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Delight of men and gods: Christiaan Huygens's new method of printing

Eric Kindel

In 1669 Christiaan Huygens (1629–95), foremost Dutch mathematician, physicist and astronomer of his era, was living in Paris. Aged just forty, he was already nearly three years into his appointment to the recently established Académie royale des Sciences. That year, 1669, Huygens devised and tested a 'new method of printing' which he recorded in a single page of notes. It involved first scribing onto then etching through a thin metal plate to form a stencil from which copies could be made using a rolling press. It was intended, Huygens said, 'for printing writing and also for geometrical figures'.

Although some three and a half centuries have passed since its invention, Huygens's new method of printing and the tests he made of it generated a group of artefacts that survive among his papers at the University of Leiden. These, together with a series of letters and other contemporary records, offer a remarkably good view of the invention and what Huygens and others thought of it. In 1950, when much of this material was published in the *Œuvres complètes de Christiaan Huygens*, the new method of printing became more visible and accessible. But apart from a few cursory references to it (noted at the end of this study), the invention attracted little attention.

This remained the case until 2004 when the Universiteitsbibliotheek Leiden mounted the exhibition 'Christiaan Huygens, facetten van een genie: de manuscripten'.[1] It coincided with the arrival at Saturn of the NASA / European Space Agency Cassini spacecraft, together with its passenger Huygens probe planned for deployment to the surface of Saturn's moon Titan. Among the many artefacts and documents associated with Huygens shown in the exhibition were a selection of those relating to his new method of printing. In an article published that same year and dealing with stencilled liturgical books at the Universiteitsbibliotheek Amsterdam, Huygens's invention was also noted by J. A. A. Biemans, and it was from this source that I first learnt of it.[2]

After visiting Leiden in 2005 to study the materials of Huygens's invention, I made reference to them in only a limited way, in conference papers given with my frequent collaborator Fred Smeijers and

1. 'Christiaan Huygens, facetten van een genie: de manuscripten', 8 April – 31 May 2004, Universiteitsbibliotheek Leiden, curated by André Bouwman (http://bc.ub.leidenuniv.nl/bc/tentoonstelling/Huygens/index.html).

2. Biemans (2004), p. 441, n. 17.

in seminars with students. The new method of printing was taken as (welcome) confirmation of our assertions about how stencils were made in the mid-seventeenth century, in Paris, when their use for generating texts was becoming increasingly noticeable. But it was also understood that there was far more to the invention than we were drawing from it, and in late summer 2007 I resolved to address the matter with greater concentration.

What follows is the story that has emerged. I begin by sketching the numerous areas of work Huygens was pursuing in 1669 and where the new method of printing fits in. The invention and its artefacts are described and illustrated, and its effectiveness for producing and duplicating documents assessed. A different method of interpretation is then attempted through readings of the classical Latin texts Huygens quoted in several of the artefacts. Additional insights are drawn from contemporary contexts: in London, where Huygens learnt of a persistent interest among English *virtuosi* in new methods of printing and document duplication; and in Paris, where innovations in the production and multiplication of texts extended to efforts to mechanize forms of writing, including through the use of stencils. The study is completed with brief comparisons between Huygens's invention and similar methods proposed in the late eighteenth and early nineteenth centuries, methods that in turn pre-figure commercial stencil-duplicating devices patented and sold after 1870.

While the study is compact, it sets out a close analysis of Huygens's new method of printing, drawing mainly on primary texts and artefacts. At times I pursue narrative strands into lengthy notes, and I hope readers will be encouraged to follow me along these byways. My aim is to make a credible claim for Christiaan Huygens as an unexpected but noteworthy contributor to the technology of graphic communication and the fluent circulation of ideas and knowledge in seventeenth-century Europe.

PARIS, 1669

At the start of 1669 Christiaan Huygens was comfortably settled in his apartments above the King's Library on the Rue Vivienne,[3] provided for him under the terms of his appointment to the Académie royale des Sciences. He had arrived in Paris in the spring of 1666 to take up the post of 'scientific director' offered to him by Louis XIV through his minister Colbert. Huygens was one of just fifteen founding members of the Académie and the only foreigner among them (Fig. 1, opposite). The programme of work he embarked on following its first meeting in December 1666 was largely of his own

3. Opposite the present-day Bibliothèque nationale de France (Richelieu); the building no longer exists.

1a. Sébastien le Clerc, Members of the Académie royale des Sciences, Paris, engraving, 100×240 mm, from Claude Perrault, *Mémoires pour servir à l'histoire naturelle des animaux*, 1671. © British Library Board. All rights reserved. Shelfmark C.128.k.4.(1.).

1b. Detail of Christiaan Huygens; identification based on Watson (1939). The lens with which Huygens is examining an object may be one of his own. Watson does not name the figure who has placed a steadying arm around Huygens's shoulder: he may be a page.

devising, and his projects during this period were richly diverse. Those of 1669 would prove no different.

The year began with the completion of a set of rules relating to the motion of colliding bodies, compiled at the invitation of the Royal Society in London.[4] Other areas of work included studies in geometrical optics and mortality tables, and the construction of a 'mobile' keyboard capable of playing a 31-tone octave. In August Huygens read his 'Discours de la cause de la pesanteur' (Discourse on the cause of gravity) to the Académie, and in the months that followed was much occupied with its defence. He worked intermittently on the revision and expansion of his 1658 treatise on clock design, *Horologium*, a book that had helped establish his reputation. The planned new edition would be built on mathematical discoveries relating to curves and falling bodies from which had arisen innovations in the design of pendulums.[5] Other papers published in 1669 included new observations of Saturn adding to those already set out in his *Systema Saturnium* (1659).[6]

Apart from his published works and the mass of documents that accumulated around them and other projects, Huygens's interests and activities can be traced in letters to fellow virtuosi. One regular correspondent at this time was Henry Oldenburg, secretary to the Royal Society. Huygens was on generally good terms with the Royal Society: in sympathy with its pursuit of natural knowledge through observation and experiment, he had met many of its members on trips to London earlier in the 1660s, and in 1663, only a year after the Society's incorporation, was elected a Fellow himself. In their correspondence of 1669, Huygens and Oldenburg ranged over numerous topics of mutual interest, among them telescope and clock design, lens-grinding and glass manufacture, and the construction of concave mirrors for heating and melting. Oldenburg was also keen to get Paris news and Huygens obliged with updates on the royal *Observatoire* then under construction, and on the

4. Published as 'Règles du mouvement dans le rencontre des corps' (Rules governing movement in the collision of bodies), *Journal des Sçavans*, 18 March 1669 (Paris), and 'De motu corporum ex mutuo impulsu hypothesis', *Philosophical Transactions of the Royal Society*, vol. 4, no. 46, 12 April 1669 (London).

5. Published in 1673 as *Horologium Oscillatorium*.

6. 'Observation de Saturne …', *Journal des Sçavans*, 11 February 1669 (in English as 'An observation of Saturne', *Philosophical Transactions*, vol. 4, no. 45, 25 March 1669).

activities of the Italian astronomer Giovanni Domenico Cassini, recently arrived at the Académie. Huygens also reported on various of his own projects and in reply Oldenburg intermittently begged him to hasten publication of new findings. To one such plea Huygens admitted 'I wish I could apply myself to it [a new treatise] with a little more assiduity, but the variety and number of my occupations is a great impediment.'[7]

In these same letters Huygens informed Oldenburg that among his varied and numerous occupations he had also devised a new method of printing. Work on it probably got under way some time in April or May, since Huygens first mentions the invention in a letter of late May. A short paragraph about it reads as a modest addendum, though Huygens did include a printed sample. Mention is made in a second letter a month later, and another sample sent. A third letter of early August refers to it once more, then nothing.[8] Though brief, Huygens's remarks and Oldenburg's several replies to them supply a variety of insights into their understanding and estimation of the new method. When these are added to the surviving artefacts of Huygens's experiments, a quite coherent representation of the invention emerges. In the sections that follow, I will review these artefacts before looking more closely at the Huygens–Oldenburg correspondence and other matters thereafter.

A 'NEW METHOD OF PRINTING': TALLY OF SURVIVING ARTEFACTS

The artefacts of Huygens's new method of printing are listed below and illustrated in the pages following.[9]

Account

An account of the new method of printing,[10] headed 'Nova Chalcographiae ratio. Inventa Lutetiae Parisiorum A° 1669, a Chr. Hugenio'; single sheet of paper (verso only), pen written, autograph.

Test plates

Test plate 1,[11] brass (with a large copper component) or pure copper. Drawn and written marks have been scribed and etched through the plate. These include two short texts: the opening line of Lucretius's *De rerum natura* and 'MANIERE NOVVELLE DE GRAVER EN EAU FORTE' ([a] new method of engraving by acid); and two overlapping, compass-scribed circles of equal diameter. There is a black residue in some parts of the circles and spread over the right third of the plate; several breaks through the metal near the plate's left edge; and a few fragmentary fingerprints.

7. Hall & Hall (1965–86), vol. 5, pp. 450–3 (letter 1135), Huygens to Oldenburg, dated 20 March 1669 (Huygens: 'A Paris ce 30 Mars 1669' [N.S.]). The treatise in question, *Dioptrica*, was published posthumously (1703). See n. 34 for an explanation of 'N.S.' (New Style) dating of correspondence.

8. The entire sequence of correspondence is considered below (p. 22 ff.).

9. The artefacts form part of the *Codices Hugeniorum* housed in the Special Collections of the University Library, Leiden. Items are generally cited by manuscript number (prefix 'HUG') and folio; artefacts are also referenced in *Œuvres complètes de Christiaan Huygens*, mainly in vol. 22 (1950), pp. 233–5 (see also n. 13 below), though not all relevant items or multiples of them are listed. One item is at the Royal Society, London.

10. HUG 32, fol. 168.

11. HUG 32, 168 (1 of 2); illustrated in *Œuvres complètes*, vol. 22, p. 235.

Test plate 2,[12] brass. Script capitals A and B have been etched into the surface of the plate but not through it.

Printed samples

These are in various multiples, all single sheets of paper:

Sample 1, in two copies.[13] This sample carries a transcription from Virgil's *Georgics*.

Sample 2, in seven copies.[14] This sample carries an ode by Horace[15] beneath which is added, under a dashed line, 'MANIERE NOVVELLE D'IMPRIMER / C. H. Invenit Aº 1669'.

Sample 3, in three copies. Titled 'Problema Alhaseni', this sample is a solution to Alhazen's Problem and contains text, a geometrical diagram and pen emendations.[16]

CLOSER OBSERVATIONS (1): THE ACCOUNT

Huygens wrote the account of his new method of printing in Latin (Fig. 2, overleaf); it is rendered below in English.[17] The account can be divided into two parts: the first part [1] records Huygens's process of work, the second [2]–[5] his reflections on it.

A new method of printing. Invented in Paris in 1669, by Christiaan Huygens

[1] A very thin brass plate is covered on both sides with an equally thin layer of wax, heated by fire. It is written on with an iron point, and is then plunged into acid which wholly eats away the letters, leaving them open. The wax is then melted away with a flame. A coating of printing ink is applied to a thicker plate and the first plate is placed on it. A damp sheet of paper is placed on the thinner plate, soft leather is placed over this, and then a thicker cloth. The whole is then subjected to pressure in the copperplate engravers' press that consists of two cylinders. In this way a reproduction of the letters is obtained on the sheet of paper in their given order and position.

[2] A means must be found to make these plates perfectly flat; because, if they are not, they do not come out of the press undamaged. I must also ask how the very thin plates of tin are made that are used to cover mirrors with mercury. Perhaps these tin plates could be used just as they are.

[3] Printers' ink is no doubt too thick for our purpose, since it does not permit the pierced plates to which it is applied to be lifted from it without damage. It needs to be reduced in some way.

[4] The experiment should be made to see if a cloth impregnated with ink and placed beneath our pierced plate would work, since this would not require such pressure from the press.

[5] In writing the letters o, a, and some others, care must be taken not to join up the line, which cuts away the metal that is enclosed, so that o and a become wholly black; although this is not a serious matter.

12. HUG 32, 168 (2 of 2).

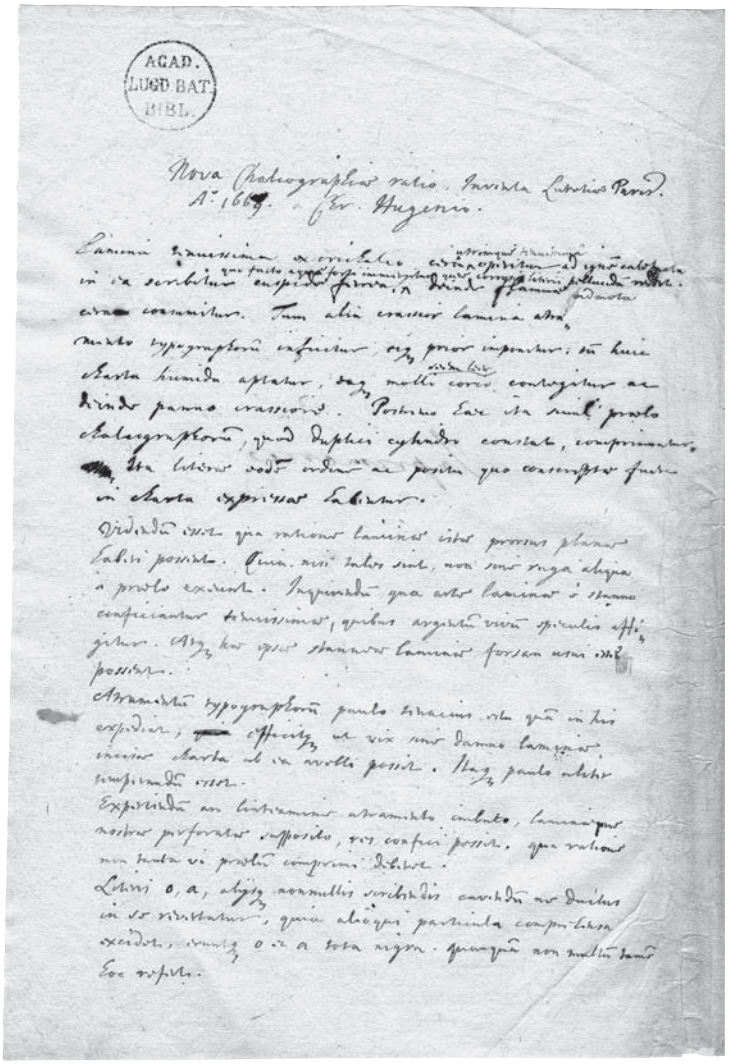
13. HUG 32, fols 177–178; fol. 177 is illustrated in *Œuvres complètes*, vol. 6 (1895), facing p. 440; fol. 178 is printed with the same matter recto and verso.

14. HUG 32, fols 170–176; one of these, probably fol. 170, is illustrated in *Œuvres complètes*, vol. 22, p. 234.

15. The texts from Horace, Virgil and Lucretius are cited in full and discussed below (p. 19 ff.).

16. HUG 32, fol. 169 and HUG 25, fol. 148; the latter is illustrated in *Œuvres complètes*, vol. 6, facing p. 462. A third copy is at the Royal Society, London, Cl.P/1/13; it was sent by Huygens to Oldenburg (cited below, n. 38). See the caption to Fig. 7 for an explanation of Alhazen's Problem.

17. The original Latin is transcribed in *Œuvres complètes*, vol. 22, pp. 233–4; its editors also supply a French translation. The English rendering here is by James Mosley; I have added paragraph numbers in brackets for reference.



2. Huygens's manuscript account of his new method of printing, ink on paper, 274×184 mm (irregular; note that 'irregular' dimensions, here and below, are given as maximums), 1669, Universiteitsbibliotheek Leiden, HUG 32, fol. 168.

Differences in handwriting between parts [1] and [2–5], namely of stroke contrast and ink density, show a change of both pen and ink, indicating that [1] and [2–5] were written at different times. (The differences are not so great, however, to conclude that two separate hands were involved.) The suggestion is that Huygens first noted down (or copied out) the process of work [1], then added observations and points for improvement subsequently [2–5]. Several emendations were also made to [1] at this later time, and the title and declaration of invention added at the top.

The scribing and initial etching stages described in [1] are largely unremarkable.[18] Etching *through* the plate, however, to form a stencil appears novel, as does the subsequent pressure transfer of ink through its cut-out parts. Yet in certain respects these latter stages are familiar: the stencil, once it is placed flat on the inked underplate, acts in effect like an incised surface from which the dampened paper, under pressure, draws up ink from the stencil's recesses – as in conventional copperplate printing. But an important difference remains: that with Huygens's method, the plate can be first scribed 'right-reading' rather than in reverse and still reproduce matter in its 'given order and position'.[19]

In [2]–[5], Huygens lists the problems and pitfalls of his method, together with ideas for how they might be improved on or avoided.

18. That is to say, the work of covering a warmed plate with 'wax' (the etch ground, though it is not clear if it is hard or soft), scribing the plate with an 'iron point' (an etching needle), etching with *aqua fortis* (using one of several possible recipes), and melting the wax away subsequently, do not appear out of the ordinary, as described and illustrated, for instance, by Bosse (Paris, 1645; full citation in n. 55).

19. Huygens fails to state that the stencil must nevertheless be placed face down on the inked under-plate (to form a reversed printing surface) in order that matter print right-reading; cf. letter from Oldenburg to Huygens (pp. 23–4, below) where Oldenburg does note the need to 'turn the plate'.

These notes suggest that Huygens undertook a first set of trials whose results pointed towards changes to be made (see also Fig. 2 caption); what is not clear is whether he completed any further trials. The caution voiced in [2], that the plates must be perfectly flat to avoid damaging them, probably refers to stresses they would experience under pressure which, if applied over an irregular surface, might crease the plate or open up fissures in it.[20] Huygens's other observations imply that the first version of his method was only partly successful. The issue of the ink's viscosity [3], for example, is significant: while thinning the ink may have held some advantages, the problem of the stencil plate sticking to the under-plate would have remained, making it difficult to peel the stencil up without damaging it each time the under-plate required re-inking.[21] Huygens's alternative of placing an ink-impregnated cloth behind the stencil [4] seems both workable and advantageous, since replenishing the printing surface in this way would render an (inked) under-plate redundant. And as Huygens predicts, less roller pressure would be needed to transfer ink through the stencil plate, thereby lessening the other likely cause of damage to it. Huygens's final caution not 'join up the line' of characters such as o and a when scribing them, and thereby cause the enclosed metal to fall away during etching [5], articulates the principal technical imperative of stencil characters which, if neglected, results in characters printing 'wholly black'.

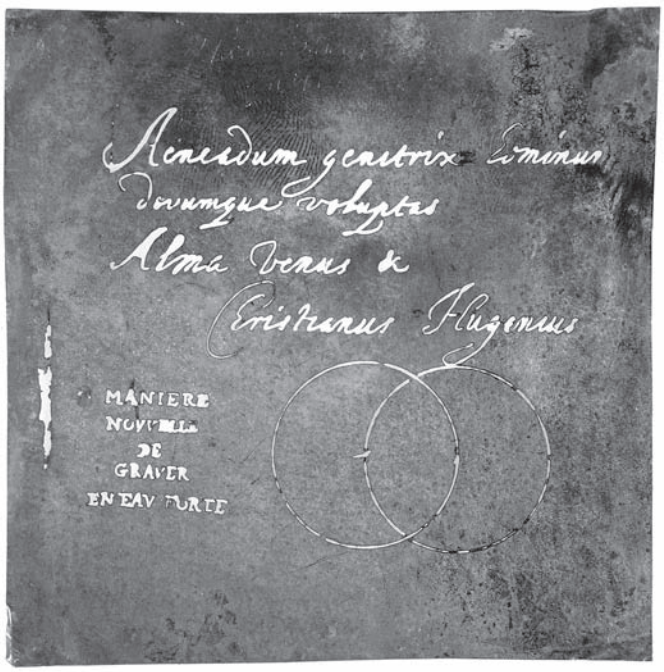
CLOSER OBSERVATIONS (2): PLATES AND SAMPLES

Turning to the otherwise successful test plate 1 (Fig. 3, overleaf), the characters o, a, and others, particularly among the centred capitals, suffer from joined up lines, caused both by the imprecise scribing Huygens warns of and by over-etching. But defects of this kind are 'not a serious matter', he concludes, and at least for the running script, one is apt to agree since they neither impair the script's legibility nor interrupt its demeanour and flow. One might indeed identify the defects as residue of the invention's most facilitating dimension: that the work of scribing matter right-reading on the plate did not require an expert engraver but might instead be done by someone less skilful – if also, therefore, more prone to faults.

The plates reveal other features of the work. Test plate 2 (not illustrated) may have been a false start: the contours of its script capitals A and B are ragged and distended, indicating an unsatisfactory etching action in which the acid bit laterally but not sufficiently downward. The incompatibility is not untypical of some acid-metal combinations and suggests that this combination was abandoned. Test plate 1 by contrast was successfully etched through to form a

20. Huygens's phrase is 'sine ruga aliqua', literally that they do not come out of the press 'without some kind of wrinkle'; cf. n. 22.

21. Peeling up the stencil from the inked, sticky under-plate would cause the small metal pieces within and around the cut-out characters to be bent outwards from the face of the stencil.



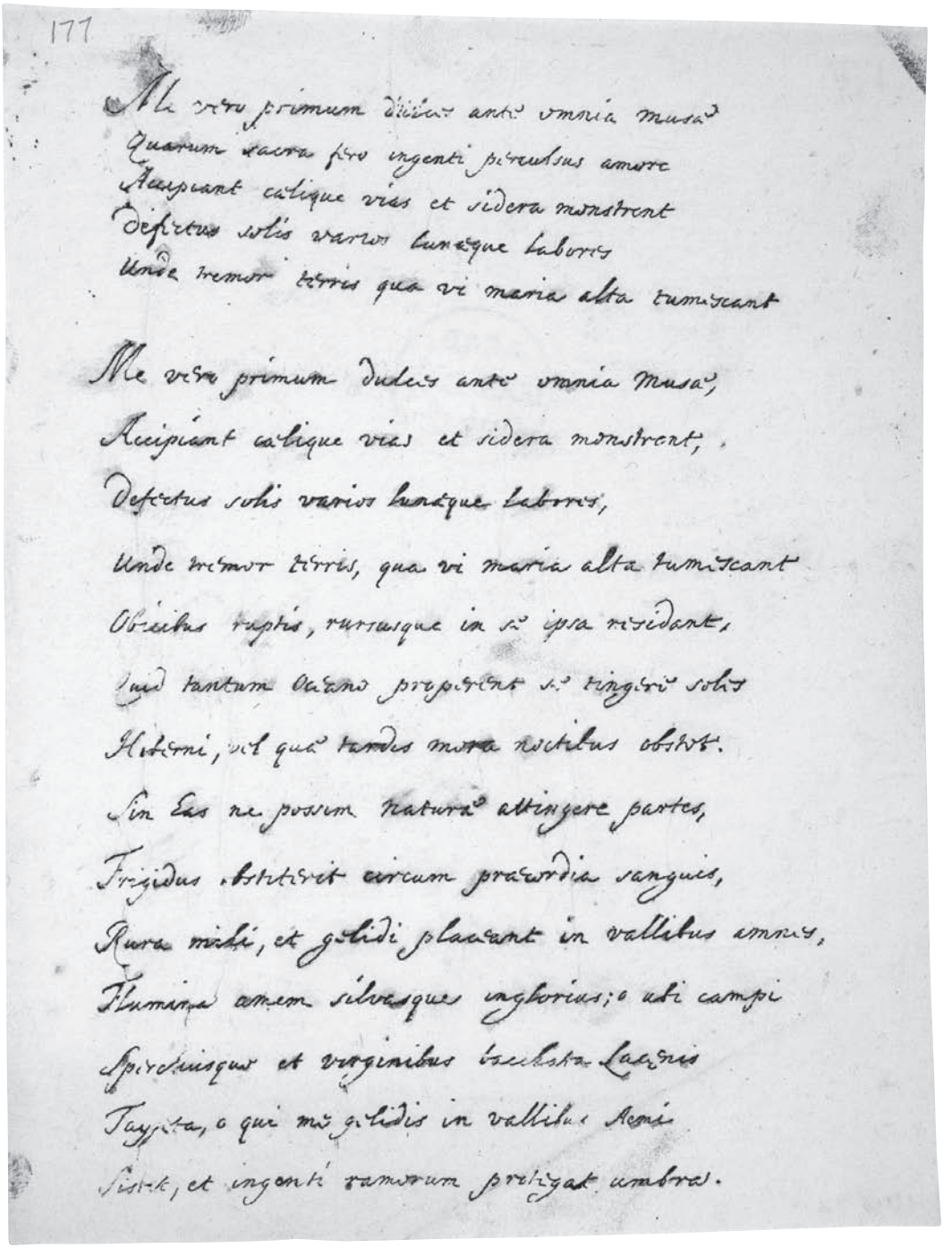
3. Test plate 1, etched copper, shown actual size (87×87 mm, irregular), 1669, Universiteitsbibliotheek Leiden, HUG 32, 168 (1 of 2).

stencil, though it was in all likelihood not used for printing since, as Huygens notes, to do so may have damaged it. The plate was instead probably retained as a demonstration and a record of work; its secondary text, 'maniere nouvelle de graver en eau forte', seems to reinforce its status as a specimen.[22] This text is suggestive in another way too: by referring to a 'new method of engraving', rather than to a 'new method of printing' (as worded in the Horace sample and in the account), Huygens seems to identify this part of the method – etching through a plate to make a stencil – as notable in its own right.

Turning to the samples, several features confirm them as having been printed by Huygens's new method: 'open' characters, with some filling in; breaks in the printed matter, in places completed with pen and ink; and ridges and creases in the paper formed by the pressure of the rolling press. Features of the samples individually reveal further dimensions of the work. Beginning with the Virgil (Fig. 4, opposite), it is set out in a running script whose overall effect is free and informal. The loops of b, e, and l are closed and so fill in. The sample's composition is irregular, even defective: its first five lines, for example, slope downward to the right and are variably spaced; the fault is resolved in the remaining fourteen lines, although their left alignment continues to waver down the margin.[23] Nor is the sample especially well printed: the first copy (fol. 177) suffers from smudging and imperfect ink transfer while the verso of the second (fol. 178) is considerably out of square. Darkened corners in

22. Notable too is the comment scribed almost imperceptibly on the front of the plate, probably after it was etched; it appears to read 'hac crassa nimis lamilla' (or possibly 'haec crassa nimis lamella'), that is to say, 'this little metal plate [is] too thick'. An excessively thick plate might explain the effect of over-etching, where the mordant has bitten too far laterally before piercing the metal. My thanks to Emma Aston and Matthew Nicholls for clarifying this phrase.

23. These compositional irregularities are accompanied by defects in Huygens's transcription. Although only fifteen lines from the *Georgics* are quoted, a total of nineteen appear on the sample. Having transcribed the first five lines of the passage, Huygens paused, left a gap, then began again at the first line, continuing through to the end but now omitting the second line; cf. n. 29.


177

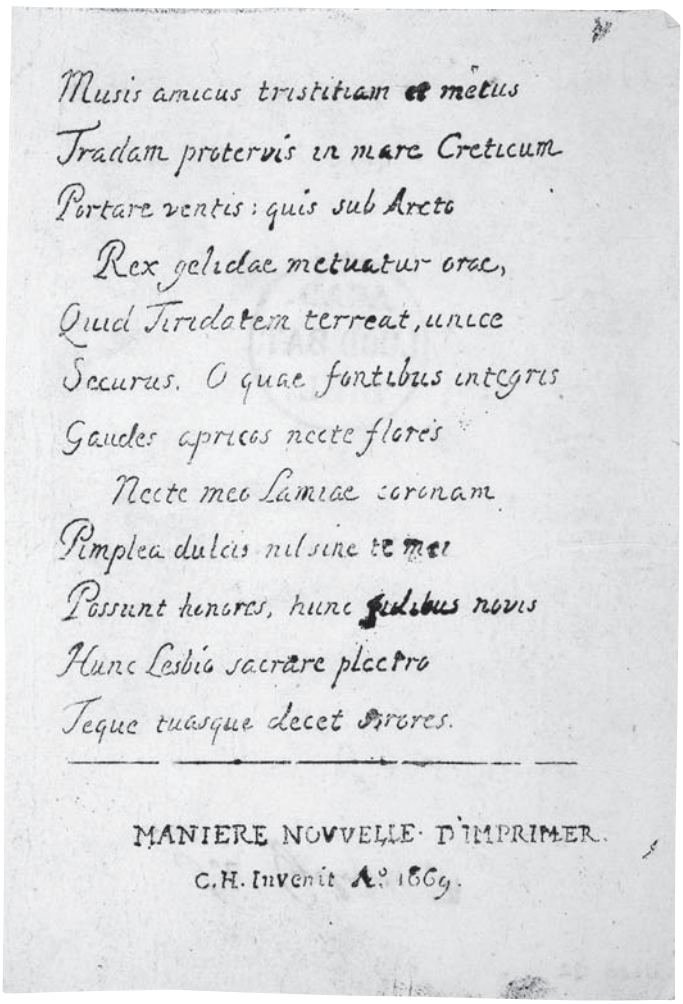
Me vera primum dulcis ante omnia Musæ
Quarum sacra fero ingenti perculsus amore
Accipiant cælique vias et sidera monstrent
Defectus solis varios lunæque labores
Unde tremor terris qua vi maria alta tumescant

Me vera primum dulcis ante omnia Musæ,
Accipiant cælique vias et sidera monstrent,
Defectus solis varios lunæque labores,
Unde tremor terris, qua vi maria alta tumescant
Obicibus ruptis, rursusque in se ipsa residant,
Quid tantum Oceano properent se tingere soles
Hiberni, vel quæ tardis mora noctibus obstet.
Sin Eas ne possim naturæ accedere partes,
Frigidus obstiterit circum præcordia sanguis,
Rura mihi, et gelidi placeant in vallibus amnes,
Flumina amem silvasque inglorius; o ubi campi
Spercheusque et virginibus bacchata Lacænis
Taygeta, o qui me gelidis in vallibus Hæmi
Sistat, et ingenti ramorum protegat umbra.

4. Sample 1, Virgil, *Georgics* 2.475–89, ink on paper, shown actual size (184×137 mm, irregular), 1669. Universiteitsbibliotheek Leiden, HUG 32, fol. 177.

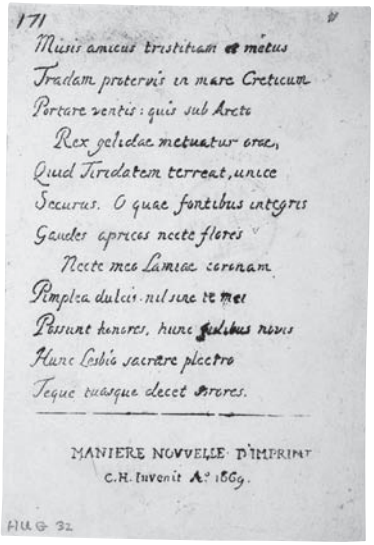
the upper-right of both samples reveal where the exposed underplate printed beyond the stencil's angled edge.

The Horace sample (Fig. 5) appears more considered. Although Huygens's script employs some cursive features, its characters do not run together but are instead carefully separated. Loops in b, e, l, and elsewhere are avoided and none fill in. Character spacing is more measured, as are inter-linear spaces. The left marginal alignment is precise with two terminal stanza lines deliberately indented. There are, admittedly, imperfections where ink has apparently spread over the stencil to spoil some characters, though one wonders if here Huygens was experimenting with a thinner ink, an alternative means of ink transmission, or both. But, overall, the sample offers sufficient proof that its composition and scribing were well planned and deliberate, even if its printing lacked full control.


Musis amicus tristitiam et metus
Tradam protervis in mare Creticum
Portare ventis: quis sub Arcto
Rex gelidae metuatur orae,
Quid Tiridaten terreat, unice
Securus. O quae fontibus integris
Gaudes apricos nocte flores
Nocte meo Lamiae coronam
Pimplea dulcis nil sine te mei
Possunt honores, hunc fidibus novis
Hunc Lesbio sacrare plectro
Teque tuasque decet sorores.

MANIERE NOVVELLE· D'IMPRIMER.
C.H. Invenit Anº 1669.

5a. Sample 2, Horace, *Odes* 1.26, 'Ode to Lucius Aelius Lamia', ink on paper, shown actual size (131 × 89 mm, irregular), 1669. Universiteitsbibliotheek Leiden, HUG 32, fol. 170.



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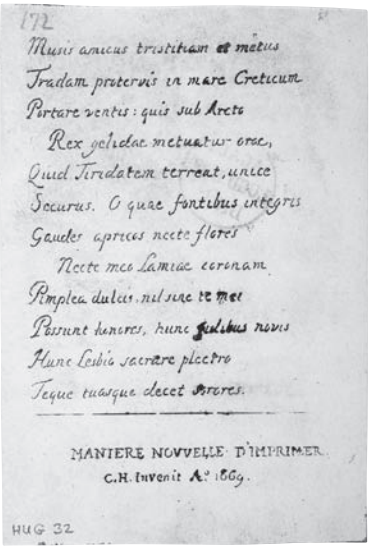

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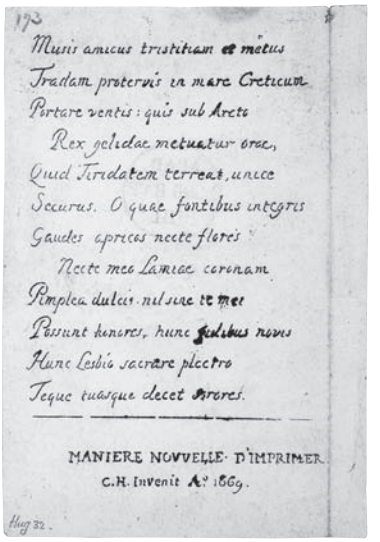

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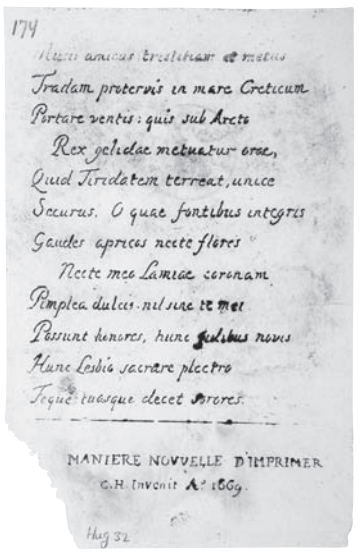

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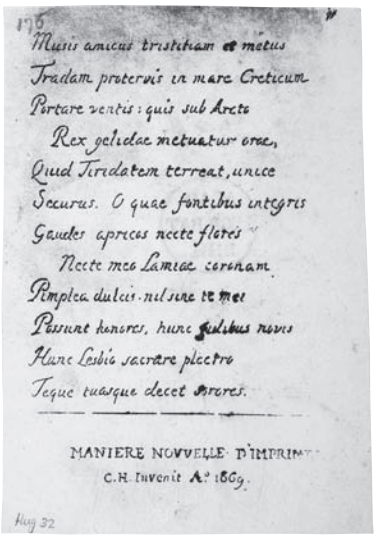
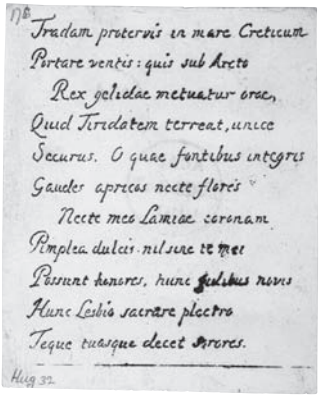


f



g

5, b–g. Sample 2, Horace, *Odes* 1.26, 'Ode to Lucius Aelius Lamia', ink on paper, reduced to 55% (linear), (all dimensions irregular), 1669. Universiteitsbibliotheek Leiden, HUG 32, fols 171–176.

b. Fol. 171, 130×88 mm

c. Fol. 172, 132×90 mm

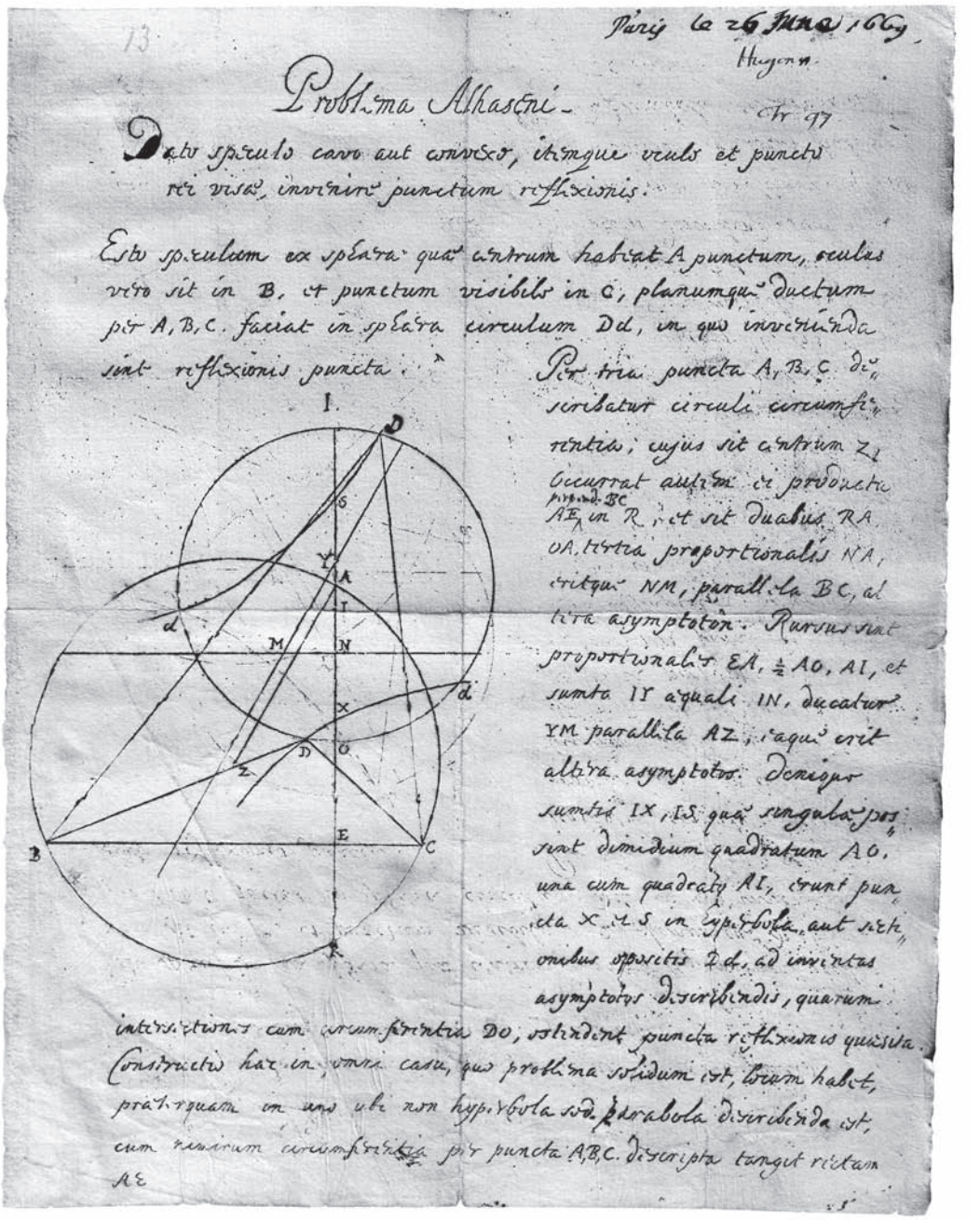
d. Fol. 173, 129×88 mm

e. Fol. 174, 131×85 mm

f. Fol. 175, 127×89 mm

g. Fol. 176, 94×77 mm

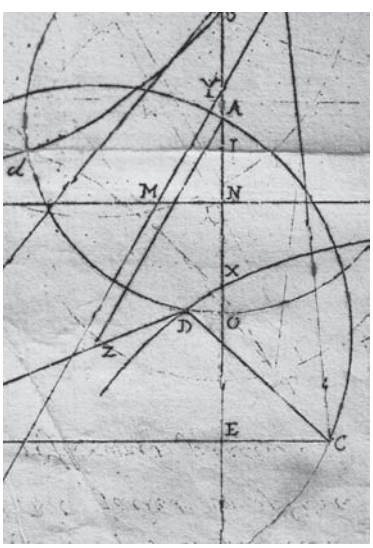
The Problema Alhaseni sample (Figs 6–7) is by some distance the most complex of the three, both in composition and in its attendant faults. Like the others, it employs a cursive script. Its characters are more carefully formed and less frequently joined than in the


Parij le 26 June 1669
Huygens
13
Problema Alhasseni.
Ctr 97
Dato speculo cavo aut convexo, itemque vculo et puncto rei visæ, invenire punctum reflexionis.
Esto speculum ex sphæra quæ centrum habeat A punctum, oculus vero sit in B, et punctum visibile in C, planumque ductum per A, B, C. faciat in sphæra circulum Dd, in quo invenienda sint reflexionis puncta.
Per tria puncta A, B, C describatur circuli circumferentia, cujus sit centrum Z, occurrat autem ei producta per A, BC AE, in R, et sit duabus RA, OA, tertia proportionalis NA, cuique NM, parallela BC, ad latus asymptoton. Rursus sint proportionales EA, ½ AO, AI, et sumto IY æquali IN, ducatur YM parallela AZ, cui æqui erit altera asymptotos. Denique sumtis IX, IS, quæ singulæ post sint dimidium quadratum AO, una cum quadrato AI, erunt puncta X et S in hyperbola, aut sectionibus oppositis Dd, ad inventas asymptotos describendis, quarum intersectionem cum circumferentia DO, solvident puncta reflexionis quæsita.
Constructio hæc in omni casu, quo problema solidum est, locum habet, præterquam in uno ubi non hyperbola sed parabola describenda est, cum nempe circumferentia per puncta A, B, C. descripta tangit rectam AE

6a. Sample 3, 'Problema Alhaseni', printed sample, ink on paper, 205 × 162 mm (irregular), reduced to 83% (linear), 1669, Royal Society, London, Classified Papers, Cl.P/1/13; sent by Huygens in his letter dated 26 June 1669. © The Royal Society.

Virgil (but not to the same extent as they are in the Horace), though closed loops remain that in many instances fill in. Numerous breaks occur among the lines and curves of the diagram which in the London copy have been completed with pen and ink (Fig. 6, b–c);[24] Huygens has also fixed several faulty letters and inserted a short text emendation. Heavily printed bands along the top and bottom of the Leiden copies (Fig. 7) are caused by ink extending beyond the stencil; these are absent from the London copy and were presumably trimmed away before Huygens sent it. Finally, the London copy shows fragments of text and diagram that have offest faintly, upside-down and in reverse onto the paper, caused when the sample was folded in half horizontally.

Gathering the samples together, it is tempting to propose an order of completion. The Virgil, the most provisional of the three compositionally, was perhaps made first with the others following on as evident improvements. There is no irrefutable evidence for this, though it is possible to assert that the Problema Alhaseni was in all likelihood *not* printed first, for reasons given below (n. 38). There is also a related question: did Huygens actually undertake this work himself? Several clues indicate that he did in large part. The scripts of the samples and test plates are Huygens's own, as can be confirmed by comparison with examples of his fair hand. Whether he cut the plates, applied the wax, etched the plates and, thereafter, rolled out the ink, layered the plates, paper and leather, and pulled



b

c

6, b–c. Sample 3, 'Problema Alhaseni'.
b. Detail of Fig. 6a.

c. Position of ink emendations in (b).

7. Sample 3, 'Problema Alhaseni', ink on paper, 228 × 167 mm (irregular), 1669. Universiteitsbibliotheek Leiden, HUG 32, fol. 169.

Alhazen's Problem is named after the Arab/Persian polymath Ibn al-Haytham (AD 965–1038/9) who made foundational contributions to the study of optics, physics, astronomy and many other fields. Neumann (1998), p. 523, summarises the problem: 'given a spherical mirror and points A, B in space, how can a point P on the mirror be found, where a ray of light is reflected from A to B? [These are points B, C, D, respectively, in Huygens's construction.] Since P must lie in the plane containing A, B and the centre of the sphere [Huygens's point A], this is really a two-dimensional problem: given a circular mirror and points A, B in its plane, find the point on the circle where a ray of light is reflected by the mirror from A to B.'

24. Approximately half of the breaks in the Leiden samples were filled in.

these through the press is more difficult to establish. Huygens does not say that he did, in so many words, but his reflections on the sum of issues arising from the trials surely point to his involvement at every stage of the work.[25]

FURTHER THOUGHTS

These observations of Huygens's account and artefacts lead one to conclude that his new method of printing worked promisingly, if not yet perfectly. They also give rise to further thoughts about its efficacy, limitations and underlying nature.

In a letter written during or soon after his trials (cited and discussed below), Huygens claimed that when using his new method 'you can both quickly engrave and print'. Huygens's sense of 'quickly' (*promptement*) may be taken in two ways, each relative to other options: first, in the sense of 'immediacy', as it would seem by comparison to commissioning, instructing and seeing work through the *ateliers* and workshops of engravers and printers; and second, literally, as a description of the speed of preparatory work and printing. If the first can only be roughly described (probably in days), the second can be more closely approximated: to cut, coat, scribe (plan, configure, execute) and etch a plate of some complexity, such as the Problema Alhaseni, would likely take several hours. Once the etched plate was readied and set in position on the inked under-plate, pulling multiples on the press might in itself go quickly, though interruptions for re-inking would slow the work, while damage to the plate could scupper it altogether.[26]

This last named issue, damage to the plate and its effect on the speed of work, points to a corollary: durability and, in turn, its effect on the consistency and potential length of the 'run' of printing. Durability issues clearly worried Huygens, and he implies that plates were indeed damaged during the trials. The problem, caused by roller pressure and too-sticky printer's ink, prompted his alternative ink-impregnated cloth in place of the inked under-plate. If tried, it would very probably have reduced the risk of plate damage as Huygens predicted, and increased the speed of work (through less frequent and risky re-inking) and quite possibly the consistency of impression (through better regulated ink delivery). Many of Huygens's samples do lack sharpness and consistency of impression, and are marred by spreading ink, blotted characters, inky fingerprints and offset matter. While these faults may in large part be assigned to the conditions of experimenting or a lack of experience in the possibly do-it-yourself printing operations, some of the

25. Leopold (1979), discussing Huygens's lens grinding and instrument making activities, addresses the extent to which he undertook 'mechanical' (i.e. hand-) work himself or left it to others. The issue is two-fold: of inclination and social standing. Huygens, for example, generally did his own detailed lens grinding but relied on others to rough out their shapes, while innovations in clock, telescope and microscope construction conceived by him and recorded on paper were frequently worked out in practice by others. In some instances it is clear that attitudes associated with Huygens's elite social position compelled him to remain aloof from the mechanician's domain. Evidence cited above, however, strongly indicates his close involvement in work on the new method of printing.

26. Gaskell (2004), pp. 220–1, discussing conventional copperplate printing, offers evidence for speed of work, and highlights re-inking as the principal delaying operation.

samples – the Problema Alhaseni in particular – demonstrate that relatively clean multiples could be achieved with only minor variations and in presumably sufficient numbers.

The methods of working and the configuration of Huygens's invention also merit general comment. In its first iteration the invention was largely determined by existing methods and technologies of engraving and etching.[27] While this is hardly surprising, Huygens's reflections on how he might make it better also show that the invention could be improved on when the restrictions of the existing paradigm were recognized and alternatives considered. Thus apart from the main innovation of creating a printing surface with a stencil, Huygens's thoughts on alternative stencil materials, and on the composition of his ink and its means of delivery (and even the possibility – only implied – of dispensing with the rolling press altogether since it delivered too much pressure and damaged the plates) point to developments that might have taken the invention away from (copperplate) printing as conventionally understood, and towards new configurations of material and equipment more suited to the kind of document production he was after.

ANOTHER APPROACH: LATIN TEXTS

Having considered the artefacts of Huygens's invention individually and as constituents of a specific process of work, they can, in the case of two of the samples and the stencil plate, be approached from a wholly different angle: through their Latin texts. By exploring the possible meanings these texts hold, observations can be advanced about points they have in common, whether they correlate in any way with their associated artefacts, and why Huygens may have chosen them.

Beginning with the Virgil, Huygens has extracted a quite particular passage from the second book of the *Georgics*.[28] Almost uniquely in the poem's four books cataloguing the pleasures and hardships of rural living, Virgil pauses to reflect at length on his 'imagination at work'. He petitions the Muses to lift him up from 'mere georgic didacticism' into a grander, scientific understanding of nature:

> But as for me, first before all may the sweet Muses, whose holy emblems I bear, receive me, stricken with a mighty love, and show the ways and stars of heaven, the varying settings of the sun and the efforts of the moon, whence the earth quakes, with what force the deep seas swell and break their barriers and sink back again into themselves, why winter suns are in such haste to dip themselves in the ocean, or what delay stands in the way of slow nights. (475–82)

27. It is worth repeating that despite generating a stencil, Huygens, in combining it with the inked under-plate, effectively returned to an intaglio printing surface.

28. Virgil, *Georgics* 2.475–89. The interpretation of Virgil's text that follows is based principally on Putnam (1979), pp. 145–50; quotes and translations are from this source. I have also drawn on Jones (1992), pp. 81–3.

Though impassioned, Virgil is also equivocal about the poet's ability to respond and rise fully to the lofty themes arrived at through understanding of this kind. In the remaining lines, therefore, he retrenches: that if the Muses should withhold enlightenment of the intellect, one may yet embrace nature's mythic landscapes and take from them pleasure and sensual delight:

> But if the chill blood around my heart bar me from the ability to approach these aspects of nature, may the countryside and streams flowing through valleys please me; may I, though I lack fame, love rivers and woods. O for the plains and Spercheus and Taygetus with its revels of Spartan girls! O for someone who might place me in the cool dells of Haemus, and shield me with the mighty shade of branches! (483–9)

In choosing these lines, one is tempted to ascribe to Huygens a like disposition. Though tenable, the ascription should be made cautiously. More to the point is the absence of any obvious correlation between Virgil's text and the new method of printing, while the physical evidence of the sample itself – its apparently rapid transcription, composition and unpractised printing – suggests only an early phase of work. The text, by extension, was perhaps chosen in these same circumstances, instinctively, and as one that could be recalled from memory, if not entirely reliably.[29] One might observe, therefore, that here text, method and artefact are comparably (or indeed coincidentally) provisional, but little more.

Turning to the Horace sample, however, one can find seemingly closer links between text, method and artefact. Huygens's chosen ode[30] begins by announcing Horace's intention to banish anxiety and political concerns to a far off place:

> Dear to the Muses, I shall abandon sadness and fear to the fierce winds to carry off to the Cretan sea, singularly unconcerned as to what king of the frozen lands under Arcturus we fear, or what dangers Tiridates dreads.

The ode then continues with Horace's petition to his Muse for a crown with which to immortalize his friend Lamia:

> O you who rejoice in untouched springs, weave together sunny flowers, weave a crown for my Lamia, sweet Muse. Without you my praises are worth nothing. It is only right that you and your sisters consecrate him in new measures, consecrate him with a Lesbian song.

The crown, or garland, here (and not uncommonly in Latin verse) refers to a poem, *this* poem, though in asking the Muses to weave a

29. Andriesse (2005), p. 58, reports that in 1639, Huygens, aged just 10, read the *Georgics* three times. It is difficult to gauge the significance, if any, of Huygens's subsequent omission of the second line (476: '… Muses, / whose holy emblems I bear, receive me, stricken with a mighty love') from the sample after having included it in the first five lines transcribed (see n. 23). It may simply be an error of haste.

30. Horace, *Odes* 1.26 ('Ode to Lucius Aelius Lamia'). For this ode, I have drawn on commentaries by Commager (1995), pp. 326–8, from which the translation that follows is also taken; West (1995), pp. 120–3; and Nisbet and Hubbard (1970), pp. 301–9.

crown, Horace seeks from they who 'rejoice in untouched springs' not only poetic inspiration but originality. The crown/poem, ostensibly to consecrate Lamia 'in new measures', in fact serves Horace: it immortalizes his innovations and offers proof to posterity that he was indeed dear to the Muses.

The circularity of this poem about poetry, one that solicits inspiration and by its very composition illustrates the gift, maps well onto the requirements of Huygens's sample. As a demonstration of a method of making – a *specimen* – the sample, like the poem, is self-reflexive: it is a document about itself. Similarly, the sample's stated new method ('Maniere nouvelle d'imprimer') is a claim to originality, proof that Huygens, like Horace, is dear to the Muses; meanwhile, its declaration of inventorship ('C. H. Invenit A° 1669') immortalizes Huygens's name.

In the third of his adopted texts, Huygens has scribed onto his test plate the opening line of Lucretius's *De rerum natura*, 'Aeneidum genitrix hominum divumque voluptas Alma Venus',[31] appending an '&', to be read as 'and so forth', thus:

> Mother of Aeneas and his race, delight of men and gods, life-giving Venus[, it is your doing that under the wheeling constellations of the sky all nature teems with life, both the sea that buoys up our ships and the earth that yields our food. Through you all living creatures are conceived and come forth to look upon the sunlight. …][32]

Lucretius has begun by identifying Venus – nature – as *the* vital force, the conceiver of life in which men delight, including, one might propose, Huygens too. The addition of his name below the transcription certainly suggests this. And while the various elements cut from the plate otherwise serve simply to demonstrate his 'new method of engraving' as suitable for written matter and geometrical figures, the pair of overlapping circles are at the same time suggestively emblematic, illustrating a kind of duplication or propagation wholly appropriate both to the chosen text and to the plate's function.

Taken together, a surface reading of Huygens's chosen texts reveals common features among them: a valuation of the natural world and knowledge of its workings, but also the anticipation of its pleasures to be enjoyed purely, simply and without anxiety. Equally, they celebrate the gift of inspiration and originality, for which the Muses are petitioned or nature's conceiving force invoked. Beneath this surface, if read philosophically, Huygens's texts articulate attitudes that are identifiably Epicurean: the search for a scientific understanding of nature (Virgil), the effort to free oneself from the worries

31. Lucretius, *De rerum natura* 1.1.

32. Lucretius (1951), p. 27. While the appended '&' on the test plate might be read as 'and', thereby coupling Huygens's name to that of Venus (see Fig. 3), his use of this symbol elsewhere indicates that he indeed meant 'and so forth'. My thanks to Joella Yoder for clarifying this point.

of political machination (Horace), and the worship of Venus/nature whose invocation prefaces the Epicurean universe constructed thereafter (Lucretius).[33] Read 'technically', the texts seem articulate in other ways, too, hinting at or announcing the status or function of the artefacts that carry them. While the latter is clearly speculative, it yet seems reasonable to assert that for someone to whom the ancient Latin authors were alive and relevant, Huygens was aware of how these texts might resonate in the artefacts of his new method of printing.

AN INVENTION SHARED

As briefly described in the introduction, Huygens did not keep his new method of printing to himself but instead sent news of it and two samples to the Royal Society in London. His correspondent was Henry Oldenburg (Fig. 8, opposite) who, as secretary to the Royal Society, handled much of its communications with virtuosi around Europe. Oldenburg found Huygens's invention intriguing and relayed the latter's remarks about it to the Society's fortnightly gatherings and, in turn, conveyed the reactions of its Fellows back to Huygens in Paris. It is of considerable interest to follow the progress of this correspondence and relate it to the minutes of meetings where Huygens's method was discussed.

Huygens first mentions his new method of printing in a letter to Oldenburg dated 29 May 1669.[34] In it he writes:

> To give you new invention for new invention, I send you a sample of my new printing process in the leaf you see here. It is intended for printing writing and also for geometrical figures. It is cheap, and you can quickly both engrave plates and print. Your Fellows will not find much difficulty in guessing how it is done; otherwise I shall provide an explanation if they wish.[35]

At the next meeting of the Royal Society twelve days later, the minutes record that

> Mr Oldenburg read a letter [sent] to him from Monsieur Huygens dated at Paris May 29, 1669, N.S., containing … his offer of communicating to the society a new way of his own contrivance to print things written and geometrical figures with little cost and great expedition; a specimen of which accompanied this letter.
>
> Mr. Oldenburg was desired to return the society's thanks to Monsieur Huygens, and to acquaint him, that there were several members, who had upon this occasion affirmed, that they had inventions of the like nature, of which trials should be made, and a specimen sent to him; and that he should thereupon be requested to communicate his method.[36]

33. For a summary of Epicurean philosophy, see (e.g.) Mautner (1996), pp. 130–1; for a concise and readable introduction to Epicurus, see (e.g.) Freeman (1938). Lucretius is Epicureanism's principal Latin adherent and *De rerum natura* his surviving masterwork. In identifying the Epicurean dimensions of the three texts, I am not suggesting that Huygens espoused Epicureanism, either as moral or natural philosophy. It may be that, apart from the sentiments these texts express, Huygens's attraction to them simply echoes the wider contemporary – and, in certain spheres, fashionable – interest in Epicureanism and in *De rerum natura* as a very literate expression of it. This interest in Epicureanism was integral to the revival of ancient Greek atomism over the course of the seventeenth century, a revival that brought innovations of considerable importance to natural philosophy; among the ancient atomists, Epicurus attracted the most attention and study, notably in the work of Pierre Gassendi.

34. Royal Society, EL/H1/63; *Œuvres complètes*, vol. 6, p. 440 (no. 1738); Hall & Hall (1965–86), vol. 5, pp. 554–8 (letter 1180). Huygens and Oldenburg corresponded in French; the English translations drawn on here are from Hall & Hall. The dates of Huygens's letters are 'N.S.' or New Style, i.e. according to the reformed Gregorian calendar not yet adopted in England; unreformed dates used by Oldenburg and the Royal Society are ten days earlier. The *Œuvres complètes* and Hall & Hall employ the latter, citing this letter as '19 May 1669'.

35. The sample leaf Huygens mentions ('un eschantillon de ma nouvelle Imprimerie dans le feuillet que vous voiez') is not extant among Royal Society materials. Remarks (above) about the status and function of the Horace sample suggest that it, rather than the Virgil, was the more appropriate for announcing the new method of printing publicly. Huygens did, however, send the Virgil sample to his brother Lodewijk in a letter written two days later, on 31 May. In it, Huygens said: 'These verses from Virgil that you see here are printed in a new way which I have invented and which I intend to improve on. It is cheap and the plates as well as the printing are done quickly and easily. There is no method other than this one for printing writing. You will be able to guess its secret easily enough, otherwise I can explain it to you, and will do so when you like.' *Œuvres complètes*, vol. 6, pp. 441–2 (no. 1739); original in French.

36. Birch (1756), vol. 2, p. 376, minutes of the 27 May 1669 meeting.

Four days on, in his next letter to Huygens, Oldenburg conveyed an account of the meeting:

> Our Fellows have ordered me to return you thanks for the sample of your new method of printing which you were pleased to send to us, as also for your offer to explain the process.
>
> A certain number among them say that they have inventions of the same kind, of which trials will be made as soon as possible in order to send you a sample. And when this trial has been made you will be invited to impart your method to us. By one of our methods, Sir [William] Petty's, as many copies as one chooses may be printed while the book is on sale; and after an edition has been sold out it is possible to print a second, a third, and so on to any desired number. Perhaps from these details, which I here give you, you will guess what it is. I believe that Mr. [Christopher] Wren has another method which is perhaps similar to yours; since you two have the same turn of mind you sometimes hit upon the same truly ingenious discovery.
>
> I do not know whether your method will print as many copies as one wishes, whether one can print with it matter that is printed already, and whether ordinary printer's ink is used. You will, if you please, inform us on these points.[37]

8. Henry Oldenburg, portrait by Jan van Cleef, 1668, oil on canvas, 838×635 mm. © The Royal Society.

A little over two weeks later, Huygens replied to Oldenburg and included another sample in his letter.

> While awaiting the attempts of those among you concerned with printing, I shall say nothing more (since you do not wish it) of my invention, although by the sample which I sent you it may, with care, be pretty easily found out, and I think that Mr. Petty's design is not very different from it, to judge by the effects which he promises for it. I wanted to try to print geometric figures also by this method; this succeeded only fairly well as you will see by the example I send you containing the construction for a problem which I solved lately and which our mathematicians thought pretty elegant.[38]

Huygens's reply and sample were duly presented at the Society's next meeting on 1 July, and recorded in the minutes:

> Mr. Oldenburg read a written letter [sent] to him by M. Huygens from Paris [dated] June 26, 1669, N.S., containing … another proof of his new way of printing, which proof was made by a geometrical figure.[39]

Again, four days later, Oldenburg conveyed news of the meeting to Huygens, and a rather feline request for him to now reveal his method:

> I have shown our Fellows the geometrical figure which you have printed by your new method. They ordered me to return you thanks, and Mr. Wren conjectures that you use the following method:

37. HUG 45 (Oldenburg folder, no. 19); Royal Society, EL/O1/117; *Œuvres complètes*, vol. 6, p. 444 (no. 1742); Hall & Hall (1965–86), vol. 5, pp. 580–4 (letter 1196); letter dated 31 May 1669. Oldenburg had copies made of his outgoing correspondence, hence the survival of letters in both Leiden and London.

38. Royal Society, EL/H1/64; *Œuvres complètes*, vol. 6, p. 460 (no. 1744); Hall & Hall (1965–86), vol. 6, pp. 42–6 (letter 1213); letter dated 16 June 1669 (Huygens: 'A Paris ce 26 Juin 1669'). The 'example' Huygens sent was the Problema Alhaseni; that Huygens did not send it together with the other sample included in his letter dated 29 May suggests that it was not the first sample to be printed (cf. discussion above, p. 17).

39. Birch (1756), vol. 2, pp. 387–8.

> Taking a brass plate as thin as paper you cover it with a varnish suitable for engraving and have the design drawn on that (taking care not to close up the letters) with such strong nitric acid as quite to pierce the brass. When this is done you turn the plate, putting it on another which is thicker and entirely coated with printer's ink; and then you pass it through a rolling press in the usual way. You will please tell us if Mr. Wren has described this correctly or not. Sir William Petty's method is different; but as he is not in England I have not permission to reveal it at present.[40]

A little over three weeks later, Huygens obliged:

> As for my method of printing, Mr. Wren has guessed it very accurately, though this will not prevent him from coming across some little difficulties if he tries to put it into practice, difficulties which I myself have not quite solved. If Sir William Petty's method can be revealed I should be very glad to know how it differs.[41]

In his next two letters to Huygens, of early September and early October, Oldenburg made no reference to the new method of printing, in part it seems because the Society Fellows were 'in the country' on summer recess and by the latter date had still not returned to London. When they did eventually reconvene, on 21 October, Oldenburg brought them up to date with the summer's correspondence, including Huygens's earlier letter:

> Mr Oldenburg produced several letters and other papers with some curiosities, come to his hands since the last meeting of the society.
>
> 1. [...]
>
> 4. Two letters to Mr Oldenburg from M. Huygens, dated Aug. 10, and Sept. 4, 1669, N.S. at Paris; the former of which ... acknowledged the doctor's [Dr. Wren's] way of compendious printing to be the same as his own.[42]

This, however, appears not to have occasioned a response from the Fellows, at least not one recorded in the minutes, and although Oldenburg and Huygens continued corresponding, often at length, neither makes any further mention of the new printing method at this time.

But this proved to be not quite the end of the matter. Six weeks later, at the Society's meeting of 2 December, the minutes record that Robert Hooke had finally completed the trial requested at the meeting of 27 May. It was of a familiar printing method but one whose 'invention' was now wholly ascribed elsewhere:

> Mr. Hooke produced a picture printed after the expeditious manner of Dr. Wren, who having covered a very thin brass-plate with etching

40. HUG 45 (Oldenburg folder, no. 21); Royal Society, EL/O2/2; *Œuvres complètes*, vol. 6, p. 474 (no. 1751); Hall & Hall (1965–86), vol. 6, pp. 91–4 (letter 1230); letter dated 5 July 1669.

41. Royal Society, EL/H1/65; *Œuvres complètes*, vol. 6, p. 480 (no. 1754); Hall & Hall (1965–86), vol. 6, pp. 161–5 (letter 1261); letter dated 31 July 1669 (Huygens: 'A Paris ce 10 Aoust 1669'). Huygens's somewhat terse remarks here can be triangulated with a letter written a week earlier by Francis Vernon to Oldenburg. Vernon (*c.* 1637–77), a Londoner serving as secretary to the English embassy in Paris, was encouraged by Oldenburg to establish links with figures at the Académie and send back news of their activities; in a relatively short time he secured the trust and esteem of several, including Huygens. In his letter, Vernon reports 'His [Huygens's] new invention for printing hee shewed mee his plate. & testifies a great Respect to Dr Wren, for hee saith hee conjectured his way of printing to bee just as it was: wch though hee speakes of as a meane Invention & putts noe mightly price upon, as hee speakes modestly of all his owne productions. Yet hee judged it a great dexterity in Doctr Wren to hitt upon just the same Method wch hee used wthout any previous hints concerning it'. Hall & Hall (1965–86), vol. 6, pp. 142–6 (letter 1250); letter dated 23 July 1669 (Vernon: 'Paris August 2d 1669' [N.S.]). The remark 'hee shewed mee his plate' may refer to test plate 1 (see Fig. 3). Vernon arrived in Paris in March 1669 and remained there until the spring of 1672. He was later murdered while travelling in Persia. Biographical details from Hall & Hall (1965–86), vol. 5, p. 462n.

42. Birch (1756), vol. 2, p. 396.

> varnish, caused it to be etched upon by a hand careful not to close any letter, in which work the aqua fortis must be so strong, as to corrode the plate quite through: Which done, the plate is to be turned and laid upon another thick plate covered all over with printer's ink, to be passed, after the usual manner, through the rolling press.
>
> Mr. Hooke was desired to prosecute and perfect this invention of Dr. Wren.[43]

This Hooke did, and presented the results two weeks later:

> Mr. Hooke exhibited another specimen of Dr. Wren's new and compendious way of printing; in which pictures likewise might be done.[44]

The meeting ended with a request for additional tests by Hooke:

> The society resolved to adjourne till the 13th of January following, by reason of the approaching festival of Christmas.
>
> In the meantime Mr. Hooke was desired to … prosecute … the new manner of printing.[45]

There is no further mention of this work in subsequent minutes of meetings in the new year, nor do artefacts documenting any of Hooke's tests survive among Royal Society materials. Neither does it appear that a specimen of these tests was ever sent to Huygens, as promised by Oldenburg in his letter of 31 May.

From this sequence of letters and references, a good deal more can be learnt than is possible from Huygens's artefacts alone. Thus, in his first letter to Oldenburg, Huygens states quite plainly that his new method of printing is for reproducing writing and geometrical figures, and is both quick and cheap. The work, he implies, can be done oneself and need not therefore involve the time and expense of engravers or printers. Oldenburg's reply is similarly revealing, beginning with his assertion that a 'certain number' of Royal Society Fellows had inventions 'of the same kind'.[46] He mentions William Petty's: its description and declared purpose seem, in concept at least, not unlike stereotyping.[47] Christopher Wren's method is also noted, which to Oldenburg appeared much nearer to Huygens's. Oldenburg also raises cogent technical queries: how many copies could Huygens's method generate, could it copy existing matter, and was 'ordinary' printer's ink used. As we have seen, the first and third queries identify issues that were central to Huygens's trials, while the second distinguishes his method as a form of duplicating, that is to say, for making duplicates from a specially made printing surface, in contrast to one capable of copying existing matter that was not necessarily originated with this in mind.

43. Birch (1756), vol. 2, p. 409. A near verbatim version of Wren's method can also be found in Oldenburg's commonplace book: 'Liber epistolari', Royal Society, MS 1, fol. 173v, headed 'Mr Wren's way of printing', n. d.

44. Birch (1756), vol. 2, p. 411; meeting of 16 December 1669.

45. Birch (1756), vol. 2, p. 413.

46. Oldenburg's original phrase is 'de mesme nature' in his letter dated 31 May 1669 (n. 38); as already quoted, the minutes of the 27 May Royal Society meeting record 'of the like nature'.

47. Stereotyping, as commonly understood, is an eighteenth-century invention.

Oldenburg's next letter in which he relates Wren's conjectural description of Huygens's method supports his earlier assertion that Society Fellows had similar inventions. The precision of Wren's 'guess' seemingly clinches Oldenburg's effort to winkle more information out of Huygens who, in reply, concedes Wren's accuracy and, if ever so tacitly, some small share of authorship. But Huygens adds an important rejoinder: that Wren will come across 'some little difficulties' in putting the idea into practice, as Huygens already has, since they haven't yet been resolved. Huygens's point, implicitly, is that while the idea may be a shared one, it is he who has got it to work, with samples to prove it.[48]

This last exchange, however, may have provided the basis for the subsequent appropriation of Huygens's method by the Royal Society after the matter dropped from his correspondence with Oldenburg. As already quoted, the minutes of Society meetings in December 1669 show that Hooke's trials were of a method repeatedly ascribed to Wren, most amply as 'Dr. Wren's new and compendious way of printing'. If Jardine correctly characterizes the close professional friendship between Wren and Hooke, and the latter's own propensity to dismiss rival claims to inventions (particularly those made by foreigners), then it might be Hooke himself who encouraged an account of the new method of printing in which Huygens's role was summarily ignored.[49] The episode appears to agree with numerous instances from this period where claims of invention, authorship, priority and 'intellectual rights' clashed, and whose resolution was often far from satisfactory – if it was attempted at all.[50]

A 17TH-CENTURY CONTEXT

Whatever the truth of invention and priority, that Royal Society Fellows readily understood Huygens's invention suggests some shared knowledge of new printing methods and a recognition of their possible benefits. As Huygens's own samples demonstrate, such informal

48. Further evidence of Wren's interest in new methods of printing can be found in Wren, *Parentalia*, a compilation of documents and texts chronicling Wren's life and work, assembled by his son (also Christopher). Among numerous other items, Christopher (Jr) lists 'several new ways of graving and etching' and 'new ways of printing' under the lengthy heading 'A catalogue of new theories, inventions, experiments, and mechanick improvements, exhibited by Mr. Wren, at the first assemblies at Wadham-College in Oxford, for advancement of natural and experimental knowledge, called then the New Philosophy: some of which … were improved and perfected, and with other useful discoveries, communicated to the Royal-Society.' Wren (1965), p. 198.

49. 'Wren … supported Hooke … with passionate dedication and determination. In return Hooke loved Wren unwaveringly …, and defended Wren with absolute, loyal intensity. It was Hooke who regularly insisted, when some claim to priority on the part of an English or continental scientist was made, that Christopher Wren had in fact invented the device many years earlier, but had disdained to write up his discovery.' Also: 'At Royal Society meetings, a pattern emerged whereby Wren and Hooke proposed some chosen investigation together, and worked on it in its preliminary stages as a partnership. Hooke next put in the detailed, time-consuming practical work to move the project through development and execution, consulting Wren when necessary. He then presented the final results to the Society on his own, with fulsome acknowledgement of Wren's input.' Jardine (2002), pp. 118, 269.

50. This much larger issue, vexatious at the time, has since proved of considerable interest to historians of science, and of the early Royal Society in particular; its prominence in the latter context at precisely this time is discussed by (e.g.) Johns (1998), chp. 7, pp. 444–542, *passim*. Ironically it was Oldenburg who later came under severest attack for purportedly compromising intellectual rights of Society Fellows. Hooke was especially aggressive in his denunciations, but so too was Christopher Wren (Jr) who, immediately after the passage from *Parentalia* quoted above (n. 48) listing his father's interests and inventions, asserted that 'Mr Henry Oldenburg, the first secretary to the Royal-Society, with disingenuity, and breach of trust, communicated, and clandestinely convey'd into foreign parts, particularly Germany and France, divers of the inventions, and original experiments of the author; which were afterwards unfairly claim'd by others, as the true inventors, and publish'd abroad under other names.' Wren (1965), p. 199.

– even 'improper' – methods were entirely capable of generating duplicates suitable for circulation, the more so since, as 'autographic', they were an unalloyed expression of authorial intent.[51] His 'Problema Alhaseni' illustrates this best: its complex text and nuanced graphic matter, otherwise time-consuming and tedious to write out and draw repeatedly, here emerge directly from Huygens's hand and in multiple.[52] Unfortunately, his remarks about the invention (that it is 'cheap' and that one can 'quickly both engrave plates and print') only hint at an awareness of broader implications: that it brought authorial control over content and form; that it circumvented the expertise and attendant costs of conventional engraving; and that with it one could *oneself* record and circulate new knowledge more immediately, bypassing the difficulties, delays and distortions of conventional printing, publishing and distribution.[53]

In locating Huygens's new method of printing in its contemporary technical context, it might first be stated that in all likelihood the method was already known of, at least notionally. Christopher Wren's startlingly accurate description of it strongly suggests prior knowledge of some kind. So, too, Oldenburg's remarks in the correspondence referring to Petty's and Wren's methods of printing, and the prescient queries he put to Huygens, make clear

51. Twyman (1990), pp. 11–12, uniquely, adopts the term 'improper' to describe the often unorthodox design and production methods of early (nineteenth-century) lithographed books, in distinction to their more 'proper' letterpress counterparts. Although Huygens's method of printing was apparently not used for books (though it might have served that purpose), it shares many features Twyman identifies in lithographic book production: economy of means, reproduction of handwriting, combination of text and image, and direct control over production. It is the latter feature which suggests the term 'autographic' to describe the printed result as direct from the hand of the author (or artist), without a technician's mediation. See Harris (1968–70), no. 4, pp. 52–4 (part 1), on the use of this term in relation to experimental printing methods and reprographic processes of the nineteenth century; she observes that autographic was often equated with 'amateur' processes of which etching was considered one. Lithography was notably welcomed in its early phases as a new method of informal printing.

52. It might be proposed that the solution to Alhazen's Problem and a wish to circulate accurate copies of it prompted Huygens's work on the new method of printing. His remark to Oldenburg that it was intended for printing geometrical figures supports the proposal; and indeed the intention is entirely appropriate to Huygens whose mathematics were fundamentally informed by geometry. But there is counter-evidence. The Problema Alhaseni sample marked the beginning of a series of exchanges between Huygens and the Liège mathematician René François de Sluse in which Oldenburg acted as intermediary. When Oldenburg learnt that Sluse was also working on problems of geometrical optics, he informed him that Huygens had found a solution to Alhazen's Problem, which he had 'transmitted to the Royal Society as a specimen of his new art of printing.' Oldenburg then sent Sluse a transcription of Huygens's sample (Hall & Hall (1965–86), vol. 7, pp. 177–93 (letter 1528), dated 24 September 1670). Sluse's work prompted Huygens to consider Alhazen's Problem anew, the result of which was a more efficient solution than his first; this Huygens *drew manually* and sent to Oldenburg, at the same time reminding him of the first solution that had been 'printed after the fashion you know of'. (Royal Society, EL/H1/72; Hall & Hall (1965–86), vol. 8, pp. 635–8 (letter 1944), dated 30 March 1672 [Huygens: 'a Paris ce 9 Avril 1672']). Eleven weeks later Huygens sent fair copy of his second solution, again drawn manually (now with compass and straight-edge) but arranged very like the original sample (Royal Society, EL/H1/73; Hall & Hall (1965–86), vol. 9, pp. 116–25 (letter 2004/a), dated 21 June 1672 [Huygens: 'A Paris ce 1er Juillet 1672']). And although concerns were periodically voiced in the correspondence about the accuracy of the transcribed solutions being sent and exchanged, at no point does Huygens appear to consider re-employing his new method of printing.

53. That many seventeenth-century natural philosophers saw new printing methods as possible aids to the circulation of accurate and reliable information that was otherwise often undermined by the vagaries of conventional publishing and distribution, is an assertion made by Johns (1998), p. 462: 'How much one should credit printed testimony would always be a matter of *ad hoc* prudence, not of formulas, let alone of a general and principled faith in the preserving powers of print. Ways of dealing with this problem would be central to the prospects of experimental philosophy. One hint of this is provided by the fact that many natural philosophers concerned themselves with the technology of printing itself. It was a subject of recurring interest.' See also n. 74 below.

Oldenburg's own awareness of copying and duplicating methods then in circulation. And apart from the efforts of his colleagues, one might also surmise that Oldenburg was familiar with the work of a figure like Samuel Hartlib who, along with Petty and Wren, had occupied himself with mechanical copying devices such as double-writing machines, and was further conversant with duplicating techniques based on the chemical transfer of written or printed matter under pressure.[54]

A second coordinate locating the new method of printing – and here risking the obvious – is its evident relationship to conventional methods of engraving and etching. The observation, discussed above (p. 19) as significantly determining the configuration of Huygens's invention (apart, that is, from its stencil dimensions), must in many respects simply reflect the increasing importance of engraving, etching and the rolling press in the 1600s. Engraving was particularly valuable to natural philosophers seeking a precise and detailed means of visualizing aspects of physics, astronomy, mechanics, geometry, horology, microscopy, architecture and many other growing spheres of knowledge. By the middle decades of the century, book-length treatises began to appear, first in French by Abraham Bosse (1645), and later (1662) in English by Royal Society Fellows John Evelyn and William Faithorne.[55] Huygens himself made extensive use of engraved illustrations and diagrams: in *Horologium* (1658), for example, his first treatise on clock design, and *Systema Saturnium* (1659)

54. Citations for Petty and Hartlib's activities concerning double-writing machines are given in Schullian (1952), p. 87, n. 6; for Wren's, with reference to Petty, see Wren, *Parentalia*, pp. 198, 214–16. Samuel Hartlib (*c.* 1600–62), was a Prussian-English polymath living in London. Although never elected to the Royal Society (having died the same year the Society was incorporated), he counted figures such as William Petty and Robert Boyle among his associates. He was also esteemed by John Evelyn whose *Sculptura* demonstrated Evelyn's own interest and expertise in copperplate engraving and 'new' printing methods, in this case mezzotint (cited in following note). In his diary, for 27 November 1655, Evelyn wrote: 'To Lond[on]. . . . Thence to visite honest and learned Mr. Hartlib. . . . He told me of an inke that would give a dozen copies, moist sheets of paper being pressed on it, & remaine perfect; & receit how to take off any print, without injury to the original in the least: This gent: was master of innumerable curiosities, & very communicative.' Evelyn (1955), vol. 3, pp. 162–3. Schullian quotes a description of Hartlib's method recorded in 1656 by the French physician and chemist Pierre Borel, as well as Hartlib's own (Latin) description. See also Bedini (1984), pp. 9–10 and n. 16. An invention descendant from Hartlib's, the 'copying machine', was eventually patented more than a century later in 1780 by James Watt (dicussed below, pp. 32–3). Evidence of (broadly) related copying methods already in circulation in the sixteenth century is supplied, for example, by reference to techniques employed by the Nuremberg writing master Johann Neudörffer *d.Ä.* for reproducing samples of his own writing for use by his pupils.

55. Abraham Bosse, *Traicté des manières des graver en taille douce sur l'airin* (Paris, 1645); second edition (1701) edited by Sébastien le Clerc; editions were also issued in Dutch (1662) and German (1669). English manuals were John Evelyn, *Sculptura: or the history, and art of chalcography and engraving in copper* and William Faithorne, *The art of graving and etching* (both London, 1662). Among Huygens's books at the time of his death in 1695 were copies of Bosse (1645) and Evelyn, in addition to Bosse's *La peintre converti* (Paris, 1667).

where he described his discovery of Saturn's ring [*sic*] and one of its moons (Titan); their preparation and publication brought Huygens into contact with engravers.[56] Later, in Paris, he regularly met with *graveurs* including Robert Nanteuil and Bosse. It is tenable, therefore, that Huygens's 'new' method of printing emerged from knowledge gained through his earlier publishing activities or through the support, guidance or inspiration of those he met in Paris, whether outside the Académie or within.[57]

Apart from attempts to position Huygens's new method of printing relative to engraving and etching, it may also be seen in proximity to another use of stencilling found in Paris at this time: for marking out texts in large liturgical books made for Catholic services.[58] Although title-pages, initials, headings and decorations were often written, drawn, and painted, chant texts (and notation) were marked out with stencils carrying individual characters (Fig. 12, overleaf). It is quite possible that the stencils were made in a manner not unlike Huygens's test plate 1, that is, by scribing (the outline of each character) into an etch ground laid on a thin brass or copper plate, then etching through the plate to create the stencil.[59] The process would have combined a mastery of letter design, engraving and etching, and been capable of generating stencils of exceptional fineness. Their use in the production of liturgical books at once displaced the work of writing while enabling texts to more nearly emulate the evenness and precision of engraved and printed characters that,

56. On 27 March 1659 Huygens wrote to Jean Chapelain that the text for his book on Saturn was finished, and that the engravers had been working on the illustrations for some time; Huygens remarked 'I could never have imagined that it would cause me so much trouble.' *Œuvres complètes*, vol. 2, p. 380 (no. 602); cf. Andriesse (2005), p. 162. The book's illustrations consist principally of copperplate engravings printed separately from the typographic and other relief matter (several woodcuts); notable is a special typographic character depicting a ringed Saturn. Since *Systema Saturnium* was the first work to describe Saturn's *ansae* ('handles') as a ring, its novel illustrations must have demanded Huygens's close supervision. A second example suggestive of Huygens's attitude towards the preparation of engravings is found in a letter he sent to Robert Moray in March 1665, after reading Hooke's *Micrographia*. In it Huygens praises the illustrations, which he surmises 'must have cost him [Hooke] incredible efforts both to draw and to get so well executed by the engraver'. *Œuvres complètes*, vol. 5, p. 282 (no. 1362); cf. Yoder (2004), p. 171.

57. Huygens's recorded meetings with Bosse (*c.* 1603/4–76) occurred during an earlier stay in Paris, in 1663, though Bosse was still active there in 1669 (see *Œuvres complètes*, vol. 4, p. 339 (no. 1111), p. 344 (no. 1115), p. 415 (no. 1155); also Brugmans (1935), p. 49). The two were on friendly terms and Huygens clearly took pleasure in discussing technical matters with him (in this case about drawing and low-relief miniatures). While there is no evidence that Bosse, an etching specialist, was directly involved in the new method of printing, he represents an outlook in sympathy with its underlying character, given his own innovations in engraving and etching, and his forward-looking endeavours to instruct others in their use by publishing techniques and procedures. Evidence for both is provided by his *Traicté des manières des graver en taille douce sur l'airin*, effectively a 'how-to' manual and, as noted, the first such book on the subject. Given the relative simplicity of the 'new' method of printing, one might speculate that engravers were already familiar with it, even if tacitly, and that Huygens only recognized its value in the context of his own activities, prompting him to record it and thereafter test it and claim it as his own. That he was susceptible to ambiguities of the latter kind is demonstrated, for example, by his periodic disputes with mechanicians arising out of his clock-making activities; cf. Leopold (1979).

58. Des Billettes (*c.* 1700, f. 166), the earliest known account of making and using stencils for texts in large liturgical books. Des Billettes states that this use of stencils was a very recent one, dating back scarcely 40 or 80 years (i.e. emerging between roughly 1620 and 1660). He gives no source or basis for the estimate, and indeed an examination of his manuscript shows that he first wrote '80 years' before inserting '40 or' in front of it, indicating uncertainty and perhaps an inclination towards the more recent date. Des Billettes goes on to suggest that the stencilling of texts was modelled on a way of working common to other practices that, when shared among workers, had given rise to this new application that was 'currently used quite frequently'. See also Kindel (2003), p. 70, n. 14.

59. Although metal (brass) stencils were made this way in the 1780s, a degree of caution should be exercised in asserting the same methods more than a century earlier, as no unambiguous account of stencil making in metal (including Des Billettes) has yet been discovered from this earlier period, nor are any contemporary examples known to survive other than Huygens's test plate 1; cf. Kindel (2003), pp. 70–81.

12, a–c. 'Graduale et antiphonale ad usum S. Ludovici domus regiæ Invalidorum', parchment, 1682. Paris, musée de l'Armée, manuscrits et imprimés, 5389 bis, 3251 BIB. (C) Paris – musée de l'Armée, dist. RMN – © Photo musée de l'Armée.

DIE I. NOVEMBRIS.
IN FESTO OMNIUM SANCTORUM.
INTROITUS. I.
Audeá mus omnes
in Dó mino,
di em feſtum ce lebrantes ſub
honó re Sanctórum ómnium:
93

a

a. Interior page (p. 93), 800 × 570 mm.

b–c. Details of stencilled text (p. 93). Comparisons of (b)/(c) and (d) illustrate in general terms the relationship between stencilled and written forms of large roman characters found in seventeenth-century liturgical books. Breaks in letters shown in (b) and (c) have been completed in ink with a pen (or brush).

Audeá mu

b

Sanctórum

c

12d. Detail of written text, 'Gradualis … Ecclesiæ Parisiensis', 8 volumes, (detail from vol. 2, title page; probably by Etienne Damoiselet, a Paris writing master), parchment, 1669, with later emendations, Musée de Notre-Dame de Paris.

Eccleſiæ à

d

in turn, were exactly those qualities esteemed in the writing of the time, but which could now be generated with stencils by someone possessing considerably less skill than the writing master.[60]

At present there is no explicit link between this use of stencils for generating texts and Huygens's new method of printing. While their technical basis is a shared one, their methods of text generation are distinct: letter-by-letter using multiple stencils positioned by hand, in contrast to an extended text scribed and transformed into a single stencil for mechanically printing duplicates. One can therefore only acknowledge their relationship in general terms. But other elements of a relationship are discernable. Both required facility in engraving and etching for making the stencils, suggesting a 'community' of knowledge that enabled them. Both supplement other efforts to mechanize attributes or circumstances of writing noticeable at around this time, and which echo Huygens's intention to 'print writing'.[61] And both allow for shifts in how texts and documents might be produced and by whom, namely, by those without much expertise in writing and character forming, or engraving and printing. Conceptually and procedurally, these seem like important shifts indeed.

60. These qualities are perhaps best demonstrated by the pre-eminent seventeenth-century writing master Nicolas Jarry (*c.* 1605–10 to before 18 Sep. 1666). As De Bure remarked in the eighteenth century 'the renowned Jarry, who has no equal in the art of writing, has … shown that the evenness, clarity and precision of engraved and printed letters can be imitated with the pen, to a degree of perfection that is unimaginable.' (Portalis (1897), p. 35). Stencils offered a wholly appropriate technical means to this end, generating similarly even and precise characters without a requisite mastery of the pen. More advantageously still, stencils enabled characters to be rendered quickly and consistently in a large size and of sufficient weight and density to be easily legible at a distance. While such attributes might have been arrived at through writing (and drawing and painting), or with engraving or printing, to do so with writing would be expensive in expert labour, and with the latter two processes immensely inefficient – indeed nonsensical – since large liturgical books were rarely needed in more than a single copy. Less advantageously, stencils necessitated 'breaks' in the forms of some characters, as Huygens himself understood ('o, a, and others', i.e. those with enclosed interiors). In many (but not all) stencilled texts, these breaks were completed with a pen or brush and ink, as Huygens did for the diagram of his Problema Alhaseni.

61. Apart from the (obvious) written character of many engraved documents, other efforts to emulate aspects of writing can be noted. Thus in 1639 the Paris writing master Pierre Moreau (*c.* 1600–48) received a royal patent for his translation into printing types of the *bâtarde italienne* and *lettres financières* with which, throughout the 1640s and for a time as 'Imprimeur du Roi', he published books of verse and pious texts (De Conihout (2004), pp. 69–73, also 80–121, *passim*). Later, one finds books whose texts and decoration were printed from engraved plates in conscious emulation of fine manuscripts. An example of this kind was published (*c.* 1680) by the Paris writing masters Louis Senault and Nicolas Duval (Becker (1997), p. 48) and quite possibly took its lead from the exquisite and much sought after prayer books of Nicolas Jarry, made by him in the middle decades of the seventeenth century. It is also worth recalling the work of the 'Commission Bignon', formed under the auspices of the Académie royale des Sciences in the 1690s. Its designs for new roman and italic types, later known as the 'Romains du Roi', drew some inspiration from contemporary writing including, in all likelihood, of masters such as Jarry. See Jammes (1961) and Mosley (2002).

LATER INVENTIONS

Having devised a means of composing, duplicating and circulating information that was at once relatively simple and reasonably convenient, one might expect Huygens to have announced his invention more widely than just to colleagues in Paris and correspondents in London. But if he did send news of it further afield, no evidence is presently known. Similarly, he might have exploited other channels of dissemination including contemporary learned journals. The *Journal des Sçavans*, published in Paris, carried letters and articles from leading figures reporting on developments and advances in the arts and sciences. Although Huygens published several items there in 1669–70, none deal with his new method of printing.[62] Among his contributions to the Royal Society's *Philosophical Transactions* at this time, again, none touch on printing. Nor did Huygens seek letters patent, as he did for other innovations he claimed, especially in the design of pendulum clocks. Thus it was not until some eight decades later that a description of the invention entered the public domain, buried deep inside Thomas Birch's *History of the Royal Society* and there effectively ascribed to Christopher Wren. On the evidence, therefore, it is difficult to establish much awareness of Huygens's invention either at the time he was working on it or in succeeding decades, much less make any confident claims for its subsequent influence. It was another new method of printing – albeit a convincingly demonstrated one – of apparently perennial interest to virtuosi but that, in this instance, was effectively closed off from view.[63]

Moving forward in time, however, it is possible to cite a number of new methods of printing bearing an indirect relationship to Huygens's.[64] Several occur in the 1780s and appear to coalesce around James Watt's recently patented copying machine. One early adopter of the copying machine (or press) was Benjamin Franklin, then resident in Paris as the United States minister to France; he took delivery of three in 1781. Franklin had apparently also experimented with a printing method based on an unconventionally-formed intaglio

62. See Claustre (1753–64), vol. 5 (FRAJGN, 1755), pp. 643–4, for items published by Huygens in the *Journal des Sçavans* in 1669–70.

63. There is, however, one final reference to the new method of printing in Henry Oldenburg's correspondence. In a letter of May 1673 to Edward Bernard, then Savilian professor of astronomy at Oxford and recently elected to the Royal Society, and apparently in reply to a query from Bernard (not extant), Oldenburg wrote 'I shall begin wth answering the import of yr post-script, concerning the way of printing copies according to Mr Hugenius. But I must first informe you, yt Mr Hugens never sent over his way otherwise, than by telling us, it was the same wth yt of Mr Surveyor, Dr Wren; wch is this following: "Take a thin Bras-plate, thin as paper; cover it wth Etching vernish, and let it be etched upon wth a hand carefull not to close any letter. The Aqua fortis must be so strong as to corrode the plate quite through. Then turne this plate, and lay it upon another thick plate, cover'd all over wth Printers Ink, and so after the usual manner pass it through the rolling presse." Sir, As I communicate this frankly to you, so I desire you would keep it to yrself, and by no means divulge it. I never saw the practise of it, though I saw an effect thereof produced by M. Hugens sending us the figure of the Alhazenian problem resolv'd by himself.' Clearly Bernard had encountered Huygens's invention previously, quite possibly through Wren who preceded him as Savilian professor and to whom Bernard served as deputy; Oldenburg himself appears to be quoting from the Royal Society's minutes or his own commonplace book (see n. 43). Hall & Hall (1965–86), vol. 9, pp. 664–5 (letter 2237).

64. It should be noted that for the present study, I have not searched in detail for relevant new printing methods from the late seventeenth century or first half of the eighteenth.

surface. A note of this work was made in 1783 by Alexis Rochon who described copies produced using Franklin's method as 'very far from being beautiful, and the ground is spotted and spoiled'.[65] Rochon had himself devised an alternative method more nearly reminiscent of Huygens's. He proposed that

> … by writing with a steel point upon a copper-plate, previously varnished, a more satisfactory result might be obtained by etching the strokes with nitric acid to a sufficient depth for the subsequent use of a liquid ink similar to that of the printers. In this case the plate may be wiped without precaution, and twelve or more copies may be pulled off upon coarse paper. The proofs are foul and reversed; whence, in order to have them neat and in the proper direction of the writing, it becomes necessary to place the same number of leaves of white paper, wetted and prepared, upon the twelve proofs, and, while the ink is still fresh, the whole being passed together through the rolling-press, the same number of counter-proofs are obtained as there were proofs … very black, neat, and legible, even when the plate has not been perfectly well wiped.[66]

Thus while the combination of autographic scribing and etching is wholly like Huygens's method, Rochon's decision to pull (reversed) copies from his (conventional intaglio) plate compelled him, in turn, to undertake an additional stage of work involving the pressure transfer of counterproofs to arrive at right-reading copies. Had stencilling been exploited, these two stages might have been completed as one.[67]

Some years later, in 1810, George Cumberland, a Bristol painter, lithographer and writer, published in *A Journal of Natural Philosophy, Chemistry, and the Arts* a letter titled 'Hints on various modes of printing from autographs'. In it he outlined numerous imaginative methods of printing he believed would 'enable a man of talents to be his own printer, and take off his own copies as they were demanded, without the intervention of a publisher'.[68] One in particular effectively reconstituted Huygens's invention:

> Let us therefore suppose a kind of copper or brass latten to be rolled thin for the purpose, and the writer to use a very corrosive ink, which in short time would eat quite through the whole body [of the latten]. He would by this means produce a stencil as fast as he could write, by means of which he would be enabled to print the right way.

While the proposal to write with corrosive ink seems hazardous at best, Cumberland helpfully reiterates the implicit advantage of stencilling over other printing methods which, as Rochon's example serves to remind, required a further offset stage of impression.

65. See Rochon (1783), pp. 343–6. The quote is from Rochon (1799), a memoir published in English (quote from p. 63). Prior to the experiment described here, it is possible (just) that Franklin encountered Huygens's invention in Birch's *History of the Royal Society* (1756). From 1757, Franklin was resident in London and regularly attended Royal Society meetings as an elected Fellow. He was acquainted with Thomas Birch, then secretary to the Society (correspondence between the two survives), and may have consulted or acquired the newly published *History* at this time. It is also notable that in late 1781 Franklin purchased a large box of brass stencils from a Paris maker, of the kind used in the production of liturgical books. Franklin did not record his reasons for the purchase, though they may relate in part to his concurrent interest in experimental printing and duplicating methods. See also Kindel (2003), pp. 74–81.

66. Rochon (1799), p. 63.

67. Rochon's and Franklin's methods are also described in Cumberland (1812), and, together with Watt's invention, summarised and discussed in [Franklin] (1997), pp. lviii–lix and 115–18. See also Bedini (1984), pp. 10–30, *passim*.

68. Cumberland (1810), p. 57. The passage is worth quoting in full. 'Every original writer justly laments the expense, difficulty, and fraud, he is subject to, if he gives his works to the press. If therefore any method could be devised, to enable a man of talents to be his own printer, and take off his own copies as they were demanded, without the intervention of a publisher, a new and brilliant era in the world of letters would be commenced; that would make thought and reflection, when justly employed, as valuable to the possessor as the talent for manual arts; and we might hope to see the day arrive, when the profession of letters might afford as probable a means of getting a fortune as any other profession whatever.' Quotes that follow are also from this source.

Cumberland also described an alternate method that dispensed with etching and, importantly, employed (oiled) paper for the stencil in place of copper or brass:

> Again let us suppose he were to make use of capital letters only [?printing types], acting as punches on paper, he would by this method have a paper stencil, that would last as long, perhaps longer, than the latten one. … common ingenuity might overcome the difficulties of the O and other letters by ties.
>
> Many people will smile at the idea of a paper stencil, who are ignorant of the nature of paper when oiled …

He went on to cite the work of Dr James Lind, physician to George III, who printed profiles of the king using an oiled paper stencil; Lind, Cumberland claimed, used the stencil 'for many thousand impressions, and saw that it was still unimpaired'.[69]

Cumberland's proposals record an important shift towards stencil duplicating configurations that would in future prove valuable. While his imaginative methods are not unlike Huygens's own (and the first method almost identical), both the use of paper for the stencil and the notion of cutting it with punches pre-figure inventions or elements of them introduced sixty years later. In the intervening decades, the copy press and carbon paper remained the principal duplicating methods, though both were limited in the number of copies they could efficiently and legibly generate. Not until the two decades following 1870 was a series of stencil duplicating devices brought onto the market that were at once convenient and commercially viable. Advances and innovations were made in three discrete but inter-related areas: in the material used for the stencil, in the tools used to cut it and in the means of ink transfer. All adopted plain, oiled or wax-coated paper for the stencil; all but the earliest adopted a mechanical (rather than a chemical) means of perforating the stencil; and all were modest in weight and scale and in some instances portable. Each was relatively clean and safe to use and none required much training or special operating conditions.[70]

Thus, from roughly 1870 to 1890, the concept of stencil duplicating was re-introduced to the worlds of commerce and trade were it met with considerable success (Fig. 13). It was by no means the only duplicating method available at the time, but for some eighty years, until the mid-twentieth century, stencil duplicating proved popular and transformed commercial document production. It was also adopted for some small-scale scholarly and technical publishing, uses that were not unlike those envisioned by Huygens. Another,

69. Many of Cumberland's methods were based on stencilling or relief printing. Evidence of his interest in experimental printing methods can be found already in 1784 when he published a brief account of a 'new mode of printing' in *A New Review* (Henry Maty, vol. 6, pp. 318–19). The 'new mode' involved scribing on, then etching into copper plates; it would, he thought, be 'very useful to persons living in the country, or wishing to print very secretly.' See Bindman (1977), pp. 42–3 and n. 17, which quotes the account in full. George Cumberland (1754–1848) was a long-time friend of William Blake whose own first self-published book, *Songs of innocence*, completed in 1789, was made and printed (by Blake, at home) from relief etched plates combining text and image. See Essick (1980), pp. 112–18, for details of Blake's likely exposure to experimental printing methods of the time, and for contemporary references to them; some of these are also discussed in Harris (1968–70), *passim*.

70. This summary is based on a review of six proprietary devices: the Papyrograph (Zuccato, 1874), the Electrical Pen (Edison, 1876), the Trypograph (Zuccato, 1877), the Mimeograph (Edison / A. B. Dick, 1880–7), the Copygraph (Broddick, 1888) and the Cyclostyle / Neostyle (Gestetner, 1880s). Edison claimed of the Electrical Pen that 'it requires no skilled expert to produce perfect work, and supplies a want in commerce, etc., long felt, and which many inventors have tried and failed to meet until now' (*Edison's electrical pen and duplicating press*, New York: Z. R. Bennett, 1876; cited in Rhodes and Streeter (1999), p. 131 and n. 38).

iv KNOWLEDGE. [OCTOBER 1, 1897.

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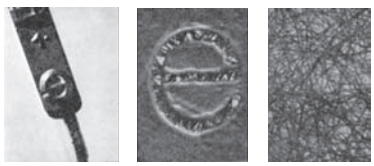
a

b



c

13, a–c. Stencil duplicator (Cyclostyle), Gestetner; from Proudfoot (1972).

a. Advertisement, 1897.

b. Portrait of David Gestetner with the automatic Cyclostyle.

c. Stencil features: typewriter key, key strike into wax laid on loose-wove paper.

rather broader, parallel might indeed be proposed between the USA (in particular) of the later nineteenth century and 1660s Paris, where stencilling offered – at vastly different scales – a convenient solution to the production of words, texts and documents.[71] Since it is untenable to propose any direct link between these times and places, the stencilling innovations found in both serve simply to illustrate how a basic technical paradigm may periodically re-emerge with lively and beneficial consequences.

A SUMMARY

On 28 August 1669, two and a half weeks after his last letter referring to the new method of printing, Huygens presented his 'Discourse on the cause of gravity' to an assembly of fellow *académiciens*. Its proposals were not received with unqualified assent, and in the weeks and months that followed Huygens endured some considerable strain in their defence, and the defence of related proofs on the motion of pendulums. These fraught and consuming matters, at the heart of his programme of research, have been proposed as contributing to Huygens's illness of February 1670 and after.[72] There is no doubt that Huygens was seriously unwell at this time and by the following September he was forced home to The Hague to recover. When he did eventually return to Paris and his post at the Académie in June 1671, existing projects and new interests clearly overtook the work on printing, as there are no indications that he returned to it.[73]

71. For evidence of the considerable interest in stencilling of all kinds in the United States at this time, and of the numerous stencil-related patents issued in the decades after the American Civil War (ended 1865), see Kindel (2002) and (2006).

72. Andriesse (2005), pp. 236–58, *passim*.

73. That the invention was still in Huygens's mind in March/April 1672, however, is confirmed by his remark quoted in n. 52.

14. Christiaan Huygens, portrait by Caspar Netscher, oil on wood, 300×235 mm (including frame not shown), *c.* 1670/1, Haagshistorisch-museum, The Hague.

Much the same seems to have occurred in London, where, as noted, there is no evidence that Robert Hooke completed the further printing tests requested by the Royal Society, or that Christopher Wren encouraged him to do so; these, too, were surely pushed aside by the two men's own relentless programmes of work.

Despite their relatively marginal status after 1669, the documents and artefacts of Huygens's new method of printing suggest that, at the time at least, he set some store in the invention as an effective means of duplicating writing and drawings. But among his many interests and endeavours, it must fairly rank as minor, while regrettably like other of his more profound innovations it went unpublished at the time and so made little noticeable contribution to the contemporary advance of technology. Regardless of its reappearance in the mid-eighteenth century, the new method of printing apparently remained on the margins: known of in concept perhaps and, as Cumberland's early-nineteenth-century experiments

suggest, occasionally revisited. Only in the thrusting commercial world of the later nineteenth century, when the need for more efficient document duplicating became irresistible, was the idea again resuscitated, reconfigured and successfully exploited.

Much of the evidence of Huygens's invention described in this study was not fully collated until 1950. That year, in the twenty-second and final volume of the *Œuvres complètes* under the heading 'Varia academica 1666–1681', the account, along with the Horace sample and the stencil plate, were variously transcribed, shown and described. They were additionally correlated with the Virgil and Problema Alhaseni samples already published in the earlier volume six (1895) together with the Huygens–Oldenburg correspondence. But the now more complete showing did not bring the invention much notice: of two references so far found, one draws on it only as evidence of a more fundamental struggle of virtuousi with the problematic worlds of seventeenth-century printing and publishing, while the other simply dismisses it as a distraction from weightier scientific concerns.[74] It is hoped, however, that the present study has expanded these too narrow interpretations, and confirmed Huygens's invention as a viable and promising means of do-it-yourself printing and duplicating able to support the circulation of ideas and knowledge. And, in its principal technical character, it further illustrates stencilling's contribution to the production of words, texts and documents in seventeenth-century Europe. In these respects Huygens's 'new method of printing' is, if modest, then richly informative too.

74. The first instance is that of Johns (1998), pp. 462–3 and n. 33. After noting a recurring interest among natural philosophers in printing methods in their pursuit of greater accuracy and reliability in published 'testimony' (quoted above, n. 53), and supplying a helpful list of references, including to Huygens, Johns concludes: 'Attempts to develop printing technologies, however, were really secondary to those that concentrated on the proper place and social management of printing, publication, distribution, and reading.' The latter instance is that of Hall (1979), p. 72, who is more dismissive: 'During 1669 Oldenburg acted as an intermediary between Huygens in Paris and Sluse in Liège in a long discussion on geometrical optics, prompted by the transmission to London by Huygens of his solution of Alhazen's Problem. (The purpose of the transmission was ostensibly to demonstrate Huygens's new method for the duplication of written matter, but its importance was in the matter thus transmitted).'

REFERENCES

Andriesse, C. D. 2005 (1993). *Huygens: the man behind the principle*, Cambridge: Cambridge University Press, originally published as *Titan kan niet slapen: een biografie van Christiaan Huygens*

Becker, David P. 1997. *The practice of letters: the Hofer collection of writing manuals, 1514–1800*, Cambridge, MA: The Harvard College Library

Bedini, Silvio A. 1984. *Thomas Jefferson and his copying machines*, Charlottesville: University Press of Virginia

Biemans, Jos A. A. M. 2004. 'Sjabloonboeken tussen handschrift en druk', in *Boek & letter: boekwetenschappelijke bijdragen ter gelegenheid van het afscheid van Prof. Dr. Frans A. Janssen*, Jos Biemans, Lisa Kuitert and Piet Verkruijsse (eds), Amsterdam: De Buitenkant, pp. 419–42

Bindman, David. 1977. *Blake as an artist*, Oxford: Phaidon, and New York: E. P. Dutton

Birch, Thomas. 1756. *The history of the Royal Society*, vol. 2 (of 4), London: A. Millar

Brugmans, Henri L. 1935. *Le séjour de Christian Huygens à Paris et ses relations avec les milieux scientifiques français*, Paris: E. Droz

Claustre, André de. 1753–64. *Table générale des matiéres* [sic] *contenues dans le Journal des Savans de l'édition de Paris, depuis l'année 1665, qu'il a commencé, jusqu'en 1750*, [etc.], Paris: chez Briasson, libraire

Commager, Steele. 1995 (1962). *The odes of Horace: a critical study*, Norman and London: University of Oklahoma Press

Cumberland, George. 1810. 'Hints on various modes of printing from autographs', *A Journal of Natural Philosophy, Chemistry, and the Arts*, January 1810, collected in vol. 28 (1811), pp. 56–9

Cumberland, George. 1812. 'Art of Copying, or of multiplying Copies', *A Journal of Natural Philosophy, Chemistry, and the Arts*, February 1812, collected in vol. 34 (1813), pp. 113–15.

De Conihout, Isabelle, and others. 2004. *Poésie & calligraphie imprimée à Paris au XVIIe siècle*, Paris: Bibliothèque Mazarine and Éditions Comp'act

Des Billettes, Gilles Filleau. *c.* 1700. 'Imprimerie de livres d'eglise, escriteaux ou sentences &c.', Case Wing MS +Z4029.225, The Newberry Library, Chicago

Essick, Robert N. 1980. *William Blake, printmaker*, Princeton: Princeton University Press

Evelyn, John. 1955. *The diary of John Evelyn*, E. S. de Beer (ed.), Oxford: Clarendon Press

[Franklin, Benjamin]. 1997. *The papers of Benjamin Franklin*, vol. 33, Barbara B. Oberg (ed.), New Haven and London: Yale University Press

Freeman, Kathleen. 1938. 'Epicurus: a social experiment', *Greece & Rome*, vol. 7, no. 21 (May 1938), Cambridge: The Classical Association, pp. 156–68

Gaskell, Roger. 2004. 'Printing house and engraving shop: a mysterious collaboration', *The Book Collector*, vol. 53, no. 2, Summer 2004

Hall, A. Rupert & Hall, Marie Boas (eds and trs). 1965–86. *The correspondence of Henry Oldenburg*, Madison: The University of Wisconsin Press

Hall, M[arie]. B[oas]. 1979. 'Huygens' scientific contacts with England', in *Studies on Christiaan Huygens: invited papers from the symposium on the life and work of Christiaan Huygens*, Amsterdam, Lisse: Swets & Zeitlinger, pp. 66–82

Harris, Elizabeth. 1968–70. 'Experimental graphic processes in England 1800–1859' (in five parts), *Journal of the Printing Historical Society*, no. 4, 1968, pp. 33–86 (parts I–II); no. 5, 1969, pp. 41–80 (part III); no. 6, 1970, pp. 53–89 (parts IV–V)

[Huygens, Christiaan]. 1695. *Catalogus variorum et insignium in omni facultate et lingua librorum, praecipue mathematicorum, politicorum et miscellaneorum amplissimi ac nobilissimi viri Christiani Hugenii Zuylichemii … quorum auctio habebitur Hagae-Comitis … 24. Octobris 1695, et sequentibus*, Hagæ-comitum: A. Moetjens

[Huygens, Christiaan]. 1888–1950. *Œuvres complètes de Christiaan Huygens*, D. Bierens de Haan, J. Bosscha, D. J. Korteweg, J. A. Vollgraff (eds) for the Hollandsche Maatschappij van Wetenschappen, The Hague: Martinus Nijhoff

Jammes, André. 1961. *La réforme de la typographie royale sous Louis XIV: Le Grandjean*, Paris: Librairie Paul Jammes
Jardine, Lisa. 2002. *On a grander scale: the outstanding career of Sir Christopher Wren*, London: HarperCollins
Johns, Adrian. 1998. *The nature of the book*, Chicago and London: The University of Chicago Press
Jones, Howard. 1992 (1989). *The Epicurean tradition*, London: Routledge
Kindel, Eric. 2002. 'Stencil work in America, 1850–1900', *Baseline*, 38, Summer 2002, pp. 5–12
Kindel, Eric. 2003. 'Recollecting stencil letters', *Typography papers*, 5, Reading: Department of Typography & Graphic Communication, University of Reading, pp. 65–101
Kindel, Eric. 2006. 'Patents progress: the Adjustable Stencil', *Journal of the Printing Historical Society*, new series, no. 9, Spring 2006, pp. 65–92
Leopold, J. H. 1979. 'Christiaan Huygens and his instrument makers', in *Studies on Christiaan Huygens: invited papers from the symposium on the life and work of Christiaan Huygens*, Amsterdam, Lisse: Swets & Zeitlinger, pp. 221–33
Lucretius (Titus Lucretius Carus). 1951 (mid 1st century BC). *On the nature of the universe*, R. E. Latham (tr.), Harmondsworth: Penguin Books
Mautner, Thomas. 1996. *A dictionary of philosophy*, Cambridge, MA: Blackwell Publishers
Mosley, James. 2002. 'Les caractères de l'imprimerie royale', in *Le Romain du Roi: la typographie au service de l'État*, 1702–2002, Lyon: Musée de l'Imprimerie de Lyon, pp. 32–78
Neumann, Peter M. 1998. 'Reflections on reflection in a spherical mirror', *The American Mathematical Monthly*, vol. 105, no. 6 (June–July, 1998), pp. 523–8
Nisbet, R. G. M. and Hubbard, Margaret. 1970. *A commentary on Horace: Odes, book 1*, Oxford: Clarendon Press
Portalis, Roger. 1897. *Nicolas Jarry et la calligraphie au XVIIe siècle*, Paris: Librarie Techener
Proudfoot, W. B. 1972. *The origin of stencil duplicating*, London: Hutchison
Putnam, Michael C. J. 1979. *Virgil's poem of the earth: studies in the* Georgics, Princeton: Princeton University Press
Rhodes, Barbara J., and Streeter, William W. 1999. *Before photocopying: the art and history of mechanical copying, 1780–1938*, New Castle, DE: Oak Knoll Press
Rochon, M. l'Abbé (Alexis de). 1783. *Recueil de mémoires sur la mécanique et la physique*, Paris: Barrois l'aîné
Rochon, Alexis. 1799. 'A memoir on the typographic art …', *A Journal of Natural Philosophy, Chemistry, and the Arts*, May 1799, collected in vol. 3 (1800), pp. 61–73
Schullian, Dorothy M. 1952. 'Notes and queries: early print transfer', *Journal of the History of Medicine and Allied Sciences*, vol. 7, pp. 86–8
Twyman, Michael. 1990. *Early lithographed books: a study of the design and production of improper books in the age of the hand press*, London: Farrand Press & Private Libraries Association

Vanuxem, Jacques. 1974. 'Un exemple de tresor perdu pour Les Invalides: les manuscrits enluminés de la fin du XVIIe siècle', in René Baillargeat (ed.), *Les Invalides: trois siècles d'histoire*, Paris: Musée de l'Armée, Hôtel National des Invalides, pp. 105–12

Vézin, Jean. 1969. 'Le graduel exécuté au XVIIe siècle pour Notre-Dame de Paris', *Scriptorium*, vol. 23, pp. 352–60, pls. 116–18

Watson, E. C. 1939. 'The early days of the Académie des Sciences as portrayed in the engravings of Sébastien Le Clerc', *Osiris*, vol. 7, pp. 556–87

West, David. 1995. *Horace Odes I: carpe diem*, Oxford: Clarendon Press

Wren, Christopher (Jr). 1965 (1750). *Parentalia: or, memoirs of the family of the Wrens; viz. of Matthew Bishop of Ely, Christopher Dean of Windsor, &c. but chiefly of Sir Christopher Wren, late Surveyor-General of the royal buildings, President of the Royal Society, &c. &c. … compiled, by his son Christopher; now published by his grandson, Stephen Wren, esq. …*, London: T. Osborn and R. Dodsley, re-publication in facsimile, Farnborough: Gregg Press

Yoder, Joella. 2004 (1988). *Unrolling time: Christiaan Huygens and the mathematization of nature*, Cambridge: Cambridge University Press

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