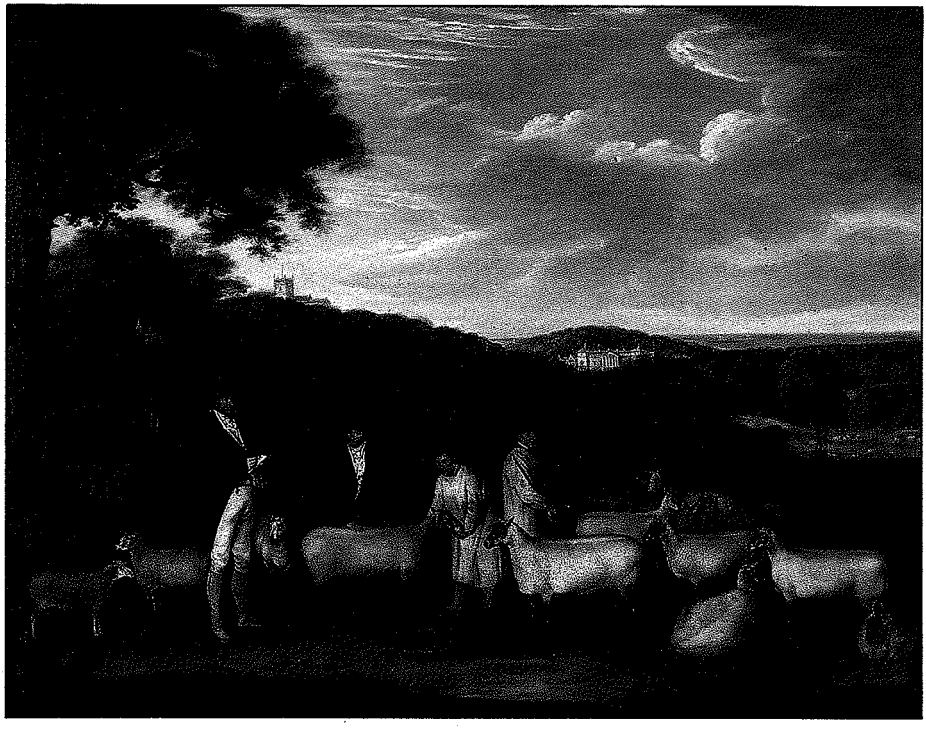
'THE BUSINESS OF IMPROVEMENT': AGRICULTURE AND SCIENTIFIC CULTURE IN BRITAIN, c.1700–c.1870

Sarah Wilmot



Coke of Norfolk and his Southdown Sheep, c.1807 by T. Weaver.

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'THE BUSINESS OF IMPROVEMENT': AGRICULTURE AND SCIENTIFIC CULTURE IN BRITAIN, c.1770 - c.1870

By

Sarah Wilmot

University of Reading

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PREFACE

My initial interest in the cultural history of science as an undergraduate was stimulated by the lectures of Mark Billinge at Cambridge University; it is to him I owe the curiosity. As a postgraduate at Exeter I undertook some preliminary research in the history of agricultural science, funded by the E.S.R.C. Thanks go to Roger Kain and G.E. Mingay who read and commented on aspects of the work at this early stage.

I am very grateful for having had the opportunity to extend the work in the History Department and the Institute of Agricultural History at Reading, owing to the generosity of the Marc Fitch Fund. The work would not have been possible without the library, bibliographical unit, and photograph collection of the Institute, run by John Creasey, Raine Morgan and Barbara Holden respectively. I am grateful to these and other colleagues at Reading for their valuable assistance and cheerful support. Charles Withers, as an editor with his own interests in the field, has been a valuable and patient critic; special thanks go to him. My thanks also go to Carol Mackay and Elizabeth Berry for their accurate typing.

I wish to acknowledge the Hampshire County Museum Service for permission to reproduce the photograph of H. Humphrey's engraving of the 'Generae of Patriotism' or 'The Bloomsbury Farmer planting Bedfordshire Wheat'. The remaining illustrations are all reproduced courtesy of the Institute of Agricultural History and Museum of English Rural Life, University of Reading.

LIST OF ILLUSTRATIONS

'THE BUSINESS OF IMPROVEMENT': AGRICULTURE AND SCIENTIFIC CULTURE IN BRITAIN, c. 1770 - c. 1870

Introduction

Ten years ago debates on late-eighteenth and nineteenth-century scientific movements firmly established the socially and culturally embedded nature of scientific activity and scientific literature.[1] It is the aim of what follows to contribute to this debate through an examination of the field of agricultural science. Chapters 1, 3, 4 and 6 place the development of agricultural science in its national context, examining the growing participation in agricultural science, its links to agricultural improvement, its intellectual history and the perspective agricultural science gives on the relationship between science and social change. Chapters 2, 5 and 7 concentrate on the internal debates within agricultural science, focussing on the two most active periods for the field, c. 1770 - c. 1800 and the 1840s -1860s. Primarily through an interpretation of the written productions of agricultural improvement, the aim of these chapters is to trace the discursive strategies adopted in the texts themselves and to minutely describe how agricultural science was represented between c. 1770 and c. 1870. The discussion pays particular attention to 'those aspects of a text which are appraisive, evaluative, persuasive or rhetorical'.[2] The agricultural texts on which these chapters are based do not comprise an exhaustive survey of available eighteenth- and nineteenth-century writings on agriculture. They do, however, represent among the most widely-read

contemporary texts of the most prominent and institutionally-active individuals of the period. They include the main texts upon which late-nineteenth century writers were to comment and on which modern accounts of eighteenth- and nineteenth-century agriculture are most frequently drawn.[3] A bibliography is included between pages 99-130 providing a guide to finding sources and indicating the range of material available.

The written accounts of agricultural texts were, of course, only one form of representation: landscape painting and engraving, examples of which are included between pages 64-65, was also central in building an image of agricultural science.[4] The meetings of agricultural societies, their commemorative dinners, the awards of medals, plates and cups, their speeches and toasts, and the agricultural shows and sheep-shearings to which visitors flocked, combined to form a living spectacle in which the meanings attached to agricultural science were reinforced and paraded. These concrete events were then translated into visual and written representations to form further layers of cultural and symbolic meaning.

The Royal Agricultural Show of 1851 forms an excellent example of these processes. The event, splendid in itself, was transformed through its location at Windsor into an activity reflecting national unity under the monarchy. The timing was also significant, occurring in the same year as the Great Exhibition. The Show also became emblematic of national prowess in an international field. The visual representation of the scene (Plate 1) clearly emphasises the theme of Royal patronage. A later written representation in the Journal of the Royal Agricultural Society of England (J.R.A.S.E.) reveals and amplifies the rich symbolic resonances of the event:

> An unusual lustre was thrown on the meeting of the Royal Agricultural Society in 1851. Men from all quarters of the world flocked towards happy England to the International Exhibition, to see with their own eyes what it was in our institutions or our race that had raised this country, with its narrow boundaries, to the proud position which she held among the nations. The Royal Agricultural Show of this year was held on the playing fields of Eton on the banks of the Thames, beneath the walls of Windsor Castle, the abode for many centuries of the sovereigns of England, over which floated the Royal Standard of the Queen.[5]

Agricultural science, in common with science in general, was an emblem of national culture: progressive, powerful and (with some important qualifications), patriotic. It was also a sub-culture, pursued by specific institutionally-defined constituencies: the members of the London and provincial agricultural societies, the patrons of the Royal Institution, those invited to attend the sheep-shearings at Holkham and at Woburn, the professionals researching at Rothamsted, and those presenting papers to the British Association for the Advancement of Science (B.A.A.S.), for example. What is known from existing research concerning the patronage, membership and confessed aims of these societies of the late-eighteenth and nineteenth century has been assembled in the following account. A detailed study of this 'sub-culture', however, is lacking and must await future research.[6] In particular, detailed prosopographical work on the membership and activities of agricultural societies is needed to clarify the links between agriculture, scientific culture and society. Nevertheless it is felt that enough research on agricultural science and related topics has been completed to render a general review of these links possible.

The importance of a review of late-eighteenth century and nineteenth-century agricultural science is to give the subject its due prominence in the

flourishing scientific culture of the period, a prominence which has been overlooked in general accounts of the history of science. The purpose of Chapter 1 is to establish the growing interest in the philosophical study of agriculture by documenting the growth in number of agricultural societies and the accompanying increase in specialist publications in the field.

Chapter 2 examines more closely how the philosophical study of agriculture was represented in major textbooks of the period, revealing an emphasis on 'experimental philosophy' and what we would now call 'applied science'. It is clear that contemporary agriculturalists both wanted to share in the 'scientific revolution' and firmly believed that science was the key to future agricultural progress. Chapter 2 focusses exclusively on the perceived role of science in the agricultural sphere. The literature also contains explicit references to advances made in other branches of learning, indicating that developments in agricultural thinking need to be placed in the general context of intellectual and cultural development.

In particular, the history of agricultural science represents one of many other histories in the struggle for authority between customary and 'scientific' or 'philosophical' knowledge.[7] William Marshall's conclusion to his book Minutes of Agriculture (1778) sums up the spirit of agricultural writers:

> Generally - the Author declares himself at open war with Custom; excepting the CUSTOM founded in NATURE, or at least supported by REASON: And he holds the LITERATURE, as well as the AGRICULTURE, whose only foundation is chance-produced custom, derogatory to Beings whose boast is RATIONALITY. His ambition is to be stigmatised with INNOVATOR.[8]

The overall trend in the literature is for deference to an older generation of farmers to be challenged, and for authority to become vested in agriculturalists with qualifications and professional training, but in the nineteenth century the climate of opinion remains transitional.

Chapter 3 attempts to step aside from representations of the importance of agricultural science in the rhetoric of contemporary agricultural texts to examine the concrete connections between science and agricultural improvement. The familiar history of agricultural and related societies furnishes us with many examples of attempts to apply science to agriculture, at individual and institutional levels. After redrawing the outline of that history, Chapter 3 reassesses the impact of science on agricultural improvement, through the eyes of contemporary scientific practitioners and through the findings of modern agricultural historians. The chapter concludes that enthusiasm for agricultural science was not mirrored by impressive practical benefits to agriculture.

Chapter 4 considers the links between natural philosophy, agriculture and national culture. At the end of the eighteenth century the study of agriculture was being included in the research and teaching activities of academics in the Scottish universities and also in the activities of some undergraduate bodies. Prominent members of the scientific community in England also made contributions to the field of agricultural research. By the mid-nineteenth century, the connection between the scientific community and agricultural societies had developed to the extent that agricultural science was now capable of offering very good career prospects for its practitioners. It is argued that it was the acceptance of agricultural research from an early

stage as a serious philosophical endeavour that made it attractive to the landowning elite. Severed from its connection with customary knowledge, traditional languages, and manual labour, the study of agriculture was able to take its place alongside other elements of elite culture.

Chapter 5 examines the way in which the estate improvement movement drew its intellectual justification from the literature of agricultural science, to which it was closely allied. Membership of an agricultural society and the performance of experiments additionally had a social cachet which enhanced the landed elite's self-image and was commemorated in a range of literature and in a genre of portrait painting. The chapter concludes that the pursuit of agricultural science was an integral part of landed society and enhanced its cultural power.

Chapter 6 reviews the implications of this conclusion with reference to the conceptualisation of the role of science and social change in the late-eighteenth and nineteenth century. In particular it is contended that the theoretical separation between aristocratic and bourgeois culture cannot be simplified into a division between one group (aristocratic) which eschewed scientific knowledge and another group (bourgeois) which actively embraced it. Membership of scientific societies and the pursuit of science was part of a shared culture which cannot be so easily compartmentalised. Neither can the pursuit of science, per se, be reduced, as it has been in some accounts, to the gathering of anti-aristocratic forces in late-eighteenth and nineteenth-century society.[9] That science was an important emblem of social change is not in dispute, as one Westminster Review of 'The objects, advantages, and pleasures of science' in 1827 described it:

> ... knowledge has, in our day, acquired the trick of becoming wealth, and rank too. It worms its way, not only into the cotton manufactories, but into cabinets of State; it learns to stand up before treasury bench and sit upon the woolsack. It pushes us from our stools; and good reason therefore that we should fear it.[10]

The relationship of science to social change was, however, complex and varied between 1770 and 1870. Chapter 7 illustrates the point with a discussion of the agricultural science literature of the period. From 1770 to the early 1800s, the agricultural literature formed part of what is described in Chapter 5 as a discourse enhancing and complementing the power of the landed elite, although not uncritically, as I hope to demonstrate. By the 1840s to 1860s the tenor of discussion had completely changed: it now formed a radical critique of aristocratic power and inherited privilege.

THE GROWTH OF SCIENTIFIC SOCIETIES, C. 1770 - 1870

> It will be generally admitted that the scientific spirit is a prominent feature of the thought of our century as compared with other ages. Some may indeed be inclined to look upon science as the main characteristic of this age. (Merz, 1896, I, 89)

The enthusiasm for science, indicated by Merz, was a European phenomenon in the nineteenth century.[11] In Britain, the efflorescence of scientific culture is partly manifest in the growing number of societies founded during the period. It has been estimated that the total complement of scientific activity in Britain by 1780 was represented by only fourteen institutions, twelve of them located in London, Edinburgh and Dublin. By 1850 the number of scientific societies had risen to 139, sixty-six per cent of which represented new institutions in the provinces. Amongst them were the Literary and Philosophical Societies of Manchester (founded in 1781), Derby (1783), Newcastle upon Tyne (1793), Birmingham, (1800), Glasgow (1802), Liverpool (1812), Plymouth (1812), Leeds (1818), Cork (1819), York (1822), Sheffield (1822), Whitby (1822), Hull, (1822), and Bristol (1823).[12]

Between 1800 and 1830 the explosion of active scientific institutions clearly focussed on the provinces. The old metropolitan centres maintained a much slower growth in the numbers of scientific societies but nevertheless saw the addition of twenty-four new societies between 1830 and 1850. These

additions included the foundation of the Geographical (in 1830), Entomological (1833), Botanical (1836), Microscopical (1839), Pharmaceutical (1841) and Chemical (1841) societies in London.

These figures on the growth of scientific institutions exclude the proliferation of agricultural societies during the same period. Indeed the notion of including them in a discussion on scientific membership, for at least one modern scholar, has been an object of disdain.[13] Part of the aim of these agricultural societies was to stake a claim for the study of agriculture as a branch of natural philosophy. To exclude them from a survey of scientific culture in the late-eighteenth and nineteenth century rests on modern definitions of science and is ahistorical, as I hope to demonstrate in the discussion which follows.

However one defines the role of agricultural societies, their growth in numbers and membership is unmistakable. The earliest movement for the foundation of agricultural societies appears to have been in Scotland. R.C. Boud's research has documented the foundation of at least fourteen agricultural societies in Scotland between 1723 and 1784 and suggests that the real total may have exceeded this number. By 1834 the total of traced agricultural societies in Scotland had risen to 136.[14] In England the movement to found agricultural societies gathered force in the last quarter of the eighteenth century, such that by 1800 thirty-five local societies were firmly established. By 1835, (admittedly incomplete) figures indicate that ninety local societies were flourishing. Agricultural societies were to expand four-fold in the next ten years, whilst estimates for 1855 and 1870 suggest societies had increased in number to a total of around 600-700.[15]

Language barriers hindered the spread of the movement in Wales, in the absence of an agricultural literature in Welsh, yet the stimulus of agricultural discussion was felt even there (see pages 37-38 below). The first agricultural society was founded in Brecknockshire in 1755. This was followed by the foundation of five county agricultural societies in Wales before 1800 and the movement was to spread to most of the counties of South Wales in the next few decades.[16] In Ireland, the Royal Dublin Society founded in 1731 for the improvement of husbandry, manufactures and other useful arts was influential in promoting the cause of scientific agriculture and local agricultural societies followed suit.[17] The Royal Dublin Society, like the Bath and West Society (founded 1777) was a society with considerable regional influence. In contrast, the London-based Board of Agriculture (founded 1793), the Smithfield Club (founded 1798), the Royal Agricultural Society of England (founded 1838), and the London Farmers Club (founded 1842) were the principal forums for the coordination of national agricultural debate.

In addition to the founding of agricultural societies, interest in agricultural improvement was manifest in the burgeoning book trade. Horn's study of new agricultural authors published between 1730 and 1800 indicates that while an average of fifteen authors per decade made their appearance between 1730 and 1789, between 1790 and 1799 the decennial total had leapt to between ninety and 100. Two thirds of the new authors were also engaged in writing county reports for the Board of Agriculture during this period.[18] From the 1780s to the 1850s, there was a five-fold increase in periodical publication. In the second half of the nineteenth century, it has been estimated that the volume of sales of the agricultural press (periodical journals and newspapers)

lay between 17,000 and 20,000 issues, and the readership approximately 50-60,000 persons. All of these newspapers and periodicals were giving considerable attention in their columns to the technical and scientific aspects of agriculture.[19]

Although the overall trend in agricultural society membership was one of growth during the period 1770-1870, it should be recognised that many of the early societies were ephemeral and that interest in agricultural science was subject to changes in the fortunes of farming. For twenty years after the end of the Napoleonic wars there was a lull in publication of agricultural texts and 'intellectual stagnation' in the development of agricultural science.[20] Amongst those agricultural societies which survived, the talk turned from science to agitation for agricultural protection as agricultural depression threatened farmers' livelihoods.[21] The 1830s and 40s saw renewed interest in agricultural societies and agricultural science. The membership of the Royal Agricultural Society reached a peak of over 7,000 in the mid-1840s, a level not repeated until the mid-1870s. The 1850s and 1860s saw a fall in agricultural society membership for reasons yet to be fully explained.[22]

Whilst scientific societies are indicative of the diffusion and growth of formal participation in scientific culture from the late eighteenth century to c. 1870, the appeal and influence of science did not rest there. The power of science, as discussed in the introduction, lay in its emblematic use as a symbol of progress, in its ability to symbolise change in general, not in its membership. It was this quality which enabled science to become a 'catalyst in the social order'.[23] I hope to develop this point with reference to agricultural science and rural society in the discussion which follows.

SCIENCE AS THE KEY TO AGRICULTURAL PROGRESS

c. 1770 - c. 1800

The insistence of science and experimental method as the basis and organising principle of modern farming is a recurring theme in a majority of agricultural texts examined for the period 1770-1800. Judging from G. Fussell's extensive bibliography of early agricultural works, it had already begun to enjoy common currency from the 1730s with the appearance of a number of works on 'experimental husbandry'.[24] An examination of the Annals of Agriculture, the only really successful and long-lived periodical that appeared regularly during this time, firmly establishes the age as one of scientific and statistical optimism. The Annals expressed the opinion that agriculture was the ideal meeting ground for scientific theory and practice, and at least twenty per cent of the articles published in its pages from 1784-1809 were concerned with agricultural experiments.[25] Examining the content of agricultural texts in detail, it would be difficult to find instances of any real application of scientific theory to agricultural methods in either stock-breeding or plant cultivation, the principles behind both of which were to remain imperfectly understood until the mid-nineteenth century or later.[26] However, in that it meant the application of a new method, a new principle of organisation and embodied new hope for the future, the influence of 'science'

was fundamental. William Marshall, for example, in his Minutes, Experiments, Observations and General Remarks on Agriculture in the Southern Counties (1799) bears this claim out:

> ... it must be acknowledged, however (and it ought to be acknowledged with a singular gratitude, by the present inhabitants of civilized nations) that it is a matter of astonishment, how a being so limited, and so transient, as man is, can make the advances, which, at various periods, he has done, towards UNIVERSAL SCIENCE ... But amid all the revolutions of human arts and sciences, is it not worthy of remark, that AGRICULTURE should never have been treated as a SCIENCE? that it should have been professedly considered, as a branch of experimental Philosophy? The UTILITY OF EXPERIMENTS IN AGRICULTURE must be obvious to everyone.[27]

In his attempts to establish agriculture firmly within the sciences, Marshall emphasised the importance of observation and recording linked to the keeping of accounts, and argued for the communication of results through more institutionalised channels than had hitherto existed: specialised agricultural publications, the formation of a college of agriculture and the setting up of experimental demesne farms. His own work used this 'systematic approach' as the basis of texts on regional methods of farming[28] and drew explicit contrasts between the 'illiterate husbandman' relying on memory, and by implication backward in his dependence of custom and habit, and the 'scientific farmer' who

> not only observes and records, the useful information which occurs to him, in the course of his practice, by INCIDENT, but discovers by experiment, valuable facts, which never might have come, incidentally, within his knowledge.[29]

Arthur Young, the second major popular and prominent agricultural writer of this period, was similarly enthusiastic on the prospects for agriculture's relationship with science:

> If this noble spirit continues, we shall soon see husbandry in perfection, as well understood, and built upon as just and philosophic principles, as the art of medicine.[30]

In this respect he claimed there had been more progress in the last ten years than in the last hundred. Akin with Marshall, Young's work embodies the idea of a body of common farmers requiring the stimulus of 'more enlightened' persons, through the medium of experimental demonstration, to shake them out of age-old practices and put agriculture on new scientific foundations. As chairman of the Agricultural Committee of Arts from 1773, editor of the Annals from 1784-1809 and as secretary to the Board of Agriculture from 1793, together with a host of informal contacts at home and abroad, Young was instrumental in stirring up a widespread interest in the development of agricultural science.[31]

Other agricultural authors made similar claims for the scientific status of agriculture: Nathaniel Kent in his widely-read Hints to gentlemen of landed property (1775), criticized earlier agricultural publications for their concern with amusement rather that profit, and similarly urged the need for attention to agriculture as a science, and the spread of knowledge on the subject via the publication of experiments in the periodical press.[32] Henry Home[33] argued for the establishment of a Board of Agriculture in Scotland based on the English model to 'grant premiums, carry out and disseminate experiments, and

answer queries' in order that 'farmers be directed to the road that leads to the perfection of their art'. By 1784, Thomas Stone was able to say that a 'knowledge of agriculture in theory and practice - ought to be the chief accomplishment of a land surveyor; or abilities the same as these, which constitute a good land steward.'[34] Charles Ley argued that landlords should specifically aim at establishing a sound agricultural training for land stewards 'in the true principles of agriculture which are at present very imperfectly understood by the generality of farmers'. By this means 'sensible and rational improvers' of estates would be produced, versed in 'theoretical and practical parts of husbandry'.[35] These agricultural writings reinforced elitism in that the landlords were seen as the natural leaders of the 'scientific revolution'. In their emphasis on the importance of costly experiments undertaken with scientific knowledge, agricultural writers inevitably implied a particularly important role for the landed gentleman: the man with the education and leisure to experiment par excellence. In his capacity to stand back from the current practice, customs and habits which bound 'common' farmers in husbandry, he was seen as being in a peculiarly privileged position.

It is a measure of the pervasiveness of this scientific movement within agriculture that a backlash can be identified in reaction to it. This is manifest both in the continued repetition of the idea which prefaces many texts that the contents are also founded on experience and practice, in addition to theory and science, and in the production of particular texts which make a point of eschewing any scientific theory.[36] Trusler's Practical husbandry, for example, is subtitled 'the result of experience and long observation'. In the frontispiece he makes the proud declaration that 'in his

work is contained all the knowledge necessary in the plain business of farming, unincumbered with theory, speculation or experimental enquiry'. One anonymous pamphleteer writing in 1785 associates such 'scientific' writings with 'mischief', because, he argues, they are not founded on a sound but on a superficial knowledge of a subject which demands practice, a disjuncture often visible, he says, between the man of science and the farmer.[37]

'Science' in agriculture was not, therefore, without its challengers; it had, however, early achieved a prominence in the literature which was reinforced by the establishment of scientific institutions, backed by influential personnel and given semi-official status in the form of the Board of Agriculture.[38]

c. 1840 - c. 1870

Between the period 1770-1800 and the 1840s, as already mentioned, there was a lull in the publication of agricultural textbooks. When agricultural interest re-emerged in a spate of publications from the 1840s onwards, the emphasis on the importance of science in agriculture had changed. In that experimental method and 'science' per se had an established role in agriculture by this period, there is no sense of the special pleading which characterised earlier debate. Writers were now on firmer foundations for their claims in that they could point to specific developments within science that had an important bearing on agricultural practice, particularly the establishment of chemistry in the analysis of plants and manures from Sir H. Davy (1778-1829) to Liebig (1803-1873). If it remained true that even by 1850 agricultural chemists had done little more than confirm current practices, it nevertheles provided writers with a justification for their expectations of future discoveries which

would release agriculture from its dependence on trial and error.[39] Such expectations, founded as they were on a faith in the progressive and evolutionary nature of human knowledge, had history as their ultimate proof.

The introductory essay in Morton's Cyclopaedia of Agriculture argued that the birth of chemistry 'forms an epoch from which all analytical progress in agriculture takes its date'. The history of agriculture prior to this new epoch was regarded, by contrast, as a curiosity in which stagnation and primitive ignorance were keynotes:

> The further we go backward in exploring its early history, the more rapidly the darkness closes around us as we attempt to penetrate beyond those points where one science after another began to throw faint gleams upon the humble labours of the most neglected and uneducated part of the human family.[40]

Agricultural literature from Elizabethan times onwards was consequently to be read with the satisfaction of tracing through it the progress of the nation and of mankind 'in those pursuits which extend the operation of mind over material nature'.[41] Such a philosophy was to dictate a particular role for the agricultural literature of the 1840s-60s in that its explicit function became the chronicling of current progress. The notion of progress through the application of science was thus written into the very fabric of the texts, as Gladstone's speech to the Royal Agricultural Society at Chester underlines:

> It is of the utmost importance that agriculture should have the means of recording its ascension or decline ... it is most essential that it should have the best and most efficacious means of comparing its state in one year with its state in another - or recording for future encouragement the progress that has been achieved in the past.[42]

The Journal of the Royal Agricultural Society of England founded specifically in 1839 to disseminate the results of agricultural experiments, exhibits precisely these features. Between 1840 and 1860 there were fifteen review articles on the 'progress of agricultural knowledge', articles which served to give both prestige and promotion to agricultural progress as a faith, a faith echoed in all major texts of the period.[43] Within this notional continuum of agrarian change, the period from the 1840s to the 1860s was conceptualised as a transition period, distinguished from the past in the 'unprecedented enquiry and interest taken both in the science and practice of farming', and on the threshold of a future age in which science would fully reveal its benefits to the farming community.[44] The sense of a revolutionary break with tradition is aptly summarised by Burn: 'The spirit of the old agriculture and the new are diametrically opposite: that of the old agriculture was to be stationary, that of the new is progress'.[45] As discussed in Chapter 1, this scientific optimism manifested itself in parallel with the formation of agricultural societies, farmers' clubs and a rapid growth in publication of agricultural periodicals.[46]

By the mid-nineteenth century agricultural science was no longer the exclusive property of the general farming public, still less that of a landowning class. This partly reflected the growing professionalisation and complexity of science in which experiments were undertaken more by full-time scientists and less by the gifted amateur. This latter group nevertheless still formed a substantial body in 1870. Using the J.R.A.S.E. as an illustration, between its foundation in 1840 and 1870, an examination of the authorship of articles published reveals that in the decade 1840-49, only fifteen and a half per cent of the articles contributed to the journal represent the work of professional

scientists (chemists, botanists, lecturers in veterinary science etc), whilst these contributions together with those of other professionals (land agents, civil engineers, ordinary vets) and prominent agriculturalists account for thirty four and a half per cent of the total. A further eleven per cent are authored by persons identifiable as landed gentlemen (titled landowners). In the decade 1850-59 the contributions of full-time scientists, other professionals and teaching agriculturalists had risen to fifty-two per cent, that of landed gentlemen of high rank had fallen to five and a half per cent. In the final period 1860-69 these figures are forty-four per cent and 0.5 per cent respectively. Taking the figures for the professional groups alone, articles contributed by specialist scientists represent forty-five per cent of the total of all articles submitted by professionals in 1840-49, sixty-two per cent between 1850 and 1859 and seventy-nine per cent between 1860-69.[47]

These changes in the scientific status of agricultural writing implied important changes in the social position and status of the writers themselves. The partial removal of science from the domain of the landowning and farming public also reflected an important change in social attitudes. With reference to the farming body, in contrast to the literature of the late-eighteenth century, mid-nineteenth century agricultural writers rarely urged the adoption of experimental methods by farmers themselves. Though in common with late-eighteenth century writings, scientific knowledge was seen as diffusing from 'enlightened persons' amongst ordinary farmers, the location of these centres of enlightenment had shifted to a position outside the landed community. In this conception the farming sector became 'ruralised' and in need of exposure to the dynamic influences of modern urban society; in

consequence the object of agricultural societies became established as the breakdown of rural isolation. Thus C. Wren Hoskyns listed the isolation of the farmer as a major barrier to progress, as significant as the variety of climate and the variety of soils: 'the influence of that mental attrition which is produced by congregation of numbers, as in towns, is to a certain extent denied him from his earliest years. The mere etymology of the words urbanity and rusticity, seems to convey the whole argument'.[48]

Copland argued that any innovations occurring in agriculture had until recently been of a limited nature specifically because of rural isolation. The 'ignorant', 'pathbeating' and 'blind' husbandmen of the past are contrasted with the 'enlightened minds of cultivators, aided by railways, free press and agricultural associations'. The former were seen as an 'enemy to science' and as 'out of date as a dodo'. In the same vein agriculture in general was frequently conceived as the 'poor relation' in terms of progress, to 'other arts' and by implication, manufacture.[49]

Landowners were similarly portrayed as in need of enlightenment by external influences; no longer flattered as the 'natural leaders' of the scientific revolution in agriculture, suggestions are numerous for their educational training. In consequence, a major theme of the literature of the period was the importance of establishing a formal system of agricultural education in order to improve the calibre of landlords, tenants, labourers and estate agents. As a system for general education, it is a distinctly different programme from that visualised in the elitist organisations proposed by eighteenth-century writers. Morton argued both for the setting-up of agricultural schools and the need for agriculturally-trained teachers in

ordinary schools. Beasley added founding schools for labourers to his list of a landowner's duties, and the incorporation of agricultural subjects into the basic education of heirs to landed estates. Land agents were to receive formal training: 'the time has come when men who mean to devote their attention to the management of landed property, must be educated for the profession'. The farmer was to be instructed in physiology, chemistry, the principles of natural philosophy, mineralogy, geology, hydrostatics, the laws of mechanics, meteorology, plant and animal diseases and breeding, together with the principles of political economy.[50]

WHAT DID AGRICULTURAL IMPROVEMENT OWE TO SCIENCE?

Attempts to apply science to agriculture

Interest in agriculture as an experimental science was a notable feature both of the early agricultural societies (Chapter 1), and of metropolitan societies such as the Royal Society of Edinburgh, the Royal Society of Dublin, the Royal Society of Arts and the Royal Institution.[51] The inter-personal connections in membership between these societies and the promotion of agricultural science were manifold. Arthur Young joined the Royal Society of Arts in 1769 and in 1773 was elected chairman of the Committee on Agriculture of that society. With Young's guidance, the society offered premiums which aimed to stimulate the pursuit of experimental agriculture. Young corresponded with members of the Royal Society engaging in agricultural experiments and published their results, including the work of John Wynn Baker who was one of the leading lights of the Lancashire Agricultural Society, and also conducted an experimental farm in the service of the Royal Dublin Society from 1764. Results of his experiments were published annually by the Society between 1764 and 1773.[52]

The Board of Agriculture, formed in 1793 with Sir John Sinclair as president and Arthur Young as secretary, expressed a commitment to experimental agriculture in its awards of premiums, sponsorship of field trials

in 1802 and 1805, and, most decisively, in commissioning a series of lectures on agricultural chemistry from Humphry Davy between 1802 and 1812 (see Plate 7 between pages 64-65). Davy was a lecturer in chemistry at the Royal Institution, and it has been remarked that during this period the Royal Institution became the Board's laboratory and Davy its salaried employee. The overlapping membership of the Institution and the Board of Agriculture was an important factor in promoting this alliance.[53] Forty-four per cent of the first Proprietors of the Royal Institution were also members of the Board of Agriculture: of a total of nineteen governors of the Institution, fourteen belonged to the Board of Agriculture. Amongst this group of fourteen were individuals at the forefront of the movement to promote experimental agriculture: Sir Joseph Banks, President of the Royal Society, who worked with Sir John Sinclair on sheep breeding. Lord Somerville, a close friend of Arthur Young, who made public his interest in agricultural science, and his belief in its importance, by sponsoring animal shows, being active in the foundation of the Smithfield Club and performing experiments on his own estate. The Earl Spencers, the 2nd Earl having interests in agricultural science and sheep breeding, the 3rd Earl helping found the Royal Agricultural Society of England in 1838, were also important figures in the agricultural field. Finally, the Earl of Winchelsea, President of the Royal Institution, also carried out his own agricultural experiments.[54]

Provincial societies such as the Bath and West also participated in this enthusiasm for agricultural experiment. To 'bring speculation and theory to the test of accurate experiment' was cited as the aim of the society at its inaugural meeting in 1777. In 1786 the Letters and Papers of the Society

carried an article 'On the Application of Chemistry to Agriculture and Rural Economy', whilst for the next decade experimental work was promoted by the Society on ten acres of land on the outskirts of Bath. The Highland and Agricultural Society also showed an early activity in the promotion of experiments.[55] Examples of this late-eighteenth and early-nineteenth century passion for agricultural experiment could be multiplied in the activities of most of those agricultural societies discussed in Chapter 1.

With the onset of the agricultural depression in the 1820s, interest in agricultural improvement dwindled. When interest in agricultural science revived in the late 1830s, agricultural societies played a similar role in disseminating and promoting knowledge of recent agricultural research. The ease of communication afforded by the railways enabled societies to attract guest speakers to their meetings, and encouraged implement manufacturers to exhibit their wares at Shows from further afield. Issues discussed in the London Farmers Club or the Royal Agricultural Society found an equally eager audience in the provinces. Colyer describes how the mid-nineteenth century agricultural societies of South Wales, 'brought in the leading scientific and practical experts to address their members. Moreover, members were strongly encouraged to repeat on their farms, some of the agricultural experiments carried out by innovators like Lawes and Gilbert, Playfair, Morton and other luminaries'. The Honorary Secretary of the Royal Jersey Agricultural and Horticultural Society (founded 1833) corresponded with the eminent scientific and agricultural figures of the day. His correspondents included Thomas Andrew Knight, John Lindley, Sir George Mackenzie, Earl Spencer, J.B. Lawes, J.C. Loudon, Sir John Sinclair, Dr Henslow and Charles

Darwin. Capitalising on this growth of provincial interest, the annual shows of the Royal Agricultural Society became peripatetic, as many leading agricultural scientists were to become in the course of delivering lectures.[56]

Achievements of agricultural science: the contemporary view

Looking back from the 1840s, there stretched a rich tradition of science contributing to agricultural improvement. Yet when interest in science revived in the 1840s, the intellectual movement was strong in its denial of such a 'tradition'. Charles Daubeny, who at various stages of his career had held chairs in Chemistry, Botany and Rural Economy at Oxford, used an analogy from medicine to express his dismissal of the early period of experimentation. The eighteenth and early-nineteenth century experiments were likened to the work of an 'empiric' (quack doctor) as compared with the work of a modern physician. The early experiments were 'as far removed from a system of perfect husbandry, as the empiric of a former age is from the more enlightened practice of the present day'.[57] Professor Johnston lecturing in 1848 on 'The Present State of Agriculture in its Relations to Chemistry and Geology', noting the existence of early experiments, focussed on their imprecision and concluded 'agriculture has scarcely been regarded by its followers as a branch of book learning at all'. The analogy he uses to contrast earlier agricultural work with that conducted in the 1840s is the difference between 'old alchymists' and the 'modern chemist'.[58]

Since, by 1840, agricultural science had become virtually synonymous with chemistry,[59] it is interesting to study the chemists' self-appraisal. Humphry Davy described agricultural chemistry as a 'science as yet in its

infancy' in the introduction to his first lecture to the Board of Agriculture delivered in 1802. The book resulting from the lecture course, first published in 1813, remained the standard text until the publication of Justus von Liebig's Organic Chemistry in its application to Agriculture and Physiology in 1840. Davy's book has been credited as the first to build agricultural chemistry into a coherent subject, but has been criticised for failing as a practical guide and in placing little importance on mineral fertilisers. It has been characterised, additionally, as a conservative work recommending the best practice already in use in the farming community.[60] When Charles Daubeny reviewed the situation in 1842 he echoed Davy's phrase of forty years earlier in describing agricultural chemistry as 'still in its infancy'. He attributed this partly to the private nature of much of the research and decried the lack of public institutions for the advancement of agricultural science in Britain as compared with the continent and Ireland, an anomalous position which has been underlined by modern research.[61]

The critical assessment of the progress of agricultural science during the seventy years following 1770 by the British professorate was clearly less than euphoric. The German chemist Liebig (see Plate 8 between pages 64-65), viewing from the perspective of continental intellectual traditions, was even more scathing. The brushes Liebig had with the agricultural community on his first visit to England in 1837 prompted the famous remark 'England is not the land of science'. His growing influence in the British scientific community under the auspices of the B.A.A.S. ensured that his views received an audience amongst British scientists. Both Charles Lyell and Lyon Playfair publicised his criticism that not enough attention was paid in Britain to abstract science,

a neglect which could only result in a failure to keep pace with other countries as a manufacturing nation.[62] Daubeny likewise echoed opinion 'expressed in other quarters on this subject' that the lack of a theoretical as well as a practical education in agricultural science was one of the principal barriers to agricultural improvement. In 1855, J.B. Lawes was speaking of agricultural chemistry as the 'science which has hardly a recognised existence'. Augustus Voelcker, consulting chemist to the Bath and West Society in 1855, and the Royal Agricultural Society from 1857, was stressing the need to concentrate on experiments to establish general princples as late as 1865.[63]

These critical assessments of the achievements of agricultural science by professional chemists were matched by the scepticism of the farming community. Philip Pusey was moved to endorce this scepticism in a paper appearing in the J.R.A.S.E. in 1850. He described the supposition that 'science, especially chemistry, was to guide and direct practical farming by conclusions formed on chemical grounds beforehand' as a 'mistake'. The reality of the situation facing the agriculturalist in the field was, in his view, too complex to be successfully modelled in the laboratory. He maintained that the knowledge of practical farmers was the key to agricultural improvement and cautioned scientists 'to patient examination of existing practice'.[64] Pusey was nevertheless instrumental in ensuring that the Journal of the Royal Agricultural Society and its Chemical Committee provided a forum for the work of the leading agricultural scientists of the day. The Society's emphasis in its first twenty years was, however, decidedly on applied rather than theoretical science, the field trials of Lawes finding a much more receptive audience than the laboratory 'speculations' of Liebig.[65]

Recent perspectives on the achievements of agricultural science

Modern agricultural historians have been equally sceptical of the contribution of science to agricultural improvement. Arthur Young's own assessment of his book A Course of Experimental Agriculture (1770) is frequently quoted: 'what I was pleased to call experiments deceived both myself and others'.[66] Fussell has commented 'The wide gulf between scientific experiment and the trial plot of the amateurish kind was difficult to pass over, and it was not bridged, dare it be said until the work of Thaer, Lawes, Gilbert, and Liebig'. Hudson and Goddard are both similarly dismissive of the period preceding the 1840s.[67] Crowther provides a corrective to these views challenging firstly, the idea that early field experiments lacked any value and secondly, that nineteenth-century field experiments progressed markedly after 1840. Early field experiments were useful as 'observation plots' for testing changes in farm practice where the criteria of success or failure were obvious. 'No elaborate experimental design' would be necessary to make a judgement on marked alterations in established practice. Crowther pointed out that such experiments still have their uses. He also stresses the uncertainty of the experiments made in the 1840s, particularly with regard to assessing the significance of the results. In this respect, the quantum leap was not between the eighteenth- and the mid-nineteenth century methods of experiment, but between the abilities of nineteenth and twentieth-century scientists to assess their results. Knowledge of soil action and statistical theory were unavailable to the experimenters of the nineteenth century.[68]

This essentially internal debate on the merits or demerits of eighteenth and nineteenth-century agricultural science is not, of course, sufficient material

with which to assess the question 'What did agricultural improvement owe to science?' Modern evidence on agrarian change during the period throws additional doubt on the connection between the two: recent work on agricultural productivity change suggests that most of the growth in yields between the Middle Ages and the nineteenth century occurred before 1770, long before the fashion for scientific agriculture. A re-examination of Arthur Young's yield data similarly concluded that the late-eighteenth century was not an 'age of improvement' but an 'age of stasis'.[69] Stasis, certainly, is the impression given by yield data until the late 1830s. A marked rise in yields did take place between the 1830s and 1860, but thereafter showed little improvement in the half-century preceding the First World War.[70]

How this mid-century rise was achieved remains unclear. It seems plausible to suggest that a major role was played by the more widespread adoption of the best practice in farming: crop rotation, cattle breeding, the use of hand tools and drainage methods, rather than by science or by mechanisation. Improvements in personal labour efficiency and hand-tool technology were responsible for much of the increase in labour productivity in the nineteenth century, rather than the advance of the science of agricultural engineering. Additionally, the slow progress of labour displacing agricultural innovation in the rural community placed further limits to the contribution of mechanisation.[71] Agricultural science, nevertheless, had an important role to play in analysis and improvement of animal nutrition, foodstuffs and fertilisers.

If the results of scientific endeavour in agriculture from the late-eighteenth century to the third quarter of the nineteenth century had been

contradictory and their effect on general productivity growth debateable, the conclusion of some modern researchers that the majority of farmers never came into contact with an agricultural paper at all and seldom purchased agricultural books casts even more doubt on the equation between agricultural improvement and science.[72]

Indeed, it is apparent from detailed textual analysis (Chapter 2) that much of the faith in science was prospective in nature. The evidence for the practical contribution of science to agricultural improvement during the period under examination was not impressive; that so many should nevertheless subscribe to societies and journals is an indication of a philosophic and ideological enthusiasm that is not mirrored in the material rewards and practical benefits to agriculture. If this is so, we must now look to scientific culture and society more closely for an explanation of the source and motivation of that enthusiasm.

4

AGRICULTURAL SCIENCE AND SCIENTIFIC CULTURE

> Agriculture is a branch of natural philosophy, and can only be improved from the knowledge of the facts, as they happen in nature. It is by attending to these facts that the other branches of natural philosophy have been so much advanced. (Home, 1757, 92)

Agriculture and natural philosophy

Illustrations of the early interest of the metropolitan scientific societies of England, Scotland and Ireland in agriculture as an experimental science have been given above. This chapter pursues the issue further through consideration of agriculture as a branch of natural philosophy and argues that what was understood and practised as natural philosophy provided an important link between agriculture and national culture.

Connections between agriculture and natural philosophy were most apparent in eighteenth-century Scotland, and were so, in part, because of the association between agricultural societies, landed patronage and the university professoriate.[73] A frequently-quoted example of this relationship is the activities of the improving landlord, Henry Home, Lord Kames; President of the Edinburgh Philosophical Society and author of The Gentleman Farmer (1776). He was 'perhaps more than anyone else ... concerned with the scientific underpinnings of agriculture', and in the preparation of his book, he was able to draw freely on the expertise of the professors of chemistry,

medicine and natural history at Edinburgh University: Joseph Black, William Cullen and John Walker respectively.[74] The professoriate also undertook technical commissions for the Board of Trustees for the Encouragement of Fisheries, Arts and Manufactures, and augmented their incomes by offering private and public lectures on agricultural topics to landed audiences. John Walker, Robert Jameson (Professor of Natural History from 1804), and Thomas Charles Hope (Professor of Chemistry) also made contributions to the Transactions of the Highland and Agricultural Society on scientific topics.[75]

The involvement of the various scientific departments of the University was underlined by the endowment of a Chair of Agriculture in 1790. The successful candidate, Andrew Coventry, was seen as something of an interloper by Walker who feared an overlap with his courses on Natural History. Coventry was himself anxious to carve a separate niche for his 'Georgical Lectures' and took care that his subject matter did not overlap with botanical classes given by Rutherford. Walker had produced a 'Syllabus of a course of lectures on Rural Oeconomy' and was delivering lectures to an agricultural audience in 1790. Cullen also gave 'Lectures on the Chemical History of Vegetables' and 'The Chemical History of Animals' as part of his lectures at Edinburgh in the 1750s. He gave private lectures on agriculture in 1768 and his manuscripts are witness to his considerable interest in the subject. Given the interest of his colleagues, the new Professor of Agriculture, Andrew Coventry, clearly felt his own position was insecure.[76] There were also other academics working on agricultural problems in Scotland during the period, including Francis Home, Professor of Materia Medica, Dr James Hutton, the geologist, and William Barron, Professor of Logic and Belles

Lettres at the University of St Andrews, who published on the mechanical principles of ploughs. Some academics also performed practical experiments on the land.[77]

In England, where intellectual activity was still dominated by Oxford and Cambridge, the institutional links between the academic and agricultural communities in the late-eighteenth and early-nineteenth centuries were weak, the interchange occurring largely on a personal level. Nevertheless, these exchanges indicate both the considerable interest among natural philosophers of the day in agricultural problems and reflect the interests of agriculturalists in natural philosophy. Erasmus Darwin, for example, was encouraged by Sir John Sinclair to publish Phytologia, or the Philosophy of Agriculture and Gardening (1800), which Darwin, in turn, dedicated to him.[78] Arthur Young made the acquaintance of Priestley the chemist in 1776, and Young's enthusiasm for pneumatic chemistry is evident in the first volume of Annals of Agriculture (1784) in which he records his own experiments on manures. Priestley expressed his interest in agricultural improvement in the reports he sent on 'agricultural discoveries made in America' to Sir John Sinclair. The botanist Stephen Hales was a co-founder of Museum Rusticum et Commerciale (1763-6) which aimed to make scientific papers more accessible to an agricultural audience.[79] The Bath and West Society set up a 'Committee of Chemical Research' in 1805 under whose guidance Drs. Archer, Boyd and Williamson began a programme of research and lectures. The Society also had links with Priestley and the botanist Thomas Curtis. By the 1790s the Royal Dublin Society had appointed Professors in Botany, Chemistry and Mineralogy and an Experimenter in Agriculture. The

Society also assembled a mineral collection, a chemistry laboratory and a lecture theatre, and, by 1797, was offering public lectures. Syllabuses were published in Chemistry (1801), Botany (1802) and Natural and Experimental Philosophy (1802).[80]

Agricultural science as a career

The commissioning of scientists by agricultural societies became a common feature of the nineteenth century. By the middle years of the century employment with an agricultural society provided a passport to a successful scientific career. Some scientists used their passports to obtain posts outside the agricultural sphere, whilst for others agricultural societies and institutions provided life-long sustenance. Lyon Playfair is an example of the first category. He began to research agricultural chemistry in the 1840s in connection with his post as honorary Professor of Chemistry at the Royal Institution of Manchester. This research interest, combined with his prestigious connection with Liebig, was enough to attract the attention of the Royal Agricultural Society which appointed him Consulting Chemist in 1843. In 1845 he was appointed to the newly-established Royal School of Mines in South Kensington and also became Chemist to the Geological Survey. James Thomas Way similarly launched his scientific career from agriculture. He was appointed Professor of Chemistry to the Royal Agricultural College at Cirencester in 1846 and between 1847 and 1857 was Consulting Chemist to the Royal Agricultural Society. In 1857 he resigned his post, and with it agricultural research, to work on the problems of London's sewage disposal, working with the Royal Commission on Sewage.

Augustus Voelcker's career began in 1847 in Edinburgh as assistant to Professor J.F.W. Johnston who was then Chemist to the Royal Agricultural Chemistry Association of Scotland. Voelcker also lectured at Durham University before obtaining the post of Professor of Chemistry at the Royal Agricultural College at Cirencester in 1849. The results of his agricultural research at Cirencester were presented to the British Association in 1859 and 1861. He was appointed Consulting Chemist to the Bath and West Society in 1855 and in 1857 to the Royal Agricultural Society. In 1863 this illustrious academic career took a more profitable direction when Voelcker resigned his post at Cirencester to become a consulting chemist in London.

John Henry Gilbert was, by contrast, to maintain his commitment to agricultural research for life. He began his research at Rothamsted with J.B. Lawes in 1843 and remained for fifty-eight years. Gilbert's career demonstrates both the interest in agriculture in the wider scientific community and the rewards available to the practitioner of agricultural science in the nineteenth century. He travelled widely and regularly attended scientific meetings, spreading news of the work at Rothamsted in Britain and America. From 1842 he attended the meetings of the British Association and presented several papers. In 1880 he was elected President of the Chemistry Section of the B.A.A.S. and chose as his address 'the progress of Agricultural Chemistry'. In 1882 he was elected President of the Chemical Society and two years later was appointed honorary Professor at the Royal College of Agriculture, Cirencester. Between 1884 and 1890 Gilbert held the Sibthorpian Chair of Agriculture at Oxford. [81]

Initiated by the influence of Liebig's work on agricultural chemistry in the 1840s, the British Association for the Advancement of Science provided a ready audience for papers on agricultural science.[82] Charles Daubeny (president of the B.A.A.S. in 1856), Augustus Voelcker and John Henry Gilbert all spoke to this major scientific forum.

Agriculture as a leisure pursuit of gentleman

There is considerable evidence, then, to suggest that agriculture was being taken seriously as a branch of natural philosophy (or science) by the academic communities of the late eighteenth and nineteenth centuries. The link between agriculture and science connected agricultural improvement with national culture. It ensured both patronage and an audience for science amongst the landed classes, patronage which provided further stimulus to the publication of books, development of lectures and the pursuit of agricultural research. The patronage of science by the landed elite was not simply related to a utilitarian enthusiasm for increasing estate revenues through the practical application of agricultural science, though this material aspect formed an important part of it. By the middle of the eighteenth century, interest in (if not the practice of) science had become a form of cultural capital alongside other pursuits reserved for the gentleman of leisure: patronage of the polite arts, philosophy and literature.[83]

Research on eighteenth-century Britain has underlined the dual nature of the participation of landed society in science. The 'utilitarian' impulse of landed society is evident in the channelling of patronage and participation into the earth sciences: agricultural chemistry, horticulture, mineralogy and

meteorology. Landowners formed forty-three per cent of the 'earth sciences sub-community' of the Royal Society of Edinburgh between 1783 and 1820. Comparing this figure with their eighteen per cent proportion of the membership as a whole indicates the strength of their interests.[84] Berman's study of the Royal Institution (RI) in the first decade of the 1800s emphasises the identity of interests between the RI and other institutional bodies controlled by landed society, specifically the Board of Agriculture and the Society for Bettering the Condition of the Poor. He demonstrates that these institutions had a similar agenda and 'roughly the same group of men sat on their governing boards' (see also above p. 23). The improving landlords amongst the membership of the RI channelled scientific work to areas 'closely related to perceived economic interests'. Berman makes the important point that these interests governed the development of science at the RI, not the independent formulations of its scientist, Humphry Davy.[85]

Pursuit of science as cultural capital is suggested in the local and national influence conferred on those members of landed society joining scientific societies. Colyer, discussing agricultural societies in South Wales notes, 'Membership of the Agricultural Society was absolutely de rigeur for any gentleman wishing to cut a dash in the country or to run for local or parliamentary office'. To participate in agricultural science required competence in the English language: only four Welsh language publications on Welsh agriculture appeared before the 1930s. Agricultural societies in Wales represented one of the links between the gentry and rural society 'whereby alternative standards ... [to] those commonly accepted were presented to other members of local society ... the mansions were, too, centres for the diffusion

of the English language as English was the language of every gentry family'.[86] A similar relationship between scientific societies and anglicisation appears to have held in eighteenth-century Scotland where 'improvement' embodied a programme of cultural, social and linguistic change in addition to economic development. Thus 'Improvers were very much the 'culture heroes' of eighteenth-century Scotland widely seen to be the figures alone capable of leading Scotland out of the dark economic and cultural age of the period immediately following the 1707 Union with England'.[87]

In eighteenth-century England, too, participation in agricultural societies was associated with leadership, heroism and patriotism, a relationship which was strengthened when England went to war with France in 1793.[88] In the nineteenth century, the pursuit of agricultural science retained both its 'utilitarian impulse' and its cultural force, but the control of the 'cultural capital' by the landed classes had become the subject of bitter struggle.

ESTATE IMPROVEMENT, AGRICULTURAL SCIENCE AND CULTURAL POWER

The 'improved' estate

Before moving on to examine the contours of that struggle, the contention that agricultural science, harnessed to estate improvement, initially both expressed and enhanced landed power, will be briefly explored. In eighteenth and early-nineteenth century literature, the estate was a powerful symbol. Duckworth encapsulates this in the preface to his analysis of Jane Austen's novels:

> ... the estate as an ordered physical structure is a metonym for other inherited structures - society as a whole, a code of morality, a body of manners, a system of language - and 'improvements', or the manner in which individuals relate to their cultural inheritance, are a means of distinguishing responsible from irresponsible action and of defining a proper attitude to social change.[89]

The literature of agricultural improvement and the rhetoric of agricultural science drew on this cultural resource to reinforce the position of the landed elite as 'natural leaders' of improvement.[90]

However, the agricultural literature differed in its conception of 'improvement' in two fundamental ways. First, whereas for Jane Austen 'improvement' and 'innovation' were antonyms, the agricultural literature routinely assumed that the terms were synonymous. Secondly, Jane Austen

carefully distinguished between estate, economic, social, cultural and moral 'improvement' and took care to observe that 'improvement' in one sphere might compromise the position of another, hence maintaining the tension underlying the 'balance' of rural society.[91] In the agricultural literature, in contrast, an elision is effectively made between landed estate improvement and economic, social, cultural and moral improvement in general. Thus the economic improvement of the estate was identified with the 'Public Good' in the sense of a public-spirited act of feeding the nation. The well-organised estate, in terms of building and land organisation, was identified with a socially and morally 'improved' rural society; the intellectual study of agriculture and the performance of experiments was identified with the rational progress of the nation. Finally, the aesthetic embellishment of country seat and park was, for a limited period at least, identified with the 'improvement' of public taste. The landed elite was involved in all these aspects of improvement, which shared in common an impulse to innovate and to remake society through the application of a systematic body of knowledge to the rural world. This is evident in discussions of the need to re-design labourers' cottages with a moral and disciplined architecture, of the need to enclose and impose order on the 'barbarous wastes', and of the need to re-design farms to produce 'rational farms' for 'rational farmers'.[92] This argument is developed below with reference to the enclosure of the commons.

E.P. Thompson notes that in the eighteenth century 'it became a matter of public-spirited policy for the gentleman to remove cottagers from the commons, reduce his labourers to dependence, pare away at supplementary earnings, drive out the smallholder'.[93] Reference has already been made to

the honour, patriotism and stress on harmony of interests that attached itself as a justification for pursuing an improved system of farming based on enlarged profit and rising rentals. Private profit was viewed by these agriculturalists as synonymous with public welfare; by the same token, every opportunity wasted of improving rentals was viewed as a national loss. Young even used tables to demonstrate that the general interests of the State received benefits as great as individual landowners from such works, 'for the riches of the nation are increased - the income - and also the industrious population'.[94]

Unenclosed commons were particularly likely to bring forth calls for landlords to show more spirit. Much of the force of the argument depended upon a particular manipulation of the term 'waste'. A contemporary pamphleteer pointed out that 'waste' and 'common' had been used 'of late years' as synonymous terms. 'Waste' not only carried powerful connotations of a barren and unprofitable area but was also imbued with undesirable moral qualities such as 'barbarity'; the force of equating 'common' with 'waste' cannot be underestimated.[95] Thompson comments that to look at the eighteenth century through the pages of the Annals or the Board of Agriculture's surveys one would suppose that 'customary sanctions had long lost their force', instead of the 'dense cluster of claims and usages' one finds from the villager's standpoint.[96]

Kent provides an interesting twist to these different perspectives on commons in his comment that: 'at present there are so many different interests subsisting upon them [the commons], that in point of real value, they are little more than blanks in the kingdom'.[97] In the few instances where any

interests in the commons were acknowledged, they were easily dismissed by the argument that improved land could support a considerably larger population in a higher standard of living than an impoverished uncultivated waste could ever hope to do; inclosing waste was thus more 'charitable'. The very idea that all 'wastes' could be made to yield a vastly increased produce was part of the myth-making.[98]

Further, it was assumed that there existed an identity of interests between landlord and tenant in the promotion of improvement via enclosure. An anonymous writer in 1780 illustrates the dependence of the tenant in this situation, in which he has no real power, upon his landlord's decisions. There is nothing necessarily reciprocal in this relationship. The tenant must either:

> ... take the inclosed land at such a rent, as the generosity of his landlord shall set upon it, or receive such compensation for the injury he has sustained by inclosure, as either the mercy of his landlord shall vouchsafe to bestow, or the equity of a few commissioners, shall deem proper to assign him. Commissioners, in whose appointment, the tenant himself had no vote, though his property hangs suspended on their choice ... as if justice was due only to men of a certain rank and property.[99]

If the tenant does receive a fair and adequate compensation, 'notwithstanding every chance against him', the writer says he should look upon himself as 'the most favourite child of fortune'.[100] Generally, however, the existence of dissent on these issues is unacknowledged in the pages of the agricultural texts. Comparison of agricultural literature with contemporaneous pamphlet literature bears witness to the extent of the silences contained within these tomes. The threat this represented did not go unremarked: one pamphleteer was convinced 'that many acts of Parliament

have been passed of late years, upon false principles which those books have inculcated'.[101]

Late-eighteenth century changes in the agrarian economy were depicted as a 'higher stage' of an inevitable and optimistic developmental sequence which was significantly telescoped to stress the dynamism of the period as compared with the stasis of the past, a bias it has taken a generation of modern historians to repair. Claims to the past were effectively short-circuited by its association with 'savagery', 'barbarism', 'ignorance' and 'habit'. Current husbandry practices which did not meet with the approval of agricultural writers, and those pursuing them, were classified with one of the greatest condemnations possible, that of belonging to a past age.[102]

As a consequence the present was imbued with an urgency to redeem the past 'lack' of improvement. Agricultural writers argued that ordinary farmers left to themselves, would remain in the 'ignorance and backwardness, which ... cloud any country, in an enlightened age, with the darkness of many preceding centuries'. It was therefore the business of landed gentlemen of superior minds 'to start beyond their age, and shine forth to dissipate the night that involves them'.[103] Howlett commented that to go back to open field husbandry would be to say goodbye to improvements and prefer to return to 'primitive barbarity'; 'surprising', he says, 'in what we are foolish to think the enlightened age of George III'.[104]

The literature provided a strong formal legitimation for the enlargement of landed estates, the concentration of capital within a strengthened tenanted sector and, on the darker side of the landscape, the reduction in numbers of the smallholders and an expansion of the wage labouring sectors. The two

main beneficiaries were, firstly, an acquisitive landed interest and secondly, a growing tenantry composed of men of education and capital, orientated towards capital-intensive methods and market expansion. These two groups were united by their joint subscription to these processes. In that it mirrored real processes of agrarian change,[105] the literature was not only programmatic in form but to a considerable extent it exhibited the characteristics of ideology in its narrowest sense; the ex post facto rationalisation of class interest. The identification in the literature of private investment with public good thus minimised the conflicts inherent in 'improvement' recognised by Austen.

The 'reformed' landlord

In addition to providing an intellectual justification for practical measures of estate rationalisation, participation in agricultural science increased the social standing of the landed elite. This did not derive simply from the identification of scientific activity with the membership of a particular elite social group, although this was an importance part of the kudos attached to agricultural improvement (see above pp. 36-38). It also derived from the identification of scientific activity with a particular form of personal character, as the improving gaze was directed inward.

Thus William Wilberforce, himself an ordinary member of the Board of Agriculture, praises the institution in his memoirs as channelling into the improvement of the land 'immense sums which might otherwise have been lavished on hounds and horses, or still more frivolously squandered on theatricals'. Similarly, the first agricultural society in Wales (founded in

1755) aimed to 'draw the attention of the nobility and gentry ... to objects worthy of it ... and consequently exciting an honest spirit of industry, and a laudable spirit of universal benevolence'.[106] In the process of pursuing agricultural science, the landed elite were proving they possessed moral qualities befitting social leadership; they were themselves 'improved'.

This was also commemorated in the visual imagery of the period (see plates between pages 64 and 65). As Asa Briggs has noted 'there grew up an "agricultural school" of painting, and great landowners and statesmen, including Thomas Coke of Norfolk, the first Earl of Leicester, the Duke of Bedford, and Lord Althorpe, were happily portrayed in the centre of farmyard scenes'. When Obelkevitch argued that 'what set off the gentry from all other classes and groups in Victorian society was their rejection of the gospel of work', he ignored the long tradition of landed society making it appear otherwise. John Barrell has effectively shown how these changes were translated into the visual imagery of landscape painting in a move away from Arcadia to a genre which acknowledged the importance and reality of work; albeit a carefully managed 'reality'.[107]

Improvement on a variety of fronts, of which agricultural science formed a part, represented both a rejection of the traditional shape of 'reality' and a 'complete cultural reorientation' of landed society, as Jane Austen had anticipated it would. This involved a distancing from the inherited structures of the past, and from the 'unimproved' elements of rural society dwelling beyond the park walls. It was also manifest in changing conceptions of governing responsibilities towards the rural poor. As Mandler has recently shown, the making of the New Poor Law was the expression of 'a modernized

gentry ethos', embodying a 'scientific' approach to poverty, not an imposition by Benthamite bureaucrats.[108]

Improvement as innovation, and participation in scientific activity, was not the antithesis but the apotheosis of landed society in the late-eighteenth and early-nineteenth century, enhancing both its material and cultural power. This configuration poses particular problems for understanding the role of science and social change in the agricultural sphere.

SCIENCE AND SOCIAL CHANGE

Science: a 'catalyst in the social order'?

Participation in scientific activity by the landed elite in the late-eighteenth and early-nineteenth century becomes problematic given claims that science or 'natural knowledge' was the peculiar possession of the new industrial and commercial bourgeoisie of provincial England, a 'separate and progressivist philosophy and cultural system'. This was the conclusion of Thackray's investigation of the Manchester Literary and Philosophical Society, a view which finds support in the research of Shapin on phrenology and Cooter on popular physiology in Edinburgh.[109] A radical and transformative role for science in social change was conceived, a formulation which has found its starkest expression in Billinge's account of 'Hegemony, Class and Power in late-Georgian and early-Victorian England'.[110]

Billinge's argument runs that the period 1780-1850 witnessed a fundamental shift in power relations within English society. From a power bloc controlled at all levels and at all points of entry by a landed elite, a transition was made to a power bloc in which urban gentry and industrial capital formed the real locus of power, whilst the landed interest clung to the outward forms of government. Fundamental to this shift was the change in the relative material fortunes of the landed interest and the urban/industrial bourgeoisie.

It is Billinge's main contention that the effective challenge of the middle classes to landed dominance was posed not only by economic determination but also by 'ideological persuasion and cultural cohesion'.

He argues that at the centre of this bourgeois challenge was science - a rival cultural edifice, starkly contrasted to aristocratic values, and appealing to the bourgeoisie in terms of its ability to 'symbolize, mirror, announce and legitimize the social and political beliefs of its adherents'. Mirroring the passage of political power, the patriarchal values of aristocratic culture also faced opposition from the scientific rationalism of the urban bourgeoisie in the early-nineteenth century. Aristocratic culture is characterised as 'essentially literate and artistic', its patronage confined to 'the polite, the decorous and the amusing', whilst bourgeois culture is characterised by a 'deliberately antagonistic' involvement in science or natural philosophy.[111]

In the light of the preceding discussion, the separation between aristocratic and bourgeois culture in Billinge's account would appear to be overdrawn. The amateur tradition in British science aligned, rather than opposed, scientific pursuit to polite culture. The cult of the amateur implied patronage or independent leisured wealth underpinning scientific endeavour, and the separation between 'science' and other forms of philosophical knowledge in Georgian England seems premature.[112] The radical force of the scientific movement implied in Billinge's account also needs qualification. In the older metropolitan or provincial centres, scientific culture developed within existing powerful and confident social elites. In these contexts, science was often not radical or marginal but bolstered an established elite in its ability to produce 'a new language of authority and political power'.[113] Such a claim has been

advanced by Lawrence and Shapin with respect to scientific culture in Edinburgh, and by Neve in his study of science in Bristol.

The lack of universal applicability of the conception of science as a radical middle-class challenge to landed authority is nowhere more apparent than in the sphere of agricultural science. As I have endeavoured to illustrate, the aristocracy and gentry fully embraced the pursuit of natural knowledge through agricultural science. This was witnessed in their patronage of and participation in agricultural societies, in the links forged with the wider scientific world and in the social cachet attached to involvement in agricultural experimentation. It has been suggested that part of the impetus behind the aristocracy's interest in science lay in the need to counteract the perceived threats posed by the French and Industrial Revolutions; in this sphere, science represented a socially conservative force.[114]

A withdrawal of landed society from participation in scientific culture in the nineteenth century is suggested in the falling percentage of its members making substantial enough contributions to science to be commemorated in the Dictionary of National Biography. Of those scientists born before 1665, fifty-two per cent belonged to the upper class, compared with only four per cent of the scientists born between 1826 and 1845.[115] Whilst there is some evidence of a decline in intellectual contributions by the landed elite to the agricultural scientific literature of the mid- and late-nineteenth century, it is not clear that such data should be read straightforwardly as a withdrawal. The membership of agricultural societies during this period remained dominated by the landed elite. In 1859 and 1860, for example, dissatisfaction was expressed with the Royal Agricultural Society for being 'directed by aristocratic

elements'.[116] This bias in the social composition of the Society stimulated the formation of the London Farmers Club in 1842 as a specific forum for farmers.[117]

K. Hudson has described the membership of local agricultural societies in the late-nineteenth century as 'microcosms of the British ruling class', although this is qualified by recognition that the aristocracy and gentry were concentrated amongst the patrons, vice patrons and vice presidents, not amongst the ordinary membership. Hudson's description of the membership of the Norfolk Agricultural Association in 1882 is also suggestive of a fusion between commercial, industrial and landed interests within the elite of late-nineteenth century rural society.[118] The membership of agricultural societies has not, as yet, been subjected to the kind of systematic prosopographical analysis which could reveal the changing social basis of participation in agricultural science.[119] The little evidence that does exist does not suggest, however, that agricultural science became divorced from aristocratic culture before 1870.

The pursuit of agricultural science remained focussed on institutions in the traditional centres of Edinburgh, London, Bath and the south of England (Rothamsted, Circencester and Woburn), whilst local agricultural societies were engaged in disseminating and testing the work of agricultural scientists of national reputation, rather than engaging in original work. The new provincial towns like Manchester and Birmingham were not unknown for their contributions to agricultural science, but they hardly dominated the proceedings.

Agricultural science and social commentary

Whilst there are a number of points at which empirical work on agricultural science challenges the 'radical science' thesis, the underlying contention that science was a cultural arena through which social change was mediated is clearly borne out in the agricultural literature. The 'radical' element of the departure represented by a scientific approach initially attached to change within the culture and economy of the landed estate, as the exchanges between Edmund Burke, the Duke of Bedford, and Arthur Young illustrate. For a limited period during the 1790s, as social revolution raged across the Continent, participation in agricultural science was anticipated with danger.

Edmund Burke's letter to the Duke of Bedford, which ran to its ninth edition in 1796, is crammed with imagery associating scientific activity with revolution. He warns:

> His Grace's landed possessions are irresistibly inviting to an agrarian experiment. They are a downright insult upon the Rights of Man ... what a pity it is, that the progress of experimental philosophy should be checked by his Grace's monopoly! Such are their sentiments, I assure him ...[120]

This exchange is further immortalised in a hand-coloured engraving by H. Humphrey entitled 'The Generae of Patriotism' or 'The Bloomsbury Farmer planting Bedfordshire Wheat' (1796).[121] This engraving (Plate 9 between pages 64 and 65) depicts the Duke showering his gold onto the soil to produce, not wheat, but a crop of liberty hats and knives, set against a background of French peasant farming. The fear clearly expressed was that the aristocracy might unwittingly become the instruments of their own destruction. Arthur Young used similar imagery in his pamphlet The Example of France, a warning

to Britain (1794). The recurring theme is that the events of the French Revolution represent the practical results of the theory of the Rights of Man and that the theory has been found wanting and should be rejected. What is interesting, vide Burke, is the use of experiments on the land as a metaphor for changes in the state as a whole.[122] As a champion of agricultural improvement, Young is nevertheless anxious to maintain a role for experimental husbandry:

> ... let us, as farmers, regard experience only; and when eternal theorists still recur to new visions of their heated brains, let us reply, the thing is tried; that method of drilling has been experimented and found good for nothing; the crop did not answer; the principles of farming are the principles of government; when you have experiment for your guide, will you resort to theory?[123]

For a transient moment in the mid-1790s, agricultural science shared in the 'extreme radical imagery' attached to science in general.[124] Agricultural science was, however, as discussed in Chapters 4 and 5, the cultural resource of the landed elite from the mid-eighteenth century to the end of the Napoleonic Wars. Its history in general ran counter to the dynamic, revolutionary and popular history of urban science in the period from the 1790s to the 1820s, and it underpinned rather than undermined establishment values.

Between the 1840s and 1870s the science practised in urban institutions has been characterised as undergoing a period of intellectual consolidation, professionalisation, and, at the same time, a loss of social force or purpose.[125] Agricultural science shared these aspects of consolidation and professionalisation and the social mobility this implied, as the careers of individual scientists discussed in Chaper 4 has demonstrated. However, the

social force of agricultural science sharpened in this period. Whilst the pursuit of agricultural science remained part of aristocratic culture in the mid-nineteenth century,[126] their leadership in the field was the subject of sustained challenge. In the course of that challenge, the literature of agricultural science became a vehicle for a form of social critique which questioned the very basis of aristocratic power (see Chapter 7).[127] It is at this particular conjuncture that the 'radical science' thesis finds application in the agricultural sphere.

7

A CRITIQUE OF ARISTOCRATIC POWER

c.1770 - c.1800: the science of flattery

In the period c.1770-1800, given the system of landed patronage on which the majority of agricultural writers depended, agricultural literature is unpromising ground for searching out seeds of a sustained social critique. As discussed in Chapter 5, by the eighteenth century, participation in agricultural improvement had become a sign of improved moral character. Criticism of aristocratic power during this period is confined to the question of whether it is exercised in a form denoting that this improvement had taken place. Trusler, for example, recommends agricultural pursuits as 'healthful, rational and pleasing', but notes in finding employment for gentlemen he may be failing to appeal: 'For any useful employ to men of fortune, in the present age, is irksome to think of. They waste the important hours and fritter away their life in trifles'.[128] Young commented that 'surely it much behoves all such landlords to think much more seriously upon the subject [of agricultural improvement], than most of them have hitherto done. It is but a poor answer to such a proposition, to say that they know but little of country affairs, and could not therefore engage in such complicated works: this is the answer of indolence or prejudice'.[129] Home drew the contrast between former expectations of a gentleman's conduct and present ones as even more sharply

differentiated:

> In former times, hunting was the only business of a gentleman. The practise of blood made him rough and hard-hearted: he led the life of a dog, or of a savage; violently active in the field, supinely indolent at home. His train of ideas was confined to dogs, horses, hares, foxes: not a rational idea entered the train, not a spark of patriotism, nothing done for the public, his dependents enslaved and not fed ... consider the present mode of living. How delightful the change from the hunter to the farmer, from the destroyer of animals to the feeder of men. Our gentlemen who live in the country, have become active and industrious. They embellish their fields, and improve their lands, and give bread to thousands.[130]

Criticisms in the agricultural literature of landlords' conduct do not radically challenge the landlord's position: the landed estate as the main unit of ownership was accepted uncritically, and it was the assumption that there were obvious benefits in extending the boundaries of private property as far as possible. The landlord's assumption of natural leadership was similarly reinforced, and the mutuality of interests between landlords and tenants in pursuing 'scientific' agriculture was also unquestioned. Large-scale 'scientific' farmers would, in fact, be the beneficiaries of many of the reforms to be implemented. However, whilst the literature provided a legitimation for private property ownership which worked in favour of landlord interests in territorial expansion at this period, it was, importantly, a legitimation which rested not primarily on any explicit claims to a tradition of paternalism, but on the values of progress, profit maximisation, rationality, and utilitarianism. As such it subtly altered the grounds on which a gentleman could make a claim to society's respect and this was to prepare the ground for a more devastating critique in the nineteenth century. As Young put it, from now on the maxim was to be: 'Judge not of a nobleman's <u>greatness</u> by the number of footmen

before his chair, - but the number of labourers on his estate'.[131]

In practical terms the landlord's established role in the late-eighteenth and early-nineteenth centuries was as provider of fixed capital and of money for investment in permanent improvement. In this respect Young, firstly, urged the nobility and gentry to 'act like merchants'; 'they should first raise a capital on which to trade; and this capital once raised should be sacred to the intended purpose'.[132] Secondly, the landlord was urged to take an active role in experimental agriculture, to demonstrate to tenants the benefits of improved methods, and disseminate knowledge through the publication of results. If unable to undertake this himself, he was to employ a professional land steward to act of his behalf. Finally, the landlord was to provide a flexible framework within which the tenantry could utilise their own potential to the full: the granting of long leases and security of tenure, and the maintenance of rents at a 'fair' value regulated by the market.[133]

Agriculturalists wrote at some length in attempting to define this 'fair' value. Home, for example, argued that any benefit deriving from the inherent fertility of the soil belonged to the landlord; additionally, a lowering of the costs of production ought to benefit the landlord on renewal of a lease. Increased productivity, however, achieved through the tenant's skill, should go to the profit of the tenant. On the other side of the equation, the landlord was entitled to expect a return for the 'risks' involved in leasing land and a return on capital outlay in improvements in the form of interest.[134]

The granting of leases was to formalise this relationship between landlord and tenant. In return for a fixed rent and a certain guarantee of the state of repair of the fixed capital of a farm at the beginning of a tenancy, the

landlord exercised control over cropping practices and retained an interest in the tenant's moveable capital through the inclusion of husbandry covenants in the contract.[135] A 'just' relationship between landlord and tenant was defined, therefore, as one regulated by free market principles and safeguarded by the provisos of a written contract. Kent, for example, argues that:

> Landowners who refuse leases .. merely because they will keep their tenants in a state of submission and dependence, are inexcusable in such conduct; because they prefer a simple gratification to their real interest, and to the enlarged notions of contributing, all they can, to the advance and prosperity of their country.[136]

By the same token, the choice of tenants was to be made on the basis of the possession of sufficient capital, skill and industry and on these criteria alone.

The importance of the tenant having a free hand in his farming, within the constraint of maintaining the land's value, was a significant underlying theme. Exhortations to the landlords to involve themselves more in fixed capital provision or experimentation, were made specifically to release the tenant's working capital, energy and skill in order that he might practice improved farming unfettered. Howlett expressed this freedom as part of the national character:

> Englishmen boast the high privilege of independence, the invaluable liberty of converting their private possessions, each man for himself, to the greatest advantage, unconnected with the whims, unsubjected to the fancies and encroachments of those around them.[137]

If commercial principles and freedom of contract were the main foundations to contemporary concepts of landlordism, the harsh economic

edicts were softened by the accompaniment of appeals to higher ideals: patriotism, honour, and harmony of interest. These ideals were modernised, rationalised and christianised at the hands of agricultural writers. Bravery in blood sports, or at the sword, was supplanted by bravery in the field of agricultural improvement. Those unwilling to undertake improvement were labelled 'timorous' or 'wanting activity'; those that were, labelled 'spirited'. It was proclaimed an occupation fit for heroes 'and in respect to honour, where will a more liberal profession be found?'[138] To heroism was added patriotism: 'men who have the spirit to undertake such improvements have also the satisfaction of knowing that they add to their country's welfare in proportion as they increase their private wealth'.[139] Religious sanction was also found: preaching to a congregation in 1792, Trusler argued that the farming community should be thankful that increasingly 'as in the early days of christianity, the gentry reside upon their estates, employing the poor and giving bread to the distressed', rather than spending their money in the metropolis and delegating estate management to an arbitrary steward.[140] Finally, the harmony or reciprocal nature of interests between landlord, tenant and labourer was emphasised.

In conclusion, the contemporary view of the landlord's role in agrarian change during this period is clearly of an ambivalent nature. The major agricultural writers valued the potential role which the landed interest might play in effecting agrarian change according to the policies advocated. However, in holding this position up for the admiration of their audience, they also exposed it to a subtle blend of criticism where reality opposed the ideal. In their constant reminders that farming was a business subject to the same

commercial laws and procedures as any other kind of business, they effectively took away from the landed interest any possible defence for its privileged position according solely to prescription.[141] The grounds for social respect had been altered: from now on the landed interest was to prove its utility. Whilst there was no fundamental challenge to the underlying system of landownership, the grounds for resistance to claims on deference to a straightforward paternal authority were effectively laid.

c.1840 - c.1870: agricultural science changes perspective

The growing institutionalisation of agricultural science and the increase in the potential reading public in the mid-nineteenth century was reflected in a growing professionalism amongst agricultural writers (see also above, pp. 18-19). These developments gave greater independence from landed patronage, ensuring that the articulation of ideas within the agricultural literature was not framed with the same degree of deference to the landowning establishment. In fact, the literature of the 1840s to 1860s exhibits an inherent 'urban bias', as was mentioned in Chapter 2, through which, for the first time, a challenge to aristocratic power in the agricultural sphere was in the making.

Mechi, under the title 'Signs of the times', thus welcomed the flow of commercial and industrial capital into agriculture, seeing the 'ancient aristocracy' superceded by 'business-like natives' bringing with them 'common sense habits of business and active progression to the benefit of the nation'. He further located criticism of his own endeavours at improvement in the 'old antiquated castle of prejudice'.[142] Morton also argued that this process of

capital flow from manufacture and commerce should be accelerated:

> To be carried out with success, agricultural improvements of every kind must be conducted on economic principles. The commercial spirit it requires to be brought to bear upon them in its most rigid form, and those who have made their capital in commercial pursuits, are the parties who are able to do this.[143]

Quoting Adam Smith, MacDonald stated in a similar vein that:

> ... to improve land with profit, like all other commercial projects, requires an exact attention to small savings and gains, of which a man born to great fortune, even though naturally frugal, is very seldom capable. The situation of such a person naturally disposes him to attend rather to ornament than to profit, for which he has so little occasion.[144]

The insistence of contemporary agriculturalists that the 1840s to 1860s represented a 'new era', was a further weapon in the rhetorical armoury which shook the traditional foundations of the estate system and argued for a complete transformation of the landholding structure along commercial lines.[145]

The proposition that the agricultural literature's treatment of the landlord's role represented a critique of existing conduct finds some justification particularly in relation to the topic of game preservation. Thus, Copland noted the 'oppressive' restrictions placed on some tenants in the Midlands by game-preserving landlords, which he regarded as a 'glaring injustice' resulting from 'selfish vanity': 'We know not whether the tenants of these petty sovereigns have submitted to this tyranny; but if they have, it is as little to their credit as Englishmen as the laws themselves are to their

landlords'.[146] He regarded the Game Laws as 'one of the last relics of the feudal system'. Morton similarly described game preservation as an 'evil' not only in terms of crop destruction but also in terms of the psychological effects on the tenantry:

> The undue preservation of game has often produced alienation between landlord and tenant, and has done more, perhaps, than any other kind of mismanagement to prevent the resources of the soil from being properly developed.[147]

In Morton's text on estate management, an entire chapter was devoted to this issue. Other authors similarly considered it an important barrier to national agricultural improvement.[148]

Wren Hoskyns additionally attributed the lack of agricultural progress in the distant past to this cause, quoting Hallam as his authority: 'The excessive passion for the sports of the field ... produced ... a strenuous idleness which disclaimed all useful occupations, and an oppressive spirit towards the peasantry, the result of a landed aristrocracy with absolute power over the course of agricultural improvement, who had not yet learned to sacrifice their pleasures to their avarice'. Following on from this, it is clear that landowners who did not take an active role in the improvement of their estates would incur the criticism of having failed in their duties.[149]

Additionally, there is in the literature an implied criticism of existing landlord conduct regarding the inadequacy of farm buildings.[150] This conclusion is, however, mainly derivative since there were few direct tirades against the landowning body on account of a perceived neglect. Copland was far closer to condemnation of landowners as a class than the other major

agricultural writers discussed, describing them as 'indifferent' to their own interests and to those of the tenantry under their care.[151] He was, however, the exception rather than the rule.

Morton's critical pen was reserved for absentee landlords whilst he, and many other agricultural authors, remained optimistic on the positive role which some resident landowners could and did play in agrarian change. Dean thought that landlords had been active in improvement as witnessed in the prizes offered by agricultural societies, particularly for livestock. As a body, he described their conduct as 'very liberal', 'putting party feeling aside', in the allowances they had made during the late depression in prices. Mechi saw them as playing a potentially important role both in selecting tenants of high calibre and in setting an improving example themselves. Beasley saw the landlord as the 'mainspring of the agricultural machine'; success or failure of agricultural endeavour, together with the 'character, morality and religion' of the agricultural classes surrounding an estate, he considered as largely dependent on the landlord's activities. Morton, in his treatment of estate management, adopted a broadly similar view.[152]

The lack of a sustained critique of the landed elite is perhaps surprising given the socially divisive nature of the political climate of the period.[153] One explanation for this is the fundamental alteration in the agriculturalists' perspective which had taken place since the eighteenth century. In the latter period already discussed, the assumption was that the landlord could be the 'natural' leader in the progress of scientific agriculture given only the right motivation. By the mid-nineteenth century, landlords were often, notwithstanding their actual participation in the agricultural societies of the

day, partially disqualified by many authors from making a positive contribution to agricultural progress by their lack of practical educational qualifications. As Caird put it 'the present age is eminently practical' and every member of the community was expected to serve an apprenticeship to his profession. The lack of any formal training for landownership was seen as a serious drawback: 'Our great universities offer him no peculiar instruction to fit him for the important functions of his station. He comes to it frequently without knowledge of its duties, and, with a consciousness of his own inability to perform them, he resigns all into the hands of his agent'. Other authors made similar comments.[154] Lack of education, however, was a relatively minor consideration in this shift of perspective.

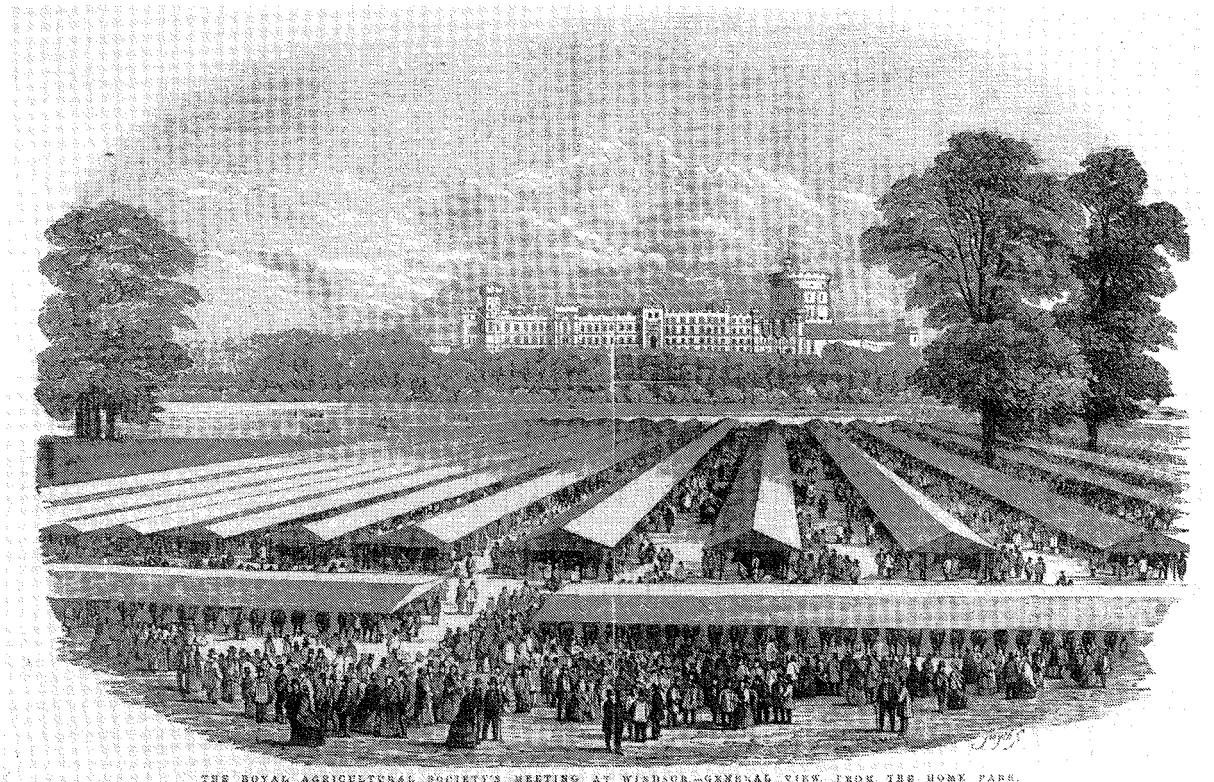
An attack on the system of landownership

The really crucial change was the redirection of attention away from the qualities of the landlord's character, and with it questions of honour, 'spirit', and to a lesser extent patriotism, which had preoccupied eighteenth-century agriculturalists, towards a concentration on the underlying system. To a certain extent, despite the practical duties urged upon the landowning class, the landlord was conceptualised essentially as a passive individual constrained from acting positively by limited powers of leasing, borrowing money, and selling and exchanging land. The blame was vented without restraint on these underlying limitations rather than on the landlord directly, as Wren Hoskyns stated:

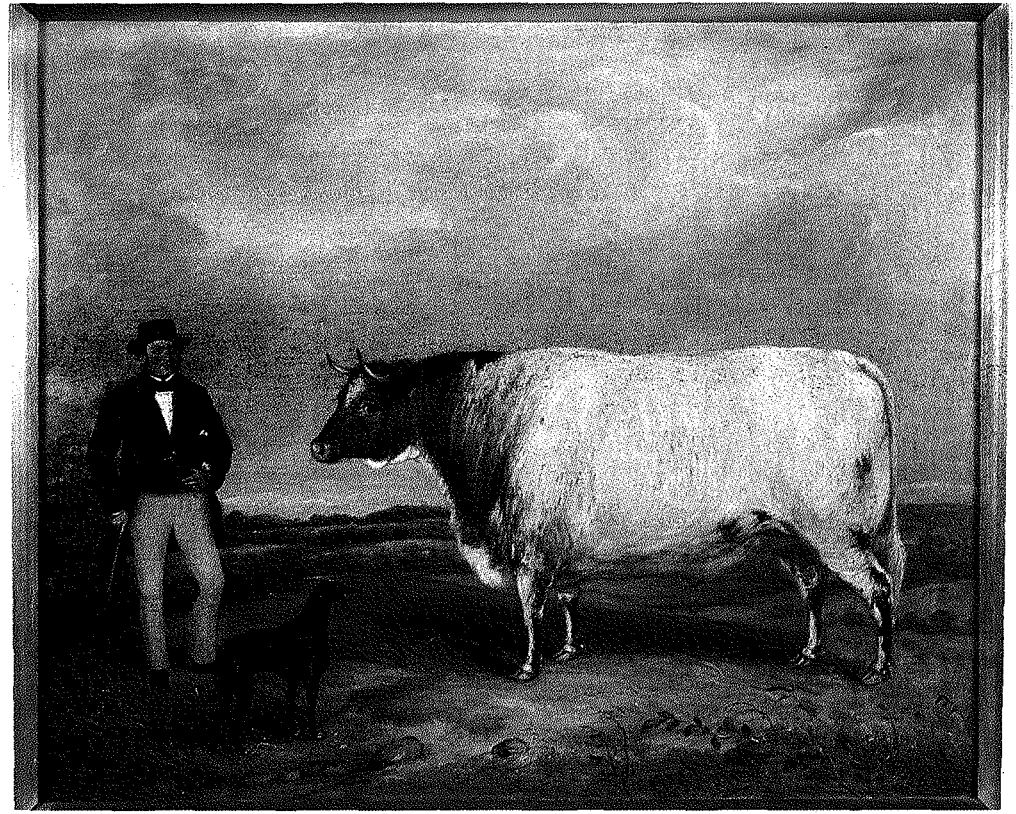
> The difficulty of improvement lies generally far less in the unwillingness or ignorance of the landowner, than in the irrelevance of the proposed advantage to his personal interests in his parental or other capacity, or in his pecuniary inability to undertake it.[155]

He noted it was all very well setting up 'ideals' of landlord activity (making permanent improvements and granting security of tenure and tenant right), but, given the tying-up of land in strict settlement, entails, and the burden of incumbrances for family portions, it was an unrealistic hope whilst such practices continued.

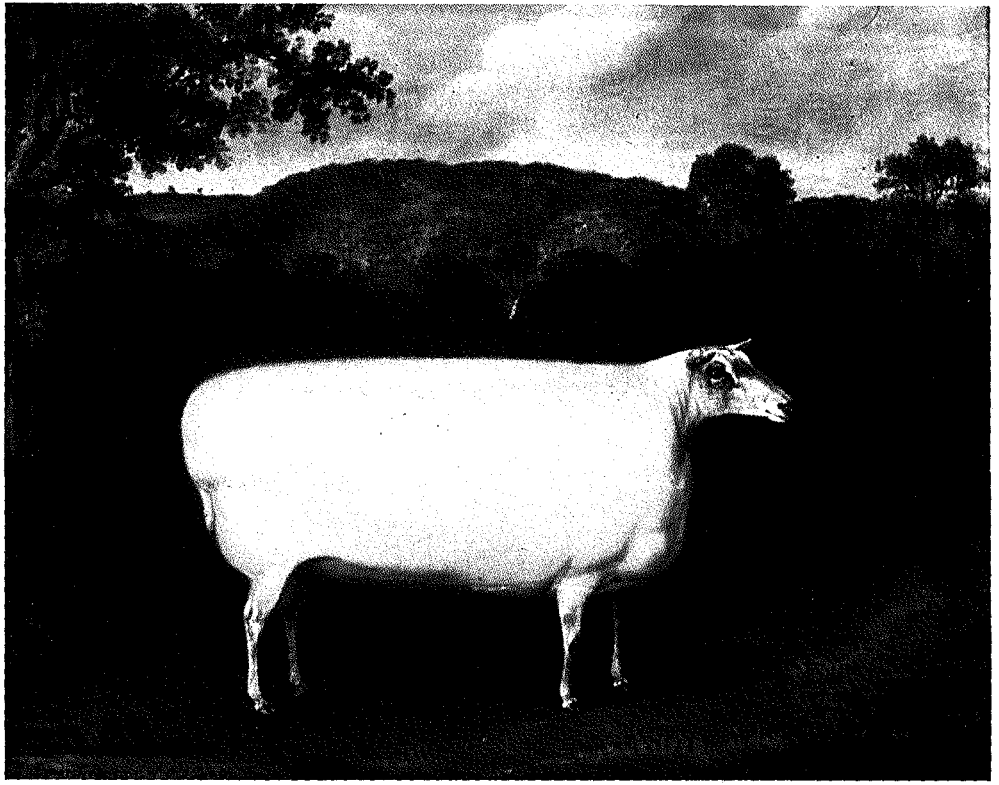
MacDonald similarly saw entail as a major barrier to progress: 'Indeed, in travelling through the country, one could readily distinguish whether an estate was entailed or not by the condition in which it was allowed to remain'.[156] Morton argued that the law of entail and its attendant incumbrances would result in 'immense losses ... sustained by the country at large, as well as by individuals, in consequence of the capabilities of the soil, being, as it were, locked up under absurd legal restrictions'. There was widespread agreement on this point by other writers. The essence of the objection was that only an estimated one-third of Britain's agricultural area belonged to its 'nominal' owners, the remainder being held by life owners under the provisions of strict settlement. Under this system land was, strictly speaking, held in trust for future generations of male heirs such that it could not be sold, exchanged, or mortgaged without great difficulty. The ensured descent of real property to the eldest male child by the custom of primogeniture meant that provision for younger sons, wives, mothers and sisters, largely had to come from raising capital sums and annual rent charges on land mortgages, resulting in some cases in generations of incumbrances being charged upon the income of estates.[157]



1 Royal Show, Windsor 1851, published in the *Illustrated London News,* 19th July, 1851

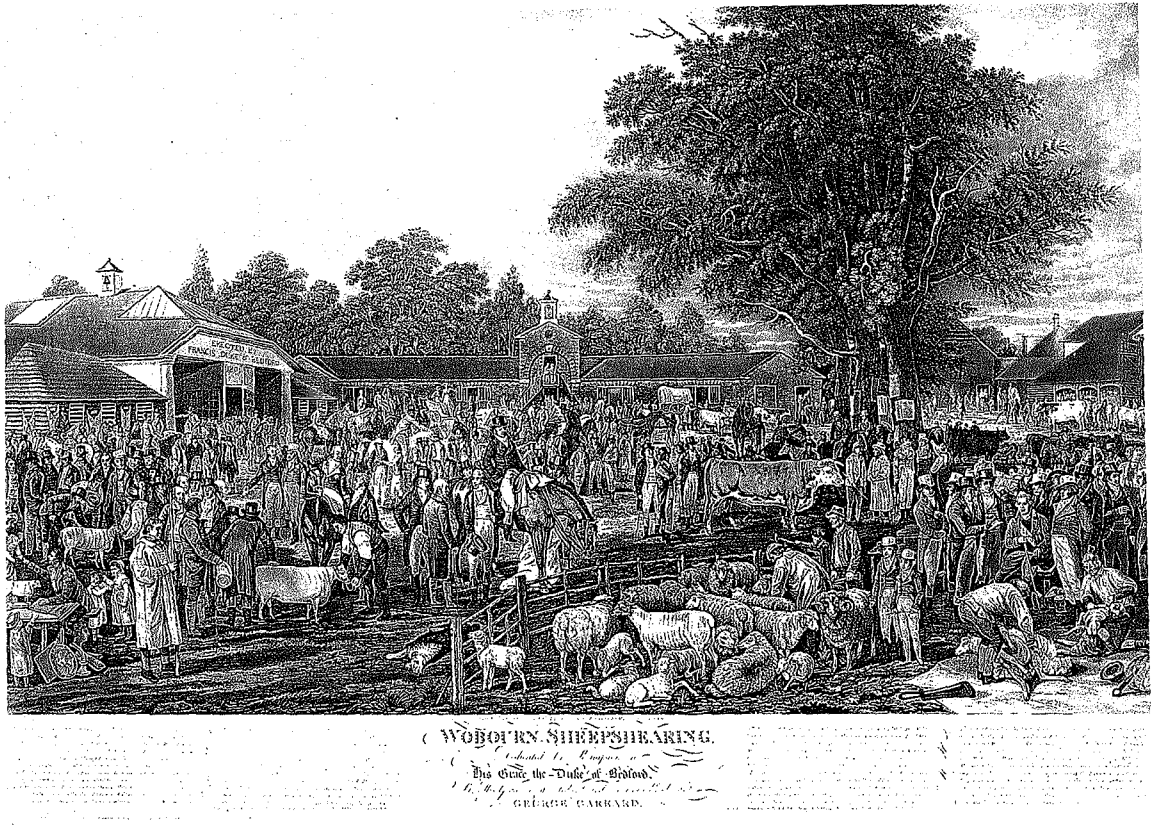


2 Champion Shorthorn, 1856, by William Smith



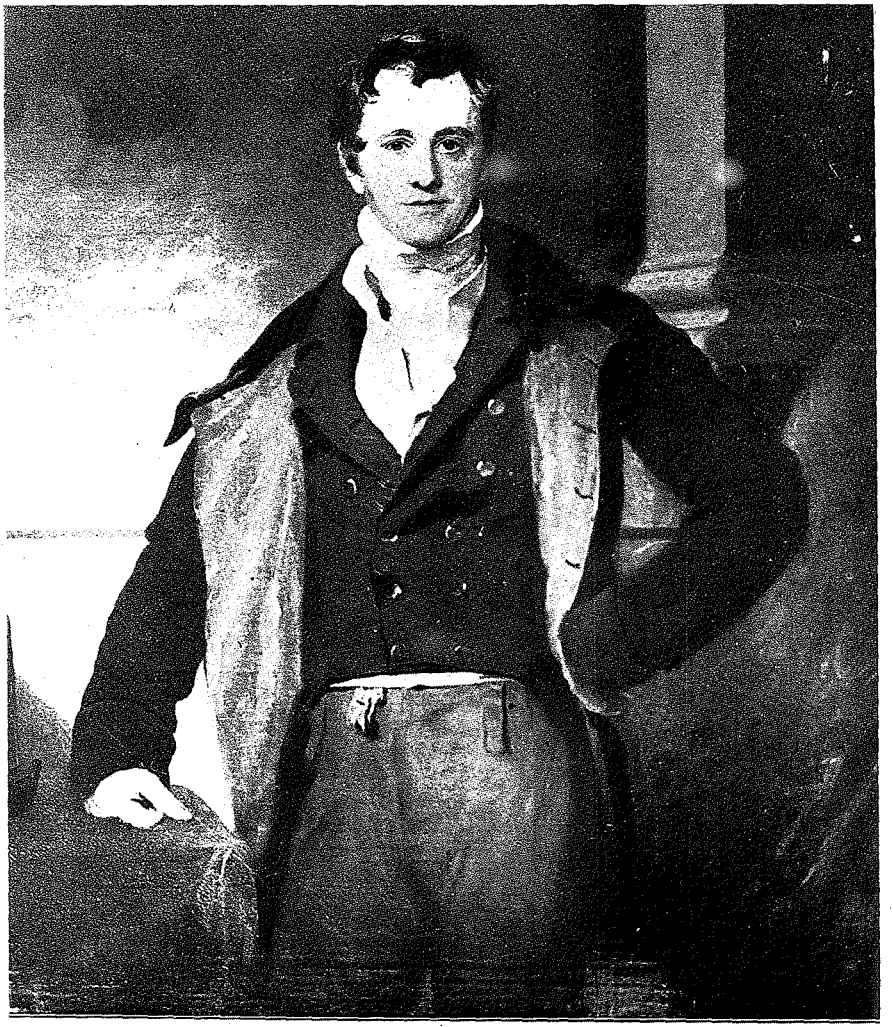
3 Four Shear Ram, 1831, by T. Weaver

4 English Agricultural Show Yard. First meeting at Oxford, 17th July, 1839



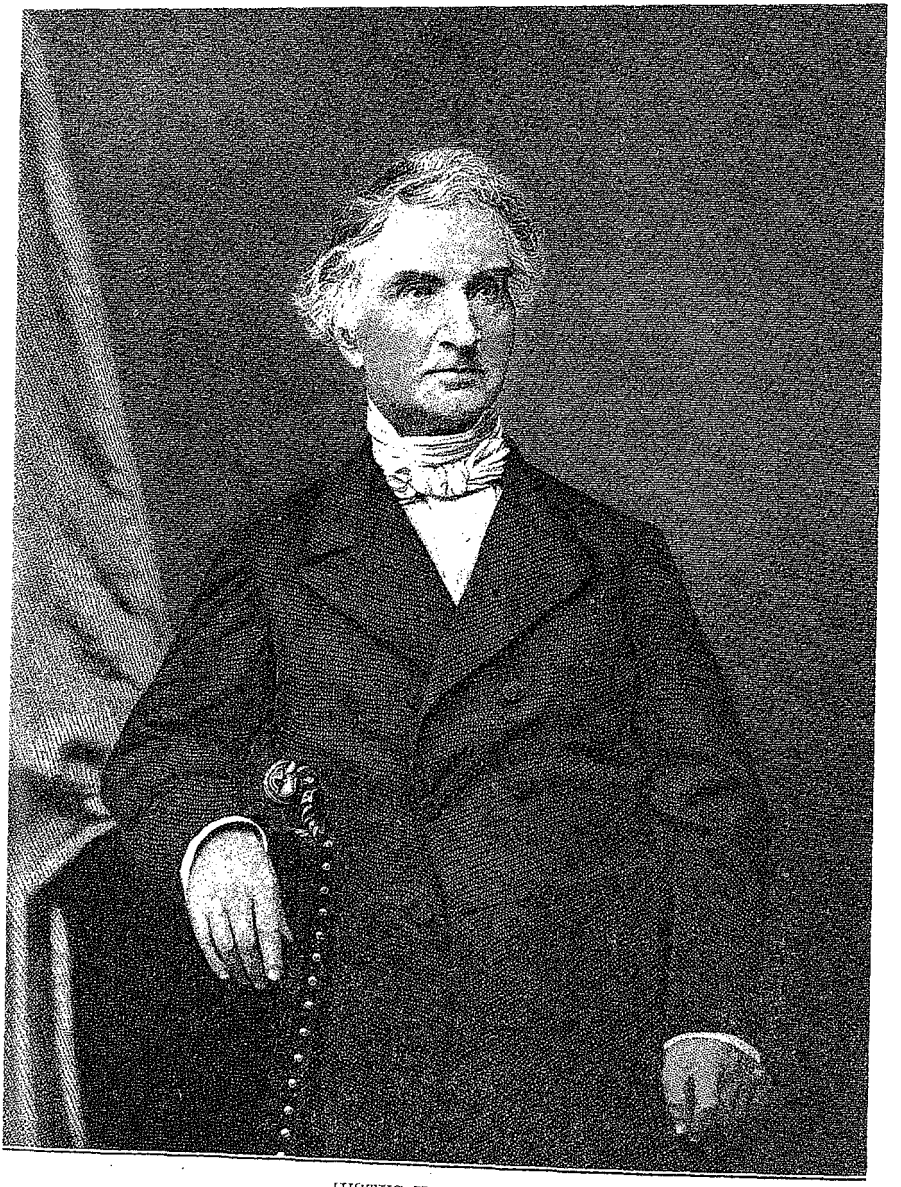
5 Woburn Sheep Shearing, 1811, by George Garrard

6 Groundslow Ploughing Match, Staffordshire, c.1839



Humphry Davy.

7 Humphry Davy



JUSTUS VON LIEBIG

8 Justus von Liebig

9 The Generae of Patriotism or, The Bloomsbury Farmer planting Bedfordshire Wheat, 1796, by H. Humphrey

Limitations on sale of land and the raising of money on mortgage, and the costly nature of such transactions, combined with the burden of family charges, were all denounced as reducing a landowner's financial ability to carry out improvements. His private capital would not be invested, again due to the very circumstances of limited ownership. Furthermore, neither could he safeguard tenants' improvements. As Wren Hoskyns pointed out, according to counsel given under the Select Committee on Agricultural Customs, the immediate owner of a settled estate had no power to give the security required by the tenant for any buildings he might erect, any drainage, fencing or grubbing he might do, or any improvement he might leave in the soil.[158]

Criticism of the system did not rest with practical considerations of this kind. The accumulation of land through legal restictions was seen as fundamentally at odds with the principles of competition and free-trade. It was claimed that it produced a body of inefficient, antiquated and underproducing great estates and hindered the flow of much-needed capital from commerce and industry. It also hindered the development of a small owner-occupier sector, thought to be beneficial on moral, social, political, and, possibly, economic grounds. From this viewpoint, even the remedies of government legislation in the form of Public Money and Drainage Acts were to be objected to, for perpetuating a system that could not otherwise exist if exposed to economic forces. Wren Hoskyns, for example, argued that such legislation 'strengthens and subsidises the system of family entail, as against purchasers, and thus prevents application of free capital to the soil'; it was argued that government policy should rather be directed to the diffusion of these immense acreages than enabling them to survive.[159]

The status accorded to ownership of such ancient family estates was further criticised for draining valuable investment from agricultural improvement in the demand it created for 'wasteful' social ostentation:

> He is expected to uphold a family repute for hospitality, and to exercise those acts of liberality and kindness which constitute the charm of neighbourhood, as well as the charities of social existence. Pride forbids him either to show his embarrassments or to retrench his expenditure; and yet his ignoble secrets ooze out in spite of all subterfuges; and the very persons who partake of his good cheer, covertly censure his imprudent lavishness.[160]

Wren Hoskyns similarly questions whether the system of settling estates is in fact even a moral benefit to the landed class: 'It is plain that estates do become worm-eaten within, let them be coated with no matter how many skins of parchment'.[161] Comments of this kind lead us on to the consideration of whether the views expressed in contemporary agricultural texts represented a clash in value systems. Whilst the agricultural texts were largely practical and financial in cast, it is clear that feelings ran deeper and expressed a sharper social antagonism than had been expressed in the late-eighteenth century. The stress laid on the need for an infusion of 'commercial spirit' was noted at the beginning of this chapter, and attention was drawn to Mechi's attribution of the public ridicule he had on occasion suffered to the ancient aristocracy. Large similarly makes an oblique reference to this difference in outlook which suggests a barely concealed antagonism between traditional landed groups and the commercial middle class. He suggests to tenantry that:

> If you rent under a generous-hearted landlord or a nobleman by birth, there is no fear of the estate falling into the hands of a money-making gentleman, there is no necessity of a lease or an agreement.[162]

This difference, however, was usually expressed more subtly by contrasting 'feudalism' (under which umbrella the Game Laws, entail and insecurity of tenure were considered) with 'commercial spirit', and free market principles.[163] The arguments were that the out-dated institutions and principles under which landed estates operated should be replaced by principles which brought land onto the same footing as manufacturing or commercial wealth; in practice, this meant the principles of political economy.

Wren Hoskyns argued that land should be left 'like every other kind of property, to its own natural tendency of accumulation and partition (to both of which it is affected, like every form of capital)'. He further quoted Mill as his authority that the breaking-up of entails, cheapening of land transfer and the granting of long leases and security of tenure were improvements in production 'as great as the invention of the spinning-jenny or steam-engine'.[164] Mechi, more bluntly, 'saw no reason why a piece of land should not change hands as a hat or a coat, or a piece of calico'.[165] Morton argued that:

> Free trade in land must assuredly sink the incompetent proprietors, whether they are titled or not, and bring the men of talent, energy, means, into more prominent positions in life. And why should it be otherwise in a commercial country? Is merit to be smothered out by unwise legislation ... the days are gone by, when the existing merit of the age can be crushed and kept back by the perpetuated merit of past ages vauntingly worn by unworthy successors.[166]

Numerous examples of this kind can be found in the literature between 1840 and 1870. Arguments employed were not without political significance, and the presence of the radical MP for Manchester, John Bright, on Morton's team of contributors to Cyclopaedia is also suggestive of linkages with wider issues.[167] It is considered, however, that sufficient examples have been cited above to support the contention that mid-nineteenth century literature did represent a rival social challenge. Unlike the eighteenth-century literature, and despite the similarity of practical prescriptions on the landlord's role in agrarian change, the effect of the agricultural debate was to question seriously the legitimacy of landlord power.

Writers sought to establish three things in the minds of their readers: first, that the existing landownership system was seriously defective in terms of enabling agricultural production to develop to its full potential; second, that it was an artificial system which had its origins in the distant past and in a fundamentally different, and oppressive, social structure; and, third, that the prospect of future improvement rested with the break-up of entailed estates and their replacement by a body of capitalist landowners, bringing with them industrial/commercial methods of management and working in an economic partnership with a truly independent tenantry.[168]

A new role for landlords?

The continued activity of landlords in agricultural societies and in making permanent investments on their estates, employing government loans or private capital, suggests the polemical nature of literature that denied their ability or will to do so. Neither, as the mid-nineteenth century

agriculturalists might lead us to believe, were the 'ideals' of landlord involvement such radical departures from past conceptions. Once again the landlord's primary role was to be that of a provider of fixed capital, laying particular stress on farm layout, farm building accommodation and underdrainage.[169] Whilst not a new role it was given new emphasis by the changed technical and economic situation of the 1840s-60s. Techniques requiring a major increase in working capital together with lower product prices meant that the landlord had to assume responsibility for fixed capital as tenants could no longer afford to. The augmentation of fixed capital was a central strand of the cost-cutting policies adopted in the changed atmosphere of competitive capitalism after the repeal of the Corn Laws. The importance of this was not lost on contemporaries in their ideas of what the landlord's role should be; it involved expenditure on a larger scale than was the case in the late-eighteenth century.

Additionally, the landlord was to ensure that the tenantry, over which he was to exercise a careful selection, had both security of tenure and security of investment for improvements by the implementation of long leases incorporating compensation clauses.[170] Where the literature of this period breaks with that of the eighteenth century is in the lack of emphasis on the landlord's potential role as an experimenter or a demonstrator of new techniques through the establishment of a home farm, this role presumably having passed largely to the professional agricultural scientists. Further, the landlord's control over cropping practices was no longer treated as advantageous. Indeed, it was more often considered as an encroachment on tenants' freedom, smacking unpleasantly of dependency, and potentially, a

drag on improvement. Morton was thus against 'objectionable restrictions' in leases. Dean similarly argued that tenants should be left to pursue their system of cultivation unfettered: 'where the farmer has not been too heavily clogged he has progressed ... but it is only under liberal covenants that he can do so'.[171] Further comments on the proper relations between landlord and tenant repeated the eighteenth-century idea that rents should be both 'judicious' (not rack rents), and, in accordance with market competition, governed by economic rather than paternal principles.[172] Morton, for example, argued that the latter principle, which could lead to the keeping-on of old tenants on under-rented farms, has 'no credit in the action - but actual discredit'.

In conclusion, it is apparent that there had been a fundamental re-negotiation of the position of landlords vis-a-vis the tenantry during the 1840s-60s. Although it must be conceded that the nature of technical change within agriculture itself added to these demands for substantial reform of the existing system,[173] the terms of the debate cannot be reduced to technical imperatives alone. Schematically, landowners had been toppled from their eighteenth-century position as 'natural' leaders of agricultural progress. By the mid-nineteenth century their actions for the good of agriculture were seen as a fulfillment of duties, viewed as palliatives compensating for an outmoded landholding system, rather than a subject of celebration.[174]

With regard to their relationships with the tenantry, it is significant that agricultural writers no longer unequivocally reinforce the patriarchal role formerly assigned to them. The development of a critical attitude towards landlord practice was encouraged amongst the tenantry. Beasley, for

example, recommended tenants evaluate landlords on exactly the same basis as tenants themselves were evaluated before embarking on a tenancy: enquiring into character, antecedents and past conduct. The landlord's actions were also to be accountable to society at large. They were no longer the necessary centres of 'enlightenment' extending a beneficial control over tenant cropping practices. Rather, the model is of a capitalist tenantry requiring only the freedom from landlord interference and proper infrastructural provision to prove themselves the repositories of everything progressive.[175]

Agricultural science and the wider political context

It is clear that the literature expressed a commercial/professional middle-class viewpoint which used science and the dictates of political economy as a justification for its policies both on technical grounds and as a rival value system to compete with inherited privilege. Further, changes in the status and power of middle-class fractions within nineteenth-century society, such that they now had a firm hold at hegemonic and ideological levels, were reflected in the production of a literature which overtly reproduced these class antagonisms and openly challenged the existing landownership system.[176] Finally, in that the object of concerted criticism was the system itself, no amount of personal enterprise on the part of individual improving landlords could undermine the force of the argument. As a body, therefore, landlords were effectively placed in a defensive position vis-a-vis a tenantry who had the weight of agricultural opinion behind them.

The main institutional aspects which received criticism, then, related to

education, tenure, the game laws, settled estates, entail and primogeniture. F.M.L. Thompson considers that the history of parliamentary attacks on these institutional constraints represented a 'history ... essentially concerned with a struggle for power' between the landed aristocracy and a wide liberal-radical cohort. It is a central tenet of his argument that to the essentially politically-motivated agitation for free trade in land, agriculturalists added a practical strand in their concern with obstacles to the financing of improvements, whether by landlords or tenants, and that this reflected important technical changes which emerged in the 1840s. These included the relative novelty of the distinction between landlord's and tenant's capital, the great growth in the need for landlord's capital and the introduction of efficient methods of field drainage.[177]

This argument ignores the fact that the ostensibly technical literature of this period was itself imbricated with clear socially and politically-motivated persuasions, that as much reflected the struggle for power at higher political levels, as it reflected a limited response to technical change. The connections of prominent agriculturalists with radical MPs has already been mentioned. Morton as editor of the Agricultural Gazette and Wren Hoskyns as his chief contributor (and Governor of the Royal Agricultural Society) were firmly committed to the ideology of 'laissez-faire', and both were later to support the movement for Free Trade in Land.[178] Furthermore, the rhetoric of the agriculturalists and their points of attack on the landed estate system parallel the rhetoric of parliamentary debates and of pamphleteers.

In a parliamentary context, Thompson draws attention to the connection of the Anti-Corn Law campaign with the later Free Trade in Land campaign.[179]

The significance of this political tradition was certainly not lost on contemporary agriculturalists. Morton, for example, talks of 'barbarous laws' when referring to entails and urges his readership to 'condemn and remove the law of entail, and more will be done to promote the prosperity of the country than Sir Robert Peel did, when to his lasting honour, he repealed the obnoxious corn laws'.[180] The evil of 'feudality' represented in this monopoly of land guaranteed by law, spoken of by Beal and others in political pamphlets, was mirrored in numerous references to 'feudalism' in agricultural texts. Additionally, the practical effects that were mistakenly supposed in political debates to derive from the abolition of primogeniture and entail, were reproduced in agricultural debates. These effects included the remodelling of the legal system of land transfer, the promotion of agricultural investment, the modernisation of landlord-tenant relations, the improvement of the condition of the agricultural labourer and the introduction of a new class of capitalist landowner.[181]

It is clear that agricultural texts shared in the making of this 'essential radical myth' as Thompson has described the onslaught against the socio-legal aspects of the landed estate system. The Tory reaction to this challenge, together with challenges represented by condemnations of the Game Laws, establishes the view that such rhetoric was perceived as a social and cultural attack, the purpose of which was to dismantle the landed-estate system and its territorial power base.[182] The specific form of the challenge emanating from the agricultural literature has been discussed in relation to the landlord's role in agrarian change. The connection of this debate with political debate, however, should alert us to the importance of wider socio-political struggles

which were both influenced by, and acting as a medium for, more circumscribed agricultural discussions.

The principal ideological dimensions of the agricultural literature of the 1840s to 1860s can be sketched as follows. First, in the representation of sectional interests as universal ones, an effective basis was prepared for a commercial middle-class challenge of the landed-estate system at its very roots. Arguing from the point of view of national productivity and social welfare, the prevention of the accumulation of land into large estates such that landownership was freed to a body of improving commercial (middle-class) landowners, or a body of independent owner-occupiers, was seen as a legislative priority, which, if carried into effect, potentially threatened to undermine the existing rural social fabric.[183] If, as Thompson maintains, the abolition of primogeniture and entail in actual fact represented little more than a 'paper-dragon',[184] effective primarily in its electioneering value, the debate nevertheless implied a role for the traditional landowning class more rigidly bound to duties of agricultural investment, and to defending its monopoly by the performance of 'good works', than had hitherto been the case. The rhetoric of the literature served to mobilise support for a middle-class critique of inherited privilege; that it rested on deeper interests than those relating to practical defects in the landed estate system is underlined by the fact that the demand for reforms was essentially as intellectual and political one, receiving only limited support from the body of farmers and labourers.[185]

A second ideological dimension of the literature lies primarily in the insistent denial that the majority of landowners either would or could participate in agrarian change under existing conditions of limited ownership.

This denial was made in the face of inconclusive evidence, then as now, as to either the prevalence or the practical effects of strict settlement. A recent review has emphasised the immense variety of family settlements, incorporating varying degrees of flexibility, which suggest a variety of effects on estate policy. This review concluded that without further substantial case studies 'the argument sometimes advanced, and certainly arguable, that the land reformers were mostly basing their attacks upon economic myths of their own making, will not be resolved'.[186] If it cannot be proved in factual terms that agriculturalists and politicians were 'tilting at windmills', it can at least be pointed out that their arguments stemmed as much from belief and abstract theorising on the nature of entail and family settlement as it did from actual practice. Their assumption that all owners of settled estates were absolutely hamstrung in terms of making improvements, without the aid of government legislation and public loans, was clearly taking only the extreme case. It was also to ignore, as Thompson has stressed, that often owners of settled estates effectively subsidised agricultural improvements from social considerations, improvements which would not have been undertaken on purely economic grounds by those new men of capital of whom agricultural campaigners were so fond.[187]

A third and final ideological aspect of the literature, effectively cutting off any recourse to a past tradition of agricultural improvement, was the literature's 'naturalisation' of the present. The insistence that the 1840s-60s represented a fundamentally new era, involving both new techniques and the need for a radically-altered system of land-holding and tenurial relations, powerfully undermined features of the existing system that could be identified

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with an 'unnatural' past: the 'feudal' system of entail or the oppressive dependence of tenants on landlord patronage, for example.[188] In view of the substantive similarities between the policies contained in late-eighteenth century literature and those of the mid-nineteenth century, it is surprising that this long tradition of improving estates should be unacknowledged.[189] Apart from a few congratulatory remarks on the foresight of Young, Townshend, Bakewell, Coke, and the Duke of Bedford and a handful of other agriculturalists, this is, however, the case. Change is firmly attributed to the period post-1815. The resultant necessity for new relations between landlord and tenant was a common cry that took no cognizance either of the tradition, or of the substantial advantages of paternalism: on the contrary, it sought to sever ties of this kind as has already been noted.[190]

The aspirations of contemporary agriculturalists thus reached far beyond the technical considerations with which they dealt, as I have attempted to demonstrate. In championing the philosophy of free trade as the prime organising principle of the agricultural system, agriculturalists not only echoed the political challenge issued to the landed interest in parliament. They added substantial respectability to these arguments in the form of an apparently value-free 'technical' justification for dismantling the social system of landed estates on which the power and influence of the landed classes was based.

8

CONCLUSION

The findings of the preceding discussion may be summarised in five main points:

Firstly, that there is no historical basis for excluding the burgeoning agricultural societies of the late-eighteenth and nineteenth centuries, their membership, or their activities, from a study that purports to dissect the anatomy of scientific culture during the period. The contemporary enthusiasm for the philosophical study of agriculture responded directly to developments within natural philosophy and medicine, a link which strengthened as agricultural chemistry began to crystallise in the nineteenth century. The widespread involvement of national and provincial agricultural societies in experimentation, their links with the academic community and the major scientific forums of the day (Chapters 3 and 4), all testify to the strength of that response. Whether or not these agricultural societies and agricultural improvers significantly advanced scientific knowledge, or strictly speaking, performed repeatable 'scientific' experiments, is a separate question which should not blind us to the contemporary importance of scientific culture to the literate agricultural community. Chapter 2 attempted to underline the point by revealing the literature's stress on science as the key to agricultural progress.

A second point is that whilst much of the enthusiasm for science was couched in utilitarian terms, the evidence available suggests that the practical benefits of science to agriculture were quite limited, even in the nineteenth century. Much of the enthusiasm apparent in the agricultural literature was generated not from striking examples of actual advances made, but from a prospective faith in the benefits of future scientific progress. Advances in agricultural science theory were also slow to develop, as the self-critical comments of contemporary agricultural chemists made clear (Chapter 3), notwithstanding greater institutionalisation and professionalism within the discipline.

This evidence, thirdly, throws into question the utilitarian basis of the zeal with which agricultural science was pursued by the eighteenth and early-nineteenth century landed elite. Chapter 5 suggested three additional reasons for the embrace of agricultural science within aristocratic culture. First, that the agricultural literature provided an intellectual justification for practical measures of estate rationalisation: 'improved' husbandry required a framework of 'improved' estate and farm layout. Secondly, that membership of an agricultural society brought with it a certain social cachet which enhanced the public standing of the landed elite. Thirdly, that active participation in agricultural experiment and estate improvements could be capitalised on as a contribution to public service, which was important for the public image of landed society. It was not until the late 1830s that this identification between the private interests of landowners and the 'Public Interest' was undermined in the agricultural literature.

A fourth point concerns the relationship between science and social class.

The close association of agricultural science with the landed elite from the mid-eighteenth century to the early-nineteenth century militates against an attempt to see all forms of natural knowledge as alien to aristocratic culture, or to reduce that culture to its dilettante and decorative aspects. The association is also indicative of the changes taking place within aristocratic culture, a culture which in histories of science is often taken as given. This account has suggested that, on the contrary, participation in agricultural science by the landed elite implied a substantial transformation of the concept of 'a gentleman' and altered the premises of social leadership (Chapter 5).

A final point, illustrated by Chapters 6 and 7, is that the relationship between agricultural science and social change was complex and historically specific. For much of the eighteenth and early-nineteenth century, with the exception of the politically tense period of the 1790s (Chapter 6), agricultural science was associated with the landed elite and was perceived as a stabilising influence. Archibald Cochrane's Treatise shewing the intimate connection that subsists between Agriculture and Chemistry (1803 edn) thus carried the motto 'Let us cultivate the Ground, that the Poor as well as the Rich, may be filled, and Happiness and Peace be established throughout our Borders'. Cochrane, and other agricultural writers during this period, saw the pursuit of agriculture as the nation's best defence against foreign foes and domestic incendiaries.

A change of perspective from the late 1830s produced a new note of social antagonism in the agricultural literature (Chapter 7). Writers criticised the landownership system for hindering the growth of agricultural output, castigated the system for its origins in the distant, 'feudal', past, and

campaigned for the replacement of entailed estates with a body of capitalist landowners experienced in industrial and commercial methods of management. The landed elite were no longer flattered as being leaders of agricultural progress themselves, and in the wake of this challenge to their leadership came open attacks on their power and influence more generally. Far from stabilising the existing social fabric, the development of agricultural science from the 1840s was seen as requiring a transformation in the structure of rural society.

It only remains to be remarked that there are great opportunities for future research in the field of agricultural science. The question of why the efflorescence of scientific endeavour described should have produced so limited an effect in terms of mid- to late-nineteenth century productivity, for example, is in urgent need of investigation. The audience for agricultural science, the membership of agricultural societies, and the subject's changing social constituency between the eighteenth and nineteenth century, has, with a few notable exceptions, been scarcely touched by historical research. It would be interesting, amongst other issues, to establish whether a withdrawal of the aristocracy and gentry from the active membership of agricultural societies and institutions is discernible in the nineteenth century.

Without such detailed empirical work, the propositions put forward relating to agricultural science and social change must remain tentative. Such evidence as has been presented here, however, may make it possible now to argue that agricultural science, in common with other branches of scientific knowledge, was capable of forming a value system around which different social groups could construct separate progressivist philosophies and cultural

mores. Since no single social class exclusively possessed that value system, it is not surprising that in the politically and socially divisive climate of the mid-nineteenth century, agricultural science became the subject of fierce argument.

REFERENCES

1. A. Thackray, 'Natural knowledge in cultural context: the Manchester model', American Historical Review, 79, 3 (1974) pp.672-709; B. Barnes and S. Shapin (eds), Natural Order: Historical Studies of scientific culture (London, 1979); I. Inkster and J. Morrell (eds), Metropolis and Province. Science in British culture, 1780-1850 (London, 1983); M. Billinge, 'Hegemony, class and power in late Georgian and early Victorian England: Towards a cultural geography', in A.R.H. Baker and D. Gregory (eds), Explorations in Historical Geography (Cambridge, 1984) pp.28-67. These authors provide an introduction to the debate and further references on the cultural and social history of science.

2. R. Scholes, Semiotics and interpretation (New Haven, 1982) p.144, quoted in J.B. Harley, 'Maps, knowledge, and power', in D. Cosgrove and S. Daniels (eds), The iconography of landscape (Cambridge, 1988) p.278.

3. A full account of the sources used and the biographies of prominent agricultural writers may be found in S. Wilmot, 'Landownership, farm structure and agrarian change in South-West England: Regional experience and national ideals' (Exeter University, unpublished PhD thesis, 1988) Chapter 1 and Appendices A.1 and A.2.

4. James Caird, 'Fifty years' progress of British agriculture', J.R.A.S.E., 51 (1890) pp.20-36; p.25.

5. H. Ritvo, The Animal Estate; The English and other creatures in the Victorian age (Cambridge, Mass., and London, 1987) Chapter 1, pp.45-81; A. Briggs, The Age of Improvement 1783-1867 (London, 1959) p.39; S. Seymour, 'Eighteenth-century parkland 'improvement' on the Dukeries' estates of north Nottinghamshire' (Nottingham University, unpublished PhD thesis, 1988) Chapter 2 and pp.471-2.

6. I am currently extending this aspect of the work under a Marc Fitch Fellowship at the University of Reading, including prosopographical work; see note 126.

7. An example is found in William Marshall's Minutes of Agriculture (London, 1778) p.150 in which his approach to nature is implicitly compared with medicine, where 'male obstetrists' were replacing 'the matronic art of Midwifery'.

8. Marshall, 'minutes', p.151.

9. Thackray, 'natural knowledge in cultural context', p.678; R. Cooter, 'The power of the body: the early nineteenth century', in Barnes and Shapin, 'natural order', pp.73-90; esp. p.76; Billinge, 'hegemony, class and power', pp.28-67.

10. [W. Bowring] 'The objects, advantages, and pleasures of science', Westminster Review, VII (April, 1827) pp.269-317; p.274.

11. J.T. Merz, A history of European thought in the nineteenth century (4 vols, Edinburgh and London, 1896-1914) vol 1, p.89.

12. J. Morrell and A. Thackray, Gentlemen of Science; Early years of the British Association for the Advancement of Science (Oxford, 1981) Appendix III, pp.546-8.

13. D.S.L. Cardwell, The organisation of science in England (London, 1957) p.78.

14. R.C. Boud, 'Scottish agricultural improvement societies, 1723-1835', Review of Scottish Culture, 1 (1984) pp.70-90; pp.73-77.

15. N. Goddard, 'Agricultural societies', in G.E. Mingay (ed) The Victorian Countryside (2 vols, London, 1981) vol 1, pp.245-259; pp.246-7; 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: Essays on rural England, 1500-1900 (London, 1979) pp.43-64; p.46.

16. R.J. Colyer, 'Early agricultural societies in South Wales', Welsh History Review, 12 (1984-5) pp.567-581; pp.568-9.

17. K. Hudson, Patriotism with Profit. British agricultural societies in the eighteenth and nineteenth centuries (London, 1972) pp.3-10.

18. P. Horn, 'The contribution of the propagandist to eighteenth century agricultural improvement', Historical Journal, 25, 2 (1982) pp.313-329; p.318.

19. Fox, 'local farmers' associations', p.54; N. Goddard, 'The development and influence of agricultural periodicals and newspapers, 1780-1880', Agricultural History Review, 31, 2 (1983) pp.116-131; pp.122-3; p.128.

20. K. Hudson, The Bath and West (Bradford-on-Avon, 1976) pp.75-81; E.J. Russell, A History of agricultural science in Great Britain 1620-1954 (London, 1966) p. 76; Goddard, 'agricultural periodicals and newspapers', p.117; S. Richards, 'Agricultural science in Higher Education: Problems of identity in Britain's first Chair of Agriculture, Edinburgh 1790-c.1831', Agricultural History Review, 33, 1 (1985) pp.59-65; p.63; p.65.

21. T.L. Crosby, English farmers and the politics of Protection 1815-1852 (Hassocks, Sussex, 1977) p.12 ff; R. Mitchison, 'The old Board of Agriculture', English Historical Review, 74 (1959) pp.41-69; p.62; N. Goddard, 'William Shaw "of the Strand" and the formation of the Royal Agricultural Society of England, J.R.A.S.E. 143 (1982) pp.98-104; p.99.

22. N. Goddard, 'The Royal Agricultural Society of England and agricultural progress, 1838-1880' (Kent University, unpublished PhD thesis, 1981) Figure II, p.99.

23. Thackray, 'natural knowledge in cultural context', pp.672-709; G.A. Foote, 'Science and its function in early nineteenth-century England', Osiris, XI, (1954) pp.438-54; Russell, 'history of agricultural science', pp.171-3.

24. G.E. Fussell, More Old English Farming Books, 1731-1793 (London, 1950). Fussell relies heavily on John Donaldson, Agricultural Biography (London 1854); William Ellis, The practical farmer, or the Hertfordshire Husbandman, containing many new experiments in husbandry (London, 1732); William Ellis, A compleat system of experienced improvements made on sheep, grass, and lambs and house lambs etc (London, 1749); Benjamin Stillingfleet, Miscellaneous tracts relating to natural history, husbandry and physick (London, 1759); Peter Templeman, M.D. Practical observations on the culture of lucerne, turnips, burnet, timothy grass and foul meadow grass, communicated by Letters to Dr Templeman (London, 1766); John Mills F.R.S, A new system of practical husbandry (5 vols, London, 1767).

25. C. Veliz, 'Arthur Young and the English landed interest, 1784-1813' (London University, unpublished PhD thesis, 1959) p.20.

26. P. Mathias, 'Who unbound Prometheus?' in A.E. Musson Science, technology and economic growth in the eighteenth century (London, 1972) pp.69-96. Mathias notes it is difficult to define links between empirical improvement and applied science with respect to agricultural innovation - much of the latter being based on 'quite irrational premisses', pp. 90-91; p.73.

27. William Marshall, Minutes, experiments, observations and general remarks on agriculture in the Southern Counties (2 vols, London, 1799) p.85.

28. Marshall, 'minutes, experiments and observations', pp.116-129; pp.55-62; pp.311-2; William Marshall, 'on improving the minds of tenants', Section VII in On the landed property of England: an elementary and practical treatise - containing the purchase, improvement and management of landed estates (London, 1804).

29. Marshall, 'minutes, experiments, observations', p.116.

30. Arthur Young, Rural economy or essays on the practical parts of husbandry (London, 1770) p.175; Arthur Young, Farmers letters to the people of Great Britain (3rd edition, London, 1771) p.467.

31. Young, 'farmers letters to the people', p. 465; Dictionary of National Biography, Leslie Stephen (ed) (63 vols, London, 1885-1900.) Despite his enthusiasm, Young was also careful to point out that to the working farmer, experimental farming could not always be recommended; cash profit remained the most essential factor of all. Fussell, 'farming books', p. 77.

32. N. Kent, Hints to gentlemen of landed property (London, 1775) p.1; p.6.

33. Henry Home, Lord Kames, The gentleman farmer; being an attempt to improve agriculture by subjecting it to rational principles (5th edn, London, 1802) p.391; p.405.

34. Thomas Stone, An essay on agriculture - with a view to inform gentlemen of landed property whether their estates are managed to the greatest advantage (Lynn, 1784) p.vii.

35. Charles Ley, The nobleman, gentleman, land steward and surveyor's complete guide...comprehending the duty and office of a land steward (London, 1787) pp.18-20.

36. Revd. Dr. J. Trusler, Practical Husbandry or the art of farming with the certainty of gain: as practiced by judicious farmers in this country. The result of experience and long observation (London, 1780) frontispiece; Home, 'gentleman farmer', p.vi; Ley, 'land steward and surveyor's complete guide', preface; J. Wimpey, Rural improvements: or essays on the most rational methods of improving estates (London, 1775) frontispiece p.65; C. Vancouver, General view of the agriculture of the county of Devon (London, 1808) p.431; Young, 'farmers letters to the people' p.428, for example.

37. A society of farmers in -shire, Political enquiry into the consequences of inclosing wastelands (London, 1785) p.2.

38. S.A. Richards, 'Agricultural science in British Higher Education, 1790-1914' (Kent University, unpublished MSc thesis, 1982) Chapter 1; Veliz, 'Arthur Young', Abstract; Chapter 1; Appendix 2; D. Spring, The English landed estate in the nineteenth century: its administration (Baltimore, 1963). He notes the 'scientific spirit' affecting land agents, p.182.

39. C.S. Orwin and E.H. Whetham, History of British Agriculture 1846-1914 (London, 1964) p.30.

40. C. Wren Hoskyns, 'Introductory Essay - Agriculture', in (ed) J.C. Morton A cyclopaedia of agriculture, practical and scientific, in which the theory, the art and the business of farming, are thoroughly and practically treated by upwards of fifty of the most eminent practical and scientific men of the day (London, 1855) p.6.

41. Wren Hoskyns, 'introductory essay', in Morton (ed) 'cyclopaedia', p.13.

42. Quoted in R.S. Burn, Outlines of modern farming. Rudimentary treatises for students of agriculture (London, 1863) p.295.

43. J. Dudgeon, 'On the progress in agriculture in Scotland since the formation of the Highland Society' J.R.A.S.E., 1 (1840) pp.59-112; John Grey, 'A view of the past and present state of agriculture in Northumberland' J.R.A.S.E., 2 (1841) pp.151-192; Earl Spencer, 'On the improvements which have taken place in West Norfolk' J.R.A.S.E., 3 (1842) pp.1-8; P. Pusey, 'On the progress of agricultural knowledge during the last four years', J.R.A.S.E., 3 (1842) pp.169-217; idem., 'On the agricultural improvements in Lincolnshire', J.R.A.S.E., 4 (1843), pp.287-316, for example. The importance of stadial theories in Enlightenment philosophy is indicated in note 102. The importance of teleological theories of human progress in the nineteenth century, both pre-and post-Darwin, is discussed in P.J. Bowler, Theories of human evolution, a century of debate, 1844-1944 (Oxford, 1986) pp.41-51; and R.M. Young, Darwin's metaphor, Nature's place in Victorian culture (Cambridge, 1985) pp.16-21. See also J. Blum, 'Agricultural History and Nineteenth-Century European ideologies', Agricultural History, 56, No.4 (1982) pp.621-631; esp. p.626.

44. Rev. A. Huxtable, The Present Prices (Blandford, 1850) p.8; Samuel Copland, Copland's Agriculture: ancient and modern (2 vols, London, 1866) p. 789; James Caird, English agriculture, 1850-1 (London, 1852) p.528.

45. Burn, 'outlines of modern farming', p.12.

46. Goddard, 'agricultural periodicals and newspapers', pp.116-131; Burn, 'outlines of modern farming', pp.303-310; Wren Hoskyns, 'introductory essay', in Morton (ed), 'cyclopaedia', pp.20-23.

47. Calculated from an analysis of the Journal of the Royal Agricultural Society of England's contents from 1840-1870.

48. Wren Hoskyns, 'introductory essay', in Morton (ed), 'cyclopaedia', p.2.

49. Copland, 'Copland's agriculture', preface, p.iv-v; see also Burn, 'outlines of modern farming', p.14. Copland's comments reflect the impact of evolutionary thought at this period, which added intellectual weight to the faith in progress. G.A. Dean, The land steward (London, 1851) p.10; D. Low, On landed property and the economy of estates (London, 1844) p.6.

50. Burn, 'outlines of modern farming', p.313: J.L. Morton, The resources of estates (London, 1858) chapter 2, pp.27-47; Dean, 'The land steward', p.236; J. Beasley, A lecture delivered to the members of the Faringdon agricultural book club on the duties and privileges of the landowners, occupiers and cultivators of the soil (London, 1860) pp.12-13; Burn, 'outlines of modern farming', p.323.

51. S. Shapin, 'Property, patronage and the politics of science: the founding of the Royal Society of Edinburgh', British journal for the history of science, 7 (1974) pp.1-41; p.9; idem., 'The audience for science in eighteenth-century Edinburgh', History of Science, 12 (1974) pp.95-121; pp.101-4; pp.106-9; M. Berman, Social change and scientific organization. The Royal Institution, 1799-1844 (London, 1978) pp.32-47; pp.68-70; J.G. Gazley, 'Arthur Young and the Society of Arts', Journal of Economic History 1, 2 (1941) pp.129-152; pp.130-145; Hudson, 'patriotism with profit', p.7; pp.10-11.

52. Hudson, 'patriotism with profit', p.7.

53. Sir E. Clarke, 'The Board of Agriculture, 1793-1822', J.R.A.S.E., 59 (1898) pp.1-42; Berman, 'social change and scientific organization', p.47.

54. Berman, 'social change and scientific organization', pp.41-5.

55. Hudson, 'Bath and West', p.8; p.21; p.23; pp.48-9; Russell, 'history of agricultural science', p.129; A. and N.L. Clow, The chemical revolution. A contribution to social technology (London, 1952) Chapter 21.

56. Fox, 'local farmers' associations', pp.49-50; p.53; Colyer, 'early agricultural societies', p.576; M. Mylechreest, 'Questions and Answers. The correspondence between Sir John Le Couteur and Thomas Andrew Knight', Annual Bulletin Societe Jersiaise 24, 2 (1986) pp.237-44; Hudson, 'patriotism with profit', p.39; p.57; Russell, 'history of agricultural science', p.103; p.166.

57. C. Daubeny, 'Lecture on the application of science to agriculture', J.R.A.S.E., 3 (1842) pp.136-168; p.138; pp.142-3.

58. Professor Johnston, 'The present state of agriculture in its relations to chemistry and geology', J.R.A.S.E., 9 (1848) pp.200-236; p.205; p.211.

59. L.J. Peel, 'practice with science: The first twenty years', J.R.A.S.E., 137 (1976) pp.9-18; pp.9-10; p.17.

60. H. Davy, Elements of agricultural chemistry (4th edn., London, 1827) pp.3-4; Russell, 'history of agricultural science', pp.67-75; D. Knight, 'Agriculture and chemistry in Britain around 1800', Annals of Science, 33 (1976) pp.187-196; pp.191-6; Berman, 'social change and scientific organization', p.60.

61. C. Daubeny, 'On the public institutions for the advancement of agricultural science', J.R.A.S.E., 3 (1842) pp.364-86; p.382; G. Grantham, 'The shifting locus of agricultural innovation in nineteenth-century Europe: The case of agricultural experiment stations', Research in Economic History, Supplement 3 (1984) pp.191-214.

62. O. Sonntag, 'Liebig on Francis Bacon and the utility of science', Annals of Science, 31, 5 (1974) pp.373-86; p.382; p.385; Morrell and Thackray, 'gentlemen of science', p.488-491; J.D. Sykes, 'Agriculture and Science', in G.E. Mingay (ed) The Victorian Countryside (2 vols, London, 1981) vol 1, pp.260-272; pp.262-3.

63. Daubeny, 'public institutions for the advancement of agricultural science', p.386; Russell, 'history of agricultural science', p.125; H.B. Wheatley, 'Sir Humphry Davy, Bart., P.R.S.', J.R.A.S.E., 65 (1904) pp.1-25; p.12.

64. Richards, 'agricultural science in higher education', p.64; P. Pusey, 'On the progress of agricultural knowledge during the last eight years', J.R.A.S.E., 11 (1850) pp.381-438; pp.381-2; p.392; idem., 'On the present state of agriculture in England', J.R.A.S.E., 1 (1840) pp.1-21; p.20.

65. Peel, 'practice with science', p.13; p.14; p.17; p.18; Pusey, 'on the progress of agricultural knowledge', p.392; Sykes, 'agriculture and science', p.263.

66. Arthur Young, 'The elements and practice of agriculture', unfinished manuscript, British Museum Add. MS. 34, 859, f.406.

67. G.E. Fussell, 'Agricultural science and experiment in the eighteenth century: an attempt at a definition', Agricultural History Review, 24, 1 (1976) pp.44-7; p.46; Hudson, 'patriotism with profit', pp.36-7; Goddard, 'William Shaw', p.99.

68. E.M. Crowther, 'The technique of modern field experiments', J.R.A.S.E., 97 (1936) pp.54-80; p.54; pp.55-61.

69. R.C. Allen, 'Inferring yields from Probate Inventories', Journal of Economic History, 48, 1 (1988) pp.117-125; p.125; Sykes, 'agriculture and science', p.261; R.C. Allen and C. O'Grada, 'On the road again with Arthur Young: English, Irish and French agriculture during the industrial revolution', Journal of Economic History, 48, 1 (1988) pp.93-116; p.104.

70. S. Wilmot, 'Landownership, farm structure and agrarian change', Tables 2.2 and 2.3, pp.104-5.

71. Sykes, 'agriculture and science', p.262; E.J. Hobsbawm and G. Rude, Captain Swing (London 1969) pp.30-1; pp.233-6; p.363; R. Samuel (ed), Village Life and Labour (London, 1975) pp.17-21; pp.18-20; A. Howkins, Poor Labouring Men: Rural radicalism in Norfolk, 1870-1923 (London, 1985) p.11; E.J.T. Collins, 'The age of machinery', in G.E. Mingay (ed) The Victorian Countryside (2 vols, London, 1981) pp.200-213; p.207; pp.211-212; G. Clark, 'Productivity growth without technical change in European agriculture before 1850', Journal of Economic History, 47, 2 (1987) pp.419-32; p.419; p.432; E.J.T. Collins, 'The rationality of 'surplus' agricultural labour: Mechanization in English agriculture in the nineteenth century', Agricultural History Review, 35, 1 (1987) pp.36-46.

72. Horn, 'the contribution of the propagandist', pp.320-1; p.323; Goddard, 'agricultural periodicals and newspapers', pp.123.

73. C.W.J. Withers, 'William Cullen's agricultural lectures and writings and the development of agricultural science in eighteenth-century Scotland', Agricultural History Review, 37, 2 (1989) pp.144-56; p.147; Shapin, 'property, patronage and the politics of science', pp.1-9; pp.17-18; Shapin, 'the audience for science', pp.99-107; Richards, 'agricultural science in higher education', p.60; 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 and Society (2 vols, Princeton, 1974) pp.407-420; idem., 'The Scottish Enlightenment', in R. Porter and M. Teich (eds) The Enlightenment in national context (Cambridge, 1981) pp.19-40; A. Chitnis, The Scottish Enlightenment: a social history (London, 1976).

74. C.W.J. Withers, 'A neglected Scottish agriculturalist: the 'Georgical lectures' and agricultural writings of the Rev. Dr. John Walker (1731-1803), Agricultural History Review, 33, 2 (1985) pp.132-146; p.137; Withers, 'William Cullen', pp.149-50; Clow, 'the chemical revolution', pp.481-3; Shapin, 'the audience for science', pp.103-104.

75. Shapin, 'the audience for science', p.103; p.104. Connections between natural science and agricultural pursuits were not limited to the professoriate. Undergraduate bodies such as the Edinburgh Natural History Society, founded by James Edward Smith in 1782, included agrarian topics in their remit. I am grateful to C.W.J. Withers for making this point.

76. Richards, 'agricultural science in higher education', pp.62-4; Clow, 'the chemical revolution', p.492; Withers, 'a neglected Scottish agriculturalist', pp.136-7; pp.143-5; Withers, 'William Cullen', p.150.

77. Shapin, 'the audience for science', p.109; Russell, 'history of agricultural science', p.45; Clow, 'the chemical revolution', pp.472-3; p.480; p.492; Withers, 'William Cullen', p.149.

78. Clow, 'the chemical revolution', p.490.

79. A. Pell, 'Arthur Young', J.R.A.S.E., 54 (1893) pp.1-23; Clow, 'the chemical revolution', p.495; p.498.

80. Russell, 'history of agricultural science', pp.59-60; Hudson, 'Bath and West', p.8; Hudson, 'patriotism with profit', pp.5-7.

81. Russell, 'history of agricultural science', provides information on the careers of Playfair, J.T. Way, Voelcker and Gilbert: pp.102-5; pp.115-6; pp.122-6; pp.166-8.

82. Morrell and Thackray, 'gentlemen of science', pp.490-1.

83. C.A. Russell, Science and Social Change, 1700-1900 (London, 1982) pp.76-9; F.M.L. Thompson, English landed society in the nineteenth century (London, 1963) p.95; G.E. Mingay, The Gentry. The rise and fall of a ruling class (London, 1976) p.163; Withers, 'a neglected Scottish agriculturalist', p.134; Shapin, 'property, patronage and the politics of science', p.9; C. Lawrence, 'The nervous system and society in the Scottish Enlightenment', in B. Barnes and S. Shapin (eds) Natural Order: Historical studies of scientific culture (London, 1979) pp.19-40; pp.21-22.

84. Shapin, 'the audience for science', p.107.

85. Berman, 'social change and scientific organization', p.2; p.45.

86. Colyer, 'early agricultural societies', p.573; p.579; D. Jenkins quoted in Mingay, 'the gentry', p.163.

87. Shapin, 'the audience for science', p.102; C.W.J. Withers, Gaelic Scotland: the transformation of a culture region (London, 1988) Chapter 2; idem., 'a neglected Scottish agriculturalist', p.134; idem., 'William Cullen', pp.147-8; Additional references listed in note 73.

88. This point will be further discussed in Chapter 4. Hudson, 'patriotism with profit', pp.102-112; idem., 'Bath and West', pp.7-8; p.25; Gazley, 'Arthur Young and the Society of Arts', p.137; Horn, 'the contribution of the propagandist', p.319.

89. A.M. Duckworth, The improvement of the estate. A study of Jane Austen's novels (Baltimore and London, 1971) p.47; p.ix.

90. L. Jordanova (ed), Languages of Nature. Critical essays on science and literature (London, 1986) has emphasised, in a later context, the interweaving of the discourses of science and literature.

91. Duckworth, 'the improvement of the estate', pp.44-8; pp.36-80. On the tension inherent in rural society see Hobsbawm and Rude, 'Captain Swing', p.47.

92. For an introduction to the literature on improving cottage architecture see Board of Agriculture, Communications to the Board of Agriculture, volume 1 (1797); Society for Bettering the Condition of the Poor (S.B.C.P.), To the English Cottager (London, 1800); M. McMordie, 'Picturesque pattern books and pre-Victorian designers', Architectural History, 18 (1975). The links between the Board of Agriculture, the S.B.C.P. and the Royal Institution in the quest for 'improvement' have been explored by Berman, 'social change and scientific organization', pp.2-70. The centrality of the estate and of estate reorganisation in the general 'improvement' of rural society is implicit in many eighteenth and early nineteenth century texts, amongst them Charles Ley, The Nobleman, Gentleman and Surveyor's Compleat Guide

(London, 1787) p.2; pp.18-22; William Marshall, On the landed property of England (London, 1804) Part 2; Thomas Stone, An essay on agriculture (Lynn, 1784) pp.232-3; J. Beasley, A lecture delivered to the members of the Faringdon Agricultural Book Club on the duties and privileges of the landowners, occupiers and cultivators of the soil (London, 1860). An analysis of the literature relating to farm design and the production of 'rational farmers' can be found in Wilmot, 'landownership, farm structure and agrarian change', pp.18-21; pp.33-48. The 'improvement' of woodland and its association with the extension of landlord power is discussed in S. Daniels, 'The political iconography of woodland in later Georgian England', in D. Cosgrove and S. Daniels (eds), The iconography of landscape (Cambridge, 1988) pp.43-82; pp.43-48. The association between enclosure and the 'moral improvement' of rural society is developed in K.D.M. Snell, Annals of the labouring poor. Social change and agrarian England, 1660-1900 (Cambridge, 1985) pp.170-4; p.218. The 'improvement' of wastes is discussed further below.

93. E.P. Thompson, The making of the English working class (London, 1968) p.243.

94. Arthur Young, Farmers Letters to the Landlords of Great Britain (London, 1771) pp.395-407; Home, 'the gentleman farmer', pp.x-xi; p.xix.

95. Thompson, 'making of the English working class', p.239; Snell, 'annals of the labouring poor', pp.170-4; p.218; Anon., Enquiry into the advantages and disadvantages resulting from Bills of Inclosure (London, 1780) p.15.

96. Thompson, 'making of the English working class', p.239.

97. Kent, 'hints', p.99.

98. Kent, 'hints', p.101.

99. Anon., 'enquiry', pp.15-17.

100. Anon., 'enquiry', pp.15-17.

101. Society of farmers in -shire, 'political enquiry', p.8.

102. Young, 'farmers' letters to the people', pp.464-5; Ley, 'land stewards and surveyor's complete guide', p.2; Marshall, 'minutes, experiments, observations', pp.85-6; Young, 'rural economy', p.35; Home, 'the gentleman farmer', p.x; p.xix; John Mordaunt, The complete steward: or the duty of a steward to his lord...also a new system of agriculture and husbandry (2 vols, London, 1761) p.168. The stress on the dynamism of the present, and the role of the landlord within that can be seen in Home, 'the gentleman farmer', pp.x-xx; Young, 'rural economy', pp.174-5; Young, 'farmers' letters to the people', p.461. The modern

reassessment of the period can be found in, for example, E. Kerridge, The Agricultural Revolution (London, 1967); M.A. Havinden, 'Agricultural progress in open-field Oxfordshire', Agricultural History Review, 9 (1961) pp.73-83; D. Woodward, 'Agricultural Revolution in England 1500-1900: a survey', Local Historian, 9 (1971) pp.325-7 and more recently, Allen and O'Grada, 'on the road again with Arthur Young', pp.93-116. Stadial theories of economic, social and moral development were an important part of Enlightenment philosophy more generally, as illustrated by J.W. Burrow Evolution and Society. A study in Victorian social theory (Cambridge, 1966) pp.7-14 and W. Stafford, Socialism, radicalism and nostalgia. Social Criticism in Britain, 1775-1830 (Cambridge, 1987) pp.90-3.

103. Young, 'rural economy', p.36.

104. It is significant that Howlett quotes Young and refers to the support of a number of prominent individuals in the Bath and West Society and the Board of Agriculture to support his arguments: 'Howlett's enquiry', p.100. In similar vein, the evidence compiled by the county reports to the Board were used explicitly to promote the cause of enclosure in Parliament through statements to Select Committees.

105. J.D. Chambers and G.E. Mingay, The Agricultural Revolution, 1750-1880 (London, 1966) pp.20-1; E. Halevy, England in 1815 (London, 1960) p.239; K. Tribe, Genealogies of capitalism (London, 1981) p.71.

106. Quoted in Clarke, 'Board of agriculture', p.35; Colyer, 'early agricultural societies', p.568-9; Asa Briggs, The Age of Improvement 1783-1867 (London, 1959); Lawrence, 'the nervous system and society', p.30-1.

107. Briggs, 'age of improvement', p.39; examples of paintings include the cover illustration by Thomas Weaver: Thomas Coke, First Earl of Norfolk and his Southdown sheep (c.1807) and Plates 4 and 5. A number of other excellent examples, including paintings by George Stubbs, Thomas Weaver, J. Digby Curtis and John Boultbee may be found in A. Cobban (ed), The Eighteenth Century, Europe in the Age of Enlightenment (London, 1969). A large number of paintings in this genre have been collected by D. Spargo (ed), This Land is Our Land. Aspects of agriculture in English art (London, Exhibition Catalogue, Mall Galleries for R.A.S.E., 1989). J. Obelkevitch, Religion and Rural Society: South Lindsey 1825-1875 (Oxford, 1976) p.40; J. Barrell, The dark side of the landscape: The rural poor in English painting 1730-1840 (Cambridge, 1980) p.13. It would be interesting to see a companion volume on representations of the rural rich in English painting.

108. Duckworth, 'the improvement of the estate', p.52; pp.42-5; p.47; R. Williams, The Country and the City (London, 1973) p.122-6; P. Mandler, 'The making of the New Poor Law Redivivus', Past and Present, CXVII (1987) pp.131-57; p.133; p.150; pp.153-6.

109. Thackray, 'Natural knowledge in cultural context', pp.672-709; p.678; S. Shapin, 'Homo Phrenologicus: Anthropological perspectives on an historical problem', in Barnes and Shapin, 'natural order', pp.41-71; pp.55-62; R. Cooter, 'The power of the body: the early nineteenth century', in Barnes and Shapin, 'natural order', pp.73-90; p.76.

110. Billinge, 'hegemony, class and power', in Baker and Gregory, 'explorations in historical geography', pp.28-67.

111. Billinge, 'Hegemony, class and power', pp.46-7; pp.53-4; p.62.

112. Berman, 'social change and scientific organization', pp.34-5; pp.39-40; Russell, 'science and social change', pp.76-80; R. Kargon Science in Victorian Manchester: Enterprise and Expertise (Manchester, 1977) Chapter 1; N. Hans, New trends in education in the eighteenth century (London, 1951) p.212; A. Thackray and E. Mendelsohn, Science and Values: Patterns of tradition and change (New York, 1974) pp.3-4; R. Williams, Keywords. A vocabulary of culture and society (London, 1983) p.278; S. Ross, 'Scientist: The story of a word', Annals of Science, 18 (1962) pp.65-86; pp.68-9; M. Berman, ' "Hegemony" and the amateur tradition in British science', Journal of Social History, 8 (1975) pp.30-50; p.35.

113. M. Neve, 'Science in a commercial city: Bristol 1820-60', in I. Inkster and J. Morrell (eds) Metropolis and Province. Science in British culture, 1780-1850 (London, 1983) pp.179-204; pp.179-80; Lawrence, 'the nervous system and society', pp.21-22; Shapin, 'the audience for science', p.101.

114. Berman, 'social change and scientific organization', p.1; p.5; p.39.

115. Thackray and Mendelsohn, 'science and values', pp.9-10; Hans, 'new trends in education', pp.32-5. A similar trend is indicated by preliminary investigations of participation in agricultural science, see pp.18-19.

116. Goddard, 'agricultural societies', pp.250-1; pp.252-3.

117. K. FitzGerald, Ahead of their time; A short history of the Farmers' Club 1842-1967 (London, 1968) p.7; p.70.

118. Hudson, 'patriotism with profit', pp.95-8; Goddard, 'agricultural societies', pp.252-3.

119. Harold Fox identified this as an important avenue for future research in 1979, Fox, 'local farmers' associations', p.56.

120. Edmund Burke, Letter to a noble lord (London, 1796) pp.63-5.

121. See Plate 9, between pages 64-65.

122. Duckworth, 'the improvement of the estate', pp.47-8.

123. Arthur Young, A Plain and Earnest Address to Britons, especially farmers (London, 1792) p.80; p.44.

124. I. Inkster, 'Introduction: Aspects of the history of science culture in Britain, 1780-1850 and beyond', in Inkster and Morrell, 'metropolis and province', pp.11-54; p.20.

125. This schematic account of the history of urban science is drawn from Inkster, 'Introduction: aspects of the history of science', p.42.

126. The social basis of participation in agricultural science requires detailed investigation, including the membership, activities and publications of agriculturalists and agricultural societies.

127. Whilst the critique questioned the basis of aristocratic power in rural society, it nevertheless maintained the primacy of private property values and the large farm structure. To find a radical critique, embodying ideas of land redistribution and communal land-holding, one has to look to the urban reform movement. A radical critique of agrarian development was not articulated within rural society, the critical focus resting with poets, painters, Radical political theorists and Chartist reform campaigners: K. Thomas, Man and the natural world. Changing attitudes in England, 1500-1800 (1983, London, 1987) pp.270-3; Williams, 'the country and the city'; W. Stafford, Socialism, radicalism and nostalgia. Social criticism in Britain, 1775-1830 (Cambridge, 1987), Essays on Spence, Ogilvie and Cobbett (Chapters 4, 5 and 13); M. Chase, 'The People's Farm'. English radical agrarianism 1775-1840 (Oxford, 1988) pp. 1-17; Hobsbawm and Rude, 'Captain Swing', p.61; p.66; p.184; D.W. Howell, Land and people in nineteenth-century Wales (London, 1977) pp.11-12; Feargus O'Connor, A practical work on the management of small farms (London, 1846) pp.3-4; p.10; pp.20-1; R. Douglas, Land, People and Politics. A history of the Land Question in the United Kingdom, 1878-1952 (London, 1976) p.103; pp.106-8; p.120. Ireland, the Scottish highlands and Wales experienced land agitation in the 1880s; Douglas's (incomplete) analysis of the demands of these rural movements suggests a general adherence to the traditional landholding structure. op. cit. p.101.

128. Trusler, 'practical husbandry', introduction.

129. Young, 'farmers' letters to the landlords', p.101.

130. Home, 'gentleman farmer', p.xix.

131 Young, 'farmers' letters to the people', p.319; see also R. Fraser, General View of the County of Devon (London, 1794) p.41.

132. Young, 'farmers' letters to the landlords', pp.9-10.

133. Young, 'rural economy', p.36; pp.361-2; Marshall, 'landed property', Part 2, Section VII, 'on improving the minds of the tenants'. Young, 'farmers' letters to the landlords', pp.404-7. Marshall, 'minutes, experiments, and observations', p.54; Kent, 'hints', p.95.

134. Home, 'the gentleman farmer', p.290; Young, 'farmers' letters to the landlords', p.18.

135. Ley, 'land steward and surveyor's complete guide', p.43-5; Halevy, 'England in 1815', p.236. R.M. Garnier, History of the English Landed Interest (London, 1893) p.372.

136. Kent, 'hints', p.96.

137. Howlett, 'Howlett's enquiry', p.97. Marshall, 'landed property', Chapter 4, Section 4.

138. Rev. Dr. J. Trusler, On the Importance, Utility and Duty of a Farmer's Life: a sermon preached at Thornville-Royal, Yorks; seat of Col. Thornton, 26 August 1792 (London, 1792) pp.17-8; see also references to note 122. Young, 'farmers' letters to the landlords', p.402, p.102, p.292, respectively; Home, 'the gentleman farmer', p.x, p.viii.

139. Young, 'farmers' letters to the landlords', p.399; Kent, 'Hints', p.9; Home, 'the gentleman farmer', p.x, p.viii.

140. Trusler, 'on the importance, utility and duty of a farmer's life', pp.17-18; Kent, 'hints', p.259; Stone, 'essay on agriculture', p.232-2.

141. In a political context, however, prescription still had considerable force as a doctrine: H.T. Dickinson, Liberty and property, Political Ideology in eighteenth-century Britain (London, 1977) p.300-2; J. Scott, The Upper Classes (London, 1982) p.98.

142. J.J. Mechi, Mr Mechi's System of Farming: how to farm profitably - or the sayings and doings of Mr Alderman Mechi (London, 1859) pp.222-3.

143. Morton, 'resources of estates', p.189.

144. D.G.F. MacDonald, Hints on farming and estate management (5th edn, London, 1865) p.527.

145. Beasley, 'a lecture', p.7; Burn, 'outlines of modern farming', p.2; J. Caird, English agriculture, 1850-1851 (London, 1852) pp. 491-3; p.495; MacDonald, 'hints on farming', pp.360-1.

146. Copland, 'Copland's agriculture', p.viii.

147. Morton, 'resources of estates', pp.14-15; Chapter 10.

148. MacDonald, 'hints on farming', p.493; Dean, 'the land steward', Chapter 2; Pusey, 'The progress of agricultural knowledge during the last eight years', pp.381-442.

149. Wren Hoskyns, 'introductory essay', in Morton (ed), 'cyclopaedia', p.7; Low, 'on landed property', p.27; Dean, 'the land steward', p.9; Beasley, 'a lecture', pp.11-12; Morton, 'resources of estates', p.x, p.viii.', p.26.

150. Caird, 'English agriculture', p.491; Dean, 'the land steward', p.176-82; Morton, 'resources of estates', Chapter 20; MacDonald, 'hints on farming', p.284.

151. Copland, 'Copland's agriculture', p.vii.

152. Morton, 'resources of estates', Chapter 8; Dean, 'the land steward', pp.16-17; Mechi, 'how to farm profitably', pp.11-12; Beasley, 'a lecture', pp.11-12; Morton, 'resources of estates', pp.23-4.

153. F.M.L. Thompson, 'Land and politics in England in the nineteenth century', Trans. Royal Historical Society, 15 (1965) pp.23-44.

154. Caird, 'English agriculture', pp.492-3. Burn, 'outlines of modern farming', p.313; Morton, 'resources of estates', Chapter 2; Dean, 'the land steward', p.236; Beasley, 'a lecture', pp.12-13.

155. Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', pp.192-4.

156. MacDonald, 'hints on farming', p.525.

157. Morton, 'resources of estates', p.20; Caird, 'English agriculture', pp.494-5; Copland, 'Copland's agriculture', p.vii, for example. Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.193. G.C. Brodrick, English Land and English Landlords (London, 1881) p.145.

158. Caird, 'English agriculture', p.495; Morton, 'resources of estates', p.20; MacDonald, 'hints on farming', p.525; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.194; p.198.

159. Caird, 'English agriculture', pp.495-7; Low, 'on landed property', p.4; Mechi, 'how to farm profitably', pp.118-9; Morton, 'resources of estates', p.20. Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.194.

160. MacDonald, 'hints on farming', p.543.

161. Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.199.

162. John Large, The secrets of farming (London, 1863) p.43; p.2.

163. Dean, 'the land steward', p.13; Wren Hoskyns, 'tenure', in Morton, 'cyclopaedia', pp.956-9.

164. Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.191.

165. Mechi, 'how to farm profitably', p.119.

166. Morton, 'resources of estates', p.191.

167. Wren Hoskyns, another of Morton's major contributors, also wrote in the Cobden Club series of essays: C. Wren Hoskyns, The Land Laws of England (London, 1870).

168. Caird, 'English agriculture', p.526; p.495; Copland, 'Copland's agriculture', pp.vii-viii; Morton, 'resources of estates', Chapter 9 and 10; pp.188-90; Wren Hoskyns, 'introductory essay', and sections on 'landlord' and 'tenure' in Morton, 'cyclopaedia'; Dean, 'the land steward', p.13; Mechi, 'how to farm profitably', pp.222-3.

169. Chambers and Mingay, 'agricultural revolution', p.129; p.163-4; Thompson, 'English landed society', pp.235-7. Caird, 'English agriculture', letter LIII; Morton, 'resources of estates'; Dean, 'the land steward'.

170. Pusey, 'the progress of agricultural knowledge in the last eight years', pp.401-414; Low, 'on landed property', p.vi; p.8; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.192; Morton, 'resources of estates', p.126.

171. Morton, 'resources of estates', p.159; Dean, 'the land steward', pp.7-8.

172. Morton, 'resources of estates', p.190; Low, 'on landed property', pp.15-17; MacDonald, 'hints on farming', p.275.

173. F.M.L. Thompson, 'The Economic and Social Background of the English Landed Interest, 1840-70 with particular reference to the estates of the Duke of Northumberland' (Oxford University, unpublished DPhil thesis, 1955); E.J.T. Collins, 'Introduction', in C.A. Jewell (ed), Victorian farming: a sourcebook (Winchester, 1975) pp.ix-xx; p.xiii - the argument advanced being that the new husbandry demanded increased capital investment and hence an increase in the borrowing powers of life owners, and a greater security for tenant investments.

174. Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.191; p.204.

175. Beasley, 'a lecture', pp.31-2; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.204. Dean 'the land steward', pp.7-8; Morton, 'resources of estates', p.10.

176. Billinge, 'hegemony, class and power', pp.36-8; p.40.

177. Thompson, 'land and politics', p.23; Thompson, 'economic and social background of the English landed interest', Chapters 1 & 2; p.33.

178. J.R. Fisher, 'Tenurial deficiencies in the English land system: the mid-nineteenth century debate', University of Newcastle, N.S.W., Australia, Dept. of Economics, Occasional Paper, no. 58 (Nov. 1980) pp.1-48; pp.18-19.

179. Thompson, 'land and politics', p.36; p.39.

180. Morton, 'resources of estates', p.186.

181. James Beal, Free Trade in Land (London, 1855) p.64; Thompson, 'land and politics', gives an extensive overview of this political literature. Copland, 'Copland's agriculture', p.viii; Wren Hoskyns, in Morton, 'cyclopaedia', p.7; p.10; p.190; Dean, 'the land steward', p.13; MacDonald, 'hints on farming', pp.525-6; Low, 'on landed property', p.4; Thompson, 'land and politics', p.38; Morton 'resources of estates', pp.188-90; Caird, 'English agriculture', pp.495-7; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', pp.186-206.

182. Thompson, 'land and politics', p.34; p.42.

183. Morton, 'resources of estates', pp.183-7; pp.188-92; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.192; Caird, 'English agriculture', p.495; MacDonald, 'hints on farming', p.525-6; Mechi, 'how to farm profitably', p.85.

184. Thompson, 'land and politics', pp.25-34.

185. Thompson, 'land and politics', p.25; Halevy, 'England in 1815', p.235; p.239.

186. J. Saville and B. English, 'Strict Settlement: A Guide for Historians', University of Hull, occasional paper in economic and social history, no. 10 (1983) p.115.

187. Mechi, 'how to farm profitably', p.85, for example, and references to note 174; Thompson, 'economic and social background of the English landed interest', pp.474-8.

188. Burn, 'outlines of modern farming', p.2; Copland, 'Copland's agriculture', p.789; p.viii; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', p.192; p.188; Low, 'on landed property', p.4.

189. Wilmot, 'landownership, farm structure and agrarian change', pp.22-27; pp.48-58.

190. Burn, 'outlines of modern farming', pp.12-14; pp.2-3; Wren Hoskyns, 'introductory essay' in Morton, 'cyclopaedia', pp.5-6; pp.19-20: Copland 'Copland's agriculture', pp.116-7; Morton, 'resources of estates', pp.428; Wren Hoskyns, 'landlord', in Morton, 'cyclopaedia', pp.192-205.

A BIBLIOGRAPHICAL GUIDE TO RESEARCH IN EIGHTEENTH AND NINETEENTH-CENTURY AGRICULTURAL SCIENCE

A. CONTEMPORARY SOURCES

1. Encyclopedias and Dictionaries

G.E. Fussell — 'Nineteenth-century farming encyclopedias: a note', Agricultural History, 55, 1 (1981) pp.16-20.

G.E. Fussell — 'Eighteenth-century agricultural dictionaries', Bulletin Institute of Historical Research, 7 (1929-30) pp.144-8.

Examples (in chronological order)

A Society of Gentlemen — The Complete Farmer: or, a general Dictionary of Husbandry in all its branches (London, 1769) [by members of the Society of Arts].

R.W. Dickson — The Farmer's Companion (London, 1813).

J.C. Loudon — An Encyclopaedia of Agriculture (London, 1825).

Baxter's — Library of Agricultural and Horticultural Knowledge (3rd edn., London, 1834).

M. Doyle — A Cyclopaedia of Practical Husbandry (London and Edinburgh, 1843).

W.L. Rham — The Dictionary of the Farm (London, 1844).

H. Stephens — The Book of the Farm (Edinburgh and London, 1844).

J.M. Wilson (ed) — The Rural Cyclopaedia (4 vols, Edinburgh, 1847-9).

J.C. Morton (ed) — A Cyclopaedia of Agriculture (2 vols, Glasgow, Edinburgh and London, 1855).

J. Large — Secrets of Farming (London and Swindon, 1863).

C.E. Green and D. Young (eds) — Encyclopaedia of Agriculture (Edinburgh and London, 1907-1909).

R.P. Wright (ed) — The Standard Cyclopedia of Modern Agriculture (12 vols, London, 1908-11).

2. Agricultural texts: practical and scientific

Bibliographies

J.S. Creasey — 'Agrarian and Food History', in G.P. Lilley (ed) Information Sources in Agriculture and Food Science (London, 1981) Ch. 20, pp.531-533.

John Donaldson — Agricultural Biography (London, 1854)

G.E. Fussell — The Old English Farming Books from Fitzherbert to Tull: 1523-1750 (London, 1947)

G.E. Fussell — More Old English Farming Books from Tull to the Board of Agriculture: 1731-1793 (London, 1950)

L.W. Hanson — Contemporary Printed Sources for British and Irish Economic History, 1701-1750 (Cambridge, 1963)

H. Higgs — Bibliography of economics, 1751-1775 (Cambridge, 1935)

Donald McDonald — Agricultural Writers from Sir Walter of Henley to Arthur Young, 1200-1800 (London, 1908)

W.F. Perkins — British and Irish Writers on Agriculture (3rd edn, Lymington, 1939)

J.A.S. Watson and G.D. Amery — 'Early Scottish Agricultural Writers (1697-1790)' Trans. Royal Highland and Agricultural Society of Scotland, XLIII (1931) pp.60-85

Examples (in chronological order)

Thomas Hale, — A Compleat Body of Husbandry (2 vols, 2nd edn, London, 1758)

Francis Home, — The Principles of agriculture and vegetation (Edinburgh, 1757)

Robert Maxwell, — The Practical Husbandman (Edinburgh, 1757)

John Mordaunt, — The Complete Steward: or the duty of a steward to his lord ... also a new system of agriculture and husbandry (2 vols, London, 1761)

Revd. Adam Dickson — A Treatise on Agriculture (Edinburgh, 1762)

John Wynn-Baker — Experiments in Agriculture (London, 1765)

A. Young — A course in experimental agriculture (2 vols, London, 1770)

A. Young — Rural economy or essays on the practical parts of husbandry (London, 1770)

A. Young — The Farmer's Kalendar (London, 1771)

A. Young, — Farmers' letters to the Landlords of Great Britain (London, 1771)

A. Young, — Farmers' letters to the people of Great Britain (3rd edn, London, 1771)

James Anderson, — Essays relating to agriculture and rural affairs (London & Edinburgh, 1775)

Dr J. Gregory, — Essays relating to agriculture (London & Edinburgh, 1775)

Henry Home, Lord Kames, — The Gentleman Farmer (Edinburgh & London, 1776)

N. Kent, — Hints to gentlemen of landed property (London, 1775)

J. Wimpey, — Rural improvements: or essays on the most rational methods of improving estates (London, 1775)

William Marshall, — Minutes of Agriculture (London, 1778)

Revd. Dr J. Trusler, — Practical husbandry or the art of farming with the certainty of gain (London, 1780)

Thomas Stone, — An essay on agriculture - with a view to inform gentlemen of landed property whether their estates are managed to the greatest advantage (Lynn, 1784)

Charles Ley, — The nobleman, gentleman, land steward and surveyor's complete guide ... comprehending the duty and office of a land steward (London, 1787)

George Winter, — A new and compendious system of husbandry, containing the mechanical, chemical, and philosophical elements of agriculture (Bristol, 1787)

A. Fothergill, — 'On the application of chemistry to agriculture', Letters and papers of the Bath Society, 3rd edn, v.3 (1791) pp.54-62

Revd Dr J. Trusler, On the Importance, Utility and Duty of a Farmer's Life: a sermon preached at Thornville-Royal, Yorks; seat of Col. Thornton, 26 August, 1792 (London, 1792)

Archibald Cochrane 9th Earl of Dundonald, A treatise shewing the intimate connection that subsists between agriculture and chemistry (London, 1795)

W. Marshall, Minutes, experiments, observations and general remarks on agriculture in the Southern Counties (2 vols, London, 1799)

Thomas Stone, ('A society of practical farmers'), A letter to the Rt. Hon. Lord Somerville...to show the inutility of the plans and researches of [the Board of Agriculture] (London, 1800)

Erasmus Darwin, Phytologia, or the Philosophy of Agriculture and Gardening (London, 1800)

W. Marshall, On the landed property of England: an elementary and practical treatise - containing the purchase, improvement and management of landed estates (London, 1804)

A Farmer and Breeder, The New Farmer's Calendar (London, 1806)

Andrew Coventry, Discourses explanatory of the object and plan of the course of lectures on agriculture and rural economy (Edinburgh and London, 1808)

J.C. Loudon, A treatise on the culture of wheat (London, 1812)

John Walker, Essays on natural history and rural economy (London and Edinburgh, 1812)

H. Davy, Elements of Agricultural Chemistry (1813; 4th edn. London, 1827)

W. Grisenthwaite, A new theory of agriculture (London, 1830)

D. Low, Elements of Practical Agriculture (Edinburgh and London, 1834)

Society for the Diffusion of Useful Knowledge, British Husbandry (3 vols, London, 1834-40)

Justus von Liebig, Chemistry in its application to agriculture and physiology (London, 1840)

P. Pusey, 'On the present state of the science of agriculture in England', J.R.A.S.E, 1 (1840) pp.1-21

J. Russell, A Treatise on Practical and Chemical Agriculture (2nd edn. London, 1840)

J.F.W. Johnston, Suggestions for experiments in practical agriculture, (Edinburgh and London, 1841)

C. Daubeny, 'On the scientific principles by which the Application of Manures ought to be regulated. A Lecture, delivered at Oxford', J.R.A.S.E. 2 (1841) pp.232-258

C. Daubeny, 'Lecture on the Application of Science to Agriculture Delivered before the Society, on Thursday the 9th of December, 1841', J.R.A.S.E, 3 (1842) pp.136-159

C. Daubeny, 'On the public institutions for the advancement of agricultural science which exist in other countries, and on the plans which have been set on foot by individuals with a similar intent to our own', J.R.A.S.E, 3 (1842) pp.364-386

P. Pusey, 'On the Progress of Agricultural knowledge during the last four years', J.R.A.S.E, 3 (1842) pp.169-217

W.H. Hyett, The Benefits which Agriculture has derived from Science, (Gloucester, 1842)

H.R. Madden, 'On the advantages which have been derived, and are likely to accrue to agriculture, from the application to it of the principles of vegetable physiology and chemistry', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 2nd series, 8 (1843) pp.281-326

H.R. Madden, 'On the advantages of extended chemical analysis to practical agriculture', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 2nd series (1843) pp. 568-583

Lyon Playfair, 'Lecture on the Application of Physiology to the Rearing and Feeding of Cattle', J.R.A.S.E, 4 (1843) pp.215-237; pp.237-266

C. Hillyard, Practical Farming and Grazing (London, 1844)

D. Low, On landed property and the economy of estates (London, 1844)

A.D. Thaer, The Principles of Agriculture (2 vols. London, 1844)

J.F.W. Johnston, Catechism of Agricultural chemistry and geology (Edinburgh, 1844)

J.F.W. Johnston, Elements of agricultural chemistry and geology (4th edn. Edinburgh and London, 1845)

A. Huxtable, A Lecture on the Science and Application of Manures (London, 1847)

J.B. Lawes, 'On agricultural chemistry', J.R.A.S.E, 8 (1847) pp.226-260

Professor Johnston, 'The Present State of Agriculture in its Relations to Chemistry and Geology. A Lecture delivered before the Society at the Meeting in York', J.R.A.S.E, 9 (1848) pp.200-236

J.F.W.Johnston, Experimental agriculture: being the results of past and suggestions for future experiments in scientific and practical agriculture. (Edinburgh, 1849)

C.W. Hoskyns, A Short Inquiry into the history of agriculture (London, 1849)

A. Huxtable, The Present Prices (Blandford, 1850)

Porcius, Mr Huxtable and his pigs (London, 1850)

E. Oke Spooner, The Adventures and Transformation of Nitrogen and Ammonia or the Rev. A. Huxtable's Great Pig Secret Analysed (London, 1850)

P. Pusey, 'On the Progress of Agricultural Knowledge during the last Eight Years', J.R.A.S.E, 11 (1850) pp.381-442

Thomas Anderson, 'On the relations of science to practice in Agriculture', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 3rd series, 4 (1851) pp.16-22

J.B. Lawes and J.H. Gilbert, 'On agricultural chemistry - especially in relation to the mineral theory of Baron Liebig', J.R.A.S.E, 12 (1851) pp.1-40

G.A. Dean, The land steward (London, 1851)

J. Caird, English Agriculture, 1850-1851 (London, 1852)

E.T. Hemming, 'On the Neglect of Chemistry by Practical Farmers; its Causes and Remedies', J.R.A.S.E, 13 (1852) pp.409-448

G.H. Andrews, Modern Husbandry (London, 1853)

C. Wren Hoskyns, 'Introductory Essay-Agriculture', in J.C. Morton (ed) A cyclopaedia of Agriculture (2 vols. London, 1855) pp.1-25

Thomas Anderson, 'On the recent progress of scientific agriculture', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 3rd series, 6 (1855) pp.306-350

Thomas Anderson, 'On the Methods by which the future progress of Agriculture is to be promoted', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 3rd series, 6 (1855) pp.468-482

J.B. Lawes and J.H. Gilbert, 'On some points connected with Agricultural Chemistry', J.R.A.S.E, 16 (1855) pp.411-502

Justus von Liebig, 'On some points in Agricultural Chemistry', J.R.A.S.E, 17 (1856) pp.284-326

Augustus Voelcker, Agricultural Chemistry. Four lectures on farmyard manure, artificial manures, barren and fertile soils, oil-cakes, etc. (London, 1857)

Alfred Sibson, Agricultural Chemistry: a familiar explanation of the chemical principles involved in the operations of the farm (preface by Dr Augustus Voelcker) (London, 1858)

J.L. Morton, The resources of estates (London, 1858)

Thomas Anderson, 'On the recent progress of scientific agriculture', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 3rd series, 8 (1859) pp. 393-414

J.J. Mechi, Mr Mechi's System of Farming: how to farm profitably - or the sayings and doings of Mr Alderman Mechi (London, 1859)

Thomas Anderson, Elements of Agricultural Chemistry (Edinburgh, 1860)

J. Beasley, A lecture delivered to the Members of the Faringdon agricultural book club on the duties and privileges of the landowners, occupiers and cultivators of the soil (London, 1860)

Prof. J. Donaldson, British Agriculture (London, 1860)

John Wilson, Our farm crops. Being a popular scientific description of the cultivation, chemistry, diseases, remedies etc, of the various crops cultivated in Great Britain and Ireland (2 vols, London, 1860)

W. Howitt, The rural life of England (3rd edn, London, 1862) Part 1, Chapter V on 'Scientific Farming', pp. 49-58

Thomas Anderson, 'Experimental Agriculture', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 3rd series, 10 (1863) pp. 110-126

R.S. Burn, Outlines of Modern Farming. Rudimentary treatises for students of agriculture (London, 1863)

John Large, The secrets of farming (London, 1863)

D.G.F. MacDonald, Practical hints on farming and estate management (London, 1864)

H.S. Thompson, 'Agricultural Progress and the Royal Agricultural Society' J.R.A.S.E., 25 (1864) pp.1-52.

Thomas Anderson, 'Experimental Agriculture and the mode in which it may be promoted', Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, 3rd series, 11 (1865) pp. 350-375

D.G.F. MacDonald, Hints on farming and estate management (5th edn, London, 1865)

Samuel Copland, Copland's Agriculture: Ancient and Modern (2 vols, London, 1866)

Anon (President of Royal Society) 'Contributions of Messrs Lawes and Gilbert to agricultural science and literature' Jnl of the Bath and West, new series, 16 (1868) pp.209-212

J. Falconer King 'On what chemistry has done for Agriculture', Transactions of the Highland and Agricultural Society of Scotland, 4th series, 5 (1873) pp.248-288

Earl Cathcart, 'Wool in relation to Science with Practice', J.R.A.S.E., 36 (1875) pp.309-347

Thomas Jamieson, The relation of chemistry to agriculture: a lecture delivered at Aberdeen [and elsewhere] (Aberdeen, 1876)

Anon, 'On the researches of Messrs J.B. Lawes F.R.C., F.C.S. and J.H. Gilbert, M.D., F.R.S., F.C.S', Jnl of the Bath and West, 3rd series, 10 (1878) pp.180-185

J. Augustus Voelcker, 'The influence of chemical discoveries on the progress of English Agriculture', J.R.A.S.E., (1878) pp.803-854

R.S. Burn, Outlines of Farm Management, (London, 1880)

H. Tanner, The Abbots farm: or Practice with Science (London, 1880)

Robert Warington, The Chemistry of the farm (London, 1881)

H. Tanner, Elementary lessons in the science of agricultural practice (London, 1883)

J.H. Gilbert, 'The late Dr. Voelcker', J.R.A.S.E., 46 (1885) pp.308-321

J. Wrightson, The principles of agricultural practise as an instructional subject (London, 1888) Chapter 1

J. Wrightson, 'The Agricultural Lessons of "The Eighties" ', J.R.A.S.E., 51 (1890) pp.275-288

James Caird, 'Fifty years Progress of British Agriculture', J.R.A.S.E., 51 (1890) pp.20-36

Sir T.D. Acland An introduction to the chemistry of farming: specially prepared for practical farmers with records of field experiments (London, 1891)

W.E. Bear, 'Desirable agricultural experiments', J.R.A.S.E., 53 (1892) pp.258-276

W. Fream, Elements of Agriculture (London, 1892)

M.C. Potter, An elementary text-book of agricultural botany (London, 1893)

H.J. Webb, Advanced Agriculture (London, 1894)

R. Hedger-Wallace, Agriculture, (London and Edinburgh, 1895)

R. Warington, Agricultural science: its place in a university education. A lecture delivered before the University of Oxford on November 5, 1896 on ... the centenary of the foundation ... of the chair of rural economy (London, 1896)

J. Augustus Voelcker, 'Sir Joseph Henry Gilbert, PhD, MA, LLD, ScD, FRS. Born August 1 1817; died December 23 1901', J.R.A.S.E., 62 (1901) pp.347-55

3. Farming Journals and Newspapers

These are a major source for details of agricultural shows, agricultural societies, lectures, experiments and book reviews. Some guides to locating eighteenth and nineteenth-century agricultural periodicals and newspapers are:

F.A. Buttress — Agricultural Periodicals of the British Isles, 1681-1900 and their location (Cambridge, 1950)
Locations of periodicals require updating from World List of Scientific Periodicals (4th edn. 1963-5) and the British Union Catalogue of Scientific Periodicals (BUCOP)

G.E. Fussell — 'Early Farming Journals', Economic History Review, 3 (1931-2) pp. 417-422

N. Goddard — 'The development and influence of agricultural periodicals and newspapers, 1780-1880', Agricultural History Review, 31, 2 (1983) pp. 116-131

D.A. Kronick — A history of scientific and technical periodicals: the origins and development of the scientific and technological press (New York, 1962)

J.A.S. Watson and M.E. Hobbs — Great Farmers (London, 1937) pp.246-62

P.J. Weindling — 'Periodical literature and societies', in P. Corsi and P.J. Weindling, Information sources for the History of Science and Medicine (London, 1981) pp. 157-72; pp. 501-8

Examples of leading titles (in chronological order)

Museum Rusticum et Commerciale; or select papers on Agriculture, Commerce, Arts and Manufactures 1764-6

Memoirs of Agriculture and other oeconomical Arts 1768-1782 (ed. R. Dossie)

The Farmer's Magazine 1776-1780 (ed. Agricola Sylvan)

Letters and papers of the Bath and West Society 1780-1829; revived 1853

Annals of Agriculture 1784-1808 (edited by Arthur Young)

Communications to the Board of Agriculture 1797-1811; 1819 (Again reflects the influence of Arthur Young)

Prize Essays and Transactions of the Highland and Agricultural Society 1799-

Agricultural Magazine 1799-1811

Farmer's Magazine [Edinburgh] 1800-1825

British Farmer's Magazine 1826- (Contents after 1846 are identical to Farmer's Magazine)

Quarterly Journal of Agriculture [Edinburgh] 1828-1868 ('Quarterly' dropped from the title in 1843)

Mark Lane Express and Agricultural Journal 1832-

Farmer's Magazine 1834-1881

Johnson and Shaw's Farmer's Almanac 1840-1872

Journal of the Royal Agricultural Society of England 1840-

Agricultural Gazette 1844-

North British Agriculturalist 1849-

Transactions of the Bath and West Society 1853-

The Farmer 1865-

Chamber of Agriculture Journal and Farmers' Chronicle 1869-1881

4. Local Newspapers

Local newspapers carried regular information on the activities of local agricultural societies. Guides to finding local newspapers and periodicals are:

D. Dixon	Local newspapers and periodicals of the nineteenth century (Victorian Studies Handlist no. 6, Leicester University Victorian Studies Centre, 1973)
R.S. Crane, F.B. Kaye & M.E. Prior	A census of British Newspapers and Periodicals, 1620-1800 (1927; repr. London, 1966)
M.J. Milford & D.M. Sutherland	Catalogue of English Newspapers and Periodicals in the Bodleian Library, 1622-1800 (Oxford, 1936)

5. Agricultural Tours

In the eighteenth and nineteenth centuries agricultural societies collectively, and prominent members individually, routinely gathered information on agrarian conditions and agrarian change. Their reports often provide useful information on locally active 'improvers' and reveal something of the consensus concerning what 'improvement', 'agricultural science', and 'agricultural practice' represented to contemporaries. Useful guides to extant sources of contemporary agricultural opinion are listed in sections a) to e).

a) Prize Essays and County Agricultural Reports

O.R. McGregor — 'The historiography of English Farming' in Lord Ernle English Farming, Past and Present (intro. to 6th edn. London, 1961) pp. 79-145 esp. pp. 97-109

McGregor gives lists of the county reports to the Board of Agriculture (1793-1817) and of the Prize Reports to the Royal Agricultural Society (1844-1870). Also listed are the county reports of the Royal Commission on the Depressed Condition of the Agricultural Interests (1881) and the Royal Commission on Agricultural Depression (1895)

b) Parish Surveys by Assistant Tithe Commissioners, c. 1840

R.J.P. Kain and H.C. Prince — The Tithe Surveys of England and Wales (Cambridge, 1985)

Kain and Prince have produced a list of the manuscript reports available on a parish basis in the Tithe File documents c. 1840. The original documents are held at the P.R.O. at Kew (IR 18/ 1-14829). Their content has been indexed by R.J.P. Kain in An Atlas and Index of the Tithe Files of mid-nineteenth century England and Wales (Cambridge, 1985) and their statistical content has been mapped for each county. In order to consult the descriptions of parish farming it is necessary to return to the original documents at the P.R.O. Selected abstracts of these descriptions and a full index in machine-readable form is deposited in the E.S.R.C.'s Archive at Essex University. A description of the wealth of information available in the tithe files is provided by Kain and Prince pp. 109-112.

c) Parliamentary Papers

J.S. Creasey — 'Agrarian and Food History', in G.P. Lilley (ed) Information Sources in Agriculture and Food Science (London, 1981) Ch.20, pp.526-583.

Creasey provides a list of indexes to official publications and parliamentary papers which include the principal reports on Agriculture (pp.535-6). Select Committee Reports on the depressed state of agriculture contain much local agricultural information and are extant for 1821, 1822, 1824, 1833 and 1837. Three reports on the employment of

women and children in agriculture also contain detailed local information and enable some qualitative assessment of employment change between 1843 and 1869. These may be located in British Parliamentary Papers 1843 (510) XII; 1868-69 (4201) XIII and 1868-69 (4202) XIII (2nd Report).

The Report from the Select Committee on Agricultural Customs B.P.P. 1847-8 (461) VII yields local details on tenancy, husbandry practices, compensation for agricultural improvements and the effects of these customs on agricultural progress. The Report on the Decline in the Agricultural Population of Great Britain, 1881-1906 gives some local impressions of the dramatic changes facing late nineteenth-century agriculture and rural society and may be located at B.P.P. 1906 Cd.3273 XCVI. Other late-nineteenth and early twentieth century reports are listed by McGregor (already cited).

d) Estate Correspondence

J.S. Creasey (1981) op. cit. has listed the main guides to archive sources and farm or estate records pp.534-5. The diaries and correspondence of farmers and landowners are an important source for gauging perceptions of and reactions to 'improvement' in agriculture and rural society in the nineteenth century. Reflecting as they do the private thoughts and actions of agriculturalists, these sources may have advantages over the accounts given in the official reports which were designed and arranged for public consumption and to influence government policy. A guide to the location of diary sources in general is W. Matthews British diaries. An annotated bibliography of British Diaries written between 1442 and 1942. (Berkeley and Los Angeles, 1950).

e) Individual Agricultural 'Explorers'.

Arthur Young	A Six Months' Tour through the Southern Counties of England and Wales (London, 1768)
Authur Young	A Six Months' Tour through the North of England (4 vols, London, 1770)
Arthur Young	The Farmer's Tour through the East of England (4 vols, London, 1771)
Arthur Young	General View of the Agriculture of the County of Norfolk (London, 1804)
Arthur Young	Autobiography (ed.) M. Betham-Edwards (London, 1898)
Wm Marshall	The rural economy of Norfolk (London, 1787)
Wm Marshall	The rural economy of Yorkshire (London, 1788)

Wm Marshall — The rural economy of Gloucestershire (London, 1789)

Wm Marshall — The rural economy of The Midland Counties (London, 1790)

Wm Marshall — The rural economy of The West of England (London, 1796)

Wm Marshall — The rural economy of The Southern Counties (London, 1798)

Wm Cobbett — Rural Rides, 1822-1830 (London, 1830)

H. Colman — European Agriculture and Rural Economy from personal observation (2nd edn, 2 vols, London and Boston, 1849)

J. Caird — English Agriculture in 1850-1 (London, 1852)

F.L. Olmstead — Walks and Talks of an American Farmer in England (London, 1852)

L. de Lavergne — The Rural Economy of England, Scotland and Ireland (Edinburgh and London, 1855)

R. Jefferies — The Toilers of the Field (London, 1892; published as letters in 1872)

R. Jefferies — Wild Life in a Southern County (2nd edn, London, 1879)

R. Jefferies — Round about a Great Estate (London, 1880)

R. Jefferies — Hodge and His Masters (London, 1880)

R. Haggard — Rural England (2 vols, London, 1901)

W.H. Hudson — Afoot in England (London, 1909)

W.H. Hudson — Hampshire Days (London, 1903)

W.H. Hudson — The Land's End (London, 1908)

F.E. Green — The Tyranny of the Countryside (London, 1913)

A.D. Hall — A Pilgrimage of British Farming, 1910-12 (London, 1913)

B. SECONDARY SOURCES

1. Histories of agricultural and related sciences

D.E. Allen, The Naturalist in Britain: A Social History (1976; reprinted Harmondsworth, Middx; 1978)

R.P. Aulie, 'The mineral theory', Agricultural History, 48, no. 3 (1974) pp.369-382

M. Bermann, Social Science and Scientific Organization. The Royal Institution, 1799-1834 (London, 1978)

C.A. Browne, A source book of Agricultural Chemistry (Waltham, Mass., 1944)

B.T. Bunting, 'Pioneers of soil science: a British view', Soil Science, 97 (1964) pp.358-9

W.F. Bynum, E.J. Browne, and R. Porter, Dictionary of the history of science (London, 1983)

J.R.R. Christie, 'The rise and fall of Scottish Science', in M.P. Crosland (ed), The emergence of science in Western Europe (London, 1975) Ch. 7, pp.111-126

A. & N.L. Clow, The Chemical revolution. A contribution to social technology (London, 1952) Chapter 21

W. Cockrill, 'A hundred years on' [in Veterinary Science], British Veterinary Journal, 131, no. 3 (1975) pp.265-271

R.J. Colyer, Man's Proper Study: A History of Agricultural Science Education at Aberystwyth, 1878-1978 (Llandysul, 1982)

E.M. Crowther, 'The Technique of Modern Farm Experiments', J.R.A.S.E., 97 (1936) pp.54-81

C. De Wit, 'Early theoretical concepts in soil fertility', Netherlands Journal of Agricultural Science, 22, no. 4 (1974) pp.319-324

G.E. Fussell, 'The technique of Early Field Experiments', J.R.A.S.E., 96 (1935) pp.78-88

G.E. Fussell, Crop Nutrition. Science and practice before Liebig (Laurence, Kansas, 1971)

G.E. Fussell, 'Science and Practice in eighteenth-century British agriculture', Agricultural History, XLIII, 1 (1969) pp.7-18

G.E. Fussell, 'Agricultural Science and Experiment in the Eighteenth Century: an attempt at a Definition', Agricultural History Review, 14, 1 (1976) pp.44-7

G. Grantham, 'The shifting locus of agricultural innovation in nineteenth-century Europe: the case of agricultural experiment stations', Research in economic history, supplement 3, (1984) pp.191-214

A.D. Hall, 'Agricultural Research in England', Jnl of the Bath and West, 4th series, 15 (1904-05) pp.175-183

A.D. Hall, 'Agricultural research in England: a retrospect', Jnl of the Bath and West, 6th series, 1 (1926-27) pp.3-10

Sir W. Henderson, '150 years of Practice with Science in Agriculture', J.R.A.S.E., 149 (1988) pp.34-51

C.J. Holmes, 'Science and the farmers: the development of the Agricultural Advisory Service in England and Wales, 1900-1939', Agricultural History Review, 36, no. 1 (1988) pp.77-86

P. Horn, 'The contribution of the Propagandist to eighteenth-century agricultural improvement', History Journal, 25, 2(1982) pp.313-329

D. Knight, Natural Science books in English 1600-1900 (London, 1972)

D. Knight, 'Agriculture and Chemistry in Britain around 1800', Annals of Science, 33 (1976) pp.187-196

A. Krezdorn, 'The evolution of horticulture as a science and a profession', Horticultural Science, 14, no. 3 (1979) pp.296-298

W. Krohn and W. Shafer 'The origins and structure of agricultural chemistry', in G. Lemaine et al, Perspectives on the emergence of scientific disciplines (Paris, 1976)

A. McCall, 'The development of soil science', Agricultural History, 5, no. 2 (1931) pp.43-56

F.R. Moulton (ed), Liebig and after Liebig: A century of Progress in Agricultural Chemistry (Washington D.C., 1942)

I. Pattison, The British veterinary profession, 1791-1948 (London, 1983)

L.J. Peel, 'Practice with science; the first twenty years' [of R.A.S.E.], J.R.A.S.E., 137 (1976) pp.9-18

H.C. Pereira, 'Agriculture and the traditions of tillage', Outlook on Agriculture, VIII, special number (1975) pp.211-212

H.S. Reed, A Short History of the Plant Sciences (Waltham, Mass., 1942)

S.A. Richards, 'Agricultural Science in British higher education, 1790-1914', (Kent University, unpublished MSc thesis, 1982)

S.A. Richards, 'Agricultural Science in higher education: problems of identity in Britain's first chair of agriculture, Edinburgh 1790-c.1831', Agricultural History Review, 33, no. 1 (1985) pp.59-65

G.K. Roberts, 'The Royal college of Chemistry (1845-1853): A Social History of Chemistry in Early-Victorian England', (John Hopkins University, Baltimore, unpublished PhD thesis, 1973)

C.A. Russell, Science and Social Change, 1700-1900 (London, 1982)

E.J. Russell, A History of Agricultural Science in Great Britain 1620-1954 (London, 1966)

W. Smith, 'Agricultural Botany in the past fifty years', Trans. of the botanical society of Edinburgh 28 (1912) pp.77-84

O. Sonntag, 'Liebig on Francis Bacon and the Utility of Science', Annals of Science, XXX (1974) pp.373-86

J.D. Sykes, 'Agriculture and Science', in G.E. Mingay (ed.) The Victorian Countryside (2 vols, London, 1981) volume 1 pp.260-272

K. Thomas, Man and the natural world. Changing attitudes in England 1500-1800 (London, 1983)

J.R. Walton, 'Pedigree and the National Cattle Herd circa 1750-1950', Agricultural History Review, 34, 2 (1986) pp. 149-170. Reviews the activities of several major cattlebreeders and provides an overview of animal improvement

C.W.J. Withers, 'William Cullen's agricultural lectures and writings and the development of agricultural science in eighteenth-century Scotland', Agricultural History Review, 37, 2 (1989) pp.144-156

2. Histories of agricultural and related societies

In addition to historical overviews of the activities of agricultural societies, this list includes specific studies of the major forums for agricultural science in the eighteenth and nineteenth centuries. It does not include literature on local agricultural societies and farmers' clubs which is comprehensively covered by H.S.A. Fox (1979), cited below.

Anon, 'The progress of agricultural societies', British Farmers' Magazine, 2nd series, 20 (1849) pp.537-40

Anon ('R'), 'On the objects and effects of the late Farming Society of Ireland', Quarterly Jnl of Agriculture, 4 (Dec. 1832-Mar. 1834) pp.511-528

'A farmer', 'On the value of agricultural societies', Quarterly Jnl of Agriculture, 1 (May 1828-August 1829) pp.343-345

D.G.C. Allan, 'The Royal Society of Arts: two centuries of interest in wool', Wool Knowledge, 3, no.4 (1954) pp.14-19

D.G.C. Allan, 'The Society for the Encouragement of Arts, Manufactures and Commerce: organisation, membership and objectives in the first three decades (1755-84): an example of voluntary economic and social policy', (London, External PhD thesis, 1979)

C. Bathurst jr & E. Kinch, Register of the Staff and students at the Royal Agricultural College from 1844 to 1879 with a short historical preface (Cirencester, 1898)

F. Bawden, 'Rothamsted experimental station', J.R.A.S.E., 127 (1966) pp.54-61

R.C. Boud, 'Scottish Agricultural improvement societies, 1723-1835', Review of Scottish Culture, 1 (1984) pp.70-90

L. Bull, History of the Smithfield Club from 1798 to 1925 (London, 1926)

N. Campbell, R. Martin, & S. Smellie, Royal Society of Edinburgh 1783-1983 (Edinburgh, 1983)

D.S.L. Cardwell, The Organisation of Science in England (Melbourne, 1957)

E. Clarke, 'The foundation of the Royal Agricultural Society of England', J.R.A.S.E., 51 (1890) pp.1-19

E. Clarke, 'The first two country meetings of the Royal Agricultural Society: Oxford, 1839: Cambridge, 1840', J.R.A.S.E., 56 (1894) pp.205-234

E. Clarke, 'The Board of Agriculture, 1793-1822', J.R.A.S.E., 59 (1898) pp.1-42

R.J. Colyer, 'Early Agricultural Societies in South Wales', Welsh History Review, 12 (1984-5) pp.567-581

E.J. Cowan, 'Agricultural improvement and the formation of agricultural societies in Dumfries and Galloway', Dumfrieshire and Galloway natural history and antiquarian society transactions, 53 (1978) pp.157-167

S. Curran, 'The Society's role in agriculture since 1800', in J. Meenan and D. Clarke (eds), The Royal Dublin Society, 1731-1981 (Dublin, 1981) pp.88-100

Henry Hall Dix, 'The Royal Agricultural Society', Gentleman's Magazine, III, n.s. (June-Nov. 1869) pp.165-176 (Part 1); pp.296-304 (Part 2)

J.R. Fisher, 'Animal Health and the Royal Agricultural Society in its early years', J.R.A.S.E., 143 (1982) pp.105-110

K. Fitzgerald, Ahead of their time. A short History of the Farmers' Club, 1842-1967 (London, 1968)

H.R. Fletcher, The Story of the Royal Horticultural Society 1804-1968 (London, 1969)

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: Essays on Rural England, 1500-1900 (London, 1979)

G.E. Fussell, 'Suffolk farmers and "The Bath and West" ', Suffolk Review, 2, no. 1 (1959) pp.13-17

N.P.W. Goddard, 'The Royal Agricultural Society of England and Agricultural Progress, 1838-1880', (University of Kent, Unpublished PhD thesis, 1981)

N. Goddard, 'Agricultural Society', in G.E. Mingay (ed.), The Victorian Countryside (2 vols, London, 1981) vol. 1 pp.245-259

N. Goddard, 'William Shaw "of the Strand" and the Formation of the Royal Agricultural Society of England', J.R.A.S.E., 143 (1982) pp.98-104

N.P.W. Goddard, 'The Royal Agricultural Society of England 1838-1988: a synoptic overview', J.R.A.S.E., 149 (1988) pp.10-23

N.P.W. Goddard, Harvests of Change. The Royal Agricultural Society of England 1838-1988 (London, 1988)

E. Grey, Reminiscences, tales and anecdotes of the laboratories, staff and experimental fields, 1872-1922 (Harpenden, 1922)

A.D. Hall, The book of Rothamsted experiments (London, 1905)

V.M.D. Hall, A History of the Yorkshire Agricultural Society, 1837-1987 (London, 1987)

H. Handley, A letter to the Earl Spencer on the formation of a national agricultural institution (2nd edn, London, 1838)

N. Harvey 'The Library of the Royal Agricultural Society of England', J.R.A.S.E., 149 (1988) pp.102-7

K. Hickson, 'The Romance of "the Royal" ', Agriculture, 60 (1953) pp.151-4

T.C. Hincks, Hints for increasing the practical usefulness of agricultural shows (London, 1845)

A. Hobson, Practice with Science: a brief history of the Royal Agricultural Society of England (London, 1953)

D.R. Hudson and K.W. Luckhurst The Royal Society of Arts, 1754-1954 (London, 1954)

K. Hudson, Patriotism with Profit - British Agricultural Societies in the eighteenth and nineteenth centuries (London, 1972)

K. Hudson, The Bath and West. A Bicentenary History (Bradford-on-Avon, 1976)

K. Hudson, 'The membership of the Bath and West Society during its first 200 years' Acta museorum agriculturae, 12, no. 1 and 2, (1977) pp.50-56

M. Hunter, The Royal Society and its fellows (London, 1982)

H.M. Jenkins, 'The Royal Agricultural Society of England', J.R.A.S.E., 39 (1878) pp.855-93

A.E. Johnston, 'Woburn experimental farm - a hundred years of agricultural research', J.R.A.S.E., 138 (1977) pp.18-26

C. Lawrence, 'The Royal Agricultural College of Cirencester', J.R.A.S.E., 26 (1865) pp.1-9

R.M. MacLeod & P. Collins (eds) The Parliament of Science: The British Association for the Advancement of Science, 1831-1981 (Northwood, Middx, 1981)

F.W.J. McCosh, 'The chemistry of plant nutrition, 1840-1860 with special reference to the experiments of Boussingault', (University of London, External Degree, unpublished M.Sc. thesis, 1969)

D.D. McElroy, 'The clubs and societies of eighteenth-century Scotland', (Edinburgh University, unpublished Ph.D. thesis, 1951-2)

T.H. Middleton, 'Early associations for promoting agriculture and improving the improver', Report of the British Association for the Advancement of Science (1912), pp.709-30

R. Mitchison, 'The Old Board of Agriculture', English Historical Review, 74 (1959) pp.41-69

J.B. Morrell & A. Thackray, Gentlemen of science: the early years of the British Association for the Advancement of Science (Oxford, 1981)

J. Murch, 'The history and literature of the Bath and West of England and Southern Counties Society', Jnl of the Bath and West, 4th series, 1 (1890-1) pp.142-52

R. Orlebar, 'How can county and local agricultural societies best assist agriculture', Jnl of the Farmers' Club (March, 1902) pp.191-214

J. Plowman, 'Oxford Farmers' Club Prize Essay', British Farmers' Magazine, 3rd series, 7 (1855) pp.378-84

T.F. Plowman, 'Agricultural Societies and their uses', Jnl of the Bath and West, 3rd series, 17 (1885-6) pp.168-188

A. Ramsay, History of the Highland and Agricultural Society, (Edinburgh and London, 1879)

S. Richards, 'The South-Eastern Agricultural College and public support for technical education, 1894-1914', Agricultural History Review, 36, 2 (1988) pp.172-187

H. Ritvo, The animal estate: the English and other creatures in Victorian England (Cambridge, Mass. and London, 1987) Chapter 1, pp.45-81

H.A. Russell, 11th Duke of Bedford, A Great Agricultural Estate: Being the Story of the Origin and Administration of Woburn & Thorney, (3rd edn, London, 1897)

Rothamsted Experimental Station, Details of the classical and long-term experiments up to 1967, (Harpenden, 1970)

The Royal Highland and Agricultural Society of Scotland, 'The Royal Highland and Agricultural Society of Scotland', Undated typescript held in the Library of the Institute of Agricultural History, University of Reading, PB 2030 (Accn no. P2104)

Royal Society of Arts, The Society's history: a bibliography and tabular supplement April 1954-April 1980 (London, 1980)

E.J. Russell and J.A. Voelcker, Fifty years of field experiments at the Woburn Experimental Station (London, 1936)

E.J. Russell, Rothamsted Experimental Station Centenary Celebration 1843-1943: the work and history of the departments (Harpenden, 1943)

E.J. Russell, British Agricultural Research: Rothamsted (Harpenden, 1946)

S. Shapin, 'Property, patronage and the politics of science: the founding of the Royal Society of Edinburgh', British journal for the history of science, vii (1974) pp.1-41

Sir John Sinclair, Plan for establishing a Board of Agriculture (London, 1793)

Sir John Sinclair, Account of the origin of the Board of Agriculture and its progress for 3 years after its establishment (London, 1796)

R. Trow-Smith, History of the Royal Smithfield Club (London, 1980)

Rt Hon. Lord Somerville, 'a proposition relative to the establishment of District Societies', Board of Agriculture MSS held at the Institute of Agricultural History, University of Reading, BV1 f. 40-2. London. Tuesday April 16th 1799

E. Tasker, 'The Society's role in agricultural education', J.R.A.S.E., 135 (1974) pp.7-16

H.S. Thompson, 'Agricultural progress and the Royal Agricultural Society', J.R.A.S.E., 25 (1864) pp.1-52

J.A. Voelcker, 'The Woburn Experimental Farm and its work (1876-1921)', J.R.A.S.E., 84 (1923) pp.110-166

J.A.S. Watson, The History of the Royal Agricultural Society of England, 1839-1939 (London, 1939)

J.A.S. Watson, and M.E. Hobbs Great Farmers (2nd edn, London, 1951)

T. de Vere White, The Story of the Dublin Society (Tralee, 1955)

H.T. Wood, A history of the Royal Society of Arts (London, 1913)

A. Young, On the Advantages which have resulted from the Establishment of the Board of Agriculture (London, 1809)

In addition to the references quoted above, the Annals of Agriculture regularly published accounts of the participants at the Holkham sheep shearings and provide occasional information on agricultural societies. The Board of Agriculture 'General Views' contain much information on agricultural societies on a county basis (see above).

3. Biographical studies of agricultural 'improvers' and agricultural scientists

(N.B. References ordered alphabetically by agriculturalist.)

Bibliographies

The bibliographical references to Section A.2. contain much information on agricultural biography. In addition, the following bibliographies may be of use in tracing specific agriculturalists:

G.E. Fussell, A Bibliography of His writings on Agricultural History (Reading, 1967). Fussell's extensive writings include biographical sketches of Young, Marshall, Sinclair, Somerville and W.L. Rham

C.C. Gillispie, Dictionary of scientific biography (New York, 1970-85)

Index Society of London, An index to the biographical and obituary notices in the Gentleman's Magazine 1731-1780 (London, 1891). A continuation of this index from 1791-1855 is available in the MSS of the National Library of Scotland Adv. MS. 34.5.23

P.M. Jacobs, Registers of the Universities, Colleges and Schools of Great Britain and Ireland (London, 1964)

H. Raven-Hart & M. Johnston, 'Bibliography of the registers (printed) of the Universities, Inns of court, Colleges and Schools of Great Britain and Ireland', Bull. Inst. Hist. Research, ix (1931-32) pp.19-30; 65-83; 154-70; x (1932-33) pp.109-13 (partially updated by P.M. Jacobs)

L. Stephen (ed.), Dictionary of National Biography (63 vols, London, 1885-1900)

M. Whitrow (ed.), 'Isis' cumulative bibliography (London, 1971). See the section on 'personalities' in the first 2 volumes which refers to the secondary literature on 'scientists'.

T.I. Wiliams, A biographical dictionary of Scientists (London, 1982)

B. Woodcroft, Alphabetical index of patentees of inventions, 1617-1852 (London, 1854; reprinted 1969)

Journal of the Royal Agricultural Society of England, 1890-1904,

Contains a series of biographical articles on: Earl Spencer, Jethro Tull, house of Russell, Viscount Townshend, Arthur Young, Robert Bakewell, Coke of Holkham, Sir John Sinclair, Lord Somerville, the Colling Brothers, Philip Pusey, William Cobbett and Humphry Davy; also the biographies of the Society itself and of the old Board of Agriculture.

Printed Proceedings of Scientific Societies.

These are often superb sources for identifying non-publishing members of the scientific community.

a) Biographies of prominent eighteenth-century agriculturalists and agricultural 'scientists'

G.E. Fussell, 'John Wynn Baker: An 'Improver' in Eighteenth Century Ireland, Agricultural History, 5 (1931) pp.151-161

S. Cox, 'Back to Bakewell', Farmers Weekly, 85, no. 23 (3rd Dec. 1976) pp.12-17

W. Housman, 'Robert Bakewell', J.R.A.S.E., 55 (1894) pp.1-31

S. De Lisle, 'Robert Bakewell', J.R.A.S.E., 136 (1975) pp.56-62

H.C. Pawson, Robert Bakewell: Pioneer Livestock Breeder (London: 1957)

H. Swan, 'Yeoman farmer in an age of reason', Farmers Weekly, 85, no.23 (3rd Dec. 1976) pp.xvii; xix; 79. Refers to Robert Bakewell.

J.A.S. Watson, 'Bakewell's Legacy', J.R.A.S.E., 89 (1928) pp.22-32

R.J. Wood, 'Robert Bakewell (1725-1795), Pioneer animal breeder and his influence on Charles Darwin', Casopsis moraveského musea, 58 (1973)

H.B. Carter, His Majesty's Spanish flock: Sir Joseph Banks and the merinos of George III of England (London, 1964)

H.B. Carter, Sir Joseph Banks [Botanist] (1743-1820): a guide to biographical and bibliographical sources (Winchester, 1987)

W.R. Dawson, The Banks letters (London, 1958)

E. Clarke, 'Francis Duke of Bedford: born July 17, 1765, died March 2, 1802', J.R.A.S.E., 62 (1901) pp.367-73

E. Clarke, 'Agriculture and the House of Russell', J.R.A.S.E., 52 (1891) pp.123-145

D.C. Edgar, 'The Cokes of Norfolk', J.R.A.S.E., 140 (1979) pp.51-62

J.J. Maling, 'Coke of Holkham', East Anglian Magazine, 33, no.11 (1974) pp.578-80

S.R. O'Hanlon, 'The handsome Englishman (Thomas William Coke of Holkham)', Agriculture, 65, no.9 (1958) pp.454-55

R.A.C. Parker, 'The financial affairs and estate management of the Cokes of Holkham in the eighteenth and nineteenth centuries', (University of Oxford, unpublished D Phil thesis, 1956)

R.A.C. Parker, Coke of Norfolk: a financial and agricultural study 1707-1842 (Oxford, 1975)

R.A.C. Parker, 'Coke of Norfolk and the agrarian revolution', in E.M. Carus-Wilson (ed) Essays in Economic History (London, 1962) Volume 2, pp.327-339

W. Rye, 'Coke of Holkham', J.R.A.S.E., 56 (1895) pp.1-14

R. Trow-Smith, 'A great county of great farmers', Farmer and Stockbreeder, 71, no.3531 (1957) pp.52-3

A.M.D.W. Stirling, Coke of Norfolk and his friends. The life of Thomas William Coke, First Earl of Leicester, Holkham, containing an account of his ancestry, surroundings, public services and private friendships, including many unpublished letters from noted men of his day, English and American. (2 vols, London, 1908)

G.A. Foote, 'Sir Humphry Davy and his Audience at the Royal Institution', ISIS, XLIII (1952) pp.6-12

A.R. Griffin, 'The Rott memorial lecture, 1978: Sir Humphry Davy: his life and work', Industrial Archaeology review, 4, no.3 (1980) pp.202-213

H. Hartley, Humphry Davy (London, 1966)

A. Treneer, The Mercurial Chemist. A Life of Sir Humphry Davy (London, 1963)

H.B. Wheatley, 'Sir Humphry Davy Bt, F.R.S. born December 17, 1778; died May 29, 1829', J.R.A.S.E., 65 (1904) pp.1-25

A. Donovan, 'William Cullen and the Research Tradition of eighteenth century Scottish Chemistry', in R.H. Campbell and A. Skinner (eds), The Origins and Nature of the Scottish Enlightenment (Edinburgh, 1982) pp.98-114

J. Thomson, An account of the Life, Lectures and Writings of William Cullen M.D. (2 vols, Edinburgh, 1859)

C.W.J. Withers, 'William Cullen's agricultural lectures and writings and the development of agricultural science in eighteenth-century Scotland', Agricultural History Review, 37, 2 (1989) pp.144-156

Anon., 'Agricultural Biography', Farmers' Magazine, 3rd series, 3 (Jan-June 1853) pp.17-25. Refers to William Ellis and Jethro Tull.

V. Bell, To meet Mr Ellis: Little Gaddesden in the eighteenth century, (London, 1956)

P. Stanbridge, 'William Ellis: the forgotten improver (the story of an eighteenth century agricultural propogandist)', Unpublished typescript c. 1984 held in the Librarian's office at the Institute of Agricultural History, University of Reading

Anon., 'Memoir of Mr Ellman, late of Glynde', in Baxter's Library of Agricultural and Horticultural Knowledge (London, 1834) pp.i-lxiv

S. Farrant, 'John Ellman of Glynde in Sussex', Agricultural History Review 26, no.2 (1978) pp.77-88

E.W. Lloyd, 'John Ellman of Glynde; his lifework and correspondence', J.R.A.S.E., 89 (1928) pp.32-50

Sir W. Gilbey, The Royal Family and farming: George III to George V (London, 1911)

P. Horn, 'Improving the Great Park: pioneer farming at Windsor', Country Life, 170, no. 4395 (12 Nov. 1981) pp.1704; 1706

M. Thevenot, 'Un Magistrat aux champs: Henry Home' (1696-1782), Etudes Anglais, 35 (1982) pp.13-25

I.S. Ross, Lord Kames and the Scotland of his day (Oxford, 1972)

W.C. Lehmann, Henry Home, Lord Kames, and the Scottish Enlightenment (The Hague, 1971)

G.E. Fussell, 'Nathaniel Kent, 1737-1816', Jnl Land Agents Society, 46 (1947) pp.150-2

P. Horn, 'An eighteenth-century land agent: the career of Nathaniel Kent (1737-1810)', Agricultural History Review, 30, no. 1 (1982) pp.1-16

C.A. Horn and P. Horn, 'Nathaniel Kent: an eighteenth-century land agent', Jnl R.I.C.S. Charter Centenary Supplement, (Sept. 1981) pp.42-44

G.E. Fussell, 'My impressions of William Marshall', Agricultural History, 23, no. 1 (1949) pp.57-61

P. Horn, William Marshall (1745-1818) and the Georgian countryside (Sutton Courtenay, 1982)

E. Kerridge, 'Arthur Young and William Marshall', History Studies, 1, no. 2 (1968) pp.43-53

C.W.J. Withers, 'William Marshall, agricultural writer in Scotland', Review of Scottish Culture, 11 (1986) pp.31-35

K. Hudson, The four great men of the Bath and West (Bath, 1973) Refers to E. Rack, A. Voelcker, T.D. Acland and T. Plowman

T.F. Plowman, 'Edmund Rack: the society he founded and the company he kept', Journal of the Bath and West, 5th series, 8 (1913-14) pp.15-16

G.E. Fussell, 'Impressions of Sir John Sinclair, Bt., First President of the Board of Agriculture, Agricultural History, 25 (1951) pp.162-9

W. Harrison, 'The Board of Agriculture, 1793-1822, with special reference to Sir John Sinclair', (University of London, unpublished M.A. thesis, 1955)

R. Mitchison, Agricultural Sir John: the life of Sir John Sinclair of Ulbster, 1754-1835 (London, 1962)

W.M. Sinclair, 'Sir John Sinclair, founder and president of the first Board of Agriculture', J.R.A.S.E., 57 (1896) pp.1-21

J. Sinclair, The correspondence of the Right Honourable Sir John Sinclair Bart (London, 1831)

E. Clarke, 'John, Fifteenth Lord Somerville', J.R.A.S.E., 58 (1897) pp.1-20

G.E. Fussell, 'A forgotten president of the Board of Agriculture. John Lord Somerville: 1765-1819', Jnl Land Agents Society, 54 (1955) pp.554-8

J.J. Maling, 'Turnip Townsend', East Anglian Magazine, 33, no. 6 (1974) pp.322-323

R.E. Prothero, 'Charles, second Viscount Townshend', J.R.A.S.E., 53 (1892) pp.1-3

Anon, 'Agricultural Biography', Farmers' Magazine, 3rd series, 3 (Jan.-June 1853) pp.17-25. Refers to Jethro Tull

Earl Cathcart, 'Jethro Tull: his life, times and teaching', J.R.A.S.E., 52 (1891) pp.1-40

G.E. Fussell, Jethro Tull: his influence on mechanized agriculture (Reading, 1973)

N. Hidden, 'Jethro Tull I, II, and III', Agricultural History Review, 37, 1 (1989) pp.26-35

T.H. Marshall, 'Jethro Tull and the 'new husbandry' of the eighteenth century', Economic History Review, 2 (1929-30) pp.41-60

E.R. Wicker, 'A note on Jethro Tull: innovator or crank?', Agricultural History, 31, no. 1 (1957) pp.46-48

H.W. Scott, 'John Walker's Lectures in Agriculture (1790) at the University of Edinburgh', Agricultural History, 43 (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)', Agricultural History Review, 33, 2 (1985) pp.132-146

R.C. Allen, & C. O'Grada, 'On the Road Again with Arthur Young: English, Irish, and French Agriculture during the Industrial Revolution', Journal of Economic History, XLVIII, no. 1 (1988) pp.93-116

G.D. Amery, 'The Writings of Arthur Young', J.R.A.S.E., 85 (1924) pp.175-188

M. Betham-Edwards (ed.) The Autobiography of Arthur Young with selections from his correspondence (London, 1898)

M. Campbell, 'Agriculturalist in the age of reason: Arthur Young in Ireland', Country Life, 160, no. 4123 (8th July, 1976) pp.110-111

A. Defries, Sheep and turnips: being the life and times of Arthur Young, F.R.S., (London, 1938)

G.E. Fussell, 'My impressions of Arthur Young', Agricultural History, 17 (1943) pp.135-144

J.G. Gazley, 'Arthur Young and the Society of Arts', Jnl Economic History, 1, no. 2 (1941) pp.129-152

J.G. Gazley, 'Arthur Young, Agriculturalist and Traveller, 1741-1820. Some Biographical Sources', Bull. John Rylands Library, 37 (1954-55) pp. 393-

J.G. Gazley, The Life of Arthur Young, 1741-1820 (Philadelphia, 1973)

C.S. Haslam, The Biography of Arthur Young FRS from his birth until 1787 (Rugby, 1930)

J.J. Maling, 'Farmer turned critic', East Anglian Magazine, 33, no. 4 (1974) pp.218-219 (Refers to Arthur Young)

G.E. Mingay (ed.), Arthur Young and his Times (London, 1975)

J.H. Middendorf, 'Arthur Young, Traveller and Observer', (University of Columbia, unpublished PhD thesis, 1953)

J.A. Paris, 'A biographical Memoir of Arthur Young', Quarterly Jnl of Science, Literature and the Arts, ix (1820) pp.279-309

A. Pell, 'Arthur Young', J.R.A.S.E., 54 (1893) pp.1-23

A. Pell, 'Arthur Young, Agriculturalist, Author and Statesman', Jnl of the Farmers Club, (April 1882) pp.49-71

D. Thomas, 'Arthur Young on Wales', Bull. Board of Celtic Studies, 20, no. 4 (1964) pp.413-421

C. Veliz, 'Arthur Young and the English Landed Interest, 1784-1813', (University of London, unpublished PhD thesis, 1959)

b) Biographies of prominent nineteenth-century agriculturalists and agricultural scientists.

A.H.D. Acland, Memoirs and letters of the Right Honourable Sir Thomas Dyke Acland (London, 1902)

T.F. Plowman, 'In memoriam: the Right Hon. Sir Thomas Dyke Acland, Bart' Journal of the Bath and West, 4th series, 9 (1898-99) pp.1-24

K. Hudson, The four great men of the Bath and West (Bath, 1973)

R.L. Greenall, 'Three nineteenth century Northamptonshire agriculturalists. [Clark Hillyard 1766-1849, farmer and writer on agriculture; Valentine Barford, 1786-1864, flock master, farmer and grazier; John Beasley 1801-74, land agent]', Northamptonshire past and present, 7, no.6 (1988-9) pp.443-459

Anon., 'The Duke of Bedford', J.R.A.S.E., 101, pt 2 (1941) p.95

E. Clarke, 'The Right Hon. Sir James Caird K.C.B., F.R.S.: born 1816, died February 9, 1892', J.R.A.S.E., 53 (1892) pp.179-82

N. Harvey, 'Sir James Caird and the landed interest', Agriculture, 60, no.12 (1954) pp.586-589

H. Edmunds, 'Eighty years of Fream's Elements of Agriculture', J.R.A.S.E., 134 (1973) pp.66-77

G.E. Jones, 'Wiliam Fream: agriculturalist and educator', J.R.A.S.E., 144 (1983) pp.30-44

J.A. Voelcker, 'Sir Joseph Henry Gilbert, Ph.D., M.A., LL.D., Sc.D., F.R.S. Born August 1, 1817; Died December 23, 1901', J.R.A.S.E., 62 (1901) pp.347-355

T. Ward, 'Archdeacon Anthony Huxtable (1808-1883) - radical parson, scientist and scientific farmer', Dorset natural history and archaeological proceedings, 101 (1979) pp.7-25

G.E. Fussell, and K.R. Fussell, 'James Finlay Weir Johnston, 1796-1855: the first university advisory chemist', Agricultural Progress, 57, (1982) pp.35-40

H.A.M. Snelders, 'James F.W. Johnston's influence on agricultural chemistry in the Netherlands', Annals of Science, 38, no.5 (1981) pp.571-84

Anon., 'Lawes, Sir J.B. Bt. F.R.S.', Jnl. of the Bath and West, 4th series, 11 (1900-01) pp.209-212

W. Fream, 'In memoriam: Sir John Bennet Lawes, Bt', J.R.A.S.E., 61 (1900) pp.511-524

C. Kirby, The English Country gentleman: a study of nineteenth century types (London, 1937). Includes an account of J.B. Lawes.

Anon., 'Biographic sketches: John Claudius Loudon', Chambers' Edinburgh Jnl. (May 4, 1844) p.284

G.E. Fussell, 'J.C. Loudon: agricultural educator', Country Gentleman's Magazine, (June 1974) pp.350-2

J. Gloag, Mr Loudon's England (Newcastle upon Tyne, 1970)

E.B. MacDougall, (ed) — John Claudius Loudon and the Early Nineteenth Century in Great Britain (Washington D.C., 1980)

M.L. Simo, — Loudon and the Landscape. From Country seat to Metropolis 1783-1843 (New Haven and London, 1988)

G.E. Fussell, — 'John Chalmers Morton, 1821-1888', Agricultural Progress, 58 (1983) pp.52-54

G.E. Fussell, — 'John Chalmers Morton, 1821-1888', Veterinary History, new series, 5, no.2 (1987-88) pp.71-80

J.C. Morton, — The Prince Consort's Farms: An Agricultural Memoir (London, 1863)

E. Clarke, — 'Philip Pusey: June 25, 1799 - July 9, 1855', J.R.A.S.E., 61 (1900) pp.1-18

P.E. Coletta, — 'Philip Pusey, English country squire', Agricultural History, 18, no.2 (1944) pp.83-91

R.W. Linker, — 'Philip Pusey, Esquire: Country gentleman, 1799-1855', (John Hopkins University, unpublished PhD thesis, 1961)

J.R. Fisher, — 'Clare Sewell Read, 1826-1905: a farmers' spokesman of the late nineteenth century', University of Hull occasional papers in Economic and Social History, no.8 (1978)

Anon., — 'Agricultural Worthies. I. The third Earl Spencer. With an appended note by the Rt. Hon. Sir Harry Verney, Bt', J.R.A.S.E., 51 (1890) pp.138-156

C.D. Edgar, — 'Honest Jack Althorp - founder of the Royal', J.R.A.S.E., 141 (1980) pp.10-22

E.A. Wasson, — 'The Third Earl Spencer and agriculture, 1818-1845', Agricultural History Review, 26, 2 (1978) pp.89-99

H. Wyndham, — 'The farming activities of the third Earl Spencer', Northamptonshire past and present, 3, no.2 (1961) pp.40-48

Prof. J. Gilbert, — 'The late Dr. Voelcker', J.R.A.S.E., 46 (1885) pp.308-21

G.E. Jones and B.K. Tattersfield, — 'John Wrightson and the Downton College of Agriculture', Agricultural Progress, 55 (1980) pp.69-77

J. Thornton, — 'The Complete Grazier', J.R.A.S.E., 54 (1893) pp.411-21. Refers to William Youatt.

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