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Nardo di Cione's 'Altarpiece: Three Saints'

Dillian Gordon, David Bomford, Joyce Plesters and Ashok Roy

Patron and location

Dillian Gordon

The tightly-knit and relatively small *oeuvre* of Nardo di Cione is based on the attribution to Nardo of the frescoes in the Strozzi chapel in Santa Maria Novella, Florence, made by Ghiberti [1], an attribution now generally accepted [2]. The frescoes are probably contemporary with the altarpiece painted for the chapel by Andrea Orcagna in 1357 [3]. Nardo, who was one of three brothers of Andrea Orcagna, matriculated in the *Arte dei Medici e Speziali* in 1343 and is sporadically documented until 1365 when he made his will 'corpore languens'. Bequests executed according to his will on 16 May 1366 make it certain that he had died by that date [4].

The altarpiece in the National Gallery (No.581) (Plate 7, p.35) shows S. John the Baptist with the text EGO VOS [sic] CLAMANTE/IN DEXERTO PARATE VIA (John I: 23), with two saints, S. James on the right with a pilgrim's staff and S. John the Evangelist on the left. It is generally accepted as being by Nardo di Cione [5], although some critics such as Offner [6] felt that only the figure of S. John the Baptist was worthy of Nardo and attributed the side saints to assistants. In fact the uniformity of style in the underdrawings (see Figs.5a, b and c) confirms that the design at least was by a single hand. If Skaug is right, as is likely, in dating the altarpiece c.1365 [7] (see also below), it places the work towards the end of Nardo's life when, already weak in 1365, he would have left much of the execution to assistants [8].

The altarpiece is supposed, on the basis of information supplied to Eastlake [9] to have come from the church now known as S. Giovanni Battista della Calza, Florence, but originally known as S. Giovanni Gerosolimitano; as early at least as 1362 the church belonged to the Knights of Malta and remained in their possession until 1529 [10]. In 1373 Bindo di Lapo Benini said he had built it at the behest of his brother, Bartolommeo, Prior of the Order in Pisa [11]. In fact, Paatz suggests that the presence of the Benini arms on the doors of the church [12] implies that the family actually built it, rather than merely extending it as Uccelli had thought [13]. Offner suggests that the altarpiece was commissioned by Benini for the high altar, with S. John at the centre as dedicatee of the church, S. James shown to commemorate Bartolommeo's father, Lapo (Jacopo) and S. John the Evangelist as S. James's brother [14].

If this is so, then it was commissioned by the same person who commissioned an altarpiece attributed to Giovanni del Biondo, originally in Santa Maria degli Angeli, Florence [15], inscribed with the name of the donor, *Bindus quondam Lapi Benini*, and the date 1364.

Intended for a chapel also dedicated to S. John the Baptist [16], it contains the unusual iconographic feature of S. John the Baptist wearing the robes of the Knights Hospitaller, presumably a reference to the family's connection with the Order. Nardo di Cione was himself working almost contemporaneously on two related triptychs for Santa Maria degli Angeli, forming part of a series of privately donated triptychs for family chapels, deriving the formula for their design from the 1364 altarpiece [17], and both dated by inscription 1365: one shows the Virgin and Child with SS. Gregory and Job on either side and according to the inscription was commissioned by Tellinus Bini [18] and the other shows the Trinity with SS. Romuald and John the Evangelist and was commissioned by Giovanni Ghiberti (Fig.1) [19]. In all three chapels the first mass was said on 1 November 1364 [20].

It may not be coincidence that Nardo di Cione and Bindo Benini were both involved in a programme of altarpieces in Santa Maria degli Angeli during the years 1364–5 and that patron and artist are again connected in a commission for S. Giovanni Gerosolimitano c.1365. The similarities of style between the National Gallery altarpiece and the Santa Maria degli Angeli commissions by Nardo di Cione bear out Skaug's dating of c.1365 for the former. Both central panels in the Santa Maria degli Angeli altarpieces include a brocade design identical to that in the National Gallery altarpiece and found again in other works attributed to Nardo di Cione, namely the *Coronation* in the Victoria and Albert Museum [21], the triptych belonging to the New York Historical Society [22] and the Prague polyptych [23]. The derivation of the pattern from a brocade cloth of honour is evident and indeed occurs as such in an altarpiece attributed to Niccolò di Pietro Gerini [24] and in one dated 1391 attributed to Jacopo di Cione [25]. The technique employed to achieve the pattern (see p.29), explains the ubiquitousness of the motif.

The unusual triptych formula of three standing saints was paralleled by Offner with a work by the Master of the Cappella Medici Polyptych [26]. However, the National Gallery altarpiece is more 'pala-like' in having a continuous surface with applied columns (see p.23), rather than being a polyptych divided into three discrete compartments, and as such is transitional [27]. Offner also noted that three saints within a self-contained whole has obvious similarities with contemporary frescoes [26].

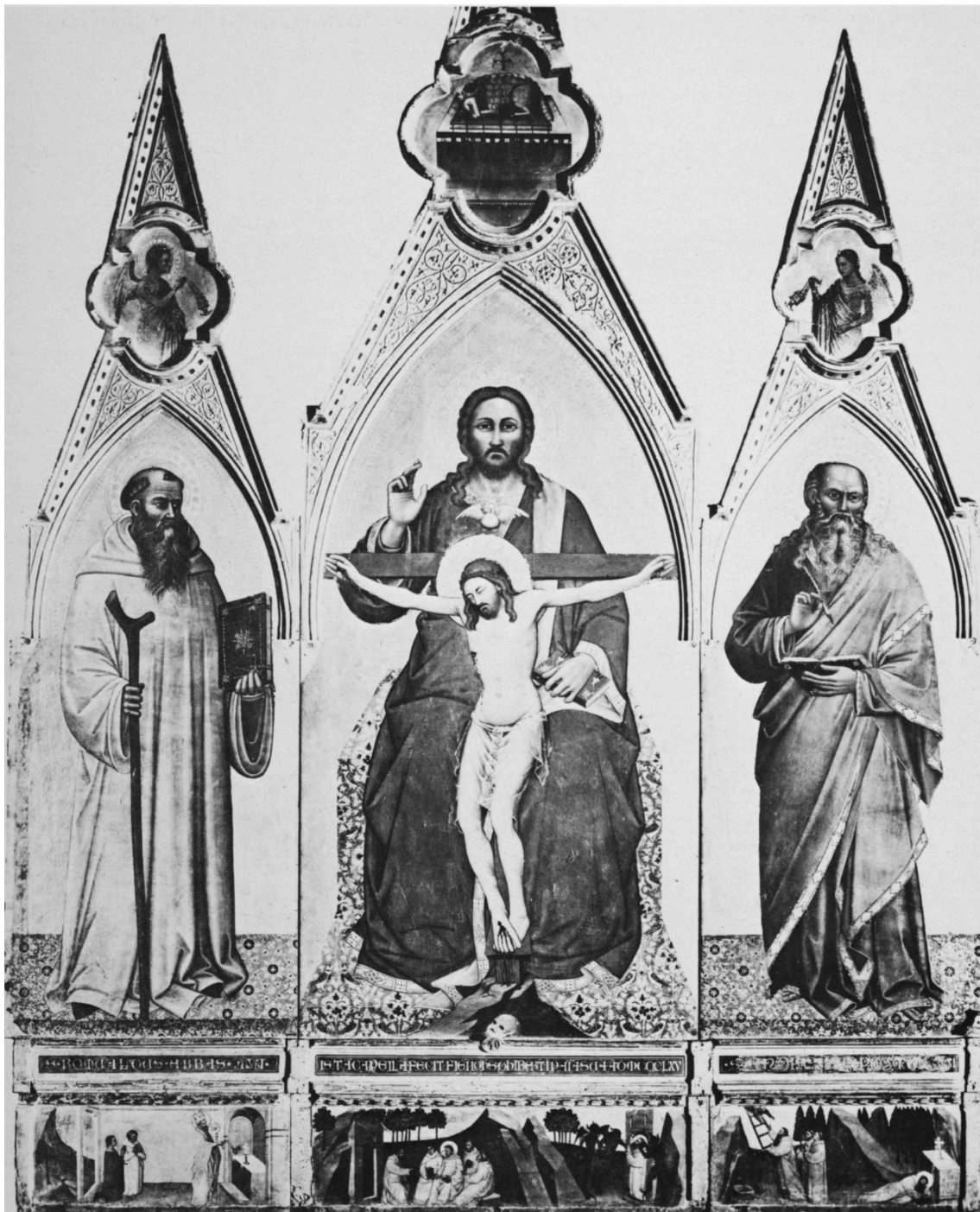


Figure 1 Attributed to Nardo di Cione, *The Trinity with SS. Romuald and John the Evangelist*, 1365. Florence, Galleria dell'Accademia (photograph: Alinari).

Notes and references

1. GIBERTI, *I Commentarii*, ed. J. von Schlosser, Vol. I, p.40.
2. OFFNER, R., *A Critical and Historical Corpus of Florentine Painting*, Section IV, Vol.II, 'Nardo di Cione' (1960), p.IIIff.
3. GARDNER VON TEUFFEL, C., 'The Buttressed Altarpiece: A Forgotten Aspect of Tuscan Fourteenth Century Design', *Jahrbuch der Berliner Museen*, **29** (1979), pp.24–30.
4. THIEME-BECKER, *Künstlerlexikon*, s.v. Orcagna.
5. DAVIES, M., *National Gallery Catalogues: The Earlier Italian Schools*, 2nd ed. revised (London 1961), pp.383–4. For recent criticism see FREMANTLE, R., *Florentine Gothic Painters From Giotto to Masaccio* (London 1975), pp.147–8 and fig.309.
6. OFFNER, R., *op. cit.*, p.37.
7. SKAUG, E., 'Punch Marks — What are they worth? Problems of Tuscan Workshop Interrelationships in the Mid-Fourteenth Century: The Ovile Master and Giovanni da Milano', in *La Pittura nel XIV e XV Secolo. Il Contributo dell'Analisi Tecnica alla Storia dell'Arte*, Comité International d'Histoire de l'Art, **3** (Bologna 1979), pp.253–82. In brief, Skaug's theory is that Giovanni da Milano brought to Florence a set of punches in

1363 which come into the Florentine repertoire c.1365. For Nardo's punches see also SKAUG, E., 'The Rinuccini Tondo — An 18th Century Copy or a 14th Century Original?', *Atti del Convegno sul Restauro delle Opere d'Arte* 1976, I (Florence 1981), pp.333–39. In a written communication to the Gallery, Skaug generously elaborated his ideas on the altarpiece under discussion.

8. See also the frescoes in the Bigallo commissioned in 1363; Procacci considered their design to be by Nardo and their execution to be by assistants. See PROCACCI, U., 'L'Affresco dell'Oratorio del Bigallo e il suo Maestro', *Mitteilungen des Kunsthistorischen Instituts in Florenz*, XVII (1973), pp.307–24.

9. DAVIES, M., *op. cit.*, p.383. Davies thought it unlikely that the altarpiece came from S. Giovanni Battista della Calza but without giving his reasons.

10. PAATZ, W., *Die Kirchen von Florenz*, II (Frankfurt 1941), p.272ff.

11. *ibid.* Paatz cites UCCELLI, G. B., *S. Giusto alle Mura* (1865), pp.84–5, which I have not been able to consult.

12. See also RICHA, G., *Notizie Istoriche delle Chiese Fiorentine*, IX (Florence 1761), p.97.

13. PAATZ, W., *op. cit.*, p.279, no. 6.

14. OFFNER, R., *op. cit.*, p.38.

15. MARCUCCI, L., *Gallerie Nazionali di Firenze. I Dipinti Toscani del Secolo XIV* (Rome 1965), note 78.

16. Florence, Archivio di Stato, *Conventi Soppressi*, 86, 95, f.30.

17. An altarpiece conforming to the same design, painted for another chapel in Santa Maria degli Angeli dedicated to S. John the Baptist is that attributed to Niccolò di Pietro Gerini, probably dated 1387, in the National Gallery (No.579). Yet another similar altarpiece dedicated to S. John the Baptist in the same church was that in the Nobili chapel, also in 1387. See GRONAU, H. D., 'The Earliest Works of Lorenzo Monaco', *The Burlington Magazine* (1950), pp.217–22.

18. MARCUCCI, L., *op. cit.*, no. 44.

19. *ibid.*, no. 43.

20. Florence, Archivio di Stato, *Conventi Soppressi*, 86, 95, f.30.

21. OFFNER, R., *op. cit.*, plate II.

22. *ibid.*, plate XVI.

23. *ibid.*, plate Va.

24. BOSKOVITS, M., *Pittura fiorentina alla Vigilia del Rinascimento* (Florence 1975), fig. 62b.

25. *ibid.*, fig.92b.

26. OFFNER, R., *op. cit.*, p.37.

27. See GARDNER VON TEUFFEL, C., 'From Polyptych to Pala: Some Structural Considerations', *Atti* [. . .], *cit.* (1981), pp.323–44, particularly p.325.

Acquisition, structure, condition and treatment

David Bomford

The altarpiece *Three Saints* by Nardo di Cione was acquired in 1857 from the Lombardi–Baldi Collection in Florence. This Collection, gradually assembled since 1838 by Francesco Lombardi and Ugo Baldi, had been catalogued in 1844 and 1845 and became known to the Trustees of the National Gallery in 1847. By then it consisted of about one hundred works of the Early Italian School, particularly Tuscan painters.

Eastlake examined the Collection in 1855 and estimated that about a quarter of it merited serious attention. Taken as a whole, however, 'the importance of the series was at no time commensurate with its extent'. Unfortunately, at that time, Lombardi and Baldi refused to divide the Collection, and Eastlake concluded that the only way of obtaining possession of the best specimens was to buy the whole gallery and afterwards to sell the less important part of it. To enable this plan to proceed, an Act of Parliament was passed in 1856 'to extend the powers of the Trustees and Director of the National Gallery and to authorise the Sale of Works of Art belonging to the public'. However, the first attempt at such an exercise (the sale of part of the Krüger Collection in February 1857) proved unsuccessful and the difficulty of disposing of works considered unfit for the National Collection became apparent [1].

In view of that, Eastlake made one last attempt (through his travelling agent Otto Mündler) in the autumn of 1857 to buy only the pictures he wanted. This time he was successful and he acquired the cream of the Collection for just £7,035 [2]. Apart from the Nardo di Cione *Three Saints* (then catalogued as Spinello Aretino) this notable purchase included the Duccio triptych *Madonna and Child with Saints* (No.566), Uccello's *Battle of San Romano* (No.583), Botticelli's *Adoration of the Kings* (No.592) and twelve panels from the S. Pier Maggiore altarpiece in the Style of Orcagna (Nos.569–78). It also included (in Eastlake's words) 'unsightly specimens of Margaritone and the earliest Tuscan painters [. . .] showing the rude beginnings from which, through nearly two centuries and a half, Italian art slowly advanced to the period of Raphael and his contemporaries'.

Nardo di Cione's *Three Saints* is almost certainly a complete altarpiece. What position it occupied and what sort of setting or frame it was in is a matter for speculation. Certainly the frame that surrounded it when it was acquired (and remained on it until 1981) was not original, although it undoubtedly echoed what had been there originally.

There are clear indications on the picture surface that there had always been columns of some sort, with bases and capitals, defining the three compartments: but the columns that existed until recently, together with the elaborate pinnacles and painted mouldings (Fig.2) probably dated only from the early nineteenth century – perhaps even from the period spent in the Lombardi–Baldi Collection.

When the picture was examined and treated in

1980–2 it was decided to remove the frame for two principal reasons. Firstly, it was considered to be overpoweringly unsympathetic to the altarpiece it surrounded: sometimes, nineteenth century interpretations of Gothic frames are very fine, but this one was crude and badly made.

Secondly, because it was rigidly attached with glue and nails all round, it was acting as a considerable restraint against the natural movement of the poplar panel. This had manifested itself in two ways. At the bottom of the right-hand compartment was a long, almost vertical split, which had already been repaired and reinforced at the back; and at the upper left corner the frame was cracking open and threatening to split the original panel in this part as well (Fig.3).

The only beneficial effect of the frame was the protection that it gave to the bottom part of the poplar panel (behind the predella) which was rotten, worm-eaten and crumbling. When the frame was removed, this part was extensively consolidated and reinforced.

The frame was removed in small sections by sawing and chiselling. At the sides and the bottom the original bare edges and front of the panel were exposed. At the top, in the region of the three arches, the structure was a little more complex. Here, elements of the original framing were uncovered.

Within each arch, there were two sections of cusped tracery which undoubtedly formed part of the nineteenth century additions. These slotted into a rebate raised up from the picture surface by about 1 cm (Fig.4).



Figure 2
Nardo di Cione,
Altarpiece:
Three Saints
(No. 581), in its
nineteenth
century frame.



It became clear that this rebate was original, since the gilded ledge which formed the base of it was continuous with the gilding on the picture surface. In addition, the moulding which capped the tracery was also seen to be original (although it had been re-gilded) since the wood from which it was made was obviously contemporary with that of the ledge beneath.

These parts of the original frame were carefully retained when the nineteenth century additions were removed. They indicated that there probably had been traceried elements within each arch originally, but no attempt was made to reconstruct them when the altarpiece was reframed after the 1980–82 treatment. A simple gilded frame with a plain predella was made, which fitted around the panel and allowed the surviving parts of the original frame to remain visible (Plate 7, p.35).

Apart from the frame removal, treatment included extensive consolidation of the cracked and worm-channelled poplar panel and the cleaning of the picture surface followed by limited in-painting of the few minor losses in the paint layers.

There was very little varnish present: the quite considerable discoloration was due almost entirely to an accumulation of grey dirt layers. The picture surface was last cleaned and varnished in 1887, but it is probable that most of the dirt was earlier than that and had not been removed during that cleaning.

Cleaning revealed that the paint and gold layers were in exceptionally good condition. There was some wearing in the head and hands of S. John the Evangelist (on the left) and a few small losses elsewhere, but no damages of any significant size.

A difficulty was encountered in the red book and in the red lining of the blue robe. Here the vermilion had blackened in a very uneven manner causing unsightly dark patches on the brilliant red pigment. No attempt was made to disguise this during in-painting (see Plate 8i, p.35). This phenomenon is discussed more fully on p.32–3.

During treatment an extensive examination of the altarpiece was carried out using X-rays, infra-red reflectography, microscopical examination and chemical analysis. The results of this examination are discussed in the systematic description of Nardo's materials and methods below.



Notes

1. The power conferred on the Trustees by Section 1 of the 1856 National Gallery Act to sell pictures and other works of art was not withdrawn until 1954, when the National Gallery and Tate Gallery Act (Section 6) specifically cancelled it.
2. £7,000 plus £35 banker's commission. Director's Report for 1857/8.

Figure 3 (Top) The nineteenth century frame splitting open at the top left corner.

Figure 4 The original rebate into which traceried elements fitted (compare with Fig. 2 in which the nineteenth century tracery is still in place).

The materials and technique: Cennino Cennini's treatise illustrated

Joyce Plesters and Ashok Roy

The technique and materials of the Nardo di Cione *Altarpiece: Three Saints* (Plate 7, p.35) constitute an interesting example of the type of workmanship in which Cennino Cennini was trained as a pupil of Agnolo Gaddi (active 1369, d.1396), whose career overlaps that of Nardo. Cennini probably wrote his famous treatise, *Il Libro dell'Arte* around 1390, towards the end of his life, but it is common for technical treatises to reflect practices of a generation or two earlier. The treatise survives as copies in three different codices. The earliest, in the Laurenziano Library, dates from the early fifteenth century but omits some sections found in the later copies. From these sources a number of transcriptions, editions and translations have been made. The most recent edition is by F. Brunello (in Italian), fully annotated [1]. For the present purpose the edition and translation quoted below is that of D. V. Thompson [2].

Nardo di Cione's *Altarpiece: Three Saints* and Cennini's treatise have in common the memory of Giotto's mastery of the modelling of three dimensional forms, particularly in evidence in the breadth and massiveness of the draped figures of the three saints in the altarpiece. Both Cennini and Nardo share also a fondness, one might almost say a weakness, for richly-patterned and gilded surfaces. The bulky figures draped in broad heavy folds of plain colour, undecorated except for narrow gold borders, recall figures in Giotto frescoes. The weight of the figures is, though, partly negated by the fact that the feet, instead of standing firmly on the ground in the Giotto manner, hang down against a perfectly vertical backcloth of gorgeously patterned gold, blue and orange brocade. The execution of painted brocades of this sort is described in detail by Cennini and regarded by him as an advanced stage in the painter's apprenticeship and a matter for great pride. In the Nardo di Cione *Altarpiece* there is no indication of the perspective of the floor nor hint of cast shadow. It is as if the painter were reluctant to interrupt the overall pattern of birds and foliage.

The craft tradition represented by Cennini spans a long period, harking back to the practices of both Giotto and Duccio, evolving through an intermingling of Siennese and Florentine influences and reaching its full, perhaps even overblown flowering in the highly-wrought and decorated surfaces of the International Gothic fantasies of Gentile da Fabriano and Benozzo Gozzoli, the latter living on until almost the end of the fifteenth century. In Volume 1 of the *Technical Bulletin* [3] there was demonstrated the survival of many of the Cennini techniques in Sassetta's Sansepolcro altarpiece painted in the early 1440s, and of which the National Gallery has seven panels. The Nardo di Cione represents an earlier, pre-Cennini, phase in the making and embellishing of Italian gilded altarpieces. For a picture of this age the condition of the paint surface is exceptionally good and it was possible to take only a small number of

samples for microscopical examination and chemical analysis, but to compensate for this, much can be learned from close study of the picture itself. The following account attempts to trace stage by stage the creation of the altarpiece, comparing and contrasting what is observed on the picture with Cennini's instructions for painting on panel. Since the application of gesso ground, bole and gold leaf is common to Italian altarpieces in general and has been well-studied [4], less attention will be paid to these preliminary stages.

The wood panel support: The wood was identified microscopically as poplar (*Populus* sp.). Cennini recommends poplar of good quality, linden or willow, all three being diffuse porous hardwoods ('hardwood' being a general term for woods from deciduous trees) of rather similar physical properties [5].

The panel consists essentially of two unequal pieces. The smaller plank comprises the left-hand compartment, while the larger comprises the centre and right-hand compartments: the vertical join between them runs down the line of the column which once divided the left-hand and centre compartments. The larger plank is wide for a single piece of poplar, but not exceptionally so: Michelangelo's *Entombment* (No.970), for example, which is painted on a single massive plank, is more than half as wide again as this. Even so, it has remained remarkably stable, with only the one split described on p.24 and very little warping or twisting: the panel maker must have chosen, cut and prepared it with particular care.

In addition to the two main pieces, there are narrow strips, also of poplar and little more than 2 cm wide, at the left and right edges. These are original and were presumably added at a relatively late stage in the construction of the panel in order to adjust it to the precise dimensions required for the altarpiece.

The two main planks are shaped at the top to form the three truncated triangles. The surviving elements of the original frame, forming the pointed arches and containing the rebates for the tracery (described above), consist of two layers of poplar attached with glue to the front of the panel. There is no indication of the precise nature of the rest of the original frame, but the positions of the four capitals and bases are still clearly visible on the picture surface. The panel is not gessoed where the predella would have been: the lower limit of the gesso is slightly raised — which one would expect if the predella and panel had been gessoed at the same time.

The gesso ground: A single comparatively thin layer of white gesso is seen in the paint cross-sections (Plates 8b, 8d and 8f, p.35). Cennini gives an elaborate procedure for coating the wood panel with several layers of *gesso grosso* followed by 'at least eight coats' of the finer gesso, *gesso sottile*. It is rare, however to discern in paint cross-sections more than two separate layers; a single one with glue priming on the surface is more common. It is feasible that if successive coats were put on in rapid succession there would be no line of demarcation between the layers when dry, or it could be that Cennini's was a counsel or perfection rarely achieved in practice. Identified chemically as calcium sulphate, X-ray diffraction powder analysis showed the white inert to



(a)



(b)



(c)

Figure 5 Infrared reflectogram details showing the underdrawing for the draperies (a) centre saint, left arm (b) enlarged detail of a (c) right-hand saint, left arm.

be a mixture of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and anhydrite (CaSO_4), with the former predominating. Gesso grounds consisting wholly of anhydrite, or of anhydrite with a small proportion of gypsum, have been identified by the same method in a number of Florentine and Siennese paintings, while gypsum alone seems to appear more frequently in the gesso of Venetian paintings. There are, however, exceptions and not enough results are yet available to have statistical significance. It may be worth noting that almost identical X-ray diffraction patterns to that for the Nardo gesso were got from the gesso ground of a small Giottesque panel in the National Gallery, *Pentecost* (No.5360) and of another panel of the same series, *The Epiphany*, in the Metropolitan Museum, New York, catalogued as Giotto [6].

The drawing of the design: incised outlines and underdrawing in black: Cennini continues:

When the gesso has all been scraped down, and come out like ivory, the first thing for you to do is to draw in your ancona or panel with those willow coals which I taught you to make before.

The 'willow coals' are slender sticks of charcoal made from willow twigs. He mentions shading in the folds and the faces, then when the charcoal drawing is complete going over it with a feather almost to erase it, after which:

[...] Take a little dish full of fresh water and a few drops of ink and reinforce your whole drawing with a small pointed minever brush. Then take a little bunch of feathers and sweep the whole drawing free of charcoal. Then take a wash of this ink, and, with a rather blunt minever brush, shade in some of the folds, and some shadow on the face.

Black, or rather, greyish, underdrawing is visible with the unaided eye and more clearly in infra-red reflectograms (Figs.5a and b) in the folds of the pink drapery of the centre figure. It looks as though it has certainly been applied in a liquid medium, not as dry charcoal or black chalk, but with a suggestion of the strokes of a broad quill pen rather than Cennini's blunt minever brush (Plate 8a, p.35 and Fig.5b). Infra-red reflectography reveals a similar style of underdrawing in the drapery of the other two figures (Fig.5c), and drawing in the flesh and faces and hands. A single paint sample was possible from a point on the pink cloak of the central figure where underdrawing could be seen. The cross-section of this sample has a thick irregular line of black particles between the gesso ground and the pink paint layers (Plate 8b, p.35). Comparison with standard microscope preparations of black pigments show a close similarity between the small shiny rounded black grains and lampblack (certainly not charcoal). Lampblack is the pigment from which black ink was made. The next stage is described:

[...] When you have got your whole ancona drawn in, take a needle mounted in a little stick; and scratch over the outlines of the figure against the grounds which you have to gild, and the ornaments which are to be made for the figures, and any special draperies which are to be made of cloth of gold.

Strongly incised outlines are present around the figures in the Nardo altarpiece. Often the painted contours of the forms, executed after the gold work was finished, do not correspond with the incised outline (Plate 8a, p.35).

The gilding and tooling: The next stage would be applying bole (the smooth red clay which owes its colour to ferric oxide) to the areas to be gilded, then laying gold leaf over that entire area. Cennini gives long and elaborate instructions (too lengthy to quote here) for applying the bole in a medium of egg white, burnishing the bole to make it quite smooth and laying the leaves of gold, the edges slightly overlapping, on the moistened surface of the bole. Equally, a solution of animal glue was used as a medium for the bole and served as adhesive for the gold [7]. On the picture the bole looks a rather dark reddish-brown in contrast to the almost vermilion-like red of the bole in the Sassetta panels. Samples of bole vary quite appreciably in colour, even though the colouring matter of the clay is essentially ferric oxide. It can be seen that the irregular edges of the leaves of gold project a little way under the paint of the figures, although Cennini recommends trimming off the excess before beginning the painting operations. In the gold background of the altarpiece it is quite difficult to distinguish the rectangular shapes of the separate small leaves of gold, and this, together with the rather dark reflecting surface, suggests that the gold has been burnished. Cennini mentions burnishers made of the hard mineral haematite, of animals' teeth, or even precious stones. The process can only be applied to water gilding, where the gold leaf is just lightly stuck to the surface with an aqueous adhesive like glue size or white of egg (as distinct from oil gilding in which the adhesive is a layer of drying oil or an oil-resin composition). The pressure of the smooth burnisher spreads and polishes the gold into a thin continuous film of the order of micron thickness. The gold of the background of the Nardo is slightly rubbed and worn so that the colour of the bole comes through in places. Next to be done would be the tooled haloes. Cennini directs:

When you have burnished and finished your ancona, you must start by taking the compasses; swinging your crowns and diadems, engraving them; tapping in a few ornaments; stamping them with tiny punches, so that they sparkle like millet grains; embellish with other punches; and do stamping if there are any foliage ornaments.

Cennini calls this 'one of the most delightful branches of the painter's craft'. M. Frinta, who pioneered the study of punchmarks in gilding, remarks that engraved and punched decoration are two more or less consecutive stages in the technique of embellishment [8]. In the Nardo altarpiece the concentric engraved circles of the three haloes are so perfectly drawn that compasses must have been used. Sometimes it is possible to see the small hole left by the point of the compasses, but here it seems to have been successfully disguised by the subsequent painting of the faces. Measurements indicate that the centres of the haloes of the two side figures are each the pupil of an eye, and of the centre figure the inner corner of his right eye. When the circles had been engraved the punched decoration could begin. Each of the three haloes is of a slightly different design, but made up of different combinations of the same small number of simple shapes or motifs made by metal punches (Fig.6).

E. Skaug, who is engaged on a monumental catalogue of Florentine punchmarks, has studied those on the National Gallery's Nardo di Cione *Three Saints*,



Figure 6 Actual size details of the punchmarks used for the three tooled haloes.

distinguishing by size and shape five (or possibly six) different motif punches. These, interestingly, he identifies as belonging to a set of punch tools brought to Florence from Siena by the itinerant painter Giovanni da Milano in 1363 [9]. They comprise ring punches giving motifs of circles and concentric circles, a cusped arch, and three different flower shapes. The tooling was done while the gesso was still pliable and not yet dried to a brittle state. The trick was to apply just enough pressure to the needle used for inscribing, or give a just sufficiently sharp tap to the punch to indent the surface of the gilded gesso without actually piercing the 'skin' of gold leaf. In achieving this Nardo was much more skilful than Sassetta whose tooling in the *S. Francis* panels seems to have gone straight through the gold, eventually resulting in small areas of gold flaking off within the tooling to expose a disturbingly large amount of red bole. The Nardo haloes are in exceptionally fine condition (Fig.6).

The brocade floor covering: Cennini devotes much attention to the subject of gold brocade. The floor in the Nardo (Plate 8c, p.35 shows a detail) would probably be the next task:

I want to show you how to make a cloth of gold. If you want to make a mantle, or a gown, or a little cushion, out of cloth of gold, lay the gold with bole; and scratch in the folds of the drapery just the way I taught you for gilding a ground.

There are no folds of drapery in the flat strip of brocade in our picture, so it would simply have been gilded like the background, but leaving the lower parts of the draperies and also the saints' feet in reserve, within the incised outlines, to be painted at a later stage. The colouring of the gold brocade is then begun:

Then if you want to make the cloth red, lay in with vermilion over this burnished gold.

In the case of the Nardo the cloth is orange, that is, it has an orange background to the design. The pigment was found by laser microspectrography and XRD to be red lead (lead tetroxide, Pb_3O_4 [10]), which has an orange rather than a pure red colour. It is made by roasting lead white or litharge. Red lead is quite rarely found in paintings, except occasionally as underpaint for the more expensive vermilion. Cennini speaks of it rather disparagingly:

A colour known as red lead is red and is manufactured by alchemy. This colour is good only for working on panel, for if you use it on the wall it soon turns black on exposure to the air and loses its colour.

There is the possibility that sulphur gases in the atmosphere could convert red lead into black lead sulphide, and this, as Cennini notes, would be more likely to happen on a wall in fresco than on a panel painting where the pigment would be protected to some extent by a film of egg or oil medium and by the varnish if the picture were varnished. The red lead on the gold brocade in the Nardo seems to have kept its brilliant colour to perfection, although quite thinly painted (Plate 8d, p.35). The procedure recommended by Cennini for executing the brocade pattern is to draw the design on parchment, prick the outlines with a needle in the customary way for a cartoon, and pounce

powdered pigment through the pricked outline so as to transfer the design in the form of dotted lines to the background colour (orange in the case of the Nardo altarpiece) which has been applied entirely to cover the gold. He exhorts the artist to, 'Make your repeats so that they register well on each side.' This suggests that the cartoon was drawn for one pattern unit only of the design and was moved along on the picture surface to make the repeats. In the Nardo the pattern is accurately centred on the middle panel. The helpful suggestion is made by Cennini that charcoal should be used for the pounce powder if the brocade background is a light colour, lead white if it is a dark colour. Cennini then describes how the darks and lights (if the drapery is modelled in folds) are added and the different colours of the design. It is at this stage that the ultramarine blue of the birds would be put on as solid patches of colour on the head and wings, and the blue of the flowers. The orange paint of the background can be glimpsed here and there under the blue, and the high opacity of these blue areas in an X-radiograph of the bottom left corner of the picture demonstrates that the highly X-ray absorbing red lead layer must run beneath the blue. Cennini specifies that all the colours must be tempered with a medium of egg yolk, and that this was the case in the Nardo brocade pattern is confirmed by the results of medium analysis (see below under *Paint medium*). Cennini then gives the method of scraping away the paint to reveal the gold beneath:

When you have pounced your cloth [that is the design for the gold cloth], take a little style of birch of hardwood or bone, with a point, like a regular style for drawing at one end, and a little edge at the other for scraping. And with the point of this style, sketch in and shape up all your cloths; and with the other end of the style, scrape and remove the colour from them, nicely, so as not to scratch the gold. And scrape whichever you please, either the ground or the pattern.

In the Nardo the orange-coloured red lead has been left as the background for the blue and gold birds, flowers and foliage. Whole areas have been scraped away within the incised outlines of the leaf shapes, presumably with a flat-ended scraper. The wing feathers of the birds have been drawn with incised lines going right through both blue and orange paint layers to reveal the gold. A wood or bone scraper would obviously be less likely to damage the gold beneath than would a metal one. It looks as if the paint was not completely dry and hard when the scraping was done, for the edges of the paint are softly curved as though still subject to slight flow. But more embellishment was still to come:

[. . .] and whatever you uncover [that is of the gold beneath the paint] stamp afterward with the rosette. And if you cannot get the rosette into the little strokes take a single little iron punch with a point like a drawing style.

Thompson explains that the rosette (Italian: *rosetta*) was a punch having several small points, presumably designed to avoid the tedium of making every dot of the 'graining' separately. The gold parts of the bodies of the birds and of the foliage have been treated in this way, using only one size of punchmark, though for the thin stems Cennini's 'single little iron punch' must have been used. It can be seen how the artist worked systematically in bands across the areas to be grained.

The tiny punchmarks look almost black, so that the grained areas of gold contrast strongly with the surrounding orange background (Plate 8c, p.35). This is because the punch-holes are deeper and narrower than the punchmarks of the tooling of the haloes, even penetrating the bole, and because dirt and old varnish has collected at the bottom of the holes with time. There is no evidence to suggest that pigment was deliberately introduced into the punch-holes. Along the very bottom edge of the panel the tooling has been omitted from parts of some of the gold motifs which may have been concealed by the original framing.

Although the design and execution of the painted floor covering in the Nardo altarpiece is both elegant and successful, it is achieved by comparatively simple means and does not exploit the most complex procedures described by Cennini for this type of work. These include the incorporation of transparent coloured glazes (both oil and egg) over gold and silver, and the scraping through of superimposed layers of paint applied to metal leaf to expose selected areas of different colours. Most of these techniques were found in the Sassetta *S. Francis* panels, but neither the execution nor the state of preservation is as sound as that in the Nardo altarpiece. It has been noted that the same brocade pattern of birds and leaves occurs in a number of altar panels, not all attributed to Nardo [11]. If, as Cennini suggests, a pricked cartoon of the pattern motifs was made it would be easy to reuse it, adapting it to different compositions, or varying colours and textures.

The gilding and tooling completed, the painting proper could begin. Cennini calls painting on panel 'a gentleman's job', compared with fresco, adding that it could be done even by someone wearing velvets on his back! The work, he says, should be carried out according to his directions for working in fresco, except in three respects:

The first, that you always want to work on draperies and buildings before faces. The second that you must always temper your colours with yolk of egg and get them tempered thoroughly — always as much yolk as the colour which you are tempering. The third is that the colours want to be more choice and well worked up like water.

The draperies of the figures: Close inspection of the surface of the picture reveals that the gilding and tooling of the haloes continues for a few centimetres under the paint of the drapery on the shoulders of each of the figures, indicating that the drapery was painted, as Cennini instructs, after the goldwork was finished. The underdrawing of the draperies has been considered above.

The pink drapery of the centre figure (S. John the Baptist): In the cross-section of the sample of the pink cloak taken to reveal the black underdrawing (Plate 8b, p.35), there was between the line of black pigment particles of the drawing and the pale pink paint of the cloak a very thin layer of deep crimson, apparently a lake pigment unmixed with white, but similar in hue to the flecks of red lake pigment in the opaque pink layer above. A thin transparent section (8 μ) cut from the sample and viewed by transmitted light showed the red layer to be translucent and glaze-like and to run into the irregular

line of black carbon particles. An explanation for its presence is perhaps to be found in Cennini's text with regard to painting on panel:

And for your great pleasure, always start doing the draperies with lac by the system which I showed you for fresco, that is leave the first value in its own colour [that is at full strength without dilution by addition of white pigment]; and take two parts of lac colour, the third of white lead, and when that is tempered, step up three values from it, which vary slightly from each other.

He is, presumably, taking the example of red draperies to illustrate the general principle of modelling drapery of whatever colour. The system, already explained, by him in connection with fresco painting, requires a series of pre-prepared mixtures of the coloured pigment chosen for the particular drapery mixed with an increasing proportion of lead white, each colour value to be kept in a separate small dish. Of interest to us is the sequence of their application:

Now take some of the first one, that is, the dark one; and with a rather large and fairly pointed bristle brush go over the folds of your figure in the darkest areas. [That is the shadows, already made dark in the underdrawing by hatching or dark washes.]

So it would seem from this that Nardo, after completing the black underdrawing in diluted ink, might well have started colouring the pink robe by going over the deepest shadows of the folds with his deep crimson-coloured lake pigment, rather than, as one might expect, laying in the whole of the drapery with the middle tone first. Cennini then gives elaborate instructions for painting next a strip of the lightest tone, then one of the middle tone and blending them together where they meet. Finally some pure white is used to 'shape up' all the areas of relief; the dark parts are gone over once more with pure colour and some outlining done for emphasis. In the paint cross-section two separate layers of pink (lake plus lead white) are just distinguishable; the upper one is slightly paler. White or near-white highlights can be seen in the pink cloak and a final glaze of red lake pigment has been added only in the deepest shadows of the folds. A very small sample of crimson glaze from a dark shadow on the pink cloak was analysed by high-performance liquid chromatography (HPLC) for identification of the dyestuff of the red lake pigment. The resulting chromatogram was closest to that of Polish cochineal rather than lac. Like Cennini's lac, Polish cochineal is a red dyestuff from a type of scale insect, but whereas lac had to be imported from Asia, Polish cochineal was extracted from a different species of scale insect found in Eastern Europe [12].

The blue drapery of the saint on the right (S. James Major) (Plate 8e, p.35): Infra-red reflectography revealed the same type of blackish underdrawing beneath the paint of this drapery (Fig.5c) that can be seen with the unaided eye, or even better by infra-red, in the pale pink cloak of the centre figure (Plate 8a, p.35 and Fig.5a). The paint was in such excellent condition that it was possible to take only one sample, from the middle tone of the saint's left shoulder. The blue pigment was identified as natural ultramarine by optical and chemical microscopy. It is of

high quality, of an intense blue. The cross-section of the sample shows the gesso ground with two blue paint layers, both consisting of ultramarine particles in a matrix of lead white, but the upper layer with more and some much larger blue particles (Plate 8f, p.35). Underdrawing was not present in this section, but its absence is not surprising since the sample was from an area of mid-tone. Cennini in describing how to make draperies in blue and purple on panel, writes:

If you want to do a blue, that is for a drapery, neither wholly modelled with lights nor all just laid flat, take some of three or four divisions of ultramarine blue: for you will find various grades of it, one lighter than another. And paint according to the light of the figure, as I have shown you above.

This description 'neither wholly modelled with lights nor all just laid flat' seems to fit very well with the blue cloak in the Nardo altarpiece, which has no white or very pale highlights and no really dark shadows. The deepest shadows appear to have been achieved by glazing with pure ultramarine over the opaque underpaint of ultramarine mixed with lead white. Although gradations are obtained by varying the proportions of ultramarine and lead white, the single paint cross-section (Plate 8f, p.35) might suggest that in addition different grades of ultramarine were employed. Cennini gives a version of the much-repeated recipe for the lengthy and laborious extraction of the pure blue pigment from the mineral lapis lazuli. In the process different grades of the pigment are extracted, the first and most highly-valued consisting of the largest and deepest coloured particles with few mineral impurities; the last with smaller and fewer blue particles and a high proportion of mineral impurities, particularly the colourless calcite. Cennini becomes lyrical on the subject of ultramarine:

Ultramarine blue is a colour illustrious, beautiful, and most perfect, beyond all other colours; one could not say anything about it, or do anything with it, that its quality would not still surpass. And because of its excellence, I want to discuss it at length, and to show you in detail how it is made. And pay close attention to this, for you will gain honour and service from it. And let some of that colour, combined with gold, which adorns all the works of our profession, whether on wall or on panel, shine forth in every object.

That the ultramarine was as costly an item as gold, and usually either supplied by the patron or the subject of a separate payment, is well-known. For the Nardo altarpiece some ounces of high quality ultramarine must have been required, suggesting an important and expensive commission.

The green drapery of the saint on the left (Plate 8g, p.35): The same type of underdrawing present in the other two figures was visible by infra-red reflectography. This differs from the drapery of the cloaks of the other two saints in being a type of *cangiante* or 'changing' drapery, that is, the lights and shadows are painted in different hues with the intention of giving a shot effect. Changing draperies are more often associated with High Renaissance or Mannerist Italian paintings, but in fact Cennini has a great deal to say about them in his section on wall paintings, in both fresco and secco medium. F. Brunello has conveniently tabulated the various combinations

of colours and pigments suggested by Cennini for the purpose [13]. None of these quite corresponds to that in the Nardo. The middle tone is an unusual almond-green shade, the shadows blue, and the highlights a pale yellowish green. It was expected that the bluish green might be the copper carbonate mineral pigment malachite, but this visual assessment was completely wrong. It proved to be a mixture of ultramarine blue with lead-tin yellow (the yellow manufactured pigment which has been convincingly identified as Cennini's *giallorino*). The same mixture seems to occur in the mid-tone, shadows and lights, but the ultramarine predominating in the shadows, and lead-tin yellow in the lights with the addition of a little lead white in the strongest highlights (Plate 8g, p.35 shows a detail). A photomicrograph of the top surface of a fragment of paint from the mid-green is seen in Plate 8h, p.35. The lead-tin yellow was identified by laser microspectral analysis, while X-ray diffraction powder analysis revealed it to be not the commonly-occurring 'type I' (Pb_2SnO_4), but the much rarer 'type II' of the two types distinguished by H. Kühn [14]. This has a main phase $\text{Pb}(\text{Sn},\text{Si})\text{O}_3$, in which silicon is an essential constituent, but also contains free tin oxide and silica. Of the few identifications of 'type II' by X-ray diffraction so far made, the one most closely related to Nardo was in the yellow of Christ's robe in a small panel, *Noli Me Tangere* (No.3894) by Orcagna (Andrea di Cione), Nardo's brother. The other two most relevant identifications were in the two Giottoesque panels mentioned above in connection with the gesso ground of the Nardo di Cione. One was in a sample from the greenish yellow background of *Pentecost* (No.5360) ascribed to Giotto, and the other in a sample from yellow drapery in another panel of the same series, *The Epiphany*, in the Metropolitan Museum, New York. Cennini does not refer to the existence of two different sorts and, indeed it would not be easy to distinguish them by simple means. Cennini even seems rather uncertain as to whether *giallorino* is a mineral or an artificially-made pigment, though his careful description of its properties comes closer to what is known to be lead-tin yellow than to any other known yellow pigment:

A colour known as *giallorino* is yellow, and it is a manufactured one. It is very solid, and heavy as a stone, and hard to break up. This colour is used in fresco, and lasts forever, that is, on the wall; and on panel, with temperas.

He goes on to say that it is very troublesome to grind (which is indeed the case with samples made in the laboratory) and remarks further:

[. . .] it is a very handsome yellow colour; for with this colour, with other mixtures, as I will show you, attractive foliage and grass colours are made. And as I understand it, this colour is actually a mineral, originating in the neighbourhood of great volcanoes; so I tell you that it is a colour produced artificially, though not by alchemy.

Kühn has demonstrated that two recipes in the fifteenth-century Bolognese manuscript (published by M. Merrifield) and deriving from glass-making, are for lead-tin yellow 'type I' and 'type II' respectively. He has prepared them and compared their chemical composition and crystallographic structure with numerous samples of yellow pigment from paintings [14]. Cenni-

ni's view that *giallorino* was 'actually a mineral, originating in the neighbourhood of great volcanoes' may derive from the fact that lumps of the pigment, both types of which are fused oxides made in a furnace at high temperatures, although hard, often have the texture of pumice stone (which is found in volcanic areas) and for the same reason, the formation of bubbles of gas in the molten state. The same confusion long persisted over the origin of Naples yellow, another fused oxide (lead antimony oxide, $\text{Pb}_2\text{Sb}_2\text{O}_7$), which replaced lead-tin yellow, the latter disappearing from use, inexplicably, about the middle of the eighteenth century. Lumps of Naples yellow also often show the same pumice-like texture and although recipes for it exist, and it also had its origins in glass and ceramic glaze manufacture, it too was described as a mineral found in the volcanic regions around Naples. It could be that the manufacture of both lead-tin yellow and Naples yellow was to some extent guarded as a trade secret.

Not only is the presence of lead-tin yellow 'type II' in the Nardo altarpiece an unusual feature, but the combination of lead-tin yellow of either type with ultramarine to make a green paint is almost unprecedented in our experience [15]. Cennini in the passage quoted above mentions *giallorino* as being useful for mixing with other pigments to make green colours. He does give instructions for making three greens from mixtures of yellow and blue pigments, but none is of *giallorino* and ultramarine. Two of the mixtures he describes, the yellow arsenic sulphide pigment orpiment (As_2S_3) with indigo and ultramarine respectively, have not to the present authors' knowledge so far been identified on paintings. The third combination, *giallorino* (interpreted as lead-tin yellow) with azurite, the blue copper carbonate mineral pigment, occasionally occurs. In fact, in our experience it is the exception rather than the rule to find in Italian paintings dating before the seventeenth century green paint in which the colour results from physical mixtures of blue and yellow pigments. Before then the green colour is almost always contributed by green copper pigments, either malachite or possibly its artificially-made equivalent, green verditer (both green basic copper carbonate, $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$), or more commonly verdigris (basic copper acetate, $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{Cu}(\text{OH})_2$), which may be mixed with either lead-tin yellow or lead white to give a range of opaque bright green tones. Cennini mentions in passing a mixture of malachite with *giallorino* when describing the depiction of trees and foliage in fresco or secco on walls. The only other common green pigment for use in wall or easel painting in medieval and Renaissance times would have been green earth, which will be referred to below under flesh painting, but this, generally having a somewhat dull greyish green colour, found rather more limited uses. It is a matter of some surprise that the pigment mixture used in the green *cangiante* drapery of the Nardo altarpiece produces such 'clean' bright-looking green tones considering that ultramarine is just slightly on the violet side of pure blue, as distinct from azurite which is just slightly on the green side. Each of the cloaks of the saints in the altarpiece displays a little of a turned back lining of vividly contrasting colour. The pink cloak of the saint in the centre has an intensely blue

ultramarine lining, the depth of colour of which seems to be enhanced by a final glaze of pure ultramarine. The *cangiante* green cloak of the saint on the left has a rose-pink lining, similar in colour to the mid-tone of the pink cloak of the central figure and presumably a mixture of lake and lead white.

The ultramarine blue cloak of the saint on the right has a scarlet lining which unfortunately has unsightly dark patches similar to those on the scarlet cover of the book held by the saint on the left (Plate 8i, p.35). The dark layer, varying in colour from purplish brown to greyish black, is very thin and on top of vermilion paint. It seemed to be quite vulnerable to the neutral organic solvents used for varnish removal. It was accordingly of interest to discover whether the surface layer comprised some degraded glaze or scumble, or whether the discoloration represented formation of black metacinnabar (α' HgS) by the photochemical conversion from the familiar red form of mercuric sulphide, vermilion. Two samples were taken, one from the edge of the cover of the book near the thumb of the left-hand saint where the dark patches are particularly noticeable, and one from a similar area on the lining of the right-hand saint's blue cloak. The microscopic appearance of the paint surfaces at high magnification was that of a degraded paint layer rather than a separate upper layer on top of vermilion. The discoloration was irregular, grading from purplish black to chocolate brown in areas seeming to form a part of the unchanged vermilion paint. The dark particles were of a similar size distribution to that of the red vermilion and seemed to be rather more concentrated along the edges of the cracks in the paint. Digestion of part of the sample from the saint's drapery with *aqua regia* yielded no residue other than mercuric chloride/nitrate, except for a few larger particles of carbon (from surface dirt) originally visible on the surface of the paint. The fine-grained blackish material all seemed to be soluble in the acid, which carbon is not. It was concluded that the dark surface material was probably original vermilion which has undergone photochemical degradation to the black form. Consequently it was decided not to remove it from the discoloured surface, thereby avoiding attrition of the surface which may also induce conversion to the black form [16]. The relative solubility of the paint at the surface may relate to degradation of the paint medium accompanying the pigment change [17]. In fact, where similar discoloration of a vermilion coat had taken place in a much later picture in the National Gallery's Collection, Cuyp, *A Hilly River Landscape* (No.53) we had the opportunity to check by scanning electron microscopy combined with energy dispersive X-ray fluorescence analysis that the blackish coating was of the same chemical composition and had the same particle characteristics as the unchanged red mercuric sulphide beneath [18].

Cennini has something to say about the phenomenon. He seems to be familiar only with the artificially made pigment, not the mineral form cinnabar, for he speaks of it as 'made by alchemy, prepared in a retort'. The method of making it by dry distillation of mercury and sulphur had been known in Europe from medieval times and even earlier in China. The artificial and natural product seem to have been used contemporaneously

and it is difficult to distinguish between them either microscopically or chemically. After describing the pigment Cennini warns:

But bear in mind that it is not its nature to be exposed to the air, but it stands up better on panel than on the wall, because in the course of time from exposure to the air, it turns black when it is used and laid on the wall.

Vitruvius and Pliny had already noted several centuries earlier the blackening of vermilion on walls and correctly attributed it not to exposure to air, but exposure to light. Cennini is probably right in believing that the change is less likely to take place on panel paintings than wall paintings, since in the former the pigment surface is to some extent protected by being enveloped in egg or oil medium, and further protected by the varnish layer if the picture is varnished. These organic coatings should serve to filter out some light radiation.

The gilding of the borders of the drapery and on the books:

While the gilding of the background and brocade floor covering is applied to the gesso ground over an intermediate layer of bole before the actual painting of the figures is begun, the gold decoration on the drapery and the books is added on top of the paint as the final stage. Under low magnification the gold can be seen to be in leaf form (not ground up and used as pigment with a medium). It is not in as good condition as the gold leaf of the background and floor covering and where it has worn or flaked off, particularly in the patterning of the borders of the draperies, a brown layer is revealed which follows the design of the pattern (Plate 8j, p.35). This seems to correspond with Cennini's description of mordant gilding. He gives two recipes for mordants or adhesives for sticking gold leaf. The first, which he calls a 'standard mordant' is made from oil (presumably linseed, since this is the only drying oil mentioned in the *Trattato*) cooked on the fire or in the sun with a little white lead and verdigris. The white lead and verdigris would each act as driers to hasten the drying of the oil when the mordant was painted out, but they would also behave as pigments, providing sufficient were present so that some remained undissolved. He also recommends adding a little varnish (which would be an oil varnish, probably of sandarac resin cooked in linseed oil) and boiling the whole mixture together. He then describes how the 'embellishments' and 'ornaments' are painted or drawn with the brush using this mixture and how the mordant is left to dry, testing it from day to day until it is just tacky. Then:

[. . .] take the pincers; cut a half leaf of fine gold [. . .] and lay it over this mordant. Press it down with cotton [. . .] [19]

The gold leaf sticks to where the mordant has been applied:

When you have got it all gilded, you may leave it, if you like, until the next day. And then take a feather, and sweep it all over; and if you want to gather up the gold which comes off, that is, the 'skewings', keep it, for it is useful to goldsmiths, or for your own affairs. Then take some cotton, all clean and new, and burnish your gilded ornament to perfection.

The presence of such a mordant was confirmed by us under the fine gold outlining of the edges and diagonal folds of the Virgin's blue cloak in Duccio's *Maestà* panel,

The Annunciation (No.1139). It was a comparatively thick translucent yellowish brown layer between the blue paint of the Virgin's cloak and the gold leaf. It was not possible to get a sample large enough for analysis of medium by gas-chromatography, but testing with biological stains on a very small sample under the microscope accompanied by heating tests indicated that the medium was drying oil, not protein, whereas gas-chromatographic analysis of samples of actual paint from the picture showed the medium to be egg. The pigment in the mordant was lead white with a little ochre. This was the first real confirmation we had obtained of the use of an oil mordant for applying gold leaf on top of paint [20].

In the case of the mordant gilding on the Nardo di Cione, no such clear-cut confirmation was obtained. A small scraping of the exposed mordant from the gold border on the green cloak was found to contain both lead and iron, presumably as lead white or lead oxide and a mixture of red earth and black pigment, but the sample was too small to test for medium as well. However, among the four samples taken for medium analysis of paint (see below) one was with gold leaf attached to blue paint from the gold border of the blue cloak of the figure on the right. The result of analysis by gas-chromatography of the sample as a whole was egg, with no drying oil detectable, identical to the result for paint samples from elsewhere in the picture. If this result is valid, and representative (and it has to be remembered it is from just one tiny sample of the order of half a millimetre diameter) it could be interpreted as the medium of the mordant being egg tempera (that is whole egg or egg yolk) like the medium of the picture as a whole, but there seems to be no mention by Cennini, or in any other relevant documentary source for the use of whole egg or yolk as a mordant for gilding, although egg white was used for gilding in manuscript illumination. If egg white were present on top of paint which itself had whole egg or yolk medium, it would go undetected by ordinary methods for medium identification.

The other possibility is a different type of mordant. Cennini, and other documentary sources, including the 'Bolognese Manuscript', give a recipe for a mordant made of crushed garlic with a little lead white and bole added. Cennini points out that you need only wait for half an hour for it to dry sufficiently to apply the gold leaf, instead of waiting overnight, or even some days, in the case of the oil mordant. Garlic contains quite complex chemical components, but no attempt has been made as yet to identify its use in old pictures, and there is no experience of what chemical changes may take place in the material with age. The identification of the mordant used for gilding on top of paint in the Nardo panel therefore remains unresolved.

The flesh painting: After his detailed treatment of drapery painting Cennini instructs:

When you have done the draperies, trees, buildings, and mountains, and got them painted, you must come to painting the faces; and those you should begin this way. Take a little terre-verte and a little white lead, well-tempered; and lay two coats all over the face, over the hands, over the feet, and over the nudes.

This curious use of green as the undermodelling for flesh is one of the most characteristic features of the vast majority of fourteenth- and early fifteenth-century Italian paintings. It seems to be present under all the flesh paint in the Nardo altarpiece, being particularly evident in the face and hands of the saint on the left where the pale pinkish flesh paint on top is worn rather thin and translucent. It is detected only with difficulty in the face of the centre saint (whose swarthy complexion, dark beard and mane of hair bear a resemblance to the S. John the Baptist in the panel in the National Gallery depicting *SS. John the Baptist and Jerome* (No.5962), ascribed to Masolino, but by some scholars to Masaccio, which must have been painted some years after Nardo's death. It also has well-concealed green undermodelling).

There were no appreciable paint losses in the flesh from which a sample could be taken to prepare a cross-section for the study of the layer structure. A tiny scraping of the green pigment was got from the edge of a paint crack on the big toe of the right foot of the saint on the left, where the green of the undermodelling was prominent. Analysis by LMA showed the presence of lead, iron, aluminium and silicon but the absence of copper. It might therefore reasonably be deduced that in the absence of a green copper pigment, the green pigment present must be green earth. Confirmation of green earth, several possible complex silicates of iron, potassium and aluminium, by X-ray diffraction powder analysis was not possible, not merely because of the small size of the sample, but because the green pigment, which if it were green earth has a complex X-ray diffraction pattern, was mixed with a good deal of lead white.

Cennini gives a detailed description of how different types of flesh should be painted, even suggesting that for a young person of fresh complexion, perhaps like the saint on the left, yolk of a town egg should be used as being paler, while for aged and swarthy persons the yolk of a country egg is good because of its 'redness' (the yolk of egg often being referred to in Italian as *rosso di uovo*, that is 'red of egg'). In practice, if egg were used as the medium for paint incorporating an opaque pigment such as lead white its initial depth of colour is likely to make little difference to the final colour of the dried paint film, but Cennini's distinction shows a certain nicety.

As with the drapery painting, Cennini directs that three values of flesh colour should be prepared, each containing a higher proportion of lead white than the last, laying each flesh colour on the face according to the modelling. He also mentions that whereas the pinks of the flesh on walls are done with *cinabrese* (a red ochre), on panel they are to be done with vermilion as the red pigment. In the faces of the Nardo there is not much sign of pink and it looks as if brown and red earth pigments predominate. It is often assumed that it is wearing and increased transparency of the upper warm-toned flesh layers which makes the green undermodelling of flesh apparent in Early Italian paintings. While this may be true to a limited extent, as with the flesh of the saint on the left of our panel, Cennini clearly indicates that some of the green ought to be left exposed:

Plate 8 Nardo di Cione, *Altarpiece: Three Saints* (No. 581).

Details from the picture (*a, c, e, g, i* and *j*) with photomicrographs of paint cross-sections (*b, d* and *f*) and the top surface of a paint sample (*h*). The photomicrographs were taken in reflected light at 220×; the actual magnification on the printed page is shown opposite.

(a) Detail of centre saint's pink drapery showing incised outline round the figure, and black underdrawing in the shadows of the folds.

(b) Cross-section of centre saint's pink drapery.

1. Gesso ground; brownish and translucent from impregnation with glue.
2. Carbon black particles of underdrawing.
3. Thin layer of deep crimson-coloured lake pigment.
4. Pale pink paint of cloak: lead white + scattered particles of red lake pigment, possibly in two layers.

(c) Detail of brocade floor covering.

(d) Cross-section from orange background of brocade floor covering.

1. Gesso ground.
2. Very thin light orange bole with gold leaf.
3. Orange paint of background of the design: red lead.

(e) Detail of right-hand saint's blue cloak.

(f) Cross-section of right-hand saint's blue cloak.

1. Gesso ground.
2. Lighter blue underpaint: natural ultramarine + lead white.
3. Deeper blue, same composition as layer 2 but with larger and more ultramarine particles.

(g) Detail of left-hand saint's green cloak showing bluish shadows and yellow highlights.

(h) Left-hand saint's green cloak. Photomicrograph of the top surface of a paint sample. Ultramarine blue particles scattered in a matrix of lead-tin yellow ('type II') and lead white.

(i) Detail of red lining of sleeve, right-hand saint, showing patchy darkening of the vermilion.

(j) Detail of mordant gilding on hem of left-hand saint's cloak. The brown mordant is visible where gold leaf has been lost.



Plate 7 (Above) Nardo di Cione, *Altarpiece: Three Saints* (No. 581), after cleaning and restoration.

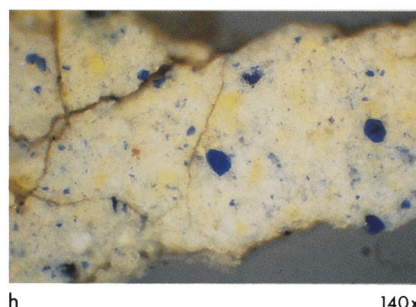
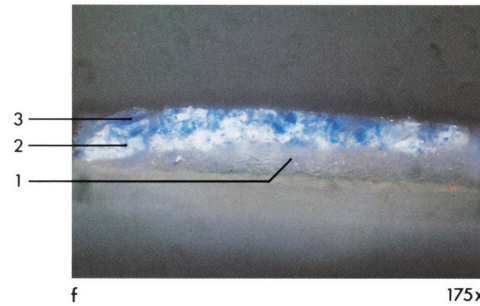
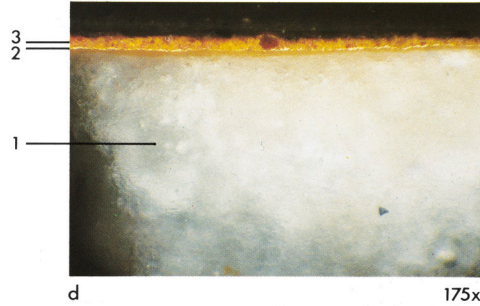
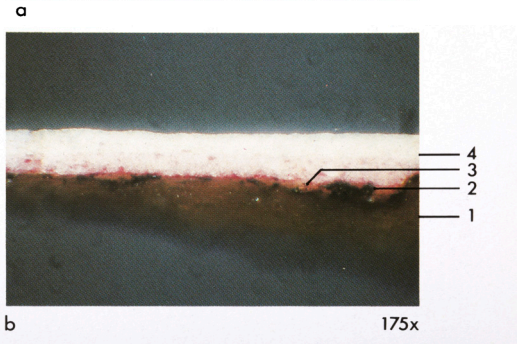
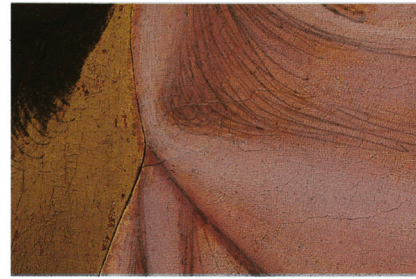


Plate 8 (Right) Nardo di Cione.
Full caption on facing page.

[...] do not work up so close to the verdaccio shadows as to cover them entirely; but work them out with the darkest flesh colour, fusing and softening them like a puff of smoke. And bear in mind that the panel needs to be laid in more times than a wall; but still not so much as not to need to have the green, which lies under the flesh colours, always show through a little.

Although no cross-section of flesh paint could be made in the case of the Nardo di Cione, it may be worth mentioning that one exists from the flesh of the Magdalen in a small panel by his brother, Orcagna, *Noli Me Tangere* (No. 3894). There the layer structure is quite complex with two layers of green undermodelling and two of flesh-coloured paint, the uppermost a pinkish layer containing vermilion particles. The green undermodelling of flesh in the Sassetta *S. Francis* panels was not the pigment green earth, but the greenish brown mixture made from black, yellow ochre and white pigments Cennini calls *verdaccio*.

Cennini concludes the directions for flesh painting with the addition of the brightest highlights, 'as over the eyebrow, or on the top of the nose' in pure lead white, the outlining of eyes, nostrils and mouth in black, and the accenting of all the details of the features in dark sinoper, meaning a dark brown earth pigment. This agrees quite well with what we see on the Nardo di Cione figures. The hair and beards seem to be painted last and the paint can be seen to go over the edges of the surrounding gold background and haloes and over the paint of the drapery at the shoulders and necklines. The green undermodelling is done for the beards and hair as well as for the flesh itself, as specified by Cennini in instructions for painting in fresco.

The paint medium: Concluding the passage describing the painting of flesh, Cennini exhorts the student of painting when working on panel to do:

[...] everything in general, as I showed you for a wall; [but] always using that yolk of egg tempera.

Four samples of paint from the Nardo di Cione *Three Saints* were analysed for medium by J. S. Mills using gas-chromatography. One was from the blue cloak of the saint on the right, another from the pink cloak of the centre saint. The third was from the orange background of the brocade floor covering, which is red lead applied on top of the gold leaf. All three gave typical chromatograms for egg. The fourth sample was from the mordant gilding of the blue cloak, comprising gilding and blue paint beneath. This sample gave an identical result to that for the other three, hence the difficulty of identifying the type of mordant, as explained above.

The matter of varnishing: The varnish removed in the recent cleaning was a readily soluble natural resin varnish, probably mastic dissolved in turpentine and applied in the nineteenth century. As mentioned above (p.25) the last record of varnishing was in 1887. Although no history of treatment survives before the picture was acquired by the National Gallery, it seems likely that it had been cleaned and revarnished, possibly more than once, before that time. Cennini's *Trattato* has a section devoted to varnish and varnishing. He says that before getting on to painting on parchment he would

like to 'look into the process of varnishing a panel or ancona and any other sort of job, except on a wall'.

He continues:

Know that the secret of the best and most beautiful kind of varnish is this: that the longer you delay after the painting of the panel, the better it is. I say emphatically: if you wait for several years, and at the very least for one, your work will come out fresher.

This view is further expounded:

Varnish is a powerful liquid, and it is revealing, and it wants to be obeyed in everything, and it cancels any other tempera. And immediately, as you spread it on your work, every colour immediately loses some of its resistance, and is obliged to yield to the varnish, and never again has the power to go on refreshing itself with its own tempera. And so it is a good plan to wait as long as you can before varnishing: for if you varnish after the colours and their temperas have run their course, they then become very fresh and beautiful, and remain pristine forever.

He even suggests a temporary 'varnish' of white of egg to protect the surface of the painting from dirt and dust until such time as it is deemed fit to varnish it with a resin varnish.

A detailed discussion of the type of varnish to which Cennini refers would be out of place here. Suffice it to say that, durability and ability to withstand washing, even scrubbing, was then regarded as desirable in a picture varnish. It is also likely that at the time the Nardo di Cione altarpiece was painted, varnishes then available would have consisted of natural resins for the most part dissolved in drying oils by means of strong heating. The 'Bolognese Manuscript', for instance, indicates that what was known in Italy as *vernice liquida* (*vernice* = solid resin, *vernice liquida* being the resin dissolved to make a varnish) was the resin sandarac boiled with linseed oil [21]. Such varnishes were probably quite viscous and Cennini recommends warming both varnish and picture and spreading the varnish with the hand or with a soft sponge with the picture lying flat.

When oil-resin varnishes of this sort discoloured with age, as natural resin varnishes inevitably do, it would have required drastic means to remove the tough polymerized film from the paint surface. Of early cleaning methods known, only caustic alkalis (a common one being ley, an infusion of wood ashes, which gives a dilute solution of potassium carbonate), or abrasives such as sand or powdered glass, would have been really effective and these would have been likely to damage the paint beneath. The almost perfect state of the paint surface of the Nardo di Cione altarpiece suggests that it can never have been subjected to such harsh cleaning methods. Perhaps it left the studio before it was ready for varnishing and, once *in situ* in the church for which it was intended, escaped varnishing until such time as there were readily available more easily-removable varnishes, the resin of which was dissolved not in drying oil but in a volatile organic solvent. Such varnishes are mentioned in the literature from the second half of the sixteenth century, for example *olio d'abezzo* (fir balsam) dissolved in *olio di sasso* (naturally occurring petroleum spirit) said by Armenini to have been used on their

works by Correggio and Parmigianino [22] or, more familiar to us, mastic in turpentine distillate as described in the 'Volpato Manuscript' [23]. Perhaps we can thank an oversight, or procrastination, for the excellent condition of the paint of the altarpiece.

The Nardo di Cione *Altarpiece: Three Saints* has been found in general to accord well with the account given by Cennini of materials and techniques employed in the mid- to late-fourteenth century, but with just a few intriguing and occasionally inexplicable variations.

Notes and references

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- THOMPSON, D. V., *The Craftsman's Handbook: 'Il Libro dell'Arte' of Cennino d'Andrea Cennini* (Yale 1933). Translated into English. The same author published an edition of the Italian text in 1932.
- WYLD, M. and PLESTERS, J., 'Some Panels from Sassetta's Sansepolcro Altarpiece', *National Gallery Technical Bulletin*, **1** (1977), pp.3–17.
- THOMPSON, D. V., *The Materials of Medieval Painting* (London 1936), gives a good summary of the processes and materials involved.
- The Italian text reads: 'un legname che si chiama arbero overo povolare'. D. V. Thompson translates this as 'a wood which is known as whitewood or poplar'. Whitewood is a very loose term which can be applied to any light-coloured wood, which poplar is when newly-cut. In the United States, Thompson's country of origin, it usually refers to poplar or related species, but in England it is used more often for light-coloured conifer woods, such as spruce (*Picea* sp.) Hence Thompson's translation of *arbero* as 'whitewood' is rather misleading to English readers. An explanation of the term is given in the first printed edition of the *Trattato*, that of Tambroni in 1821. In a footnote he explains that *arbero* and *povolare* both mean *pioppo* that is the modern Italian name for poplar, and adds that 'even today the Tuscans call poplar *arbero*'. (*Trattato della Pittura di Cennino Cennini* messo in luce la prima volta con annotazioni dal Cavaliere Giuseppe Tambroni (Rome 1821), p.98.)
- Thanks are due to Sir John Pope-Hennessy, Mr Keith Christiansen and Mr John Brealey for their kind cooperation in the examination of the Giotto 'Epiphany' in the Metropolitan Museum of Art, New York.
- MERRIFIELD, M. P., *Original Treatises Dating from the XIIth to the XVIIIth Centuries on the Arts of Painting*, 2 vols. (London 1849), Vol.II, p.468.
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- SKAUG, E., 'Punchmarks – What are they worth? Problems of Tuscan Workshop Interrelationships in the Mid-Fourteenth Century: The Oville Master and Giovanni da Milano', in *La Pittura nel XIV e XV Secolo. Il Contributo dell'Analisi Tecnica alla Storia dell'Arte*, a cura di Henk W. van Os e J. R. J. van Asperen de Boer, *Atti del XXIV Congresso Internazionale di Storia dell'Arte* (Bologna 1979).
- Lead was detected by LMA, and the powder pattern was found to be in agreement with JCPDS file No.8–19. The eight strongest lines in Angstroms of the XRD pattern for lead tetroxide (*minium*) are: **3.38** (100), 3.11 (20), **2.90** (50), 2.79 (50), 2.63 (30), 1.90 (20), 1.83 (20), 1.76 (30). Relative intensities in brackets.
- See p.21 for examples. A 'Madonna and Child' attributed to Cenni di Francesco di Ser Cenni has behind the figures looped-up curtains featuring the same bird and leaf pattern, the motifs adapted to fit the folds of the drapery. See FREMANTLE, R., *Florentine Gothic Painters from Giotto to Masaccio* (London 1975), p.383, fig.780.
- KIRBY, J., 'A Spectrophotometric Method for the Identification of Lake Pigment Dyestuffs', *National Gallery Technical Bulletin*, **1** (1977), pp.35–48, gives details of the history, sources, preparation and chemical constitution of red lake pigments of natural dyestuffs.
- BRUNELLO, F., *op. cit.*, p.90.
- KÜHN, H., 'Lead-tin yellow', *Studies in Conservation*, **13** (1968), pp.7–33.
- The only other occurrence so far of a green paint composed of a mixture of ultramarine and lead-tin yellow was identified in what seems to be a totally unrelated picture, Lubin Baugin, 'The Holy Family with SS. Elizabeth and John and Angels' (No.2293). Baugin (c.1610–1663) was a French painter who imitated Italian Renaissance painters.
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- RASTI, F., and SCOTT, G., 'The Effects of Some Common Pigments on the Photo-oxidation of Linseed Oil-based Paint', *Studies in Conservation*, **25** (1980), pp.145–56.
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- Thompson here translates as 'cotton' Cennini's *bambagia*, which, indeed, in modern Italian is the word used for cotton wool. It seems doubtful whether actual cotton was in use in Italy at this period, but Cennini uses *carta bambagina* for 'paper' (which would at this time imply paper made from linen rags), and this Thompson (note 1, pp.6–7) elects to translate simply as 'paper'.
- PLESTERS, J., ROY, A. and BOMFORD, D., *op. cit.*, p.172.
- MERRIFIELD, M. P., *op. cit.*, Vol.II, p.488.
- ARMENINI, G. B., *Dei Veri Precetti della Pittura* (Ravenna 1586), pp.128–9.
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