Cultural Heritage Science

Maria Perla Colombini
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Analytical Chemistry for the Study of Paintings and the Detection of Forgeries

Springer

Cultural Heritage Science

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Preface

Works of art have been copied and reproduced for millennia. The attribution of paintings to a specific artist often requires careful technical study, which can also assist in the detection of fakes. Indeed, forgeries are endemic in today's commercial art world, and the attribution of a painting, or the disproving of an attribution, or the identification of a deliberate fake is a curatorial and analytical challenge. Copying paintings and works of art has long been a tradition in art schools but did not have the purpose of creating false paintings. Instead, forging paintings, which requires ingenuity and invention, is an art in itself, and famous cases highlight the skill and deliberate intention of deceit by master forgers (e.g., Vermeer's paintings made by Han van Meegeren, Matisse's drawings by Elmyr de Hory, and Mantegna's or Van Dyck's or Brughel's paintings by Eric Hebborn). Forgeries gain illegal status when the act of falsification is linked to monetization. Established for old master paintings mainly during the nineteenth and twentieth centuries, the process of production of forgeries are known from the late Republican Age for the reproduction of Greek sculptures. It is noted that at the time, copies served a different purpose than modern forgeries, and the concept of authenticity had a quite different meaning than the one we will discuss in this book. Today, falsified paintings are plenty, including works by Monet, Renoir, Manet, Sisley, Modigliani, Picasso, Matisse, Gauguin, Cezanne, Tamara De Lempicka, and Klimt. Indeed, paintings existing in important museums and collections throughout the world or sold at auctions are still feared to be non-original, thus creating heated debates between art historians and experts. The unmasking of a forgery may require technical evidence to conclusively prove that a painting is a fake; indeed, the use of imaging techniques and instrumental analysis of materials has a fundamental role in the determination of the materials used by a painter, and this can be essential in the authentication of paintings, or the identification of a forgery. Indeed, the authenticity of a work carries significant value and contributes to reinforce the art market. It must, therefore, be highlighted that the protection of artistic heritage is strongly linked to our legal system, which prohibits illicit trade of works of art and their falsification. The aim of this book is to provide those with an interest in technical study and authentication with an overview of the analytical methods and imaging techniques that are used to study paintings, and that

are currently used to detect forgeries or provide scientific evidence that can corroborate or disprove authenticity. It is noted here and throughout the book that multiple evidence is used to inform attribution today.

The book guides the reader to understand first which approaches (Chaps. 1 and 2) are used in the authentication of works of art providing an overview on scientific studies and particularly analytical chemistry. An introductory chapter (Chap. 3) provides an overview of the different types of materials that may be encountered in paintings. An understanding of the chemical nature of materials aids in the interpretation of data obtained from imaging and analysis. With this information, curators and scientists can evaluate the likelihood that a particular material was available to artists in a particular period. In the chapters that follow, specific examples of how results of analytical methods are interpreted are given, together with examples of applications of specific techniques to address different questions that may relate to composition, condition, or technique.

Digital techniques are emerging as fundamental tools to assess paintings, permitting the comparison of similarities between paintings. These subjects are discussed in Chaps. 4 and 5.

Chapters 6, 7, 8, 9, 10, 11, and 12 deal with material characterization of paintings using instrumental methods, reporting the important updated techniques used in the field, complemented with several examples of application and exhaustive bibliography.

Isotope analysis for authentication is discussed in Chaps. 13 and 14, revealing the potential of radiocarbon dating and of the use of lead isotope ratios for identification of a pigment source or dating.

Finally, the book concludes with Chaps. 15 and 16 with the presentation of case studies and a discussion of art law. Recommendations for purchasing works and how art collectors and conservators may most safely approach the market are provided.

We hope that this book offers a useful source of information for those with an interest not only in authentication but, in a broader sense, in heritage science. Gathering knowledge on currently available techniques and case studies is an aid to those already working in this field, but this book aims to go further: it has the purpose to educate those entering the field by providing a comprehensible background of material characterization and analytical procedures for the study of paintings. We anticipate that new methods will be introduced in the future for examining paintings – a growing area of development includes the combination of spectroscopic data and the use of machine learning.

We also hope this work will continue to strengthen the collaboration between experts (art historians, connoisseurs, conservators, chemists, biologists, and physicists) in the decision-making required during authentication.

We acknowledge the many authors and reviewers who have contributed to this volume, who have embarked on this scientific challenge enduring the impatience of the editors. Finally, particular thanks go to the research group Scich (http://scich.dcci.unipi.it/) at the University of Pisa, who have worked for 30 years in the field of the development of analytical methods, particularly focusing on the complex

challenges of the identification of organic components in works of art; through their hard work and long-standing dedication, today we have developed multi-analytical approaches which provide key information both for the authentication and the conservation of our cultural heritage.

We hope that the present book will offer the opportunity to further consolidate links between art and science, and to bring young people to work in this fascinating field.

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Contents

Part I
Approaches to the Authentication of Works of Art

Chapter 1
The Eye Versus Chemistry? From Twentieth to Twenty-First Century Connoisseurship

Anna Tummers and Robert G. Erdmann

Abstract This essay traces the evolution of connoisseurship in the Netherlands from the early twentieth century to current and future challenges. In the twentieth century, the attitude of art historians towards chemistry varied from extreme distrust to extreme optimism about the possibilities of the discipline to provide conclusive evidence in authentication matters. While the chemical methods and technical means to research paintings have developed at an unprecedented pace in the twenty-first century, some of the key questions crucial to classifying works of art remain largely the same (e.g. how much consistency to expect in an artist's brushwork, painting technique and choice of materials?). However, other questions are new (e.g. how to interpret vast amounts of new data?) and call for a fundamentally different approach: for a cross-pollination of (technical) art history, chemistry and data science. While surveying recent developments, this essay discusses the merits and drawbacks of several modern analytical techniques (including as MA-XRF, HIS/RIS, isotope analysis and GC-MS) as well as the potential of digital aids (smart tools). The focal point of this essay is on the Netherlands since advances in the scientific investigation of works of art have repeatedly transformed the practice of connoisseurship here.

Keywords Connoisseurship · analytical methods · paintings · digital techniques

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1.1 Connoisseurship, the Humanities and Some Recent Insights from Cognitive Psychology

Determining who painted what and when is one of the most difficult tasks of the art historian. Connoisseurship (i.e. the evaluation of the characteristic qualities, the dating and the attribution of works of art) involves estimating variabilities that can be tantalizingly difficult to determine. How much consistency can one expect in an artist's inventions, style and technique, choice of materials and workshop practice? Did the artist use one particular style that gradually developed over time or, instead, different manners at the same time? To what extent did he/she involve workshop assistants and was he/she consistent in doing so (or not doing so)? Even when secure evidence is scarce or missing, the art expert has to form a mental image –consciously or subconsciously– of what is characteristic of the artist in order to make a decision. Evidently, the validity of an attribution hinges on the correctness of the expert's assumptions.

Moreover, the determination of authorship also usually involves assessing the quality of the art work. Although key to the artist's goals and to the reception of the art work, the question how to define (high) quality is notoriously hard to tackle from an academic perspective.[1] For old master paintings, given the guild regulations and possible workshop assistance, the question is not just what level of quality can be expected of work by the master's hand but also –and perhaps more importantly– what level of quality the master demanded in the paintings he/she deemed worthy of carrying his/her name (Tummers 2011: 81–112). Here again, the issue of consistency is relevant: how much variation did the master allow in paintings produced in his/her workshop? And did the artist –as many old masters did– consciously produce works of different quality levels, that were priced accordingly?

In short, judging a picture is far from simple, no matter how swiftly the judgment is sometimes made. It involves myriad questions that touch on different academic disciplines, including art history and materials science. Moreover, the inherent complexity of the task entails a risk. As the psychologist and Nobel laureate Daniel Kahneman has shown, the human brain works with two different systems: a quick sub-conscious way of assessing (often referred to as 'intuitive') and a slower, conscious thought-process (Kahneman 2011). In daily life, the brain tends to simplify, thereby delegating the mental process to a sub-conscious part of our brain. When confronted with complex questions, the brain commonly substitutes a complex question with an easier one (Kahneman 2011). Though in many cases effective and efficient -and occasionally even better than conscious decisions- our intuitive tendency to simplify can also lead to dangerous biases and oversights in the decision-making process (Gladwell 2005: 48ff; 263–264 (example of a racial bias); see also Dijksterhuis 2007).

[1] One of the few scholars who attempted to answer this question is Jakob Rosenberg in his book *On Quality in Art* (Rosenberg 1967).

Given these insights into the workings of the brain (Kahneman 2011; Gladwell 2005), it is not surprising that there have long been discussions about the nature of connoisseurship among art experts. Throughout the twentieth century there have been two opposing views as to what should have the most weight in the attribution process: the connoisseur's intuition, that is, the sudden insight that the connoisseur experiences without fully grasping its origin (Kahneman's 'system 1'), or rational, communicable arguments (Kahneman's 'system 2'; Tummers 2011: 30–60). Although both aspects can be considered part of the same decision-making process, their different nature has long caused tension in both theory and practice.

The complexity of the decision-making process and the danger of oversimplifications may also explain the fierce criticism connoisseurs have often received. Already in the eighteenth century, the French scholar and theologist l'Abbé Du Bos dismissed 'the art of predicting the author of a painting by recognizing the master's hand' as 'the most faulty of all the arts, apart from medicine' (Du Bos 1719 [ed. 1993], 296). In the twentieth century, the attribution of paintings was reviled as subjective and intuitive, and as tainted by the market (Chapman and Weststeijn 2019: 10–15). Consequently, the term 'connoisseur' has acquired negative connotations, conjuring up the image of a presumptuous, outdated and inadequate judge of pictures –an attractive target for ridicule (Fig. 1.1).

As a result, academic art history repeatedly attempted to avoid connoisseurship at the start of the twentieth century, claiming it would not be quite 'theoretical' and

Fig. 1.1 Saul Steinberg, 'Gentlemen, it's a fake!', cartoon published in *The New Yorker*, 6 May 1950

'scholarly' enough to be worthy of serious academic attention (Muthesius 2013; Martin 1904). Avoiding connoisseurship did not solve the issue, however; it merely left academics vulnerable to the reproach that their discipline lacked a firm foundation (Pächt 1986 (ed. 1999): 66–67). For the history of art cannot be written without a basic classification of who created what and when. Therefore, other art experts chose the opposite strategy and attempted to mend the situation by creating a more 'objective' and 'scientific' connoisseurship. In the Netherlands the conservator Maurits van Dantzig in particular set out to develop a concrete (verifiable) method to attribute paintings based on rational arguments that could be checked (Van Dantzig 1936, 1978).[2] Despite his efforts, however, art historians remained divided. Even the prestigious Rembrandt Research Project (the largest and most advanced research project dedicated to sorting out the oeuvre of one single painter, pioneering several advanced scientific techniques) did not believe that the intuitive component could or should be taken out of the decision making process, as we will see (Bruyn et al., vol. 1, 1982: XVII; see below and note 22).

Meanwhile, another blow to the connoisseur's reputation came from the field of philosophy. In the 1950s and 1960s Arthur Koestler and Alfred Lessing argued that it made no aesthetic difference whether a painting is forged or not. Therefore, the person who pays a large sum of money for an original but would have no interest in a reproduction or imitation which he could not tell from the original, or worse, who prefers an aesthetically inferior original over an excellent forgery, is said to be at best confused and at worst a snob (Koestler 1955; Lessing 1965). It raised the question why connoisseurs should bother to tell originals and forgeries apart at all.

Although Koestler's and Lessing's claims were effectively refuted by the philosophers Nelson Goodman and Denis Dutton in the late 1960s and 1970s (see below), the fact that the validity of connoisseurship was questioned in this way, is telling. It is hard to imagine that a similar claim would be made for any other field of study (i.e. that it would make no difference if an expert's analysis and appreciation is based on an authentic or a forged piece of evidence). For example, should one value real and counterfeit money in the same manner if one cannot tell the difference? Should historians interpret and appreciate real and forged historical artefacts such as Hitler's diary or pieces of the dead sea scrolls in the same way if they cannot tell these apart? It is the emphasis on the *aesthetic* properties of course that makes the difference here. Yet the question was if the aesthetic properties could be separated entirely from any cultural or historical context.[3]

Goodman argued that since the exercise, training and development of our powers of discriminating among works of art are plainly aesthetic activities, the aesthetic

[2] The first one to devise concrete method to attribute paintings was the Italian art expert Giovanni Morelli. Although Van Dantzig did not refer back to him, his method seems indebted to his well-known Italian predecessor. See Tummers 2011: 30 ff.

[3] According to Goodman the idea that one should strip oneself of all the vestments of knowledge and experience when encountering a work of art derives from the Tingle-Immersion Theory which was developed around 1800 and has since then become part of the fabric of what Goodman calls our 'common nonsense' (Goodman 1983: 102).

properties of a picture include not only those found by looking at it but also those that determine how it is to be looked at (Goodman 1969: 111–112). In his view, the knowledge that a picture is an original and not a copy, imitation or forgery is a critical and valid factor in our response to it. [Indeed, the impact of such knowledge has recently been confirmed by neuroscientific research (see Huang et al. 2011; Wolz and Carbon 2014).]

Denis Dutton made a similar point but arrived at it differently. He stated that all visual art is necessarily performative, as it represents an achievement within a certain cultural and historical context. It is this achievement that determines its value as an art work (and makes it relevant to art history). Therefore, if our understanding of this achievement alters drastically when a work of art is exposed as a forgery, in his view it is no longer the same object, in so far as its position as a work of art is concerned (Dutton 1979: 314).

Although philosophers thus underscored the importance of connoisseurship, many academic art historians stayed clear of in-depth visual analysis and moved instead towards contextual and historical approaches in the 1970s and 1980s. Iconography, social history and socio-economic perspectives gained ground, causing art historians to rely heavily on verbal and contextual evidence rather than on their eyes. In an effort to change this, Harvard Professor and drawings expert Henri Zerner wrote an engaging essay on connoisseurship's bad reputation in 1987. "Ours is a logocentric culture", he stated: "We trust the written document much more than our visual understanding of an image. This must be changed and we must attend to visual clues if we want to get something out of our visual legacy" (Zerner 1987: 290).

While major research projects dedicated to individual artists such as Rembrandt, Rubens and Van Gogh greatly expanded our visual understanding of these masters at the end of the twentieth century, the advances in connoisseurship hardly impacted the academic curriculum. In 2009, Paul Craddock sharply observed: "the subject of authenticity does not seem to be seriously studied or taught to prospective art historians/curators, much less to materials scientists […] an honorable exception being the centre for study of forgery with its own museum at the University of Salerno" (Craddock 2009: 6). This lack of academic attention is disconcerting and yet somewhat understandable. Connoisseurship and authentication skills require arduous practice including extensive first-hand observation and in-depth study of important art works, copies and imitations, which not all universities can provide.

Nevertheless, the twenty-first century witnessed a renewed academic interest in connoisseurship as well as a theoretical refinement in thinking about issues of authenticity. Prominent academics who had not themselves dedicated their lives to sorting out the oeuvres of artists started to underscore the importance of this specific type of visual knowledge. David Freedberg eloquently argued that it was not just fundamental to art history but also potentially a 'core discipline in the humanities' as connoisseurship shared its 'evidential paradigm' with other types of scholarly detective work involving the interpretation of clues, symptoms and pictorial marks (Freedberg 2006; see also Ginzburg 1980). Stephanie Dickey stated that the continuing value of connoisseurship could be claimed both on theoretical and practical grounds: "Broad historical theories that build on works of art as evidence fall like a

house of cards if assumptions about the authenticity of those works prove incorrect" (Dickey 2015: 5). In 2019 the Dutch art historical yearbook was even dedicated entirely to connoisseurship, which is framed as the 'history of visual knowledge since the Renaissance'. According to Chapman and Weststeijn, connoisseurship is now widely understood as 'an essential and ever-evolving art-historical method'. Moreover, there is an 'enhanced rigor, [an] interdisciplinary reliance on materials science and neuroscience, and [a] new theoretical awareness' that represent a departure from the past (Chapman/Weststeijn 2019: 7).

This essay takes a closer look at the interaction between connoisseurs and chemists throughout the twentieth century, as well as at the current interdisciplinary character of authenticity research and its challenges. The main line of enquiry focuses on how advances in the scientific investigation of art works have repeatedly transformed the practice of connoisseurship in the Netherlands and on what is needed to effectively face future challenges.

1.2 The Eye Versus Chemistry: Early Interactions Between Connoisseurs and Chemists

No incident illustrates the deep distrust of an early twentieth century art expert towards chemical evidence better than a curious booklet of 89 pages with the title *Real or fake? Eye or Chemistry?,* dated 1925. It is written by Cornelis Hofstede de Groot, then one of the leading art historians and the author of a ten-volume survey book on Dutch seventeenth-century painting (Hofstede de Groot 1908–1927). He published the booklet in response to the lawsuit *Fred Muller & Co. vs H.A. de Haas*, the first court case in the Netherlands in which chemical evidence was brought to bear in an attribution matter. The bone of contention was the attribution of a small painting: the *Laughing Cavalier* (Fig. 1.2). Cornelis Hofstede de Groot had recognized it as an authentic Frans Hals (1582/83–1566) in 1923 and provided a certificate of authenticity. Both the certificate and painting had subsequently come into the possession of a certain H.A. de Haas, who had sold it via the auction house Fred Muller & Co. to a private collector for fl. 50.000,- (at the time the equivalent of fourteen years' salary for the average man[4]). A few months afterwards, however, the buyer demanded to be reimbursed claiming that the painting was in fact a forgery. The auction house looked into the matter, agreed with the buyer, reimbursed him, and subsequently asked Hofstede de Groot to cover a third of the damages suffered (circa fl.16.666,-). Hofstede de Groot refused to do so. He indicated that in his view he could not be held accountable for the prices fetched by paintings he had authenticated, and he offered to research the painting anew. After a second inspection, however, he concluded once again that in his view the painting was by Frans Hals.

[4] The equivalent is taken from Lopez 2008: 46

Fig. 1.2 Anonymous, *Laughing Cavalier*, ca. 1923, pastiche in the style of Frans Hals, current location unknown

The auction house then subpoenaed the seller, Mr. de Haas on the 9th of December 1923. Muller and Co. demanded that the purchase contract be annulled and that the purchase amount be reimbursed including interest as well as their litigation expenses. The burden of proof that the auction house presented was substantial. The painting had been researched by a team of experts who had jointly written a report: Sir Charles Holmes, director of the National Gallery in London, Prof. dr. Wilhelm Martin, director of the Royal Cabinet of Paintings, The Mauritshuis, in the Hague and Prof. dr. F.E.C. Scheller, chair of Inorganic Chemistry at Delft University of Technology.[5] Especially the materials science part of the investigation was disconcerting. Only the first test had yielded a positive result: the paint layer did not dissolve when treated with the usual 96% alcohol solution, which agrees with what one would expect of a seventeenth-century painting. However, when touched lightly with a cotton ball soaked in water, the paint became soft; with a soft brush and water the paint layer could even be entirely removed. Moreover, the researchers found artificial ultramarine in several locations throughout the painting, a pigment that had only been discovered in 1826. Furthermore, the researchers observed cobalt blue (through the microscope) in several locations in the background, a pigment that was not manufactured commercially until the early nineteenth century.[6] A chemical

[5] The report was published in its entirety as an appendix in Hofstede de Groot 1925: 74ff.

[6] According to the experts consulted during the trial, cobalt blue was first produced commercially around 1820/1830 (Hofstede de Groot 1925: 84); nowadays we believe it was somewhat earlier in 1807.

analysis of the white used in the painting identified it as zinc white, a pigment that has only been available since 1781. Also, a radiography of the picture revealed two nails that had been hammered into the picture from the front; these were machine-made and could therefore not have been produced before the nineteenth century. The conclusion was obvious: the painting could not be by Frans Hals or a contemporary; it was made by a modern forger or imitator.

The lawsuit received much press coverage and constituted a serious blow to the reputation of Cornelis Hofstede de Groot. After an impressive career as deputy director of the Royal Picture Gallery the Mauritshuis (1891–1896) and director of the Print Room at the Rijksmuseum (1896–1898) and dozens of prestigious publications, he lived as an independent art historian mostly from the certificates of authenticity that he provided (Ekkart 1979). When the court case had dragged on for one and a half years, he suddenly brought it to a halt, presumably in an attempt to prevent further damage to his reputation. Before the judge could reach a verdict, Hofstede de Groot purchased the contested painting for the full amount of fl. 50.000,-, which made the law suit redundant. He then defended his point of view in his publication *Real or Fake?* In a nutshell, he argued that his expert eye should outweigh the chemical evidence presented in court. It is a position one can hardly imagine taking nowadays, and therefore an interesting benchmark in our study of the development of connoisseurship. For what criteria did Cornelis Hofstede de Groot use to substantiate his attribution? And how did he come to dismiss 'chemistry' so radically?

Although Hofstede de Groot hardly defines criteria for assessing paintings, the way in which he attacks his opponents is revealing. Hofstede de Groot points his arrows mostly at Professor Wilhelm Martin, who is said to base himself too often on his 'feeling for style' (*stijlgevoel*).[7] Interestingly, Hofstede de Groot does not dismiss such a 'feeling for style' as a valid criterium; he just did not think Professor Martin possessed it. To Hofstede de Groot it seems to have been self-evident that an expert had a certain 'feeling' for the characteristic style of a painter, which enabled him to judge attributions better than a layman, an intuitive kind of insight that would normally not require much explanation. Given the circumstances, however, he felt obligated to refute the claims of his adversaries. Therefore, he wrote his argument in the form of a *negatio* (a denial of the contrary), a rebuttal of the expertise that had been used against him in court.

In doing so, he did not shy away from technical evidence. In particular, the discovery of modern nails in the picture and the solubility of the paint layer seem to have worried him. Therefore, he had confronted the painter and restorer who had asked him to assess the painting in 1923: Theo van Wijngaarden (1874–1952), nowadays better known as the mentor and business associate of master forger Han van Meegeren (1889–1947). Van Wijngaarden immediately admitted that he had hammered modern nails into the painting. These would not be situated underneath the paint layer, however; he claimed that he himself had covered their heads with tiny

[7] Hofstede de Groot 1925: 28–29.

retouches. He also provided an explanation for the solubility of the paint layer: he was in the possession of a product –invented by himself but kept a secret– that could render any old master painting in oil soluble in water, which he demonstrated on the spot on another seemingly old painting. Ignorant of the massive swindling for which van Wijngaarden would later become known, Hofstede de Groot did not raise further questions. He mentioned Van Wijngaarden in good faith in his publication and indicated that the restorer was willing to demonstrate his product on any old master painting (Hofstede de Groot 1925: 13).

Having thus 'refuted' the chemical evidence, Hofstede de Groot then proceeded to counter Martin's style analysis. In the expert report, Martin had indicated that he recognized a certain similarity to Hals' oeuvre (notably elements that seemed to have been copied from Hals's famous *Jolly Toper*), but that he did not encounter the distinctive characteristics of Hals' own hand, which he had described in rather broad terms as a 'playfulness of spirit' (*dartelheid van geest*), a 'secure hand' (*zekerheid van voordracht*), a '*virtuoso* manner of painting' (*gave schilderwijze*) and 'a lighthearted mobility in head and body' (*luchtige bewegelijkheid in hoofd en lichaam*) (Hofstede de Groote 1925: 82–83). Several elements in particular deviated from what Martin would have expected of Hals: the stockiness of the shoulder area in relation to the head, the rough indication of the left cheek and neck which did not show the underlying structure, the course definition of the hair roots, the way in which the mouth and teeth were depicted and the light reflection on the lower lip.

According to Hofstede de Groot, however, a 'secure hand' was a rather 'subjective feeling'. Although this remark seems to imply that he believed that Martin's criteria were perhaps not objective or clear enough, he merely objects to Martin's application of the criteria. Hofstede de Groot argues that the disputed picture does in fact show 'a secure hand'. He also believes that 'playfulness of spirit' is a valid criterium, but he claims that it does not apply to all Hals's works. Hals's late regent group portraits, for example, are far from playful in his view, thereby touching indirectly on the ambivalence of the term. For did it allude to a certain playfulness in the subject depicted or rather in handling of the brush? Moreover, in Hofstede de Groot's view, the coarse brushwork was not unusual for Hals, and neither was the stockiness of the shoulder area; he provides no fewer than 20 comparative examples to substantiate his claim(s). Ironically, one of the reference works he uses has the same provenance as the contested *Laughing Cavalier*: it is picture of a boy smoking that Theo van Wijngaarden had also asked him to assess in 1923 and that Hofstede de Groot had like so much that he had purchased it for himself. The similarities were not coincidental: the picture appears to be a forgery by the same hand, presumably by someone from Theo van Wijngaarden's workshop, possibly Han van Meegeren (Kraaijpoel and Van Wijnen 1996: 49; Lopez 2008: 24).

Many of Hofstede de Groot's reference works have been de-attributed since then. He thus did not just lack clear criteria to distinguish between an authentic Hals and an imitation, but also a clear frame of reference. Wilhelm Valentiner's oeuvre catalogue of the artists from 1923 lists 322 paintings as by the master without (much) further explanation (which is about 25% more than today's most positive estimate, see Slive 2014). It brings to mind how broadly Hals's oeuvre was defined at the

beginning of the twentieth century and how much the paintings ascribed to Hals's hand varied in quality.

While this unclear frame of reference gave Hofstede de Groot some leeway for new attributions, the chemical analyses did not leave room for doubt. If the painting had indeed been made with modern materials, it could not possibly be by Hals. Like an alley cat, and perhaps against his better judgment, Hofstede de Groot opted for the frontal attack: the samples taken would not be from the original paint layer but exclusively from later retouches. The Professor in chemistry had not understood what exactly he had been researching. In the introduction he explained that his defense was directed mostly at Professor Martin, not at Prof. F.E.C. Scheffer "for one cannot argue with a chemist about art. In painting the eye has to hold the highest authority, just like the ear does in matters of music. Here not the tuning fork; there not the test tube." (Hofstede de Groot 1925: 5)

The fact that Hofstede de Groot did not bother to have the paint layer that he believed to be original tested by a chemist, gives the impression that he must have at least suspected something was wrong. For the outside world, his booklet did not put an end to speculations about the status of the *Laughing Cavalier*. Shortly after its publication, a rumor spread that the picture was a forgery by Leo Nardus (1868–1955) or Han van Meegeren, a claim that Hofstede de Groot -once again- denied firmly and publicly. In an interview with the newspaper *Het Vaderland* of 10th of June 1926, he exclaimed: "they would wish they could paint like that!" Over the following decades, however, scientific evidence was no longer dismissed so radically by art historians; it became something to be reckoned with.

Two more forgery trials contributed to create a turning point in the history of connoisseurship. Just a few years after the trial about the *Laughing Cavalier* ended abruptly, a larger trial in Berlin in 1932 underscored importance of chemical evidence. The court case concerned 33 paintings in the style of Vincent van Gogh (Fig. 1.3). The dealer Otto Wacker stood on trial for fraud, falsification of documents and breach of contract (Charney 2015: 26–27; Koldehoff 2002). The paintings had been confiscated when the organizers of a commercial exhibition at Paul Cassirer in 1928, Grete de Ring and Walter Feilchenfeldt, had recognized four works as forgeries and grew suspicious of the other works supplied by Wacker. Before the lawsuit several prominent Van Gogh experts had provided certificates of authenticity for Wacker's Van Gogh pictures, including Jacob Baart de la Faille, Julius Meier-Graefe, H.P. Bremmer and Hans Rosenhagen. In anticipation of the court case, however, their opinions started to change. De la Faille published a book in which he dismissed all 33 paintings as forgeries: *Les Faux Van Gogh* (*The Van Gogh Forgeries*, De la Faille 1930).

During the trial, the experts continued to revise their opinions and were ultimately unable to reach a consensus. On the witness stand Baart de la Faille declared that he believed five of the 33 paintings to be genuine after all. Meier-Graefe, on the other hand, believed all works to be forgeries; Rosenhagen thought that fourteen works which he had previously authenticated were inferior works but nevertheless genuine; and H.P. Bremmer believed eight of the pictures were genuine and eight forgeries (Feilchenfeldt 1989: 294–295). Possibly, the fact that these same experts

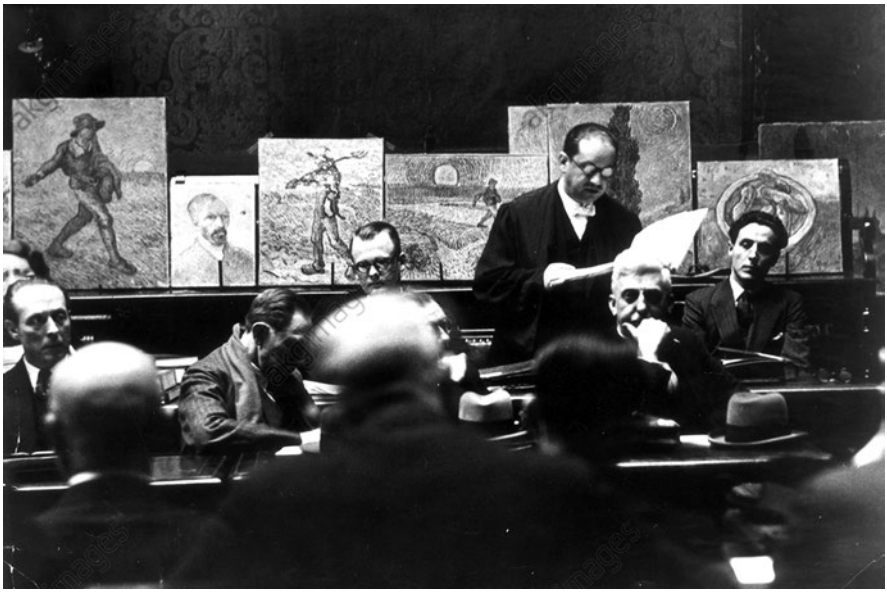

Fig. 1.3 Otto Wacker on trial with the suspected Van Gogh forgeries in the background, 1932

had previously provided certificates of authenticity for (some of) these works may have influenced their judgment. Their behavior resembles a curious phenomenon described by Daniel Kahneman and Amos Tversky as the *sunk cost fallacy*: investors who have already lost money on a project several times are nevertheless likely to re-invest in the project (Kahneman and Tversky 1979).[8] In any case, the court also invited a more independent expert to weigh in on the matter: Professor Ludwig Justi, director of the Nationalgalerie in Berlin, who had just exhibited Van Gogh paintings from the Kröller-Müller collection in the Kronprinzenpalais in December 1928 and used the occasion to compare these with ten of the Wacker Van Gogh pictures, which were hung nearby in his study. His conclusions were straightforward: all the Wacker pictures were "forgeries beyond any doubt"; each lacked the signs of the artist's struggle with his subject and they were, moreover, of varying quality in his view (Feilchenfeldt 1989: 295).

Furthermore, the court also consulted other specialists, including the Dutch chemist and restorer Martin de Wild, who had recently completed a PhD dissertation on the scientific analyses of paintings (De Wild 1928), and the German restorer Kurt Wehlte. De Wild tested the oil paint in the contested pictures and found some unusual components: resin and lead had been mixed in with the oil, presumably to

[8] The *sunk cost fallacy* may also explain Hofstede de Groot's perseverance in the Hals controversy described above. He had invested both his reputation and actual money in his attribution of the *Laughing Cavalier* and the *Boy Smoking*.

make it dry faster.[9] He had never encountered these chemicals in his analyses of securely attributed Van Gogh paintings and the chemical evidence was therefore persuasive. Wehlte made a close comparison of the painting technique based on x-radiographs of a Wacker painting and a reference work, demonstrating how the build-up of the paint layers differed noticeably. Ironically, the reference work he used has been de-attributed in 1970 and even labeled a forgery (De la Faille 1970: 594).[10]

In hindsight, Wehlte's analysis therefore underscores –once again– the necessity of a clear frame of reference. Chemical evidence such as a x-radiographs proved very useful to study the build-up of paintings; however, without sufficient and secure reference data, no valid conclusion could be drawn. Likewise, De Wild's scientific analysis was –to a large extent– a matter of interpretation. He could prove –without a doubt– the presence of resin and lead, but these were not anachronistic materials, as in the case of the Hals forgery.[11] The validity of his conclusion thus hinged on his expert knowledge of reference works (which he had researched in depth for his dissertation). In this respect, his analysis was rather similar to the approach of Ludwig Justi, who compared a large number of genuine Van Gogh paintings with a very secure provenance to ten contested works (see above). Such a side by side comparison of securely attributed works and contested pictures was quite rare at the time (and it still is – due to the limited accessibility of the high value original works); art experts usually had to rely heavily on their visual memory (Wallert and Van de Laar 2011: 70–71). Having secure reference material in sufficient quantity available greatly facilitated the interpretation. Only in this manner could one begin to answer crucial questions such as: How much consistency can one expect in an artist's inventions, style and technique, choice of materials and workshop practice?

Yet there was a sharp contrast between De Wild's observations and Justi's. While De Wild's data was clear and could be checked, Justi's observations remained more implicit. Like Hofstede de Groot and (Wilhem) Martin before him, Justi seems to have relied rather strongly on his intuitive insights, which he did not explain extensively. According to Justi one could recognize a genuine Van Gogh by studying the brushwork; each stroke 'has a very clear significance, because of its size and direction, its surface structure and colour, and also because of its relation to the surrounding brushstrokes'. He did not specify how exactly the brushwork deviated in the

[9] These elements had already been encountered in 1929 during a chemical analysis at the Nationalgalerie (*Die Kunstauktion*, 10 February 1929; *De Telegraaf*; Tromp 2006: 58 note 40). Presumably, the analysis was done by E. Täubner, chemist at the German National Museums, who declared in 1932 that he had researched 5 or 6 paintings at the Nationalgalerie, half of which were genuine and the others forgeries. Tromp 2006: 58.

[10] The work has gone missing during the Second World War, preventing further technical research. It can only be researched on the basis of photographs.

[11] Although de Wild is usually credited with the discovery of resin and lead (Charney 2015: 27), the presence of these elements was published already in 1929, see note 11.

Wacker paintings, stressing merely how 'obvious' it was to the eye. One 'had to be blind *not* to see it'! (Justi 1929; Feilchenfeldt 1989)

It was precisely this absence of rational, communicable arguments that was a thorn in the side of the Dutch restorer Maurits van Dantzig. In 1937 he published a book entitled *Frans Hals: Echt of vals? (Frans Hals: Genuine or Fake?)* in response to the first ever overview exhibition of paintings by Frans Hals in Haarlem (Van Dantzig 1937). In the introduction he sharply criticizes art experts 'who have the habit of answering every question relating to the value of an artwork with the Yes! Or No! of their aesthetic feeling' and their refusal to make the experiences that underpin their aesthetic judgement explicit.[12] In his view clear and verifiable criteria were needed to determine if a painting was an original, copy, imitation, forgery or other type of work. He developed a new method, which he would later call 'pictology' (Van Dantzig 1947; Van Dantzig 1973). On the basis of his own observations of the well-documented and securely attributed core oeuvre of Frans Hals, he made a list of 44 traits that he deemed characteristic of the artist. He subsequently applied the criteria to the 116 works on display and reached a devastating conclusion: only 33 were authentic works by Frans Hals in his view, 5 doubtful, 42 were wrongly attributed and 36 paintings were even forgeries in his opinion.[13]

Van Dantzig's harsh conclusions initially met with a lot of resistance in Dutch art community. Trained as a restorer, Van Dantzig had no formal art historical training and was mocked by academic art historians. Tellingly, the first Professor in Art History in the Netherlands, Wilhem Vogelzang (1875–1954), donated a copy of Van Dantzig's book to the Utrecht University library with the inscription: 'Handed over as an example of shoddy literature'.[14] Indeed, Van Dantzig's conclusions were far reaching and some of the works he dismissed are nowadays seen as undisputed originals, such as *Jasper Schade* (National Gallery, Prague) and *Laughing Boy* (Mauritshuis, The Hague). Nevertheless, his insistence that clear rational arguments were needed, constituted an important step forward in history of connoisseurship. Moreover, his careful observations of the works of Frans Hals, Rembrandt and Van Gogh (for each of which he eventually compiled a list of over 100 visual characteristics) are still of great value to art historians (Van Dantzig 1978; Hendriks and Hughes 2009).

In his lists Van Dantzig made no reference to his intuitive expertise or 'feeling for style' (contrary to predecessors such as Martin and Hofstede de Groot). Instead, he wrote down in great detail what he had observed. He noted, for example, how Frans Hals had a habit of depicting his figures in relaxed, natural poses, with limbs in angular constellations with each other and with the picture plane. "That is not coincidental. […] An angular position breaks through the picture plane and creates a connection with the viewer" (Van Dantzig 1937: 7). He also had a sharp eye for the

[12] Van Dantzig 1937: 2.

[13] Van Dantzig 1937: 3. Van Dantzig indicates in the introduction that he had seen more exhibitions that comprised doubtful works but this particular one exceeded all the others in his view: Van Dantzig 1937: 1.

[14] Storm van Leeuwen 1977: 89, note 3.

peculiarities of the brushwork: how Hals blended his final touches wet-in-wet with both foreground and background; and how he both painted and drew at the same time, indicating colours and shapes simultaneously, for example by depicting the highlight on the nose in the shape of the curvature of the nose. His systematic analysis of the oeuvre of Frans Hals constituted the first step in developing his new method. The central idea is that attributions should be quantified: buttressed by a large number of clearly and explicitly described characteristics, which could be checked and corrected by later scholars (Tummers 2011: 33 ff).[15] Given his emphasis on objective criteria that could be checked, it is interesting that Van Dantzig does not mention the potential of chemical analyses when discussing forgeries. Although chemical evidence had started to play a significant role in court cases, it was far from usual in the regular authentication practice. When one of Van Dantzig's most talented pupils, Storm van Leeuwen, evaluated his master's legacy in 1977 he mentioned this oversight as an important lacuna (Storm van Leeuwen 1977). It explained some of the resistance Van Dantzig had encountered in his view; he had dismissed paintings too quickly as forgeries, ignoring the potential of chemical analyses to confirm his suspicions.

While art experts were thus slow to incorporate chemical analyses in the authentication process, forgers were quick to use the chemical evidence presented in the different court cases to improve their skills (Wallert and Van de Laar 2011). They developed new techniques to make sure their paint layer would not dissolve when tested and they were more careful to select materials that were not anachronistic. Master forger Han van Meegeren, for example, started working with a new binding medium: he mixed fugitive oils with phenol-formaldehyde, also known as 'bakelite'. Using an oven to speed up the drying process, he created a paint layer that was just as hard as a naturally aged oil paint. Moreover, it allowed him to create a convincing pattern of cracks – which constituted another notoriously difficult challenge for forgers. Furthermore, he started to paint forgeries on top of actual seventeenth century canvases and made great efforts to obtain pigments that were consistent with the period (Fig. 1.4). Ironically, one of the most expensive pigments he purchased, natural lapis lazuli or ultramarine blue, later turned out to have been diluted with a cheaper modern blue (cobalt).[16] It was an oversight that amused the later master art forger Eric Hebborn, who had the advantage of knowing the outcome of the Van Meegeren trial in 1945–47 (Hebborn 1991: 121–122).

[15] His method is reminiscent of the method pioneered by his famous Italian predecessor, Giovanni Morelli (1816-1891), who also insisted on closely describing visual clues (although Van Dantzig never mentioned Morelli in his writings, see Storm van Leeuwen 1979). See also above, note 2.

[16] According to his own saying Van Meegeren paid 5000 guilders (current value circa 35.500 euros) for 100 grams of natural lapis lazuli, see Wallert and Van de Laar 2011: 79; see also Wallert and Van de Laar 2018.

Fig. 1.4 Tubes with pigments confiscated in Van Meegeren's workshop in Nice and entered as evidence in the Van Meegeren trial, Rijksmuseum Amsterdam

1.3 The Van Meegeren Scandal: A Turning Point

The Van Meegeren trial constitutes a definitive turning point in the history of connoisseurship. After having created forgeries of old master paintings with tremendous success for over a decade, Van Meegeren was arrested at the end of the Second World War. The charge did not concern the forgeries, however, but a far more serious crime: treason through collaboration with the Germans. He was accused of having sold a crucial part of the Dutch cultural heritage, a painting by Johannes Vermeer, *The Adulteress*, to the German marshall Herman Göring without the necessary export permission. Caught between a rock and a hard place, Van Meegeren decided to reveal his deceit: he defended himself by stating that he had not sold an authentic Vermeer painting but, instead, a forgery by his own hand. Moreover, he claimed authorship of six other paintings in the styles of Pieter de Hooch and Vermeer, including the well-known *Christ and his Disciples at Emmaus* at the Boijmans Museum in Rotterdam. It resulted in a highly unusual court case, in which the forger was keen to prove his guilt, as it would free him of more serious accusations (Fig. 1.5).

Despite an overwhelming amount of evidence, it was hard to accept the deceit for some of the art experts who had authenticated, bought or praised the paintings before. They had invested in the paintings in a material or immaterial way, and

Fig. 1.5 Court case against Han van Meegeren (lower left, on the accused bench) 29 October 1947 (featuring his forgery *Christ and his Disciples at Emmaus* in the background at the right)

therefore seem to have been prone to the so-called *sunk cost fallacy* (see above and Kahneman and Tversky 1979). For example, when the trial had already started Federica Bremmer still included the painting *Christ and his Disciples at Emmaus* in a revised edition of her survey of art history, stating: 'As my personal opinion I would like to state that it is completely unacceptable that this work, which has no equal in the expression of a deep religious emotion, could have been painted by a cowardly cheater […] If this work is indeed old, Vermeer would be the only painter who could have created it. After serious consideration, we have therefore decided to keep the painting in its place for the time being' (Bremer 1945: foreword).

After the trial reached a conclusion, it had become virtually impossible to deny Van Meegeren's claim.[17] Not only had the police found evidence of the forgeries he had created in his workshop in France, Van Meegeren had demonstrated how he

[17] Nevertheless, Dirk Hannema, the director of the Boijmans Museum who had purchased the painting, would continue to believe in its authenticity until his death in 1984, and so did D.G. van Beuningen, owner of one of the Vermeer forgeries (*The Last Supper*). Moreover, the Flemish art dealer Jean Decoen tried to disprove the chemical evidence presented in the court case by Professor Coremans in several publications and Van Beuningen repeatedly threatened to sue Coremans over the matter (Decoen 1951; Van de Brandhof 1979: 9–10). In 1968 Bernard Keisch published new

created his forgeries by making a new one in prison. Moreover, an elaborate expert report confirmed that the pictures could not possibly date from the seventeenth century. It was written by seven prominent paintings experts: Prof. dr. Paul Coremans, head of the Central Laboratory of Belgian Museums, Dr. Wiebo Froentjes, a chemist working for the Dutch Ministry of Justice, Dr. Harold J. Plenderleith, Keeper of the Research Laboratory of the British Museum in London, F. Ian G. Rawlins, Assistant Keeper of the National Gallery in London, Prof. dr. I.Q. van Regteren-Altena, Professor in art history at the University of Amsterdam, Dr. H. Schneider, former director of the National Institute for Art Historical Documentation (RKD) and Dr. Martin de Wild, the chemist and restorer who had also been consulted by the Berlin court during the Wacker trial.

The strongest evidence concerned the new binding medium Han van Meegeren had used. As we have seen, Van Meegeren painted his forgeries on top of authentic seventeenth century canvases and made great efforts to obtain pigments that were consistent with the period. In departure from seventeenth-century practice, however, he employed a modern binding medium, phenol-formaldehyde, which allowed him to imitate the cracked and hardened surface of centuries-old oil paintings. With two different tests involving a sulphuric acid solution and an ammonia solution, which caused yellow and blue discolourations, the chemists were able to demonstrate its presence throughout in the contested works (Huussen 2009: 99; Tummers et al. 2019b: 999). Phenol-formaldehyde had only been invented in 1907; thus, these paintings could not have been created before the twentieth century. [Furthermore, the presence of cobalt blue also pointed to a later date, see above.]

The stylistic analysis of the paintings written for the court emphasized many shortcomings which -according to the experts- did not agree with an attribution to Vermeer, such as the unclear definition of the space and the unhealthy flesh colour of the faces (Schneider 1947). For the purpose of legal proof it was not necessary to delve deeply into the stylistic interpretations. But it was certainly curious that the paintings had been described in radically different ways before and after Van Meegeren's confession, especially *Christ and his Disciples at Emmaus*. Both before and immediately after the trial, art historians described the picture in quite generic terms strongly infused with value judgments (Weerdenburg 1988). Before the trial the painting was said to be 'Vermeer's best work' (Bredius 1937); the composition was said to be well-balanced, the colors exquisite, the still life better than any other from the period, Christ's face was 'filled with secrecy' (Knuttel 1938) and the maid 'perhaps the most beautiful one Vermeer ever painted' (Van Thienen 1939). After the trial, the composition was seen as unbalanced and rather forced, the colors too gray, Christ's face decidedly effeminate (Kilbracken 1967), the maid cross-eye and bald, and her lips too thick (Van Dantzig 1947).[18]

scientific proof confirming the status of both these Van Meegeren paintings as forgeries based on the radioactivity of the lead (Keisch 1968).

[18] In attribution matters it is often striking how differently the quality of paintings is judged when their attribution changes, even when the same expert re- or de-attributes the work. Though this could be done maliciously to massage the evidence in order to convince the reader of one's judg-

The mistaken attribution was perhaps somewhat understandable. Van Meegeren had created such a convincing pattern of cracks that even the restorer who cleaned the painting for the Boijmans Museum failed to notice that the work did not date from the seventeenth century (Van Dantzig 1947: 63). In art-historical terms, the situation was not clear-cut. *Christ and his Disciples at Emmaus* had been recognized as an early work by the art historian who discovered the painting, Abraham Bredius, and in his early period, Vermeer varied his style and technique considerably.[19] Moreover, the reference material Bredius and others were using had been 'polluted' as similar forgeries had already been accepted as authentic (Wallert and Van der Laar 2011).

Nevertheless, the Van Meegeren trial exposed a serious shortcoming in connoisseurship. A large number of experts had clearly been unable to distinguish between an authentic old painting and a forgery. Moreover, they had even celebrated a forgery as one of Vermeer's best works. This painful conclusion not only affected the reputation of connoisseurs in the field of Dutch painting more than any previous error had done, it also heightened the awareness of the difficulties involved in attributing and dating paintings. In the aftermath of the court case, scholars became more cautious when authenticating and dating pictures. Attributions based on the intuition of an expert without much explanation were no longer acceptable. From now on arguments were needed. As Arie Bob de Vries, then director of both the Mauritshuis and the National Institute for Art Historical Documentation (RKD), put it: 'every attribution must be supported by evidence, insofar as one can provide proof in the thorny field of such conclusions' (De Vries 1939 [ed. 1948]: 71). De Vries, who had published a Vermeer oeuvre catalogue just before the start of the Second World War in 1939, revised his book considerably in 1948, bringing down the number of paintings he categorized as authentic Vermeers from 43 to 35 – a selection that has hardly been debated or altered since then (Tummers 2011: 27–29).

1.4 Excessive Optimism: The Potential and Limitations of Scientific Techniques

After the Van Meegeren scandal, art historians did not only specify in much greater detail what visual observations, archival and documentary evidence led to their attributions, but also gradually started to expand their visual analysis by systematically integrating scientific techniques. In Belgium, a National Centre for Research of the Flemish Primitives was established in 1949, which resulted in the publication

ment or save one's reputation, it could also be the effect of (altered) subconscious associations and expectations, which can truly make us look differently. It would be a fascinating subject for further research.

[19] Compare Johannes Vermeer, *Christ in the House of Martha and Mary*, c. 1655, National Gallery of Scotland, Edinburgh; Johannes Vermeer, *Diana and her Companions*, c. 1655-56, Royal Picture Gallery Mauritshuis, The Hague.

of numerous technical studies, including Prof. Coremans' technical analysis of Jan and Hubert van Eyck's famous *Ghent Altarpiece* in 1953 (Coremans 1953). Although early technical studies concentrated mostly on x-radiography and pigment analyses of paint samples, these were soon expanded with new techniques (Ainsworth 2005). Van Asperen de Boer, a physicist in the art history department at the University of Groningen in the Netherlands, was the first to develop infrared reflectography (IRR) for the study of paintings, a technique which proved particularly useful for examining early Netherlandish pictures as it exposed detailed underdrawings in these works (Van Asperen de Boer 1969).

In the field of seventeenth century paintings, the Rembrandt Research Project, founded in 1968, constituted a major step forward. At the initiative of Bob Haak, curator of old masters at the Amsterdam Historical Museum, a team of five leading Rembrandt experts set out to redefine Rembrandt's entire painted oeuvre: Josua Bruijn, Professor of art history at the University of Amsterdam, Haak himself, Simon Levie, the director of the Amsterdam Historical Museum, Pieter van Thiel, curator of old master paintings at the Rijksmuseum and Ernst van de Wetering, staff member of the Central Research Laboratory of Objects of Art and Science. At the start of the project, many connoisseurs were doubtful about the validity of existing attributions to Rembrandt. For example, Horst Gerson, professor of art history at Groningen University, noted in the introduction to his 1968 monograph on Rembrandt that he largely agreed with what British collectors tended to say about Dutch old masters, namely that 'nearly half of the old masters are wrongly attributed and the others are not old at all' (Gerson 1968: 160). He also pointed out that no Rembrandt scholar had ever even seen all possibly authentic Rembrandt paintings in real life (Tummers 2011: 40).

The members of the Rembrandt Research Project were the first to do so. In pairs of two they traveled the world, observed over 600 potential Rembrandt paintings in real life, described these in painstaking detail, and decided on the attributions as a group. Moreover, they tested a variety of scientific techniques systematically as to their merit in sorting out Rembrandt's oeuvre. Whereas previous generations of art historians had been hesitant and sometimes even skeptical about incorporating chemical research, the members of the Rembrandt Research Project signaled rather an excessive optimism: a relatively widespread belief that science held the answers and could potentially replace the eye in matters of attribution (Bruyn et al. 1982–, vol. I: XIIIff). However, their systematic application of technical research methods proved otherwise.

Dendrochronology proved useful in dating the oak panels Rembrandt used for his early paintings. By determining the approximate year in which the tree used to make the panel was felled, the technique provides a 'terminus post quem' that is, dates after which the painting had to have been made. Tests executed by Peter Klein and his team at the Ordinariat für Holzbiologie at the University of Hamburg provided surprising results when applied to paintings that the Rembrandt Research Project had originally considered later imitations (Bruyn et al. 1982–, vol. I: XII). Most of these turned out to be done on authentic seventeenth-century panels, which