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# Samuel van Hoogstraten: Perspective and Painting

Christopher Brown, David Bomford, Joyce Plesters and John Mills

## Introduction

Christopher Brown

### The artist

The mechanics of the Dutch art market in the seventeenth century encouraged artists to specialize: having established a reputation as a painter of still-life or landscape, for example, an artist would tend to paint only that subject and indeed to repeat with only slight variations particularly successful compositions. Samuel van Hoogstraten, the artist of the National Gallery's *Peepshow* (No. 3832; Fig.1 and Plate11, p.64), was one of the exceptions [1]. We know genre scenes, portraits, architectural fantasies and religious subjects from his hand and according to Arnold Houbraken [2], who was his pupil, he also painted landscapes, marines, animals,

flowers and still-life. In other respects too, Hoogstraten was unusual among Dutch seventeenth-century painters. He was well-travelled, and lived and worked in Vienna, Rome and London. However, the single most exceptional feature of Hoogstraten's career was that, in addition to being a successful painter, he was a distinguished poet and dramatist. He wrote on religious and classical themes as well as poems and plays on subjects taken from contemporary history: he also composed a number of epithalia. In the portrait (Fig. 2) in the introduction to his treatise on painting, the *Inleyding tot de Hooge Schoole der Schilderkonst*, Hoogstraten presents himself in the guise of both painter and poet: the four-line encomium beneath it begins, 'Hoogstraten, die 't penseel verwisselt met de pen' (Hoogstraten who interchanges his brush with his pen) [3].

Samuel van Hoogstraten was born in Dordrecht in 1627. He was at first a pupil of his father Dirk van

**Figure 1** Samuel van Hoogstraten, *Peepshow with Views of the Interior of a Dutch House* (No.3832), shown after restoration. The *Peepshow* is now displayed on a pedestal, with a modern light source.







Hoogstraten and after his father's death in December 1640, of Rembrandt in Amsterdam. Hoogstraten seems to have been in Rembrandt's studio from the winter of 1640–41, when he was only thirteen years old, until shortly before April 1648, when he is known to be back in Dordrecht. Rembrandt was at the height of his fame, completing 'The Nightwatch' in 1642. His studio was filled with brilliant young painters: among Hoogstraten's fellow pupils were Carel Fabritius, Constantijn van Renesse and Abraham Furnerius. Having left Rembrandt's studio and returned to Dordrecht to work as an independent artist, Hoogstraten travelled to Vienna in May 1651, where he received the patronage of Emperor Ferdinand III. In his portrait in the *Inleyding* he can be seen wearing the gold medal presented to him by the Emperor. In 1652 Hoogstraten was in Rome but had returned to Vienna by the following year. He was back in Dordrecht in 1654 and married there in 1656: he appears to have remained in the town until he left for London at some time before September 1662. The National Gallery's *Peepshow* dates from the last years of the 1650s [4]: it was painted in Dordrecht before Hoogstraten's departure for England. There was a sizeable community of Dutch artists in London and Hoogstraten was much in demand as a portrait painter. He was still in London at the time of the Great Fire in September 1666: he gives an account of the outbreak of the Fire in the *Inleyding* [5]. Hoogstraten returned to Holland shortly after, settling in The Hague. He was back in Dordrecht by 1673, serving as one of the Provosts of the Mint. It was during these years, after his return to his native town, that he was working on his theoretical and technical treatise on painting, the *Inleyding tot de Hooge Schoole der Schilderkonst: anders de Zichtbaere Werelt* (Introduction to the High School of the Art of Painting: or The Visible World), which was published by his brother François in Dordrecht in 1678, the year of Hoogstraten's death.

The *Inleyding* is divided into nine books, each bearing the name of one of the Muses. Each book is prefaced by an allegorical print showing the Muse surrounded by both mythological and modern figures. The allegory is explained in verses which face it. Each book has a particular theme: that of the first, Euterpe, is drawing; that of the second, Polymnia, is anatomy; that of the third, Clio (Fig.3), the supremacy of history painting in the hierarchy of subject-matter; and so on.

Much of the text is conventional and derivative: Pliny and Philostratus, Vasari and Lomazzo, and, above all, Van Mander, are quoted at length, with or without acknowledgement. Many of the sections which are most interesting to a modern reader are those which contain anecdotes about Hoogstraten's own career: exchanges with Rembrandt, descriptions of Fabritius's now lost

**Figure 2** (Above, left) Samuel van Hoogstraten, etched *Self-Portrait*. On the paper beneath his left hand is his age, 50, and the date 1677. The *Self-Portrait* is included in the introductory section of his treatise, *Inleyding tot de Hooge Schoole der Schilderkonst* (Dordrecht, 1678).

**Figure 3** Samuel van Hoogstraten, *Clio de Historyschryfster*. Etching facing p.68 in the *Inleyding*. The Third Book, which elevates history above all other subjects for the artist, bears the name of Clio, the Muse of History. The book in her hand is Thucydides.





perspective paintings, his account of the Great Fire of London, a poem written in Vienna in 1651 about his journey from Dordrecht, and so on. Despite the apparently rigorous organization of the book there are a number of these extended asides which provide a fascinating glimpse of Hoogstraten's milieu. There was, however, so little theoretical literature on painting published in Holland in the seventeenth century — the *Inleyding* is the only extended treatise published between Van Mander's *Schilderboeck* of 1604 and Lairesse's *Het Groot Schilderboek* of 1707 — that, for all its ponderous classical references and borrowings from Vasari and Van Mander, it is of undeniable importance as an account of contemporary artistic attitudes and practice.

### The peepshow

The peepshow was a shortlived phenomenon in Holland in the seventeenth century [6] and is an aspect of Dutch artists' fascination with perspectival and optical devices. The effect that such boxes had on contemporaries can be judged by John Evelyn's account of a peepshow he saw in London in 1656: '[...] was shew'd me a pretty Perspective & well represented in a triangular Box, the greate Church at Harlem in Holland, to be seene thro a small hole at one of the Corners, & contrived into a handsome Cabinet. It was so rarely don, that all the Artists and Painters in Towne, came flocking to see & admire it' [7]. Only six of these boxes, all of which simulate a domestic or church interior, survive and the one in the National Gallery is without doubt the best of them. It is the only one which is signed: the signature is in the form of a letter addressed to 'Monsieur S de Hoostraten a Dordrecht' lying on a chair in the corner of the principal room.

Hoogstraten's interest in perspective and illusion is well documented. In his extensive account of his master [8] in volume 2 of *De Grootte Schouburgh der Nederlantsche Konstschilders en schilderessen* (Amsterdam, 1719) Houbraken wrote that Hoogstraten principally worked on portraits, history paintings and perspectives of interiors ('*Perspectiven in kamers*'). These last, he says, were viewed through a hole made in the side. Houbraken adds that he has seen several of these, in which Hoogstraten has conjured up a whole palace and galleries supported by marble columns in a small space. Hoogstraten himself discusses such perspective boxes in his *Inleyding*, describing them, in a memorable phrase, as '*de wonderlijke perspectyfkas*', in which a figure the size of a finger appears lifesize. He cites classical, Renaissance and contemporary practitioners of the art of skilful perspective painting, particularly praising his fellow-pupil Carel Fabritius, and he lists writers on perspective, among them Dürer, Vredeman de Vries and Samuel Marolois.

Disappointingly, however, he fails to describe a *perspectyfkas* in any detail or to instruct his readers in the method of their construction. After urging painters to read the perspective writers, he says that he knows a short-cut to an understanding of perspective which he will describe when he has the time and the inclination ('*de tijdt en de lust*'). This tantalizing remark concludes the Seventh Book which is dedicated to the Muse Melpomene and is principally concerned with the effects



**Figure 4** Samuel van Hoogstraten, *View down a Corridor*, canvas, 264 × 136.5 cm. Monogrammed and dated 1662. The National Trust, Dyrham Park, Gloucestershire.

of light and shadow. We know from Houbraken that Hoogstraten planned a second book, the *Onzichtbaere Werelt* (Invisible World): he may have intended to expand on this subject in that work.

Hoogstraten's only surviving *perspectyfkas* is a five-sided box painted on the inside to show a domestic interior: the sixth side is open to admit light, which was probably filtered through specially treated paper. The letter addressed to Hoogstraten which lies on a chair has suggested to some writers that this interior is intended to show the artist's own house in Dordrecht but in fact it is impossible to reconstruct the ground plan of the interior and the house is likely to be entirely imaginary, although no doubt composed of actual features.

The notion, suggested by Koslow [9], that it tells the story of an amorous encounter between the man at the window and the woman reading is entirely fanciful. Such meaning as the box does possess is contained in the scenes painted on its exterior. On the three sides are three small scenes identified by *cartellini* as *Amoris Causa*, an artist making a drawing of the Muse, Urania; *Lucri Causa*, a *putto* with crown and sceptre pouring gold and silver coins from a cornucopia, while behind is a painter at an easel on which is a portrait of a woman; and *Gloriae Causa*, an artist seated at his easel, with a *putto* who has placed a gold chain around the artist's neck and is crowning him with a laurel wreath. These are three incentives of the painter described by Seneca in his *De Beneficiis* [10] — Love of Art, Wealth and Fame — and they are also the subjects of the three last parts of the last book, Book 9, in the *Inleyding*. Book 9 is named after the Muse of Astronomy, Urania, who represents the artist's striving towards Heaven or the Sublime. It is therefore entirely appropriate that she should represent *Amoris Causa* on the exterior of the box. It is entirely appropriate too that a portrait should stand for *Lucri Causa*, as portraiture was considered by Hoogstraten and many of his contemporaries as an inferior genre of painting, which was undertaken simply to provide the artist with money to live. In the hierarchy of subject matter which he outlines in his third chapter, named after Clio, the Muse of History, Hoogstraten ranks portraiture (of which he was a distinguished practitioner throughout his career) very low down: the highest form of art was in his view history painting, that is, the treatment of mythological, classical and historical subjects. The subject of third side of the box, *Gloriae Causa*, Fame, was an entirely laudable aim, bringing the best artists just rewards, like a gold chain and medal — such as Hoogstraten himself had received from Emperor Ferdinand and a laurel wreath.

On the top of the box is a slightly risqué decorative element, Venus and Cupid in bed. In order to tease the spectator, the scene is difficult to see unless viewed from a particular angle, having been painted in an anamorphic projection.

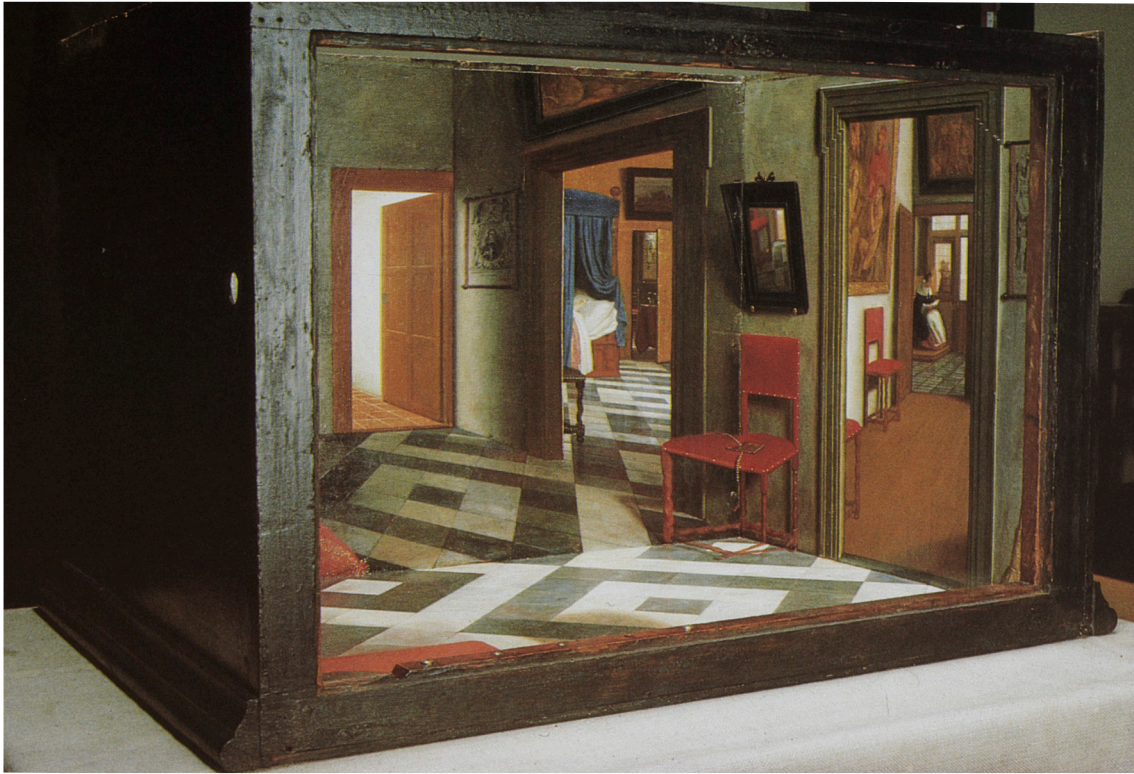
Although the London box is the only known peepshow by Hoogstraten, other perspective paintings by him are known. A number of large-scale canvases, showing figures in marble columned courtyards, survive: at least some of these form part of a series and may well have been part of a scheme of decoration commissioned from Hoogstraten by the Finch family during his

stay in England. However the best-known and most effective of his large-scale perspective paintings is the *View down a Corridor* of 1662 which is at Dyrham Park in Gloucestershire (Fig.4) [11]. Today this large upright canvas is placed — as it was always intended to be — at the end of an actual corridor where it has the effect, when seen from a distance, of prolonging the corridor. Like the peepshow, it is a highly effective illusion and testifies to the artist's skill in deceiving the eye. It was admired by Samuel Pepys who saw it on 26 January 1663 at Mr Povey's rooms in Lincoln's Inn Fields: '[...] went and dined at Mr. Povys [...] above all things, I do the most admire his piece of perspective especially, he opening me the closet door and there I saw there is nothing but only a plain picture on the wall.'

## Notes and references

1. MACLAREN, N., *The Dutch School: National Gallery Catalogues* (London 1960), pp.192–95. A new edition of *The Dutch School*, expanded and extensively revised by the present writer, will appear in 1988. See also SUMOWSKI, W., *Gemälde der Rembrandt-Schüler*, Vol.2 (Landau 1983), cat. no.886.
2. Houbraken's account of his master is in *De Groote Schouburgh der Nederlandsche Konstschilders en schilderessen*, Vol.2 (Amsterdam 1719), pp.115–70.
3. The whole poem, written by J. Oudaan, reads: 'Hoogstraeten, die 't penseel verwisselt met de pen, / Wildat zyn vaderland hem dus naer 't leeven ken, / Min in zyn beeld, dan konst op loutre reedens gronden, / Geroemt in Cesars-hof te Roome, en binnen Londen.'
4. MACLAREN, N., *op. cit.*; KOSLOW, S., *op. cit.*; and SUMOWSKI, W., *op. cit.* concur in this dating.
5. *Inleyding*, p.266.
6. KOSLOW, S., "'De wonderlijke Perspectyfkas': An Aspect of Seventeenth Century Dutch Painting', *Oud Holland*, 82 (1967), pp.33–56. Koslow's article contains a catalogue of all the surviving peepshows.
7. DE BEER, E.S. (ed.), *The Diary of John Evelyn*, Vol.3 (Oxford 1955), p.165 (5 February 1656).
8. See Note 2.
9. See Note 6.
10. Book 2, chapter 33. A Dutch edition of the *De Beneficiis* was published in Amsterdam in 1672 (Volume 1, p.649). KOSLOW, S., *op. cit.* notes, however, that Van Mander mentioned these three incentives when discussing a drawing by Cornelis Ketel which illustrates them and so Van Mander rather than Seneca may have been Hoogstraten's direct source.
11. SUMOWSKI, W., *op. cit.*, cat. no.895.





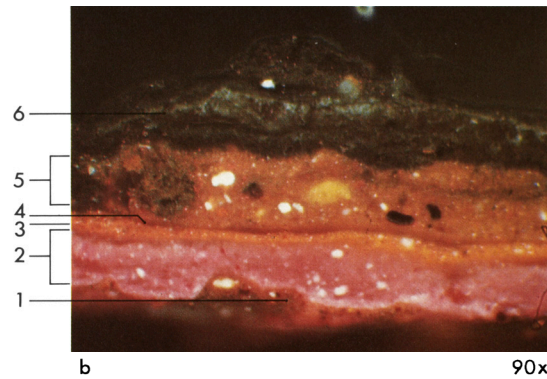
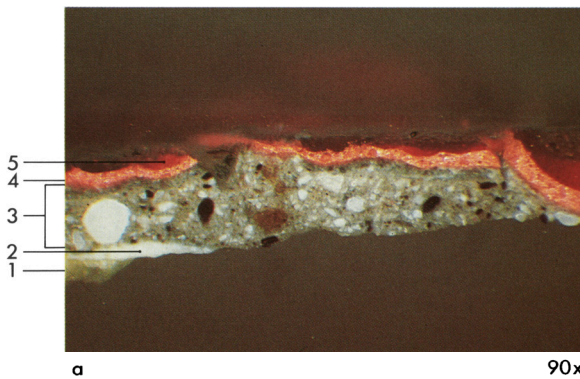
**Plate 11**  
Samuel van Hoogstraten,  
*Peepshow with Views of the Interior of a Dutch House* (No. 3832), after restoration.



**Plate 12**  
(Far Left)  
The dog seen through the peephole.



**Plate 13**  
(Left)  
Detail of the interior, after cleaning.



**Plate 14**  
Samuel van Hoogstraten,  
*Peepshow with Views of the Interior of a Dutch House* (No. 3832). Full caption on facing page.



**Plate 14** Samuel van Hoogstraten, *Peepshow with Views of the Interior of a Dutch House* (No. 3832). Photomicrographs of paint cross-sections, photographed in reflected light under the microscope at 110×. Actual magnifications on the printed page shown opposite.

**(a)** Red paint of the chair seat in Plate 13. Sample taken before cleaning.

1. Chalk ground. (The upper brown granular ground found elsewhere is not present beneath the paint of the tiled floor.)
2. Lead white underpaint of floor tiles.
3. Grey of darker-toned floor tile: carbon black and lead white, with large aggregates of the latter visible.
4. Closely-packed crystalline particles of vermilion.
5. Deep red glaze of lake pigment, identified as madder lake. (The remains of discoloured varnish and retouchings are present at the surface.)

**(b)** Black paint from around the peephole, from the exterior of the side depicting *Amoris Causa*. Sample taken before removal of varnish and repaint, from near where subsequent cleaning tests revealed a bright pink layer in patches of damage and wearing.

1. Trace of brown granular upper ground, consisting of brown earth pigment, carbon black and lead white, as found elsewhere except beneath the tiled floor.
2. Thin pale pink layer followed by thick bright pink, both containing lead white mixed with madder lake.
3. Orange-red layer, mainly ochre and lead white, with a few vermilion particles.
4. Orange glaze-like layer (not analysed).
5. Thick heterogenous orange-brown layer, mainly ochre pigments and lead white, but with scattered inclusions of red (including vermilion), black and yellow pigments, possibly applied in two coats. This might be a preparation, or even a filling, on the worn and damaged area around the peephole, before repainting.
6. Sequence of layers of black and dark grey repaint. Most of the layers incorporate occasional small vermilion particles.

Although the layer structure is complex, the pink paint applied directly on the brown granular ground would appear to be original, representing a pink border or frame around the scenes depicted on the outside of the two ends of the box. The part around the peepholes which are situated within the frame or border would clearly get the most wear, and would therefore need frequent repainting. It is not possible to determine when the pink borders were painted over.

## Perspective and peepshow construction

David Bomford

### Some perspective theory and history

The simple principle which governs perspective theory was expressed with characteristic elegance by Leonardo: 'Perspective is nothing else than seeing a site behind a flat transparent pane, on the surface of which are marked all the things which are behind that glass and which can be conducted by means of pyramids to the point of the eye and these pyramids intersect the said pane' [1]. Leonardo's 'pyramids' are cones of light rays travelling from an object to the eye, and by marking where they intersect the 'transparent pane' (the picture plane) a perspective image of the object is constructed. That is the straightforward aim of perspective: constructing two-dimensional images of three-dimensional objects and spaces then become a succession of geometrical exercises [2].

Although it had been used in a rudimentary and empirical way in painting since early in the fourteenth century, the invention of scientific perspective is generally credited to Brunelleschi in around 1420 [3]. The first written account is that of his friend Alberti in the treatise *On Painting* written in 1436 [4]. Without a single diagram, Alberti described the drawing of a chequer-board floor stretching away behind the picture plane towards a *centre point*, now known as a *vanishing point*, where all the orthogonals (lines perpendicular to the picture plane) met. This classic demonstration became known as the *costruzione legittima* [5].

Single-point perspective of this kind transformed drawing and painting in fifteenth-century Italy. It was still the most important spatial construction in seventeenth-century Holland, and remains so today. It should be understood, however, that it only applies to objects whose principal surface lies parallel to the picture plane. In this convention, parallel lines within the front surface do not converge: parallels in depth (that is, orthogonals) converge to the central vanishing point.

To take account of objects inclined at angles to the picture plane, the construction is modified. In *two-point perspective*, horizontal parallels converge to two vanishing points at the left and right, but verticals do not converge. In *three-point perspective*, horizontal parallels converge to the left and right, while vertical parallels converge to a vanishing point above or below the object. With certain refinements, these three constructions can accommodate most situations that painters encounter.

What we have called two-point perspective, which in a symmetrical form becomes *bifocal* perspective, was first described in *De Artificiali Perspectiva* by a French priest Jean Pélerin, known as Viator. This profoundly influential work was first published in 1505 and was republished, both legitimately and in pirated editions, throughout the sixteenth century [6].

It is impossible to assess the direct influence of such treatises as those of Alberti and Viator on Dutch seventeenth-century painters, because their theories became incorporated and adapted in other works.

Hoogstraten himself, in his *Inleyding tot de Hooge Schoole der Schilderkonst* (1678), has curiously little to say about perspective theory and his chapter on perspective consists mainly of a discussion on the use of mirrors; but he does make direct recommendations on which authors to consult. He certainly knew and praised Alberti's treatise, of which reprinted editions were available in Amsterdam and elsewhere [7].

Then, at the end of the chapter he says that it would be appropriate for him to expound the fundamentals of perspective further, but others before him have done that so extensively it would bore him. So, he recommends the writings of 'Albert Durer, Hans de Vries, Maroldis [sic], Guido Baldi, of den nieuwen vond van des Argues' [8]. He goes on to say that if he feels like it, or has the time, he will show an even shorter method: but he seems neither to have found the time nor felt like it, because there is no further mention of perspective in the book [9].

Dürer, influenced directly by the treatises of both Alberti and Viator, had published his *Underweyssung der Messung*, which contained a section on perspective, in 1525. In it are to be seen the famous illustrations of the artist using a drawing frame, in which the fixed position of his eye (marked by a pointer) anticipates the fixed peephole in the Dutch seventeenth-century perspective box. Here, too, are simple examples of negative or decelerated perspective, which is the basis of *anamorphosis* (see below): the example he gives is of lettering on a high wall in which the highest letters must be larger than those lower down in order to appear the same size to a viewer on the ground.

Hoogstraten's second recommendation, 'Hans de Vries' is Hans Vredeman de Vries, a figure essentially of the sixteenth century (b.1527) but a key influence on seventeenth-century perspective practice through the publication of his perspective treatise in 1604–1605. He was primarily interested in architecture and his treatise is essentially a reference collection of plates showing elaborate architectural fantasies, all drawn with strict and detailed perspective constructions. These prints were republished throughout the seventeenth century and it is difficult to over-emphasize their importance as a source for artists trying to comprehend the possibilities of perspective theory.

Hoogstraten's 'Maroldis' is Samuel Marolois who was instrumental in republishing Vredeman de Vries's treatise and indeed intended to incorporate it in a treatise of his own [10]. Marolois represented a newly emerging discipline, quite distinct from the mainly pictorial approach of Vredeman de Vries. He was one of the first of the mathematical perspectivists, and was primarily a mathematician. His work was still perfectly comprehensible to non-mathematicians however and, along with the prints of Vredeman de Vries became the most important reference work for seventeenth-century Dutch artists studying perspective; but the divergence between practical and mathematical perspective was already growing and it is probable that Hoogstraten's last two recommendations — the works of the mathematicians Guidobaldo and Desargues — were not widely read or understood by practising artists.

Nevertheless, Dutch painters of the seventeenth cen-

tury did achieve extraordinarily complex compositions without necessarily understanding all the geometrical principles that lay behind them. Perhaps the most brilliant sustained exercise in practical perspective during this period was the work of Pieter Saenredam — both paintings and drawings — which has been much studied in recent years [11]. It has even been possible to determine the direct sources he studied, from the inventory of his library when he died [12]. What is significant about his approach, however, is that despite his meticulous accuracy he was ultimately prepared to sacrifice precision for the *look* of a painting. Kemp has demonstrated how Saenredam subtly adjusted the proportions in at least one of his church interiors to achieve a heightened (literally) visual impact [13]. Here, mathematics established the essential form but the painter controlled the final harmony.

There was one further writer on perspective, not mentioned by Hoogstraten, but who was also influential for Dutch seventeenth-century painters. He was Hendrick Hondius, an engraver and publisher in The Hague who published editions of both Vredeman de Vries's (who taught him) and Marolois's work. In 1622 he published a treatise of his own aimed specifically at the needs of practising painters and draughtsmen. Essentially a practical manual, Hondius's book broke no new ground, but synthesized in the most clear and concise way the work of previous, more original writers.

As Wheelock has observed, none of these treatises really acknowledged the major advances in optics and geometrical perspective that were occurring during the first part of the century: they were firmly based on traditional theories inherited from the sixteenth century [14].

Even Hoogstraten, writing in the late 1670s has nothing new to add although he describes optical aids such as the *camera obscura*: as we have seen, he chose to write very little in *Inleyding* on perspective theory. His extant paintings show that, although he was clearly fascinated by *trompe l'oeil* and perspective effects and was extremely skilful and ingenious at incorporating them into his work, his ideas were usually based on the simplest central perspective system. As an example, his celebrated *View down a Corridor* at Dyrham Park (Fig.4) is purely Albertian in its perspective, and relies for its illusion on its setting and on Hoogstraten's mastery of composition, light, shade and texture. His sophistication lies not in his depiction of receding space, which is entirely conventional, but in his precise calculation of how light and detail are less defined in more distant objects. In *Inleyding* he observes how colours in the distance seem less bright, that shadows seem to disappear and that both these factors diminish distant figures: even a magnifying glass (telescope?) will not show the shadows more clearly [15].

Hoogstraten's most ambitious surviving work is his *Peepshow*, now in the National Gallery (Fig.1). Although, as will be seen below, the basic perspective scheme within the box is based on central vanishing points, projection of the composition onto angled planes requires a working knowledge of *anamorphosis*, a reversed adaptation of central perspective theory. As if to signal the perspective principle which underlies the interior of

his perspective box, Hoogstraten has chosen to place an anamorphic painting on the outside, so it is almost the first image that the observer sees.

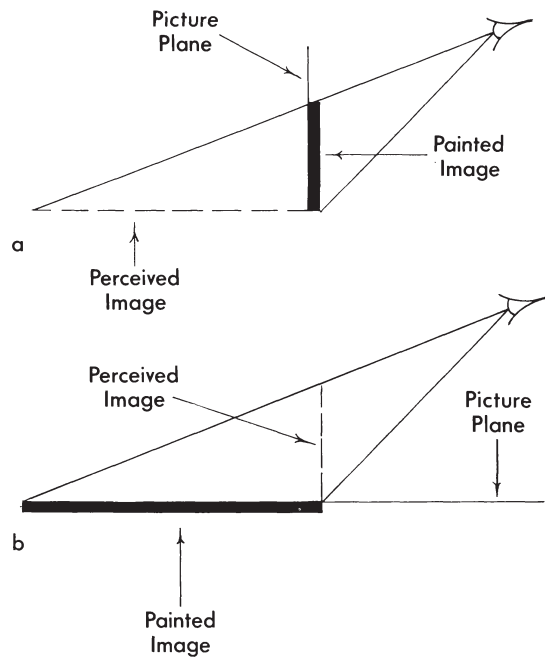
**Trompe l’oeil and anamorphosis: the outside of the Hoogstraten ‘Peepshow’**

Trompe l’oeil is not easy to define, since deception of the eye is, in essence, the aim of most representational painters. However, its strict meaning is confined to situations in which the viewer is genuinely uncertain whether he or she is looking at a flat painting or the real objects depicted. Thus, for a trompe l’oeil to create this sense of unease and ambiguity, it must show low-relief objects, close to the picture plane, which could conceivably be the real thing [16].

There are many seventeenth-century Dutch painters whose delight in detail, texture and accuracy led them to experiment with trompe l’oeil effects. Perhaps the most prolific of them in this regard was Cornelis Gysbrechts whose work included a succession of imitation letter-racks, partly open cupboards, a famous painting of the back of a canvas painting and an extraordinary cut-out easel complete with paintings, palette, brushes and mahlstick [17]. Gysbrechts has a distant connection with the present study, because almost half of his trompe l’oeil paintings are in Danish collections, as well as three of the six surviving peepshows (see below). Gysbrechts worked in Denmark for about four years from 1668 for Frederic III and Christian V and his paintings, together with the peepshows and many other curiosities formed a unique *perspectiv kammer* in the Royal Collection [18].

Hoogstraten’s first major experiment with trompe l’oeil effects was his *Man putting his Head through a Window* (now in Vienna), dated 1653; on the outside of our *Peepshow*, he has included only modest examples of trompe l’oeil, in the strictest sense. The pictures at each end, *Amoris Causa* and *Gloriae Causa*, are surrounded by painted frames of black with an underlying red tone, which cast painted shadows on the pictures. On the back panel, however, *Lucri Causa* is surrounded by a real moulded frame. Two other peepshows have trompe l’oeil designs on the outside, showing conventional motifs of drawers with handles and quill pens tucked into a stretched tape. These were intended to give the effect of a small chest of drawers containing coins, writing materials and so on.

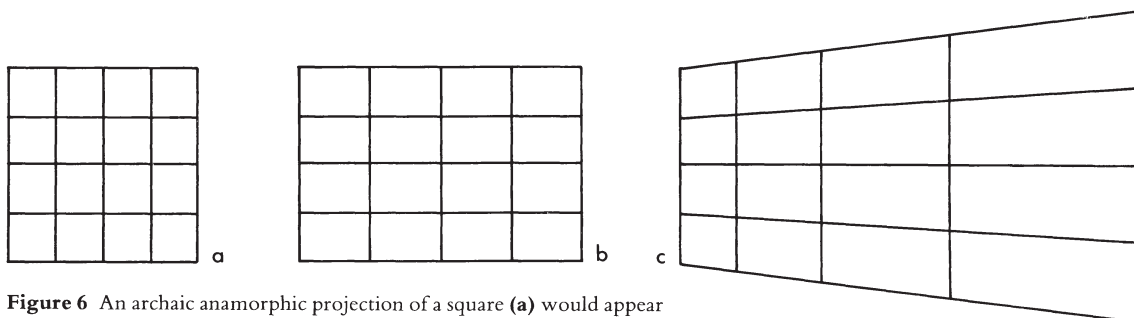
On the outside of the lid, Hoogstraten demonstrates the technique of *anamorphosis* as though preparing the



**Figure 5** Relative positions of picture plane, painted image and perceived image in (a) a conventional perspective painting, and (b) an anamorphic painting.

viewer for the technical brilliance of the interior of the box. Anamorphosis is a curious experimental diversion in perspective practice which seems first to have appeared in Leonardo’s notes, although the word itself did not appear until the seventeenth century [19]. An anamorphic image is one that appears distorted when viewed conventionally, but assumes the correct proportions when viewed obliquely from a fixed point or a peephole. It is based on the principle of negative perspective, since the positions of painted image and perceived image are reversed with respect to conventional perspective painting (see Fig.5). Anamorphosis developed into an increasingly complex exercise with the use of cylindrical mirrors and the construction of images that were circularly anamorphic. Unlike linear anamorphic images, which are not difficult to interpret, circular anamorphoses are almost impossible to recognize without the use of a cylindrical mirror placed at their centre. One of the most celebrated examples, from the Danish Royal *perspectiv kammer*, was a circular double portrait of Frederic III and his queen [20].

Linear anamorphic images began to appear in sixteenth-century perspective treatises [21] and are to be



**Figure 6** An archaic anamorphic projection of a square (a) would appear elongated as in (b). A correct anamorphic projection would appear trapezoid in shape to take account of the visual angle as in (c).



found in Marolois's treatise of 1614. His treatment is still somewhat archaic in that the anamorphic image is created simply by stretching the normal image in one dimension. The intervals of a true anamorphic image should not only increase as they recede from the eye, but should also fan out into a trapezoid shape, to take account of the visual angle (Fig. 6).

Well-known examples of linear anamorphoses are the *Portrait of Edward VI* (National Portrait Gallery, London) and the skull in Holbein's 'Ambassadors' (No.1314) both of which assume their correct shape when viewed from one side of the picture.

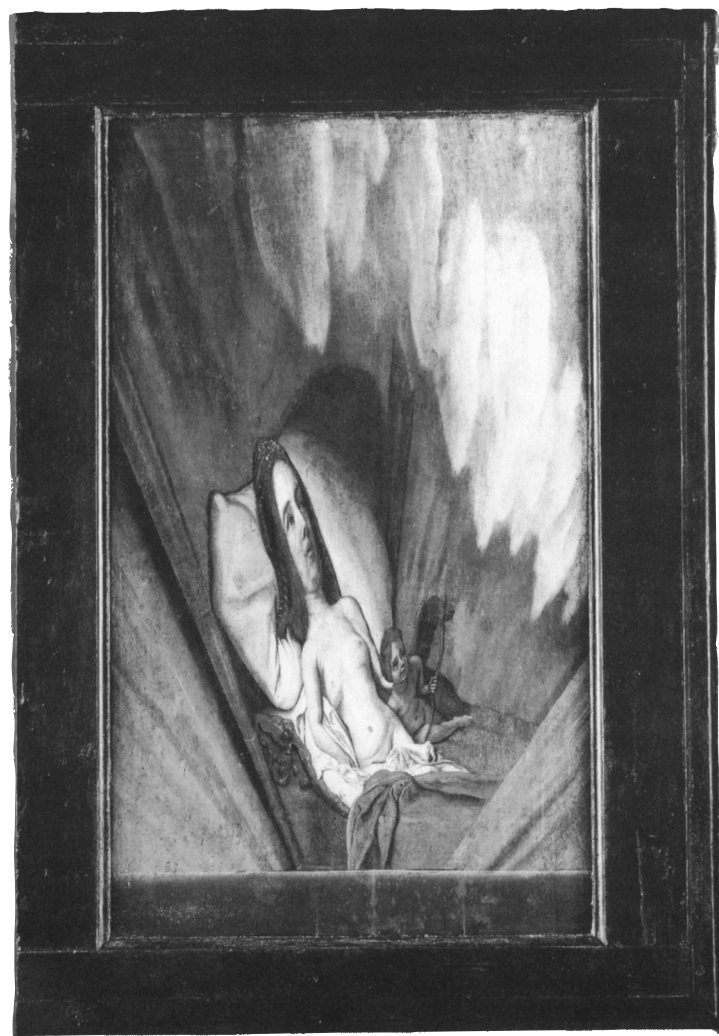
Hoogstraten's peepshow lid showing Venus and the infant Cupid in bed (Fig.7) is a straightforward trapezoid anamorphic projection which is observed correctly by the observer approaching the right-hand end of the box. However, the centre of projection — the point from which it must be viewed — is off-centre and does not quite correspond with the viewer's approach to the peephole. It is not, in truth, an entirely successful anamorphic image: there seems to be no point from which it is convincingly corrected. No drawing lines are detectable and it is probable that the construction method was more or less empirical. For a truer measure of Hoogstraten's skill of anamorphic projection, albeit of a more unusual kind, the inside of the *Peepshow* must be studied.

### Principles of the peepshow: the inside

Hoogstraten's *Peepshow with Views of the Interior of a Dutch House* is one of only six Dutch peepshows of various shapes and sizes which are known to survive from the seventeenth century and is the only certainly attributed one [22]. It is, moreover, the most complex of them in that it has a peephole at either end, whereas the others have (or used to have) just a single peephole in the front panel. Clearly it is considerably more difficult to construct a perspective device which works equally well from two widely separated viewpoints than one with only a single viewpoint.

The six peepshows all have the same principle in common: on the inside faces of a closed wooden box an interior scene of a church or house is painted. The perspective construction of the scene is aligned so that, when viewed through a peephole in one side of the box, a convincing illusion of receding space with apparently free-standing figures and furniture is seen, although there are no actual models standing in the box.

The use of a peephole places certain constraints on the viewer which are essential for the success of the illusion. Firstly, it imposes monocular vision, which denies the viewer any sense of scale or depth: with one eye it is impossible to gauge whether an object is large and far away or small and near. In a conventional painting, near and far objects are painted in the same plane, their relative distances being suggested mainly by size, direction and overlap: this is the basis of all perspective theory. A peepshow, on the other hand, combines both real and suggested space and, unless there are glaring discontinuities between the two, a single eye cannot (in theory) gather enough information to distinguish between them; it therefore interprets the painted space as



**Figure 7**  
The *Peepshow*,  
outside of the  
lid.

an extension of the actual space. Of course, in practice, the technique of the deceptive painting is not always good enough for the illusion to be wholly convincing.

The inability to judge scale with a single eye and the exclusion of the full-size world outside the peepshow allows the viewer to imagine that he or she is actually looking into a life-size room with the peephole at normal eye-level. As Hoogstraten himself wrote, '[...] through the knowledge of this science one can also make the strange miraculous perspective box which if painted right and with knowledge shows a finger-long figure as though life-size' [23].

The other necessary limitation imposed by the peephole is that it forces the viewer to look from the point where the perspective construction originates: this is, by definition, immediately opposite the central vanishing point of the composition, and from nowhere else will the spatial illusion be convincing.

Constructing a composition in which orthogonals converge to a vanishing point is not difficult on a single picture plane; but it becomes a much more complex operation when the composition is, in essence, projected onto two or three planes intersecting at various angles. Moreover, while *conventional* paintings should, in theory, be viewed from a position opposite the central vanishing point (if there is one), there is in practice considerable tolerance in the viewing position: the

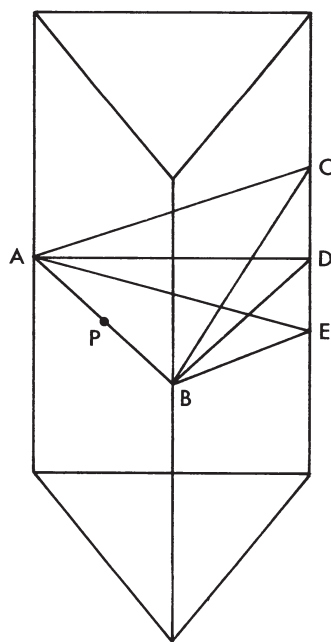
perspective construction will work with the viewer at any reasonable angle, and straight lines on the picture surface will remain straight. However, for a construction projected on to two or more intersecting planes, a problem arises: straight lines that continue across the angled joins will not appear straight unless viewed from the correct position.

The geometrical principle behind this can be simply explained as follows. If two lines meet at an angle, then they will appear straight and continuous (co-linear) if viewed along the plane which contains them both. Thus, in Fig.8, representing the simplest type of triangular peepshow, the junction of lines AC and BC will appear straight and continuous if viewed along the plane ACB. Similarly lines AD and BD, and lines AE and BE will appear co-linear if viewed along planes ADB and AEB, respectively. The peephole P is placed on the line AB where the planes meet and from there all three pairs of lines will appear straight. Moreover, if AB is horizontal then the junctions of AC/BC, AD/BD and AE/BE will also all appear horizontal when viewed from P. This is not easy to envisage, but is demonstrably true: three of the extant peepshows are triangular and have floor and ceiling transversals constructed in exactly this way [24].

For a simple triangular peepshow with an essentially symmetrical design there remains a slight tolerance of viewing position. In theory the peephole could be anywhere along the line AB, but since the composition is likely to be constructed with a true central vanishing point, perspectival distortions would arise if the peephole were not more or less centrally placed.

However, it is only horizontal transversals which allow this slight latitude in viewing position. For any other 'straight' line which passes across an angled join, whether in a triangular, rectangular or pentagonal peepshow, the imaginary plane that contains it will pass through the peephole at a different orientation. The peephole becomes the only point at which all these planes intersect.

It can be seen, therefore, that the compositional planning of a perspective box is by no means straightforward.



**Figure 8**  
Geometrical principles of a triangular peepshow.

ward. Of course, much of the drawing could be done empirically, but at least the geometrical construction of planes intersecting at the peephole would have to be understood. It should be remembered, too, that the position of the peephole is not determined by the composition, as might seem implied by the above theory, but the very reverse: undoubtedly the peephole was made first and the design on the unpainted box angled towards it.

### Peepshow construction

Even if the theory was understood by the perspective-box painters of the seventeenth century, there still remained immense practical problems in drawing the unified design on several angled panels and in constructing a closed box with an adequate amount of light to illuminate the interior. It is not known how, precisely, the design was projected onto the inside faces of a peepshow, but clearly a detailed perspective drawing of the scene would have been made first. After that, the procedure would vary according to the shape of the box, but possibly may have used translucent paper or material folded or joined into the correct shape and placed immediately in front of the drawing. By the use of stretched strings or lines of sight from the position of the peephole, key points corresponding to the drawing behind would be marked on the paper. Once a few points were in place, the rest could be deduced from the geometrical principles outlined above. Triangular peepshows were the easiest to plan. The central vanishing point would invariably be in the apex of the construction, and the fold in the paper model would be placed against the vanishing point on the drawing; the transversals could be plotted as in Fig.8, the spacing between them being determined empirically or mathematically.

In general, however, one drawing would not be enough. For the extensive chequerboard floors seen in four of the peepshows, and for their elaborate beamed ceilings, separate drawings would have to be made to assist with projection on to the paper model. For the National Gallery box, with its opposing peepholes, two sets of drawings would have been necessary, and here a new problem arises: the fields of view observed from the two peepholes must meet somewhere, and the peepshow geometry principle simply cannot work from two opposite directions. How Hoogstraten solved this problem is described below.

Once the projected drawing on the paper model had been made, it was a relatively simple matter to transfer the design on to the prepared panels of the peepshow. The painting then proceeded in stages. The individual panels were painted largely with the structure dismantled: it would, indeed, be very difficult to do it otherwise, but examination of the peepshows confirms it also, because paint is found inside the joins. However, the panels were presumably assembled from time to time as the painting progressed in order to check the alignment of the composition. Quite major alterations are visible (for example, in the chair legs of the Hoogstraten box) demonstrating that not all the problems were resolved in the drawing. The peepshow was finally assembled



properly, layers of paint were applied across the joins (and the outside faces were painted, if desired). Final sharp details, such as the edges of floor tiles and highlights were the last touches. Obviously the success of the illusion depended on making the angled joins as invisible as possible and so not only did they have to fit together well, but the paint across them had to appear more or less continuous and is usually thicker than elsewhere for this reason.

The carpentry of the peepshows was presumably carried out by professional panel-makers and is, in general, no better or worse than that of an average panel painting: panels are of oak, butt-jointed and occasionally dowelled. However, peepshows are, by their very nature, fragile structures and they have all suffered splits, disjoints and losses over the years. One particularly vulnerable part of any peepshow is the light aperture and in only one of the boxes is it still intact. The problem of how to introduce light into an otherwise closed box seems to have been solved in two ways. The Detroit box still has its complete front panel (although at present it is exhibited without it) which contains the central peep-hole and, above it, a mirror which is pivoted horizontally in an aperture and may be angled to reflect light into the box [25]. Positioning the mirror above the peephole avoids the viewer seeing it directly and blocking out the light with his or her own head.

The other kind of light aperture was altogether simpler and consisted of oiled or translucent paper stretched across the opening; this would require the peepshow to be viewed alongside a reasonable light source, such as a sunlit window or a bright lamp. Traces

of paper are to be found around the edges of the aperture in three of the peepshows. Some of the paper fragments are clearly more recent than the seventeenth century, but it is to be expected that stretched paper would have a fairly short life and would have to be renewed regularly. Also it is possible that the apertures may have been altered, perhaps an original mirror being replaced by paper.

The natural position of the light aperture, whether of the mirror or paper type, would be above the peephole for those boxes with a single peephole. This is indeed the case for the three in which the front panel is still relatively intact, but two of the boxes have lost their front panels altogether. The sixth box, the National Gallery Hoogstraten, has a different arrangement: one complete side of the rectangular box is open and appears to have had paper stretched across it. This would have given a side light to the view from either peephole and one of the most ingenious features of the box is that the scene is painted as if there were a partly shuttered sunlit window on that side of the room. Shadows and reflections on the floor and walls appear to emanate from there. Real light and painted light become joined in a way that heightens the sense of illusion.

### Perspective and geometry of the Hoogstraten 'Peepshow'

The light provided by the illusory shuttered window illuminates the central hall of a Dutch house. Looking in through the light aperture (Figs.9 and 10) one sees a distorted jumble of walls and windows, open doors with



**Figure 9**  
The Peepshow seen through the light aperture looking towards the right-hand end.



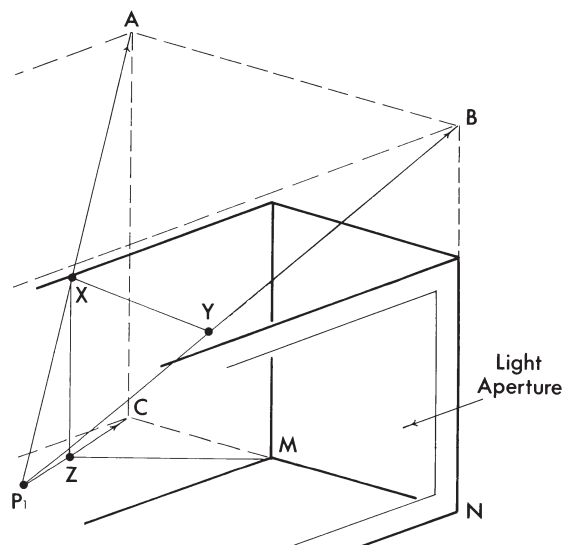
**Figure 10**  
The Peepshow  
seen through  
the light  
aperture  
looking  
towards the  
left-hand end.



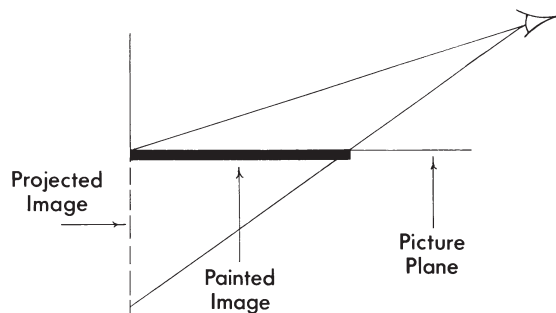
rooms beyond, crooked floor tiles, misshapen chairs and an oddly proportioned dog. Only from the peephole at either end does the scene assume order and coherence.

The peepholes are placed exactly opposite each other and command fields of view that are symmetrical to each other in real space, but quite asymmetrical in projected or imaginary space. From the left-hand peephole, real and projected space at the right-hand end of the box are shown in Fig.11. The end wall of the painted room is in the same plane as the end wall of the real box, but continues above it and further to the left. By drawing lines of sight from the peephole  $P_1$  to the corners of the projected room, A, B and C, we can see how the image must be constructed on the inside of the box. In this way the line to A intersects the box at X, which lies on the join of the back wall and lid of the box. The line to B intersects the lid at Y and the line to C intersects the back wall at Z. The top of the projected end wall AB therefore has to be painted along XY and the far left corner of the projected room AC has to be painted at XZ.

It can be seen from this that the entire end wall of the room has to be painted on three perpendicular planes: the end of the box, part of the underside of the lid and part of the back panel. The part painted on the end of the box is undistorted because it is viewed conventionally from the peephole; but the parts on the lid and back panel are distorted since they are essentially anamorphic projections (see Fig.12). The actual base of the wall, MN in Fig.11, appears to be co-linear with the painted extension ZM but is actually co-linear with its projection CM. By the peepshow principles outlined above, ZM and MN appear to be straight and continuous because



**Figure 11** The relation between real and projected space at the right-hand end of the box.



**Figure 12** The projected image is an anamorphic projection of the painted images on the back wall and the underside of the lid.



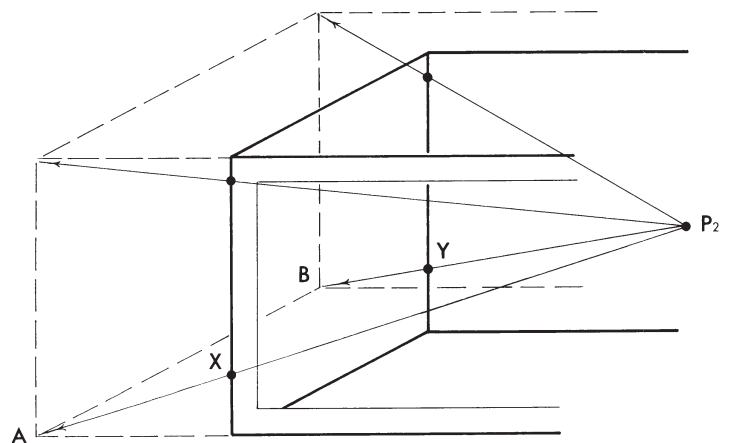
**Figure 13**  
The *Peepshow*,  
underside of  
the lid.

the plane that contains them both passes through the peephole.

The perspective organization of this end of the box seems at first glance complex, but is in reality quite simple. It is very confusing trying to work it out from the jumble of painted images: it can only be done by studying the undistorted end panel together with the *projections* of the angled parts. When this is done, it can be seen that we have classic single-point perspective with all the orthogonals converging to a vanishing point exactly opposite the peephole — which happens to coincide with the other peephole. Parallels within the picture plane or its extension do not converge — for example, the top and bottom of the doorway are firmly horizontal — but since the position of the eye is fixed at the peephole, some real convergence does appear to happen at the limit of lateral vision.

The ceiling of the room cannot be seen from the left-hand peephole  $P_1$  because the underside of the lid visible from there forms the upper part of the opposite wall, as described above. However, the ceiling can be seen from the right-hand peephole  $P_2$ , looking towards the left-hand end of the box (Fig.13). The relationship between real and projected space at this end of the *Peepshow* is shown in Fig.14 and it will be seen that it differs from the one already described. Here, the projected space is longer and wider than that of the real box, but has the same height. In this illusory room, we are to imagine ourselves much closer to the right-hand end wall than we are to the left-hand end.

Similar lines of sight can be drawn from the peephole  $P_2$  to the corners at the left-hand end of the projected room. It can be seen that the base of the end wall AB is painted as a horizontal line XY, about one-quarter of the way up the end panel. Lines of sight to the top corners of



**Figure 14**  
The relation  
between real  
and  
projected  
space at the  
left-hand end  
of the box.

the wall show that they should, in theory, be painted fractionally below the true corners of the *Peepshow*, but Hoogstraten has, in fact, simplified the construction by having the two pairs of corners coincide. To the critical eye, this makes the ceiling appear slightly shorter than the floor, but most observers do not notice it.

The ceiling and that part of the floor painted on the base panel are undistorted since they are viewed at the correct angle from the peephole. However, the floor tiles also continue onto the left end and back panels of the *Peepshow*. The floor on the end panel is painted in true single-point perspective since it is being viewed frontally from the peephole: the vanishing point of the perspective system is, again, at the peephole. The floor on the back panel is painted anamorphically, since it is viewed as an angled projection.

The chairs and the dog seem to have been worked out empirically, as the several *pentimenti* of the chairs confirm. The dog is a mongrel of frontal and anamor-





**Figure 15** (*Above, left*)  
The dog seen through the light aperture combines an undistorted top half and an anamorphic bottom half.



**Figure 16** (*Above, right*)  
Seen through the peephole, the anamorphosis is corrected and the dog assumes its true proportions.



**Figure 17** (*Right*)  
Infra-red detail of the circular mat showing the discontinuity in the floor tiles at this point.



phic painting: its top half, on the end panel, is undistorted but its bottom half, on the floor panel, is elongated and only assumes the correct proportions of the top half when viewed from the peephole (Figs.15, 16 and Plate 12, p.64).

We have examined the geometrical and perspectival arrangements of real and projected space as viewed from both ends of the *Peepshow*. We have observed, too, that these two spatial constructions must meet somewhere and that there must be some discontinuity where they meet: but, for the most part, Hoogstraten avoids discontinuity very cleverly. The floor on the base panel works equally well from either end and the back wall of the painted room, with its open door and window, is also undistorted from either direction. The limits of vision on the underside of the lid are where the upper wall (visible from  $P_1$ ) meets the ceiling (visible from  $P_2$ ) and although a discontinuity is visible there, it is difficult to see and hardly noticeable (see Fig.13).

The only point at which Hoogstraten has had to solve a serious continuity problem is in the floor painted on the back panel of the *Peepshow*. Here it has to link along the entire length of the *Peepshow* with the undistorted floor of the base panel and, as we have seen, lines that appear straight from one peephole cannot appear straight from the other. Hoogstraten has chosen to align the major part of the floor correctly for the left-hand peephole  $P_1$ , and to make the transition near that end of the box. Where the transition occurs, he has disguised it in the simplest possible way by painting a chair, a fallen cushion and a circular mat over it. An infra-red photograph of the area around the circular mat shows how the floor tiles are

differently aligned to either side of it and that the precise transition occurs under the left-hand part of its circumference (Fig.17).

### Structure and design details

The description of space and perspective outlined above confined itself to the central room of the Dutch house depicted in the *Peepshow*. There are, of course, other rooms opening in succession off the central hall, one (the *voorhuis*) with a seated woman reading, another with a woman in bed; and these, in turn, lead to views outside the house — a garden, a street with a man peering in and, at the left-hand end, an extraordinary long view along a terrace, through some trees to a distant castle and forest beyond. But these further rooms and spaces are only conventional painted representations: the central hall is the only part of the house in which real and painted space are combined.

It ought to be possible to make a coherent ground plan of the house, but glimpses of the various rooms through open doors do not give quite enough information. There are inconsistencies of space and light direction which make one hesitate to attach too much significance to such a plan and cast doubt on whether the *Peepshow* is an accurate model of a real house: more likely, it combines real, observed elements into an imaginary whole.

Its disposition on the inside panels of the *Peepshow* was clearly altered at a very early stage. Hoogstraten seems to have wanted to fix the main design axis of the room first by drawing in the two pivotal doorways, one at each

**Figure 18**  
Infra-red detail of the right-hand end showing drawing lines of the doorway to the left of the present position.



**Figure 19**  
The lower ledge of the light aperture showing upholsterer's studs and notch; also (at the left) narrow recessed rectangle in the base panel.



end: but his first idea was to have the two doors set nearer to the back panel, with more wall space between them and the light aperture. This is evident from the infra-red photographs which show the drawing lines for the doors in their initial positions (Fig.18). Very little underdrawing is seen elsewhere but, as Joyce Plesters observes below, this is not unexpected as the ground colour is relatively dark.

The light aperture, we have noted, has traces of paper stuck around the edges, but it is unlikely that the original arrangement would have been merely stretched paper glued directly across the opening. The wood that frames the aperture is rebated on the outside, suggesting that some secondary frame fitted into it. This frame may have been the support for stretched paper or (less likely) a pivoted mirror. Until recently, a frosted glass window was fitted right inside the aperture, but this was relatively modern: and when it was removed it was seen that it had been concealing two small conceits of design with which Hoogstraten had finished his peepshow.

On the ledge which forms the bottom of the light aperture is a row of brass studs and a curious notch in the wood (Fig.19). The purpose of these only becomes clear when looking through the left-hand peephole very steeply downwards. We can then see a chair immediately in front of us and the ledge of the light aperture forms its back, complete with upholsterer's studs: the notch in the wood is the near upright of the chairback. On the seat of the same chair is a letter bearing Hoogstraten's name.

Alongside this chair and next to the light aperture is another curious detail. A narrow rectangle, end-on to the open side of the box, has been dug out of the base panel as if something were once let in there. The recessed rectangle seems to form the top of a strip of brown brocade-like material painted on the floor panel next to the chair (Fig.19). A possible explanation is that origin-

ally there was a narrow strip of wood set vertically into the base panel which continued up to the top of the *Peepshow*. This would have been painted to match the brown brocade strip on the floor and, together, from the left-hand peephole, they would have appeared like a fold of curtain at the illusory window of the light aperture.

Would this have served any function other than to reinforce the illusion of the window? There is evidence to suggest that it would indeed have had a very practical function: it would have prevented one peephole being seen from the other. For nothing would be more calculated to destroy the carefully contrived illusion than to see a second observer's eye staring straight into one's own.

The evidence that such a masking strip (disguised as a curtain) was originally present is to be found on the end walls of the *Peepshow*: where the design would have been hidden, it has not been painted. Thus, at the left-hand end there is a plain black strip, and at the right-hand end the grey wall colour continues, but the engraving hanging there is not completed. It is not clear how the strip would have been supported in its vertical position; there are no grooves up the inside of the light aperture and no corresponding slot on the underside of the lid — only small blemishes that suggest it may have been lightly pinned or glued in the correct position.

With these details Hoogstraten comes close to breaking the unwritten rule of peepshows — that the illusion should depend entirely on paint and perspective, and not require models or embellishments within the box. But, of course, there really were no rules and Hoogstraten was perfectly entitled to embellish his extraordinary and complex illusion in any way he wished. One of the other five peepshows also steps fractionally across this narrow line. In the Copenhagen *View of a Voorhuis* the figures and animals are of painted paper, cut out and stuck on to the inside of the box.



## A note on condition, treatment and display

For a structure of its size and age, and bearing in mind its constant use by generations of curious viewers, the *Peepshow* is in a reasonably good state. The main joints between the wall panels have loosened in places but appear never to have come apart entirely. The angles with the floor are secure; the lid has always been detachable.

However, two panels had split right across and were repaired during recent treatment. These are the flat panel of the lid which was split along its length but was held together by the surrounding mouldings; and the left-hand end panel which had split and shrunk, leaving a gap of some 5mm right across its width. The panels are, of course, restrained by joins with other panels and with mouldings and therefore splits are likely to occur as they all try to move with changes in relative humidity: they are, however, painted on both sides which affords some measure of protection. Nevertheless, many minor cracks and splits have developed along the grain at the edges of all the panels and some were threatening to extend themselves unless repairs were undertaken.

The structure of the *Peepshow* was repaired in a long and complex operation during the overall treatment of 1984–6 [26]. This involved removal of all mouldings and the joining of the many splits by panel repair techniques that were essentially traditional, but complicated by the fact that the main assembly could not be dismantled. The gap in the left end panel was filled with new wood and subsequently inpainted. When the structure was secure, the mouldings were replaced. In addition, new mouldings identical to the old ones were replaced on the side of the box containing the light aperture: there had originally been mouldings on this side — they appear in an old photograph — but they were removed to accommodate a modern light-box thirty or forty years ago. The light-box was removed as part of the recent treatment and will not be reinstated.

The inside and outside of the *Peepshow* were cleaned; the varnish was heavily discoloured and the outside had been considerably repainted to conceal damage. The condition of the paint is, naturally, better inside the box, although not free from wearing, indicating previous cleanings. The outside is quite scratched and battered and the paint on the mouldings and around the peepholes is largely worn away. Nevertheless, the central picture areas on each outside face are surprisingly intact and only limited restoration was necessary. The intention in restoring the outside of the box was to leave a certain amount of wear and tear visible, since it would be unrealistic to expect an object which is half painting and half furniture to have survived for three hundred years in a pristine state.

The *Peepshow* is now displayed with its light aperture left open, covered by clear perspex. Viewers are encouraged to look through the peepholes first, before walking around to look into the open side. Diffused, wide-angled illumination is provided by a separate light box mounted on the plinth on which the *Peepshow* stands: the centre of the light source is aligned to the centre of the light aperture.

## Acknowledgements

To Niels-Knud Liebgott, Keeper of the Nationalmuseum, Copenhagen, for his help in permitting an examination of the three peepshows there and for allowing the authors (CB and DB) to study the inventories of the Danish Royal Collection; to Iva Lisikewycz of the Detroit Institute of Arts for her help with examination of the Detroit peepshow; to Karin Groen of the Hamilton Kerr Institute, Cambridge for kindly translating key passages of Hoogstraten's *Inleyding* and to Paul Hannah of the National Gallery Design Studio for drawing the line diagrams to show the optical principles of peepshows.

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22. For the fullest description of all six peepshows, see KOSLOW, S., 'De wonderlijke Perspectyfkas', *Oud Holland*, 82 (1967), pp.33–56.

Apart from the National Gallery Hoogstraten, the peepshows are, as listed by Koslow:

1. 'View of a Reformed Church', Nationalmuseum, Copenhagen.

2. 'View of a Catholic Church', Nationalmuseum, Copenhagen.

3. 'View of a Large Room', Museum of Fine Arts, Detroit.

4. 'View of a Voorhuis', Nationalmuseum, Copenhagen.

5. 'View of a Voorhuis', Bredius Museum, The Hague.

23. *Inleyding*, *op. cit.*, p.274.

24. The Copenhagen boxes (nos. 1 and 2 in Note 22), and the Hague box (no.5).

25. The Detroit box is described in detail in RICHARDSON, E.P., 'Samuel van Hoogstraten and Carel Fabritius', *Art in America*, XXV (1937), pp.141–52.

26. The structural treatment was carried out with great skill and ingenuity by David Thomas of the National Gallery Conservation Department.

## The materials and technique of the 'Peepshow' in relation to Hoogstraten's book

Joyce Plesters

### Introduction

There are comparatively few documentary sources, either published or in manuscript, which date from before the eighteenth century, so it is only rarely possible to compare data from the technical examination of a specific painting with a contemporary written account of painting practice. Attempts have been made to do this on two occasions in past numbers of the *Technical Bulletin*, firstly with Rubens's *Samson and Delilah* (No.6461) and the De Mayerne Manuscript [1], and secondly with the Nardo di Cione *Altarpiece: Three Saints* (No.581) and Cennini's *Il Libro dell'Arte* [2]. The most recent example differs in that artist and author are one and the same person, Samuel van Hoogstraten.

### The form and technical content of the book

In the first part of this article Christopher Brown has commented on the art-historical significance of the book; here the parts dealing with the practical aspects of painting will be discussed, apart from perspective, for which see David Bomford above, p.70ff.

Hoogstraten's book [3] is separated in time from Cennini's treatise by nearly three centuries, but they have in common that each was intended for the instruction of youthful or apprentice painters. Not unexpectedly, Hoogstraten's treatise differs greatly in form and content from Cennini's. These differences are not, as might at first be supposed, the result of a fresh and original approach to the subject by the later author, but of a gradual evolution of treatises on painting in the intervening years. Cennini's treatise was itself a great advance on the medieval 'secret books' which preceded it, and were usually just compilations of miscellaneous recipes. It is well-organized under different sections such as drawing (as a fundamental study, given ample space also in Hoogstraten's book), pigments, painting on walls, on panels, in fresco, egg, oil, and so on (Hoogstraten's book is here rather less systematic). These divisions are carried over into much later treatises. In his introductory chapters Cennini seeks to elevate the position of the painter from craftsman to artist and stresses the nobility of the art, but apart from this short introduction it is primarily and essentially a practical 'how to do it' manual. In Hoogstraten's book theoretical content outweighs practical instruction, and it is interesting to discover how and why this change came about.

In evaluating early documentary sources on painting materials and techniques a few general principles may usefully be observed. The business of painters is painting, not writing (or, necessarily, reading either). Practical handbooks on painting tend not to be written by great painters, who, if they write at all (and some, like Rembrandt, chose not to) do so on a more elevated plane. Leonardo's *Trattato della Pittura* is more an intellectual exercise than a handy guide to studio



practice, and disappointingly little technical information can be gleaned from the letters of Michelangelo or Poussin. Cennini was famous for his writing, not his painting, of which no authentic example seems to have survived. The same can be said of Giovanni Battista Armenini, author of a published and well-known treatise on painting of which the first edition is dated 1574 [4]. Plagiarism was rife and whole passages were transcribed, sometimes wrongly transcribed, from manuscript to manuscript and book to book over long periods of time. Even more so than with most other subjects, books on painting materials and technique tend to be out of date even before they are written or published. Cennini is describing techniques which were in common use at least fifty years earlier. Hoogstraten's book, published in 1678, the year of his death, would probably hark back to practice in Holland in the 1630s or 1640s.

Hoogstraten divides his book into nine chapters, each named after one of the nine classical Muses. One of the principal influences on treatises on painting came with the Renaissance, the rediscovery of the literature and art of classical antiquity. Wherever he can find an opportunity, Hoogstraten shows off his knowledge of the art, history and mythology of classical antiquity (education in Holland in the seventeenth century would, of course, have meant Latin School) and introduces lengthy accounts of Greek and Roman painters and sculptors. Much of this is lifted from Pliny or Vitruvius, whose writings had been in circulation since the fifteenth century, and indeed an edition in Latin by Junius of the chapters on painting in Pliny's *Natural History* had been published in Amsterdam in 1637 under the title *De Pictura Veterum Libri Tres*, followed in 1641 by a Dutch translation. It became *de rigueur* in books on painting to have at least a passing reference to Apelles.

It is evident from the *Peepshow* that Hoogstraten had a special interest in perspective. An edition of Alberti's *Della Pittura*, written c.1435–6, which contains the first written exposition of the subject, was published in Amsterdam in 1649. Holland in the seventeenth century was famous for research into optics, including optical devices like the *camera obscura* (see above, under *Perspective*, p.65ff).

The study and depiction of the human figure, particularly the nude, and the proportions of the human figure, gained importance in the Renaissance and were treated in detail by Leonardo and Dürer. Subsequent treatises on painting usually had a chapter on the subject, appropriately illustrated, and Hoogstraten gives lengthy treatment to this topic.

Vasari, well-known as a practising painter, became even better known for his monumental written work, the *Lives of the Artists*, which included artists both past and present. There is much interesting and valuable information on artists' techniques and materials scattered throughout the 'Lives'. Later authors, including Hoogstraten, borrowed, usually without acknowledgement, snippets and anecdotes from the 'Lives' to a greater extent than they did from the introduction which appeared in the first and second editions (1550 and 1568 respectively), but was rather neglected by translators and commentators before the late nineteenth century. The

Introduction, which Vasari refers to, rather perversely, as the 'theoretical part', extends to thirty-five chapters and constitutes an excellent handbook to the practice of architecture, sculpture and painting of the time, arranged systematically rather like Cennini's treatise. A predecessor of Hoogstraten's, Karel van Mander, a Netherlandish painter who had lived in Italy, published in Haarlem between 1603 and 1604 *Het Schilder Boek*, a large-scale work on the lives of the painters, past and present [5]. He came to be known as 'The Dutch Vasari'. Imitating Van Mander, Hoogstraten produces anecdotes about the practices of antique and modern painters, mentioning some Italian ones such as Beccafumi and Bassano. At the end of the second edition of the 'Lives', Vasari included a short section on 'Diverse Flemish Painters' in which he baldly states that the brothers Van Eyck were the inventors of oil painting, and he elaborates on this and on the circumstances of the discovery in his account of the life of Antonello da Messina who, he says, brought the secret of oil painting from the Netherlands to Italy. Vasari seems to be the sole source of this story of the 'invention' of oil painting, and not until the nineteenth century was it proved to be false, but the relevant passages from Vasari had already been transcribed and paraphrased in numerous books on painting, including Van Mander's. They appear yet again in Hoogstraten's book where he speaks of different media used in painting [6]. He seems justifiably proud that it was, as he believed, a Netherlander who made the discovery.

By the late sixteenth-, and even more so in the seventeenth-century, books on painting, particularly in Italy, had already relegated practical instruction to a few chapters and theory began to take precedence. This included discussions on the nature of painting, the idea of beauty, and the appropriate choice and treatment of subject matter. More attention was given to symbolism of colour than to preparation and properties of pigments, and more to the proper costume the characters depicted should wear than to the method of painting and glazing different coloured draperies. These traits can be seen in Hoogstraten's book. Also relevant is the establishment of Academies of Art, one in Florence by Vasari, and towards the end of the sixteenth century that by the Carracci in Bologna. In Holland in the sixteenth century the training of painters was still regulated by the Guilds of S. Luke and was by long apprenticeship, but the idea of the Academy was current among Dutch artists and even the title of Hoogstraten's book, the 'High School' or 'Advanced School' of painting, indicates that it was intended for the more academic approach to teaching. It may be that the students admitted to academic classes had already completed their apprenticeship in the mechanics, as it were, of painting, or that by the late sixteenth or the seventeenth century a lower grade of craftsman or apprentice was delegated to tasks like grinding colours and preparing varnishes, so that detailed instructions on these matters were no longer so necessary in treatises on painting. Also, ready-made artists' materials were becoming available and the preparation of panels and canvases could be given to specialist craftsmen outside the studio.

The above can give only a few signposts to show how

and why Hoogstraten's book acquired its particular form and content.

## The pigments

On p.220 Hoogstraten turns to colours and pigments [7]:

The main colours are seven and they belong to the planets; but the number we have for this purpose [that is, for painting] is unlimited.

By the seventeenth century there do seem to have been difficulties in obtaining some pigments and Van Mander writing in 1604 already advises the painter to lay up a store of choice pigments, implying that these were not always readily available.

Hoogstraten gives for each of the seven colours in turn a reference to its use in classical antiquity, the information usually deriving from Vitruvius or Pliny, and its symbolic significance. For example, for the first colour he lists, yellow, he remarks: 'Panacus, Phidias's brother, painted the walls of Minerva's temple in Elis with saffron mixed with milk; but others used Sil Atticum or the Athenian ochre', asserts that yellow signifies wisdom, nobility and generosity and describes the sea god Neptune as being dressed in a yellow mantel. He then gives a succinct account of the pigments painters customarily used in his own times, and it is this account which will be compared to the results of examination of the *Peepshow*.

### Yellow

The yellows which we use are light and brown Roman ochre, massicot and schietgeelen [yellow lakes]. Orpiment may also sometimes be employed in beautiful draperies.

Yellow and brown earth pigments occur in various parts of the *Peepshow* and brown earth pigment as the major component of the upper layer of the ground (see below under *Ground*). The only other yellow detected was lead-tin yellow, confirmed by XRD powder pattern to be 'type I',  $\text{Pb}_2\text{SnO}_4$ . This is by far the most commonly occurring type and has been identified in a number of seventeenth-century Dutch paintings including several by Rembrandt, notably in the latter's *Belshazzar's Feast* (No.6350) as the bright yellow impasto of Belshazzar's brocade cape and, mixed with lead white, in the writing on the wall. In the *Peepshow* lead-tin yellow ('type I') is used for bright yellow highlights, for example on the yellow ochre painted frames of the pictures hung on the walls. It also provides the apparently lime-green colour of the foliage of the trees seen through the windows (see below under *Green*).

It has been established that in written sources dating from before the mid-eighteenth century the term 'massicot' or 'masticotte' usually refers, not to the pale yellow lead monoxide (often known as litharge), but to the mixed lead and tin oxide, lead-tin yellow [8]. It was a staple pigment of the fifteenth-century Netherlandish painters and seems to have been in continuous use right through the sixteenth- and seventeenth-centuries in both Dutch and Flemish schools. A simple recipe for the manufacture of what would be 'type I' was noted by us in a sixteenth-century manuscript deriving from the south Netherlands [9]. In fifteenth-century Netherlan-

dish paintings lead-tin yellow is often used to imitate objects made of gold metal, such as jewellery and brocade, tiny points of lead-tin yellow impasto simulating the glittering effect. Hoogstraten has used exactly the same technique for the gold braid and fringe on the red cushion lying on the floor.

There was no convincing evidence for the presence of yellow lakes in the *Peepshow*, certainly not as yellow glazes. 'Schietgeel' is an abbreviation for 'verschietgeel', meaning 'disappearing' or fading yellow. The fugitive character of yellow lakes is probably responsible in some cases for the unnaturally blue leaves sometimes seen in seventeenth-century Dutch flowerpieces and landscapes since combinations of yellow lakes with blue pigments were often used to make greens (see below under *Green*).

### White

White belongs to Luna, and it signifies innocence, purity and truth: but for the Javanese it means sadness. Here shell or lead white is mostly used by us.

By shell white, Hoogstraten may mean calcium carbonate white made from crushed oyster shells or egg shells, or merely a particular grade of lead white. Calcium carbonate in the form of chalk was found only in the lower layer of the ground of the *Peepshow* (see below under *Ground*). The white of the paint layers was all lead white, and an X-ray diffraction powder pattern of a sample of white impasto on the dog's tail identified it as pure basic lead carbonate, without admixture of either the normal lead carbonate or of calcium carbonate. High quality lead white was produced in Holland in the seventeenth century by the traditional method of exposing lead metal to carbon dioxide, a process differing little from that used in classical antiquity, but which came to be known as the Dutch or stack process.

### Red

The red used by the Ancients was Sinopis Pontica. We use Indian red and brown-red, vermilion and red lead.

Elsewhere Hoogstraten speaks of lake pigments, including red. Indian red and brown-red would be (like the Sinopis Pontica, mentioned by Vitruvius) red earth pigments, their colour depending on ferric oxide.

Red earth pigments do occur in the *Peepshow*, for example in the allegorical scenes on the outside of the box which are executed in rather subdued colours and where red ochre seems to substitute for vermilion. The principal red pigment elsewhere is vermilion (red mercuric sulphide,  $\text{HgS}$ ), of remarkable intensity of colour, particularly so in the upholstery of the chairs, where in fact it is enhanced by the addition of a thick glaze of red lake pigment (see below). The strong orange hue of the wood of the chair legs and that in the wall hangings (which are presumably intended as gilded and embossed leather) in some of the rooms is not a single orange-coloured pigment, but vermilion thinly scumbled over a yellow earth pigment. Red lead, which is in fact more orange than red in colour, was not identified in the *Peepshow*. It occurs rather rarely in easel paintings, and mostly in underlayers rather than on the surface. An example of it in a Dutch seventeenth-century painting is the orange sash of Prince Frederik



Henry of Orange in the portrait of the latter which hangs on the wall in Jan Molenaer's interior *A Young Man and Woman making Music* (No.1293).

Three samples of red lake pigment from the *Peepshow* were examined first by a recently-developed method of microspectrophotometry [10] and then by high-performance liquid chromatography (HPLC) [11]. The first sample was of the red glaze, of a rather scarlet shade, on top of the vermilion of the red chair seat which is painted on the floor of the interior of the *Peepshow* close to the broom (see Plate 13, p.64). A paint cross-section from this red chair seat is illustrated in Plate 14a (p.64), and shows the red glaze. A reflectance spectrophotometric curve was plotted from the paint cross-section. The second sample was a fragment of very dark brownish red glaze of what seems to be the end of a dark red curtain painted on the floor of the box and a transmittance curve was plotted from this. Its dark colour was in fact largely due to an admixture of carbon black. The third sample looked quite different and came from the outside of the box. It was of a bright pink paint first revealed when black repaint was removed during cleaning from round the viewing holes at either end of the box, though it was later found to extend to a much larger area (see below under *Layer structure*). It consisted of lead white mixed with a red lake pigment of which red flecks were visible in the bright pink matrix. A reflectance spectrophotometric curve was taken of a scraping of the pink. The results of HPLC showed that in all three samples the dyestuff of the red lake was natural madder, while the spectrophotometric curves of all three were closely similar, indicative of a plant rather than an insect dyestuff, and closer to the standard curve for natural madder than any other.

Holland was famous in the seventeenth century for the manufacture of vermilion by the dry process of heating mercury and sulphur and collecting the crystalline sublimate, a method akin to that practised in classical antiquity and even earlier in China, but which was by then called the Dutch method. A. van Schendel has published some manuscripts dating from the latter part of the seventeenth century which describe in detail the production of vermilion by this method in Amsterdam [12]. Some of the vermilion in Dutch pictures of the period is remarkable for its colour and quality, being of a pure intense red without a noticeable orange tone, reminiscent of red geranium petals.

It seems likely that the vermilion found in the *Peepshow* is the dry process variety, though it is difficult to distinguish it from the natural mineral form, cinnabar, either by optical or scanning electron microscopy. An SEM micrograph of a sample of vermilion from the *Peepshow* is shown in Fig.20 and may be compared with an SEM micrograph of particles of ground cinnabar (Fig.21; see also pp.54–5).

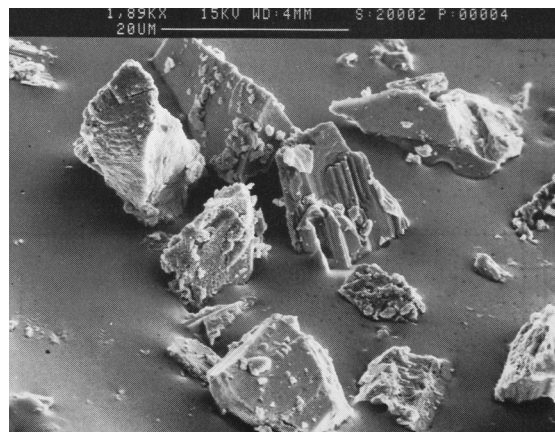
The vermilion paint on the interior of the box seems in excellent condition, protected as it is by lake glazes and also having always been exposed to relatively low light levels. By contrast, the vermilion paint of the red bed cover on the outside of the lid of the box looks dry and granular on the surface and seems to have darkened slightly, particularly on the ridges of the impasto which have the purplish, slightly metallic look typical of red

mercuric sulphide which has changed to the black form with exposure to light, possibly exacerbated by mechanical abrasion [13]. It was noted that vermilion particles were scattered in some of the upper layers of paint in areas of colour other than red. This is the case with some of the grey paint of the walls and floor of the interior and may be due to Hoogstraten having had some difficulty with the positioning of the chairs for correct perspective, for *pentimenti* are clearly visible, particularly of the red upholstery. In painting out the earlier versions he may have transferred vermilion particles to the brush used for wall and floor paints. The black of the outside of the box has been repainted many times, except for just around the allegorical scenes, some of the earliest repainting perhaps by Hoogstraten himself or contemporary with him. These upper layers of black paint, which were not all removed in cleaning, contain scattered vermilion particles which may have been spread during past cleanings, repaintings and revarnishings from areas of red paint detectable beneath the surface (see below under *Layer structure*). Detachment of vermilion particles from the paint layer may be caused by breakdown of the medium accelerated by this pigment [14].

Madder cultivation and production was also an important industry in Holland at the time and much of the dyestuff was exported, though that utilized for



**Figure 20** Samuel van Hoogstraten, the *Peepshow*. SEM micrograph of a sample of vermilion, probably of the dry process form. Gold-coated, 8720 ×.



**Figure 21** SEM micrograph of ground natural cinnabar vermilion for comparison with Fig. 20. Gold-coated, 1890 ×.

artists' pigments must have represented a small proportion of the total output compared to the quantities needed for cloth dyeing. R. Harley remarks on the fact that by the seventeenth century the Dutch were the most advanced growers in Europe and when some time later a native industry was established in England, the technical terms used, for example in describing different qualities of madder, were of Dutch origin [15]. The limited number of analyses of red lake pigments in paintings carried out in the National Gallery up till now, by means of an earlier and less refined microspectrophotometric method [16], by thin-layer chromatography, or by HPLC, has detected a far higher proportion of incidences of insect dyestuffs compared with plant dyestuffs, and occurrences of madder have been comparatively rare.

### Black

Black was the fourth colour of the ancient Greeks; for it is believed that they used no other colours but white, yellow red and black; and this black was vitriol, or otherwise Trigon from burnt wine sediment, or from grape pips; however, it is said also that walrus [ivory?] black was discovered by Apelles. To the Javanese black signifies joy, but to us mourning and sadness; it is given to Saturn. Besides ivory and walrus black, lamp black is also used, but charcoal black from vines is more successful.

In none of the paint or ground samples from the *Peepshow* were the characteristic splinter-like particles of wood charcoal seen. The pigment particles viewed under the optical microscope were small and rounded, or larger aggregates of such particles. Unfortunately it was in this case impossible to say whether the pigment was bone (or ivory) black or lamp black, since the particles of these two types of black look very similar not only under the optical microscope, but also in the SEM. A method which has been used by us successfully in the past is X-ray diffraction which gives for bone or ivory black a powder pattern for calcium phosphate. The problem with the *Peepshow* samples was that there seemed to be no pure black paint; even an apparently intense black was found to contain scattered particles of lead white, earth pigments, and often vermilion, so that the sample would have given an impossibly confused powder pattern. At some future date it may be possible to identify the black in a sample by combined SEM/XRF analysis. It is conceivable that Hoogstraten thought pure black would give too dark an effect, in view of the low level of light within the box.

### Blue

Hoogstraten remarks, with reference to the claim made by Vitruvius and Pliny that the painters of antiquity confined themselves to four colours only: 'But it seems a miracle to me that the ancient painters would not have had blue, only what could be mixed from their white and black [...]'. He then goes on to recount an anecdote of the Netherlandish painter Coxie being sent a blue pigment from Venice by Titian in order to paint the blue mantle of the Virgin in a copy he was making of a Van Eyck. He says it is believed that this particular blue pigment came from the mountains of Hungary and it was 'more easily obtained before the Turk became

master over there, like many pigments which used to be known and are no longer nowadays.' R. Harley states [17] that the story derives from the Spanish painter and author Francisco Pacheco, writing in 1649, and demonstrates that it may be deduced that the pigment in question was azurite. In fact, Vasari mentions Coxie [alternative spelling: Coxie] making the copy, but it is Van Mander, who in his life of Van Eyck mentions the matter of the blue pigment, and Hoogstraten must have taken the account from him [18]. Hoogstraten continues:

For our blues we have at our disposal English, German and Haarlem ashes, smalts, blue lakes, indigo and the invaluable ultramarine.

There has been considerable discussion in the nineteenth century and currently as to what exactly is meant in early documentary sources by 'ashes' with reference to blue pigments. The French nomenclature was 'cendres bleues', in English sometimes corrupted to 'Sanders blue'. R. Harley has summarized the available evidence and although it might seem reasonable to suppose that one at least of Hoogstraten's three types of 'ashes' might be ultramarine ash, that is, the palest blue fraction left at the end of the extraction of ultramarine from lapis lazuli, she supports Eastlake's view that the term 'ashes' was not apparently applied to this substance in the seventeenth century [19], and it appears more likely that some form of copper carbonate blue was intended and probably the early manufactured form rather than the mineral azurite. However, 'ashes of ultramarine' is specifically mentioned in the De Mayerne MS, in addition to the unqualified term 'ashes' in the context of blue pigments [20], so it seems possible that one of Hoogstraten's types could have been ultramarine ash.

Smalt, the cobalt blue glass pigment was known in the Netherlands in the sixteenth century. The earliest occurrence we have of it in a National Gallery picture is in a mixture with both azurite and ultramarine from blue drapery in the early canvas painting (*Tüchlein*), *The Entombment* by Dieric Bouts (No.664), an account of which has been given in the last issue of this *Bulletin* [21]. It has been identified used alone as the blue of the Virgin's cloak in *The Adoration of the Kings* by Pieter Bruegel the Elder (No.3556) which is signed and dated 1563, where it shows characteristic greyish discoloration, and in numerous seventeenth-century Dutch and Flemish paintings, including a number by Rembrandt, Hoogstraten's teacher [22]. Hoogstraten may be using the plural 'smalts' either to denote different grades of the pigment or different places of origin. The late sixteenth-century Italian author Lomazzo in his treatise on painting speaks of smalts in the plural and mentions that of Flanders as being best of all [23]. It is also not impossible that smalts with colouring agents other than cobalt were available. The only one encountered by us was identified on the *Altarpiece of S. George* attributed to the Valencian painter Marzal de Sas (Victoria & Albert Museum, London), datable c.1410–20, was of a slightly greenish blue nearer to the colour of azurite, and proved to consist of a glass of which the colouring agent was copper, not cobalt.

In the *Peepshow* the blue pigments identified were natural ultramarine, azurite, smalt and what is likely to



be indigo. There was no indication that the copper carbonate blue was the synthetic variety, nor was there any evidence for the presence of blue lake pigments.

Natural ultramarine seems to have been used comparatively lavishly and to be of high quality. It was identified in samples from the deep blue of the bed hangings, the blue of the sky seen through the window on the left wall and of the sky in the picture partly painted on the inside of the lid, and in the bluer of the floor tiles. Azurite was found only in a sample of green (see below under *Green*), and as scattered particles in a sample from a pale blue floor tile. The comparatively large irregular size and shape of the deep blue crystalline particles certainly suggests the natural mineral rather than the synthetic form, which did not appear to be present.

### *Green*

The colour green refreshes the aching eyes, says Seneca; but I wish that we had a green pigment at our disposal as good as the red or yellow. Terre verte is too weak, Spanish green [verdigris] too crude and the ashes [artificial green copper carbonate?] not sufficiently durable. Berggroen [mountain green, that is, malachite] was used in ancient times for daubing on walls and for rough sketching. Green signifies youth, joy and incorruptibility. It is fitting for Venus.

By the seventeenth century the art of producing beautiful and durable greens from verdigris and ‘copper resinate’, such as are seen in the works of Van Eyck, seems virtually to have been forgotten. In both Dutch and Flemish seventeenth-century pictures greens tend to be combinations of blue and yellow, either physical mixtures of the pigments ground together, or optical mixtures where one colour is glazed over another [24].

Hoogstraten’s dissatisfaction with the green pigments available is manifest in the *Peepshow*. No green pigment as such was detected. The lime-green foliage of trees seen through the window in the back wall is painted in lead-tin yellow with the clumps of foliage very lightly sketched in with black on top to give a quite convincing greenish effect. The deep green of the two bushes or small trees seen through the open doors on the left-hand wall proved to consist of an underlayer of a yellow earth pigment similar to yellow ochre, and an upper layer of comparatively coarse azurite particles mixed with a more translucent yellow earth pigment similar to raw sienna in colour. The dull ‘greens’ which feature in the pictures hung on the walls of the interior of the box, as well as those which occur in the allegories on the outside, all seem to consist merely of mixtures of black with yellow and yellow-brown earth pigments. Hoogstraten has been clever in painting the pictures depicted as hung on the walls of the interior in very muted colours, as also the allegories on the outside, so as markedly to contrast the clarity and vividness of the ‘real-life’ scene both in the interior of the box and of the outdoors as viewed from within, with the imaginary world of the pictures and allegorical scenes.

### *Purple and violet*

Hoogstraten, anxious to show off his knowledge of classical mythology, recounts at length the supposed discovery of murex purple when the dog belonging to

the Phoenician god, Hercules Tyrius, picked up and bit one of the shellfish which produces the dyestuff while walking with his master on the beach. Murex purple does not appear to have featured in the artists’ palette in Hoogstraten’s time, so he continues:

With us lakes are in use, not only the purple, but the blue, green, and brown or yellow lakes.

In fact, in the *Peepshow* the only lake pigment detected was a red lake, madder lake, for which see above under *Red*.

### **The paint medium**

It can be seen from Table 1 below, compiled by J.S. Mills, that medium analysis of samples from the *Peepshow* gave very unexpected and confusing results (see also section on *Paint medium* below). Not a great many analyses of media of seventeenth-century Dutch paintings have been carried out, but of these few, fatty acid ratios have indicated that the medium is a drying oil. Hoogstraten speaks of oil painting, and of its supposed invention by Van Eyck (an account which he has taken over from Vasari, via Van Mander, and further elaborated). However, some comments which he makes with respect to the use of glue and egg medium in antiquity may be of some relevance in assessing the puzzling results of medium analysis of the *Peepshow* which suggest that the medium is not simply a drying oil:

Glue and egg paints are certainly not to be banned completely, firstly because of their lively clarity and then because of their ease of handling in skilled painting; and especially because they are capable of many uses where oil paint falls short. The clarity of the size and egg paint is very suitable for showing something in candlelight or from a distance, as in panoramas or in enclosed theatres. Also when a piece is to hang directly opposite the light of a window, glue or egg paint is better than oil paint since it does not glare [...] [25]

### **The layer structure**

The wood of the box was confirmed to be oak (*Quercus* sp.) by microscopical examination of thin transverse sections.

### *The ground or preparation*

Except for the main area of the floor of the interior, the inner and outer surfaces of the box all have the same double ground. Directly on the wood is a thin, rather irregular layer of the chalk/glue ground traditionally used on Early Netherlandish panels, while above this is a dark granular brown layer consisting of a mixture of brown earth pigment, carbon black (of the type described above under *Black*) and lead white, some of the latter in the form of large aggregates). From samples taken from the tiled floor it would seem that the upper brown layer was there omitted except for where it appears to have been extended down from the walls round the edges of the floor. Hoogstraten remarks on the part the colour of the ground plays in the appearance of the finished painting [26], so he may deliberately have refrained from covering the white chalk ground with a

brown layer in the area of the tiled floor so as to maintain its lightness and brightness.

### *Underdrawing*

The infra-red photographs, which have been discussed by David Bomford above in connection with perspective, show some not very strong outline drawing. These black outlines are visible on the tiled floor, which is not unexpected since there is only the whitish chalk ground beneath the paint. What is surprising is that they are also visible on the walls, for example in *pentimenti* of the door frames (see Fig.18), for under the grey paint of the walls is the brown granular upper ground layer which occurs everywhere except the main area of the floor. It is rare for a black underdrawing on a dark ground to be revealed by infra-red but an example occurs in an infra-red photograph of the landscape background in Rembrandt's large equestrian portrait, *Frederik Rihel on Horseback* (No.6300) which shows sketchy coarse black underdrawing. The ground on the canvas is a darkish brown earth pigment. It may be that the IR-reflectivity of some reddish brown earth pigments is sufficient to produce a contrast with the absorption of radiation by the carbon black of the underdrawing. The Hoogstraten ground also contains granules of lead white and lighter red-brown earth pigments.

### *The paint layer structure*

This is relatively simple in the interior of the box, sometimes comprising only a single paint layer, as in the pale blue of the sky as seen through the window, and in some of the floor tiles. Elsewhere there is the traditional technique of glazing an opaque underlayer to intensify the colour, for example the ultramarine blue of the bed curtains glazed with what appears to be indigo (see above under *Blue*) and the vermilion of the red upholstery of the chairs glazed with madder lake (Plate14a, p.64). A more complex layer structure found in samples from the floor can be simply explained either by the different colours of the tiles overlapping to some extent, or by the presence of *pentimenti* of the parts of the chairs, and other features which are painted on the floor.

The allegorical scenes on the three sides of the exterior of the box are also comparatively simply painted directly on the brown granular upper layer of ground, and, as mentioned above, in muted colours in a very limited range of pigments. The scene of Venus and Cupid in bed which is depicted on the outside of the lid of the box is also quite simply, but much more crudely painted, though it does, unlike the allegorical scenes, display the use of vermilion and of blue pigments (small and a dark blue pigment which is probably indigo). Beyond the immediate vicinity of the allegorical scenes on the sides of the exterior of the box there do seem to have been some changes made, some perhaps quite early and maybe even by Hoogstraten himself. The outside of the box would have got more wear and tear than the inside of course, and the two sides which have the eyeholes more so than the side without. Immediately outside the allegorical scenes on the ends of the box having the eyeholes there can be detected a slightly raised-up border about 5 cm wide. This corresponds to

some rather bright mauvish pink paint which was revealed when black overpaint was removed from the damaged areas around either eyehole. This pink paint is directly on the brown granular ground and is everywhere covered with several layers of black, which for the most part were not removed during cleaning. The red lake pigment present was found to be madder (see above under *Red*), like the two samples of red lake from the interior of the box. The pink border seems therefore to have been present at a very early stage of the decoration of the outside of the *Peepshow*. In one or two samples there is between the pink border and the black repaints a buff-coloured layer which looks like a new preparation, and a coat of vermilion. Plate 14b (p.64) shows a cross-section illustrating this sequence of layers. Additionally there can just be perceived under the black background of the allegorical scenes and well within the raised border, patches of red paint. The black paint of the moulding round the outside of the lid also has red, and in some parts yellow, paint beneath it. It would seem therefore, that although the allegorical scenes on the sides and top of the box were painted at a very early stage and have remained unaltered, apart from slight wear and damage, the decoration of their surrounds and of the structural framework of the outside of the box has undergone some early changes in colour scheme. The present pedestal table on which the *Peepshow* stands is not the original one and it has been suggested that it may have had originally an oriental, or imitation oriental, lacquer stand. Even this suggestion seems a little difficult to reconcile with the idea of a brilliant pink border round two of the allegorical scenes.

### **Varnishes and varnishing**

There is no evidence as to whether or not Hoogstraten varnished the *Peepshow*. What is certain is that layers of old varnish were removed during cleaning with solvent mixtures ordinarily used for cleaning pictures, but these are likely to be varnishes of later date. In his book Hoogstraten broaches the topic of varnish by remarking that varnishing paintings is an old custom, but adds that some use it to add a gloss to their unpleasant products, and introduces a note of humour with an anecdote of a foolish character who got varnish not only on his spoiled painting, but went out into the street with his clothes shining with sticky varnish. He then paraphrases the much quoted passage from Pliny extolling Apelles' legendary varnish: 'A very thin varnish which protected his paintings from dust and gave them a beautiful gloss' [27]. Significantly, Hoogstraten omits Pliny's description of Apelles' varnish being dark or black in colour. He then concludes briefly:

Our varnish, consisting of turpentine [that is, the solid turpentine resin], spirit of turpentine, and pulverized mastic dissolved, is good enough for our works.

This is very reassuring, for a solvent varnish of this type would have been comparatively easy to remove in any past cleanings without having to resort to harsh cleaning agents which might damage the paint.

There is a curious reference to 'le vernix de Hoogstraten' in the De Mayerne MS, but the name Hoog-



straten has been struck through and that of Vandenstrate inserted in the adjoining margin [28]. Even discounting the deletion, there is unlikely to be any connection with Samuel Hoogstraten's varnish specification as given above, for, as Van de Graaf has noted, Samuel would have been only fourteen years old when that part of the De Mayerne MS was written; he adds, though, that De Mayerne might have known Samuel's father, also a painter.

It is difficult to judge what influence Hoogstraten's book might have had on later painters. It has been pointed out that A. Bredius, in his exhaustive survey of Dutch painters' possessions, compiled mainly from inventories made posthumously, lists remarkably few books, and among them only a single copy of Hoogstraten's treatise [29]. The importance of the book to us now is not merely as an account of Hoogstraten's own practices and views, but as a reflection of those of Dutch painters of the preceding half century.

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22. For example, smalt mixed with lead white in the greyish blue sky of Rembrandt's 'Portrait of Frederik Rihel on Horseback' (No.6300).
23. LOMAZZO, G. P., *Trattato dell'arte della pittura, scultura et architettura* (Milan 1584).
24. Various types of mixed greens have been identified in pictures by Rubens, for example a mixture of azurite with a yellow lake in the landscape of 'The Judgement of Paris' (No.194). In Rembrandt's portrait 'Saskia van Ulenborch' (No.4930), the green of leaves of Saskia's bouquet has been achieved by a glaze of yellow lake over blue underpaint composed of azurite mixed with lead white. The now-browned foliage of the tree in the background of Hals's 'Family Group in a Landscape' (No.2285) consists of smalt mixed with a yellow earth pigment similar in appearance to raw sienna.
25. HOOGSTRATEN, *op. cit.*, p.337.
26. *ibid*, p.321.
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28. VAN DE GRAAF, *op. cit.*, pp.201 and p.83.
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## The paint medium

John Mills

The identification of the medium of the paint of this object was initiated in the expectation that it would prove to be simply linseed oil, and not unusual in any way. In the event, results of the first analyses seemed to suggest a partial use of egg tempera as well as oil. More samples were taken in an effort to clarify the matter but led only to an even more confused picture. Results did not all fit into a pattern of use of mixtures of egg and linseed oil but implied the possible presence both of walnut oil, and further non-drying fats (in addition to those from egg) with a low palmitate/stearate ratio.

The analyses are shown in Table 1. The azelate/palmitate ratios are indicative of drying (high ratio) or non-drying (low ratio) fats or intermediate mixtures. The palmitate/stearate ratios are indicative of oil type (for pure oils) or suggestive as regards mixtures of fats/oils. The table sufficiently indicates the confused nature of the results: the interpretations are an attempt to make sense of them but must be treated with caution.

A word must be said about the phrase 'glue fats', used in the table. We have in the past tended to disregard the possibility that animal glues have a significant fat content. It was indeed our finding that this was negligible, based on examination of modern glues, but recently a paper has appeared which reports on the palmitate and stearate composition of a variety of animal glues [1]. Unfortunately no indication is given as to the absolute amounts present so we still cannot be sure whether samples of glue-containing paint (or ground) of the sizes we are accustomed to examine would yield observable amounts of fatty acid esters. Currently we are

looking at as many glue-bound paint grounds as we can find to get information on this, and first indications are that non-drying fats are indeed observed. Unfortunately there is not necessarily any certain way of distinguishing such non-drying fats from those of egg yolk: the only differences are quantitative and in some cases the palmitate/stearate ratios are the same.

As can be seen from the table, the ground of the painting showed non-drying fats with a palmitate/stearate ratio of 1.4. This is probably too low for egg fats and, according to the paper cited, would be of the right order for the fats in hide glue from sheep or ox. A similar ratio (associated with the low azelate peak of non-drying fat) was found for two of the paint samples also. While reluctant to suggest that these were of paint applied in glue (distemper) medium, it is hard to believe that simple contamination with non-drying fat from any source would be sufficiently gross to swamp completely evidence of any other medium, especially drying oil.

While the possibility must not be entirely dismissed that the above findings may simply reflect the hazards of sampling, involving more than one layer; possible later paint additions; all the vicissitudes gone through by what was, after all, a piece of furniture liable to be mended, polished or otherwise treated with various materials; there *are* reasons for thinking that unusual binding media were occasionally employed by Dutch artists at this period. Joyce Plesters, in her article above, has pointed out Hoogstraten's own written references to the uses of glue and egg media. An analytical study has indicated [2] that Van Baburen in one of his paintings used a mixture of linseed oil, egg, and a carbohydrate material (possibly molasses) to bind the ground. Analytical work from this laboratory has indicated nothing unusual in the few samples of *paint* examined from work by Jan Steen, Carel Fabritius, Rembrandt, Ruysdael, Hobbema or Gerrit Heda. However the *ground* of Hobbema's *Avenue, Middleharnis* (No.830) seemed to contain egg as well as oil, while the red layer of the double ground of Eeckhout's *Four Officers of the Wine-rackers' Guild* (No.1459) contained no oil but only a low level of saturated fats which could come from egg or, conceivably, glue. The ground of Rembrandt's *Self Portrait aged 63* (No.221) also seemed to contain both egg and oil (from an analysis carried out many years ago, however).

Clearly the results of medium analysis on Dutch seventeenth-century paintings are too few for any general conclusions, but indicate that the matter is not as simple as might be supposed. It needs further study.

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**Table 1** Samuel van Hoogstraten, *A Peepshow*. Results of medium analysis.

Sample	P/S ratio	A/P ratio	Interpretation
<b>Inside</b>			
Red on floor	2.5	0.3	mixed egg and oil
White, top L.H. corner	2.3	0.3	mixed egg and oil
Grey, L.H. wall top	1.6	1.7	linseed oil
Black, top back wall	1.3	0.8	linseed oil
Black, another sample	2.8	0.8	walnut oil?
Black, inside lid	2.0	0.6	mixed egg and oil
White ground	1.4	0.25	glue fats?
Yellowish, top back wall	1.7	0.2	glue fats?
<b>Outside</b>			
White, side panel	2.7	1.0	walnut oil
Brown, on lid	2.1	1.0	mixed oils
White, on lid	2.1	0.5	mixed oils
Red, on lid	2.2	0.3	mixed egg and oil
Blue-grey, on lid	2.7	0.13	egg
Black, on lid	1.7	0.2	glue fats?