

Underdraining and the English Claylands, 1850-80: A Review

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NINETEENTH-century underdraining has lacked detailed studies in the literature of English agricultural history.¹ The recent articles of Sturgess² and of Collins and Jones,³ discussing clayland agriculture during the period 1850-80, are, therefore, welcome for drawing attention to the role of underdraining. Yet it is a reflection upon the equivocal nature of the evidence so far utilized that their interpretations of the importance of this improvement differ so widely.

Sturgess has argued that before 1850 "attempts . . . to increase the supply of provender from the arable and to expand the livestock sides" of the "farms failed because of the difficulty of growing fodder crops on undrained clays."⁴ But during the 'fifties and 'sixties this lack of fodder was overcome by supplementing hay with oilcake, and by improving crop yields with the introduction of draining and artificial fertilizers. Vetches and mangolds were grown and yields of hay were increased, which together permitted an increase in livestock production. According to Sturgess these changes were restricted to the clayland farms of the wet north and west, for on the clays of the drier east and south it was difficult to establish permanent pasture. He made no estimate of the amount of land drained.⁵

Collins and Jones in reply, although recognizing a regional distinction between the midlands and the south and east, preferred to regard the claylands as three linked ecosystems comprising clayland dairying, clayland fattening, and clay wheat-and-bean husbandry, each of which was marked by "well-defined systems of interacting living organisms and physical environment."⁶ Within the area so delimited, they argued that there was no revolution in technique during the period 1850-80, but merely a series of adaptations to the

¹ I am grateful to Lord Barnard, the Duke of Northumberland, and the Trustees of the Bedford Settled Estates for giving me access to papers in their possession. I also wish to thank Professor H. C. Darby, Mr H. C. Prince, Dr F. M. L. Thompson, and Dr A. R. H. Baker for their comments on, and criticisms of, this paper.

² R. W. Sturgess, 'The Agricultural Revolution on the English Clays', *Agricultural History Review* (hereafter A.H.R.), xiv, 1966, pp. 104-21; R. W. Sturgess, 'The Agricultural Revolution on the English Clays: a Rejoinder', A.H.R., xv, 1967, pp. 82-7.

³ E. J. T. Collins and E. L. Jones, 'Sectoral Advance in English Agriculture, 1850-80', A.H.R., xv, 1967, pp. 65-81.

⁴ R. W. Sturgess, *op. cit.*, p. 120.

⁵ *Ibid.*, p. 112.

⁶ E. J. T. Collins and E. L. Jones, *loc. cit.*, pp. 65-6.

swings in the market towards livestock production. No revolution in terms of agricultural outputs took place because there was too little input in terms of capital investment. Insufficient draining was done, and the draining which had been carried out had not improved clayland agriculture. The effects of this neglect were not offset by the use of oilcake and fertilizer. By comparison, in the light land ecosystem productivity was much higher.

Sturgess, in a rejoinder, defined his argument more concisely and claimed that "over the 'fifties and 'sixties there occurred a technical revolution on the clays of the north and west of the country which consisted in the conversion of cornland to an intensive grassland husbandry on newly drained farms."¹ He emphasized the fact that the clay areas of the north and west were well drained, estimating that over 2 million acres had been drained there, in contrast to the neglected Weald, East Anglia, and the East Midlands.²

Each argument hinges on replies given to two basic sets of questions, the technical and the economic. The former deal with the extent of draining and the amount of oilcake and artificial fertilizer used; the latter with the amount of capital investment needed and applied, and the extent to which productivity was affected. This paper intends to analyse one aspect of the technical problems, that of draining.

Greatly differing estimates have been advanced of the amount of land drained in the nineteenth century. It is not known accurately how much land was drained, either regionally or locally, and the evidence submitted both by Sturgess and by Collins and Jones is insufficient to support their cases: their conclusions about the extent of draining, therefore, remain unproved. As Collins and Jones first offered an estimate of amount of land drained, their figure will be discussed before that of Sturgess.

The Estimate of Collins and Jones

Collins and Jones base their assumption that too little land was drained on three sources: (a) the 1870 Agricultural Returns; (b) Bailey Denton's 1880 estimate; (c) Caird's 1873 estimate. But each of these sources is unreliable. (a) The 1870 Returns contain no information as to acreages drained, and are simply qualitative statements, to which "Agriculturalists who are well acquainted with the manner in which our farming is carried on may not probably attach much importance . . ."³ (b) Denton's figures are only estimates and even as such will bear more than one interpretation. Collins and Jones only use Denton's 1880 figures, but as Denton offered a similar set in 1873, it is useful to compare the earlier with the later set, and also to make direct com-

¹ R. W. Sturgess, A.H.R., xv, 1967, p. 87.

² *Ibid.*, pp. 84-5.

³ *Agricultural Returns for Great Britain*, British Parliamentary Papers (hereafter B.P.P.), 1870, LXVIII, p. 16.

parison of Denton's and Caird's 1873 estimates. In 1873 Denton thought that 3 million acres had been drained in England and Wales.¹ This figure comprised two components: $1\frac{1}{2}$ million acres drained with money borrowed under the various Land Improvement Acts—the public component; and $1\frac{1}{2}$ million acres drained with money derived from the private capital of landowners—the private component. Denton believed that 20 million acres required draining in England and Wales. The acreage drained expressed as a percentage of the total requiring draining gives a figure of 15 per cent. Seventeen million acres remained undrained; but in his evidence Denton admitted that of the amount remaining to be drained, only 8 million acres would be capable of profitable draining, that is draining that would pay in the form of increased rental 5 per cent on the outlay.² He did not expand this statement, but assuming that the 3 million acres he had stated as drained were 'profitable draining', then the total acreage which had required draining and which would be profitable after draining would amount to no more than 11 million acres. That landowners or tenants would drain land which would not pay for draining is unlikely and it is more realistic to express Denton's 3 million acres drained as a percentage of the total of land that would pay for draining: in this case the proportion increases to 27 per cent (Tables I and II).

Denton was inconsistent in his estimates and by 1880 he had revised several of his figures. He repeated the statement that 3 million acres had been drained in England and Wales but changed the ratio of public to private draining.³ With the money borrowed under the Land Improvement Acts, Denton suggested that $1\frac{1}{3}$ million acres had been drained in England, Wales, and Scotland. As one-third of this amount had been spent in Scotland he reckoned that 1 million acres had been drained in England and Wales with public money, and that the remaining 2 million acres had been drained privately. He further reduced the total acreage requiring draining to 18.455 million acres. The amount drained expressed as a percentage of the total requiring draining, as in 1873, gives a low value of 16.5 per cent (Table I). But, as in 1873, Denton admitted that only half of the undrained land would pay for draining.⁴ Working on the assumption made for the 1873 estimates, the 3 million acres drained represented 28 per cent of the total that would pay for draining, a value that is much higher than the 16 per cent calculated by Collins and Jones (Table II).

(c) Collins and Jones further note that Caird's estimate of the acreage of drained land in 1873 agrees closely with that of Denton. But Caird thought

¹ *Select Committee of the House of Lords on the Improvement of Land*, B.P.P., 1873, xvi, Q. 586-9.

² *Ibid.*, Q. 798-807.

³ *Royal Commission on the Depressed Condition of the Agricultural Interests, 1880-1882*, B.P.P., 1881, xv, Q. 4707-22.

⁴ *Ibid.*, Q. 6324, 6385-6.

that only 10 million acres required draining.¹ He also claimed that with the money borrowed under the Land Improvement Acts, 2 million acres had been drained. But Caird did not include the acreage drained out of private capital; if draining financed privately were to be included, there would be little correspondence between Caird's estimate and that of Denton, which included the private capital element.

TABLE I
LAND DRAINED: ESTIMATES OF CAIRD AND DENTON
(In millions of acres)

<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>		<i>E</i>	<i>F</i>
<i>Date</i>	<i>Authority</i>	<i>Area requiring draining</i>	<i>Land drained With public money</i>	<i>With private money</i>	<i>Land remaining to be drained</i>	<i>Percentage drained</i>
1873	Denton	20	1.5	1.5	17	15
1873	Caird*	10	2	—	—	—
1880	Denton	18.455	1	2	15.455	16.5

* Caird's estimates refer to England, Wales, and Scotland; Denton's to England and Wales.

TABLE II
LAND DRAINED: ITS RELATION TO LAND THAT WOULD PAY FOR DRAINING
(Based on Denton's estimates: in millions of acres)

<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
<i>Date</i>	<i>Acreage drained</i>	<i>Acreage undrained</i>	<i>Amount of C that would pay for draining</i>	<i>Total acreage that would pay or had paid for draining</i>	<i>Area drained as percentage of E</i>
1873	3	17	8	11	27
1880	3	15.455	7.5	10.5	28

Not only do the estimates vary, but it is necessary to remember that they are only estimates, and that their reliability may be questioned. Denton in 1873 claimed that 20 million acres required draining, but as the total cultivated area of England and Wales at the time was 26½ million acres,² the idea that

¹ *Select Committee of the House of Lords on the Improvement of Land*, B.P.P., 1873, xvi, Q. 4126.

² *Agricultural Returns for Great Britain*, B.P.P., 1873, LXIX (2).

20 million acres required draining was, as the *Edinburgh Review* noted, exaggerated.¹ Denton's figure of 3 million acres drained by either 1873 or 1880 is also open to question. The 1873 estimate according to the *Edinburgh Review* was "purely speculative and probably inaccurate."² Caird's figures differed distinctly from those of Denton: in estimating the total acreage drained with money borrowed under the Land Improvement Acts in England, Wales, and Scotland, Caird put the figure at 2 million acres in 1873 while Denton in 1880 calculated the acreage for the same area as $1\frac{1}{3}$ million. Yet to some extent the acreage estimated to have been drained under the Improvement Acts should have been fairly easy to ascertain as the inclosure commissioners printed the amount lent under such acts, and all that was necessary was to divide this total sum by a figure which represented the average cost of draining per acre.

No such calculation could be made for draining executed out of private capital: to account for this sector of draining, Denton and Caird put forward ratios attempting to explain the relationship of draining financed by public money to draining financed privately. Such ratios could be little more than guess-work and the variations amongst those proposed reveal this fact. Denton in 1873 calculated that the ratio between public and private expenditure on draining was 1 : 1;³ in 1880 his ratio rose to 1 : 2;⁴ in the *Edinburgh Review*, Caird was reported as estimating the ratio at 1 : 3,⁵ while the *Edinburgh Review* itself in 1880 felt that Caird underestimated the amount spent privately.⁶ The fact that Denton doubled the estimate of private draining in seven years and that Caird, who as an inclosure commissioner had as much opportunity as Denton of gauging the amount of land drained, put his ratio even higher, is an indication of the uncertainty existing in measuring the acreage drained privately.

Collins and Jones believed that too little land was drained in the period 1850-80: but what has emerged is the unreliability of the figures advanced by both Denton and Caird. These are crude estimates which when inspected closely give contrasting results; and their calculation makes their approximation to reality difficult, if not impossible, to gauge. With such conflicting statements it would seem unwise to form any conclusions about the amount of land drained.

The Estimate of Sturgess

To support his claim of sufficient draining in the north and west Sturgess has noted that "of the first £2½ million borrowed from the government and

¹ 'Agricultural Depression', *Edinburgh Review*, 151, 1880, p. 29.

² *Ibid.*, p. 29.

³ *Select Committee of the House of Lords on the Improvement of Land*, B.P.P., 1873, xvi, Q. 586.

⁴ *Royal Commission on the Depressed Condition of the Agricultural Interests, 1880-1882*, B.P.P., 1881, xv, Q. 4719-21.

⁵ 'Agricultural Depression', *Edinburgh Review*, 151, 1880, p. 30.

⁶ *Ibid.*

improvement companies between 1846 and 1855, 83 per cent was spent on estates in counties to the north and west of Leicestershire."¹ This percentage was derived from notices of applications in the *London Gazette* for draining loans. But inconsistencies occur in the material. The loans recorded in the *London Gazette* covered only those made under the government loans of 1846 and 1850 and the Private Money Draining Act, 1849. The improvement companies were not required to publish notices of applications there. The percentage that Sturgess has established for the amount drained in the north and west of England applies only to loans under the government loans and Private Money Draining Act; the pattern that these are supposed to indicate may not bear any relationship to that established by the loans issued by the improvement companies.

Furthermore, the sums referred to in the *London Gazette* notices were not necessarily the sums borrowed by the landowners. All that a notice of application in the *London Gazette* indicated was that a loan was intended to be made on the estate named:² the loan itself may not have been taken up, or, if it was, not to the amount stated in the notice. Thus the Earl of Ellesmere undertook in 1847 to borrow £4,000 to drain his Northamptonshire estate, but no evidence exists of such a loan having been made:³ again the Duke of Cleveland agreed to borrow £6,170 to drain his Northamptonshire estate in his notices of application, but the amount actually borrowed was only £5,000.⁴

The pattern Sturgess suggests is known to be an inaccurate one, nor can it be applied to other and later loans. But the total amount borrowed under such loans is at least known. In calculating the area drained in the north and west at over 2 million acres, Sturgess has to estimate the amount drained privately and he has adopted Denton's 1880 ratio of public to private draining of 1 : 2. The use of this ratio at once places Sturgess's figures in the same realm of unreliability as those advanced by Denton himself.

The areas that Sturgess adopts of differing intensities of draining are at variance. He claims that there was a lack of draining in the East Midlands:⁵ but in his area of sufficient draining—that is the area to the north and west of Leicestershire—he includes Leicestershire and Nottinghamshire which in any reckoning must count as part of the East Midlands.

¹ R. W. Sturgess, A.H.R., xv, 1967, pp. 84-5.

² Public Money Draining Act, 9 & 10 Vict., c. 101, s. 18; Private Money Draining Act, 12 & 13 Vict., c. 100, s. 5.

³ Notice of Application in the *London Gazette* dated 9 February 1847; Public Record Office, IR3/6-38, Certificates of Draining Advances under the Public Money Draining Acts.

⁴ Notices of Application in the *London Gazette* dated 12 February 1847, 28 August 1850, 25 August 1851; Raby MSS., Staindrop, Durham; Draining Reports on the Government Loan, 1848-53.

⁵ R. W. Sturgess, A.H.R., xv, 1967, p. 84.

Was Draining Confined to the Claylands?

Neither Sturgess nor Collins and Jones make out a strong case for their arguments because they are unaware of how much land was drained both regionally and totally throughout England. Detailed studies have to be made of the areas and the amount of land drained. On the Duke of Northumberland's estate in Northumberland, for example, a great deal of draining was carried out during the period as Table III demonstrates. In the Barrasford, Chatton,

TABLE III
ACREAGE DRAINED ON THE NORTHUMBERLAND ESTATES
OF THE DUKE OF NORTHUMBERLAND*

<i>Bailiwick</i>	<i>Total acreage of bailiwick, 1866</i>	<i>Total acreage drained in bailiwick 1844-80</i>	<i>Acreage drained as percentage of total acreage of bailiwick</i>
Alnwick	9,685	6,718	69
Barrasford	8,098	1,747	22
Chatton	19,391	4,652	24
Longhoughton	6,353	4,895	77
Lucker	9,330	5,854	63
Newburn	3,269	2,271	69
Prudhoe	4,997	2,365	47
Shilbottle	5,179	3,571	69
Rothbury	15,524	2,520	16
Tindale	60,747	2,602	4
Tynemouth	4,522	3,404	75
Warkworth	4,371	3,471	79

* Alnwick MSS., Alnwick Castle, Northumberland, Business Minutes, vol. 37, p. 208, 16 February 1866; Fields Drained, vols. 1-3, 1844-1903.

Rothbury, and Tindale bailiwicks, the amount was small but this is explained by the fact that they contained large areas of moorland where open draining was more important than underdraining: the other bailiwicks were all low-lying and covered with boulder clay. The Duke of Cleveland's Northamptonshire estate was also well drained. It lay mainly on boulder and Oxford clays, and by 1872 virtually the whole estate of about 3,500 acres had been drained. Between 1849 and 1853 on the Sudborough section of the estate, which contained about 1,000 acres, no less than 920 acres had been drained.¹ Both these estates diverge from the pattern established by Sturgess and by Collins and Jones, being estates that were well drained; that of the Duke of Cleveland is

¹ Raby MSS., Draining Account Books, 1861-72 and 1864-71; Draining Reports on the Government Loan, 1848-53.

also an example of a well-drained estate in the East Midlands. We need to know to what extent these were, or were not, typical of the pattern of draining during the period 1850-80.

Both Sturgess and Collins and Jones have discussed draining that occurred specifically on the claylands, but it is necessary to establish if this was always the case. Although Collins and Jones recognized different types of soils in their light land ecosystem,¹ they did not elaborate the pedological variations in their clayland ecosystems. They may be fully aware of their definition of clayland, but it must be remembered that claylands are to be found in most parts of the country² and encompass a great variety of soil types. For example the boulder clays in Northumberland vary from heavy, stiff clays in the south-east of the county to sandy loams on Tweedside. It is unquestionable that draining occurred on soils which could never be classed as clays and which could not be fitted into the clayland ecosystems of Collins and Jones. For example, on Burton Farm (about 1,040 acres) near Bamburgh, which lay on boulder clay, and which formed part of the estate of the Earl Grey in Northumberland, only 13 per cent of the 458 acres drained by 1847 was regarded by the tenant as 'clay', while 48 per cent was 'clay-turnip soil', 35 per cent 'turnip soil', 3 per cent 'loam', and 1 per cent 'bog'.³ On the same estate, on West Learmouth and Sunnyslaws Farm (about 1,250 acres) near Cornhill, which lay on boulder clay and glacial sands and gravels, only 6 per cent of the 226 acres drained by 1847 was classed as 'clay', while 19 per cent was 'moor-land', 26 per cent 'turnip soil' and 'turnip land', and 48 per cent loams of various descriptions.⁴ We need to know to what extent such proportions were typical not only in Northumberland, but in the country as a whole, before the impact of draining on clayland agriculture can be judged.

Was Drained Land Converted to Pasture?

Not only can the amount of land drained be questioned, but also the agricultural practice after draining. Sturgess argues that in the north and west of the country during the 'fifties and 'sixties, cornland was converted into intensive grassland on newly drained farms. But studies on two estates in Northumberland reveal no such consequential conversion. On the estate of the Earl Grey a study of the cropping of eight farms covering about 5,000 acres was made with the purpose of discovering the percentage occupied by corn and grass (Table IV). All corn crops—wheat, barley, and oats—were included in

¹ E. J. T. Collins and E. L. Jones, *loc. cit.*, p. 66.

² See map in H. C. Darby, 'The Draining of the English Claylands', *Geographische Zeitschrift*, 52, 1964, p. 191.

³ Grey MSS., Department of Palaeography and Diplomatic, University of Durham, Draining Reports for 1847, Box 550.

⁴ *Ibid.*

the corn percentage, while the total of old grass, new grass (grass in an arable rotation), hay, and seeds made up the grass percentage. Percentages were worked out at ten-yearly intervals from 1845, over the period in which Sturges suggested change took place, with a percentage in 1870 to mark the end of the period. On these farms draining started in 1840, and the main body of the work was completed by 1855: only at Ulgham Grange did draining on a large scale extend for a longer period, with as much being done between 1850 and 1865 as between 1841 and 1850. The eight farms were located in different parts of Northumberland: Ulgham Grange and Broomhill were situated near the coast

TABLE IV
PERCENTAGE OF CORN AND GRASS LAND ON EIGHT FARMS
OF THE GREY ESTATE, NORTHUMBERLAND*

<i>Farm</i>	<i>Acreage in 1845</i>	<i>Completion date of main body of draining</i>	1845		1855		1865		1870	
			<i>Grass</i>	<i>Corn</i>	<i>Grass</i>	<i>Corn</i>	<i>Grass</i>	<i>Corn</i>	<i>Grass</i>	<i>Corn</i>
Burton	1,044	1848	37	34	32	38	44	22	43	33
Bradford	495	1851	34	33	37	39	47	35	40	38
East Learmouth†	889	1852	38	34	21	41	12	46	—	—
Ancroft										
East Side	636	1850	37	40	30	31	29	38	35	42
Broomhill	546	1854	41	29	28	32	52	26	48	28
Presson	965	1858	39	37	39	38	42	32	37	34
Town										
Howburn‡	228	1854	47	38	43	25	42	32	46	37
Ulgham Grange	360	1865	21	36	34	29	44	27	33	35

* Grey MSS., Estate Cropping Book, 1845-78; Draining Material, 1840-69, Boxes 550 and 551.

† No returns recorded after 1867.

‡ No returns for 1865: percentage based on returns for 1864.

south of Howick; Burton, Bradford, and Ancroft East Side about Bamburgh and Ancroft; and East Learmouth, Presson Town, and Howburn on Tweed-side near Cornhill. All the farms lay on boulder clay, with the exception of East Learmouth Farm which was on glacial sands and gravels. Percentages of corn and grass fluctuated throughout the period, but in 1870 although there was an increase in grassland in most places in comparison with the 1845 figures, cornland could not be said to have declined greatly and on some of the farms it had increased. On this estate no general conversion from cornland to grassland after draining seems to have occurred.

A similar study of five farms, from different bailiwicks on the Duke of Northumberland's estate, conveys the same impression. It was based on land use noted on farm agreements, which did not specify crops but did indicate whether the land was in tillage or old grass, arable or pasture (Table V). The main work of draining on these farms had been carried out by 1860, but by that

TABLE V
PERCENTAGE OF LAND UNDER GRASS OR ARABLE ON FIVE FARMS ON
THE DUKE OF NORTHUMBERLAND'S ESTATE*

<i>Farm and bailiwick</i>	<i>Acreage c. 1850</i>	<i>Percentage of farm drained by 1860</i>	<i>Tillage</i>	<i>Grass</i>	<i>Tillage</i>	<i>Grass</i>	<i>Arable</i>	<i>Pasture</i>
Greenfield (Alnwick)	448	76	1852 80	20	1878 78	22	1901 28	72
Hole and Highstead (Tindale)	337	37	1850 37	63	1884 26	74	1897 —	100
Acklington High Park (Warkworth)	461	44	1849 54	46	1861 54	46	1875 48	52
Wandon and Blakelaw (Chatton)	494	49	1848 97	3	1858 92	8	1880 67	33
Chishillways (Barrasford)	445	45	1850 50	50	1868 51	49	1881 36	64

* Alnwick MSS., Farm Agreements.

date there had been no appreciable conversion of arable to pasture. The exception was Hole and Highstead farm: here, however, the fields in arable in 1850 were still in arable in 1884 and the increase in the pasture percentage is a result of the addition of 100 acres of pasture before 1884. In the period from 1850 to 1884 on this farm there was no conversion of arable to pasture after draining. The evidence from these two estates, where the farms were well drained, does

not support Sturges's view of change. The figures in Table V suggest that the movement from arable to pasture occurred after 1870, not directly after draining had been carried out. It would seem to be a consequence not of technical change but of economic factors.

Was Land Improved by Draining?

Collins and Jones put forward a contradictory case in describing agricultural change after draining. They note that draining allowed the introduction of green crops and roots on to fallows,¹ but previously they claim that hopes for introducing turnips on to clays after draining were misjudged and the "belief that drainage could introduce the turnip husbandry to clayland farms" was unrealized.² With such conflicting statements it is relevant to discuss whether draining could bring about the introduction of green crops and roots to clay farms. Collins and Jones have assumed that unless draining led to the introduction of turnip husbandry it had failed in its aims. But not all agriculturalists believed that draining could bring about the revolutionary changes predicted by Joshua Trimmer in 1847.³ William Sample, agent for the Duke of Portland's Bothal (Northumberland) estate, realized in 1852 that, even with draining, strong clayland could "poach" in a wet season with sheep feeding on it.⁴ But this fact did not deter him, and it was the necessity of removing excess water from the land that encouraged him to implement an intensive programme of draining between 1835 and 1880.⁵

Yet draining could bring changes: on the Duke of Northumberland's estate much drained land in the 'fifties was used for the cultivation of turnips;⁶ in Devon on the Duke of Bedford's mid-Devon estate, of the 135 acres drained between 1868 and 1870 on Wheatley Farm (which was farmed by the estate over the same period), 35 acres were put to turnips immediately after draining.⁷ There could be a change in husbandry: Thomas Sample could write in 1885 of the Duke of Portland's Northumberland estate, "the better class of land by draining became capable of producing turnips and thus the rents of the farms did not so entirely depend upon the wheat crop as they formerly did." (This statement refers to the period between 1858 and 1885.)⁸ On the same estate, William Sample in 1849 realized the necessity to drain land if green crops were

¹ E. J. T. Collins and E. L. Jones, *loc. cit.*, p. 75.

² *Ibid.*, pp. 67-8, 72.

³ *Ibid.*, p. 67, quoting J. Trimmer, 'On the Improvement of Land as an Investment for Capital', London, 1847.

⁴ Northumberland Record Office (hereafter N.R.O.), ZSA/1/2, Letter from William Sample to the Duke of Portland, 13 October 1852.

⁵ N.R.O. ZSA/1/2, Letter Book of William Sample.

⁶ Alnwick MSS., Statistical Report of Farms on the Duke of Northumberland's Estate for 1850.

⁷ Bedford MSS., Bedford Estate Office, London, Annual Reports, 1868-70.

⁸ N.R.O. ZSA/3/31, Memorandum re Corn Scale regulating the Rents of the Bothal Estate, 3 February 1885.

to be grown: he wrote: ". . . it is intended that the land which has not been drained had better not be sown with winter tares . . ."¹ Draining could lead to the cultivation of turnips and other green crops, and in some cases help in the adoption of turnip husbandry. The theory of Collins and Jones of the failure of draining to bring about such changes breaks down in certain localities. Whether these examples are merely exceptions to the theory cannot as yet be judged; this will be revealed only by more detailed research. What is suggested is that the statements of Collins and Jones must be treated with reserve.

Conclusion

The generalizations that Sturges, and Collins and Jones have made about draining may be questioned. The acreage drained during the period 1850-80 is unknown: the evidence offered by them does not alter this fact. It is unwise to put any confidence in estimates which are so variable and unreliable, and in notices of applications for draining loans which provide only a partial account. Regional differentiation in draining activity cannot be gauged, nor is it clear how much draining took place on soils other than clays. The claims of Sturges and of Collins and Jones of agricultural change after draining do not apply in all cases. A conversion of cornland to grassland after draining did not occur in all parts of the north and west of the country; while draining could lead to the cultivation of turnips and other green crops on clayland farms.

In spite of these conclusions, the contributions of Sturges and of Collins and Jones are significant in drawing attention to the existence of underdraining as an agricultural improvement. They have reviewed its importance and attempted within the limitations of their generalized data to answer the questions of its regional occurrence and its effects upon agricultural practice. These are questions that we must continue to ask, but with the use of more detailed studies. Acreage drained must have a more statistically correct background, as must the locale and the occasion of draining; and if judgements are to be made about changes in agricultural practice, land use and yields before and after draining must be carefully examined. The answers are to be found in studies both of the draining activities on landed estates, regionally and according to size, and of the various government and improvement companies' draining loans. Such investigations are likely to produce some progress in the understanding of the significance of draining in nineteenth-century agriculture.

¹ N.R.O., ZSA/1/2, Letter from William Sample to the Duke of Portland, 31 July 1849.