This gives us a small but tangible glimpse into his working process.

His arresting soot-and-spit images exhibit a wide variety of marks and textures with which he skillfully rendered perspective and light and shade. A detail from the small drawing *Farmscape with totems* (fig. 10), for example, reveals how the paper surface became highly abraded with repeated passes of Castle's sharpened stick, allowing him to achieve areas of remarkably rich black. For this drawing the artist chose a heavy paper or card able to withstand his vigorous working of the surface. Viewed with raking light, the support exhibits a slight sheen, causing the velvety texture of the black trees and totems along the horizon to stand out in contrast. Castle must have appreciated the surface disruption of heavily worked areas such as this for their textural qualities. And while Castle often created rich blacks by filling in forms with this stick-applied soot technique, he also combined line drawing with soot washes to achieve dramatic tonal variation and create volume through subtle shading.²¹ For the application of washes it appears that Castle preferred to use wads of cotton, paper, or cloth-wrapped cotton, as described previously, all frequently encountered among his archived ephemera. Castle could grasp these compact tools firmly between his fingers, dip into his wash or rub into a dry medium, and then apply the medium to his drawing with confident, controlled strokes.²² An important clue to his technique are the striations that appear along the axes of the strokes, where the irregular texture of a wad of cloth (perhaps even the artist's fingernail or a stick inserted in the wadded material) displaced the medium during the application process (fig. 11). Occasionally, Castle even used his finger to wipe soot wash across the page, leaving fingerprint-like striations in the liquid medium.



Fig. 10. Detail of *Farmscape with totems*, 3 3/4 x 6 1/4 in. (9.5 x 15.9 cm): Repeated passes of Castle's sharpened stick abraded the surface, creating areas of rich, velvety black. Philadelphia Museum of Art, 2007-121-13a; Gift of the James Castle Collection and Archive



Fig. 11. Detail of *Farmscape with plank totems*, 3 3/4 x 6 1/8 in. (9.5 x 15.6 cm): Striations along the strokes of wiped soot wash were caused by the irregular texture of the wadded cotton or cloth Castle used to apply the medium. Collection of Marion Boulton Stroud, Elverson, Pennsylvania

CASTLE'S PAPERS

The lines and washes in Castle's creations owe their appearance as much to the physical characteristics of his supports as to his application techniques. Whether he consciously chose from his found papers based on specific working properties or simply reacted to the surface qualities he encountered, he clearly was able to exploit their distinctive characteristics using a range of drawing techniques. The Castle family's post office and community store brought the artist into contact with an enormous array of paper products, and he seems to have made use of practically every paper he encountered.²³ From the printing industry he employed periodicals, magazines, newspapers, catalogues, and calendars, and from the packaging industry, ice cream cartons, milk-bottle lids, food labels, cigarette packs, and matchboxes. He also drew on used envelopes, wrapping paper, and recycled notebook papers from his nieces' and nephew's homework. Elements in his constructions were fashioned from shopping bags, corrugated and other types of cardboard, and even asphalt roofing paper (also known as tar paper).

As with the work of any artist, the physical properties of Castle's chosen supports were integral to the artistic result. The purpose for which a paper or paperboard was manufactured, as well as its degree of wear, determines how it receives a design medium and significantly affects the final appearance of the work of art. The smooth, calendered, and sized finishes of writing papers, for example, promote the fluid application of ink, while the finish of paper products intended for commercial printing ensures that ink sits crisply on the surface (Schwalbe 1962).²⁴ When Castle drew on such supports, the fine, undulating soot lines glided easily over the surface. By comparison, lightly sized or unsized papers and boards are more absorbent, and a liquid medium sinks more quickly into the fiber matrix.²⁵ Castle executed dozens of remarkable drawings on unfolded and flattened cardboard from boxes of safety matches, where the slightly compressed surface imparted some resistance before the soot mixture was absorbed. It seems clear that Castle understood and even deliberately exploited the individual qualities of the supports he chose, sometimes cleverly incorporating flaws and irregularities of shape into his compositions. For example, in *View from inside shed through shed doors* (fig. 12), executed on a split and flattened envelope with the flap torn off, the curving roof line takes advantage of the concave, angled top edge of the paper, enhancing the sense of perspective.

Another preferred Castle support was wax-coated paperboard from frozen-food cartons (Worthington 1950; Austin 1950),²⁶ which he used primarily for the bold, full-color works described previously. One common characteristic that defines these pieces is Castle's practice of selectively scraping away and disrupting the waxy surface with an implement such as a stick or razor blade, vigorously abrading the paper



Fig. 12. *Farmscape, view from inside shed through shed doors*, 8 x 9 1/2 in. (20.3 x 23.5 cm); Philadelphia Museum of Art, 2007-121-7; Gift of the James Castle Collection and Archive

fibers before and during color application. This allowed for the penetration and saturation of his liquid colorants into the paper fiber matrix, which was made more receptive to moisture through the removal of much of the wax coating. Visually, the pronounced texture of the roughened surface is evident in raised fiber clumps, perhaps contributing to the earlier designation of these works as “colored pulp” drawings. By contrast, where the waxy surface was not scraped away, the liquid medium beaded up and dried on the surface, forming fine tide lines of concentrated color observed in a number of Castle’s works. The striking result of Castle’s technique, in the true tradition of watercolor painting as described by Cohn, is that the white of the support is exploited in many works to create highlights. In *Red “dream house” in color-block landscape* (figs. 13a, 13b), for example, four small white windows punctuate the image, and the white support reflects up through the translucent media elsewhere, enhancing the brilliance of the colors. The brightness of wax-coated food cartons and their ability to resist distortion from contact with liquid surely must have attracted Castle to them as supports for his full-color works (Cohn 1977).²⁷ The works made on this type of waxed food carton, which was not commonplace until the 1950s, can therefore be dated broadly to Castle’s later career (Worthington 1950).²⁸

Castle’s constructions and books utilize perhaps the widest range of commercial papers and paperboards. These myriad commercial paper scraps and fragments often are coated, commercially printed, or incorporate colored or foil-laminated facing papers, through which “surface”—color, texture, printed design—becomes a primary element in his expressive vocabulary. One particularly interesting example is



Fig. 13a. Verso of *Red “dream house” in color-block landscape*, 3 1/2 x 6 3/4 in. (8.9 x 17.1 cm); Philadelphia Museum of Art, 2007-121-22; Gift of the James Castle Collection and Archive



Fig. 13b. Detail of recto of *Red “dream house” in color-block landscape*, 3 1/2 x 6 3/4 in. (8.9 x 17.1 cm); Philadelphia Museum of Art, 2007-121-22; Gift of the James Castle Collection and Archive

a construction of a long-legged black bird for which he tore, wrapped, and layered numerous scraps of asphalt roofing paper around a corrugated cardboard core.²⁹ The rich, dense blackness of the bird’s body echoes the literal weight of the unconventional material. The long, gray cardboard legs are punctuated at the foot by small patches of bright yellow printing, a part of the commercial packaging from which the legs were cut and torn. This is a wonderful example of Castle’s clever use of the inherent qualities of his found materials. Other constructions whimsically incorporate found commercially printed patterns, which Castle fashioned into colorful garments that he wrapped around various figures. Such playful details give glimpses of Castle’s visual acuity and highlight his attention to the tactile qualities of his found materials.

FINAL THOUGHTS

Technical study of Castle’s art—drawings, constructions and, in particular, his color works—has proved essential to deciphering the artist’s unusual and often complex mixtures of media and colorants and his idiosyncratic methods. It

also confirmed the value of applying traditional techniques of examination and analysis to the work of an artist outside the mainstream. Detailed visual examination helped to dispel misconceptions about certain techniques—the application of “colored pulp,” for instance—and allowed us to develop and refine meaningful descriptions for others—“stick-applied soot lines and wiped soot wash,” for example.

During our study, soot and saliva were confirmed for the first time as Castle’s principle drawing medium, and 22 colorants were identified in the form of water-soluble dyes, paints, chinks, pastels, and wax crayons. The confirmed use of many of these media demonstrates that Castle did, in fact, have access to conventional artists’ materials during his career. However, his creative extraction of water-soluble dyes from papers, his use of laundry bluing as a colorant, and his adaptation of soot and saliva as an ink show that he also was actively engaged in developing his own materials. The variety of colorants detected underscores the complexity and scope of Castle’s palette, which complements the remarkable creativity with which he used these materials. Furthermore, the development dates of certain colorants, and of the waxed food cartons and other packaging materials that he used for supports, provide a basis for scholars to establish a chronology for some of his works. Ultimately, a technical study such as this deepens our understanding of an artist’s body of work and opens avenues for future exploration. Castle’s are fascinating works—whimsical, often profoundly moving and surprisingly sophisticated, and full of experimentation and diverse materials—with the remarkable power to captivate us so completely.

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NOTES

1. Jeffrey Wolf documented numerous accounts of Castle working in taped interviews for his 2008 documentary film *James Castle: Portrait of an Artist* (New York: FFSTAA/Breakaway Films). See also a letter from Robert L. Beach to A. Kenneth York, October 26, 1960 (location of the original letter is unknown; a transcript of the letter exists in the archives of the J Christ Gallery in Boise, Idaho).

2. According to Harthorn (2005), “Charcoal soot was collected from the wood-burning stove (coal-burning stove in later years). . . . Many years later when the stove was replaced by an electric oven, Castle’s sister Emma and her husband Joseph Beach acquired wood soot for Castle to use from the Veterans Hospital in Boise” (13). For this information the author relies on the 1960 letter from Robert L. Beach to A. Kenneth York (see note 1). For details of scientific analysis of the soot, see Price 2008, 175–177.

3. Castle’s great-nephew Doug Wade recalled, “The only time I . . . saw him really draw was when I snuck up on him and he would generate a lot of spit and . . . his lower lip would be welled up with spit and he’d just dip the stick in there and then put it in the soot and he’d draw with that” (interview by Jeffrey Wolf, 2005 transcript of tape recording 8:7 [08:18:13]).

4. These variations in soot tone may have resulted from Castle changing his soot sources (from wood to coal, for example) or, in cases where the soot exhibits a markedly blue or brown tone, from the addition of a pigment or water-soluble dye.

5. Earlier essays on Castle suggest a variation on the perceived technique used in his full-color drawings. As Yau (2000) describes it, “Castle . . . carefully mixed together found colored paper and water. He used his fingers to turn this mixture into pulp, which he manually applied to other surfaces” (20). The source of this notion is not known; perhaps it derived from a family member’s interpretation of Castle’s technique or from the pulpy appearance of his roughened supports.

6. Townsend (1998) discusses the materials that have been incorporated into pastel since it became commercially available in the later 19th century, noting that manufacturers select the binding medium for each pigment mixture to produce pastel sticks with uniform handling properties. According to Townsend, “a considerable range of materials can be used to bind the coloured and white pigments and extenders which constitute the bulk of a pastel stick: drying oils, natural resins, waxes, plant gums, proteins such as glue, casein and conceivably egg may have been used in the past” (21–28).

7. Among the materials preserved in Castle’s workroom were dried-up poster paints in glass jars (Carter’s Tempera Color and Derayco Poster Color), colored pencils (several Sabra Jerusalem pencils, one Eagle brand Alpha pencil no. 9245, two boxes of school “crayon pencils” from the Sunset Crayons Co.), chinks and pastels (in an “Alphacolor chalk pastels” cardboard box from Weber Costello Co., including one oil-pastel stick with a wrapper reading “Sketcho/Blue” from Prang Co.), and hard school chalk (in a “Colored Chalk Crayon” cardboard box by Binney & Smith Co. [now Crayola LLC]).

8. The water-soluble dyes detected were developed in the late 19th century and were used widely in printing and colored-paper production. The HPLC analysis was conducted by Maarten van Bommel, Instituut Collectie Nederland, Amsterdam.

9. The term “poster paint” generally denotes an opaque water-based paint of bulky, creamy consistency sold in jars or tubes. Poster paint is designed for less permanent applications, such as children’s artwork or craft projects. Poster paints differ from artists’ watercolors in that they are bulky and contain lesser-quality ingredients. Poster paint produces a dense film that prevents light from being reflected

from the underlying paper, clearly setting it apart from watercolor. A major group of coloring components found in these paints are synthetic organic colorants.

10. Guy Wade Jr., Castle's nephew, remembered that Castle "always had colors available to him. Anytime he wanted to why he could use the watercolors us kids had . . . those little watercolors that come in a metal . . . bracket" (interview by Jeffrey Wolf, 2005 transcript of tape recording 8:10 [08:22:44]).
11. According to Gerry Garrow, "He would . . . take the little water pods out and soak them in water and then put his cloth in it if he wanted to do a wash" (interview by Jeffrey Wolf, 2005 transcript of tape recording 24:6 [05:24:09]).
12. The chromium in the green pigment was detected by EDS. XRD analysis revealed 10 intense lines at 2.66, 2.48, 1.67, 3.63, 1.43, 1.82, 2.18, 1.46, 1.29, and 1.09Å that matched with JCPDS reference pattern #38-1479 for chromium oxide (Cr₂O₃, eskolaite). The XRD analysis was undertaken by Andrew Lins at the PMA.
13. The chrome yellow (lead chromate, PbCrO₄) was indicated by ions for chromate in the LDMS spectra at m/z 100.1⁻, 184.0⁻, and 200.0⁻; and for lead, clusters at m/z 207.9⁺, 251.0⁺, 262.9⁺, and 430.0⁺.
14. Wax crayons for drawing purposes were first introduced by Binney and Smith in 1903 (Ellis and Yeh 1998, 51).
15. The paraffin wax detected in the studio crayons and wax samples from drawings consisted primarily of straight-chain saturated hydrocarbons in the C₂₀–C₃₅ range, in agreement with Warth 1956, 404–405. According to Warth, hydrogenated fish oils contain 4–8% myristic, 29–32% palmitic, 18–22% stearic, 23–36% arachidic, and 13–17% behenic fatty acids (548). Samples of crayon particles from some of Castle's works and from Little Lulu crayons were similar in composition to Warth's description, and closely matched the composition of reference samples of hydrogenated fish oils obtained from ChemService, West Chester, PA, and Werner G. Smith, Inc., Cleveland, OH. For hydrogenated fish oil in crayon manufacture, see Ackman 1989, 421.
16. The notion that Castle may have used laundry bluing was suggested by his niece Gerry Garrow in an interview with Ann Percy, April 26, 2006.
17. The Prussian blue (iron hexacyanoferrate, Fe₄[Fe(CN)₆]₃) was indicated by a C-N stretching band at 2090 cm⁻¹ in the sample's FTIR spectrum and by iron detected by EDS. One brand of laundry bluing, Mrs. Stewart's Bluing, contains Prussian blue and still is manufactured by Mrs. Stewart's Bluing Corp., Bloomington, Minnesota, <http://www.mrsstewart.com/index.htm> (accessed 08/07).
18. The starch identification was made by FTIR; characteristic spectral bands for polysaccharide were very strong O-H and C-O stretching bands at 3350 and 1150-1020 cm⁻¹, respectively. For details see Price et al. 2008, pages 179, 241.
19. The first version of the fiber-tipped pen, the European Kaweco Signier of 1911, was short lived. After its second commercial introduction in 1946, the fiber-tipped pen was accepted rapidly. The brand name Magic Marker was introduced in 1952 (Ellis and Yeh 1998).
20. For the complete list of colorants identified and their development dates, as well as the sampling and instrumental details, see Price et al. 2008, 2011.
21. According to Guy Wade Jr., "He used that lid and then somehow or another, if he didn't have the right texture, why he'd go around to another part of it and work his way around inside that jar lid because some places he wanted dark and sometimes he didn't but he'd take one of those sticks and sharpen it up, sucker stick, and he'd take this . . . and draw his pictures, and blend it" (interview with Jeffrey Wolf, 2005 transcript of interview tape 8:8 [08:18:44]).
22. A possible source for these application materials was found among his possessions: a circular disk consisting of many layers of white open-weave cloth (perhaps a coffee filter), from which he may have peeled away layers for enfolding the cotton wads prior to use.
23. Guy Wade Jr. recollected that "[James] and Mom played a game. They had the trashcan sitting out the door while she put a whole bunch of stuff in there. But she saved the paper and everything and she put them up on top for him, so when he came to take the trash out, well, he'd always take the lid off and he got in and got them and he'd run to his office with them and then he'd come back and take the trash out, but he'd get those papers out of there first" (interview with Jeffrey Wolf, 2005 transcript of interview tape 8:3 [08:05:44]).
24. In discussing Castle's found papers, it is useful to recognize the characteristics of the surface-treated papers and boards, which he employed from a wide variety of commercial packaging, publication and advertising sources (for example, can labels, cracker boxes, calendars) and which include both pigment binders and wax coatings. "Surface treatment" is a general term used by the paper and paperboard industry to describe the application of adhesives, pigment-adhesive coatings and other functional products to the already formed fibrous web. Surface treatments are distinct from internal treatments such as the incorporation of sizes, fillers, and other loading agents into the fibrous web during formation.
25. In this essay, the paper products described as thin cardboard also may be described as folding paperboard or boxboard, a broad category of commercial paperboard suitable for making folding cartons. Its qualities permit scoring and folding, and, depending on the printing requirements, variable surface properties. See the American Forest and Paper Association's Web site, <http://www.afandpa.org> (accessed 11/06/07).
26. GCMS analysis of one such support for Castle's *Red "dream house" in color-block landscape*, executed on a Holland-brand ice cream carton panel, showed that the panel was coated with paraffin wax, consisting primarily of straight-chain saturated hydrocarbons in the C₂₀–C₃₅ range. For GCMS sampling and instrumental details, see Price et al. 2008, 240, note 25. Wax-coated and impregnated papers and boards were developed for the frozen-food-packaging industry during the 1940s and 1950s. Fully refined paraffin or paraffin with microcrystalline wax was used to impregnate and coat the carton stock to improve its physical properties.
27. Cohn's 1977 discussion of traditional watercolor techniques includes much that relates to Castle's inventive approach. For example, she explains that "If unabsorbive paper is without tooth, washes do not tend to run smoothly, finding little friction in the surface to overcome a liquid's natural tendency to coalesce into droplets" (17). She also refers to "wet abrasion" (45), an artist's deliberate damaging

of a sheet's surface sizing so that washes flow more easily—akin to Castle's selective roughening process. Cohn also comments that traditional artists choose papers for their resistance to cockling, a function of thickness and sizing, and that artists exploit the white of the paper so that "the light will reflect through the layers of color and provide the highlights of the design where color is absent" (16), two concepts readily exploited by Castle in his waxed food-carton works.

28. The frozen-food industry emerged after World War II and grew rapidly during the 1950s and 1960s. The folding half-gallon ice cream carton was introduced in 1948, according to the ice cream producer Stewart's Shops (see <http://www.stewartshops.com/ContentManager/index.cfm?Step=Display&ContentID=3>, accessed 10/07). Additional research into the product and company histories of the identifiable food-carton supports on Castle's works may aid in assigning a *terminus post quem* for individual works. For discussions of specialty paper products produced for the frozen food industry, see Worthington 1950 and Austin 1950.

29. Castle sometimes tore away the brown facing paper from corrugated cardboard and used either this facing paper or the exposed corrugated or fluted core component independently. These appear fairly frequently in his constructions and books, but he occasionally executed drawings on pieces of brown corrugated cardboard as well.

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