

Metalpoint Drawing: The History and Care of a Forgotten Art

Beth Antoine

INF 392E: Technology and Structure of Records Materials

Karen L. Pavelka, Instructor

November 7, 2007

Table of Contents

Introduction.....	2
History.....	2
Materials & Techniques.....	7
Substrate and Ground Preparation.....	7
Media.....	8
Identification of Materials.....	10
Common Conditions and Treatment Options.....	12
Staining and Abrasion.....	13
Foxing.....	14
Flaking.....	14
Blackened White Lead.....	15
Storage and Handling.....	16
Conclusion.....	17
References.....	18
Illustrations.....	20

“In order to avoid careless facility, I dig my roots obstinately, stubbornly in the crude untaught line buried in the living flesh of the primitives, a line whose purity pours out and flows so surely in the transparency of its sunny clarity...I dedicate my ardent wish to draw with all the precision possible, using the inflexible media of silverpoint and goldpoint that reveal instantly the clearest graphic eloquence.”

- Joseph Stella

Introduction

Metalpoint is a drawing and writing medium that dates from antiquity and was particularly popular from the 14th century to the beginning of the 16th. The technique of metalpoint involves dragging a stylus of metal across a substrate prepared with a slightly abrasive surface coating, or ground. As the metal is drawn along the surface, tiny particles of metal are left behind, creating a mark. Although it is quite difficult to use, metalpoint produces a particularly fine and delicate mark, making it a desirable tool for the highly skilled draftsman. Metalpoint drawings require careful handling and special storage conditions because their surfaces are fragile and easily blemished.

History

Metalpoint was used as a writing tool before it was employed by artists as a fine drawing medium. As early as the twelfth century and likely earlier, Medieval scribes used metalpoint on parchment to rule lines for manuscript text and to layout guides for the ornamentation in the margins.¹ By the beginning of the 15th century, Italian merchants commonly used metalpoint booklets for accounting purposes. The booklets contained sheets of paper prepared with a ground for marking with a stylus. Watrous suggests that metalpoint was used as a writing implement through the 17th century.²

By the 14th century, metalpoint was commonly used as a drawing medium, as is described by both Petrarch and Boccaccio, the latter referring to the use of the stylus by

¹ James Watrous. *The Craft of Old-Master Drawings*, 3.

² Ibid.

the artist Giotto.³ It was used at the height of its popularity by artists such as Leonardo da Vinci, Sandro Botticelli, Fra Filippo Lippi, and Albrecht Dürer.

In *Il Libro dell' Arte*, an artist manual written in the late 14th century, Cennini describes the technique of metalpoint for the artist in training. He states that metalpoint drawing should be mastered by the apprentice before moving on to attempt painting.⁴ Because it requires much more control and precision than other drawing media, it is the most valuable skill for a draftsman to acquire.

It is often assumed that Medieval and early Renaissance artists chose to use metalpoint solely for stylistic reasons, but in fact, they did not have a great variety of drawing media to choose from.⁵ Metalpoint became the medium of choice before the availability of graphite, conté crayon, and natural chalks. The graphite pencil did not gain widespread popularity until the 17th century.⁶ Charcoal was available, but it did not provide the level of permanence required for the rough use that many preparatory drawings sustained. Cennini recommended sketching with charcoal and fixing the image by retracing it in silverpoint.⁷

Metalpoint is one of the most difficult of all drawing media, as Hilton Brown describes, it, “is an exacting technique requiring consummate control of both mind and hand.”⁸ Metalpoint marks are indelible; erasure is impossible except with careful scraping

³ Ibid, 4.

⁴ Cennino d'Andrea Cennini. *The Craftsman's Handbook "Il Libro dell' Arte."* Translated by Daniel V. Thompson, Jr. (New York: Dover, 1960): 5.

⁵ Margaret Holben Ellis. “Metalpoint Drawings” *Drawing* 2, no. 3 (1980): 59.

⁶ Roy Graf. “Techniques and Subsequent Deterioration of Drawings.” *ICCM Bulletin* 5, no. 1 (1979): 16.

⁷ Cennini. *The Craftsman's Handbook "Il Libro dell' Arte."* 17.

⁸ Hilton Brown. “Looking at Paintings.” *American Artist* (May 1981): 71.

or sanding of the ground. A contemporary artist, Laura Shechter, estimated that a finished 8”x10” metalpoint drawing requires 100-200 hours to complete.⁹

Metalpoint has an inherently even quality, in both tonal range and texture. The application of greater pressure on the stylus will not create a darker or thicker mark; it will only scratch the surface of the ground. The fragility of the ground necessitates a light touch, producing a uniform surface. In order to make a broader mark, the artist must employ a stylus with a blunter tip. Styluses of the Renaissance often had a tip on either end, with varying degrees of fineness.¹⁰ Shaded areas of a drawing must be built up with careful hatching and cross-hatching techniques. It is not possible to produce a black mark. This inflexibility of the medium makes metalpoint most appropriate for small, detailed compositions depicting still objects. It is less effective when depicting movement or for quick, loose sketching, which requires a free-flowing stroke.

A technique to add tonal range to metalpoint drawings became popular in the early Renaissance, as interest in three-dimensional imagery grew. Using metalpoint on a toned ground and adding white highlights renders a chiaroscuro effect. The ground provides the middle of the tonal range, and the highlights create greater contrast against the darker strokes of the metalpoint. Cennini describes this drawing technique as a necessary skill for the art student “to approach the glory of the profession...”¹¹ Highlights were most commonly applied with white lead, usually in the form of watercolor or oil paint.

⁹ Laura Shechter. “Art Currents: Silverpoint and Meticulous Drawing.” (Lecture to the National Arts Club, NY), <http://www.biddingtons.com/content/silverpoint.html>

¹⁰ Francis Ames-Lewis. *Drawing in Early Renaissance Italy*. (New Haven, CT: Yale University Press, 1981): 36.

¹¹ Cennini. *The Craftsman’s Handbook “Il Libro dell’ Arte.”* 9.

Metalpoint began to decline in popularity in the 15th century and was nearly obsolete by the 16th century. As more types of media became available and artists became increasingly concerned with depicting dynamic scenes with greater accuracy and three-dimensionality, their requirements for a drawing medium began to change. Artists turned to pen and ink for more flexibility, versatility, and a stronger line quality; and to natural chalks for greater tonal range.¹²

Although metalpoint drawings are scarce after the 16th century, some artists continued to choose the medium. A rare 17th century example is Rembrandt van Rijn's drawing of his new bride Saskia in 1633.¹³ During the 19th century there was a brief resurgence in the popular use of metalpoint, especially among conservative English artists. There was enough demand that from 1896 to 1910 Winsor & Newton sold metalpoint kits, which included a silverpoint stylus and a sketchbook of prepared paper.¹⁴

Although metalpoint is no longer a well-known drawing medium, a small contingent of artists have continued to use it to create incredibly delicate and ethereal images. 20th century metalpoint artists include Otto Dix, Paul Cadmus, Pavel Tchelitchew, and Pablo Picasso. These Modern artists, who had a wide range of drawing media to choose from, deliberately chose metalpoint for the fine detail and precision that is unattainable through other media. The American artist, Joseph Stella described metalpoint as, "the clearest graphic eloquence."¹⁵ Contemporary artists use a variety of materials as metalpoint supports, many of which were not available to Medieval and

¹² Ames-Lewis. *Drawing in Early Renaissance Italy*, 43.

¹³ Bruce Weber. *The Fine Line: Drawing with Silver in America*. (West Palm Beach, FL: Norton Gallery and School of Art, 1985): 11.

¹⁴ *Ibid*, 20.

¹⁵ Brown. "Looking at Paintings," 70.

Renaissance artists. These include commercially prepared clay-coated paper (also known as cameo paper), zinc white and titanium white pigments, white casein paint, and commercially produced gesso. Clay-coated paper can be purchased commercially and used without preparation, but the mark will be lighter than that on a substrate prepared with ground pigments. Both casein paint and gesso can be applied to a substrate as a ground without mixing with other ingredients. The contemporary stylus is often a pin vise or a mechanical pencil, replacing the ornate metal and wood styluses of the Renaissance.

Although it is not currently possible to purchase metalpoint tools at local art supply stores, there are several websites that provide instruction for how to prepare grounds and how to make a stylus, and some even sell ready-made metalpoint supplies.¹⁶ For artists who prefer to mix a traditional ground; a 1:2:4 solution of marble dust, zinc oxide dry pigment, and gelatin is an effective, non-toxic substitute for Cennini's recipe of bone dust, white lead, and glue water.¹⁷

¹⁶ *Silverpoint Drawing Complete*, <http://silverpointweb.com/> and *Painters Studio: Artist Materials and Techniques*, <http://paintersstudio.com/drawing/metalpoint.php>

¹⁷ This recipe was developed by the author after consultation with Karen Pavelka and the examination of both traditional and modern recipes. Watrous provides a chart of the effectiveness of various grounds, which proved especially useful.

Materials & Techniques

Substrate and Ground Preparation

The majority of the extant Medieval and Renaissance metalpoint drawings were produced on a paper substrate.¹⁸ According to Cennini, artists in training would often use fig or boxwood panels dusted with chalk and saliva to learn and practice on. These panels could be erased and reused repeatedly. Parchment was also a commonly used substrate and could be coated in the same manner as paper.

There are many variations in recipes and techniques for preparing grounds. They were commonly prepared with powdered bone dust, seashells, eggshells, white lead, or a combination of these. Cennini explains which bones are preferable and how to grind them.¹⁹ The ground materials were mixed with a binding medium and brushed onto the substrate. Common binding media included glue water, made by soaking parchment or leather scraps in hot water; gum water, usually made with gum arabic; linseed oil; and saliva. Saliva was not recommended for making a permanent ground. Cennini's recipe called for the application of anywhere from one to nine coats of ground to the substrate. He also described techniques for the mixing of toned grounds by adding ground pigments to the mixture. The most common ground color was green, likely due to the availability of the pigment, Terre Verte. Other tints described include pink, violet, bluish, greenish

¹⁸ Letizia Montalbano and others. "Italian Metalpoint Drawings: International Studies of the Artistic Technique." *ICOM 13th Triennial Meeting, Rio de Janeiro, 22-27 September 2002: preprints*, ed. Roy Vontobel, 609-614. (James & James (Science Publishers) Ltd., 2002): 610.

¹⁹ Cennini, *The Craftsman's Handbook "Il Libro dell'Arte,"* 4.

gray, and flesh colored. The recipes call for the use of indigo, hematite, vermillion, ocher, and bone dust.²⁰

Media

Many different metals and metal alloys can be used for metalpoint drawing, each having different characteristics which lend themselves to different uses. Though the various metals vary in character, they are relatively homogenous in contrast to most other types of media.

Lead is a very soft metal and can mark paper without a ground. Used in this manner, it is the only erasable type of metalpoint. Cennini describes erasing the media with breadcrumbs.²¹ It was generally only used for rough sketches as its soft quality also made it rather impermanent, blurring and smearing with age.²²

Silver has consistently been the favorite and most commonly used metal for drawing. In fact, other types of metalpoint are often mistakenly labeled silverpoint simply because it is the most well known. Many early manuals recommend silver over all other metals for its superior qualities as a drawing medium.²³ It produces a particularly delicate line and tarnishes to a warm brown tone.

Artists employed styluses made of several different alloys in order to take advantage of the desirable characteristics of various metals. Commonly used alloys include brass, bronze, and lead alloyed with tin. Cennini describes an alloy of two parts

²⁰ Ibid, 9-12.

²¹ Ibid, 7.

²² Montalbano. "Italian Metalpoint Drawings: International Studies of the Artistic Technique." *ICOM 13th Triennial Meeting, Rio de Janeiro, 22-27 September 2002: preprints*, 611.

²³ Watrous. *The Craft of Old-Master Drawings*, 12.

lead to one part tin. Unalloyed lead is quite soft, so the tip dulls quickly with use. Tin is so hard that it will only leave a mark on a very tough surface and is likely to damage the surface of most grounds. By mixing the two, the negative characteristics of each are minimized and an effective tool is formed. Gold and silver are also almost always alloyed with a small amount of copper because they are also too soft on their own. Brass, an alloy of copper and zinc, and bronze, an alloy of copper and tin, vary greatly in their proportions and often also include lead and zinc.

Through analytical techniques, mercury is often detected as a component of silverpoint. Its presence may be due to the use of silver amalgam or from later contamination.²⁴ Medieval metallurgists used mercury to form silver amalgam in the process of collecting bits of silver from workshop floors for reuse. It is possible that the amalgam was mistaken for silver and used to make a stylus or that some of the mercury remained in the silver after the purification process. Alternatively, the mercury may have contaminated the silver years later.

All types of metalpoint appear gray when first drawn (including gold and copper) and light metals such as silver produce a mark that is darker in value than the solid metal. As the metals are exposed to the air, they begin to tarnish, or oxidize, producing corrosion products that alter their appearance. Color changes vary according to metal composition, air quality, exposure to light, and the grounds they are applied to.

²⁴ Alain Duval. "PIXE Analyses of Metalpoint Drawings." In *6th International Conference on Non-destructive Testing and Microanalysis for the Diagnostics and Conservation of the Cultural and Environmental Heritage: Rome, May 17th-20th 1999: Proceedings*, eds. Maurizio Marabelli and Concetto Parisi, 1007-1022. Italian Society for Non-destructive Testing, 1999. and Kristi Dahm. "The Stylus Revealed: A Metalpoint Identification Study of 15th and 16th Century Drawings in the Metropolitan Museum of Art." *The Paper Conservator* 28 (2004): 81.

Color changes may occur within a month to several years after the mark is produced. The marks may also become more transparent with age. The following is a list of the chemical changes that occur and the color changes that they produce:²⁵

Silver:	Formation of silver sulfide.	Turns warm brown and darker in value.
Gold:	No change.	No change.
Lead:	Formation of lead carbonate.	Turns bluish and darker in value.
Tin:	Formation of tin salts.	Remains light in value.
Bismuth:	No change.	In severe pollution, may darken.
Copper:	Formation of copper carbonate.	Turns greenish or yellowish.
Brass:	Light gray zinc modifies the green patina of copper.	Turns yellowish or green gold.
Bronze:	Light gray tin salts modify patina of copper.	Turns yellowish or green gold.

Identification of Materials

The identification of the types of metals used in metalpoint drawings by visual examination can be difficult, if not impossible, because of the number of variables involved.²⁶ Metals do not tarnish consistently and their color may vary depending on the type and color of the ground they are applied to. Metalpoint can also be difficult to distinguish from graphite in some cases. The presence of a ground is a good indication of metalpoint, but in the case of lead on unprepared paper, the two may be more difficult to

²⁵ Watrous, *The Craft of Old-Master Drawings*, 20 and Ellis, "Metalpoint Drawings," 59.

²⁶ Dahm. "The Stylus Revealed," 75.

distinguish. Watrous offers a rather unscientific approach as he describes that under the microscope, leadpoint appears more striated and the particles appear more “eccentrically deposited” than graphite particles.²⁷

Several studies have been conducted using non-invasive analytical techniques to identify the materials used in metalpoint drawing. Kristi Dahm successfully identified materials present in the media and ground using X-Ray Fluorescence (XRF), but found that Multispectral Infrared Reflectography (MSIRR) yielded inconclusive results. Both Montelbano and Duval reported positive results using Particle Induced X-ray Emission (PIXE) in their identification studies. And Reiche, et al. conducted multiple successful studies using PIXE and Spatially Resolved Synchrotron Radiation Induced X-ray Florescence (SR-XRF).

The main arguments in conservation literature for the use of analytical techniques for metalpoint identification are to avoid mislabeling and for the possibility of aiding authentication efforts. These reasons seem insufficient to justify the risk and expense involved in the examinations.

To date, none of the studies that have been completed adequately explain the benefits of acquiring the knowledge that they seek. Dahm suggests that the identification of the composition of the media could aid in the authentication of drawings by linking artists to certain types of styluses or by creating an historical timeline of when which metals were used. There are far too many variables and too little historical evidence for this to be a valid argument. Not enough is known about how Renaissance artists acquired, stored, or employed their styluses. Did they only have one to choose from or a

²⁷ Watrous. *The Craft of Old-Master Drawings*, 16.

variety at the ready in their studio? Did they share them with the others artists at work in the studio? Did they have precise control over the metallic compositions? It is also not known if there truly is an historical trend in the use of certain metals for drawing.

Another problem with the use of analytical techniques for the identification of metalpoint drawing materials is that the conclusions drawn are subjective and may be flawed. The interpretation of the spectra in these types of analyses is not straightforward. The apparatus collects data on all of the materials of the object together, so the researcher must attempt to isolate the data on the targeted materials from the rest of the object. For example, in order to determine the composition of the media, the researcher must “subtract” the spectra of the ground and the paper from the spectra of the entire object. This process can be difficult, as the researcher must use parts of the object that do not contain any media to determine what to subtract. If the ground and the paper are not consistent in thickness or composition, the results will be inaccurate.

Common Conditions and Treatment Options

Due to the nature of the materials and construction, metalpoint drawings are susceptible to certain types of deterioration. Common condition problems stem from the loss of adhesion of the ground to the substrate, abrasion and staining of the surface, and the formation of corrosion products on the surface of the ground from the reaction of the lead component in the ground with sulphur in the atmosphere. Most of the condition problems arise from improper storage and handling. Many Renaissance metalpoint

drawings developed these conditions from decades of over-exhibition and rough use at the time of production.²⁸

Regardless of the media, drawings on prepared paper pose challenges to the conservator because basic conservation treatments, such as dry cleaning and aqueous washing, are damaging to the surface. There has not been much variation in the materials and techniques used over time, so conditions and treatment needs are quite consistent for all metalpoint drawings.²⁹

Staining and Abrasion

The surface of prepared paper is quite fragile and friable. It can easily be marked and abraded by the slightest contact. Shuffling loose sheets together and other careless handling will quickly abrade the surface of the ground. Scratches in the ground below the media result in the total loss of the metalpoint line.

Because the powdery ground is naturally absorbent, metalpoint drawings are often disfigured by fingerprints and other oily stains. The ground is also water-soluble, so in high humidity, the ground will wick up water from the atmosphere along with the soiling it contains. The ground becomes soft and dull in the presence of water, and tide lines are typically left behind.³⁰

It is inappropriate to attempt to remove surface blemishes with eraser crumbs or other dry cleaning methods, because the friction would burnish and darken the surface of

²⁸ Montalbano. "Italian Metalpoint Drawings: International Studies of the Artistic Technique." *ICOM 13th Triennial Meeting, Rio de Janeiro, 22-27 September 2002: preprints*, 613.

²⁹ Ellis. "Metalpoint Drawings" *Drawing 2*, no. 3 (1980): 59.

³⁰ *Ibid*, 60.

the ground. Aqueous washing is also inappropriate due to the solubility of the ground. Treatment with bleach should be avoided, as both oxidative and reductive bleaches may cause discoloration of the naturally oxidized media.³¹

A somewhat reversible cosmetic treatment, which may be appropriate in some cases, is the retouching of the surface with artist pastels.³² The decision to attempt this treatment should be based on the condition of the object, paying particular attention to the stability of the ground. Removal of the pastel may be attempted by stroking the media with a soft brush and blowing it with dry air.³³

Foxing

Prepared papers are usually quite resistant to foxing, but on occasion foxing may be found. This condition is believed to be caused by exposure to high relative humidity. Foxing on prepared paper should be left untreated, as any effective treatment would damage the surface of the ground. Standard aqueous treatment for foxing would result in a dark spot and halo effect, worsening the aesthetic disruption of the original condition.³⁴

Flaking

The flaking of the ground from the substrate is a common condition caused and/or aggravated by inappropriate environmental conditions. A dry environment may cause the

³¹ Ash, 4.

³² Eric Harding. "Restoration of Drawings Executed on Prepared Paper." *The Conservator* 2 (1993): 27.

³³ Ibid, 27.

³⁴ Ibid, 26.

binding medium of the ground to dry out and lose its ability to adhere to the paper.³⁵

Widely fluctuating relative humidity is another cause of flaking. Because paper is hygroscopic and the ground is less so, the two materials expand and contract at different rates in the presence of moisture. The ground has a tendency to pull away from the surface of the paper, as it is unable to shrink and swell along with the substrate.³⁶

Blackened white lead

White lead was commonly used in the grounds and as highlights on metalpoint drawings. This pigment has long been known to turn black with age. The condition is caused by a reaction between the lead pigment and sulphur in the atmosphere. White lead is basic lead carbonate ($\text{PbCO}_3 \cdot \text{Pb(OH)}_2$), which is unstable in the presence of sulphurous compounds. It readily reacts with hydrogen sulphide to form black lead (II) sulfide (PbS).³⁷ This reaction has also been attributed to the microbial action on the glue binders present in the ground.³⁸ Blackening can also occur on 18th and 19th century restoration treatments covering stains and other blemishes.³⁹ As these early restoration efforts were often performed using white lead pigment, the restorations, themselves, will blacken with age.

Quattrocento artists were aware that white lead was likely to blacken with time, as Cennini warns the apprentice of the phenomenon in his manual.⁴⁰ Despite this flaw, the

³⁵ Ellis. "Metalpoint Drawings" *Drawing* 2, no. 3 (1980): 60.

³⁶ *Ibid*, 60.

³⁷ Gettens, Rutherford J., Hermann Kühn, and W. T. Chase. "Lead White." *Studies in Conservation* 12, no. 4. (1967): 5.

³⁸ Smith, 250.

³⁹ Harding. "Restoration of Drawings Executed on Prepared Paper," 26.

⁴⁰ Cennini, *The Craftsman's Handbook "Il Libro dell' Arte,"* 34.

pigment was preferred to other whites because of its brilliance and great covering power. During the Renaissance, drawings were often used as tools in the workshop for working out compositions for paintings. Artists did not often avoid the use of white lead for drawing if it was only necessary for it to survive for the duration of the project.⁴¹

Blackened white lead is often extremely distracting to the composition of the work, and can result in the total loss of the meaning of the image. When the highlights of an image become the darkest darks, it can become difficult for the human eye to interpret the three-dimensional illusion that the artist intended.

Standard conservation treatment for the reversion of blackened white lead is local application of ethereal hydrogen peroxide with a soft brush. It has also been reported that the application of peroxide gels and vapors have also been effective.⁴² The peroxide oxidizes the black lead sulphide (PbS) to lead sulphate (PbSO₄), which is white and has very similar morphological characteristics to the original pigment material.⁴³

Storage and Handling

Because the majority of the condition problems commonly found on metalpoint drawings are caused by improper handling and storage, preventive measures should be the priority. Proper protection of the surface of the drawings and control of atmospheric conditions may protect the works of art from all avoidable deterioration. Metalpoint drawings should always be stored in an acid-free mat, which will protect the surface from

⁴¹ Ames-Lewis. *Drawing in Early Renaissance Italy*, 38.

⁴² Margo R. McFarland. "The Whitening Effects of Peroxide Gels on Darkened Lead White Paint." *The Book and Paper Group Annual* 16 (1997).

⁴³ Ibid.

abrasion and staining. The environmental conditions should be kept as stable as possible and extremes in relative humidity should be avoided in order to avoid flaking and foxing. Particularly if the ground is actively flaking, the drawing should not travel or come in contact with static acrylic sheeting.⁴⁴

Conclusion

Metalpoint is an intriguing, though often forgotten, art form that holds an important place in the history of art. Its unique aesthetic qualities and challenging technical requirements make it a highly respected and cherished drawing medium. The materials and structure that create these characteristics render most standard conservation treatments inappropriate. The preservation measures of controlling storage and handling conditions are the best means of ensuring that this unique and fascinating medium continues to survive.

⁴⁴ Ellis. "Metalpoint Drawings" *Drawing 2*, no. 3 (1980): 60.

References

- Ames-Lewis, Francis. *Drawing in Early Renaissance Italy*. New Haven, CT: Yale University Press, 1981.
- Ash, Nancy, ed. *Paper Conservation Catalog*. American Institute for Conservation of Historic and Artistic Works, Book and Paper Group, 1985.
- Brown, Hilton. "Looking at Paintings." *American Artist* (May 1981): 70-98.
- Cennini, Cennino d'Andrea. *The Craftsman's Handbook "Il Libro dell'Arte"*. Translated by Daniel V. Thompson, Jr. New York: Dover, 1960.
- Dahm, Kristi. "The Stylus Revealed: A Metalpoint Identification Study of 15th and 16th Century Drawings in the Metropolitan Museum of Art." *The Paper Conservator* 28 (2004): 75-86.
- Doherty, M. Stephen. "The Shimmer of Silverpoint Drawings." *American Artist* (August 2000): 64-70.
- Duval, Alain. "PIXE Analyses of Metalpoint Drawings." In *6th International Conference on Non-destructive Testing and Microanalysis for the Diagnostics and Conservation of the Cultural and Environmental Heritage: Rome, May 17th-20th 1999: Proceedings*, Eds. Maurizio Marabelli and Concetto Parisi, 1007-1022. Italian Society for Non-destructive Testing, 1999.
- Ellis, Margaret Holben. "Metalpoint Drawings: Special Conservation Problems for Collectors." *Drawing* 2, no. 3 (1980): 59-61.
- Gettens, Rutherford J., Hermann Kühn, and W. T. Chase. "Lead White." *Studies in Conservation* 12, no. 4. (1967): 125-139. <http://links.jstor.org/sici?sici=0039-3630%28196711%2912%3A4%3C125%3ALW%3E2.0.CO%3B2-0>
- Graf, Roy. "Techniques and Subsequent Deterioration of Drawings." *ICCM Bulletin* 5, no. 1 (1979): 16-19.
- Harding, Eric. "Restoration of Drawings Executed on Prepared Paper." *The Conservator* 2 (1993): 24-28.
- McFarland, Margo R. "The Whitening Effects of Peroxide Gels on Darkened Lead White Paint." *The Book and Paper Group Annual* 16 (1997): 55-65.
- Montalbano, Letizia and others. "Italian Metalpoint Drawings: International Studies of the Artistic Technique." *ICOM 13th Triennial Meeting, Rio de Janeiro, 22-27 September 2002: preprints*, ed. Roy Vontobel, 609-614. James & James (Science Publishers) Ltd., 2002.

- Painters Studio: Artist Materials and Techniques*,
<http://paintersstudio.com/drawing/metalpoint.php> Accessed October 23, 2007.
- Reiche, I. and others. "Nondestructive investigations of Durers Silverpoint Drawings by PIXE and SR-XRF." In *Art 2002: 7th International Conference on Non-destructive Testing and Microanalysis for the Diagnostics and Conservation of the Cultural and Environmental Heritage: 2-6 June 2002, Congress Centre Elzenveld, Antwerp, Belgium: Proceedings*, eds. Grieken, R van and others. University of Antwerp, 2002.
- Reiche, I. and others. "Spatially Resolved Synchrotron Radiation Induced X-ray Fluorescence Analysis of Rare Rembrandt Silverpoint Drawings." *Applied Physics A- Materials Science & Processing* 83 (2006): 169-173.
- Schmidt, Charles. *Silverpoint Etcetera: Contemporary American Metalpoint Drawings*. Elkins Park, PA: Entourage: Exhibitions, 1992.
- Shechter, Laura. "Art Currents: Silverpoint and Meticulous Drawing Techniques by Old Masters & Contemporary Artists." (Lecture to the National Arts Club, New York City, 10/16/2000) in *Biddington's Art Gallery Website*,
<http://www.biddingtons.com/content/silverpoint.html>
- Silverpoint Drawing Complete*, <http://silverpointweb.com/> last updated, January 2007.
- Smith, Gregory D., Alan Derbyshire, and Robin J.H. Clark. "In Situ Spectroscopic Detection of Lead Sulphide on a Blackened Manuscript Illumination by Raman Microscopy." *Studies in Conservation* 47 (2002): 250-256.
- Watrous, James. *The Craft of Old-Master Drawings*. Madison, WI: The University of Wisconsin Press, 1967.
- Weber, Bruce. *The Fine Line: Drawing with Silver in America*. West Palm Beach, FL: Norton Gallery and School of Art, 1985.

Illustrations



Leonardo da Vinci, *Study of Hands*, c. 1474
Silverpoint with White Highlights on Pink Prepared Paper, 214 x 150mm
Royal Library, Windsor



Albrecht Dürer, *The Painter Lucas van Leyden*, 1521
Silverpoint on paper, 244 x 171 mm
Musée des Beaux Arts, Lille



Joseph Stella, *Flower Study*, c. 1919
Silverpoint and Crayon on prepared paper, 32.8 x 16.5 cm
Smithsonian American Art Museum
http://nmaaryder.si.edu/search/search_artworks1.cfm?StartRow=1&ConID=4624&format=long



Richard A. Kirk, *Giantess and the Jelly Tots*, 2006
Silverpoint on board
<http://www.richardakirk.com/giantess.html>