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Part Seven: Wadham and Wren Transcript

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Wadham and Wren

Professor Lisa Jardine

Slide 0: Wrenslide 1: Mary Beale portrait of Dr John Wilkins RSThey are now erecting a Colledge for Experiments et Mechanicks at Oxford, toward which Dr. Wilkins hath given 200 pounds. It is over the Schooles or in the long Gallery, where all the Models of Inventions Arts etc are to bee reserved with a Treatise added to each of them shewing the structure and use of it. They desire Greattricks [Greatorex] to bee the keeper of that College.In the second half of the seventeenth century in England, a procession of great figures emerged to become the founding figures of modern science (what was then called natural philosophy). Today it is the originality of these 'men of genius' that we are inclined to celebrate. Yet the most innovative aspect of the period's scientific activities was a whole series of collaborative intellectual enterprises, which were unlike any that came before them in their capacity to mobilise and organise original ideas and their technical application. Anyone who visited Dr John Wilkins, in the 1650s was struck by the unusual and productive way in which he had managed to orchestrate the activities of a group, or 'club', of brilliant individuals he had brought together at Wadham College. In spite of a tendency of these visitors to want to attribute what they were shown to individual prodigies -- like the adolescent Wren --, it is apparent that it was the Oxford group, under Wilkins's direction, which was responsible for the technological successes at Wadham. Indeed, what is striking when we consult the seventeenth century records -- the books, letters and documents which provide us with the history of this intellectually crucial period -- is with what regularity individuals like Boyle, Halley, Hooke, Petty, Wren -- even the famously reclusive Newton --, point to collaborative effort, shared data-collection and the hands-on involvement of others as the catalyst for their originality, stimulating theoretical or technological breakthrough.Today, taking as my example they precocious scientific talent of Sir Christopher Wren, I want to propose that it was the organisational infrastructure -- working arrangements, procedures and attitudes -- of seventeenth-century science, every bit as much as its pioneering theories and experiments which made the breakthrough to modern scientific understanding (in theory and in practice) possible. Specifically, I shall argue that the vision of Dr John Wilkins, later Bishop of Chester, was the inspiration not just for the Royal Society, but for the entire so-called scientific revolution in England. The model for progress in the new experimental sciences, I maintain, was a network of young and talented, skilled practitioners, coordinated and driven by the vision of a charismatic programme-planner and organiser. John Wilkins was the archetypal such visionary.In the elegantly-written preface to his ground-breaking book on microscopy, Micrographia, or some Physiological Descriptions of Minute Bodies, published in London under the imprimatur of the new Royal Society in 1665, the virtuoso experimenter, inventor and polymath Robert Hooke paid lengthy tribute to the vital role Dr John Wilkins had played in nurturing and developing not just his own talents, but those of the entire circle of seventeenth-century English virtuosi. Without Wilkins, he wrote, his own investigations of nature would have led him nowhere, and this was true for most contemporary English innovators:There is scarce any one invention, which this Nation has produced in our Age, but it has some way or other been set forward by his assistance.Without Wilkins's guidance and encouragement, Hooke maintained, he would never have seen how to advance his ideas in observational science, nor have had the opportunity to pursue them in the first place, and his exquisite, engraved line drawings of natural phenomena as viewed under the new microscope would never have seen publication.Hooke makes one further claim in his preface to Micrographia, concerning Wilkins's involvement in his decision to make and illustrate a book-length series of observation using the new microscope. It was Wilkins, Hooke tells his reader, who persuaded him to 'follow in the footsteps' of Christopher Wren, another, slightly older protégé of Wilkins's, who had, with Wilkins's guidance, undertaken the 'first beginnings' in microscopical drawings of this kind. For Wilkins it was the project that mattered. Any one of his gifted young practitioners might be substituted for another. With Wren too busy to complete this particular project, it was, Hooke tells us, Wilkins's decision to substitute the younger man with comparable drafting skills:At last, being assured both by Dr. Wilkins, and Dr. Wren himself, that he had given over his intentions of prosecuting it, and not finding that there was any else designed the pursuing of it, I set upon this undertaking.slide 2 & 2A: engravings of flea and louse from Hooke's MicrographiaIn his own day, Wilkins's was a name to conjure with internationally in influential intellectual circles, and his was a palpable presence in London, determining the shape of a whole range of important initiatives in the worlds of politics, religion and learning. He was charming, intelligent and well-connected; he was gregarious, curious and an enthusiastic networker. In the words delivered by one of the royal chaplains at his funeral: 'He had an Understanding that extended to all parts of useful Learning and Knowledg; a Will always disposed to Great, and Publick, and Generous things. … In great matters, he judged so well, that he was not usually surprized with events'. He was also a survivor. Although Wilkins was a man of pronounced opinions and decided religious beliefs, he survived a series of cataclysmic regime-changes, retaining his importance, high office and significant influence, first in the turmoil which followed the execution of Charles I, then during the ten years of the Commonwealth and the Cromwellian Protectorate, and finally, in the period of re-messaging and reconstruction which followed the Restoration of Charles II. As he weathered the political changes, he carried his 'boy wonders' with him. We should, I suggest, take Hooke's comments seriously, and treat Wilkins as in an important sense the originator of a characteristically modern way of conducting scientific research. Without Wilkins's carefully-designed and choreographed group practice, his equipping of laboratories with the latest equipment (and raising the sponsorship to do so), without his supervising of exchanges of ideas and skills between like-minded experts, such individual brilliant men would not have got their ideas off the ground, nor would their breakthroughs have carried the scientific endeavour forward to modernity. And topics introduced

for investigation by Wilkins tended, I suggest to continue to be pursued by those who had worked under him, long after his own death.The claim that Wilkins empowered a generation of brilliant innovators by encouraging group inquiry and information sharing is, on the face of it, a reasonably uncontroversial one. We can understand it clearly in the context of astronomy, where the habit began early of pooling observational data, collected in locations at considerable distances apart, as the basis for tables establishing the regular movements of celestial bodies and supporting generalised theories about them. But I am talking of more than data-collection here. The interactions I am proposing took place at the level of shared engagement in experimental activity, over extended periods of time, to a pre-arranged programme, under the guidance of what amounts to a gifted research professor. What is more difficult for the historian is to demonstrate Wilkins at work in the leadership capacity I have just described. Fortunately, we are able, by unearthing occasional references in the surviving records, to follow the progress of some members of the Oxford circle who later rose to positions of prominence themselves, as they developed their interests during the second half of the seventeenth century under Wilkins's organising influence. Today, the example I shall focus on is that of Christopher Wren.*In 1647, Christopher Wren, later part of the Wadham group, part of the team experimenting with manned flight under the direction of Wilkins, had had prior experience working on the action of muscles, too, as assistant to the physician Sir Charles Scarburgh, when he was briefly employed as his junior technician and amanuensis. In the mid 1650s, Wilkins provided the working environment, proposed the programme of research, and brought together expertise from a number of quarters, as well as prior experience with practical experimenting in a particular field, to create a team project, with, hopefully, improved chances of success.slide 9: Wren view of Windsor, Hollar engravingThe Wren-Wilkins relationship was formed at a moment of national crisis. When Charles I's trial was imminent and his fate virtually sealed at the end of 1648, Wilkins, who since summer 1642 had served as chaplain to Charles Louis, Elector Palatine, eldest son of Charles I's sister Elizabeth, took steps to ensure that he could take advantage of his Palatine connection in case he needed to flee the country. Between late December 1648 and January 1649 Wilkins shuttled between Oxford and London, negotiating successfully to obtain a position in the retinue of Charles Louis, who was scheduled to return to those Palatinate territories which had been reassigned to him by treaty at the end of the thirty years war, the previous year. His preparations included soliciting a place for Wren in Charles Louis's household. Wilkins brought Wren to the Elector's attention via a letter requesting patronage for his young protégé. In it Charles Louis is identified as 'a great Lover and Encourager of Mathematics, and useful Experiments' and thus Wren's ideal benefactor. (Wilkins had dedicated his Mathematical Magic to Charles Louis, Elector Palatine, and referred in the dedicatory letter to the Elector's long-standing interest in and enthusiasm for 'all Kinds of Ingenious Arts and Literature', so there is reason to think that Wilkins sincerely believed Wren's talents would appeal to his employer.) Charles Louis left England in early March 1649; he was accompanied by Wilkins, and probably by Wren.Wren's letter to the Elector Palatine once again allows us to glimpse Wilkins in his capacity as research director. In this case he masterminds the allocation of credit for originality in respect of specific pieces of technology developed by his research team. It was, wrote Wren, his benefactor and mentor Wilkins who had insisted that he must claim for himself, and offer to his hoped-for patron, two 'devices', or pieces of technology (described in papers attached to the letter), to whose successful development he had made important technical contributions: a mechanical seed-drill for sowing corn evenly and without waste, and a duplicate-writing machine which would make a perfect copy of a hand-written document as it was written.The two 'papers' Wren presented to Charles Louis described inventions on which the Wilkins group had been working collaboratively for several years (they crop up repeatedly in Hartlib's correspondence and memoirs), in which a number of Oxford 'virtuosi' had a hand. It might be argued that they were not Wilkins's to assign to the young Wren. But if Wilkins regarded himself as the official head of the organised group developing the seed-drill and double-writing machine, and was providing the funding and direction, he may have considered it reasonable to exploit his stake in these potentially lucrative inventions when lobbying on Wren's behalf.William Petty, in particular, regarded both the seed-drill and the double-writing machine as projects of his own. He had been responsible for bringing early prototypes of both 'engines' into the Oxford club, and had taken an active role in their development, successfully applying for patents speculatively for each of them in his own name. In July 1648 Hartlib recorded that Petty had taken out a patent on a mechanical sowing-machine, whose technical features were a significant improvement on earlier designs:The 4 of Juli he [Petty] told mee also of a new invention of his for setting of corne not according to Sir Cheney [Culpeper]'s contrivances (for these would not doe) but of his owne whereby hee is able to doe all that either Plats [Hugh Platte] or Demmock [Cressy Dimmock] undertake by way of Instrument.In late February 1649 Hartlib reported that 'Petty's agriculture instrument hath beene really and sufficiently tried'. By the middle of that year Hartlib had further news about the trials of his design, and particularly the fact that it could be marketed in such a way that its machinery could not be copied. The following September Hartlib noted that Petty was once again going down to the country to 'trie his engine for corne-businesse'. It seems that Petty lodged the patent for his sowing-engine, then took the problem to the Oxford group for team development, first under his own direction, and subsequently under Wilkins's. The mechanically able Christopher Wren was allocated to the project for research and development work. Hence Wren's appearance working on precisely the ventures which interested Petty. The trials, however, evidently ran into difficulties. In the spring of 1651, a member of the Oxford group, John Lydall, reported to his ex-pupil John Aubrey in London that the engine was 'not yet altogether compleated.' In Lydall's letter, Petty's and Wren's name are both associated with the 'new engines' on which the group is working:Here have been some late inventions with us of some new engines, one is how to set a field of corne as soone as otherwaies it can be sowne & [harrowed] invented by Dr Petty but not yet altogether compleated. Another is how with ye same weights to weigh graines & scruples, & dramms & ounces, both the scale & weights hanging slid at an aequall distance from the centre of the ballance, invented by Mr Wren a Bachelor of arts of Waddham, who likewise invented another engine for double writing.When Petty

reported on the ‘corn engine’ to London virtuosi in the same year, he too referred to it as ‘our’ project, thereby acknowledging the shared nature of the undertaking. His account also makes it clear that Wilkins is seen as the group’s organiser: I have lately had severall relations from Oxford concerning the fruits of our Corne Engine both by writing & word of mouth Whereof One writeth that Mr Warden Wilkins should say such a quantity of Corne to bee on the ground, as (if so) makes the Encrease of what was sowne 120 for one. … I thinke there is little danger of immodesty to inferred that the Engine doth without dispute save three quarters of the seed.It seems that Wilkins took advantage of his key position in the Oxford group to attribute the seed-drill and the double-writing instrument to Wren in his patronage-seeking letter (assigning him the intellectual property, as it were), to ensure that his skills looked especially attractive to his potential patron. Once again we can see that Wilkins considered himself to be entitled to orchestrate the inventive efforts of his gifted colleagues, though in this case Petty, who had anticipated lucrative profits from the seed-drill and double-writing machine, continued to contest Wren’s claims to both.William Petty dedicated the published account of his double-writing machine to Robert Boyle, youngest son of the Earl of Cork as part of his 1648 bid for a patent. Boyle, recently settled in England from Ireland, already had a reputation for using his considerable wealth to support scientific projects. In his dedication, Petty identifies Boyle as the ideal intellectual backer, because he both funds and participates in the ventures he undertakes:Men dedicate their books to the patrons of the subjects, whereof they write, and I dedicate an useful and new invention to you, who … do not only profess yourself a Maecenas of such things, but can descend (or rather ascend) to the practice of them yourself.Petty hopes to be able to participate, under Boyle’s patronage, in the kind of group laboratory practice, shared ideas and centralised funding already associated with Wilkins:I having concredited unto you all my treasure of this nature, may hope for some of your experiments to be entrusted unto me. For my study and ends being enquiries into nature, and useful arts, and finding how ill my abilities to make experiments answer my inclinations thereto, I know no readier way to become fat in that kind of knowledge, than by being fed with the crumbs, that fall from your table.Petty, in other words, here asks for Boyle to take on the role of director of research to his own disparate experimental ventures. Wilkins evidently had the same idea.Slide 9A: Robert BoyleWilkins first met Boyle in London in the autumn of 1653 (having been introduced by the enterprising fixer, Hartlib), and immediately began to encourage him to join the Oxford circle. Like Petty, he identified in Boyle a man of means who might be persuaded to support the kind of guided research already being carried out by the Wadham circle. Once sure of Boyle’s interest, Wilkins set about creating a working environment for Boyle comparable to his own at Wadham, including finding a suitably qualified young man to act as his ‘operator’, or laboratory technician (a position Hooke eventually took up). He also offered to secure lodgings close to Wadham where Boyle could set up his ‘elaboratory’ and a meeting room. With Boyle installed in premises equipped and funded by himself for scientific purposes, Wilkins envisaged the possibility of a significant expansion in the activities hitherto conducted at Wadham, and in the refurbished space on the third floor of University premises in the Old Schools Quadrangle nearby.On 14 September 1655, Boyle wrote to Hartlib that he had visited Wilkins in Oxford, ‘with whom I spent a day with noe Small Satisfaction’. Wilkins introduced him to members of the club and showed him his garden, where Boyle saw ‘Indian wheat’ and nasturtiums growing (‘which flowers he sayes make excellent Sallads’). He was also shown Wren’s transparent beehive, and reported that although two of the three storeys of the hive were functioning well, the third was ‘nothing neere so well replenish’d which did somewhat discontent the Dr’. The hive did function well, though, in allowing the visitor to watch the bees at work inside it. slide 10: Wren’s drawing of a three-storey, transparent beehive (though without his own ornaments)What Wren and Wilkins shared with others in the Wadham group like Hooke and Petty was a burning desire to create a future which would allow them to forget the chaos of the 1640s and 50s. Their passionate commitment to new technology stemmed from the belief that human nature was so fundamentally flawed, that no man alone could hope to survive in turbulent, unpredictable times. Only through meticulously organised collaboration might groups of talented individuals recover sufficient understanding to improve the lot of humankind. As Wilkins wrote in a sermon delivered in 1649, in the period immediately following Charles I’s execution:We may infer, how all that confusion and disorder, which seems to be in the affairs of these times, is not so much in things themselves, as in our mistake of them.slide 14: Engraved Wilkins portrait frontispiece alongside WrenThe organisation of Willkins’s Wadham club, under his own charismatic leadership, was his way of endeavouring to restore order to the ‘confusion and disorder, which seems to be in the affairs of these times’. As it turned out, it was also the key to scientific progress, and the foundation for a scientific practice which paved the way to modernity. It is an irony that would not have been lost on the Warden of Wadham that his strategy for correcting the ‘mistakes’ which had led to civil war and regicide in England should have produced another seismic change, another overturning of the existing order – the scientific revolution.

NOTESi. Hartlib papers 28/2/78B. The preceding paragraph runs: ‘Wren is made Fellow of All Soules College. His instrument of double-writing will require some practise, but that of Perspective he prefers before the other. Id. [Greatorex]’.ii. The classic account is John Evelyn’s visiting Wadham in 1654: ‘We all din’d at that most obliging and universally Curious Dr Wilkins’s at Waddum, who was the first who shewed me the Transparent Apiaries. … He had also contrived a hollow Statue, which gave a Voice, and uttered words, by a long and concealed pipe that went to its mouth, whilst one spake thro it, at a good distance, and which at first was very Surprizing. He had above in his Gallery and Lodgings variety of Shadows, Dyals, Perspectives, places to introduce the species, and many other artificial, mathematical, Magical curiosities; A Way-Wiser, a Thermometer, a monstrous Magnes, Conic and other Sections, a Balance on a demie Circle, most of his owne and that prodigious young Scholar, Mr. Chr.: Wren; who presented me with a piece of white marble, which had been stained with a lively red, very deep, as beautiful as if it had been natural.’ E. S. de Beer, The Diary of John Evelyn (Oxford: Clarendon Press, 1955) 3,

110-11.iii. I owe the idea that Ingenious Pursuits: Building the Scientific Revolution, On a Grander Scale: The Outstanding Career of Sir Christopher Wren and The Curious Life of Robert Hooke: The Man Who Measured London form a trilogy and are part of a single enterprise to Professor Jacques Heyman, in a review of The Curious Life of Robert Hooke published in the THES [date]. I am aware that the seeds of my present argument were sown by Charles Webster in his magisterial work, The Great Instauration: Science, Medicine and Reform 1626-1660 (London: Duckworth, 1975).iv. 'If these my first Labours shall be any wayes useful to inquiring men, I must attribute the encouragement and promotion of them to a very Reverend and Learned Person, of whom this ought in justice to be said, That there is scarce any one invention, which this Nation has produced in our Age, but it has some way or other been set forward by his assistance. My reader, I believe will quickly guess, that it is Dr. Wilkins that I mean. He is indeed a man born for the good of mankind; and for the honour of his Country. In the sweetness of whose behaviour, in the calmness of his mind, in the unbounded goodness of his heart, we have an evident Instance, what the true and the primitive unpassionate Religion was, before it was soured by particular Factions' [full reference].v. 'By the Advice of this Excellent man I first set upon this Enterprise, yet still came to it with much Reluctancy, because I was to follow the footsteps of so eminent a Person as Dr. Wren, who was the first that attempted any thing of this nature. ... But at last, being assured both by Dr. Wilkins, and Dr. Wren himself, that he had given over his intentions of prosecuting it, and not finding that there was any else designed the pursuing of it, I set upon this undertaking, and was not a little encouraged to proceed in it, by the Honour the Royal Society was pleased to favour me with, in approving of those draughts (which from time to time as I had an opportunity of describing) I presented to them. And particularly by the Incitements of divers of those Noble and excellent Persons of it, which were my more especial Friends, who were not less urgent with me for the publishing, then for the prosecution of them' [full reference].vi. William Lloyd, A Sermon Preached at the Funeral of the Right Reverend Father in God, John Late Lord Bishop of Chester ... on Thursday the 12. of December, 1672 (London, 1675), p. 36.vii. On Wilkins see B. Shapiro, John Wilkins 1614-1672: an Intellectual Biography (Berkeley and Los Angeles: University of California Press, 1969); H. Aarsleff, 'John Wilkins', Dictionary of Scientific Biography 14 (1976); R. Lewis, John Wilkins's Essay (1668) and the context of seventeenth-century artificial languages in England (unpublished Oxford DPhil, 2003). I am extremely grateful to Rhodri Lewis for giving me access to his thesis.viii. For the classic modern account of the importance of laboratory group practice for science see Bruno Latour, Science in Action: How to follow Scientists and Engineers through Society (Cambridge, Mass.: Harvard University Press, 1987). James Gleick, Isaac Newton (London, Fourth Estate, 2003) is a good recent example of how persuasive the 'isolated loner' version of intellectual (and particularly mathematical) creativity remains. Gleick's highly readable version of Newton takes Westfall's masterly intellectual biography (R. Westfall, Never at Rest: A Biography of Isaac Newton (Cambridge: Cambridge University Press, 1980)) and reshapes it into a kind of interior monologue, 'explaining' the man behind the ideas.ix. Even that supposedly most solitary of scientifically-minded individuals, Isaac Newton, used tabulated materials based on teams of observers (compiled by the assiduous Edmond Halley) in his Principia mathematica.x. '[He] was an Assistant to the said Dr. Scarborough, in anatomical Preparations and Experiments, especially upon the Muscles of human Bodies, during their Studies at Oxford and elsewhere' (S. Wren, Parentalia: Or Memoirs of the Family of the Wrens (London, 1750), p. 187).xi. Once again, Hooke returned to the problem posed by Wilkins repeatedly in the course of his scientific career. Waller reports: 'On the 4th of Feb. 1674/5 several Observations and Discourses having been made about the Structure of the Muscles of Animals, Mr. Hooke said, "That his Observation was, that the fleshy part of a Muscle consisted of an infinite number of exceeding small round Pipes, extended between the two tendons of the Muscles, and seem'd to end in them ... He said that the reason of the moving of a Muscle might be from the filling or emptying of those Pipes. ... He intimated also, that he knew a way of making succedaneous Muscles for a Man to supply the defect of his Muscles for flying, and give one Man the strength of ten or twenty, if required.' Waller, Posthumous Works, p. xix. On 25 April 1678 Hooke demonstrated muscle-movement, using 'a Chain of small Bladders fastened together, so as by blowing into one Pipe, the whole might be successively fill'd, and by that means contracted' (Waller, Posthumous Works, p. xx).xii. This was when Charles Louis threw in his lot with the Parliamentarians against the royal party at the outbreak of the first civil war. According to the inscriptions on letters in the Hartlib archive, Hartlib also became a 'servant of the Elector Palatine' in 1642.xiii. For a full account of what follows see Jardine, On A Grander Scale, chapter 2.xiv. On 4 December 1648 William Hamilton wrote to Hartlib that: 'Mr Wilkins the Prince Electors chaplaine, & Warden of Waddam ... has come to London to the Prince & so hath continued ever since; & I beleeve will so long continue yet' (Hartlib papers 9/11/2A). On 16 January 1649 Hamilton informed Hartlib that 'Mr Wilkns the prince Electors chaplaine, after he came [back to Oxford] from London, stayd but about a fortnight or 10. days heer, & went back again, wher he hath continued since' (Hartlib papers 19/11/4A). Charles Louis left for the Continent shortly after 13 March 1649 (Jardine, On a Grander Scale, chapter 2). on 16 December 1658 Hartlib wrote to Boyle concerning a distinguished academic in Germany, and commented that Wilkins might already know him: 'if I should tell his name, perhaps, [he is] not unknown to Dr. Wilkins, when he travelled beyond the seas'. (M. Hunter, A. Clericuzo, and L. M. Principe, The Correspondence of Robert Boyle, 6 vols. (London: Pickering & Chatto, 2001) 1, 294-5).xv. Parentalia, p. 183. If we take the dedication seriously, then Wilkins believed that the kinds of practical experiment, inventions in the field of new technology, and diverting scientific and technical pass-times he described in Mathematical Magick would particularly appeal to his employer. If so, Wilkins may have acquired his habits of (and confidence in) collegial inquiry and collaborative experimenting under the guidance of a virtuoso employer during his years serving the Elector.xvi. 'I should not thus have presented my Diversions where I owe my Study and Business, but that where All is due, a Man may not justly withhold any Part. This following Discourse was composed some Years since, at my spare Hours in the University. The Subject of it is mixed Mathematicks; which I did the rather at such Times make choice of, as being for the Pleasure of it more proper for Recreation, and for the Facility,

more suitable to my Abilities and Leisure. I should not, Sir, have been ambitious of any so Great (I could not of any Better) Patronage, had not my Relation both engaged and emboldened me to this Dedication. They that know Your Highness, how great an Encourager You are, and how able a Judge in all Kind of Ingenious Arts and Literature, must needs acknowledge Your Pressures and Low Condition to be none of the least Mischiefs (amongst those many other) under which the Commonwealth of Learning does now suffer. It would in many Respects much conduce to the general Advancement of Religion and Learning, if the Reformed Churches, in whose Cause and Defence Your Family hath so deeply suffer'd, were but effectually mindful of their Engagements to it. And particularly, if these present Unhappy Differences of this Nation, did not occasion too much Forgetfulness of their former Zeal and Professions for the Vindicating of Your Family, and the Restoring of Your Highness: The Hastening and Accomplishment of which, together with the Increase of all Heavenly Blessings upon Your Highness, shall be the hearty daily Prayer of, Your Highness's most Humble and most Devoted Servant and Chaplain, John Wilkins.' J. Wilkins, Mathematical Magick: Or the Wonders That may be perform'd by Mechanical Geometry, in Works (London, 1708), fol. Gg4r.xvi. Parentalia, p. 183. The third paper attached to the letter was a set of drawings of tiny living organisms viewed under the microscope. We have already seen how, a decade and a half after he had authorised Wren to present his microscopic drawings to the Elector, Wilkins transferred that initiative from Wren to Hooke to complete. This is the project which Wilkins later reallocated to Hooke, for which Hooke expresses his gratitude in the preface to Micrographia. Before taking Wren off this undertaking, Wilkins had been instrumental in having Wren's drawings of a much-magnified flea and louse presented to the restored King Charles I, along with a three-dimensional model of the surface of the visible face of the moon, showing its mountains and valleys. This latter object was a physical realisation of the landscape so vividly described by Wilkins in his Discovery of a world in the moone.xviii. Hartlib, for example, had had a personal financial stake in Cressy Dimmock's earlier version of an agricultural engine of some related kind. [Hartlib papers reference]xix. In January 1645, Sir Cheney Culpeper wrote to Hartlib, alerting him to a prototype 'engine for settinge corne' made by Mr Platte, who had recently died, which 'may (very likely) be yet bowght for money at his woorkemans; I conceive theire will be better wayes fownde out, but for the presente I heartily wishe to have one of his partly to preserve it, partly to try it & partly to use it as a step to further thowghts' (Hartlib papers, 13/59A). An undated document in Petty's hand gives an abstract of an engine developed by Cressy Dymock (Hartlib papers, 62/50/17A-18B). On 6 August 1648 Culpeper wrote to Hartlib asking for clarification as to whether the engine being developed (perhaps from some combination of the designs of Platte and Dymock) was going to be attributed to Petty alone, or to a consortium including both Culpeper (who have invested money in it) and Petty (Hartlib papers, 13/27A-B). On 4 October 1648 Culpeper wrote to Hartlib: 'I perceive that I am to expecte from mr Petty that (yf I do not submitte to his conditions of an after proposition) he will indeavor to showlder me out of my owne designe. … Nowe, I have opened the designe & my thowghts concerninge it, I have disbursed my monyes & am ready upon reasonable conditions to disburse more, & claime but my share in that which was wholly myne'. Petty applied for a patent on his sole behalf in July 1648. xx. 'He hath also scanned and corrected Plats his calculations about the encrease in corne.The benefit of this new kind of agriculture will be bee [sic] 1. for saving so much in that which is otherwise sowen. 2. in getting of that lesser quantity so much more of encrease.' Frank, 'John Aubrey, FRS, John Lydall, and science at Commonwealth Oxford', p. 202.xxi. 'The 6 of July Petty came to mee acquainting mee with the success of his instrument for setting of corne which he hath sent formerly to his friend Dency in the country, that it hath fully succeeded and answered expectation so that the husband-men there judged it the best corne. The setting of 2 at once doth better then one alone. The instrument can bee kept secret that none can find out the mysterie. The whole instrument costs no more than 50 shillings and his joyner or carpenter, who is bound to secrecy, is very greedy of making it. Hee is now making another, friends affording him the lands to make more of his experiments.' Frank, 'John Aubrey, FRS, John Lydall, and science at Commonwealth Oxford', p. 202.xxii. Frank, 'John Aubrey, FRS, John Lydall, and science at Commonwealth Oxford', p. 215.xxiii. In a letter to Boyle of 8 December1657, Hartlib described an agricultural engine, in whose development Culpeper had been involved (perhaps the seed-drill), as 'the new invented plough of Dr. Wilkins'. Hunter et al, Correspondence of Boyle 1, 244.xxiv. Petty to ?, 7 August 1651. Hartlib papers 67/11A.xxv. For an equivalent story of Wren and Petty's development of a 'double writing machine', undertaken collaboratively in the Wilkins circle, but for which they each applied for a patent, see Jardine, On a Grander Scale, pp. 89-96. In this case it was generally agreed that Wren's was ultimately the more successful design.xxvi. Hunter et al, Correspondence of Boyle 1, 72.xxvii. Hunter et al, Correspondence of Boyle 1, 73.xxviii. Letter from Wilkins to Boyle, 6 September 1653: 'You have so well acted the part, which belongs to me, of returning acknowledgments for the favours recieved at London, that I am as much ashamed, as unable to imitate you. But I have known, Sir, that you are a great master of civilities as well as learning, and therefore shall in all things most willingly submit. I had thought you had gone out of town shortly after the time I waited upon you, which was the reason I did not attempt to trouble you with a visit' (Hunter et al, Correspondence of Boyle 1, 145).xxix. 'This bearer is the young man, whom I recommended to you. I am apt to believe, that upon trial you will approve of him. But if it should happen otherwise, it is my desire he may be returned, it being not my aim so much to prefer him, as to serve you, which your own eminent worth will always oblige me unto with my utmost zeal and fidelity.' Hunter et al, Correspondence of Boyle 1, 145. Robert Hooke may well have been the young man sent by Wilkins as a possible suitable 'assistant' to Boyle. It is even possible that Boyle agreed then to take him on. Had Boyle not been called home to Ireland on urgent family business at that moment, such an appointment would have solved Hooke's financial difficulties, and served Boyle's scientific purposes. Instead, Hooke went on working for Willis, until 1655, when Boyle did finally establish a residence for himself in Oxford. In November 1654 Hartlib noted: 'Dr Wellis [Willis] of Dr Wilkins acquaintance a very experimenting ingenious gentleman communicating every weeke some experiment or other to Mr. Boyles chymical servant, who is a kind of cozen to him' (cit. Frank, Harvey and the Oxford Physiologists, p. 165).xxx.

Hunter et al, Correspondence of Boyle 1, 145.xxxi. Rooms in the Old Schools Quadrangle had already been refurbished to provide an anatomy theatre in the 1630s, while a third floor was built at the expense of Thomas Bodley, to increase the space for what became the Bodleian Library. See Frank, Harvey and the Oxford Physiologists, p. 46; Jardine, On a Grander Scale.xxxii. Hunter et al, Correspondence of Boyle 1, 190-2.xxxiii. Discourse Concerning the Beauty of Providence, p. 65. cit. Aarsleff, 'John Wilkins', p. 377, note 40.