

William Cullen's Agricultural Lectures and Writings and the Development of Agricultural Science in Eighteenth-Century Scotland*

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Abstract

It is now becoming recognized that the Scottish agricultural improvers had earlier antecedents than many of their English and Welsh counterparts. In this article, the work of William Cullen is analyzed to demonstrate the significance of his agricultural lectures at Edinburgh and Glasgow in the 1740s and 1750s, and to suggest the strength of links between the Scottish scientific community and agricultural improvement. Linked intellectually with figures such as Maxwell and Kames, Cullen conducted practical experiments on family farms and represented a striking example of that blend of practice and scientific abstraction which helped transform eighteenth-century Scottish farming through practical education.

WHEN Allan Ramsay wrote in his 1723 poem 'The Pleasures of Improv[e]ments in Agriculture', how Scotland was a 'Nation Long more keen of martial toil/than cultivating of a yeilding [*sic*] soil', he could perhaps not have foreseen those developments that were to characterize Scottish agriculture during the later eighteenth century.¹ Yet, in closing his poem, written in praise of the foundation that year of The Honourable the Society of Improvers in the Knowledge of Agriculture in Scotland,

Ramsay points to some of the means by which agricultural knowledge in Scotland was improved and disseminated in following years.

continou Best of Clubs Long to Improve
your native Plains and gain your nations Love
Rowse evry Lazy Laird of each wide feild
that unmanurd not half their Product yeild
shew them the proper season soil and art
how they may Plenty to their Lands impart
Treeple their Rents encrease the farmers store
without the Purches of one Acre more

Much modern research has been concerned with investigating the bases to agricultural change in eighteenth-century Scotland (see below). It has suggested, too, that that image of earlier backwardness epitomized in Ramsay's 'Lazy Laird' and evident in some interpretations of Scotland's agrarian history must be reappraised.² Several authors have shown how the late seventeenth century in particular was marked

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¹ In A M Kinghorn and A Law (eds), *The Works of Allan Ramsay*, Edinburgh, 1961, III, pp 171-172.

² The image of backwardness and of triumphalist 'revolution' in the eighteenth century is one favoured by J E Handley, *Scottish Farming in the Eighteenth Century*, Edinburgh, 1953; *Idem*, *The Agricultural Revolution in Scotland*, Edinburgh, 1963; H Hamilton, *An Economic History of Scotland in the Eighteenth Century*, Oxford, 1963.

by major advances in land management and in legislation toward an improved agriculture.³

Drawing as it did upon this earlier 'impetus to improvement',⁴ the eighteenth century (the latter decades especially) may, nevertheless, be distinguished from it as one of the principal periods of change in Scottish agriculture both because of the scale of change then taking place – geographically throughout Scotland (excepting perhaps the Highlands) and in the degree to which new practices were being adopted – and because of the involvement then of particular agencies acting to advance agricultural knowledge in ways not typical of earlier periods.⁵ Several related topics have been identified in this latter context.

As Boud has shown, The Honourable the Society of Improvers was the first of many agricultural 'improvement' societies founded in Scotland during the eighteenth century whose concern was with advocating better principles and practices of rural management.⁶ Many were short-lived and

of only local significance but others provided an important means to the sharing of observations on farming practice and a forum in which to debate innovations in crops and techniques. In their dates of foundation and their attention to agricultural education, many of these organizations in Scotland were in advance of their counterparts in England and Wales although bodies in those countries shared the same concerns.⁷

Additionally in Scotland, there were a number of formal institutions whose agenda, at least in part, covered agricultural improvement. In this category we may include, for example, the Edinburgh Society for Encouraging Art, Science, Manufactures and Agriculture, founded in 1755, which gave prizes for essays on topics such as tree planting and manures; the Royal Society of Edinburgh, begun in 1783, which was at its foundation concerned with agriculture; the Highland and Agricultural Society of Scotland; the Select Society, begun in 1754; and the Philosophical Society, founded in 1737. These and other bodies illustrate the close links that existed between social and cultural institutions, scientific enterprise, and the development of the Scottish rural economy in the eighteenth century.⁸ The attention given to agrarian matters by such bodies varied, however, and taken together, their

³ On this point, see for example, T C Smout and A Fenton, 'Scottish Agriculture before the Improvers – an Exploration', *Agric Hist Rev*, 13, 1965, pp 73–93; I D Whyte, *Agriculture and Society in Seventeenth Century Scotland*, Edinburgh, 1979; *idem*, 'George Dundas of Dundas: the context of an early eighteenth-century Scottish improving landowner', *Scott Hist Rev*, LX(1), 1981, pp 1–13; R A Dodgshon, *Land and Society in Early Scotland*, Oxford, 1981; T C Smout, 'Where had the Scottish economy got to by 1776?', in I Hont and M Ignatieff (eds), *Wealth and Virtue: the Shaping of Political Economy in the Scottish Enlightenment*, Cambridge, 1985, pp 45–73; Anand C Chitnis, 'Agricultural improvement, political management and civic virtue in enlightened Scotland: an historiographical critique', *Studies on Voltaire and the Eighteenth Century*, CCXLV, 1986, pp 475–488; *idem*, 'The Eighteenth-Century Scottish Intellectual Inquiry: Context and Continuities versus Civic Virtue', in J Carter and J Pittock (eds), *Aberdeen and the Enlightenment*, Aberdeen, 1987, pp 77–92.

⁴ R H Campbell, 'The Enlightenment and the Economy', in R H Campbell and A Skinner (eds), *The Origins and Nature of the Scottish Enlightenment*, Edinburgh, 1982, pp 21–22.

⁵ Recent detailed reviews of the development of Scottish agriculture since 1700 include Dodgshon *op cit*; M L Parry and T R Slater (eds), *The Making of the Scottish Countryside*, 1980; G Whittington, 'Agriculture and Society in Lowland Scotland, 1750–1870', in G Whittington and I D Whyte (eds), *An Historical Geography of Scotland*, 1983, pp 141–164; D Turnock, *The Historical Geography of Scotland since 1707*, Cambridge, 1982, pp 66–82.

⁶ R C Boud, 'Scottish Agricultural Improvement Societies, 1723–1835', *Review of Scottish Culture*, 1, 1984, pp 70–90.

⁷ On such bodies in England, see for example, N P W Goddard, 'Agricultural Societies', in G E Mingay (ed), *The Victorian Countryside*, 1981, I, pp 245–259; *idem*, 'William Shaw "of the Strand" and the formation of the Royal Agricultural Society of England', *JRASE*, CXLIII, 1983, pp 98–104; H S A Fox, 'Local farmers' associations and the circulation of agricultural information in nineteenth-century England', in H S A Fox and R A Butlin, (eds), *Change in the Countryside*, Institute of British Geographers Special Publication 10, Oxford, 1981, pp 43–64 and notes therein; K Hudson, *Patriotism with profit: British agricultural societies in the eighteenth and nineteenth centuries*, 1972; *idem*, *The Bath and West: a bicentenary history*, Bradford-on-Avon, 1976; on Wales, see R J Colyer, 'Early agricultural societies in South Wales', *Wel Hist Rev*, 12(4), 1985, pp 567–581; H Edmunds, 'The History of the Brecknockshire Agricultural Society, 1755–1955', *Brycheiniog*, II, 1956, pp 32–36; E Wyn Jones, 'The First Carmarthenshire Agricultural Society', *Carm Antiq*, III, 1961, pp 150–156; W H Howse, 'Radnorshire Agricultural Societies', *Rad Soc Trans*, XV, 1945, pp 23–31.

⁸ S Shapin, 'The audience for science in eighteenth-century Edinburgh', *Hist Sci*, XII, 1974, pp 99–104.

contribution to agricultural knowledge was certainly less vital than that of the specifically agricultural societies. The Highland and Agricultural Society only took that title from 1834 (being begun in 1784 as the Highland Society of Scotland), agricultural interests having before then vied for attention with a commitment to Gaelic culture.⁹ And although the Philosophical Society contained members of The Honourable the Society for Improvers and declared agriculture important, only five per cent of known topics for discussion in the Philosophical Society in the twenty years from 1748 were on agriculture and improvement.¹⁰

The involvement of institutions with rural improvement was paralleled by an expansion of published works on agriculture. Texts describing established practices – ‘Husbandry, till of late, was intirely managed in Scotland by the Vulgar, who, like Moles, ran on blindly in the Track their Fathers had made before them’¹¹ – were increasingly complemented in Scotland during the 1700s by works which offered, often in combination, practical guides based on experiment and personal experience and philosophical speculations as to the future utility or scientific basis of given techniques.¹² Texts stressing the relationships between agriculture and

chemistry were particularly important.¹³ Thus Francis Home in his 1757 *The Principles of Agriculture and Vegetation* in part intended his work to educate ‘... those whose minds have never been improved by science, taught to make observations or draw conclusions’. Home chose to demonstrate through experimentation the scientific basis to the ‘principles of agriculture’, particularly its ‘dependence on chymistry’.¹⁴ Lord Kames represented many of these concerns in his work. He was a forward-thinking landlord, a member of several ‘improving’ institutions and author of *The Gentleman Farmer being an attempt to improve Agriculture, by subjecting it to the Test of Rational Principles* (1776) in which he argued ‘Agriculture justly claims to be the chief of arts: it enjoys beside the signal pre-eminence, of combining deep philosophy with useful practice’.¹⁵ And James Hutton, the late eighteenth-century geologist, himself an improving landlord in the then relatively advanced county of Berwick in south-east Scotland,¹⁶ saw the chief concern of his agricultural manuscripts ‘to make philosophers of husbandmen and husbandmen of philosophers’.¹⁷

⁹ R I Black, ‘The Gaelic Academy: the cultural commitment of the Highland Society of Scotland’, *Scott Gaelic Studs*, XIV(II), 1986, pp 1–38; R C Boud, ‘The Highland and Agricultural Society of Scotland and the Ordnance Survey of Scotland, 1837–1875’, *The Cartographic Journal*, 23(1), 1986, pp 3–26.

¹⁰ R L Emerson, ‘The Philosophical Society of Edinburgh 1748–1768’, *Brit Jour Hist Science*, 14, 1981, pp 133–176; on the Select Society, see R L Emerson, ‘The social composition of enlightened Scotland: the select society of Edinburgh, 1754–1764’, *Studies on Voltaire and the Eighteenth Century*, CXIV, 1973, pp 291–329; on such societies in general, see D McKie, ‘Scientific societies to the end of the eighteenth century’ in A Ferguson (ed), *Natural Philosophy through the Eighteenth Century and Allied Topics*, 1972, pp 133–143; J E McClellan, *Science Reorganised: Scientific Societies in the Eighteenth Century*, New York, 1985.

¹¹ The quote is from R Maxwell, *The Practical Husbandman: being a Collection of miscellaneous papers on Husbandry*, Edinburgh, 1757, p 339.

¹² J A S Watson and G D Amery, ‘Early Scottish Agricultural Writers (1697–1790)’, *Trans Highland and Agric Soc of Scotland*, XLIII, 1931, pp 60–85.

¹³ E J Russell, *A History of Agricultural Science in Great Britain 1620–1954*, 1966; G E Fussell, ‘Science and Practice in Eighteenth-Century British Agriculture’, *Ag Hist*, XLIII, 1969, pp 7–18; *idem*, *Crop Nutrition: Science and Practice before Leibig*, Kansas, 1971; *idem*, ‘Agricultural Science and Experiment in the Eighteenth Century: an Attempt at a Definition’, *Agric Hist Rev*, XXIV, 1976, pp 44–47.

¹⁴ F Home, *The Principles of Agriculture and Vegetation*, Edinburgh, 1757, pp 2–4.

¹⁵ H Home [Lord Kames], *The Gentleman Farmer being an Attempt to improve Agriculture, by subjecting it to the Test of Rational Principles*, Edinburgh, 1776, p v; on Kames’ work as an agriculturalist and theorist in the context of eighteenth-century Scottish improvement, see G Bryson, *Man and Society: the Scottish Inquiry of the Eighteenth Century*, Princeton, 1945, pp 53–77; Handley, 1953, *op cit*, pp 140–141; 1963, *op cit*, pp 39–49; W C Lehmann, *Henry Home, Lord Kames, and the Scottish Enlightenment*, The Hague, 1971; I S Ross, *Lord Kames and the Scotland of his day*, Oxford, 1972.

¹⁶ R A Dodgshon, ‘Land improvement in Scottish farming: Marl and Lime in Roxburghshire and Berwickshire in the Eighteenth Century’, *Agric Hist Rev*, 24, 1978, pp 1–14.

¹⁷ Royal Society of Edinburgh, MS C.5; on Hutton’s role as an agriculturalist, see J Jones, ‘James Hutton’s Agricultural Research and his Life as a Farmer’, *Annals Sci*, 42, 1985, pp 573–601.

This involvement by prominent scientific men, 'go-ahead lairds',¹⁸ the place of surveyors and other individuals as agents of landscape change,¹⁹ the importance of newspapers and periodicals,²⁰ even the role of tenants and labourers as initiators of change,²¹ was supported in later eighteenth-century Scotland by the development of a more formal educational concern for agriculture. This was evident in Edinburgh at least in Walker's courses of 'Georgical Lectures' and the foundation of Edinburgh Agricultural Society,²² and in the establishment in 1790 of a Chair of Agriculture at Edinburgh University.²³ Lectures in agriculture were also intended in Aberdeen University that year but not begun.²⁴

This conjunction of institutions, individuals, utilitarian philosophy, scientific advance and agricultural prosperity was both shaped, and itself influenced by, those broader concerns of the period with improvements of the Scottish way of life. 'Cultivation' was linguistic, cultural, a

matter of manners and civic virtue as it was also a question of rural productivity.²⁵ The association of agricultural advance with cultural and social improvement was apparent in the involvement of many eighteenth-century Scottish agrarian writers and scientists (themselves landowners and members of the urban élite if not also university lecturers or audience), with what has been called the 'utilitarian impulse'. This impulse was itself part of an expanding Scottish 'earth science tradition' embracing geology, natural history, and, particularly important in relation to agricultural improvement, the science of chemistry.

Natural philosophy and medicine were also essential elements in the intellectual enquiries characteristic of eighteenth-century Scotland.²⁶ One author has seen these links between the demand for scientific knowledge, social cultivation and the importance attached to utility in terms of an 'institutionalized alliance between agricultural improvement, powerfully argued by the august landed audience, and the rationalizing impulse of scientific intellectuals'.²⁷ Whilst we might concur with a more recent claim that 'the contributions of the Enlightenment to economic life, whilst admitted, have to be evaluated with care',²⁸ it is clear that agricultural improvement in eighteenth-century Scotland was

¹⁸ T M Devine (ed), *Lairds and Improvement in the Scotland of the Enlightenment*, Strathclyde, 1978; R H Campbell, 'The Scottish improvers and the course of agrarian change in the eighteenth century', in L M Cullen and T C Smout (eds), *Comparative Aspects of Scottish and Irish Economic and Social History 1600-1900*, Edinburgh, 1977, pp 204-215.

¹⁹ I H Adams, 'The Agents of Agricultural Change', in M L Parry and T R Slater, *op cit*, pp 155-175; S Macdonald, 'The role of the individual in agricultural change: the example of George Culley of Fenton, Northumberland', in H S A Fox and R A Butlin, *op cit*, pp 5-22.

²⁰ N Goddard, 'The Development and Influence of Agricultural Periodicals and Newspapers, 1780-1880', *Agric Hist Rev*, 31, II, 1983, pp 116-131.

²¹ S Macdonald, 'Agricultural Improvement and the Neglected Labourer', *Agric Hist Rev*, 31, II, 1983, pp 81-90; Campbell, 'The Scottish Improvers', *op cit*, pp 210-211.

²² H W Scott, 'John Walker's Lectures in Agriculture (1790) at the University of Edinburgh', *Ag Hist*, XLIII, 1969, pp 439-445; C W J Withers, 'A Neglected Scottish Agriculturalist: the "Georgical Lectures" and Agricultural Writings of the Rev Dr John Walker (1731-1803)', *Agric Hist Rev*, 33, II, 1985, pp 132-146.

²³ S Richards, 'Agricultural Science in Higher Education: Problems of Identity in Britain's First Chair of Agriculture, Edinburgh 1790-1831', *Agric Hist Rev*, 33, I, 1985, pp 59-65; see also chapter VIII 'Agriculture' of the British Association's *Edinburgh's Place in Scientific Progress*, Edinburgh, 1921, pp 162-167 (by J A S Watson); A Smith, 'Agricultural education and its needs', *Scott Jour Agric*, 111, pp 155-160.

²⁴ K Blaxter, 'Agricultural Science and Practice', *Proc Royal Soc Edin*, 84B, 1983, pp 6-7.

²⁵ N T Phillipson, 'Culture and Society in the Eighteenth Century Province: the Case of Edinburgh and the Scottish Enlightenment' in L Stone (ed), *The University in Society*, Princeton, 1974, II, pp 407-420; *idem*, 'The Scottish Enlightenment' in R Porter and M Teich (eds), *The Enlightenment in National Context*, Cambridge, 1981, pp 19-40; N T Phillipson and R Mitchison (eds), *Scotland in the Age of Improvement*, Edinburgh, 1970; A Chitnis, *The Scottish Enlightenment: a Social History*, 1976; John Robertson, 'The Scottish Enlightenment at the limits of the civic tradition', in Hont and Ignatieff (eds), *op cit*, pp 137-178 places particular emphasis on the institutional impetus to improvement and enlightenment.

²⁶ R Porter, *The Making of Geology: Earth Science in Britain 1660-1815*, Cambridge, 1977, pp 149-165; Chitnis, 1986, 1987, *op cit*.

²⁷ Shapin, *op cit*, p 102.

²⁸ Campbell in Campbell and Skinner, *op cit*, p 8.

part of a longer-running and wider enterprise that was then, simultaneously, a matter of social and scientific advance, individual action, institutional motivation, practical experience, and theoretical reasoning.

With these issues as introduction, this paper is an attempt to contribute to our understanding of the links between agricultural improvement and enlightenment science in eighteenth-century Scotland. What follows aims to cast light upon the means by which agricultural knowledge was advanced within this wider context of improvement by looking at the work and agricultural writings of one individual, William Cullen. Cullen, who was born in Hamilton in 1710 and who died in Edinburgh in 1790, is perhaps best known for his contribution to medical knowledge.²⁹ But he was much involved with agricultural topics throughout his life. This involvement is evident in several ways: in university and private lectures he gave on agriculture and agricultural chemistry; in his practical research on scientific improvements in agriculture; in his manuscripts, especially his 'Reflexions on the Principles of Agriculture and Remarks on the Principles of Agriculture', the 'Abstract' of his lectures and a never published book, and his lengthy 'Essays on the Plow'; in his close relationship with Lord Kames who at one time saw in Cullen the potential author of 'a treatise on agriculture, better than the world ever yet saw'; and, lastly, in his membership of institutions, most notably the Select Society, the Philosophical Society and the Royal Society of Edinburgh.

Each of the above suggests Cullen was, in some senses, representative of an age. But the breadth of his involvement with agricultural improvement and particularly

his lectures on agriculture, agricultural chemistry and the bases to plant nutrition suggests Cullen to have been an important individual figure in agricultural circles in eighteenth-century Scotland. More than that, however, the inclusion of agricultural topics in his chemistry lectures in the 1740s and in his privately-given lectures on agriculture in 1768 highlights that philosophical concern not only of eighteenth-century Scotland but throughout Europe with advances in agriculture based on practical knowledge and theoretical discourse. In examining Cullen's agricultural lectures and writings, what follows has two related aims. The first, given what little attention has been paid to them hitherto, is to introduce to a wider audience the range and content of Cullen's unpublished agricultural manuscripts. The second is to suggest that in examining his work and in the social relations of which he was part, Cullen may be used to illuminate the links between agricultural improvement and scientific knowledge in eighteenth-century Scotland.

I

Cullen's agricultural work may be divided into two sections. In the first are his early unpublished writings and lectures of the late 1740s and 1750s to which very little critical reference has been made, the most important items here being the 'Abstracts' of his lectures, his 'Reflexions on the Principles of Agriculture and Remarks on the Principles of Agriculture' and his work on the plough.³⁰ In the second are his later lectures, one set of which was a privately-given course in 1768 on agricultural topics which was published in abridged form posthumously³¹ and which has received passing attention elsewhere,³² and an

²⁹ This principal work was his classificatory work on diseases, *Synopsis Nostologiae Methodicae*, 1769; on Cullen's life and works in general, see J Thomson, *An Account of the Life, Lectures, and Writings of William Cullen, MD*, Edinburgh, 1859, 2 vols.

³⁰ Cullen's agricultural manuscripts are housed in Glasgow University Library, MSS Box 7.3.

³¹ Various titles: *The Substance of Nine Lectures on Vegetation and Agriculture delivered privately in 1768*, 1796 and *Lectures on Vegetation and Agriculture*, 1796.

³² Emerson, 'The social composition', *op cit*, p 313.

unpublished manuscript entitled 'Lectures on the chemical history of vegetables'³³ dating from about 1755, which has not previously figured as part of Cullen's agricultural concerns. Linking all Cullen's agricultural work is his correspondence and friendship with Lord Kames.

Dating Cullen's first formal involvement with agricultural improvement is relatively easy. He lectured in medicine and other subjects, including chemistry, at Glasgow University from 1744 and was professor of medicine there from 1751 to 1755. He became professor of chemistry at Edinburgh in 1756, was elected to the 'chair of physic' there (essentially physiology) in 1766 and from 1773 until his death was professor of medicine at Edinburgh University. We know that his second course of lectures at Glasgow in 1748 was entitled 'Chemical lectures and experiments directed chiefly to the Arts and Manufactures' and that Cullen saw in these lectures a means to make chemical knowledge useful in an agricultural context.³⁴ In a letter of 1749 to Lord Kames, Cullen noted

As the course was intended to teach the elements of a chemistry applicable to arts in general, chemistry claimed a place; and though I was not well prepared on that subject, yet I thought it was proper to make a beginning, and at least to open young gentlemen's views on the subject.³⁵

From this letter we know not only that Cullen had already begun his agricultural enquiries but also that further research was planned.

I now take the liberty you were pleased to allow me of consulting you about my plan for prosecuting the study, or, if you please, the improvement of agriculture. Your recommendation of this subject has very much strengthened my own inclinations this way, and this would have appeared sooner, if my practice and the teaching a course of chemistry had not entirely occupied me during the winter; but now the last is over, I resolve, during the summer,

to apply to some experiments that relate to agriculture; but lest I lose my labour in random experiments, I wish to have your advice, and to know from you what experiments are likely to prove decisive and fittest to ascertain the principles of agriculture.³⁶

It is from this period that Cullen brought together his experiments and thoughts in his 'Reflexions on the Principles of Agriculture'. And to judge from a lengthy book outline entitled simply 'Agriculture', Cullen clearly had it in his mind to produce a text drawing on his work.

Most of his practical research was carried out either on his own farm, or from 1752 on his brother's farm at Parkhead near Glasgow. From 1756, Cullen farmed an estate at Ormiston, near Kirknewton in West Lothian. To Andrew Wight, whose review of the state of Scottish agriculture was published in 1778, Cullen's farm was among the best in the area.

I have reason to know that he is thoroughly acquainted with every branch of agriculture, both in theory and practice. Already, during his short possession, his turnip and wheat make a figure. He will prove a blessing to the neighbourhood, both by example and precept.³⁷

Cullen's relationship with Kames was both scientific and social. Their correspondence includes letters on the chemical bases to manures (a subject on which Cullen was, by 1750, corresponding with Du Hamel); the best means of planting cabbages; and on questions of plant physiology.³⁸ Kames proposed Cullen as a member of the Philosophical Society in a letter of 17 November 1749.

I live in the faith [wrote Kames] that you are going on briskly with your experiments, and that no concerns of interest make an avocation. I propose you as a member in our Philosophical Society, and indeed we greatly want members of activity and genius . . . In short, my sedate purpose is, that your

³³ Royal College of Physicians, Edinburgh, MS M5.40.

³⁴ Campbell in Campbell and Skinner *op cit*, p 10; Thomson *op cit*, I, pp 62-63.

³⁵ GUL MS Box 7.3.5; Thomson, *op cit*, I, pp 596-597.

³⁶ *Ibid*: Thomson *ibid*, I, p 596.

³⁷ A Wight, *Present State of Husbandry in Scotland*, Edinburgh, 1778, 4 vols, III, p 469.

³⁸ Thomson, *op cit*, I, pp 62-69, 591-602.

name shall be carried down to posterity by a treatise on agriculture, better than the world ever yet saw.³⁹

By 1753 Kames was still exhorting Cullen to draw together his experimental notes and manuscripts and write a book on agriculture.

I no sooner get a moments leisure than I think of my old project for you about agriculture – I would not be surprised if you were offer'd 200£ for the Copy. I have many notes and useful Remarks gather'd in the course of several Years which might find a place. Were we together three days, you might pick out what would serve your purpose.⁴⁰

Reference to 'the Copy' almost certainly means Cullen's 'Reflexions' and his other manuscripts, including his book synopsis. Despite this offer and an earlier prompt by Kames to Cullen to 'Remember also to contribute to the Philosophical Society about which I am turned extremely keen now that I have got in a good measure of the management of it',⁴¹ Cullen failed to collect and publish his papers. Those two papers Cullen did deliver to the Society – 'Reflections on the study of Chemistry' and 'An Essay towards ascertaining the Different Species of Salts' – were not directly concerned with agricultural topics,⁴² although the possibility remains of Cullen having spoken to that body on such matters (see below). There is no evidence to point to Cullen having delivered papers either on agricultural improvement or on chemistry as an agriculturally useful science to the Select Society following his admission in June 1757.⁴³ It is possible, however, that his 'Essay on the Plow' was read before some public society, most probably the Philosophical Society of the University of Glasgow.⁴⁴

Cullen's 'Lectures on the Chemical History of Vegetables' (and the accompanying 'The Chemical History of Animals') may

be dated to 1755 or possibly 1756, and were given as part of his lectures as professor of chemistry at Edinburgh. His privately-delivered lectures on agriculture were delivered in 1768, possibly under the continued promptings of Kames though there is no direct evidence for this.⁴⁵ But whilst we have an indication of their content, much of it drawing upon his earlier work, it is not known to whom these were given, or if they were presented as part of the formal business of a given society or institution, and it is impossible now to know the audience.⁴⁶ But the fact that there are surviving abstracts of the lectures in the hand of the Revd Dr John Walker,⁴⁷ a close friend of Cullen, Philosophical and Select Society member, and himself later a keen agricultural propagandist through natural history lectures, reasonably suggests that Cullen addressed like-minded members of that wider audience of social and scientific improvers in eighteenth-century Scotland.

II

In addition to the more detailed pieces – 'Reflexions', the work on the plough, his book synopsis, and an 'Abstract of Dr Cullen's Lectures on Agriculture' – Cullen's unpublished agricultural manuscripts include letters to Kames; correspondence from a Robert Berrie and a Mr Tullidolph on agricultural matters; a note on the utility of banking fields to prevent flooding; a detailed paper on manures; a short folio entitled 'Why Grains Thin Sown Ripens Late'; and part of a lecture Cullen at some time presented to the Ratho Club, an agricultural improving body located west of Edinburgh.⁴⁸ Notes in parentheses on three

³⁹ *Ibid.*, pp 62–63.

⁴⁰ National Library of Scotland, MS 3892.

⁴¹ Thomson, *op cit.*, I, p 74.

⁴² Emerson, 'The Philosophical Society', *op cit.*, pp 159, 162.

⁴³ Emerson, 'The Select Society', *op cit.*, p 327.

⁴⁴ Thomson, *op cit.*, I, p 65.

⁴⁵ Blaxter, *op cit.* p 6.

⁴⁶ It is likely that Cullen chose to give these lectures in 1768 because that was the first year he started giving his lecture courses on medicine alternately by years with John Gregory, Professor of Practice of Physic at Edinburgh. This 'free time' may explain why he chose to give them then.

⁴⁷ Edinburgh University Library, MS Dc.3.70.

⁴⁸ GUL, MSBox 7.3.4.

of the manuscripts – his correspondence from Tullidelph (a short piece entitled 'Thoughts on Vegetation and the Effects of Lime', dated 7 January 1760; on Cullen's 'Observations on Natural Manures'; and on his letter on salt from Berrie – suggest that they were each intended 'for the Edin. Soc. or the Phil. Soc. of Edin.'. These marginalia, in a later hand, cannot be dated. Although the possibility exists that Cullen aired his views on agricultural chemistry (and those of others on whose work he had commented) to either the Edinburgh Society or the Philosophical Society, we may never know for sure that he did.

The 'Abstract of Dr Cullen's lectures on Agriculture' is a quarto manuscript of 24 pages giving, in considerable detail, the contents of seven lectures.⁴⁹ Some lectures are untitled. From examination of their content, the subjects covered were the bases to plant nourishment from the soil (lecture 1); 'Roots' (lecture 2); on soils and soil fertility (lectures 3–5); 'Effects of Roots' (lecture 6); and 'Improvement of Soils' (lecture 7). The lectures are undated. Almost certainly, however, they are those given to his chemistry students in Glasgow in 1748. The lectures begin with the statement 'All Plants derive their Nourishment wholly or chiefly from the Soil', from which followed, noted Cullen, two further questions; 'What is the nourishment of Plants?', and 'Whether or not all Plants have one common Nourishment' and how such nourishment was applied. We know from his letter of 1749 to Kames that Cullen had by then included agricultural topics in his chemistry lectures (see above), and later in the same letter Cullen notes, 'To begin, then, the whole of the principles of agriculture may be referred to two heads, that is to say, they use either those which relate to the nourishment of plants,

or those which relate to the application of that nourishment'.⁵⁰ The fact that he was declaring in 1749 an earlier interest – 'It is the substance of a few lectures I gave in my course of chemistry'⁵¹ [author's emphasis] – and that his declaration to Kames of their principal intent mirrors that in the 'Abstract' itself almost certainly means that Cullen's lectures detailed in the 'Abstract' date from 1748–49. (It is possible, of course, that the 'Abstract' *manuscript* does not date from then.) The fact that the abstract dating from 1768 in Walker's hand has the same lecture titles may suggest, too, that Cullen's later lectures drew substantially if not entirely from his university chemistry course of twenty years before.

As might be expected, Cullen's lectures focus in particular upon matters of agricultural chemistry; the chemical bases to plant nutrition, the chemical means of improving soil quality, and the question of the 'heat' needed in soils for proper plant growth: 'To procure this middle Temperature in Soils is the chief object of Husbandry'.⁵² The lectures on soils considered the ingredients – 'Clay, Sand and Mucilage' – that were 'most proper for Vegetation', the proportions of these ingredients as the cause of soil diversity, and on the ways in which 'a Soil may deviate from Fertility and how recovered'. His attention to the use of dung, 'saline manures', rotation of crops and lime as means of soil improvement drew not only upon the work of those persons mentioned in the lectures – notably Stephen Hales, Jethro Tull and Du Hamel – but also upon his own inductive and empirical methods as an eighteenth-century scientist. 'The Knowledge of Causes [noted Cullen] entirely from Experience shew it only in a Single Instance. A Number Shews it in general. Farther Experiments shew it depending

⁴⁹ GUL, MS Box 7.3.2.; Thomson, *op cit*, I, pp 596–7.

⁵¹ GUL, MS Box 7.3.5.; Thomson, *op cit*, I, p 596.

⁵² GUL, MS Box 7.3.2, Lecture 2, f 3.

⁴⁹ GUL, MS Box 7.3.2., 7.3.3.

on particular Circumstances. This gives Axioms, every Intelligent Artificer forms these & is so far a Philosopher'. He continues

The principal Means & Practices already found out & found by such Inductions as above but the foundations not transmitted or known to our Farmers therefore the Business of the Gentle Philo. to explain the foundations and thereby fix ascertain & properly diversify the common Methods the principal point.⁵³

This concern with the philosophical means to practical ends marks Cullen as typical of the period. More than that, however, his lectures illuminate the way in which such 'Gentleman Philosophers' clearly saw in themselves the means by which scientific (philosophical) discourse could actually be 'transmitted or known to our Farmers' as a profoundly useful practice. Cullen's scientific interest in calcareous salts, for example, is evident in his later essay on the subject to the Philosophical Society.⁵⁴ His intent that such 'philosophical' knowledge be useful to the 'Intelligent Artificer' is the underlying theme of his agricultural writings, particularly his 'Reflexions on the Principles of Agriculture'.

This thirty-three page manuscript contains in an expanded form parts of Cullen's lectures but, in the reflexive tone it adopts to some of the subjects covered there and in the title itself, must be presumed to post-date his lectures. The 'Reflexions' is divided into two 'Sections', the first concerning the nourishment of plants, the second on 'the nature of the Nourishment of Plants and of the means of impregnating Soils therewith'. In the first section, Cullen discusses those questions to which he had drawn Kames' attention in 1749: the likelihood of there being a 'Common Nourishment' differently used by all plants or if the soil contains 'a variety of juices

respectively suited to the nourishment of different Plants'. In deciding that 'we need to seek for the nourishment of vegetables no where else than in the destroyed matter of Vegetables themselves', the second section is taken up with the best means 'under which it is to be procured by the Husbandman'.⁵⁵ If, in one sense, the two sections of Cullen's 'Reflexions' mirror in their content the contemporary concern with theoretical discourse and practical improvement, we should remember also that, to Cullen (and to others), observations on soil chemistry, marls, manures, and plants for land management were inseparable parts of that broader 'utilitarian impulse' toward individual and national prosperity through improved agriculture. Cullen saw the relationship between farmer and theorist as reciprocal, if not equal. In concluding a discussion of the chemical basis to manures, he notes how 'With respect to the choice of putrid or putrefying matters it concerns the Farmer to enquire'. Farmers could tell from experience the proper practical course (the *amount* of manure to use); it was the business of the chemist and natural historian to enquire into the *causes* of observable differences in manures and soil fertility.

Cullen's 1755 'Lectures on the Chemical History of Vegetables' further reveal his knowledge on the chemical basis to plant growth and the utility of different plants. His discussion of 'the natural history of vegetables' was, in Cullen's words, a 'Pharmaceutical Chymistry',⁵⁶ a necessary interest in *Materia Medica* for any eighteenth-century physician. Whether his students were keen to have agricultural and botanical topics as part of their medical syllabus is hard to know: Cullen clearly thought such a conjunction of subjects necessary. In his lectures on the chemical history of vegetables, Cullen notes 'I must

⁵³ GUL, MS Box 7.3.2.

⁵⁴ A Donovan, *Philosophical Chemistry in the Scottish Enlightenment*, Edinburgh, 1975, pp 67-69, 86-88; *idem*, 'William Cullen and the Research Tradition of Eighteenth-Century Scottish Chemistry' in Campbell and Skinner (eds), *op cit*, pp 98-114.

⁵⁵ GUL, MS Box 7.3.3.

⁵⁶ RCPE, MS M5 40, Lecture 2 f 21.

tell you Gentlemen, that it is impossible for me to go on with this Subject without introducing a great many Botanical names, and I hope you are all acquainted with these, at least you should be'.⁵⁷

Cullen also turned his mind to the plough, as did others in this period.⁵⁸ What little attention has been paid to his work on the plough⁵⁹ has failed to note that there are two extant manuscripts, differently titled and with some variation in content. A third manuscript simply lists issues addressed in the longer pieces. Of the two longer manuscripts, the first and presumably earlier piece (both are undated but may be presumed synchronous with his 1748 lectures⁶⁰) is entitled 'An Essay on the construction & operation of the Plow'. It is an unfinished 12vo manuscript of thirty pages in Cullen's hand with numerous corrections and marginal notations. His object is to explain 'the mechanical principles on which ploughs have been constructed, to find out what is the importance and effect of each part, and to examine what variation each or all of them require, according to the difference of soil in which they are employed'.⁶¹

The second shorter 12vo manuscript (17 pages) is entitled 'An Essay on The Construction of the Plow'. There are no illustrative figures and the lack of corrections suggests it is a later version. Cullen is concerned in his essay 'to apply Scientific principles' to something which, in his view, had 'been improved so far as to answer the purposes of Art tolerably well

but they have Seldom been carried in that way to their utmost perfections'.⁶² It is unlikely that Cullen included his work on the plough in his lectures. It was, he wrote, 'of a nature not much akin to my ordinary Studies'. But he clearly intended it to be useful, if more to husbandmen than philosophers.

The persons to whom this is addressed are Suposed to be acquainted with the Structure of an ordinary plow & with the Names applied to The Several parts of it a description therefore of a plow is here omitted tho it might be necessary to Some who may look into this Essay but to Such every plowman can Supply the defect.⁶³

It is clear also that Cullen at some time intended (and failed) to gather his lectures and writings together in book form. Amongst his surviving manuscripts is an undated nine page 12vo manuscript in his own hand entitled simply 'Agriculture'. There is no reference to this work in his other writings and if this is 'the Copy' to which Kames refers in a letter of 1753 (see above), it is not discussed again. Part I reveals Cullen's concern with the chemical basis to plant nourishment. The intended extensive discussion of the degeneracy and improvement of soils and on manures that follows in Part II Book II draws upon work in his lectures and in his piece on manures. The later sections of Book II, from Chapter III 'Of Sowing' onwards, are departures from his other work. Although the attention intended to be directed to discussion of management practices suited to given soils and particular products may well have drawn from his lectures and his earlier 'Reflexions', they also represent a considerable broadening in scope and intent. The inclusion of issues relating to Scottish agriculture in general reinforces the claim that Cullen, like many others in eighteenth-century Scotland, saw his individual and institutional interest in

⁵⁷ *Ibid.*, Lecture 1 f 5. It is quite likely that medical students were familiar with or, at least, knew of agricultural texts in this period and earlier. *The Physiological Library begun by Mr Stewart and some of the Students of Natural Philosophy of Edinburgh*, printed in 1725 has several agricultural works, including Evelyn's translation of Quintinye's *Compleat Gardener*, Lord Belhaven's *The Countryman's Rudiments*, Edinburgh, 1707, and John Ward's *Compleat System of Husbandry and Gardening*, 1716.

⁵⁸ G E Fussell, 'Ploughs and Ploughing before 1800', *Agric Hist.*, XL, 1966, pp 177-186.

⁵⁹ Donovan, *Philosophical Chemistry*, *op cit*, p 69; Thomson, *op cit*, I, p 65.

⁶⁰ Thomson, *op cit*, I, p 65.

⁶¹ GUL, MS Box 7.3.1. Both versions of the manuscript on the plough are catalogued under this number.

⁶² GUL, MS Box 7.3.1. ('Essay on the Construction of the Plow'), ff 1-2.

⁶³ *Ibid.*, f 17.

agricultural chemistry as an important means to national prosperity.

III

Assessment of Cullen's place in the development of agricultural science in eighteenth-century Scotland rests not only upon comparison of his work with those others who wrote about agricultural chemistry but also upon what this work and his social and scientific relations with individuals and institutions reveals as to the context in which such useful science was being practised.

It is possible that Cullen knew, as he lectured his chemistry students in Glasgow from 1748, of those earlier lectures on agriculture given by Robert Maxwell, secretary to the Society of Improvers,⁶⁴ and likely, too, that he supported Maxwell's plea for a more formal educational concern: 'Altho' there is not, or perhaps never may be in our Time, a College of Husbandry established by Authority; yet surely, every probable Opportunity of improving in the Knowledge of it should be embraced'.⁶⁵ Cullen's inclusion of agricultural topics in university courses of chemistry lectures, his 'Reflexions', and even his 1768 lectures should, however, not be seen as a direct response to Maxwell's claim, the promptings of Kames or of any particular stimulus. His agricultural work was a reflection of that much wider and deeper concern with ways of making science useful, of uniting through science the practical but essentially individual experience of Scottish farmers with those rational and theoretical principles thought to underlie all husbandry.

In the simplest sense, Cullen's lectures have an historiographical significance. His evident concern to educate, if only partly,

an audience of 'gentlemen' in matters of rural economy follows that of Maxwell. He pre-dates Walker's lectures on natural history and agriculture and the founding, in the year of Cullen's death, of the Chair of Agriculture at Edinburgh University and the beginnings of formal if unsustained agricultural interest at Aberdeen. But Cullen's lectures and writings have more than a simple historical importance. In his attention to agricultural issues in chemical, medical, and botanical lectures, Cullen was varying the practical means to a widely-shared philosophical end.

Home's *The Principles of Agriculture and Vegetation*, for example, stressed through experiments the links between plant physiology and soil chemistry. Although this work has been both praised by one writer as 'of first rate importance in the history of Scottish agriculture'⁶⁶ and seen by another as 'more indicative of a disappearing epoch than the forecast of a new era of agricultural science',⁶⁷ it may also be seen as a profoundly *practically-based* enquiry in a way Cullen's work was not. Home's work was not a practical guide, however: 'I don't intend in the following remarks to settle facts, or teach the practical part of farming. That I leave to farmers'. Whilst his concern, like Cullen's, was with the scientific (chemical) principles to agriculture, Home's faith in the utilitarian aspects of the science was less strong than Cullen: 'As this science [chemistry] is but of late invention, and has not yet been cultivated with that regard to utility, and the improvement of trade and manufactures, as it ought and might, agriculture is hardly sensible of its dependence upon it'.⁶⁸

Increasingly during the eighteenth century, others were aware of the links between the two and of the relations between science and practice in general. Works that might be mentioned in this

⁶⁴ This point is made also by Donovan, *Philosophical Chemistry*, *op cit*, p 287 n68.

⁶⁵ Maxwell, *op cit*, p 381 and see also pp 379-380 for notes by Maxwell on his lectures.

⁶⁶ Handley, 1953, *op cit*, p 129.

⁶⁷ Blaxter, *op cit*, p 6.

⁶⁸ Home, *op cit*, p 5.

context are John Randall's *The Semi-Virgillian Husbandry* (1764), George Fordyce's *Elements of Agriculture and Vegetation* (Edinburgh, 1765), John Mills' *The Natural and Chemical Elements of Agriculture* (1774) – itself a translation of Adolf Gyllenborgii's *Agriculturae Fundamenta Chemica* (Uppsala, 1761) – James Anderson's *Essays Relating to Agriculture and Rural Affairs* (1775), and, later in the century, Cochrane's (Lord Dundonald) *Treatise on the Connection of Agriculture with Chemistry* (1795). That these and other works on agricultural chemistry appeared when they did may be considered the result of several factors in combination: the continuation and expansion of that earlier interest in scientific agriculture evident elsewhere in Great Britain and in Scotland from the later 1600s;⁶⁹ the contemporary expansion of knowledge in chemistry during the eighteenth century and a parallel expansion in commitment to its utility as applied science; and in those particular forces – intellectual, institutional, social – making for change in eighteenth-century Scotland and earlier. What distinguishes Cullen within the development of agricultural science in eighteenth-century Scotland is that, in his lectures and writings, we can more clearly see the means by which that expressed commitment to a given philosophy was made real.

Other contemporaries placed much less emphasis on the scientific basis to agricultural improvement. Dickson's *A Treatise of Agriculture* (1762) was much more concerned with the best means of managing plants and with the implements of tillage than with the chemical basis to agriculture,

although Book III of his work does discuss manures and their operation. Wight's 1778 work is in another tradition still: that of a national survey of practice. Kames' *The Gentleman Farmer* is principally concerned with the practice of agriculture. Part I of his book is so entitled and has 14 chapters in distinction to Part II which has only 3 chapters on the 'Theory of Agriculture' including one on the 'Food of Plants, and Fertility of Soil'. The distinction between these expressed means of improvement – the observational and empirical tradition of Dickson and Kames and the philosophical reasoning toward rational principles evident in Home, Fordyce, and Cullen – was noted by Kames himself: 'To be an expert farmer, it is not necessary that a gentleman be a profound chymist. There are however certain chymical principles relative to agriculture, that no farmer of education ought to be ignorant of'.⁷⁰

Cullen's own ability as a 'profound chymist' and his increasing involvement with chemistry and medicine may be advanced as the principal reasons why he neither published his agricultural writings nor wrote the book that his 'Agriculture' manuscript suggests was in his mind. His agricultural interests were not forgotten as his career developed but his university role simply became more pressing.⁷¹ It had probably become so as early as 1752 and 1753. He had by then not even communicated the results of his chemical experiments begun in 1748 and 1749 to his mentor Kames who, in July 1752, was moved to write to Cullen 'If I do not get this summer some of your experiments about husbandry, I will abandon you altogether as an utter bankrupt'.⁷² Kames was still pressing Cullen on agricultural matters

⁶⁹ Russell, *op cit*; Fussell, 'Science and Practice', *op cit*, A and N L Clow, *The Chemical Revolution: A Contribution to Social Technology*, 1952 esp pp 456–514; Campbell in Campbell and Skinner, *op cit*; It may also be that the adoption of Newtonian method in science in Scottish universities in the seventeenth century allowed for the more rapid expansion of inductive empiricism during the eighteenth century. On this point, see Christine M Newton, 'Newtonianism in Scottish Universities in the Seventeenth Century', in Campbell and Skinner, *op cit*, pp 65–85 and esp p 83.

⁷⁰ Home [Lord Kames], *op cit*, p 292.

⁷¹ Donovan, *Philosophical Chemistry*, *op cit*, p 69; N Campbell and R Martin S Smellie, *The Royal Society of Edinburgh (1783–1983)*, Edinburgh, 1983, pp 4, 10.

⁷² Thomson, *op cit*, I, p 598.

as late as 1775 but by then Cullen's professional obligations and medical researches were filling his time, Kames was drafting his own work and at the same time turning to another Edinburgh chemist, Joseph Black, to fulfil a role he had twenty-five years before envisaged for Cullen. In July 1775 Kames wrote to Black noting '... for if I mistake not greatly, the principles of agriculture will in your hands make one of the most interesting articles of a course of chymistry . . . after preparing yourself by a course of proper experiments, lectures upon agriculture would turn out much to the public benefit and no less to your own reputation'.⁷³

IV

This paper set out to illuminate the relationships between agricultural improvement, scientific practice, and public benefit in eighteenth-century Scotland through examination of the work of one individual. Several observations may be made in conclusion. Cullen's agricultural

work was part of a broader enterprise in which, by the second half of the eighteenth century especially, the links between practical agriculture and philosophical science, particularly chemistry, were widely recognised and a major thrust in the wider move to improvement. His lectures demonstrate one means by which these relationships were discussed by and disseminated to that wider audience of gentlemen who, in university classes, membership of institutions, and on their own estates, sought to bring benefit to themselves and their nation. Cullen's relationship with Kames mirrors that wider network of social connections in which context both chemical science and agricultural improvement were debated. This paper has suggested that Cullen's lectures reinforce the role of formal education as a means of agricultural knowledge in eighteenth-century Scotland. And this may be to suggest, too, that in order to understand better the relationships between agriculture, science, and social improvement in the Scotland of that period, we may have to proceed in ways taken by those very persons we now seek to study: by examination of the individual in order to proceed to more general principles.

⁷³ EUL, MS Gen. 873/1/83-84; see also EUL, MS Gen. 873/1/85 [Kames to Black, 5 Sept 1775] in which Kames writes 'I have been amusing myself with dipping into the theory of agriculture; and at every turn I find more philosophy in it than I am master of'.