Any additions to the file of watermarks that has been compiled will not only improve our understanding of Rembrandt's progress on his plates, but will enable us to test and refine the conclusions reached so far. — Erik Hinterding

It is no exaggeration to say that Rembrandt's etchings count among the most compelling examples of artistic production in the history of Western culture. The many catalogues of the artist’s prints compiled since 1751—describing multiple states, ordering works by subject matter or by date, distinguishing his work from that of his pupils, and identifying copies and posthumous impressions—attest to the enduring fascination with Rembrandt's technical experimentation and his versatility in interpreting the human psyche and capturing the natural world. Not surprisingly, the complexity and artistic creativity of these prints continue to inspire scholarly research, technical investigation, and multidisciplinary teaching approaches. As such, in addition to their acquisition by larger municipal museums, there is a history of collecting Rembrandt etchings among American college and university museums in the last century, a phenomenon explored further in Andaleeb Badiee Banta's essay (pages 11-21).

Beginning with an initial collecting of prints during the 1940s, students' encounters with Rembrandt as printmaker at Cornell University have been pursued through connoisseurship, exploration of subject matter and seventeenth-century Dutch culture, and an introduction to the artist's process and materials. These efforts have been supported by a number of Rembrandt-related exhibitions at the Johnson Museum over the years, and were particularly catalyzed in the 1990s and 2000s thanks to the former Richard J. Schwartz Director Frank Robinson's specialization in seventeenth-century Dutch art. Stephanie Wiles's strong background in works on paper has supported further initiatives since she assumed the directorship in 2011; the present exhibition is the largest of these devoted to Rembrandt at Cornell.
Since 2015, a cross-disciplinary research project, Watermark Identification in Rembrandt’s Etchings (WIRE), has focused students’ attention and research efforts on the subject of Rembrandt’s watermarks. The project is meant to teach students about the importance of watermarks as a means to understand the artist’s printing practice, and to enable their contribution to an interactive online program designed to simplify the watermark identification process and further clarify aspects of Rembrandt’s printing process and chronology. From its inception, the project has proceeded as a series of semester-long courses, blending aspects of the art history seminar and the engineering research group and drawing students of various disciplines to participate, some for multiple semesters. This essay is intended to provide background for the current state of watermark study in Rembrandt’s prints, to elucidate the WIRE project’s dialogue between the disciplines of art historical inquiry and computational study, to chart its progress thus far, and to explore its implications for cross-disciplinary collaborations on the college and university level. It will make the case for a steady digital expansion of the taxonomy of watermark types compiled by Nancy Ash, Shelley Fletcher, Erik Hinterding, and others over the past three decades, and hint at useful possibilities its procedures have generated.

With each semester, new WIRE project students have been steeped in the lessons of previous watermark research. As such, it seems appropriate first to outline here the issues and history surrounding Rembrandt’s paper supports and watermarks, tapping the store of knowledge that has given rise to the present investigations. The following therefore might be considered a short primer for understanding Rembrandt’s papers and the usefulness of watermarks as a tool for reconstructing his printing practices.

Interest in Rembrandt’s printing supports has a long history, dating almost as far back as the production of the prints themselves. At least as early as 1668, a year before the artist’s death, collectors were admiring the artist’s use of Asian papers for the printing of certain impressions. Englishman Edward Browne, while traveling in Amsterdam, noted finding Rembrandt impressions on “Indian” paper. This expensive paper actually came from Japan, but it is sometimes confusingly referred to as “Indian” paper because the Dutch East India Company was the trade vehicle. Rembrandt seems to have first made prints on Japanese paper in 1647. After this, he frequently used Japanese paper for early editions—print runs of perhaps twenty-five to fifty impressions—especially for prints with dark tonalities or heavy use of drypoint, because he understood the ability of these less-absorbent papers to show heavily-inked areas to more harmonious effect than European papers (cat. nos. 10, 12, 29, 43, 48, 51, 52, 64, and 65). Rembrandt also printed on other supports, including coarse grayish cardoes papier (cartridge paper) meant for packaging gunpowder, and, also beginning around 1647, on vellum, or calf skin (cat. no. 44). Rembrandt’s use of different supports has been studied extensively and, as here, the inclusion of a range of these has become frequent in exhibitions of his prints.

Of all of these support types, however, only laid papers of European manufacture can situate individual impressions in time, or group them with other prints from the same edition, through the characteristics imparted by the papermaking process. In the paper mills of Rembrandt’s Europe, this depended on a steady rotation of pairs of handheld paper molds or sieves (fig. 2), consisting of wooden frames with rows of very closely spaced horizontal wires called laid wires, fastened to the mold with rows of more widely spaced vertical wires called chain wires (fig. 3). A single overlay frame called a deckle fit both molds precisely, to confine the formed sheet to an even rectangle as each mold was dipped in turn into the vat of pulp.

Watermarks, designs made from bent wire, were attached to the grid of each paper mold to indicate the maker or geographical origin, or sometimes its intended market. Since two molds were used in the production process, these watermarks were made as identical as possible to each other so that the resulting batch of paper was uniformly marked. But because molds and watermarks were handmade, slight variations occurred between them, which is why the nearly identical watermarks from a pair of molds are referred to as “twinmarks.” In addition, due to the increasing need for successful papermakers to set their papers apart from imitators, French and then German papermakers began to attach a second watermark, called a countermark (usually letters or words), to the mold during the sixteenth and seventeenth centuries. Typically, with European papers, the main watermark was found on the right side of the mold, while the countermark was found on the left. The tendency of the paper pulp to settle more thinly over the wires and watermark of the mold is what transfers these characteristics to the finished sheet of paper.

Especially in the case of larger sheets, watermarks and countermarks occupied relatively little of the area of the sheet, which means that an impression from a small copperplate will often be printed on a portion of the paper that does not include the watermark. The result is that only about one third of Rembrandt’s etchings printed on European papers display a watermark or part thereof. Even so, the presence of watermarks in this approximate third of Rembrandt’s prints on European paper has enabled a significant increase in knowledge about Rembrandt’s production practices. In addition, certain geopolitical and
FIG. 2 Modern laid paper mold and deckle made by Timothy Moore.

FIG. 3 Detail of Moore's mold, showing horizontal laid wires, vertical chain wires, and wire watermark design.

mercantile circumstances can help explain the appearance or disappearance of certain papers in Rembrandt's work.

Only a fraction of the paper used in the Netherlands during the first two thirds of the seventeenth century was produced there. This is largely because papermaking required fast-moving streams or rivers, rare in the Low Countries, to power paper mills. For example, many of Rembrandt's earlier prints appear on Swiss paper marked with the canton of Basel's heraldic sign, the Basel Crosier (see cat. nos. 1 and 59). With the gradual removal of wartime obstacles to seaborne trade, as well as the treaties of Münster and Osnabrück in 1648, which ended continental wars including that of the Dutch with Spain, paper from southwestern and central France began to appear in greater quantities on the Dutch market. This paper was often either made in French mills owned by Dutch entrepreneurs, or brokered by Dutch merchants. This explains both the relatively sudden advent of watermark types not previously seen in the Netherlands, such as the Phoenix and the Paschal Lamb, and perhaps, more importantly for Rembrandt studies, the disappearance of once common Swiss papers as the market shifted. This also resulted in many French papers marked specifically for the Dutch market, bearing, for example, the coat of arms of the city of Amsterdam, or referencing the seven provinces of the Dutch Republic.

Scholars have been examining the watermarks found on artists' papers at least since the late nineteenth century. But the study of watermarks in these early days relied largely on freehand copying or tracing of watermark designs, which, due to the difficulties of properly seeing watermarks on heavily inked sheets, complicated the process of assembling exact matches required to reunite sheets from the same mold and confidently draw conclusions about printing practices. It has only been with the advent of photographic techniques such as betaradiography, as pioneered since 1980 by Nancy Ash and colleagues in the United States, that it has been possible to systematically obtain clear radiographic images of watermarks. In the later 1980s, the members of the Dutch Rembrandt Paper Research Project developed a method for recording watermarks on Rembrandt prints in the collection of the Rijksmuseum using low-energy or grenz x-ray technology. These technology-intensive methods, and to a lesser extent, even simple transmitted and raking light photographs, have allowed researchers to overcome the inconsistencies of previous watermark tracing methods and enabled the exact matching of watermarks.

The significance of watermarks to understanding Rembrandt as printmaker

The availability of images, combined with exhaustive research, has led to important conclusions about Rembrandt's practice. The WIRE project at Cornell is based primarily on the pioneering scholarship contained in Erik Hinterding's book Rembrandt as an Etcher: The Practice of Production and Distribution, which appeared in 2006 as an expansion of Nancy Ash and Shelley Fletcher's 1998 publication Watermarks in Rembrandt's Prints. Hinterding's work has greatly enhanced the picture of Rembrandt as printmaker, offering conclusions about the types and quantities of paper the artist was accustomed to use.

According to the system Hinterding adapted from Ash and Fletcher, within each type (Basilisk, Double-headed Eagle, Arms of Amsterdam, etc.) the differing variants are
FIGS. 4, 5 Can you spot the differences? Radiographs of Double-headed Eagle twinmarks A.a.a. (top) on an impression of Naked Woman Seated on a Mound, ca. 1631, in the British Museum, London, and A.a.b. (bottom), on an impression of Diana at the Bath, ca. 1631, in the Uffizi, Florence. (Images courtesy of Erik Hinterding)

assigned uppercase alphabetical designations—A, B, C, D, and so forth. Watermarks that share characteristics within these variants but are not identical to each other are termed subvariants, and given a further set of lowercase initials—A.a. and A.b., etc. Within subvariants, Hinterding distinguished twinmarks with a further set of lowercase letters. For example, papers designated A.a.a. and A.a.b. would be twinmarks from the same batch (figs. 4, 5).30

Each watermark subvariant stands for a batch of paper; all told, Rembrandt is believed to have used more than 250 such batches in his career. WIRE project discoveries have already begun to augment that number. Hinterding's research also revealed Rembrandt's practice of making plate changes for successive states in rapid succession, often within the availability of a single batch of paper. He also discovered that, of all the different plates printed on a given batch of paper, those with the most recent dates are almost invariably the freshest, darkest impressions, while impressions from earlier plates on the same paper often showed wear. This phenomenon revealed Rembrandt going back to his stock of earlier plates to reprint them along with new ones, and led to the rule of thumb that the latest in-plate date of a plate on a given paper often dates the group of all plates printed on it.31

Often, watermarks can be used to assist in the virtual reassembly of the remaining impressions from an edition. For example, research for the WIRE project has revealed that Harvard University Art Museums' fourth-state impression of the Christ Crucified between the Two Thieves: 'The Three Crosses' (cat. no. 37) bears an example of the Strasbourg Bend D.a. watermark. This discovery adds it to the only four other known impressions of this print in this edition of the fourth state, the paper datable to circa 1653.32 Another example is Christ Preaching ('La Petite Tombe') (cat. nos. 48-50); various impressions of this popular print are known on papers with the Q.a.a. and Q.a.b. twinmarks of the Foolscap with Five-Pointed Collar watermark, to which the WIRE project research has now added a new instance (cat. no. 49).33

As previously mentioned, watermarks can also be used to reassemble groups of plates all printed at roughly the same time. In the exhibition, impressions of Self-Portrait Leaning on a Stone Sill (cat. no. 3; fig. 6), The Hog (cat. no. 23; fig. 7),34 and Ephraim Bonus, Jewish Physician (cat. no. 9) all appear on the same paper marked with an image of a Basilisk, the twinmarks A.a.a. and A.a.b. (figs. 8a,b).35 This shows Rembrandt going back to reprint earlier plates—in this case, the self-portrait is reprinted approximately eight years after its first creation. Twenty-five different plates appear on this large-format Basilisk A.a.a. paper, indicating that Rembrandt must have bought a rather large batch of it.
FIG. 6 Transmitted light detail of *Self-Portrait Leaning on a Stone Sill* (cat. no. 3), with Basilisk twinmark A’.a.b., image reversed. (Image courtesy of Theresa Fairbanks-Harris)

FIG. 7 Beta-radiograph detail of *The Hog* (cat. no. 23) with partial Basilisk twinmark A’.a.a. (Image courtesy of the Conservation Center, Institute of Fine Arts, New York University)

FIGS. 8 a,b Radiographs of Basilisk twinmarks A’.a.a. (left) and A’.a.b. (right) both on impressions of *Presentation in the Temple: Oblong Print*, ca. 1640, in the Rijksmuseum, Amsterdam. (Images courtesy of Erik Hinterding)
given the potential future income they would represented. And he did demonstrably release or sell some of his plates during his lifetime, notably portrait plates that remained with the sitter, presumably either as a gift or as part of the commissioning arrangement.

One such example is the plate for his famous portrait of Jan Six (cat. nos. 10 and 11), which remains with Six’s descendants in Amsterdam to this day. And, in at least one documented case, Rembrandt sold the plate of Abraham Casting Hagar and Ishmael, 1637 (NHD, no. 166), to the Portuguese painter Samuel ben Orta. Others obtained Rembrandt plates during the artist’s lifetime. For instance, the Amsterdam print publisher Dancker Danckerts owned the plate for Descent from the Cross: Second Plate (cat. no. 25) and an unidentified Saint Jerome subject, as documented in his inventory of 1667 found in the Amsterdam city archives. Other evidence in the form of a large shipment of 189 Rembrandt etchings to Italian collector Antonio Ruffo in Messina, sent just before Rembrandt’s death on October 4, 1669, suggests that Rembrandt was still actively involved in distributing impressions of his prints from a variety of plates even at that late date.

The Amsterdam print publisher and connoisseur Clement de Jonghe (ca. 1624–1677) appears to have been the recipient of the greatest number of Rembrandt’s copper-plates—seventy-four of them—as shown by the 1679 inventory of his shop and home. Little is known about the relationship between Rembrandt and de Jonghe, but the two must have known each other at least since 1651 when Rembrandt etched his portrait (cat. nos. 12–15). No documentation is known showing exactly when de Jonghe obtained plates from the artist, although it is possible he received some during Rembrandt’s lifetime. Study of the watermarks found jointly on Rembrandt impressions and on other artists’ prints from Clement de Jonghe’s stock seems to argue for the latter’s obtaining plates from Rembrandt at least later than 1656. Increased access to watermark images and their comparative study proposed by the WIRE project may shed greater light on this topic in future.

### The Cornell WIRE project: Goals, methods, and progress

The Watermark Identification in Rembrandt’s Etchings (WIRE) project at Cornell is a collaboration among the Johnson Museum and the School of Electrical and Computer Engineering in Ithaca, Cornell Tech in New York City, and key external museums and technical experts (see Appendix 1). Conceived on a model of participation by cross-disciplinary student teams with the oversight of Cornell faculty and Johnson Museum staff, WIRE is dedicated to ongoing research and interface development to significantly streamline access to and raise awareness about Rembrandt’s watermarks for printing practice and chronology purposes. The project aims to establish new
research tools available to a collaborative community of users—curators, students, collectors, art historians, archivists, librarians, and other humanities professionals. These tools are necessary because, given the hundreds of subvariants within the watermark types (with more being discovered), as well as the difficulties inherent in distinguishing between marks (even in high-quality photographic images), there remains significant risk of error in comparing an unidentified watermark with those illustrated in Hinterding’s publication.

The WIRE project originated from a related initiative, the Chain Line Pattern Matching Project (CLiP), launched in 2012 when paper conservator Margaret Holben Ellis encouraged Professor C. Richard Johnson, Jr. to consider applying his computational approach to thread counting for canvas weave matching in historic paintings, in which Professor Johnson had been successfully engaged for years, to mold screen pattern matching for laid papers. Johnson and Ellis set about matching chain line patterns in Rembrandt’s papers to determine the feasibility of finding moldmates (sheets of paper made from the same mold) without using watermarks. In 2014, the Dutch University Institute for Art History in Florence granted the project access to a large dataset of radiographs of Rembrandt’s papers, which featured many moldmates identified by matching watermarks. This spurred the creation of a semiautomated software tool for marking and matching chain line patterns, which prompts the user to click on three spots in the images and then automatically marks a user-selected number of spots along each chain line on the radiograph of a given sheet. The marked locations can then be used to compose straight line patterns drawn through the marked points. The similarity of chain line patterns in all pairings of images in the full dataset can be ranked. A top ranked set of four matching chain line patterns was thus discovered in the dataset from the Dutch University Institute for Art History. Three of the images contained only fragments of the top of a foolscap watermark, but their chain line pattern match helped confirm that all could be identified as Foolscap with Five-Pointed Collar, Hinterding subvariant K.a.a.

The large size of the dataset, and the need to use watermarks for verification in assessing the accuracy of the CLiP similarity evaluation procedure, drove the need for a faster, computer-assisted means of classifying watermarks according to the Hinterding taxonomy. The shift from using watermark identification as a step in chain line pattern matching performance assessment to using chain line pattern matching in service to watermark identification, in particular with fragments and twins, gave rise to the first gathering of a cross-disciplinary student research group at Cornell in the fall semester of 2015. Dr. Hinterding’s direct involvement in the project from its inception stemmed from a desire to preserve the watermark taxonomy he inherited and expanded. This connection was facilitated by Professor Johnson’s appointment as scientific researcher at the Rijksmuseum.

During the subsequent four academic semesters, the WIRE project has proceeded as a hybrid of an engineering research group and an art history seminar, composed of students with different academic backgrounds and skill sets (see Appendix 1). Guided by the present authors, they are responsible for foundational readings and discussion as well as individual progress on watermark decision tree branches by type, group feedback sessions, and presentations on related topics. The group is conceived as a learning laboratory where students contribute to the ongoing development of a cross-disciplinary learning model in the computational art history field, squarely aligned with the Johnson Museum’s teaching mission and emphasis on learning from original works of art.

The WIRE project’s objective is to build an interrogatory, computer-based interface that delivers a definitive watermark identification according to the fifty-four types of Rembrandt watermarks encompassed in Hinterding’s taxonomy. Its identification tool is based on the model of the decision tree, a branching graph that allows the researcher to visualize all possible outcomes of a series of decisions (fig. 1), a sort of visual algorithm or procedure for solving a recurrent problem. This particular approach was chosen in large part because it best approximated Hinterding’s winnowing process for separating subvariants when he assembled the 2006 publication.

In the WIRE project, students construct decision tree branches for watermark types that take the form of a sequence of comparison images and questions with binary answers—“yes/no,” “one/two,” “square/rounded,” etc.—about features of the watermark and its placement on the mold. These questions develop incrementally from close visual observation and comparison, and are vetted by the group for clarity. The questions guide the researcher quickly and consistently to the correct watermark subvariant, unlocking access to information about the dating of the print where known. Differentiation between watermarks frequently exploits the often crucial placement of watermark elements relative to chain lines in the laid paper mold as a unique distinguishing feature. All such identifying features are scale-invariant—they relate to relative position, number, and size of features within the image, but do not rely on matching the exact dimensions of a given watermark. This aspect allows the user to compare multiple image sizes and formats with the visual models provided in the decision tree, even images in different scales.
The virtue of the WIRE project's current focus on Rembrandt is the manageable and definable dataset going forward. The benefit of semiautomation rather than an automated, machine-learning approach to similarity assessment for this project is that the knowledge of the original watermark experts is maintained and enhanced by the WIRE student researchers in the form of a verbal record of distinguishing features presented in the questions asked of the researcher. This subject expert terminology is already watermarks experts is maintained and enhanced by the automated, machine-learning approach to similarity assess­­ment for this project is that the knowledge of the original watermark experts is maintained and enhanced by the automated, machine-learning approach to similarity assessment for this project.

The resulting interface allows a user to upload a watermark image in any format in the image editor box at left, and select the matching watermark type from choices provided. The user then follows the short sequence of questions provided, with annotated images supplied for further guidance. The user may backtrack or start over at any time. Ultimately, the user will find an exact match with the subvariant letter designation found in Hinterding's 2006 book. Students have been drafting reports for each individual branch they complete, culling out information from the 2006 publication about other collections holding prints with that watermark, and other plates that appear on that paper, to offer context for each subvariant "answer." These reports are part of ongoing discussions with Dr. Hinterding for determining how, in the future, this information could appear online when the user arrives at the correct watermark subvariant.

The implications of new watermarks, and next steps
Along with the systematic student development of the decision tree and the software allowing users to access its store of visual differentiations, the WIRE project is focusing on museums whose Rembrandt print holdings were not surveyed and imaged for previous watermark catalogues. This newly gathered data will drive the project's second phase, that of developing an online database of Rembrandt watermarks in American collections. In addition, the present authors along with subsequent WIRE student cataloguing assistance are revisiting some collections whose Rembrandt watermarks were catalogued but not imaged in Hinterding's 2006 publication. The purpose of this is to verify existing watermarks, catalogue those not previously noted, and collaborate with curators and conservators to establish imaging procedures and parameters for the proposed database. Many of these collections are among the lenders to this exhibition and have generously lent time and expertise toward these efforts (see Appendix 1). As hoped, this process has already yielded a crop of new instances of previously identified watermarks; it has also uncovered new watermarks not already present in the Rembrandt taxonomy or previously associated with Rembrandt's prints.

For example, the plate for Rembrandt's Self-Portrait (?) with Plumed Cap and Lowered Saber (see cat. no. 1), dated 1634, underwent significant changes during Rembrandt's lifetime. In the first state, the composition began as a three-quarter length figure on a rectangular plate; in state two, the plate was cut down into a rough oval, keeping just the bust of the figure. In its third and final state, the oval plate was smoothed and regularized. Previous watermark study has shown that the initial cutting down of the plate happened relatively quickly, due to the existence of impressions of both first and second states on paper from the same batch bearing the Basilisk B.a. watermark. An impression of state two with an Arms of Würtemberg watermark—also appearing on other Rembrandt prints dating to 1634 and earlier—further helps to temporally situate the printing of the second state. Finally, an impression of state three features an Eagle with Basel Crosier watermark also found on impressions of Abraham Casting out Hagar and Ishmael (NHD, no. 166) from 1637. This means the plate was smoothed to its final oval prior to that date.

Building on this background knowledge, research for the WIRE project and new photography by the Yale University Art Gallery's paper conservation lab have revealed that the Yale impression of Self-Portrait (?) with Plumed Cap and Lowered Saber (fig. 11) also has an Arms of Württemberg mark (fig. 12) nominally of the A variant type. However, the mark exhibits previously unseen characteristics, indicating an apparently new subvariant, and thus a...
Does the eagle have one or two heads?

- Select -
  One head
  Two heads

Example: In the top images, the eagle has one head (marked with red).

Is there one central crown or two individual crowns?

- Select -
  One crown
  Two crowns

Example: In the top images, the double-headed eagle has one crown (marked with red).

FIGS. 9, 10 Screen shots showing two successive steps in the WIRE software for the identification of a test subject Double-headed Eagle watermark.
previously unidentified batch of paper used to print this plate. Correspondences with watermarks on archival documents further suggest that the Yale impression of Self-Portrait (?) with Plumed Cap and Lowered Saber was printed during the 1630s. Another third-state impression of this print has recently come to light, as a gift to the Johnson Museum from former director Frank Robinson in 2016 (cat. no. 1). This impression was found to show a Basel crosier watermark with initials “MB” flanking the crosier inside the shield (fig. 13). This watermark stood out because none of the variants published by Hinterding exhibits such initials. Indeed, in consultation with Dr. Hinterding it was deemed to be new to the Basel Crosier type. Since Swiss papers like this are rare in Rembrandt’s printing practice after the early 1640s, a printing date before 1642 might be advanced. Therefore, two new batches of paper can provisionally be added to the list of ten already associated with the printing of this plate between 1634 and 1651, both arguably early. As such, our picture of Rembrandt as printmaker continues to expand, and here also perhaps our sense of the popularity of the tronie type Rembrandt was creating by cutting down the plate.

A second example of a new watermark found on Cornell’s previously unpublished fifth-state impression of The Flight into Egypt: Altered from Segers (cat. no. 34) helps to reconstruct a batch of paper used for a later edition of the plate. Upon first examination, the watermark on this sheet (fig. 14) appeared to be a countermark IHS subvariant A.b. Indeed, the only print previously found on this paper was another fifth-state impression of the same print, in the Rijksmuseum (fig. 15). So the Johnson Museum print and the Amsterdam print appeared to be printed on moldmate sheets. However, a renewed examination of the Cornell IHS countermark revealed that it is in fact not an exact match to the Hinterding A.b. subvariant, but instead nearly identical due to the variation in the shape of the S, at the top. Therefore, rather than being moldmates, it seems logical to assume these countermarks might instead be twinmarks from the same pair of molds.

Two other impressions of the same state of The Flight into Egypt: Altered from Segers appear on papers bearing the respective twinmarks of the Strasbourg Lily 4WR A.b. subvariant. Both this mark and the IHS countermark are found only on that same print—and only in the fifth state. Additionally, all four impressions discussed here are printed on half sheets. Thus, given the evidence of watermarks and paper size, the IHS countermarks on the Cornell and Amsterdam impressions could logically be the twinmarks for the two impressions showing Strasbourg Lily with initials 4WR A.b.a., and A.b.b., which are also half-sheets, and also twinmarks. Additionally, the fact that the three impressions classified as state V-a all appear with either
IHS or Strasbourg Lily marks makes further sense because IHS is the countermark for some Strasbourg Lily 4WR A variants. If this is the case, the new Cornell watermark helps to reconstruct a later edition of The Flight into Egypt: Altered from Segers, and also becomes a new subvariant to be added to the Rembrandt taxonomy. Finally, a new instance of this same Strasbourg Lily watermark has come to light on an impression of the eighth state of Adoration of the Shepherds: A Night Piece (NHD, no. 300); since the date of this print is ca. 1657, this watermark indicates a print date for all of the impressions of The Flight into Egypt: Altered from Segers of not earlier than 1657, which fits with the wear exhibited by the plate in these impressions.

Cases like these underscore the WIRE project’s dedication to incrementally filling in gaps in Rembrandt’s printmaking chronology. From the standpoint of the decision tree branch construction, the discovery of new watermarks necessarily forces a reconsideration, and in some instances a reordering, of the decision tree branch for that watermark. Because the existing taxonomy and its images—extensive as they are—are the sources for the construction of the branch, a new question has become apparent: how to integrate a newly discovered watermark into the decision tree without upsetting the existing structure? In the case of the aforementioned Basel Crosier watermark with the initials MB, this task fell to Riley Henderson, Cornell Class of 2018, who had already developed the decision tree branch for the Basel Crosier mark and its eleven preexisting subvariants. Based on similarities of various details other than the letters, as well as the presence of a chain line running down the center of the shield, she proposed that the mark be added to the E variant group, where it has been given the subvariant designation “E.b.” becoming the twelfth Basel Crosier subvariant, with Dr. Hinterding’s approval.

The discovery of new watermarks and the alteration of the decision branch for the Basel Crosier watermark made clear that the decision tree software must be adaptive. This requirement is now under consideration by Professor Johnson, Cornell Tech electrical and computer engineering professor Vikram Krishnamurthy, and his PhD student Sujay Bhatt, who are treating these questions as an advanced applied mathematics issue, developing an algorithm for automating the insertion of new parts into the decision tree as they arise. For this reason, in the spring of 2017, WIRE students not only developed individual branch diagrams for Rembrandt watermark types (see figs. 1 and 16) and coded them into the software, but were also directed to construct decision “tables” (fig. 17A). For every subvariant of a particular watermark type, a decision table asks and answers all questions used in identifying all subvariants within that particular type, not just the questions asked of a user following one specific path to a particular subvariant. This richer set of information enables computational algorithms to revise and upgrade the original branch.

Further, careful reordering of the questions asked (fig. 17A) can lower the average number of steps required to receive a correct answer for any subvariant. For example, in
fig. 17B, the average number of questions to a solution when starting with Question 1 is \((2+2+2+4+4+3)/6 = 17/6 = 2.833\), which can be slightly reduced by starting with Question 4, producing an average of \((2+3+3+3+3+2)/6 = 16/6 = 2.667\). In some instances, this efficiency is helpful. In other instances, the ability to generate different tree diagrams based on these tables might enhance the ability to better identify watermarks from fragments (when a watermark is cut off at the edge of a sheet). When a fragmentary watermark is encountered, it may prove useful to redraw the pertinent decision tree so that the user is asked questions relevant to what is visible in the fragment first, before other questions. This ability of the decision table and pertinent mathematics to bring to light all the different possible decision tree branches makes the decision table a powerful tool, which could ultimately provide the foundation for a better method of drawing up and expanding decision trees. This could have broad applications in a range of disciplines.

As the project progresses, certain modifications will allow for the growth of the decision tree, and for the enhancement of the user interface. For example, in the process of developing a consistent methodology for imaging and comparing watermarks during the 1980 and 1990s, Nancy Ash and other colleagues strongly recommended accounting A: Decision Table

<table>
<thead>
<tr>
<th>Variant</th>
<th>Q1: Is the middle petal divided by a central line?</th>
<th>Q2: Are the three bars at the center of the Lily the same width?</th>
<th>Q3: Are the petals of the Fleur-de-lis close together?</th>
<th>Q4: Are the ends of the three bars at the center square?</th>
<th>Q5: Is the outer tip of one of the smaller leaves (at bottom) close to the chain line?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.a.</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>B.a.</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>B.d.</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>C.a.</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>C.b.</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>C.c.</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

B: Path Table

<table>
<thead>
<tr>
<th>Variant</th>
<th>Starting with Q1</th>
<th>Starting with Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.a.</td>
<td>Q1(N), Q3(N)</td>
<td>Q4(N), Q3(N)</td>
</tr>
<tr>
<td>B.a.</td>
<td>Q1(Y), Q2(N)</td>
<td>Q4(Y), Q1(Y), Q2(N)</td>
</tr>
<tr>
<td>B.d.</td>
<td>Q1(Y), Q2(Y)</td>
<td>Q4(Y), Q1(Y), Q2(Y)</td>
</tr>
<tr>
<td>C.a.</td>
<td>Q1(N), Q3(Y), Q4(N), Q5(Y)</td>
<td>Q4(N), Q3(Y), Q5(Y)</td>
</tr>
<tr>
<td>C.b.</td>
<td>Q1(N), Q3(Y), Q4(N), Q5(N)</td>
<td>Q4(N), Q3(Y), Q5(N)</td>
</tr>
<tr>
<td>C.c.</td>
<td>Q1(N), Q3(Y), Q4(Y)</td>
<td>Q4(Y), Q1(N)</td>
</tr>
</tbody>
</table>

FIG. 16 Decision tree branch for Fleur-de-lis watermark, developed by Phoebe Ross, Spring 2017

FIG. 17 Decision table for Fleur-de-lis watermark, developed by Phoebe Ross, Spring 2017
The seeds for WIRE’S proposed database of Rembrandt watermarks in American collections were presciently sown by Nancy Ash and her colleagues in 1986.\textsuperscript{7} The database image dataset (see Appendix 2).

sider questions of format and delivery of images, and have helped construct the WIRE project’s first nonradiograph Gallery, have been especially helpful in reexamining Yale’s Center for British Art, and Suzanne Boorsch, the Robert L. of paper for the Yale University Art Gallery and the Yale this regard, Theresa Fairbanks-Harris, senior conservator of the NU-ACCESS program at Northwestern University. In addition, to encourage standardized image gathering of watermarks and chain line patterns in Rembrandt’s etchings by museums with limited technical resources, a portable imaging system is under development in a collaboration with Paul Messier at the Yale University Lens Media Lab, John Delaney in the conservation lab at the National Gallery of Art, and Marc Walton and Oliver Cossairt in the NU-ACCESS program at Northwestern University. In this regard, Theresa Fairbanks-Harris, senior conservator of paper for the Yale University Art Gallery and the Yale Center for British Art, and Suzanne Boorsch, the Robert L. Salley Curator of Prints and Drawings at Yale University Art Gallery, have been especially helpful in reexamining Yale’s Rembrandt prints and in imaging watermarks to help consider questions of format and delivery of images, and have helped construct the WIRE project’s first nonradiograph image dataset (see Appendix 2).

The seeds for WIRE’s proposed database of Rembrandt watermarks in American collections were presciently sown by Nancy Ash and her colleagues in 1986.\textsuperscript{7} The database proposed by the WIRE project will be informed by their original ideas, as well as by the International Society of Paper Historians cataloguing standards.\textsuperscript{74} The uses of such a database will be many, but among them will be the facility to find and compare multiple instances of a given watermark across collections, to compare and verify twin-marks across extant edition-mates of a given print, and to easily add new watermarks to the list of papers on which a given print is found. Perhaps most useful to researchers will be the ability to easily compare watermark and chain lines with the actual surface image of the print, with all of its visual cues about state, quality of impression, apparent plate wear, and inking and wiping details. These cues, as Erik Hinterding has demonstrated, can reveal so much in tandem with paper characteristics for situating an impression in Rembrandt’s chronology.

**Conclusion**

Despite the important foundational work on Rembrandt’s watermarks accomplished over the past three and a half decades, it has become clear that the picture of Rembrandt as a printmaker can still benefit from refinement and clarification. Key paths to this refinement include seeking out the many watermarks still remaining to be discovered, expanding the taxonomy for Rembrandt’s watermarks, and making it broadly accessible to researchers at many levels. The procedures put in place by WIRE student teams promise to result in a useful and accessible decision tree structure that will in turn encourage the construction of a larger database of Rembrandt watermarks in United States collections.

The recording of fifteen new examples of watermarks in the holdings of just the two organizing institutions of this exhibition suggests the likelihood of discovering further previously unseen marks. These additions also encourage engagement with many smaller college, university, and municipal museums with Rembrandt etchings in their collections. Appendix 2 details progress in cataloguing these previously uncounted collections, as well as the results of a renewed effort in the collection of the Yale University Art Gallery, which has revealed more watermarks than previously noted. Finally, investigations are expanding to include papers found in the drawings of Rembrandt and his students, as watermark evidence suggests the use of printing papers for some drawings supports in Rembrandt’s milieu.

The complex story of Rembrandt’s papers and their interpretation is humbling, but the practice of student involvement in research is a constant call to recalibrate and clarify expectations and goals, demanding that all participating researchers, whether students, faculty, or museum professionals, maintain vigilance as active learners. This research model offers various encouraging benefits, including an energetic and computer-savvy workforce who...
have developed a range of skills, and a partial overlap of student cohorts from semester to semester that continually transforms learners into mentors as the project progresses. Further, the project offers students the opportunity to pursue research of value to the field without the necessity of physical access to large urban concentrations of museum collections.

The WIRE project has engendered dialogue among project staff and students who are open to learning about each other's fields. As such, it can be viewed as a sort of crucible for the development of students interested in art who can speak the language of colleagues in technical and computational fields—colleagues who, in turn, can offer much toward the furthering of important questions in the study of art. The academic museum—with its object-based approach to works of art, and its pre-existing connections to related professions such as conservation and conservation science—provides a natural forum in which to assemble such a research group. And, in a broader sense, linking computational studies with traditional humanities content on the campus of a research university stands to inform other such relationships and projects in the growing field of digital humanities.

ENDNOTES

1 A full listing of student participants in the WIRE project is found in Appendix 1.
2 Amsterdam-London 2000-01, 34.
3 For further discussion of collecting at Cornell, see page 18.
4 Exhibitions featuring Rembrandt at Cornell include: Dutch and Flemish Prints from the Seventeenth Century (September 3-29, 1968); Dutch Drawings of the Seventeenth Century, from a Collection (November 6-December 23, 1970); Master Prints from Upstate New York Museums (October 28-December 31, 1995); Ziet, de Dag Komt Aan: Dutch Landscape Prints and Drawings (June 15-August 6, 1995); Things of this World: Dutch Prints and Drawings of the Seventeenth Century (December 21, 1996-March 9, 1997); Rembrandt and the Art of Etching (January 10-March 15, 1998); Reflections to Astound: Seventeenth-Century Dutch Prints from a Private Collection (August 28-November 7, 1999); Fresh Woods and Pastures New: Seventeenth-Century Dutch Landscape Drawings, from the Peck Collection (January 29-March 26, 2002); Etchings by Rembrandt from the S. William Pelletier Collection (January 17-April 4, 2004); A Portrait of the Artist, 1525-1825: Prints from the collection of the Sarah Campbell Blaffer Foundation (September 1-December 31, 2005); Rembrandt Etchings Collected by Nancy and Nelson Schaeffer, Jr. (April 1-June 18, 2006); Rembrandt at 400 (April 1-June 25, 2006); A Changing Landscape: Prints and Drawings 1570-1670 from the Arthur and Arlene Elkind Collection (February 3-April 8, 2007); The New and Unknown World: Art, Exploration, and Trade in the Dutch Golden Age (August 13-October 2, 2011). All but the 1968, 2006, and 2007 exhibitions were accompanied by a catalogue.
5 Erik Hinterding, Rembrandt as an Etcher: The Practice of Production and Distribution (Udderkerk an den IJssel: Sound and Vision, 2006), 3 vols. This publication, often referenced in this essay, will be noted hereafter simply by means of the abbreviation EH 2006, followed by volume and page numbers.
6 For a glossary of terms and techniques, see pages 212-214.
8 White 1999, 10. Archival documents from 1643 and 1644 respectively mention shipments of large quantities of Japanese paper to the Netherlands. See Stockholm 1968, 173, as cited in Van Breda 1997, not paginated. See also EH 2006, I, 182, note 336. It is also possible that some of Rembrandt's Asian papers were Chinese, though the greater likelihood is that they are Chinese-style papers of Japanese craft.
9 EH 2006, I, 112.
10 White 1999, 10.
11 Ibid., 262, note 33.
12 S. W. Reed, "Types of Paper Used by Rembrandt," in Boston-New York 1969, 178-80, was an early example. Sale catalogues and catalogues raisonnés have also often included discussions of Rembrandt's papers; see Mayer Haumont, "Rembrandt's Papers," in Ritman 1995. Also, G. Biörkland, "Old Paper," in Stockholm 1968, 165-73.
13 For details on the construction of paper molds, see Löber 1982, 13-26; De Lalande 1761-89. For more detail on the paper-making process itself, see for example Hunter 1947, 177-79.
15 EH 2006, I, 45.
17 Stevenson 1951-52, 65.
18 Löber 1982, 50.
19 As Erik Hinterding relates about his experience of the ratio of watermarked to nonwatermarked prints, "A total of 2,369 complete or fragmentary watermarks were found in the more than 7,000 etchings by Rembrandt examined, and 1,998 of them could be identified." EH 2006, I, 42.
21 Laurentius 2008, vi.
23 Laurentius 2008, vi.
24 Voorn 1960, 102.
26 As Theo and Frans Laurentius note, during the eighteenth century paper molds and were made with thicker wires, to speed up the drainage of water from the mold, increasing efficiency and profits. This results in more clearly legible chain lines and watermarks. Seventeenth-century paper characteristics therefore can be harder to read than eighteenth-century ones, which explains some of the difficulties researchers of Rembrandt watermarks have traditionally encountered. See Laurentius 2008, v.
27 Beta-radiography uses a polymethacrylate sheet labeled with radioactive carbon-14 to produce an image on a radiographic film, which reveals the watermark and other mold characteristics without obstruction by the ink of the design. This method produces high quality and high contrast images of watermarks and other texture characteristics of paper. For a fuller description of these techniques, see Tydeman 1967; Ash 1986, 64; and Chapel Hill-Ithaca 1999, 117-24.
28 Laurentius et al. 1992, 353-84. See also Erik Hinterding's interview, pages 59-63.
29 Amsterdam-London 2000-01, 23.
30 EH 2006, II, 10.
It cannot be a match for published variants because in addition to some variations in the quartered arms within the shield, the "4B" pendant below the shield is reversed with respect to the coat of arms. The watermark for this print was previously catalogued under "Unrecognizable ZZ.zz" (EH 2006, II, 241). The print is numbered there as 1931.46.

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APPENDIX 1

WIRE project participants, 2015–present

Project leaders
Andrew C. Weislogel, the Seymour R. Askin, Jr. ’47 Curator, Earlier European and American Art, Herbert F. Johnson Museum of Art, Cornell University

C. Richard Johnson, Jr., Jeffrey S. M. Hedrick Senior Professor of Electrical and Computer Engineering, Cornell University / Jacobs Fellow in Computational Arts and Humanities, Cornell Tech / Scientific Researcher, Rijksmuseum, Amsterdam / Computational Art History Advisor, RKD—Netherlands Institute for Art History (The Hague)

Project advisory group
Margaret Holben Ellis, Eugene Thaw Professor of Conservation, Conservation Center of the Institute of Fine Arts, New York University

Erik Hinterding, Curator of Prints, Rijksmuseum, Amsterdam

Nadine Orenstein, Drue Heinz Curator in Charge, Department of Prints and Drawings, Metropolitan Museum of Art

Oya Yildirim Rieger, Associate University Librarian, Scholarly Resources and Preservation Services, Cornell University Library

Stephanie L. Wiles, the Richard J. Schwartz Director, Herbert F. Johnson Museum of Art, Cornell University

Cornell University: WIRE project students (2015 to present)
Sujay Bhatt, PhD candidate, Electrical and Computer Engineering, Cornell Tech

Margaret Canfield ’20, History of Art/Chemistry

Katrina Ferreira ’20, Hunter R. Rawlings III Cornell Presidential Research Scholar, Industrial and Labor Relations

Virginia Girard ’17, History of Art

Riley Henderson ’18, History of Art

Amanda House ’17, Computer Science

Dong Ki Kim, M.Eng ’16, Electrical and Computer Engineering

So Jeong Lim ’20

Hao Lu, M.Eng ’16, Electrical and Computer Engineering

Anjum Malik ’16, Anthropology

Elizabeth Martinson ’17, History

Katarina Martucci ’20, Electrical and Computer Engineering

Alison McCann, PhD candidate, History of Art

Kira Nicolai ’16, History of Art/Statistics

Margaret Orbon ’17, History of Art

Oscar Rieveling ’16, History of Art/French

Phoebe Ross ’17, Industrial and Labor Relations

Jason Setter, M.Eng ’16, Electrical and Computer Engineering

Samantha Siegler ’18, History of Art

Nina Simpkins ’19, History of Art/Information Science

Xuelei Xi, M.Eng ’17, Electrical and Computer Engineering

Cornell University: Faculty and staff
Michele Brown, book conservator, Olin Library Paper Conservation Lab

Michele Hamill, paper and photograph conservator, Olin Library Paper Conservation Lab

Jill Iacchei, Olin Library Paper Conservation Lab

Professor Vikram Krishnamurthy, Electrical and Computer Engineering, Cornell Tech

Professor Steve Marschner, Computer Science

Caitlin Moore, Olin Library Paper Conservation Lab

Brittany Rubin, print room curatorial assistant, Herbert F. Johnson Museum of Art

Jennifer Scheuer, printmaking specialist, Department of Art

Bruce Walter, Senior Research Associate, Program of Computer Graphics
Outside Cornell

OBERLIN COLLEGE
Andaleeb Badiee Banta, Curator of European and American Art, Allen Memorial Art Museum

UNIVERSITY OF IOWA
Timothy Barrett, Director, Center for the Book

FRANCES LEHMAN LOEB ART CENTER, VASSAR COLLEGE
Patricia Phagan, the Philip and Lynn Straus Curator of Prints and Drawings

METROPOLITAN MUSEUM OF ART
Louisa Smieska (Cornell PhD '15), Andrew W. Mellon Foundation Conservation Fellow in the Department of Scientific Research

MORGAN LIBRARY & MUSEUM
Reba Fishman Snyder, paper conservator

NATIONAL GALLERY OF ART
John Delaney, Senior Imaging Scientist, Scientific Research Department

NEW YORK UNIVERSITY
Lydia Aikenhead, conservation student, Conservation Center of the Institute of Fine Arts
Saira Haqqi, Conservation Center of the Institute of Fine Arts

NORTHWESTERN UNIVERSITY
Professor Oliver Cossairt, Electrical Engineering and Computer Science, Northwestern University/Art Institute of Chicago Center for Scientific Studies in the Arts (NU-ACCESS)
Professor Marc Walton, Materials Science and Engineering, McCormick School of Engineering and Applied Science, NU-ACCESS

STATE UNIVERSITY OF NEW YORK AT CORTLAND
Professor Charles Heasley, Printmaking and New Media

SYRACUSE UNIVERSITY
Domenic J. Iacono, Director, Syracuse University Art Galleries

UNIVERSITY OF WISCONSIN, MADISON
Devin Conathan, Department of Electrical and Computer Engineering
Professor William A. Sethares, Electrical and Computer Engineering

YALE UNIVERSITY
Suzanne Boorsch, the Robert L. Solley Curator of Prints and Drawings, Yale University Art Gallery
Theresa Fairbanks-Harris, Senior Conservator of Paper, Yale University Art Gallery and Yale Center for British Art
Paul Messier, Lens Media Lab, Institute of the Preservation of Cultural Heritage

INDEPENDENT SCHOLARS
Georg Dietz, independent paper expert
Timothy Moore, paper moldmaker, Concord, Michigan

We also acknowledge the assistance provided by the Dutch University Institute for Art History, Florence.
Annotated list of previously unpublished watermarks catalogued by the WIRE project, 2015–present
By collection, with selected illustrations

1. Herbert F. Johnson Museum of Art, Cornell University
   Compiled by Elizabeth Martinson, Cornell ’17, and Brittany Rubin

   The Small Lion Hunt (with Two Lions), ca. 1629
   Etching
   Bartsch/White and Boon 115 only state; NHD 28, ii/ii
   Gift of Paul Ehrenfest, Class of 1932, 84.029.013
   WATERMARK: Foolscape with Five-Pointed Collar, Hinterding subvariant K.i. (for reference: EH 2006, II, 133; illus., III, 233)

   The Rat Catcher, 1632
   CAT. NO. 18
   Etching
   Bartsch/White and Boon 121 iii/iii; NHD 111 iii/iii
   Gift of Wellington R. Burt, Class of 1926, 65.023
   WATERMARK: Countermark, Hinterding subvariant PDB'.a.a. (for reference: EH 2006, II, 89; illus., III, 146)

   The Angel Appearing to the Shepherds, 1634
   Etching, engraving, and drypoint
   Bartsch/White and Boon 44 iii/iii; NHD 125 iii/vi
   Bequest of Louis J. Heizmann, 74.057.009
   WATERMARK: Miscellaneous, Late, similar to Hinterding subvariant B.a. “OCTUIER 1749” (for reference: EH 2006, II, 238; illus., III, 503)
   NEW PROPOSED TWIN MARK: Miscellaneous, Late B.a.b.

   Self-Portrait (?) with Plumed Cap and Lowered Saber, 1634
   CAT. NO. 1
   Etching and engraving
   Bartsch/White and Boon 23 iii/iii; NHD 135 iii/iii
   Gift of Margaret and Frank Robinson, in honor of Susan Lynch, 2016.039.001
   WATERMARK: Basel Crosier, similar to Hinterding subvariant E'.a. with the addition of letters M and B to either side of the shield bearing the crosier (for reference: EH 2006, II, 64; illus., III, 130)
   NEW PROPOSED SUBVARIANT: Basel Crosier E'.b.
   (For further discussion and watermark illustration, see page 42.)

   Three Oriental Figures (Jacob and Laban?), 1641
   Etching and drypoint
   Bartsch/White and Boon 118 ii/ii; NHD 190 ii/ii
   Gift of the Estate of Louis H. and Katherine W. Pollak, TR 9705.005

   The Hog, 1643
   CAT. NO. 23
   Etching and drypoint
   Bartsch/White and Boon 157 i/iii; NHD 215 i/iii
   Acquired through the generosity of Helen-Mae and Seymour R. Askin, Jr., Class of 1947, Nancy and Nelson Schaeen, Jr., Class of 1950, and through the Margaret and Charles Treman, Class of 1930, Fund, supplemented by Margaret and Frank Robinson, 2003.086
   (For further discussion and watermark illustration, see pages 36-38.)

   The Flight into Egypt: Altered from Segers, ca. 1652
   CAT. NO. 35
   Etching, engraving, and drypoint
   Bartsch/White and Boon 56 vii(?)/vii; NHD 271 v-a/vi
   Membership Purchase Fund, 84.010
   WATERMARK: Countermark IHS, closest to Hinterding subvariant A.b. (for reference: EH 2006, II, 154; illus., III, 300)
   NEW PROPOSED TWIN MARK: Countermark IHS A.b.a.
   (For further discussion and watermark illustration, see pages 42-43.)

2. Allen Memorial Art Museum, Oberlin College
   Compiled by Katrina Ferreira, Cornell ’20; Phoebe Ross, Cornell ’17; with Andaleeb Badiee Banta and Andrew C. Weislogel.

   Man in Cloak and Fur Cap, Leaning against a Bank, ca. 1630
   Etching
   Bartsch/White and Boon 231 i/iii; NHD 48 i/iii
   Special Gifts Fund, 1966.21
   WATERMARK: Partial foolscape, variant indeterminate

   The White Negress, ca. 1630
   Etching
   Bartsch/White and Boon 357 ii/ii; NHD 56 iii/iii
   Gift of the family of Ralph F. Hirschmann (OC 1943 and D. Sc. 1969), RC2017.4
   WATERMARK: Partial Arches, not in Hinterding
The Angel Appearing to the Shepherds, 1634
Etching, engraving, and drypoint
Bartsch/White and Boon 44 iii/iii; NHD 125 iii/vi
R. T. Miller Jr. Fund, 1957.22
\textbf{WATERMARK}: Basel Crosier, Hinterding subvariant A.a.b.
(for reference: EH 2006, II, 61; illus. III, 102)

Christ Driving the Money Changers from the Temple, 1635
Etching with touches of drypoint
Bartsch/White and Boon 69 i/ii; NHD 139, i/iv
Gift of the Max Kade Foundation, 1968.128
\textbf{WATERMARK}: Foolscap with Five-Pointed Collar.
Hinterding subvariant K.c.b. (for reference: EH 2006, II, 131; illus. III, 228)

\textbf{Jan Uytenbogaert, Preacher of the Remonstrants}, 1635
Etching
Bartsch/White and Boon 279 iv/vi; NHD 153 iv/ix
Gift of the Max Kade Foundation, 1968.129

Young Man in a Velvet Cap (Petrus Sylvius?), 1637
\textbf{CAT. NO. 6}
Etching
Bartsch/White and Boon 268 ii/ii; NHD 164 ii/ii
Gift of the Max Kade Foundation, 1968.131
\textbf{WATERMARK}: Fragment, three roundels together in pyramidal form, possibly from a foolscap

\textbf{Abraham and Isaac}, 1645
Etching
Bartsch/White and Boon 34 only state; NHD 224 i/ii
Gift of Mrs. John A. Hadden, 1968.23

\textbf{Ephraim Bonus, Jewish Physician}, 1647
\textbf{CAT. NO. 9}
Etching, engraving, and drypoint
Bartsch/White and Boon 278 ii/ii; NHD 237 ii/ii
Gift of the Max Kade Foundation, 1967.41
\textbf{WATERMARK}: Basilisk, Hinterding subvariant A.a.a.
(for reference: EH 2006, II, 65; illus. III, 101)
(For further discussion see pages 36–38.)

\textbf{Saint Jerome beside a Pollard Willow}, 1648
\textbf{CAT. NO. 30}
Etching with drypoint
Bartsch/White and Boon 103 ii/ii; NHD 244 iv/iv
Gift of the Max Kade Foundation, 1967.42
\textbf{WATERMARK}: Foolscap with Five-Pointed Collar.

Landscape with Three Gabled Cottages beside a Road, 1650
\textbf{CAT. NO. 56}
Etching and drypoint
Bartsch/White and Boon 217 iii/iii; NHD 248 iii/iii
Gift of the Max Kade Foundation, 1967.44

Presentation in the Temple in the Dark Manner, ca. 1654
Etching and drypoint
Bartsch/White and Boon 50 only state; NHD 295 only state
Gift of the Max Kade Foundation, 1967.46
\textbf{WATERMARK}: Countermark PB, Hinterding subvariant A.a.b. or PB A.b. (for reference: EH 2006, II, 87; illus. III, 142)

\textbf{Christ Preaching ('La Petite Tombe')}, ca. 1657
\textbf{CAT. NO. 50}
Etching and drypoint
Bartsch/White and Boon 67 only state; NHD 298 i/ii
Gift of Mrs. John A. Hadden, 1968.21
\textbf{WATERMARK}: Strasbourg Lily, Hinterding variant A.4WR or B (subvariant not in Hinterding)
(fig. 1)
3. Syracuse University Art Galleries

Compiled by Elizabeth Martinson, Cornell ’17; Brittany Rubin; and Andrew C. Weislogel; with Domenic J. Iacono.

**Three Heads of Women, One Asleep.** 1637

Etching

Bartsch/White and Boon 368 i/i; NHD 161 i/iii

Gift of Mr. Cloud Wampler, 1963.936

**Remark:** Watermark: Countermark NB, Hinterding subvariant A.a.

Note: This print has not been previously documented with this watermark. The mark appears on only one other known print: *Nude Man Seated on the Ground with One Leg Extended,* 1646 (NHD 234 ii/i), in the collection of Teylers Museum, Haarlem (KG.3761). The date of that print suggests 1646 as the earliest print date for this impression.

**Landscape with Cottage and a Large Tree.** 1641

Etching

Bartsch/White and Boon 226 i/i; NHD 198 only state

Gift of Mr. Cloud Wampler, 63.923

**Remark:** Watermark: Strasbourg Lily, Hinterding variant D.b.

Note: This watermark also appears on an impression of *Landscape with Cottages and a Hay Barn: Oblong* (NHD 199 only), in the collection of the National Gallery of Art, Washington, D.C. (1943.3.7108).

*Self-Portrait Etching at a Window.* 1648

Etching and drypoint

Bartsch/White and Boon 222 iv/v; NHD 240 iv/ix

Gift of Mr. Cloud Wampler, 1963.1053

**Remark:** Watermark: Most likely Strasbourg Lily, Hinterding subvariant G.c.a. or G.c.b. (for reference: EH 2006, II, 218; illus., III, 463-64). These are catalogued as twin watermarks, and may even be the same watermark due to their similarity.

Note: Due to in-plate dates of other prints appearing on this paper, this impression is likely datable to 1651 or after.

**A Scholar in his Study (**Faust**).** ca. 1652

Etching, engraving, and drypoint

Bartsch/White and Boon 270; NHD 270 iv/vii

Gift of Mr. Cloud Wampler, 1963.1045

**Remark:** Watermark: Partial, with a distinct "4W." Most likely a Strasbourg Lily, possibly Hinterding subvariants 4WR A.b.a., 4WR A.h., or 4WR B.i. (for reference: EH 2006, II, 197, 199, 202; illus., III, 403, 413, 427), or a Strasbourg Bend, possibly Hinterding variant E.c. (EH 2006, II, 188; illus. III, 381).

4. Yale University Art Gallery

Compiled by Theresa Fairbanks-Harris; Virginia Girard, Cornell ’17; Sarah Schlick, Yale ‘18; and Andrew C. Weislogel; with Suzanne Boorsch and C. R. Johnson, Jr.

Selected previously published watermarks are included where new information has arisen or a watermark image is now available.

**The Rat Catcher.** 1632

Etching

Bartsch/White and Boon 121 iii/iii; NHD 111 iii/iii

Gift of Mrs. Vincenzo Ardenghi, 1931.49

**Remark:** Watermark: Basilisk, not found in Hinterding

(for reference: EH 2006, II, 218; illus., III, 463-64). These are catalogued as twin watermarks, and may even be the same watermark due to their similarity.

Note: Due to in-plate dates of other prints appearing on this paper, this impression is likely datable to 1651 or after.

**The Raising of Lazarus: The Larger Plate.** ca. 1632

Etching and engraving

Bartsch/White and Boon 73 vi/vi; NHD 113 vi/vi

Gift of Frederic George Achelis, B.A. 1907, 1925.90

**Remark:** Watermark: Basilisk, Hinterding subvariant B.c.

(for reference: EH 2006, II, 71; illus., III, 119)

**New Proposed Twinmark:** Basilisk E.a.b.

Note: The watermark on this print is a Basilisk E variant, which is different from all other Basilisk marks because the chain lines run horizontally across the design instead of vertically. The loops of the tail do not match the variant E.a. in width or curve pattern.

**The Raising of Lazarus: The Larger Plate.** ca. 1632

Etching and engraving

Bartsch/White and Boon 73 vi/vi; NHD 113 vi/vi

Gift of Frederic George Achelis, B.A. 1907, 1925.90

**Remark:** Watermark: Basilisk, Hinterding subvariant B.c.

(for reference: EH 2006, II, 69; illus. III, 115)
The Good Samaritan, 1633
Etching, engraving, and drypoint
Bartsch/White and Boon 90 i/iv; NHD 116 i/iv
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, B.A. 1907, 1925.91
WATERMARK: Arms of Burgundy and Austria, Hinterding subvariant A.a.a. (for reference: EH 2006, II, 42; illus., III, 63)
NOTE: The presence of this watermark on a number of impressions of the first state of this print in the same state indicates an edition printed together, with a likely date of circa 1632, before Rembrandt's added signature and date of 1633 in the fourth state. Ten other impressions are documented on this paper and its twinmark, A.a.b.

The Good Samaritan, 1633
Etching, engraving, and drypoint
Bartsch/White and Boon 90 iv/iv; NHD 116 iv/iv
Gift of Lydia Evans Tunnard, 1980.43.47

Self-Portrait with Raised Saber, 1634
Etching, with touches of burin
Bartsch/White and Boon 18 ii/ii; NHD 134 ii/ii
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, B.A. 1907, 1925.93
WATERMARK: Basel Crosier (crosier only, without surrounding shield and crown), not in Hinterding, cf. Heawood 1184

Self-Portrait (?) with Plumed Cap and Lowered Saber, 1634
Etching and engraving
Bartsch/White and Boon 23 iii/iii; NHD 135 iii/iii
Gift of Mrs. Vincenzo Ardenghi, 1931.048
WATERMARK: Arms of Württemberg, not in Hinterding (for reference: EH 2006, II, 52–53; illus. cf., III, 82)
NEW PROPOSED SUBVARIANT: Arms of Württemberg A.b.
NOTE: This watermark appears to be a new subvariant of the Arms of Württemberg, variant A. In addition to some variations in the quartered arms within the shield, the “4B” pendant below the shield is reversed with respect to the coat of arms. The watermark for this print was previously catalogued under “Unrecognizable ZZ.zz” (EH 2006, II, 241, there catalogued as 1931.46).

Jan Uytenbogaert, Preacher of the Remonstrants, 1635
Etching
Bartsch/White and Boon 279 vi/vi; NHD 153 vii/ix
Gift of Mrs. Howard C. Morse, 1957.45.35
NOTE: This print in this state is not catalogued with this watermark in Hinterding or in NHD. This paper also features the countermark PvL.a. This watermark does appear on state v.

Fig. 2

Fig. 3
Old Man with a Divided Fur Cap, 1640
Etching and drypoint
Bartsch/White and Boon 265 i/ii; NHD 182 i/ii
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, B.A. 1907, 1925.109
WATERMARK: Partial Foolscap, Hinterding subvariant ZZ.zz (published EH 2006, II, 312, not illus.) (fig. 5)

Cottages and Farm Buildings with a Man Sketching, ca. 1641
Etching
Bartsch/White and Boon 219 only state; NHD 201 only state
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, BA 1907, 1925.121
NOTE: This is the countermark to Foolscap with Five-Pointed Collar, Hinterding subvariant K.a., the paper datable to circa 1650.

The Flute Player (‘Het Uilespiegelje’), 1642
Etching and drypoint
Bartsch/White and Boon 188 iv/iv; NHD 211 iv/iv
The Walter R. Callender, BA 1894, Memorial Collection, Gift of Ivy Lee Callender, 1962.45.418
WATERMARK: Partial foolscape, three roundels, two on top, one on bottom (for reference: EH 2006, II, 126; illus., III, 219–20)
NOTE: Other impressions of this print show Foolscap with Five-Pointed Collar, Hinterding subvariant L.z.z., partial (just the roundels), but similarly two on top, one on bottom. This is likely an I variant (see EH 2006, II, 292 cf. Rijksprentenkabinet impression). The likely printing date is ca. 1648.

The Three Trees, 1643
Etching, engraving, and drypoint
Bartsch/White and Boon 212 only; NHD 214 only
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, BA 1907, 1925.119
NOTE: Due to in-plate dates of other prints appearing on this paper, this impression is likely datable to circa 1652.

Abraham and Isaac, 1645
Etching
Bartsch/White and Boon 34 i/ii; NHD 234 ii/ii
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, B.A. 1907, 1925.122
WATERMARK: Miscellaneous, Late, not in Hinterding, last letter of the watermark T or L (?) (fig. 6)
**Jan Asselijn, Painter ("Krabbetje"), ca. 1647**
Etching, engraving, and drypoint
Bartsch/White and Boon 277 iii/iii; NHD 236 iv/vii
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, BA 1907; 1925.125

**Watermark:** Arms, unidentified, similar to Hinterding subvariant B.a.b. (published EH 2006, II, 56; for reference: illus. III, 89)
(fig. 7)

**Saint Jerome beside a Pollard Willow, 1648**
Bartsch/White and Boon 103 ii/ii; NHD 244 iv/iv
Gift of Mr. and Mrs. Christopher Tunnard, 1973.156.6

**Watermark:** Partial Foolscap with Seven-Pointed Collar, possibly Hinterding subvariant C.a.a. (for reference: EH 2006, II, 140; illus., III, 257)

**Panorama near Bloemendaal Showing the Saxenburg Estate ("The Goldweigher’s Field"), 1651**
Etching and drypoint
Bartsch/White and Boon 234 only state; NHD 257 only state
Gift of Edward B. Greene, 1900, 1931.10

**Watermark:** Paschal Lamb, Hinterding subvariant A.c. (EH 2006, II, 164; illus. cf. III, 324)

**Note:** This watermark is likely to be an unidentified twinmark of the Paschal Lamb, variant A.c. Hinterding notes that it is likely the entire variant A consists of various twinmarks in different stages of deformation, and that one batch of paper may encompass the whole group of watermarks.
The Circumcision in the Stable, 1654
Etching
Bartsch/White and Boon 47 i/ii; NHD 280 iii/v
Everett V. Meeks, BA 1901, Fund. 2007.16.2
**WATERMARK:** Countermark GI, Hinterding subvariant GI.a.b. (for reference: EH 2006, II, 76; illus., III, 126)
**NOTE:** This countermark's letter I is not exactly parallel with the adjacent chain line; rather it bends away from it; this matching detail confirms the subvariant.

Christ Presented to the People: Oblong Plate, 1655
*CAT. NO. 46*
Drypoint
Bartsch/White and Boon 76 viii/viii; NHD 290 viii/viii
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, BA 1907, 1925.137
**WATERMARK:** Grapes, Hinterding subvariant A.zz. (published EH 2006, II, 148)
(fig. 8)

Christ Preaching ("La Petite Tombe"), ca. 1657
Etching and drypoint
Bartsch/White and Boon 67 only state; NHD 298 i/ii
Fritz Achelis Memorial Collection, Gift of Frederic George Achelis, BA 1907, 1925.134
**WATERMARK:** Foolscap with Five-Pointed Collar, Hinterding subvariant Q'.a. (published EH 2006, II, 135, illus. III, 241)
**NOTE:** Closer inspection confirms the Yale watermark as a subvariant Q'.a.b. (see cat. no. 49, fig. 31) (fig. 9)
Further sources for Rembrandt watermark study

Books and articles


John Barcham Green, Papermaking by Hand, Maidstone, 1967.


Selected online resources

