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Out of the reach of cattle? Animal subjectivities shaping the electrical cultures of British livestock farming in the second half of the 20th C.

Résumé
This paper explores the use of electricity in 20th-century British farming, as captured in the agricultural press, advisory literature, films and specialist publications intended for the farming community. Through the lens of livestock management, the article addresses the ways in which non-human animal physiologies and subjectivities were implicated in the emerging energy landscapes of the post-war British countryside. Land value at the time was framed by an emphasis on sector-wide efficiency gains, and drivers for increased productivity. By taking electric fencing within dairy production after the Agriculture Act (1947) as a case study, the article refocuses electrical history to consider non-human animal impacts on energy transformations. It argues, firstly, that in Britain during the 1940s-80s energy decisions impacting on the managed spaces of the farm were caught up in the experiences of livestock, and, secondly, that the energy decisions that moulded the spacialities of agricultural practice in this period were shaped by livestock's responses to that experience.

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INTRODUCTION

Services
ALL ELECTRICAL INSTALLATIONS AT MAINS VOLTAGE MUST BE OUT OF REACH OF CATTLE AND PROPERLY EARTHED.

- Adequate lighting (flourescent is preferable)
- A power point for a hand inspection lamp or clippers; power for hand-held equipment should be supplied through a step-down transformer
- A clean water supply for treatment and washing down.[1]

1 The range of on-farm uses publicised for electricity in British livestock production after the second world war was vast. Portable equipment for rearing and health management, such as infra-red lamps and clippers, were powered by it. Electricity installed in livestock housing, powered ventilation, heat and light; timing systems and automation; water pumps, and pressure hoses to clean down stalls and holding pens; cooling, storage, and steam sterilizing. Electrical motors drove milking machines, chaff cutters, feed mixers, driers and lifting mechanisms. Promoters argued that electricity had the potential to help the farmer to avoid the impacts of adverse weather; advocates offered reliability, and readiness to be used day and night: post-war modernity seemed to equate with the ability to step outside annual cycles of season and climate. Electricity was being folded into the mix of on-farm power and used in novel technologies such as electric fencing to energise previously unpowered systems.[2]

2 The dairy sector was one of the earliest to experience the push to adopt electricity in agricultural production, and from the time of the Electricity Act (1947), energy decisions favouring electrical infrastructure had been embedded into the farm's built environment. According to one Agricultural Electrification Adviser writing in the late 1950s, its adoption on farm "must, at times, amuse those who worked on this subject in the thirties, when the general apathy in farming affairs applied, above all, to electricity."[3] But, by the mid-1980s electricity had become sufficiently well managed and reliable in rural Britain for it to be treated as a commonplace, taken-for-granted service. On-farm familiarity with electricity had grown through the provision of Ministry of Agriculture Fisheries and Food (MAFF)'s advisory materials,[4] the agricultural press' articles on the topic, advertising of specialist equipment, and leading texts.[5] As the MAFF's booklet *Cattle Handling* suggests, by 1984 it had become so familiar, hidden and regularised that specific advice was needed to bring

1 Anon, *ADAS Cattle Handling*, MAFF Booklet 2495 (Alnwick: MAFF, 1984).

2 C. A. Cameron Brown, "Electricity On The Farm; The Power And The Price", *Agricultural Review; Selected Articles* (London: Hulton Press Ltd., C. 1956), 58-61; advertisement, British Electrical Development Association, London, *Agriculture*, vol. 63, n° 3, June 1956, vi; advertisement for British Thomson-Houston Company Ltd., Rugby, *Agriculture*, vol. 63, n° 3, June 1956, vi.

3 Cameron, "Electricity On The Farm", 58 (cf. note 2). By 31st March 1955, he said, the Central Electricity Authority had recorded 157,000 farms having a mains supply in England and Wales, with 12,000 being connected annually.

4 E.g., Wolseley Sheep Shearing Machine Company Ltd. Witton, Birmingham, *Farmer And Stockbreeder*, 2nd Jan 1945, 12; John F. S. Steel, Clyde Mills Bingley, *Farmer And Stockbreeder*, 2nd Jan 1945, 35; Wolseley Electric Fencing, Wolseley Sheep Shearing Machine Company Ltd. Witton, Birmingham, *Farmers' Weekly*, 7th Jan 1955, 82; Alfa-Laval Co Ltd., Cwmbran, Monmouthshire, *Farmers' Weekly*, 7th Jan 1955, 15; *Cattle Handling*, MAFF Booklet 2495; Anon, "The Repair And Maintenance Of Farm Buildings", *Fixed Equipment On The Farm*, Leaflet N° 26, MAFF, (London: HMSO, 1965); *Electricity On The Farm*, (Electricity Council, Southern Electricity Board, MAF, Helen Wiggins' Films, 1969), Anon, *Electricity On The Farm*, (London: British Electrical Development Association, 1956) 3, 88; C. Robinson, "Advisory Work In Agriculture And Electricity" *Rural Electrification Conference 1962, Pt 1, Electricity Supply/Agricultural Advisory Services Sessions*, Nottingham, 11th April 1962; Brian Nicol, Producer, *Electricity—Power For Good* (North Eastern Electricity Board Turners Film Productions, 1961), Yorkshire Film Archive NEFA 19315, ELECTRICITY - POWER FOR GOOD | Yorkshire Film Archive **(Yfanefa.Com)** (accessed 7th Oct 2022).

5 E.g., James A. S. Watson, James A. More, *Agriculture: The Science and Practice Of British Farming* (Edinburgh and London: Oliver and Boyd Ltd., 1944); Edwin Gunn, *Farm Buildings: New And Adapted* (London: Crosby Lockwood & Son Ltd., 1945); D. H. Robinson (ed.), *Fream's Elements Of Agriculture* (London: John Murray, 1962); C. A. Jewell, *Farming*, vol., 1, (London, New York, Melbourne, Toronto, Wellington: The Caxton Publishing Co., 1965).

it back into sight. In MAFF's view, maintenance, and safety, rather than promotion, had become paramount. But where did the cattle, from whom electricity must apparently be kept out of reach, feature in this; what part, if any, did animal subjectivity play in the history of agricultural electrification, and how do we know? In answering this question, this article argues that the emerging familiarity of livestock with electrical appliances and the management practices resulting from their adoption into farming enabled the consumption of electricity on farm. The cows helped to make it work. In this way, non-human animals were not simply impacted by the results of the energy decisions made by farmers, they helped shape Britain's energy landscape and culture. This finding opens new avenues of research within energy, agricultural and environmental history.

3 As Harriet Ritvo has observed, from the nineteenth century animal husbandry was one of the "most tightly structured" examples of "the interactions" between humans and other animals, shaped by both "economics" and "by anatomy".[6] In 20th C. livestock farming, human decisions, including energy decisions, continued to shape what animal geographer Lewis Holloway has called the "spacialities of agriculture" and "built agricultural practice" of non-human animal experience. Livestock's experiences of farming were and are, he suggests constantly informed by "particular technologies, spacialities, knowledges and so on", across a range of farming practices seen at any particular time.[7] People's energy decisions on farm were therefore clearly implicated in livestock's experiences in Britain in the 1940s to 70s. But, more than this, human energy decisions were also impacted by the reactions, behaviours, and subjectivities of cattle. Though the whole agrifood system, farm to fork, was purposed to human consumption, and the relations of power between humans and other animals in livestock production remained fundamentally uneven, non-human animals were not necessarily materially "at the complete disposal of human beings" in the mid 20th C.[8]

4 The case for an approach that adds the non-human animal to history has been proven by animal historians including Harriet Ritvo, and Erica Fudge. As Ritvo has noted, the "animal turn" brings other animals, always present in the humanities, into critical line of sight. As she observes, for example, "livestock has traditionally attracted the attention of economic historians who focus on agriculture", but the way in which the animal is to be understood has changed, taking into account the interests of the other animal, and the relationships between humans and other animals.[9] The value of this has been outlined by Fudge, who has argued that "introducing animals as actors and not just as objects into our work will ... broaden and deepen what we might know about the past". A cow, she posits, "is capable not only of being affected by, but also of affecting, its – our shared – world." And this will "challenge some assumptions as to what the focus of our discipline might be."[10] In this case, by taking up the challenge of de-centring the human focus of the discipline and writing "cows into history,"[11] shifting our focus within the history of electricity and the history of agriculture, we see that the eventual ubiquity of electrical power in UK agriculture depended on more than just the human actors' responses. It also depended on adjustments made in answer to livestock's subjectivity and agency.[12] It will help agricultural historians to better understand how and why some technologies were adopted when and at they speed that they were.

6 Harriet Ritvo, *The Animal Estate: The English and Other Creatures in the Victorian Era* (Cambridge, MA: Harvard University Press, 1987), 5.

7 Lewis Holloway, "Subjecting Cows to Robots: Farming Technologies and The Making Of Animal Subjects", *Environment And Planning D: Society And Space*, vol. 25, n° 6, 2007, 1055.

8 NB Ritvo argued that both "material" and "rhetorical animals" were "at the complete disposal of human beings", Ritvo, *Animal Estate*, 5.

9 Harriet Ritvo, *Animal Estate*, 5 (cf. note 6) (Charlottesville, VA and London: University of Vriginia Press, 2010), 1-2.

10 Ritvo, Id.; Erica Fudge, "Milking Other Men's Beasts", *History and Theory*, n° 4, 2013, 15, 17.

11 Fudge, Ibid., 15.

12 Fudge, Ibid., 21; see also Sandra Swart, *Riding High: Horses, Humans and History In South Africa*, (Johannesburg, Wits University Press, 2010).

5 As will be seen, livestock's passive and active responses to novel electrically powered practices generated knowledge about the value and use of electricity on the farm, both in the development of new equipment and in its use. Including cows, I therefore argue is crucial to understanding the history of the ways in which electrical power became entangled with the landscapes and processes of British dairy farming.

6 Split into three parts, the article will firstly set the scene on electricity supply in the British countryside for the decades immediately following the second world war; secondly, focus on the role accorded to electricity as a power for good in farming, its regulation and management at the time; and thirdly, argue for the value of considering non-human animals in energy history through the case study of electric fencing in dairy farming. Within this, the sub question "how do we know?" is perhaps the easiest to answer. The sources used here were created, and subsequently selected and maintained, by human actors. But, belonging to agricultural discourse founded on human interactions with livestock, they also contain incidental traces of other animal actors and their subjectivities in text, image, and (in the case of some films) sound.[13]

7 For consistency, this article draws on a 5-year sample for the month of January[14] from 1945-1980 of two widely-respected national farming journals published in the UK: *Farmer and Stockbreeder*, and *Farmers Weekly*.[15] The sample is supplemented, for corroboration and context, with: archival materials held at the Museum of English Rural Life (MERL), including unpublished research by the National Institute for Research in Dairying (NIRD); grey literature collected by a Regional MAFF office now held at the Yorkshire Museum of Farming; Parliamentary Papers; and published standard texts. Together, these sources capture two modalities. Firstly the intent i.e., what should happen according to policy makers, researchers, and advisors motivated by the fundamental, utilitarian, economic framework of livestock production. Secondly: the experiential – what happened on the ground. The second includes evidence of non-human animal responses to electricity, and human reactions to these, and suggests that farmers, farm managers and stockmen were both aware of the risks attendant on livestock handling around electrical devices on farm and had to adjust their own conduct accordingly.

8 The history of electrification and electricity in the British countryside was demonstrably much messier and far less linear than the agricultural policy, financial interventions, education, advice and advocacy of the time envisioned.[16] But, while

13 This methodology is foundational to animal history, e.g., see Ritvo, *Animal Estate*, 4-5 (cf. note 6).

14 January was a higher-usage month for electricity in the UK due to its latitude.

15 *Farmer And Stockbreeder* (*F&S*) was established in 1889, merged with National Farmers Union's Journal *British Farmer* 1971, and then published as *British Farmer and Stockbreeder* until closure 1984; *Farmer's Weekly* (*FW*) was established 1934.

16 Foundational accounts of the history of the adoption and use of electricity within the British countryside include work by John Weller, *History Of The Farmstead: The Development Of Energy Sources* (London: Faber And Faber, 1982), Leslie Newman, *The Electrification Of Rural England And Wales* (Unpublished Thesis Submitted For The Degree Of Master Of Philosophy, Inst. Agricultural History & Museum Of English Rural Life; March 1991); John Sheail, *Power In Trust: The Environmental History Of The Central Electricity Generating Board* (Oxford: Oxford University Press, 1991); Richard J. Moore-Colyer, "Lighting The Landscape: Rural Electrification In Wales", *Welsh History Review*, vol. 23, n° 4, 2007, 72-92; Paul Brassley, "Electrifying Farms In South West England", Paper Delivered To BAHS Spring Conference, Askham Bryan, April 2013; Paul Brassley, Jeremy Burchardt, And Karen Sayer (eds.), *Transforming The Countryside The Electrification Of Rural Britain* (London and New York, NY: Routledge, 2017). The wider history of electricity and its supply in Britain before the second world war is outside the scope of this paper, but can found in the following classic accounts: Leslie Hannah, *Electricity Before Nationalisation: A Study Of The Development Of The Electricity Supply Industry In Britain To* 1948 (London and Basingstoke: The Macmillan Press, 1979); Leslie Hannah, *Engineers, Managers And Politicians: The First Fifteen Years Of Nationalised Electricity Supply In Britain* (London: The Macmillan Press, 1982); Bill Luckin, *Questions Of Power: Electricity And Environment In Interwar Britain* (Manchester and New-York, Ny: Manchester University Press, 1990); Graeme Gooday, *Domesticating Electricity: Technology, Uncertainty And Gender, 1880–1914* (London: Pickering & Chatto, 2008). These accounts are also increasing internationally, for example most recently Richard F. Hirsh, *Powering American Farms: The Overlooked*

rightly complicating the history of the adoption of scientific and technical innovations in agriculture, including electricity, and the meanings associated with both resistance and adoption for rural communities, none of these accounts have addressed the significant part that livestock also played in rural electrification.[17] If we do not take the non-human animal into account, we are missing a vital piece in the process of understanding how and why certain electrical technologies were made and adopted, and the process of how new ways of knowing and acting were constructed in agricultural discourse.

RURAL ELECTRICITY SUPPLY AND DEMAND

9 As Ruth Sandwell has argued in *Powering up Canada* (2016), the story of "the interrelationships between old and new forms of energy," of "tangled issues relating to changing human energy use, including cheapness and familiarity, adaptability..., as well as advertising, propaganda, and fear" all play a part in the entanglement of people, and environment, and the processes of producing, carrying and consuming energy' including electricity.[18] The introduction of "the automobile ... telephones, electricity and farm machinery", in rural areas of the USA, similarly all presented opportunities and challenges. As Deborah Fitzgerald has observed in *Every Farm a Factory* (2003), farm families addressed each in complex ways, looking to their "relationships with others in the community for guidance and support." Assessing the emergence of a new, industrial paradigm there in the 1920s, electricity in rural America was one of "a new set of opportunities and constraints", of "systems of production and consumption" functioning "like grids" that farmers and rural communities were starting to engage with, adapt to or resist. Electrification was billed in the USA, as in the UK, as transformative, but so too were tractors, pesticides and other applications of science and technology. Each "was located within a matrix of technical, social, and ideological relationships that both constrained and sustained change".[19] And this holds equally true of the UK.

British policymaking in the period 1945-80 was 10
influenced by the United Nation's nascent Food and Agriculture Organisation's (FAO) drive to increase food production from the mid-1940s, in order to meet the fundamental need for improved nutrition and generate reserves of food.[20] We can see this at work across the financial levers at the disposal of the domestic government, which sought to give farmers preference where they could. The electricity boards for example could offer farmers a "Farm Tariff" or a "Contract Rate" with a "lower fixed charge and higher unit charge" for agricultural consumers "whose consumption of electricity was limited by the nature of their business".[21] Agricultural historians, historians of science and environmental historians are currently tackling that policy history across the Global North, within critical assessments of its international legacies, impacts, and maps of High Modernism.[22] But, the UK's determination to get

Origins Of Rural Electrification (Baltimore, MD: John Hopkins University Press, 2022).

17 NB It was argued that most farms' electricity demands only needed a single phase supply and did not justify the additional costs of three phase. George Sewell Director, *Your Electricity Supply*, EDA Film (Greenpark Production, Films Producers Guild, London, N.D.), Museum of English Rural Life, Watts Films, D WATT PH6_33.

18 Ruth W. Sandwell (ed.), *Powering Up Canada: A History of Power, Fuel, And Energy From 1600* (Montreal and Kingston, London, Chicago, IL: Mcgill-Queen's University Press, 2016), 353-354.

19 Deborah Fitzgerald, *Every Farm a Factory: the Industrial Ideal in American Agriculture* (New Haven, CT and London: Yale University Press, 2003), 3, 5.

20 Footage reflecting the FAO's 1945 founding mission is accessible via About FAO | Food and Agriculture Organization of the United Nations (03/04/2023).

21 *Committee Of The Privy Council For Agricultural Research. Report Of The Agricultural Research Council For The Year 1958-59*, vol. 8., Cmnd. 1069, 1959-60, 110. *South Western Electricity Board. Report And Accounts And The Report Of The South Western Electricity Consultative Council For The Year Ended 31st March 1959 Together With The Report And Accounts Of The Board For The Fifteen Month Period From 1st January, 1958 To 31st March, 1959*, vol. 12, 1959-59, paper 303, 1163.

22 Shane Hamilton, "Agribusiness, The Family Farm, And The Politics Of Technological Determinism In The Post-World War II United States", *Technology And Culture*, vol. 55, n° 3, 2014, 560-590; David D. Vail, *Chemical Lands: Pesticides, Aerial Spraying, And Health In North America's Grasslands since 1945*, (Tuscaloosa, AL: University Of Alabama Press, 2018); Venus Bivar, "Agricultural High Modernism And Land

mains electricity to farmers after the second world war was consistent with the larger FAO mission. As Mr Anthony Hurd MP moved in 1953, "this House, noting the benefits already brought to many villages and farms by main electricity, believes that the development of food production depends increasingly on the use of electric power".[23] Harnessed to husbandry, it was suggested, electricity would result in raised production for the farmer and abundance for the consumer. We see this emphasis, pushing back against its still thriving alternatives, in the advisory leaflets published by MAFF and the Electricity Council, distributed at agricultural shows in the period.[24] Electricity was seen as a power for good in agriculture, and thus as a good for all. In fact, drawing on David Edgerton's observations in *Shock of the Old* for a moment, it might be argued that mains electricity had a "high cultural" significance[25] whenever it was linked with British farming at this point.

11 Despite the net long-term trend of adoption, in practice there was a very mixed picture of access to and use of mains electricity on the farm throughout our period.[26] In 1892 chemist Willian Crookes (1832-1919) had expected electricity to become a boon to agricultural production through the destruction of insect pests.[27] But, regardless of his, and then Borlase Matthews,' enthusiasm,[28] the broad project of rural electrification in Britain was still a persistent and enormously complex problem long after the formation of the National Grid in 1926. Michael Kay and Graeme Gooday identify three phases of early electrification in Britain at the turn of the 19th C. and 20th C.: experimental (1870s-80s), fashionable (1890s), and normalized (1900s-1930s) in relation to many well-appointed country houses. But outside its ground-breaking, fashionable adoption via independent generation on rural estates, the third "normalised stage" of electrification[29] came much later to the British countryside than to its industrial and manufacturing regions.[30] Akin to Crookes, the British Electrical Development Association (BEDA) can be found promoting electricity in 1947 to control "flies and other pests" in "cowsheds, dairies, boxes, stables and piggeries", within a suite of farm applications supposed to lead to "a prosperous agriculture and a happy and contented countryside".[31]

12 The journey in agriculture to the stage at which mains electrical installations and applications were normalised for farmers and stockmen, depended on a huge effort from Government, advisors, managers, promoters, engineers,

Reform In Postwar France", *Agricultural History*, vol. 93, n° 4, 2019, 636-655; Carin Martin, "Modernized Farming But Stagnated Production: Swedish Farming In The 1950s Emerging Welfare State", *Agricultural History*, vol. 89, n°4, 2015, 559-583; Nicola Gaberllieri, "'California Dreamin': Rural Planning And Agricultural Development In Italy's Grosseto Plain, 1949-1965" *Agricultural History*, vol. 94, n°2, 2020, 224-250; John Agar, Jacob Ward, (eds), *Histories Of Technology, The Environment and Modern Britain* (London: UCL Press, 2018); Fred Ekpe F., Ayokhai, Rufai Bwashi, "West African Women And The Development Question In The Post-World War II Economy: The Experience Of Nigeria's Benin Province In The Oil Palm Industry", *Journal Of Global South Studies*, vol. 34, n° 1, 2017, 72-95; Dominic Berry, "Agricultural Modernity As A Product Of The Great War: The Founding Of The Official Seed Testing Station For England And Wales, 1917–1921", *War & Society*, vol. 34, n° 2, 2015, 121-139.

23 Anthony Hurd, "Electricity Supplies to Rural Areas", House Of Commons, *Hansard*, Fifth Series, vol. 516, Elizabeth II Year 2, 1351-1442.

24 Advert For Electricity Council Leaflets, Stand D 34, Royal Show Stands and Exhibitors Catalogue, July 1965, 40.

25 David Edgerton, *The Shock of The Old: Technology And Global History Since 1900* (London: Profile Books Ltd., 2008), 4, 212.

26 *Historical Electricity Data 1921 To 2021, Electricity Supply, Availability And Consumption*, Department Of Business, Energy And Industrial Strategy, Electricity_Since_1920.Xls (**Live.Com**) (accessed 13th Jan 2023).

27 Gooday, *Domesticating Electricity*, 154 (cf. note 16).

28 E.g., Richard Borlase Matthews, *Electro-Farming: Or the Application Of Electricity To Agriculture* (London: E. Benn Ltd., 1928); Richard Borlase Matthews "Electricity On The Poultry Farm", *in* Miss O. Comyns Lewer (ed.) *Feathered World Year Book* (London: The Feathered World, 1932).

29 Michael Kay, Graeme Gooday, "From Hydroelectricity to The National Grid: Harewood House and The History of Electrification In Britain, 1900–1940", *History Of Retailing And Consumption*, vol. 4, n1, 2018, 43-63, 46.

30 Abigail Harrison-Moore, Graeme Gooday, "Decorative Electricity: Standen and The Aesthetics Of New Lighting Technologies In The Nineteenth Century Home", *Nineteenth-Century Contexts: An Interdisciplinary Journal*, vol. 35, n° 4, 2013, 363–83.

31 Anon, *Electricity on The Farm* (London: British Electrical Development Association, 1956).

suppliers, and policy makers. This came in the form of advertisements, publications, broadcasts, films, conferences, and advice distributed at agricultural shows via mobile units and market-town showrooms. And, akin to the belief that success was based first and foremost upon a notion of "efficiency" already dominant in the USA's agricultural advice,[32] it used the rhetorical tropes of progress, and increased productivity. Indeed, many of the themes that Gooday has identified in the early promotional campaigns, that focused on the facility of electricity for householders,[33] persisted in Britain long after 1945 within discussions of agriculture, farms, and food production. British advocates for the use of electricity in farmhouses and cottages for instance represented it as the most up-to-date energy, the most efficient and technologically best suited to the demands of the modern farmer at home and persuade the labourer to stay on the land.[34] However, it was not until after the Electricity Act 1957 that the proportion of farms supplied by the grid rose to 80% c. 1958-60.[35] The story of supply was complicated by: topography; the absence in rural areas of a pre-existing, standard infrastructure; legacies of the political, legislative and commercial frameworks within which electricity had already been generated and distributed; unreliable supplies; cost; the differences between rented, tied and owned property; and public responses to pylons situated in places deemed scenic, idyllic or picturesque.[36]

As the oral historical material captured in Brassley *et. al.*'s *The Real Agricultural Revolution* (2021) suggests, however, there might be any number of reasons why a particular farmer didn't invest straight after 1945 in technical innovations, including electrical plant and equipment: life stage, family decisions, prior investment in existing machinery, concerns about financial risk, or larger-scale long-term farm planning decisions.[37] What is therefore important, as Edgerton also suggests, "is the technology that counts: not only the famous spectacular technologies but the low and ubiquitous ones. The historical study of things in use, and the uses of things."[38] In Britain, for those who wanted to use electrical power, there were utilitarian alternatives to the mains. Many farmers, as Brassley *et al.* have observed, accessed the BBC's agricultural broadcasts via rechargeable battery-powered radios,[39] and sufficient farmers still ran their own generating plant in 1960 that one *Punch* author made a satirical claim that farm labourers' perks included free electricity in their cottages, as well as free firewood.[40] Whether *Punch* might be considered authoritative or not, the frequency of power cuts in rural areas certainly necessitated the availability of backup generation even for those farms connected to the national grid. The issue of weak infrastructure remained challenging enough that the specialist monthly *Dairy Farmer* carried a feature on it in 1975 (between the fuel crisis of 1973 and before the national rolling power cuts of the later 1970s).[41] It was not therefore that farmers were necessarily against

32 Fitzgerald, *Every Farm*, 5 (cf. note 19).

33 Graeme Gooday, "Electrical Futures Past", *Endeavour*, vol. 29, n° 4, 2005, 150.

34 Karen Sayer, "Electrification and Its Alternatives in The Farmer's and Labourer's Home", *in* Paul Brassley, Jeremy Burchardt and Karen Sayer (eds.), *Transforming the Countryside. The Electrification Of Rural Britain*, (London and New York, NY: Routledge, 2017), 117-134; Karen Sayer, "Electricity In The Country Cottage, 1920-1970", *in* Paul Barnwell (ed.), *Working Class Housing* (Oxford: Rewley House Studies in The Historic Environment, Oxford University, 2019).

35 Weller, *History Of The Farmstead*, 164, 169-71 (cf. note 16); N. Harvey, *A History Of Farm Buildings In England & Wales* (Newton Abbot, London: David & Charles, 1984), 211, 216; Newman, *The Electrification Of Rural England And Wales*, 200 (cf. note 16).

36 Brassley, Burchardt and Sayer, *Transforming the Countryside* (Cf. note 16).

37 Paul Brassley David Harvey, Matt Lobley, Michael Winter, *The Real Agricultural Revolution: The Transformation of English Farming 1939-1985* (Woodbridge: The Boydell Press, 2021), 203-210.

38 Edgerton, *Shock of The Old*, 5-6, 212 (cf. note 25).

39 Brassley, *et al., Revolution*, 73 (cf. note 37); Paul Brassley, "Electrifying Farms In England", *in* Paul Brassley, Jeremy Burchardt and Karen Sayer (eds.), *Transforming the Countryside. The Electrification Of Rural Britain* (London and New York, NY: Routledge, 2017), 83-115.

40 Ronald Duncan, "The Lure of The City", *Punch*, vol. 238, n° 6240, 27th Apr. 1960, 589.

41 Frank Walsh, "Plan Standby Power Now", *Dairy Farmer*, March 1975. Related marketing E.g., advertisement for N. J. Fromet & Co. Ltd., Stamford, Lincs, *Dairy Farmer*, March 1975, 43; advertisement for Godfreys, Branchley, Tonbridge, Kent, *Dairy Farmer*, March 1975, 43; advertisement for King

using electrical power, it was that the grid did not necessarily suite them. They had a questioning eye, and, if they were in animal husbandry, they had to pay attention to its usefulness with livestock.

ELECTRICITY AS A POWER FOR GOOD MANAGEMENT

14 As Brassley *et al.* show, the most significant increases in funding for agricultural research took place in the twenty-five years after the second world war. Advice came from a range of independent agricultural research centres, State-sponsored research bodies, their commercial equivalents, educational centres, and experimental farms.[42] Government provided much of the funding as well as the organisational structures for agricultural research, education, and advice.[43] As they note, E. J. Russell, *A History of Agricultural Science* (1966) believed that a higher proportion of public funding was going to the agricultural sciences at that point than other key policy areas due to "its immense value for food production".[44] This is in marked contrast to Julian Huxley's assessment of research funding in the 1930s, when agriculture and agricultural sciences were receiving just ¾ of a million pounds per annum compared to 2 ¼ millions for industry and its sciences.[45]

15 Efforts were made not only to develop and promote, but also to test, standardise, and make farm electrical equipment safe via the work of the Central Electricity Authority, the Area Boards, the British Standards Institution, and the British Electrical Development Association.[46] At the same time, electrical power and electrical systems were being woven into a range of practices, including legal-, institutional-, and material-control.[47] By the late 1960s, this landscape was still fundamental to the publicity for the Electro-Agricultural Centre at Stoneleigh. Established by the Electricity Council at the National Agricultural Centre (NAC) and owned by the Royal Agricultural Society of England (RASE), the Centre aimed to "display ... fundamental techniques in the use of electricity in agriculture". It had, it stated, "a technical and product information library, and ... provision for demonstrating new equipment" and worked with the NAC to demonstrate "electrical methods ... as part of new farming techniques" and "electric farming". It sought "to help all concerned keep up to date with the latest electrical developments in agriculture". It was, it said, designed "to assist farmers in their efforts to increase productivity and cut costs".[48]

16 In passing through he national regulatory structures, which shaped the products on the market and reassured consumers and operators alike, the electrically-powered equipment of the farm was no different to any other.[49] The safety of human

Engineering Ltd., Greenland Mills, Bradford-On-Avon, *Dairy Farmer*, March 1975, 44.

42 Brassley *et al., Revolution*, 24-87 (cf. note 37).

43 The Agricultural Research Act, 1956 (4 & 5 Eliz. 2, C. 28), established an Agricultural Research Fund and The Agricultural Research Council (ARC), which took over responsibility for the independent research institutes from MAFF. funding for agricultural research increased steadily through the 1950s. in its first year, ARC spent £3,895,601. In 1957 it spent £3,895,601. In 1958 it spent £4,184,221. *Agricultural Research Fund Account 1956-57. Account Prepared Pursuant To Section 1 (5) Of The Agricultural Research Act, 1956, Of The Receipts Into And Issues Out Of The Agricultural Research Fund In The Year Ended 31st March 1957; Together With The Report Of The Comptroller And Auditor General Thereon.* 1957-58, BPP 130, vol. 20, 101; *Agricultural Research Fund Accounts 1957-58. Account Prepared Pursuant To Section 1 (5) Of The Agricultural Research Act, 1956, Of The Receipts Into And Issues Out Of The Agricultural Research Fund In The Year Ended 31st March 1958, Together With The Report Of The Comptroller And Auditor General Thereon. (In Continuation Of House Of Commons Paper* n° *130 Of 1957-58.)*, 1958-59, BPP 20, 101.

44 Brassley *et al.*, *Revolution*, 44-45 (cf. note 37).

45 David Edgerton, "Time, Money, And History", *ISIS*, vol. 103, n° 2, 2012, 321-322.

46 E.g., Central Electricity Authority. Eighth Report And Statement Of Accounts For The Year Ended 31st March 1956, vol. XVI.13, 1955-56, **Https://Parlipapers.Proquest.Com/Parlipapers/Docview/T70.D75.1955-045484?Accountid=13651** (accessed 14th Dec 2022).

47 Miriam R. Levin, "Contexts of Control", *in* Miriam R. Levin (ed.), *Cultures Of Control* (London and New York, NY: Routlegde, 2000), 24-26.

48 Advert, *Agriculture,* vol. 75, n° 7, July 1968, iv; advert issued by The Electricity Council, England and Wales, and repeated publication in at least vol. 75, n° 8, August 1968; vol. 75, n° 9, September 1968.

49 See Graeme Gooday, *Domesticating Electricity*, 61-89, 99-105, 115-119 (cf. note 16).

users for instance was covered by specific regulations on electrical installations that were in play at the start of our period. British Standards such as "Battery-operated electric fences B.S. 1222-1945", were part of the regulatory, legal discourse that applied throughout Britain and its region of influence.[50] British Standard (B.S.) 1222-1945 for instance ensured that "the energy supplied to fencing livestock be so limited and controlled that under the most extreme conditions it shall not cause danger". Other countries used mains powered fences, but this was "not recommended for use in this country", at the time, therefore did not conform to this standard. Later in 1954 the NIRD carried out tests on mains-powered prototypes, including a Wolsey unit, against the International Commission on Rules for the Approval of Electrical Equipment (CEE) "Specification for Mains Operated Electric Fence Controllers" (1949),[51] and a committee "representing sixteen interested organisations" outlined the requirements for "Mains-operated Electric Fence Controllers" B.S.2632:1955, including the B.S. markings to be printed on safe devices that reassured the user.[52] And, there seems to have been a push in that part of the sector most connected to policy-making to adopt the mains-powered versions. Potential developments in all aspects of livestock farming worldwide were regularly researched and discussed after the second world war. "Never in the history of agriculture was it more important to understand the problems present and future, and the achievements of the farmer overseas", James Turner, the then President of the National Farmer's Union, urged in the Foreword to Clyde Higgs' *Continental Journey* (1945). And in Higgs' view, the use of electricity in farming, drawing on developments in Europe, as well as America and New Zealand, was a key part of the planning for transformative change. Throughout *Continental Journey*, alongside the other practical developments and comparisons, there were constant references to electric light, electric motors, etc. and injunctions to "do more of this at home". Reporting on developments in Denmark, Higgs recorded that electric fences "have been the subject of considerable research" and that there were "fifty thousand in use", produced by twenty manufacturers. As a result, "the countryside is covered with electric fences – all connected directly to the mains".[53] Similar observations about the reach of electricity and its value in farming persisted.[54]

Within the UK's legal and advisory controls, the producers and operators of the electrical equipment used on livestock farms thus had to address animal bodies and animal behaviours in the design, production, and safe use of electricity, whatever the rhetorics of the promoters. In the legal frameworks, it was soon recognised that care also had to be taken to ensure regular maintenance of electrical installations and connections within agricultural buildings to ensure that they were not exposed to weathering and damp,[55] and the industry was already aware of the implications of rearing animals near

50 B.S.1222-1945 required the pulse of electricity in the output to be no more than 3.0 millicoulombs, at a peak of 500 milliampres, at a duration of no more than 0.1 second and a period of no less than 0.75 seconds between pulses. dissemination was via test cases. E.g., A Study Carried Out By The NIRD Engineering Department, Test Report 560/4 For R. J. Fullwood And Bland Ltd., Fullwood Electric Fence Controller, Commercial Report, 2, MERL Catalogue Ref D NIRD ET1/93 - No 56C/4 : Fullwood Electric Fence Controller. Dissemination also took place through published reports, E.g., "New Standards", "Appendix, New Zealand Standard Specifications Recommended During The Year For Declaration, Revision, Or Withdrawal", New Zealand Standards Council (Department Of Industries And Commerce), *Annual Report For The Year 1948-49*, 15 Appendix To The Journals Of The House Of Representatives Of New Zealand (**Natlib.Govt.Nz**) (accessed 4th Jan 2023).

51 Anon, "Electric Fences", *Electrical Review* 6th July 1945, vol. CXXXVII, n° 3528, 38; Anon, "Wolseley Prototype Mains-Operated Electric Fence Controller", MERL Catalogue Ref, D NIRD ET1/299 - N° 54D/3.

52 Book Reviews, *Agriculture*, vol. 68, n° 3.

53 E.g., Donald Vandepeer, "The Story Of The F.A.O.", *Agriculture*, vol. 62, n° 7, October 1955, 307-309; Clyde Higgs, "The Story Of The Agricultural Advisory Service", *Agriculture*, vol. 62, n° 7, October 1955, 310-312; G. J. Ter Brugge, "Reallocation Of Farmland In The Netherlands", *Agriculture*, vol. 62, n° 7, October 1955, 339-342; Clyde Higgs, *Continental Journey: An Account Of The State Of Agriculture In Germany And Denmark In The Autumn Of 1945. With Portrait And Illustrations* (Worcester: Littlebury and Co. Ltd., The Worcester Press, 1946), 7, 78, 83, 42, 44, 66.

54 E.g., Anon., "Mains-Operated Electric Fence Controllers", Book Reviews, *Agriculture*, vol. 63, n° 3, June 1956, 144.

55 Anon, "The Repair And Maintenance Of Farm Buildings", *Fixed Equipment On The Farm,* Leaflet n° 26, MAFF, (London: HMSO, 1965), 11.

electrical installations in the 1940s. In Gunn's *Farm Buildings* (1945) for example there is an advert for a wiring system that explicitly refers to "ammonia fumes" as one of several adverse conditions under which farm wiring systems had to function.[56] But, as can be seen in the Code of Recommendation for the Welfare of Livestock: Cattle (approved c. 1968), there were additional steps that needed to be taken about cattle inside farm buildings and around farmyards. The anticipated risks of animal actions, such as livestock reaching up and chewing cables, had to be mitigated by the farm manager ensuring installations were out of reach or covered, the animals thereby shaping installations, and influencing safety regulations.[57] The ongoing need to mandate the careful installation of electricity in the livestock industry for the benefit of both human handlers and animals can be seen in the epigraph.

18 Of course, it is important to recognise that the attention paid to the interaction between animals, humans and farm technology did not necessarily result in longevity for the cow. As Roche *et. al.* have suggested, in their industry-led study of the history of grazing, it sometimes resulted in the culling of specific individuals that failed to conform physiologically to the new electrically-powered management regimes linked to rising production demands, such as faster milking speeds. Those that were deemed to be "disruptive" behaviourally re a new "routine" could also be slaughtered, especially if that agency "increased the risk to [human] milker health and safety".[58] It is unclear how many animals may have been culled for this reason, as the use of slaughter to shape a herd, e.g., in terms of health, or breeding capability, was often recommended in our period, but the actual numbers not recorded. In 1950 W. K. Hunter advised farmers to "consign all unsuitable animals for slaughter", for instance, and was consistent with his guidance on breeding, health, and disease control being designed to enable the farmer's "cows [to] live a normal life, which means a longer and more productive life".[59] This was a standard practice. A film about the rearing of bulls for Britain's artificial insemination (AI) programme noted that if a bull "failed" its rigorous scrutiny "he'll be slaughtered", and only one in four passed the whole "four-year testing period".[60] And, the normalisation of the "killability" of cattle in relation to disease control has been discussed by Lewis Holloway *et al.*. As they have argued, the practice both actively generated "populations of animals with certain characteristics,' and closed other routes of development.[61] Culling curated on-farm norms around health and behaviour. But, from the practice of culling non-compliant animals we can also infer that some cattle could either not adapt physiologically to, or actively resisted electrically powered technologies, and this from the industry point of view took time and effort, and therefore human attention and resource, to address.

19 This matches the understanding in the period itself that cattle had agency, and that influenced human decision-making. As R. R. Mercer phrased it, following a 1960s national study of cows' behaviour by the Agricultural Land Service (ALS), cows "sometimes do things simply because they feel like it and not because they are made to do them". Good stockmanship was, it therefore concluded, the ability to consider individual cows' behaviour, not just the herds' behaviour or hierarchical position.[62] Within the grazing sector new management practices were being developed that reshaped the layout of the farm to significantly reduce capital and human labour input,

56 Gunn, *Farm Buildings*, 111-113, 136 (cf. note 5).

57 Anon, ADAS *Cattle Handling*, 15 (cf. note 1).

58 J.R. Roche, D.P. Berry, A.M. Bryant, C.R. Burke, S.T. Butler, P.G. Dillon, D.J. Donaghy, B. Horan, K.A. Macdonald, K.L. Macmillan, "A 100-Year Review: A Century of Change in Temperate Grazing Dairy Systems", *Journal Of Dairy Science*, vol. 100, n° 12, 2017, 10192.

59 W. K. Hunter, "The Cow Is Also an Animal", *Farmers Weekly*, 6th Jan 1950, 41-43.

60 Anon, "Bull Rearing Unit & Cattle Breeding Sub-Centre, Chippenham", (N.D.) MERL, D Watt, Ph6_20, 8-9 Mins.

61 Lewis Holloway, Niamh Mahon, Beth Clark, Amy Proctor, "Living With Cows, Sheep And Endemic Disease In The North Of England: Embodied Care, Biosocial Collectivities And Killability", *Environment And Planning E: Nature And Space,* vol. 6, n° 2, 2022, 14.

62 R. R. Mercer, "Dairy Cows Are Individuals", *Agriculture*, Feb. 1967, 97.

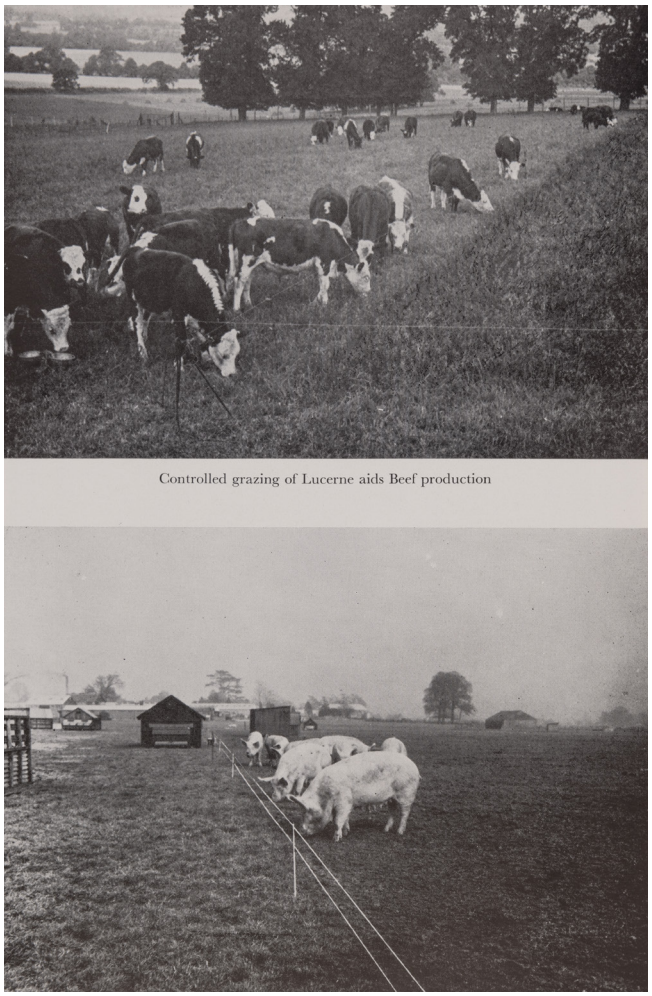

Figure 1: Electric fencing made it easier to feed cattle flexibly for the short term by setting up multiple paddocks, temporary leys, seeded with lucerne, or a strip of land that had been seeded with kale (called "kale folding"). Plate VIII, *Electric Fencing Bulletin*, n° 47 MAFF (1966) © the Museum of English Rural Life

alongside investments in drainage, and grass.[63] But, as we can see with the ALS study, within this non-human animals' indirect and direct interactions, behaviours and responses to new methods and their associated technologies, were being observed, written up and discussed by researchers who needed to recommend optimal, yet safe conditions for raised production.[64] This means that both non-human animals' bodies and subjectivities were contributing to the formation of these systems, and that includes the energy decisions relating to them.

ELECTRIC FENCES AND HANDLING CATTLE

Cow's bodies co-produced the post second world war grazing landscape and its attendant technologies including electric fencing. In the UK,[65] as Roche *et. al.* observe, the need to improve the quality of available feed within the cow's reproductive cycle, to supplement or protect grass and manage its nutritive and calorific value, lead to the widespread adoption of electric fencing, alongside the seasonal effects of calving – the right grass had to be available at the right time, to suite the animals' reproductive cycle.[66] Electric fencing made it easier to feed cattle flexibly for the short term by setting up multiple paddocks, temporary leys, or a strip or land that had been seeded with kale (called "kale folding").[67] And by the mid-1960s, electric fencing had become sufficiently ubiquitous that an image of a cow trying to dodge it could be used in Britain quite wryly to catch the reader's eye. Hence, in an article promoting well-managed, high-output grassland, entitled "The Extra Grass", *Agriculture*, we catch a Jersey cow kneeling, stretching to the choicest blades. Her nose hidden, she is after the so-called "green gold" in the face of the wire running just above her shoulders.[68] It represents very well the way that electric fencing was depicted in Britain during our period, as an adaptable and important part of a suite of changes to post second world war grazing practice, that practice itself

63 Roche *et al.*, "A 100-Year Review", (cf. note 58).

64 E.g., Robert Davies, "'Clock Hand' Fencing Moves Flock Round The Grazing", *Farmers Weekly*, 17th May, 1974.

65 Solid fencing had come to firmly establish the legal boundaries and tile of land in colonial North America, in part in the face of animals knocking it over, during the 1930s lightweight, flexible, electric fencing was initially developed in the USA. See William Cronon, *Changes In The Land: Indians, Colonists, And The Ecology Of New England* (New York, NY: Hill And Wang, 1983), 130-132, 134. For its use in New Zealand, see V. Jones, "50 Years Of Power Fencing", *Proceedings Of The New Zealand Grassland Association* 49, (Hamilton, New Zealand, Gallagher Group, 1988), 145-149; Roche *et al.*, "A 100-Year Review", 10191-10192, 10195-10196, 10199, 10221 (cf. note 58).

66 Roche *et al.*, "A 100-Year Review", 10221 (cf. note 58).

67 A. S. Foot, J. F. Lovett, "Electric Fencing", Bulletin n° 147, MAFF (London: HMSO, C. 1964); K. J. Richards, Director, *Profit From Experience* (ICI Film Unit, C. 1947), MERL D WATT PH6_10.

68 Anon., "Green Grass", *Agriculture*, vol. 71, n° 4, April 1964, 149.

Figure 2: Many images of electric fencing show cattle reaching under the wire to graze. "The Extra Grass" *in* "Green Grass", *Agriculture*, vol. 71, n° 4, April 1964. © the Museum of English Rural Life.

characterised like this as advantageous from the cattle's point of view, the fencing something that she would respect.

21 But, this was not a straightforward shift from one form of fencing to another. As the advisory literature implies, some persuasion was needed. In a letter to the local press, one farmer, J. C. Kidner, said he had increased his yield from 134 gallons per acre in 1951 to 338 gallons by 1955, for example, but "was not sure that electric fences for grazing were economic, and ... was inclined to try paddock fencing in future with less moving of the fences".[69] Electric fencing wasn't always the first thing that innovative farmers opted for to reduce labour costs. An advisory film, *Profit from Experience* (c. 1947) recognised this by including the conversational question "'have you tried electric fencing?" "No [the drawn-out hesitant response]. There might be something in it though" before passing onto a textbook about grass. As the film is seeking to show that it ought to be cheaply installed alongside other grassland improvements, later the same man has added it to the upgrades he has been working on and is shown adapting scrap iron for wiring uprights. The narrator explains "the fence is moved each day, to give the ten cows a ration of about a sixth of an acre". The strip grazing has reportedly increased his use of grass by 40%, and got the cows out of store into the fields early. With the film focusing on the cattle grazing contentedly, the narrator asserts "the cows show their appreciation with an early flush of milk when the prices are still high", before one cow suddenly steps back from the wire, shocked, and the film cuts to several cows chewing the cud alongside the fence.[70] Made by ICI, who didn't manufacture electrical equipment, the viewer is nevertheless expected to adopt it as part of the system that enables ICI's products to work, persuaded by what they have seen of the cow's response, as well as the farmer's experience.

This "paddock grazing system", linked to the 22
season and cow's physiological cycles, needed to be researched and promoted.[71] Wire and barbed wire fencing had already been used to alter the productive scope of the farm on large pastures, and electric fencing had been proven for sheep husbandry in Australia and New Zealand.[72] But electric fencing's importance within the integrated system required a dedicated MAFF bulletin (Bulletin n° 147).[73] And, because new equipment such as the electric fence might contribute to productivity gains such as increased milk output, yet could also pose a risk to both human operators and animal subjects, organisations such as the NIRD tested the prototype designs being made by Wolsey and other companies.[74] As Abigail

69 J. C. Kidner, "Treat Grassland as A Crop", *West Sussex Gazette & South of England Advertiser*, 30th Jan 1958, 5, Col. D.

70 Richards, *Profit from Experience*, 3:01, 9:46, 12:00 (cf. note 67).

71 E.g., A. D. Park, Principle of The Shropshire Farm Institute; A. D. Park "The Walford Smallholding", *Agriculture*, vol. 75, n° 7, July 1968, 338-342.

72 John Pickard, "Wire Fences in Colonial Australia: Technology Transfer and Adaptation, 1842-1900", *Rural History*, vol. 21, n° 1, 2010, 27-58; Jones, "50 Years Of Power Fencing", 145 (cf. note 65); for the ecological reading of fencing more generally, see A. Mcinturff, *et al.*, "Fence Ecology: Frameworks for Understanding the Ecological Effects of Fences", *Bioscience,* vol. 70, n° 11, 2020, 971-985.

73 Bulletin n° 147 was revised periodically from 1950 throughout our period, according to the MERL catalogue: Electric Fencing 1950; 2nd ed. Feb. 1953; 3rd ed. June 1957; 4th ed. 1966 (Reprinted with minor corrections 1969), (3rd impression with amendments 1972); 5th ed. 1976.

74 N° 52D/4: Wolseley Prototype Electric Fence Unit, National Institute for Research In Dairying, Technical Records, Records Of Experiments And Trials, Confidential

Woods has observed, agricultural research findings were rarely disseminated, received or implemented straightforwardly.[75] But reports produced by NIRD show time was spent assessing different models' conformity with British Standards, especially of new prototypes, in the laboratory and the field. Undertaken by the engineering department, the bulk of each NIRD report focused on the technical aspects of the design, voltage and duration of the electrical pulse plus durability, robustness of the contacts etc. In this case, a 90-volt dry battery produced a 0.6 millicoulomb for a 500 Ohm load, with a peak output of 380 milliamperes for 0.8 millisecond with 1.6 seconds between pulses, and lasted about three to four months in field tests. But the utility of electric fencing being the integrated paddock grazing system, the period of field testing was a grazing season, and a key stated assumption was that "the cow is a satisfactory test animal". In other words, the responses of "milking cows"[76] (of unspecified breed) to the equipment were generalised across all cattle as an experimental model. The cows were thus a key part of the testing regime, and therefore key to generating knowledge about the effectiveness of the controllers.[77]

23 Once in use, a dialogue then also seemed to ensue between farmer and livestock through the medium of the fencing. Perhaps unsurprisingly if farmers were mocking up posts from scrap metal, as advocated in the ICE film, electric fencing was not always reliable beyond the bounds of NIRD. But, if fences fell slack, lost charge or a particular individual simply ignored the so-called "sting",[78] then grazing animals could push them over, stretch them, and (like the cow seeking the best grass – a commonplace image) graze under them. In one article in *Agriculture* (1957) for instance it was suggested that a reason to adopt mains-powered electric fences was that "complaints that cows ignore the shock" from a battery-powered fenced "should be less frequent".[79] In other words, the effectiveness of any electric fence relied fundamentally on the animals' active compliance once shocked. It still relies on their continuing to learn about it and work with the knowledge down the generations. Advice today, provided by the Agriculture and Horticulture Development Board (ADHB), is that the level of (safe) shock from an electric fence "should be sufficient that the animal remembers it", and that animals should be able to "detect the electrical field around the wire before they make contact with the fence". Their predicting a shock based on prior experience means that the fence will work at lower voltages, and from their sensing the electrical field alone.[80]

In other words, according to sector-leading guid- 24
ance, the usefulness of electric fencing depends at least in part on animals' familiarity with it and subsequent submission, i.e., on animal subjectivity and agency. This is not new guidance. To mitigate some of the risks, in the standard text on power farming, which outlined the technical specification of wires and heights for different stock,[81] writing in 1959, C. Culpin argued that the:

> first point to observe about using fences effectively is that it is worthwhile to take care to introduce stock to the fence in a manner which

Reports (Typed Manuscript) On Dairy Equipment, 1952, MERL Catalogue Ref D NIRD ET1/297; N° 56D/1: Burgess Prototype Electric Fence Unit, MERL Reference Number D NIRD ET1/302, 1956.

75 Abigail Woods, "Science, Disease and Dairy Production In Britain, c. 1927-80", *Agricultural History Review*, vol. 62, n° 2, 2014, 294-314.

76 MERL Catalogue Ref D NIRD ET1/93 - N° 56C/4: Fullwood Electric Fence Controller, 2.

77 Fullwood Electric Fence Controller. Electric fencing was also in use for other livestock, but NIRD were focused on cattle.

78 Advert Wolseley Sheep Shearing Machine Company Ltd. Witton, Birmingham, *Farmer and Stockbreeder*, 2nd Jan 1945, 12.

79 Clyde Higgs, "Milk at Lower Cost", *Agriculture*, vol. 62, n° 3, June 1955, 131-132.

80 Anon, Agriculture And Horticulture Development Board, ADHB Knowledge Library, Electric Fencing For Livestock | AHDB (accessed 10th Jan 2023); ADHB recommend lower electric fence voltages where animals have been trained, E.g., "Calves Or Untrained Cattle Require 4,500-5,500V, You Can Use 3,500-4,500V For Trained Cattle". "Components Of an Electric Fence", ADHB, Components Of An Electric Fence | AHDB (accessed 10th Jan 2023).

81 A. S. Foot, J. F. Lovett, "Electric Fencing", Bulletin n° 147, MAFF (London: HMSO, C. 1964); Advertised in *Agriculture*, vol. 71, n° 1, January 1964, 51; C. Culpin, *Farm Mechanization Management*, (London: Crosby Lockwood & Son, Ltd., 1959), 195-197.

> enables them to be quite sure that it is touching the fence – however gently – that gives them the unpleasant shock. This must be done when the animals are quiet and unafraid. The worst possible method of introducing stock to the fence is to drive them on to it, since they will probably run straight through it and will still not understand what caused the pain. One method of training stock is to put them quietly into a small specially erected training fence and leave them to reach for tempting food placed just beyond the fence.[82]

25 In other words, it was already recognised by the late-1950s that the electric fence only worked if the cattle were trained and complied in its use. The technology relied on the cows' familiarity and consent, and therefore understanding, i.e., their subjectivity, which permitted them to establish that the "pain" they felt was due entirely to the fence. It is a striking additional detail in a textbook that focuses in the main on technical specifications, labour costs and comparative values of different mechanical appliances on farm, and continues with that focus in the rest of the chapter on "Mechanization of Livestock Handling". Culpin does not seem otherwise especially concerned with animal welfare. He states that the cattle will feel pain without compunction, and elsewhere in the section he obliquely refers to what is called the "electric dog" (an electrically power goad) being used to bring "any reluctant animas forward".[83] This passage therefore suggests that factoring in animal experience was absolutely essential to the successful operation of an electrically-powered (human) labour-saving tool. This is confirmed as an expectation across the sector's advisory publications, and the information provided directly by producers. Jewell for instance offers advice to farmers folding cattle on kale that "cattle will normally take one row from under the fence, and it should therefore be so placed so as to allow this to be easily eaten but to keep the next row out of reach".[84] In their own guidance, Wolseley, the leading manufacturers of this equipment, set out like Culpin to explain how to train cattle to use the fence. "Remember", it states, "it is not the wire that holds them, but *their fear* of the sting... No animal should be turned out into the field until it has been trained". [my italics].[85] Animal subjectivity and agency enabled electric fencing to work and this was the focus of the advice provided to farmers through the period.

The MAFF cattle handling booklet reveals more 26
broadly the importance of human attentiveness and observation in relation to cattle behaviour, and the significance of this in designing appropriate and effective equipment and structures for their handling. If cattle subjectivity is ignored, the leaflet implies, this would result in a failure to manage the cattle at all. The advice is worth quoting at length:

> An understanding of cattle behaviour leads to a design which will reduce stress on both animals and handlers. Behaviour is affected by breed, temperament and the way in which the animals have been reared – cattle raised on the open hill will be more lively than those accustomed to close confinement and human contact.
> ... Isolation (except when sick or giving birth) causes agitation and should be avoided. ...
> Cattle ... are reluctant to enter darkened or shadowy areas and over-react to quite small things in their path, such as gullies or abrupt changes in floor material. ...
> When cattle are rounded up a critical distance must be maintained between handler and cattle; this varies between breeds and according to rearing. If this "flight zone" or "circle of safety" is entered, the animals may break away and run.
> .... There should be little need for sticks or electric goads. Goads cause less carcass bruising than sticks, but make cattle "jumpy" and apt to kick when approached from behind. Excessive noise and over-use of goads, sticks and dogs provoke alarm and unpredictable behaviour. Shouting, clashing of steel gates and the general

82 *Ibid.*, 195-196.
83 *Ibid.*, 197.
84 Jewell, *Farming*, 258-59 (cf. note 5).

85 Anon., *The Wolseley Electric Fencer*, (N.D.), Yorkshire Museum Of Farming, Murton Park Archival Source, L6067, Shelf 73, Acc. n° 2.693, 9.

> commotion of barking dogs and bellowing cattle, is stressful to both operators and animals – leading to fatigue, mistakes and accidents. If quietly handled the cattle will settle and move calmly forward in the required direction.[86]

27 This commentary ends in a sharp contrast between what is an almost dystopian scene of clashing human and animals noise vs an ideal scene of quiet cooperation. The section addresses potential negative outcomes in terms of productive outputs (bruised carcasses would be less saleable/of lower value than unbruised), but there is also a clear sense that the handlers of cattle **must** adhere to cattle norms and be responsive to them for human safety, not simply commercial interests. They are also specifically tasked within this discussion to avoid the use of electric goads, which are represented as more troubling in the long run than sticks as they will result in the cattle becoming more "jumpy" and inclined to kick. Though farm buildings and equipment designed to handle cattle were in place to generate production gains,[87] cattle responses and subjectivity had to be addressed, and human behaviour changed (including reduced use of electric goads) for electricity to be effective in uses far beyond electric fencing. This is a relatively late publication in the range of this article, but its advice reflects the integration of ideas from the mid-1960s, and continuity with the ADHB's current information in which electricity's value in farming rests on livestock co-operation and learning.

CONCLUSION

28 Livestock in the period after the second world war started to be hived off into specialist categories: animals for breeding, for rearing and for production; animals harnessed to production were increasingly divided between dairy and beef herds. In each case they were more and more the product of specialist breeding programmes focused on increasing output or meeting other production needs. In this sense, they were treated as a technology on the farm. Bred to adhere to specific production requirements, to meet policy and market demands within particular legal frameworks, they (and the foods they produced) were also apparently subject to a rapidly changing environment of new and adapted technologies.[88] As part of this, a wide range of ideas about the value and use of electricity in British farming were tested and tried out across their bodies – by farmers, livestock handlers, policy makers, advisors – but none would risk the accidental loss of a valuable animal, and all had to hope that the cow had learned her lesson near the charged fence. Meanwhile, passively, the products and by-products of cows (milk, and ammonia) helped to determine the ways in which electricity could be installed safely within the fabric of the buildings designed to house and manage them.

29 Throughout our period there were legal duties on the owner if their livestock crossed boundaries onto another's land.[89] The fact of culling in livestock farming as an attempt to address what some farmers' saw as poor temperament and resistance to increasing milking speeds as new electrically-powered technologies came in, conforms to this understanding of their position: it is another form of fencing. This supposed fact, that "modern livestock' seem to live "highly constrained lives", has even led to a questioning of their role as paradigmatic for the definition and concept of domestication, as many species become domesticated without being quite so

86 Anon, *ADAS Cattle Handling*, 2-3 (cf. note 1).

87 J. F. Fisher, "Large Dairy Herds in New Zeeland (2)", *Agriculture*, vol. 75, n° 9, Sept 1968, 431-434; P. D. Friend And J. P. Harrison, "Farm Buildings Association 1971 Tour Of France", *Agriculture*, vol. 79, 193-197.

88 Dominic Berry, "Plants Are Technologies" *in* Jon Agar and Jacob Ward (eds.), *Histories of Technology, the Environment, and Modern Britain* (London: UCL, 2018), 161-185; at the time, livestock were also represented rhetorically as technological components of the modern farm as "Animal Machines", by Ruth Harrison in her influential 1964 critique of nascent factory farming *Animal Machines*. Ruth Harrison, *Animal Machines: The New Factory Farming Industry* (London: Vincent Stuart, 1964).

89 These laws were disseminated to farmers through the specialist press, e.g., Anon, "Rights and Wrongs Of Stock Trespass", *Farmer And Stockbreeder*, 4th-5th Jan 1955, 57.

contained.[90] However, both observations suggest that for modern livestock there is no simple underlying constraint at work that is empty of their subjectivity, experience, and response. In the case of electric fencing, they were implicated fully in its development because livestock cross fences, and for electric fences to work livestock had to learn and conform.

30 If we look at livestock, we can see that the adoption of a novel energy and its practical, everyday use, regardless of progressivist promotion, therefore involves more than simple human decision-making, or human systems. Fudge argues her point using Early Modern English sources read through the lens of Temple Grandin's animal science research. The approach offers us the opportunity to reconsider, the "possibility of" non-human animals having a "truly constitutive role in making not only [their] own, but of a shared world". And, to explore new ways of "addressing and assessing the world" to better understand it, and the assumptions that we make about our own world.[91] That should include our energy decisions and the study of energy transitions. Applying that point to 20th C. agricultural sources tests its generalizability in terms of period, and subdiscipline. In the case of the equipment designed to cause an electric shock, then there was the need to consider both the impact of that physiologically, and animals' behavioural responses and actions following it. By the late 1960s, addressing livestock, not just human, interactions with electrical installations and equipment was built into research, legal and technological discourses. This has not so far been addressed in the agricultural histories charting the roll out of mains electricity, but throws additional light on that history.

Aligned to the overarching theme of this col- 31
lection, the history of the use of electricity in British livestock farming in the 1940s-1980s is best understood as multiple histories of successive adaptations to specific locales, social and economic scenarios where different meanings of electricity were articulated and adopted within different parts of the industry. By addressing this messiness through the case study of cattle management, and looking for the animal-human relationships within this, we can also see that the use of electricity in livestock farming was shaped not only by policy, legal requirements, expert advice or the economics of labour saving and efficiency – the watch words of the day – but additionally by the responses of subjective non-human animals. At the least discursively they may be read as subjects of study through which knowledge was generated, and human expertise formed; as components of the farm impacting materially through bodily products on its fabric and services they contributed to these multiple histories and the normalisation of electricity as an energy in the country. In Britain during the 1940s-80s energy decisions impacting on the managed spaces of the farm were caught up in the experiences of livestock. The energy decisions that moulded the spacialities of agricultural practice in this period, and therefore the landscape of livestock farming were shaped by livestock's bodies, knowledges and subjectivities. In sum, cattle *enabled* electricity to be used on the livestock farm.

90 Strother E. Roberts, "That's Not a Wolf: English Misconceptions And The Fate Of New England's Indigenous Dogs", *William And Mary Quarterly*, 3d Ser., vol. 79, n°3, 2022, 357-392, 361, 375-6.

91 Fudge, "Milking Other Men's Beasts", 23, 27, 28 (cf. note 10).

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