Pyrrhic Progress –

Antibiotics and Western Food Production (1949 – 2013)

Claas Kirchhelle

Thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in the Faculty of History at the University of Oxford

University College, University of Oxford
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Short Abstract

This dissertation addresses the history of antibiotic use in British and US food production between 1950 and 2013. Introduced to agriculture in the 1950s, antibiotics underpinned the 20th-century revolution in Western food production. However, from the late 1950s onwards, controversies over antibiotic resistance, residues and animal welfare began to tarnish antibiotics' image.

By mapping both the enthusiasm and the controversies surrounding antibiotic use, this dissertation shows how distinct civic epistemologies of risk influenced consumers', producers' and officials' attitudes towards antibiotics. These differing risk perceptions did not emerge by chance: in Britain, popular animal welfare concerns fused with new scenarios of antibiotic resistance and drove reform. Following 1969, Britain pioneered antibiotic resistance regulation by banning certain feed antibiotics. However, subsequent reforms were only partially implemented, and total antibiotic consumption failed to sink. Meanwhile, scandals and public pressure forced the American FDA to install the first comprehensive monitoring program for antibiotic residues. However, differing public priorities and industrial opposition meant that the FDA failed to convince Congress of resistance-inspired bans. The transatlantic regulatory gap has since widened: following the BSE crisis, the EU phased out growth-promoting antibiotic feeds in 2006. The US proclaimed only a voluntary and partial ban of antibiotic feeds in December 2013.

In the face of contemporary warnings about failing antibiotics, the dissertation shows how one group of substances acquired different meanings for different communities. It also reveals that the dilemma of antibiotic regulation is hardly new. Despite knowing about antibiotic allergies and resistance since the 1940s, no country has managed to solve the dilemma of preserving antibiotics' economic benefits whilst containing their medical risks. Historically, effective antibiotic regulation emerged only when differing perceptions of antibiotics were broken down either by sustained regulatory reform or large crises.

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Long Abstract

This dissertation examines the history of antibiotic use in British and US food production between 1950 and 2013. Introduced in the 1950s, antibiotics underpinned the 20th-century revolution in Western agriculture and enabled an unprecedented rise of meat production and consumption. However, from the late 1950s onwards, controversies over antibiotic resistance, residues in food and animal welfare began to tarnish antibiotics' image. With about half of the world's antibiotics currently used in agriculture and levels of bacterial resistance rising, this dissertation is not only a history of 20th-century agriculture and consumerism; it also provides an historical analysis of the unsolved dilemma of antibiotic regulation.

In order to highlight the distinct development of consumer, agricultural and regulatory perceptions of agricultural antibiotics, the dissertation analyses antibiotic discourses in British and US newspapers, consumer bestsellers, fashion and farming magazines and government archives. The dissertation is divided into four parts, each consisting of three chapters. Of these three chapters, one studies the development of consumer discourse concerning antibiotics, another agricultural discourse, and another the state discourse. The first two parts of the dissertation analyse the time between agricultural antibiotics' mass-advent in the early 1950s and the first wave of antibiotic regulation following 1965. The last two parts of the dissertation highlight the emergence and widening of a transatlantic

divide regarding the regulation, perception and use of agricultural antibiotics from the 1970s to the present.

The dissertation places a special emphasis on farmers' perception of antibiotics. As producers and consumers, farmers were exposed to conflicting assessments of antibiotics' relative risks and benefits. As laypersons, they also had the final decision on whether or not to purchase antibiotics and how to use them. In contrast to existing accounts' focus on physicians and veterinarians, the dissertation's consumer- and use-centred perspective reveals the interaction and influence of economic, political and cultural factors on the trajectory of post-war antibiotic use and its concomitant problems. The dissertation highlights that attitudes towards antibiotics differed both intra- and internationally. Directly affecting antibiotics' regulation, these differing risk perceptions did not emerge by chance.

In the US, a pre-existing cultural focus on toxic hazards allowed agricultural antibiotics to evade additional regulatory scrutiny following the discovery of the antibiotic growth effect in 1949. Because of their non-toxic and non-carcinogenic properties, few objections were raised to antibiotics' increasingly common presence in all aspects of US food production. On farms, antibiotics' tripartite function of combatting and preventing bacterial disease and promoting animals' growth turned them into keystones holding together increasingly intensive animal production systems. However, by the mid-1950s, a rising popular backlash against the invisible contamination of food, bodies and the environment also affected attitudes towards antibiotics, which were culturally associated with unrelated hazardous chemicals. As a result of a 1956 milk scandal and on-going residue

problems, the US pioneered a national monitoring program for antibiotic residues in milk in the early 1960s.

While US authorities were under significant public pressure to address residues in food, antibiotic-associated hazards like the selection for bacterial resistance and the neglect of animal welfare attracted less attention. Even after the publication of US reports on 'horizontal' resistance proliferation in 1966, the FDA continued to focus policies on limiting Americans' exposure to antibiotic residues by banning food preservatives and pioneering a further residue monitoring program for meat. Officials considered problems of bacterial resistance to be limited to antibiotics' immediate presence in feeds, animals and food.

In contrast to the residue-centred discourses of the US, British concerns about agricultural antibiotics were more diverse. Although many consumers were also concerned about residues, a media analysis shows that there were equally strong concerns about agricultural antibiotics' role in enabling bad animal welfare conditions and selecting for bacterial resistance. Initially, none of these concerns was strong enough to prevent Britain's mass-licensing of agricultural antibiotics via the Therapeutic Substances Act of 1953. However, from the late 1950s onwards, the fusion of formerly distinct welfare, residue and resistance concerns turned agricultural antibiotics into common denominators of popular protest. Resistance data provided by the British Public Health Laboratory Service (PHLS) played a significant role in directing public concerns towards antibiotic resistance and provoked official action. During the 1960s, three expert reviews addressed the agricultural selection for antibiotic resistance and established a regulatory distinction between therapeutic antibiotics valuable to human medicine and irrelevant nontherapeutic antibiotics. In 1969, the so-called Swann report referred

to this division when it pioneered resistance-inspired antibiotic regulations by calling for a ban of low-dosed antibiotic growth promoter feeds containing 'therapeutic' antibiotics.

After partial antibiotic bans were adopted by Britain and member states of the European Economic Community (EEC), antibiotics lost their status as a common denominator of agricultural reform demands. With public attention fading, bureaucratic rivalries and agro-industrial opposition resulted in a significant watering down of many of the Swann report's recommendations. It also emerged that the so-called Swann bans did not adequately address veterinary prescription practices and cross-resistance to different antibiotics. As a consequence, agricultural antibiotic use and resistance continued to rise. Lagging behind other nations in terms of residue monitoring, external pressures and scandals turned into the driving force of British antibiotic reform in the 1980s. With antibiotics re-emerging as a common denominator of concerns about agriculture in the wake of the 1996 BSE crisis, Britain re-joined reformers at the European level and supported a phase-out of antibiotic growth promoters in 1998 and 2003.

Similar resistance-based reforms did not occur in the US where public concerns about bacterial resistance remained subordinate to those involving the chemical contamination of food and bodies. Although European measures led to the creation of an FDA Task Force and the endorsement of growth promoter restrictions in 1972, significant industry pressure, lacklustre public support and the successful application of counter-science made subsequent ban attempts fail. In 1975, concerns about bacterial resistance prompted the FDA to launch a second circuitous attempt to ban antibiotic feeds via its National Advisory Food And Drug

Committee (NAFDC). However, the FDA failed to secure a full NAFDC endorsement of European-style bans. Although Commissioner Donald Kennedy decided to withdraw antibiotics without further expert reviews in April 1977, industrial opposition, an economic slow-down, diminishing public support for substance restrictions and the legal system's insistence on proof of harm led to the bans' renewed failure. In 1978, Congress imposed a moratorium on FDA action, which was prolonged by an NAS study in 1980. 1970s ban attempts finally ended in 1985, when the US Department of Human and Health Services rejected a petition by the National Resources Defence Council to ban antibiotic feeds because of imminent harm.

Meanwhile, both European and US farmers remained opposed to restrictions that might threaten antibiotic-dependent production systems during times of increasing economic insecurity. This did not mean that farmers were not concerned about the hazards of controversial agricultural technologies. Most farmers simply saw no alternative to the post-war logic of intensification, which relied on antibiotics and other chemicals to maintain profits and control disease pressure. Between the 1970s and 1990s, farmers' rejections of externally imposed substance restrictions resulted in increasing tensions between farmers and environmentalists and consumers. Fears amongst the latter group contributed substantially to the rise of the organic sector and its promises of antibiotic- and chemical-purity, which were not being guaranteed by the state. However, residue-free food would not protect consumers from an increasingly 'resistant environment'.

With American antibiotic reform stagnating, the regulatory divide between the US and Europe widened rapidly between the 1980s and 2000s. Under political

pressure as a result of EU bans on antibiotic growth promotion, the American FDA proclaimed only a voluntary and partial ban of antibiotic feeds in December 2013. The absence of statutory antibiotic restrictions in the US is partially due to the fundamental weakening of the FDA under the Reagan administration, the increasing prominence of cost-benefit risk assessments and divided national opinions toward agricultural risks. In the absence of a macro-crisis like BSE, agricultural antibiotics never emerged as a common denominator of agricultural protest and remain subjected to counter-science and controversies over the extent of their hazard to humans.

By tracing agricultural antibiotics' different fates on both sides of the Atlantic, this dissertation shows how one group of substances acquired different meanings for different communities and nations. Significantly, it also reveals that the dilemma of antibiotic regulation is hardly new. Despite knowing about antibiotic allergies and resistance since the 1950s, no country has managed to satisfactorily solve the agricultural dilemma of preserving antibiotics' economic benefits whilst containing their medical risks. Historically, effective antibiotic regulation emerged only when differing perceptions of antibiotics were broken down by either sustained regulatory reform or large crises. By analysing the foundations of fragmented antibiotic perceptions, this dissertation hopes to contribute to a unified understanding of agricultural antibiotics and their challenges.

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List of abbreviations

AAA	Agricultural Adjustment Act
AAFC	Antibiotics in Animal Feeds Subcommittee (NAFDC)
ACMSF	Advisory Committee on the Microbiological Safety of Food
AGP	Antibiotic Growth Promotion
AGPs	Antibiotic Growth Promoter Feeds
AHI	Animal Health Institute
APF	Animal Protein Factor
ARC	Agricultural Research Council
BEUC	The European Consumer Organisation
BF	British Farmer
BFS	British Farmer & Stockbreeder
BMJ	British Medical Journal
BPA	British Pig Association
BSE	Bovine Spongiform Encephalopathy
BuFo	Bureau of Food
BVA	British Veterinary Association
BVM	Bureau of Veterinary Medicine
CAP	Common Agricultural Policy
CAST	Council for Agricultural Science and Technology
CCC	Commodity Credit Cooperation
CIA	Critically Important Antibiotic
CLM	Countway Library of Medicine
CSM	Committee on Safety of Medicines
CVM	Center for Veterinary Medicine
DARC	DEFRA Antimicrobial Resistance Coordination
DEFRA	Department for Environment, Food and Rural Affairs
DESI	Drug Efficacy Study Implementation
DQA	Data Quality Act
DRB	Drug Research Board (NRC-NAS)
EARSS	European Antimicrobial Resistance Surveillance System

EC	European Committee
EEC	European Economic Community
EPA	Environmental Protection Agency
EPHLS	Emergency Public Health Laboratory Service
EU	European Union
FAIR	Federal Agriculture Improvement and Reform Act
FBNews	Farm Bureau News
FEDESA	European Federation of Animal Health
FedReg	Federal Register
FDA	Food and Drug Administration
FDAMA	Food and Drug Administration Modernization Act
FDC	Federal Food, Drug, and Cosmetic Act
FOR	Forum on Regulation
FQPA	Food Quality Protection Act
FSA	Food Standards Agency
FW	Farmers Weekly
GATT	General Agreement on Tariffs and Trades
GFI	Guidance For Industry (FDA)
GRAS	Generally Recognized as Safe
HEW	Department of Health Education and Welfare
HHS	Department of Human and Health Services
HPLC	High-Performance Liquid Chromatography
IoM	Institute of Medicine
ITFAR	Interagency Task Force on Antimicrobial Resistance
JSC	Joint Sub-Committee on Antimicrobial Substances
LIN	London Illustrated News
MAFF	Ministry of Agricultural Fisheries and Forestry
MH	Ministry of Health
MLC	Meat and Livestock Commission
MMB	Milk Marketing Board
MoF	Ministry of Food
MRC	Medical Research Council
NAAS	National Agricultural Advisory Service

NAFDC	National Advisory Food and Drug Committee
NARA	National Archives and Records Administration, College Park
NARMS	National Antimicrobial Resistance
NAS	National Academy of Sciences
NCA	National Cattlemen's Association
NDA	New Drug Application
NEJM	New England Journal of Medicine
NFU	National Farmers Union (UK)
NOAH	National Organisation for Animal Health
NOP	National Organic Program
NPPC	National Pork Producers Council
NR	National Review
NRC	National Research Council (NAS)
NRDC	National Resources Defence Council
NSS	National Sampling Scheme
NYT	New York Times
OMB	Office of Management and Budget
OTA	Office of Technology Assessment
OTC	Over-The-Counter
PAMTA	Preservation of Antibiotics for Medical Treatment Act
PF	Progressive Farmer
PHLS	Public Health Laboratory Service
PHIA	Public Health Improvement Act
POM	Prescription Only Medication
PPM	Parts Per Million
PrFa	Prairie Farmer
IPrFa	Indiana Prairie Farmer
PSAC	President's Science Advisory Committee
RCVS	Royal College of Veterinary Surgeons
RSPCA	Royal Society for the Prevention of Cruelty to Animals
RUMA	Responsible Use of Medicines in Agriculture Alliance
SAP	Scientific Advisory Panel (MAFF)
SCAN	Scientific Committee for Animal Nutrition

SciAm	Scientific American
SGFS	Steering Group on Food Surveillance
SMAC	Standing Medical Advisory Committee
SMZ	Sulfamethazine
SVS	State Veterinary Service
TNA	The British National Archives
TSA	Therapeutic Substances Act
TTIP	Transatlantic Trade and Investment Partnership
UN	United Nations
vCJD	variant Creutzfeldt-Jakob Disease
VETU	Veterinarians' Union
VMD	Veterinary Medicines Directorate
VMR	Veterinary Medicines Regulations
VPC	Veterinary Products Committee
VRC	Veterinary Residues Committee
WAEC	War Agricultural Executive Committees
WF	Wallaces Farmer
WHO	World Health Organisation
WP	Washington Post
YBL	Yale Beinecke Library

Hos ego in pugna vici victusque sum ab isdem.

(Pyrrhus, Paulus Orosius Historiarum Adversum Paganos Liber IV, 1, 14.)

Introduction

The last 70 years have seen an unprecedented shift in the way the West produces its food. Transported from the 1930s to the 21st century, a time travelling farmer would have great difficulty recognizing the landscape around him. Field sizes have increased, machines have mostly substituted manual labour, and a declining number of farms are run by nuclear families enjoying a high standard of living. However, the most dramatic change our time traveller will observe is that animals have virtually disappeared from common sight. Instead of the dirty farmyards and little paddocks of the past, the densely packed herds of the present have mostly vanished into vast, gleaming, air-conditioned buildings where feeding is done at the push of a button and manure is removed via ingenious waste systems. For most consumers, food production has become completely abstract. Moreover, animals themselves have changed. Perhaps familiar with Aldous Huxley's fictional Internal and External Secretion Trust, the time traveller will note that animals are relatively standardised and have been bred to fit into the factory-like production systems of the present.[1] And all this had been achieved within the span of a few decades. It is indeed a Brave New World the time traveller is witnessing.

However, our expert time traveller will soon wonder why these confined animals are so productive. After all, previous generations had also attempted to increase herd densities in the name of productivity but infectious disease

[1] Aldous Huxley, *Brave New World* (London Vintage, 2007 [1932]), p. 62.

continuously thwarted overly ambitious attempts. Our time traveller will find the answer to his question both in animals' water and feed and in a nearby refrigerator, where syringes are stored for the convenience of husbandrymen. Contained in all these agricultural implements are antibiotics. Their effects are profound. Were our time traveller able to analyse the microbial ecology in and on animals, farms, food and the surrounding countryside, he would find that bacterial diseases of the past have been checked and transformed by the liberal use of antibiotics. In the Brave New World of the present, the macrobiological revolution of food production has been achieved in no small part by a mass-modification of the microbial ecology.

The significant role that antibiotics play in modern food production is often underappreciated. In schools, children learn the story of Alexander Fleming's 'accidental' discovery of penicillin, museums feature exhibitions on 'yellow magic' and patients routinely ask their doctors to prescribe antibiotics for various ailments. So common and important have antibiotics become in human medicine that recent books even talk about an "Antibiotic Era".[2] However, with some estimates claiming that over fifty percent of antibiotic production is not destined for human use,[3] it is important not to forget that antibiotics constitute one of the keystones holding together modern food production.

After 1945, the so-called second agricultural revolution brought dramatic changes to Western livestock production: herd sizes grew rapidly and all-year-

[2] Scott H. Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics* (Baltimore: Johns Hopkins Press, 2015).
[3] For an overview of the many estimates of total antibiotic use see Timothy F. Landers et al., 'A Review of Antibiotic Use in Food Animals: Perspective, Policy, and Potential', *Public Health Reports,* 127/1 (2012), p. 6.

round production systems meant that animals disappeared into closed housing systems. However, the new intensive indoor systems faced significant obstacles in the form of infectious disease. In this situation, antibiotics' tripartite function of combating bacterial infections, preventing new infections and increasing animals' feed efficiency turned them into 'panaceas' for intensive livestock production. Similar to human medicine, farmers and veterinarians soon became dependent on routine antibiotic use to sustain their herds' health and productivity.

Unfortunately, agriculture's antimicrobial blessing came at a price: antibiotics could mask bad animal welfare conditions, and residues in food and the environment could create or trigger allergies to antibiotics. Moreover, in an almost pyrrhic fashion, every use of antibiotics to achieve immediate production gains could select for bacterial resistance and impair future antibiotic efficacy.[4]

Western consumers, farmers and officials faced a dilemma: whereas residue and welfare problems could be contained by allowing drugs to clear animals' systems and by upgrading housing, the problem of bacterial resistance would be solved only by banning or restricting agricultural antibiotic use. Unsurprisingly, opinions on which antibiotic benefits to keep and at what cost varied widely.

Following initial euphoria, some consumers and media commentators began to regard agricultural antibiotics as dangerous and unnatural. Antibiotics' presence on farms and in foods seemed to symbolize worrying developments in an increasingly abstract, industrialised and 'chemicalised' agricultural world. As

[4] Tony Lawrence, Vernon Fowler, and Jan Novakofski, *Growth of Farm Animals* (3rd edition edn.; Wallingford and Cambridge (MA): CABI, 2012), pp. 325-27.

in the case of the dubious pigs salesman *Antibiotix* in *Asterix and the Cauldron*,[5] consumers often blamed farmers for excessive antibiotic use in food production while continuing to demand cheap meat.

In contrast to such allegations, farmers themselves frequently had an ambivalent relationship with antibiotics. As producers and consumers of food, farmers were forced to weigh societal and personal health concerns against economic and socio-political pressures favouring antibiotic-dependent production systems. After their earlier investments, a majority of farmers found the scales tipped in favour of continued antibiotic use.

The growing divide between consumer and agricultural demands left regulators facing a difficult decision. Whose fears and concerns should they prioritise? Whose expertise should they listen to? Whereas agro-industrial interests favoured a compromise solution allowing for continued antibiotic use, concerns about bacterial resistance made consumer and environmental advocates call for substantial antibiotic restrictions. In the course of the 20th century, regulators' situation was further complicated by the increasingly globalised nature of agricultural commodity flows, bacterial ecologies and antibiotic resistance. Although America's new system of intensive agriculture engendered an unprecedented standardisation of Western agriculture, pre-existing national regulatory and consumer cultures fragmented international responses to intensive agriculture's problems and antibiotics' pyrrhic dilemma.

Using agricultural antibiotics as a *leitmotiv*, this dissertation links the distinct stories of consumers, farmers and regulators into a unified account of

[5] R. Goscinny and A. Uderzo, *Asterix and the Cauldron*, trans. Anthea Bell and Derek Hockridge (Orion Children's Books: London, 2005 [1969]).

20th and 21st century food production, consumer cultures and risk regulation. In order to do so, it analyses the history of agricultural antibiotic use and regulation in the United States of America and the United Kingdom. Because of the contemporary challenges posed by bacterial resistance, this dissertation is also an attempt to answer why both Americans and Europeans have so far failed to establish a coordinated and effective policy regarding agricultural antibiotic use. In accordance with the 2014 *History Manifesto*,[6] the dissertation's analysis of over half-a-century of non-human antibiotic use is explicitly meant to provide a helpful tool for contemporary politics.

A central concept informing the dissertation's analysis is the notion that there are few more powerful motivators for human action than a shared sense of risk and health fears. If Roy Porter's dictum of "health" as "the backbone of social history"[7] is true, then health fears were the muscles driving some of the biggest changes in modern agriculture, consumption and governance. It is therefore necessary to analyse the different processes by which actors framed antibiotics as health risks.[8] However, individual definitions of risk would be insufficient to explain the reshaping of larger attitudes towards industrial agriculture. Following the late Ulrich Beck, notions of risk are powerful social binding agents when shared by larger groups. Moreover, it is unimportant whether risks turn

[6] Jo Guldi and David Armitage, *The History Manifesto* (Cambridge: Cambridge University Press, 2014).
[7] Roy Porter, 'Doing Medical History from Below', *Theory and Society,* 14/2 (1985), p. 192.
[8] For the process of making fear manageable by narrowing it to definable areas see Georg Krücken, *Risikotransformation. Die Politische Regulierung Technisch-Ökologischer Gefahren in Der Risikogesellschaft* (Opladen/ Wiesbaden: Westdeutscher Verlag, 1997).

out to be exaggerated or false. The virtual presence of risk suffices to exert power over groups and societies.[9]

Potent fears of invisible contamination made agricultural antibiotics appear risky in certain sectors of society. In turn, shared definitions of antimicrobial risk became essential to critical groups' identities and allowed them to distinguish themselves from other groups via the conspicuous consumption of food from organic sources. In the case of residues and animal welfare, societies had to ask themselves whether 'pure' and ethically sound food was a right or a privilege to be purchased from specialist suppliers.[10]

However, as already mentioned, the outcomes of such risk evaluations could vary strongly. On both sides of the Atlantic, pre-existing risk cultures shaped antibiotic regulation in different ways and constituted what Sheila Jasanoff has termed distinct "civic epistemologies"[11]. However, these epistemologies were not unchangeable. During the past 70 years, hegemonic power struggles over definitions of risk and safety have played an important role in agricultural antibiotics' national and transnational history.[12] Operating on both sides of the Atlantic, pharmaceutical corporations and agricultural lobbyists were well aware of the need to frame public concepts of risk and repeatedly

[9] Ulrich Beck, *Risikogesellschaft. Auf Dem Weg in Eine Andere Moderne* (Frankfurt a. M.: Suhrkamp, 1986), pp. 29-31 and 35, Ulrich Beck, *Weltrisikogesellschaft. Auf Der Suche Nach Der Verlorenen Sicherheit* (Frankfurt am Main: Suhrkamp, 2007), pp. 22-23 and 36. Other authors, who have dealt with the power of risk and risk distribution are Mary Douglas and Aaron Wilavsky, *Risk and Culture. An Essay on the Selection of Technical and Environmental Dangers* (Berkeley, Los Angeles and London: University of California Press, 1982), Stephen Hilgartner, 'Overflow and Containment in the Aftermath of Disaster', *Social Studies of Science,* 37 (2007).
[10] Beck, *Risikogesellschaft. Auf Dem Weg in Eine Andere Moderne*, pp. 14; 17-19; 29-31 & 35.
[11] Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe & the United States.* (2 edn.; Princeton and Oxford: Princeton University Press, 2007), p. 8.
[12] The term hegemony is based on Antonio Gramsci's concept of cultural hegemony see Alex Demirovic, 'Politische Gesellschaft – Zivile Gesellschaft. Zur Theorie Des Integralen Staates Bei Antonio Gramsci', in Sonja Buckel and Andreas Fischer-Lescano (eds.), *Hegemonie Gepanzert Mit Zwang. Zivilgesellschaft Und Politik Im Staatsverständnis Antonio Gramscis* (Baden-Baden, 2007).

acted as "merchants of doubt"[13] by financing counter-expertise and *othering* opponents. Some organic farmers also framed conventional competitors as irresponsible and dangerous in order to boost trust in their own goods. Ultimately, all sides employed strategies of agnogenesis[14] – the conscious creation of ignorance and doubt – to discredit opponents' expertise and integrity in public discourse, courts and parliaments.

However, when discussing the role of risk cultures and agnotology, it is important to remember that most farmers and consumers were by no means passive recipients of external expert discourses. Instead, they repeatedly asserted independent grassroots agency. Whereas consumers chose to boycott products they deemed risky, farmers always had the final say about whether to purchase and use antibiotics or not. In the case of farmers, to write a "use-centred" [15] history of agricultural antibiotics is to write a history of the *in situ* appropriation of pharmaceutical high-technology by lay-users far away from sites of pharmaceutical power, university expertise or governmental control.

In order to provide a comprehensive history of agricultural antibiotic use in the UK and US whilst leaving the functional differentiation between consumer, agricultural and official discourses intact, the dissertation is divided into four parts. Each part is composed of three chapters analysing the development of public, agricultural and official relations with agricultural antibiotics. The

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[13] Naomi Oreskes and Erik M. Conway, *Merchants of Doubt. How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (New York et al.: Bloomsbury Press, 2010).

[14] Robert N. Proctor, 'Agnotology. A Missing Term to Describe the Cultural Production of Ignorance (and Its Study)', in Robert N. Proctor and Linda Schiebinger (eds.), *Agnotology. The Making and Unmaking of Ignorance* (Stanford: Stanford University Press, 2008), p. 27.; the use of scandal was another popular way to discredit opponents and resembles what Ari Adut describes for politics and art in Ari Adut, *On Scandal. Moral Disturbances in Society, Politics, and Art* (Cambridge: Cambridge University Press, 2008).

[15] David Edgerton, *The Shock of the Old. Technology and Global History since 1900* (London: Profile Books, 2006), p. xii.

dissertation's structure is inspired by Bruno Latour's network theory[16] and Niklas Luhman's concept of society as a unified macro system integrating multitudes of smaller autonomous social systems.[17] As a result, readers can either read the dissertation as a comprehensive history of agricultural antibiotics or eclectically focus on individual communities' antibiotic relations.

The first two parts of the dissertation cover the time from antibiotics' mass-introduction to agriculture in the early 1950s to 1969 when the UK pioneered a new kind of resistance-based antibiotic regulation with the so-called Swann Report. Part One focuses on the history of US agricultural antibiotic use, while Part Two covers the UK. The following two parts analyse the growing divergence between US and British antibiotic regulation after 1969. Whereas the EU ultimately phased out certain so-called subtherapeutic forms of agricultural antibiotic use in 2006, the American Food and Drug Administration (FDA) is still struggling to implement antibiotic restrictions in 2015. Part Three traces developments in Britain and Europe from Swann onwards and Part Four analyses the complications of US antibiotic regulation.

In order to provide the desired macro and micro narratives, the dissertation utilizes a wide range of sources between 1945 and 2015. Sources include governmental documents on antibiotic policy; national newspapers and magazines; scientific publications in the fields of agriculture, biology, veterinary and human medicine; farming magazines and consumer publications.

Although newspapers are a notoriously difficult group of sources due to their overlapping descriptive and normative functions, they are an invaluable

[16] Bruno Latour, *Science in Action* (Cambridge (Ma.): Harvard University Press, 1987), Bruno Latour, *Reassembling the Social. An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2007), pp. 249-61.
[17] Niklas Luhmann, *Die Gesellschaft Der Gesellschaft* (Frankfurt a.M. : Suhrkamp, 1997), p. 78.

trove of agricultural risk and societal mobilisation discourses. The analysed newspapers cover a wide range of political spectra in the US and Britain. Among the British newspapers analysed are *The Times*, *Guardian*, *Observer*, *Daily Telegraph, London Illustrated News* and *Daily Mirror*. In the US, the analysis comprises the *New York Times, Time Magazine*, *Newsweek, The Washington Post, Scientific American*, *The National Review* and *Vogue.*

Due to this study's emphasis on lay-actors' agency, niche publications for specific milieus are of particular interest. Despite their reputation for being somewhat dry, farmers' magazines are fascinating sources. Frank Uekötter's work on German agricultural journalism has shown that farm magazines provide a central forum for establishing a common agricultural identity.[18] Farm magazines are also the place where negotiations about the adoption of technologies like antibiotics take place between farmers and the agricultural and industrial expert system through articles, advertisements and letters to the editor. Magazines likewise reveal the changing status of organic agriculture within the farming community. The British publications studied are *Farmers' Weekly* and *British Farmer*. In the US, the dissertation's media analysis encompasses *Progressive Farmer*, *Feedstuffs*, *Wallaces Farmer*, *Prairie Farmer, Indiana Prairie Farmer*, *Farm Journal* and *Farm Bureau News*.

Lifestyle guides and fashion magazines also provide invaluable glimpses into the transient world of Western food consumption and value systems. In the late 1960s, the advent of pro-organic restaurant recommendations in

[18] Frank Uekötter, 'Landwirtschaftliche Zeitschriften Als Medien Der Verwissenschaftlichung Der Landwirtschaft Und Der Vergesellschaftung Der Agrarwissenschaften', in Sigrid Stockel, Wiebke Lisner, and Gerlind Rüve (eds.), *Das Medium Wissenschaftszeitschrift Seit Dem 19. Jahrhundert. Verwissenschaftlichung Der Gesellschaft – Vergesellschaftung Der Wissenschaft* (Stuttgart: Franz Steiner Verlag, 2009).

publications like *Vogue* indicate shifts in the fashionableness of food choices and growing fears of antibiotic residues and bacterial resistance in the upper and middle classes. Changing attitudes towards antibiotics and intensive agriculture also become apparent in bestsellers and nutritional campaigns by journalists, intellectuals and activists. Ruth Harrison, Rachel Carson, Ralph Nader, Jeremy Rifkin, Orville Schell, Michael Pollan and Jonathan Safran Foer[19] are just a few of the bestselling authors criticising conventional agriculture since the 1950s.

Given agricultural antibiotics' prominence in the history of Western food production, it is surprising that few historians have chosen to cover this subject. Many general histories of agriculture tend to treat antibiotics *en passant* and instead focus on other chemicals like fertilisers, insecticides and pesticides.[20] Meanwhile, there are numerous monographs devoted to other controversial 20th century substances like DDT, DES, BPA and Agent Orange.[21] Historians of food

[19] Ruth Harrison, *Animal Machines* (London: Vincent Stuart Ltd, 1964), Rachel Carson, *Silent Spring* (New York: First Mariner Books, 2002), Jeremy Rifkin, *Beyond Beef. The Rise and Fall of the Cattle Culture* (London and New York: Penguin Books, 1992), Orville Schell, *Modern Meat. Antibiotics, Hormones and the Pharmaceutical Farm* (New York Random House, 1985), Michael Pollan, *The Omnivore's Dilemma. A Natural History of Four Meals* (London and New York: Penguin Books, 2006), Jonathan Safran Foer, *Eating Animals* (London and New York: Penguin Books, 2010).

[20] B. A. Holderness, *British Agriculture since 1945* (Manchester: Manchester University Press, 1985), John Martin, *The Development of Modern Agriculture. British Farming since 1931* (London et al. : MacMillan & St. Martin's Press, 2000), Douglas R. Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century* (Chicago: Ivan R. Dee, 2002), Deborah Fitzgerald, *Every Farm a Factory. The Industrial Ideal in American Agriculture* (New Haven and London: Yale University Press, 2003), Alan L. Olmstead and Paul W. Rhode, *Creating Abundance. Biological Innovation and American Agricultural Development* (Cambridge et al.: Cambridge University Press, 2008), Frank Uekötter, *Die Wahrheit Ist Auf Dem Feld. Eine Wissensgeschichte Der Deutschen Landwirtschaft* (Göttingen: Vandenhoeck & Ruprecht, 2010), pp. 340-44, Ernst Langthaler, 'Landwirtschaft Vor Und in Der Globalisierung', in Ernst Langthaler and Reinhart Siedler (eds.), *Globalgeschichte 1800-2000* (Wien et al. : Böhlau Verlag, 2010).

[21] Christian Simon, *Ddt. Kulturgeschichte Einer Chemischen Verbindung* (Basel: Christian Merian Verlag, 1999), Nicolas Rasmussen, 'Plant Hormones in War and Peace: Science, Industry, and Government in the Development of Herbicides in 1940s America', *Isis,* 92/2 (June) (2001), Nancy Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des* (New Haven and London: Yale University Press, 2010), Sarah A. Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals* (Berkeley at al. : University of California Press, 2013), Soraya Boudia and Nathalie Jas (eds.), *Powerless Science? Science and Politics in a Toxic World* (New York and Oxford: Berghahn, 2014).

have also given the subject of agricultural antibiotics a wide berth and instead focus on changes in 20th century diets and nutritional standards.[22] Similarly, environmental historians have not linked histories of modern chemical use, food production and consumption. Although transnational flows of labour, chemicals and commodities have been studied in the context of colonial and postcolonial history,[23] there are no comparable studies of Western agriculture and food consumption following 1950. When it comes to the history of medicine, there are numerous works dealing with antibiotics in the context of human medicine, regulation and the pharmaceutical industry, but hardly any addressing non-human antibiotic use. [24]

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[22] Jean-Louis Flandrin and Hans Jürgen Teuteberg, 'The Transformation of the European Diet', in Jean-Louis Flandrin and Massimo Montanari (eds.), *Food. A Culinary History from Antiquity to the Present* (2 edn., European Perspectives: A Series in Social Thought and Cultural Criticism; New York and Chichester: Columbia University Press, 1999), Claude Fischler, 'The 'Mcdonaldization' of Culture', ibid, Harvey Levenstein, 'The Perils of Abundance. Food, Health, and Morality in American History', in Jean-Louis Flandrin and Massimo Montanari (eds.), *Food. A Culinary History from Antiquity to the Present* (2 edn., European Perspectives: A Series in Social Thought and Cultural Criticism; New York and Chichester: Columbia University Press, 1999), Sidney W. Mintz, 'Food and Eating: Some Persisting Questions', in Warren Belasco and Philip Scranton (eds.), *Food Nations. Selling Taste in Consumer Societies* (London and New York: Routledge, 2002), Hans J. Teuteberg, 'The Birth of the Modern Consumer Age. Food Innovations from 1800', in Paul Freedman (ed.), *The History of Taste* (Berkeley and Los Angeles: University of California Press, 2007), Peter Scholliers, 'Novelty and Tradition. The New Landscape for Gastronomy', in Paul Freedman (ed.), *Food. The History of Taste* (Berkeley and Los Angeles: University of California Press, 2007), Warren J. Belasco, *Appetite for Change. How the Counterculture Took on the Food Industry* (2nd edn.; Ithaca and New York: Cornell University Press 2007).

[23] Judith A. Carney, *Black Rice. The African Origins of Rice Cultivation in the Americas* (Cambridge M.A. and London: Harvard University Press, 2001), John Soluri, *Banana Cultures: Agriculture, Consumption and Environmental Change in Honduras and the United States* (Austin: University of Texas Press, 2005).

[24] Allan M. Brandt, *No Magic Bullet. A Social History of Venereal Disease in the United States since 1880* (New York and Oxford: Oxford University Press, 1985), Peter Neushul, 'Science, Government, and the Mass Production of Penicillin', *Journal of the History of Medicine and Allied Sciences,* 48 (1993), Rock Brynner and Trent Stephens, *Dark Remedy. The Impact of Thalidomide and Its Revival as a Vital Medicine* (New York: Perseus Books, 2001), Kathryn Hillier, 'Babies and Bacteria: Phage Typing Bacteriologists, and the Birth of Infection Control', *Bulletin of the History of Medicine,* 80/4 (2006), Angela N. H. Creager, 'Adaptation or Selection? Old Issues and New Stakes in the Postwar Debates over Bacterial Drug Resistance', *Studies in History and Philosophy of Biology and Biomedical Sciences,* 38 (2007), Scott H. Podolsky, 'Antibiotics and the Social History of the Controlled Clinical Trial. 1950-1970', *Journal of the History of Medicine and Allied Sciences,* 65/3 (2010), Christoph Gradmann, 'Sensitive Matters: The World Health Organisation and Antibiotic Resistance Testing, 1945-1975', *Social History of Medicine,* 26/3 (2013), Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics*, Christoph

However, over the past decade, the historiographic gap regarding agricultural antibiotics has gradually diminished: in 2004, the late Mark Finlay published a pioneering essay on *Hogs, Antibiotics and the Industrial Environments of Post War Agriculture*.[25] Published in the same volume, Roger Horowitz's *Making The Chicken of Tomorrow*[26] traced the history of the US poultry sectors' antibiotic-dependent development. In 2009, Robert Bud's seminal *Penicillin: Triumph and Tragedy*[27] devoted an entire chapter to agricultural antibiotics and linked their history to a general history of antibiotic use and its challenges. In the same year, J.L. Anderson's *Industrializing the Corn Belt*[28] also contained a chapter studying agricultural uses of antibiotics and hormones in the US between 1942 and 1972. In 2010 and 2015 respectively, Kendra Smith Howard published an essay and a monograph on the history of US milk production and purity up to the 1970s.[29] Both her essay and book dealt extensively with issues relating to antibiotic use and problems in dairy farming and also focussed on farmers' perception of technological risk. In 2011, Andrew Godley and T.A.B. Corley published a useful overview of the history of the veterinary medicines industry

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Gradmann, 'Re-Inventing Infectious Disease: Antibiotic Resistance and Drug Development at the Bayer Company 1945-1980', *Medical History,* 60/2 (2016 (in print)).

[25] Mark R. Finlay, 'Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture', in Philip Scranton and Susan R. Schrepfer (eds.), *Industrializing Organisms. Introducing Evolutionary History* (Hagley Perspectives on Business and Culture; London: Routledge, 2004).; Finlay's later essays on the subject remain unpublished seeMark R. Finlay, ''Consumerist Terrorists': Battles over Agricultural Antibiotics in the United States and Western Europe', in Christoph Gradmann and Flurin Condrau (eds.), (Upcoming).

[26] Roger Horowitz, 'Making the Chicken of Tomorrow. Reworking Poultry as Commodities and as Creatures, 1945-1990', in Susan R. Schrepfer and Scranton Philip (eds.), *Industrializing Organisms. Introducing Evolutionary History* (New York et al., 2004).; also see Roger Horowitz, *Putting Meat on the American Table. Taste, Technology, Transformation* (Baltimore, 2006).

[27] Robert Bud, *Penicillin: Triumph and Tragedy* (Oxford: Oxford University Press, 2009).

[28] J. L. Anderson, *Industrializing the Corn Belt. Agriculture, Technology and Environment, 1942-1972* (Dekalb: Northern Illinois University Press, 2009).

[29] Kendra Smith-Howard, 'Antibiotics and Agricultural Change: Purifying Milk and Protecting Health in the Postwar Era', *Agricultural History Society,* 84/3 (2010), Kendra Smith-Howard, *Pure and Modern Milk. An Environmental History since 1900* (Oxford: Oxford University Press, 2013); see also Kendra Smith-Howard, *Perfecting Nature's Food: A Cultural and Environmental History of Milk in the United States, 1900-1970* (Wisconsin: University of Wisconsin-Madison (Dissertation), 2007).

in Britain.[30] In 2012, Ulrike Thoms published an expert-centred overview of agricultural antibiotics' history in West-Germany.[31] Agricultural antibiotics and disease problems in modern agriculture have also featured in Abigail Wood's work on animal health regimes and the relations between veterinarians, farmers and governmental officials in 20th century Britain.[32] In 2015, Hannah Landecker published an intriguing essay on the long-term consequences of antibiotics' mass-introduction to the environment for human and non-human history.[33] In the same year, Anne Hardy's *Salmonella Infections, Networks of Knowledge, and Public Health in Britain 1880-1975*[34] analysed the development of foodborne infections and British scientific and official responses. Currently, Delphine Berdah is working on a comparative history of agricultural antibiotics in France and the UK between the 1940s and 1970s.

While all of the above-mentioned studies have played an important role in the development of this dissertation, none address the history of the use, perception and regulation of non-human antibiotic use in a transatlantic context. In the face of current WHO warnings about failing antibiotics, my dissertation aims to go a step further and provide an integrated account of differing risk

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[30] T. A. B Corley and Andrew Godley, 'The Veterinary Medicines Industry in Britain, 1900-2000', *Economic History Review,* 64 (2011).
[31] Ulrike Thoms, 'Between Promise and Threat. Antibiotics in Foods in West Germany 1950-1980', *NTM,* 20 (2012); see also Ulrike Thoms, 'Antibiotics in Foods: Precarious Matters under Discussion', in Viola Balz, Alexander Von Schwerin, and Bettina Wahrig (eds.), *Precarious Matters/ Prekäre Stoffe. The History of Dangerous and Endangered Substances in the 19th and 20th Centuries* (Berlin: Max-Planck-Institut für Wissenschaftsgeschichte (Preprint), 2008).
[32] Abigail Woods, 'Why Slaughter? The Cultural Dimensions of Britain's Foot and Mouth Disease Control Policy, 1892-2001', *Journal of Agricultural and Environmental Ethics,* 17 (2004), Abigail Woods, 'The Farm as Clinic: Veterinary Expertise and the Transformation of Dairy Farming, 1930–1950', *Studies in History and Philosophy of Biological and Biomedical Sciences,* 38 (2007), Abigail Woods, ',Partnership' in Action: Contagious Abortion and the Governance of Livestock Disease in Britain, 1885-1921', *Minerva,* 47 (2009), Abigail Woods, 'Is Prevention Better Than Cure? The Rise and Fall of Veterinary Preventive Medicine, C. 1950-1980', *Social History of Medicine,* 26/1 (2012).
[33] Hannah Landecker, 'Antibiotic Resistance and the Biology of History', *Body & Society* (2015).
[34] Anne Hardy, *Salmonella Infections, Networks of Knowledge, and Public Health in Britain 1880-1975* (Oxford: Oxford University Press, 2015).

perceptions and antibiotic regulations. Only by understanding antibiotics' different meanings for different groups will regulators on both sides of the Atlantic be able to formulate and institute a coherent policy to maintain antibiotics' efficacy.

Part One – USA: From industrialised agriculture to manufactured hazards (1949-1966)

Chapter One: Picking One's Poisons – Antibiotics and the Public

Although the use of antibacterial remedies is probably as old as humanity itself, the first half of the 20th century saw the revolutionary introduction of a whole series of effective, industrially produced antimicrobial drugs. In the early 1900s, German scientist Paul Ehrlich triggered a large-scale hunt for so-called magic bullets. During a time of rapidly growing knowledge about bacterial taxonomy and diseases, scientists subsequently began searching for substances that only targeted *prokaryotic* bacteria cells while leaving *eukaryotic* animal cells unharmed. By the 1930s, the discovery and mass-production of chemically synthesised sulpha drugs like Prontosil seemingly answered Ehrlich's challenge. However, toxicity problems and the rapid development of bacterial resistance soon triggered a second round of research.[1]

Researchers now grew interested in the antibacterial substances produced by certain microorganisms, which Rutgers University microbiologist Selman Waksman termed 'anti-biotic' ('against-life') in 1941.[2] Of this second generation of antibacterials, penicillin is undoubtedly the most iconic. Isolated and refined from the fungus *Pencillium notatum* in Oxford and subsequently purified and mass-produced in the US, penicillin cured many sulphonamide-

[1] Bud, *Penicillin: Triumph and Tragedy*, pp. 13-17, Gradmann, 'Sensitive Matters: The World Health Organisation and Antibiotic Resistance Testing, 1945-1975', p. 558.
[2] 'History of the Word 'Antibiotic' / Discussion between Dr. S.A. Waksman and Dr. J.E. Flynn on 19 January 1962', *Journal of the History of Medicine and Allied Sciences,* XXVIII/3 (1973).

resistant bacterial infections.[3] The vast resources deployed by the Allies to turn penicillin into a mass-medicine also made it exemplary of a new kind of planned 'Big Science'.[4]

With production of unpatented penicillin expanding rapidly after 1945, prices collapsed and pharmaceutical companies began to search for new, patentable antibiotics. They did not have to look for long: employing mass-screening techniques, companies experienced a veritable antibiotic gold rush. In 1943, a team surrounding Selman Waksman had already discovered streptomycin. In 1946, Parke-Davis isolated the antibiotic chloramphenicol. Two years later, the Lederle Laboratories branch of American Cyanamid patented Aureomycin (chlortetracycline). In 1949, Pfizer isolated Terramycin (oxytetracycline) and Selman Waksman discovered neomycin. Between 1952 and 1953, Pfizer and Lederle raced to patent tetracycline.[5] Meanwhile, Dorothy Hodgkin's decryption of penicillin's molecular structure indicated that a bountiful age of synthetic antibiotics might be forthcoming.[6]

1950s physicians were thus able to choose from a wide range of potent antibacterials: inhibiting bacterial cell wall synthesis by binding important enzymes, so-called β-lactam antibiotics like penicillin G and V were mostly effective against single-walled gram-positive bacteria. By contrast, so-called broad-spectrum antibiotics like the tetracyclines prevent the docking of tRNA at the ribosome and prevent protein synthesis in both gram-positive and double-

[3] Bud, *Penicillin: Triumph and Tragedy*, pp. 28-44, Neushul, 'Science, Government, and the Mass Production of Penicillin', Eric Lax, *The Mould in Dr Florey's Coat. The Remarkable True Story of the Penicillin Miracle* (London: Abacus, 2011).
[4] For other examples of 'Big Science' see Peter Galison and Bruce Hevly, *Big Science. The Growth of Large-Scale Research* (Stanford: Stanford University Press, 1992).
[5] Bud, *Penicillin: Triumph and Tragedy*, pp. 107-08.
[6] Methicillin, the first semi-synthetic antibiotic, was developed in 1959; ibid., pp. 120-28.

walled gram–negative bacteria.[7] Defeating old scourges like tuberculosis, gonorrhoea, syphilis and typhoid, second-generation antibiotics were celebrated as true panaceas.

However, the flood of new antibiotics also increased competition amongst pharmaceutical companies. Keen to maximise profits, companies looked for new markets. The economic potential of the veterinary market was particularly promising. Although antibiotics like gramicidin had already been used against bacterial udder infections in cows (mastitis) during the 1940s, the post-war price decline meant that pet-owners and farmers could afford routine antibiotic treatment for animals.[8] Instead of calling a veterinarian, farmers could medicate entire herds by mixing antibiotic concentrates into feeds and water.

Non-therapeutic antibiotic applications soon also proved lucrative. In 1948, researchers discovered and linked vitamin B12 to the hitherto mysterious Animal Protein Factor (APF), which stimulated growth and was present in animal products but absent in cheaper and less efficient plant-based feeds.[9] Merck researchers also discovered that culture broths for streptomycin produced vitamin B12 – thereby turning fermentation wastes into valuable feed components. In 1949, American Cyanamid Lederle Laboratories researchers Thomas Jukes and E.L. Stockstad found that chicks fed chlortetracycline (Aureomycin) fermentation wastes grew faster than chicks fed crystalline

[7] Jason C. Gallagher and Conan Macdougall, *Antibiotics Simplified* (Boston et al.: Jones and Bartlett Publishers, 2009).
[8] Bud, *Penicillin: Triumph and Tragedy*, pp. 165-66.; George A. Woods, 'Potions For Pets', *New York Times* [In the following: *NYT*], 25.07.1954, p. SM20.
[9] Finlay, 'Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture', p. 243.

vitamin B12. Jukes and Stockstad soon discovered that animals' 'additional growth' was caused by chlortetracycline residues in the fermentation wastes. [10]

Announced in April 1950, the so-called antibiotic growth effect was good news for antibiotic manufacturers[11] and received glowing coverage in the US press.[12] Whereas humans received antibiotics therapeutically for limited periods of time, long-term antibiotic growth promotion (AGP) opened a large new outlet for the oversupplied antibiotic market. 'Subtherapeutic' antibiotic growth promoter feeds (AGPs) initially contained doses 30 to 100 times weaker than doses for therapeutic treatment and significantly improved animals' rate of gain.[13] For a time, it seemed as though antibiotics could not only cure the sick but also solve global nutritional problems.[14]

While early researchers believed that antibiotics optimised the microbial flora in animals' digestive systems,[15] the exact mechanisms behind AGP remain unclear. There are several competing theories: (1) that by inhibiting bacterial digestion, antibiotics maximise the amount of available sugar; (2) that feeding antibiotics favours the presence of vitamin-producing bacteria and combats toxin-producing bacteria; (3) that antibiotics favourably change the acidity of animals' stomachs.[16]

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[10] Thomas H. Jukes, *Antibiotics in Nutrition* (New York: Medical Encyclopedia, 1955), pp. 17-18, E.L.R. Stokstad et al., 'The Multiple Nature of the Animal Protein Factor', *Journal of Biological Chemistry,* 180/2 (1949).
[11] Finlay, 'Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture', p. 244.
[12] Ibid.; Waldemar Kaempffert, 'Science in Review', *NYT*, 16.04.1950, p. E9.
[13] Jukes, *Antibiotics in Nutrition*, p. 57, R. Braude, H. D. Wallace, and T. J. Cunha, 'The Value of Antibiotics in the Nutrition of Swine: A Review', *Antibiotics and Chemotherapy,* 3 (1953).
[14] 'Antibiotics Attain Big Medical Field', *NYT*, 13.05.1950, p. 19; 'Animal Feed Supplement Has Terramycin Factor', *NYT*, 30.10.1950, p. 38; 'Business: How to Grow Faster', *Time*, 26.02.1951 [*Time Magazine* articles have been taken from TIME Online Archives, which do not provide page numbers until 1980]; 'Antibiotics Give Pigs A Fast Start In Life', *NYT*, 08.06.1952, p. F4.
[15] Jukes, *Antibiotics in Nutrition*, p. 41.
[16] Lawrence, Fowler, and Novakofski, *Growth of Farm Animals*, p. 327.

However, this lack of knowledge did not prevent AGPs' mass-introduction to US agriculture or their use in feed trials on prison inmates and Guatemalan schoolchildren. According to the director of the International Institute of Nutrition of Central America and Panama, malnourished "children may some day be eating aureomycin candy to improve their diets." [17] Referring to the significant changes wrought by antibiotics, the *Washington Post* enthused:

> Each week 80,000 chicks are produced and moved to [Armour & Co's] Ches-Peake farm, (…). By scientific feeding, controlled temperatures, germ-killing rays, water treated with such drugs as terramycin, aureomycin, and antibiotics [sic], the birds are ready for slaughter in three-fourths the time by ordinary methods.[18]

Employing Huxleyian rhetoric, *Time* magazine described how Pfizer was shaking up conservative farmers with the help of "synthetic sow's milk spiked with terramycin."[19] Thanks to antibiotics, "platoons of little pigs were enjoying a peril-free infancy (…) none are trampled or eaten; no luckless runts are left teatless."[20] On Pfizer farms, piglet mortality had declined from between 21-33% to 5%.[21] Sows could be "put back to work" immediately instead "of (…) performing no other service than can be performed by the milking machine at the nearest dairy."[22] By 1954, penicillin co-discoverer Sir Alexander Fleming predicted that penicillin's use as a growth promoter might some day exceed therapeutic uses.[23]

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[17] Milton Levenson, 'Six Latin Nations Study Nutrition', *NYT*, 11.05.1951, p. 27; trials with streptomycin were also considered; 'Vitamin B-12 Spurs Growth, Dietitians [sic] Told', *WP*, 19.10.1950, p. 14.
[18] John W. Ball, 'New Chicken Procedures Like Factory', *WP*, 22.05.1951, p. B2.
[19] 'Science: Pigs Without Moms', *Time*, 03.12.1951.
[20] Ibid.
[21] Ibid.
[22] 'Antibiotics Used on Livestock by Hormel To Clear Bacteria for Full Effect of Fodder', *NYT*, 13.12.1951, p. 53.
[23] Foster Hailey, 'More Care Urged In Antibiotics Use', *NYT*, 25.03.1954, p. 59.

Trust in the new 'miracle drugs' was such that journalists did not object to antibiotics' planned use as food preservatives or plant sprays either.[24] There really seemed to be no area of human health and food production in which antibiotics could not work miracles. In 1953, the *Post* rejoiced: "antibiotics are becoming wonder drugs to save food crops (…), give us more and tastier meats, even aid in making beer and whisky."[25]

Nowhere was early antibiotic-enthusiasm greater than in *Scientific American*: proclaiming an "antibiotic age"[26] in 1951, Kenneth B. Raper surveyed antibiotics' overall impact: the wholesale market value of antibiotic and vitamin B12 feed supplements was already estimated to be worth ca. $40-50 million. With production costs of antibiotics like penicillin falling from ca. $20 to 4¢ per 100,000 units between 1943 and 1951, it was obvious that agricultural antibiotic-use would continue to expand.[27] According to another article, antibiotics and other chemicals would advance "agricultural efficiency at least as much as machines have in the past 150 years."[28] By taming capricious nature, agriculture's chemical revolution was finally allowing humans "to free [them]selves from the dismal philosophy of Robert Malthus."[29]

Scientific American's attack on Malthus supported a central tenet of American political discourse. According to Malthus, the human population's exponential growth would always exceed the linear growth of agricultural productivity. As a consequence, population growth would inevitably be halted

[24] N.S. Haseltine, 'Drug Found to Seal in Flavor Of Food as It Is Being Canned', *WP*, 18.05.1950, p. B8; Idem, 'Whale Meat Kept by Antibiotics Reported Coming to US Kitchens', *WP*, 20.10.1956, p. C11; 'Food News: Preservation Process', *NYT*, 29.11.1955, p. 26.
[25] 'Antibiotics Now Fighting Plant Diseases', *WP*, 11.09.1953, p. 19.
[26] Kenneth B. Raper, 'The Progress Of Antibiotics', *Scientific American* [in the following *SciAm*], 186 4/1952, p. 49.
[27] Ibid., p. 54.
[28] Francis Joseph Weiss, 'Chemical Agriculture', *SciAm*, 187 08/1952, p. 18
[29] Ibid.

either by preventive checks on fertility or positive checks – i.e. rising mortality through famine.[30] However, following 1945, unprecedented agricultural productivity not only promised to defeat Malthus' law but was also seen as an effective way to contain communism. In his 1949 'Four Point Speech', President Truman equated global economic and agricultural development with victory over communism. For patriotic US researchers, the promulgation of agricultural efficiency became a moral duty. Over the next twenty years, the US doctrine of scientific plenty resulted in a surge of foreign aid and investment in US agricultural intensification.[31]

The Cold War paradigm of Western plenty also influenced other US newspapers' on-going support of agricultural antibiotics. For the *NYT*, rising antibiotic use and meat consumption symbolised American progressivism.[32] In 1955, the *Post* reported that agricultural progress was allowing the average American to consume 13% more food than in pre-war years.[33] Increased chemical and drug use was seen as a necessary pre-condition of US plenty:

> Nowadays the doctor arrives with a station wagon full of hypos, stimulators, pills and penicillin and Buttercup gets the benefit of modern medicine. (…), a high-producing purebred nowadays is ashamed to show up at milking time without twice the load her grandmother carried.[34]

In 1959, the *NYT* celebrated the "chemical revolution on the farm" for "all but [wiping] out the Malthusian fear": "… [it] has gone too far to be halted or

[30] Irmi Seidl and Clem A. Tisdell, 'Carrying Capacity Reconsidered: From Malthus' Population Theory to Cultural Carrying Capacity', *Ecological Economics,* 30/3 (1999).
[31] Nick Cullather, *The Hungry World. America's Cold War Battle against Poverty in Asia* (Cambridge (Ma.) and London: Harvard University Press, 2010), pp. 2-10.
[32] John Stuart, 'American Farmer Still Making 'Hay'', *NYT*, 13.12.1953, p. F1.
[33] Jack Ryan, 'Farmers Reaping Bumper Crop of Chemicals', *WP*, 20.03.1955, p. F1.
[34] Aubrey Graves, 'Ever Try to Stuff a Heifer with King-Size Antibiotics?', *WP*, 04.01.1953, p. B2.

reversed. Today it is an Age, not an event – an Age that offers great opportunities for the future for those who can harness and exploit them." [35]

However, agriculture's chemical abundance also exacted a price. Following 1945, environmental cancer research heightened Americans' wariness of long-term exposure to minute doses of invisible chemicals.[36] Chemical residues in food seemed particularly problematic. In 1949, Republican Representative Frank B. Keefe successfully lobbied for the installation of a Congressional Select Committee to Investigate the Use of Chemicals in Food and Cosmetics. Following Keefe's death, Democrat Representative James J. Delaney took over the Committee's chair.[37] In 1951, the Select Committee's report attacked the use of inadequately tested synthetic substances and demanded new legislation to protect the public from carcinogens and latent poisoning.[38] Having lost his wife to cancer, Delaney continued to crusade for stricter regulations for the next two decades.[39]

Many of Delaney's efforts were, however, weakened by a concerted counter-campaign. Attempting to ward off public criticism, the Manufacturing Chemists' Association hired Hill and Knowlton, a public relations firm renowned for defending the tobacco industry against cancer allegations.[40] Supporters of agricultural chemicals used similar strategies to weaken new legislation: in 1954,

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[35] William Burry Furlong, 'Chemical Revolution on the Farm', *NYT*, 04.10.1959, p. 37; see also 'Agriculture: The Pushbutton Cornucopia', *Time*, 09.03.1959.
[36] Christopher C. Sellers, *Hazards of the Job. From Industrial Disease to Environmental Health Science* (Chapel Hill & London: North Carolina Press, 1997), pp. 221-24.
[37] Wallace F. Janssen, 'Fda since 1938: The Major Trends and Developments', *Journal of Public Law,* 13/1 (1964).
[38] 'Investigation Of The Use Of Chemicals In Food Products. Report', *Union Calendar*, No. 1139, Report 3254, 03.01.1951, pp. 1-11.Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, pp. 80-81.
[39] David Vogel, *The Politics of Precaution. Regulating Health, Safety and Environmental Risks in Europe and the United States* (Princeton and Oxford: Princeton University Press, 2012), pp. 45-46.
[40] Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, p. 81.

the so-called Miller Act (Pesticide Chemicals Act) attempted to reconcile chemical use with consumer safety by mandating the establishment of 'safe' tolerance levels for chemical residues.[41] In 1958, industry lobbying also influenced the new Food Additives Amendment to the 1938 Federal Food, Drug, and Cosmetic Act (FDC). Instead of the proposed mandatory testing regime for new substances, Congress passed a weaker bill, which merely required unspecified proof of additives' safety.[42] Similar to the 1954 Miller Act, the 1958 Amendment also tolerated residues of legal additives if they remained within pre-defined levels. According to historian Sarah Vogel, the 1958 Amendment weakened consumers' protection against hazardous chemicals *per se* and made risk dependent on the amount of chemical exposure.[43]

The only exception to the dose-response dominated 1958 Amendment was the so-called Delaney Clause. A direct result of James Delaney's lobbying, the Delaney Clause established a zero-tolerance policy for carcinogens in food. By stating that carcinogens were unacceptable regardless of their dosage, the Delaney Clause epitomised Americans' growing preoccupation with cancer. However, by focussing precautionary risk policy on carcinogens alone, the Delaney Clause indirectly legitimised threshold models for non-carcinogenic substances like antibiotics and limited discussions of chemical risk to the issue of residues.[44]

Despite the watering-down of many chemical guidelines, the debates triggered by Delaney and his supporters left a strong impression on the public's

[41] Janssen, 'Fda since 1938: The Major Trends and Developments', p. 208.
[42] Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, p. 81.
[43] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, pp. 15-42, Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, p. 81.
[44] Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, p. 82.

mind: even supposedly 'safe' chemicals could prove dangerous in the long-term. Agricultural antibiotics' reputation suffered accordingly.

During the second half of the 1950s, media reports on food-borne cancer hazards began to mention non-carcinogenic antibiotics alongside suspect carcinogens like DDT and food dyes. In 1956, the *NYT* reported on the International Union Against Cancer's symposium in Rome. During the symposium, scientists warned that inadequately tested food additives were creating a "serious public health problem."[45] According to William Hueper, head of the US National Cancer Institute's Environmental Cancer Section, suspected carcinogens included: dyes, thickeners, synthetic sweeteners, preservatives, bleaches, fat substitutes, pesticide residues, chemical sterilizers, wrapping materials, oestrogens and antibiotics.[46]

Public suspicion of agricultural antibiotics also grew because of increased knowledge about antibiotic allergies. During the 1940s, it emerged that some people were allergic to certain antibiotics. Allergies to β-lactam antibiotics like penicillin were particularly frequent. Allergic reactions to penicillin could range from mild skin irritations to painful hives or a lethal anaphylactic shock. Meanwhile, studies on nurses revealed that constant antibiotic-exposure could foster the development of such hypersensitivity.[47] In 1957, the US Food and Drugs Administration (FDA) published a survey of severe reactions to antibiotics. Between 1953 and early 1957, 1070 'life-threatening' allergic reactions had been reported to the FDA. The cases included 72 penicillin-related

[45] Arnaldo Cortesi, 'Cancer Is Traced To Food Additives', *NYT*, 21.08.1956, p. 31.
[46] Ibid.
[47] The National Archives [in the following TNA] PIN 20/216 (Sensitisation of Nursing Staffs to Antibiotics, Extract from *The Lancet*, 4 Jul, 1953), pp. 1-3; 'Medicine: Hold That Penicillin', *Time*, 30.10.1950.

deaths. During the same time, physicians had reported a further 1925 'severe' reactions.[48]

Initially, commentators failed to make the connection between antibiotic exposure in medical and agricultural settings.[49] Reporting on modern dairy production in 1951, *NYT* journalist Jane Nickerson regarded antibiotic residues in milk as an "interestin[g], if not too seriou[s]"[50] annoyance, which merely complicated the production of cheese by inhibiting essential bacteria.

Such complacency began to change following the 1956 publication of an FDA survey of antibiotic residues in milk. US consumers were alarmed to hear that up to 10% of milk might be contaminated with penicillin. Although officials claimed that detected residues were insufficient to create new allergies, they could trigger existing allergies.[51] The fact that the penicillin residues had been found in milk made the scandal particularly poignant. As recently shown by historian Kendra Smith-Howard, milk held a special place in the minds of American consumers. A fundamental symbol of health, milk was associated with feeding the young, infirm and vulnerable.[52] Prior to the Second World War, measures to secure milk purity had centred on the eradication of pathogens like *Salmonella* and tuberculosis.[53] However, after 1945, the detection of chemical and radioactive residues in milk challenged pre-existing notions of purity and

[48] Nate Haseltine, '72 Deaths Laid To Penicillin Use', *WP*, 04.10.1957, p. B1.
[49] Robert K. Plumb, 'Antibiotics' Use in Raw Food Cited', *NYT*, 14.09.1957, p. 20; a rare exception is Louly Baer, 'Keeping Foods Pure', *NYT*, 09.02.1952, p. 12.
[50] Jane Nickerson, 'News of Food: Milk Plant Doubles Output', *NYT*, 25.04.1951, p. 45.
[51] Nate Haseltine, 'Milk Samplings Yield Traces of Penicllin', *WP*, 22.02.1956, p. 3.
[52] Smith-Howard, 'Antibiotics and Agricultural Change: Purifying Milk and Protecting Health in the Postwar Era'.
[53] Peter Atkins, *Liquid Materialities. A History of Milk, Science and the Law* (Farnham and Burlington: Ashgate, 2010), pp. 225-45.

safety. As a consequence, definitions of milk purity began to encompass the absence of chemical adulterants.[54]

Changing definitions of purity also challenged laypersons' unrestricted access to potent therapeutics. By the late 1950s, cancer fears and concerns about the invisible contamination of foodstuffs led to a new ambivalence of US media reports on agriculture's 'chemical revolution': continuing to celebrate 'synthetic' chemicals for harnessing capricious nature, reports also demanded that farmers contain the very same 'synthetic' substances so as not to adulterate 'natural' food and bodies.

Public concerns were further heightened in 1959 when the new Delaney Clause forced the FDA to take action against millions of pounds of cranberries produced with the herbicide aminotriazole ahead of Thanksgiving, the most important date in cranberry growers' year.[55] Hitting the US cranberry industry hard, the scandal reinforced public fears that farmers were abusing chemicals for the sake of profit. The FDA's nearly simultaneous disclosure that 3% of milk samples contained "substantial residues"[56] of pesticides and 3.7% contained penicillin residues did not reassure consumers.[57]

One year later, journalist and future Pulitzer Prize winner William Longgood stoked concerns with his bestselling book *The Poisons In Your Food*. In his introduction, Longgood invited consumers to inspect their shopping baskets:

> Then there's the milk you give the children (…). But did you know the odds are (…) one to ten it contains antibiotics? (…). Sunday's chicken may have traces of antibiotics, arsenic and artificial sex hormones (…). The

[54] Smith-Howard, 'Antibiotics and Agricultural Change: Purifying Milk and Protecting Health in the Postwar Era', pp. 329-30; 32-33.
[55] Janssen, 'Fda since 1938: The Major Trends and Developments', p. 209.
[56] 'Trace of DDT Found in 1958 Tests Of Milk in Washington, Other Cities', *WP,* 22.12.1959, p. A1.
[57] 'US Pushes Fight to Rid Milk of Penicillin Dregs', *WP*, 03.12.1959, p. B2.

> roasts or steaks probably have traces of hormones, antibiotics and the inevitable poisons that went into the cattle's diet.[58]

Referring to the 1958 Amendment, Longgood accused Congress of having legalised "mass poisoning (…) by granting FDA the right to determine how much poison residue may remain on marketed food."[59] For Longgood, agricultural antibiotics were no longer miracle substances but sinister contaminants. In contrast to official assurances, cooking did not destroy antibiotic preservatives and the milk scandal had shown "how precarious the public's margin of safety is when a dangerous drug is placed in the hands of laymen (…) who are expected to exercise their sense of responsibility at the risk of losing money."[60] Linking them to rising allergic reactions, Longgood claimed that antibiotic residues acted as 'vitamin antagonists' and masked disease in slaughtered animals.[61]

Unsurprisingly, Longgood's book provoked angry reactions. In *Science*, William J Darby, an influential nutritionist from Vanderbilt University, attacked the book as "an all-time high in 'bloodthirsty pen-pushing'" from the "bias of the non-scientific, natural food-organic cult."[62] Longgood's "authorities" were "the cult leaders (…) or a few true scientists whose work or expressions have been taken either out of context or out of time … ."[63]

Dispensing with a bibliography, some of Longgood's claims were indeed sketchy. However, the fact that *The Poisons in Your Food* managed to elicit a review in *Science* showed that the days of wholesale chemical optimism were

[58] William Longgood, *The Poisons in Your Food* (New York: Simon and Schuster, 1960), p. 2.
[59] Ibid., pp. 72-73.
[60] Ibid., p. 152.
[61] Ibid., p. 154 & 56.
[62] William J. Darby, 'Review, the Poisons in Your Food by William Longgood', *Science,* 131/3405 (1960).
[63] Ibid.

over. In the public's mind, the promised chemical cornucopia was acquiring the bitter aftertaste of invisible and potentially carcinogenic residues.

In contrast to residues, the growing occurrence of bacterial resistance caused far less negative publicity for agricultural antibiotics. Although many of the exact mechanisms were still unknown at the time,[64] experts were well aware of the general phenomenon of bacterial resistance. As early as the 1930s, physicians had noted that certain bacteria species became resistant against first generation sulpha drugs.[65] In the case of fungal antibiotics, the penicillin-developing Oxford team noticed the occurrence of penicillin resistance as early as 1940.[66] Five years later, Sir Alexander Fleming warned about the development of bacterial resistance upon receiving the Nobel Prize.[67]

In order to prevent bacterial resistance, physicians were cautioned to prescribe combinations of different antibiotics and reserve antibiotics for essential treatments.[68] However, with some hospitals spending up to 40% of their pharmacy bill on antibiotics, it was clear that medical antibiotic use was far from targeted.[69] Struggling to keep up with 4,562 new prescription products between 1951 and 1961, many physicians also proved susceptible to aggressive pharmaceutical marketing. Although they often lacked proof of efficacy and discouraged a proper diagnosis of infections, 'shotgun' courses of fixed-dose antibiotic combinations proved particularly popular. Prominent US infectious

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[64] FC Tenover, 'Mechanisms of Antimicrobial Resistance in Bacteria', *American Journal of Infection Control,* /June 34 (5 Suppl 1) (2006).
[65] Christoph Gradmann, 'Magic Bullets and Moving Targets: Antibiotic Resistance and Experimental Chemotherapy, 1900-1940', *Dynamis,* 31/2 (2001).
[66] George W. Gray, 'The Antibiotics', *SciAm,* 08/1949, p. 33.
[67] Alexander Fleming, 'Nobel Lecture', *nobelprize.org* (http://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/fleming-lecture.html [accessed: 14.08.2014]).
[68] George W. Gray, 'The Antibiotics', *SciAm,* 08/1949, p. 34.
[69] 'Surgeons Warned About Antibiotics', *NYT*, 02.11.1951, p. 22.

disease experts like Maxwell Finland from Boston's City Hospital soon attacked what they saw as irresponsible marketing practices and physicians' accommodativeness.[70]

Further contributing to lax prescription practices was the predominant view of bacterial resistance as a relatively static phenomenon.[71] The 'vertical' view of hereditary resistance proliferation held that antibiotic-resistance was either already present or resulted from spontaneous mutations in previously susceptible bacterial strains. Often benefiting from an antibiotic environment, resistant strains then passed on their resistance to subsequent generations.[72] However, with a constant stream of new antibiotics entering the market during the 1950s, American commentators deemed the random emergence of local bacterial resistance containable. Surprised by British concerns about antibiotic resistance in 1953, the *NYT* noted: "The British are probably too pessimistic. There is no reason to think antibiotics are on the way out."[73]

By the late 1950s, outbreaks of resistant pathogens made such optimism wear thin. In 1958, US Surgeon General Leroy Burney categorized resistant staphylococci as a "problem of national significance."[74] Speaking at the 1959 meeting of the Association of American Physicians, Maxwell Finland warned: "physicians who are overconfident of germ-killing wonder drugs are living in a fool's paradise where their patients may die."[75]

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[70] Jeremy A. Greene and Scott H. Podolsky, 'A Historical Perspective of Pharmaceutical Promotion and Physician Education', *JAMA,* 30/7 (2008), p. 831, Podolsky, 'Antibiotics and the Social History of the Controlled Clinical Trial. 1950-1970', p. 327.
[71] Gradmann, 'Sensitive Matters: The World Health Organisation and Antibiotic Resistance Testing, 1945-1975', pp. 556-60.
[72] George W. Gray, 'The Antibiotics', *SciAm,* 08/1949, p. 33-34; Francis J. Ryan, 'Evolution Observed', *SciAm*, 10/1953, pp. 79-80 & 82.
[73] W.K., 'Will Antibiotics Be Abandoned', *NYT*, 26.07.1953, p. E7.
[74] Nate Haseltine, 'Hospital-Bred Germs Target Of Drive Here', *WP*, 29.10.1958, p. B1.
[75] 'Medicine: Mixed Blessing', *Time*, 18.05.1959.

Similar to fears of antibiotic allergies, concerns about bacterial resistance failed to spread from the hospital to the farm. Throughout the 1950s, public perceptions of antibiotic resistance in medical and agricultural settings remained curiously divorced. None of the analysed US newspapers addressed the fact that bacterial resistance could just as easily emerge in animals and spread to humans. The only exception to this epistemic divide was a letter to the *Post* in August 1952, which criticised veterinary antibiotic overuse and briefly alluded to the danger of resistance selection. AGPs were not mentioned.[76]

By the end of the 1950s, US perceptions of agricultural antibiotics were thus characterised by a double-rift. The first rift separated anti-Malthusian promoters of chemical abundance from a growing group of consumers concerned about 'unnatural' and potentially carcinogenic residues in their food. The second rift divorced discussions of antibiotic risk in human medicine from those in agricultural settings.

The 1960s saw Americans not only grow more suspicious of agricultural antibiotics but also of the companies producing them. Previously venerated as "merchants of life,"[77] the value of American pharmaceutical companies had more than quadrupled from $500,000,000 after the Second World War to $2,200,000,000 in 1958.[78] However, companies' behaviour had occasionally been questionable. Between 1959 and 1962, investigations by the Senate's Antitrust and Monopoly Subcommittee shed a harsh light on dubious mark-up

[76] H.C. Newman, 'Using Antibiotics', *WP*, 21.08.1952, p. 8.
[77] Tom Mahoney, *The Merchants of Life. An Account of the American Pharmaceutical Industry* (New York: Harper & Brothers, 1959).
[78] John W. Finney, 'The Drug Industry: What It Is And How It Operates', *NYT*, 13.12.1959, p. E8.

prices, questionable marketing practices and attempts to drive generic drug producers out of business.[79]

The most damaging findings came to light in May 1960, when Democrat Senator Carey Estes Kefauver's Subcommittee announced that it was investigating extra income received by the head of the FDA's Antibiotics Division, Henry Welch. Between 1953 and 1960, Welch had received $287,142 for his role as editor-in-chief of the journals *Antibiotics and Chemotherapy* and *Antibiotic Medicine and Clinical Therapy*. Financed by industry, the widely distributed journals contained articles designed to advertise a whole range of antibiotic products – sometimes prior to their licensing by Welch's division.[80] Industry representatives had even edited some of Welch's official speeches – in one case, a Pfizer slogan had been written into a speech to "jazz it up."[81] A defiant Welch was forced to resign from the FDA in mid-May 1960.[82] Republican Secretary of Health Arthur Flemming subsequently ordered a review of all of Welch's licensing decisions.[83]

Only one year later, the thalidomide scandal struck a second blow to public trust in the pharmaceutical industry. In 1957, the West German company *Chemie Grünenthal* had begun to market a new substance called thalidomide as a sedative and soporific suitable for pregnant women. Despite early evidence linking thalidomide to neural damage and foetal malformation, *Chemie Grünenthal* continued to market its teratogen until November 1961. By then,

[79] For a collection of contemporary accounts of the investigations and subsequent legislation see Richard Harris, *The Real Voice* (Macmillan, 1964).
[80] Podolsky, 'Antibiotics and the Social History of the Controlled Clinical Trial. 1950-1970', pp. 360-65.
[81] 'FDA Aide's Talk Edited By Ad Man', *NYT*, 02.06.1960, p. 25.
[82] 'Drug Aide Quits; Blames Politics', *NYT*, 20.05.1960, p. 12.
[83] Podolsky, 'Antibiotics and the Social History of the Controlled Clinical Trial. 1950-1970', p. 364.

exposure to thalidomide was believed to have caused an estimated 10,000 malformations and several hundred deaths.[84] Fortunately, thalidomide had not been licensed for US markets. Despite repeated licensing requests, FDA reviewer Frances Oldham Kelsey had deemed industry data insufficient and demanded further trials. Kelsey's heroic story, however, also highlighted how lucky Americans had been. With no requirements for manufacturers to submit clinical trials or report adverse effects, Kelsey's doubts had been the only thing standing between thalidomide and the US market.[85]

The early 1960s were thus extremely damaging for both pharmaceutical producers and the FDA: the Kefauver Hearings and the Welch and thalidomide scandals had revealed immoral business practices and gaping holes in US consumer protection. Reacting to this combined crisis in 1962, President Kennedy awarded Kelsey the President's Award for Distinguished Federal Civilian Service[86] and signed the FDC's so-called Kefauver-Harris Amendment. While the 1962 Amendment mandated pre-licensing efficacy tests of new drugs via controlled clinical trials, drug manufacturers were required to report adverse reactions one year later.[87]

However, by 1962, consumer distrust was rapidly encompassing the entire chemical industry. Published about two weeks ahead of the signing of the Kefauver-Harris Amendment, *Silent* Spring, the iconic environmentalist bestseller by marine biologist and conservationist Rachel Carson, launched a

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[84] Brynner and Stephens, *Dark Remedy. The Impact of Thalidomide and Its Revival as a Vital Medicine*, pp. ix; 5-20; 32-35.
[85] Daniel Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda* (Princeton and Oxford: Princeton University Press, 2010), pp. 238-56.
[86] Bridget M. Kuehn, 'Frances Kelsey Honored for Fda Legacy', *JAMA,* 304/19 (2010).
[87] Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, p. 229; 592.

frontal attack on chemical polluters and on DDT in particular.[88] Similar to antibiotics, the insecticide DDT was widely regarded as a success story of wartime science. Liberally used by the Allies during the war, DDT's post-war introduction to civilian life was a major commercial success.[89] Unfortunately, DDT's similarity to antibiotics did not end here. It quickly became clear that DDT use could select for resistance in insect populations and result in residues, which accumulated in animal tissues because of DDT's high fat solubility. DDT concentrations were especially high towards the top of the food chain. In the case of America's heraldic animal, the bald eagle, DDT resulted in thinner eggshells, which were unable to support the weight of brooding parents. In addition to silencing nature, Carson accused DDT and other chemicals of causing cancer. Of *Silent Spring's* seventeen chapters, five were devoted to pesticides' and herbicides' potential carcinogenicity.[90]

Although it profited from earlier bestsellers like *The Poisons in Your Food* and anarchist Murray Bookchin's nearly contemporaneous bestseller *Our Synthetic Environment,*[91] *Silent Spring's* successful fusion of environmental concerns and health concerns triggered a whole series of environmentalist bestsellers and media reports. Its prestige heightened following Carson's death from cancer two years later.[92] By December 1962, the *Post* noted that *Silent*

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[88] Carson, *Silent Spring*.
[89] Simon, *Ddt. Kulturgeschichte Einer Chemischen Verbindung*, Edmund Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to "Silentspring"* (Cambridge: Cambridge University Press, 2001).
[90] Carson, *Silent Spring*.
[91] Using the pseudonym Lewis Herber, the anarchist Bookchin made similar claims; Lewis [Pseudonym for Murray Bookchin] Herber, *Our Synthetic Environment* (New York: Knopf, 1962).
[92] Amongst others: Ralph H. Lutts, 'Chemical Fallout: Rachel Carson's Silent Spring, Radioactive Fallout, and the Environmental Movement', *Environmental Review,* 9/3 (1985), Simon, *Ddt. Kulturgeschichte Einer Chemischen Verbindung*, Garry Kroll, 'The 'Silent Springs' of Rachel Carson: Mass Media and the Origins of Modern Environmentalism', *Public Understanding of Science* 10 (2001), Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to*

Spring had turned chemical use into "the most controversial non-political subject in American agriculture."[93]

Significantly, *Silent Spring* fixated US and – by extension – Western public attention firmly on the dangers of invisible and carcinogenic chemical residues.[94] While this attention was undoubtedly important and resulted in the 1972 US ban of DDT, it could also detract from other important issues. In the case of agricultural antibiotics, residue and cancer fears overshadowed a meaningful public discussion of bacterial resistance. Despite very brief warnings in Longgood's and Herber's books,[95] most articles in the US media upheld the epistemological divide between bacterial resistance in humans and animals.[96]

It was only in August 1966 that bacterial resistance resulting from agricultural antibiotic use turned into a major concern for the US media. On August 4th, 1966, the prestigious *New England Journal of Medicine* (NEJM) warned about a new theory of antibiotic resistance proliferation: instead of merely passing on resistance vertically to subsequent generations, bacteria could exchange blueprints for antibiotic resistance – so-called R Factors – horizontally across species borders.[97] Discovered by Japanese researchers, horizontal resistance transfer was possible via the exchange of tiny fragments of extra-

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"Silentspring", David Kinkela, *Ddt and the American Century: Global Health, Environmental Politics, and the Pesticide That Changed the World* (Chapel Hill: University of North Carolina, 2011).
[93] 'Dairymen Warned on Pest Poisons', *WP*, 11.12.1962, p. A4.
[94] Simon, *Ddt. Kulturgeschichte Einer Chemischen Verbindung*, pp. 14-21, Russell, *War and Nature: Fighting Humans and Insects with Chemicals from World War I to "Silentspring"*, pp. 204-23.
[95] Longgood, *The Poisons in Your Food*, p. 154.; Herber, *Our Synthetic Environment*.
[96] Theodore R. Van Dellen: 'How to Keep Well', *WP*, 18.03.1960, p. B8; John A. Osmundsen, 'Resistant Germs Reported On Rise', *NYT*, 12.03.1961, p. 55; see also telling comments by animal health columnist Frank Miller; Frank Miller, 'The Wonderful World of Animals', *WP*, 26.04.1962, p. D18; Idem, 'The Wonderful World of Animals', *WP*, 14.04.1964, p. D9.
[97] E. S. Anderson and Naomi Datta, 'Resistance to Pencillins and Its Transfer in Enterobacteriaceae', *The Lancet,* 285/7382 (1965).

chromosomal DNA called plasmids.[98] With one bacteria strain able to communicate resistance to another strain, locally emerging resistance could spread throughout the regional, national and ultimately global microbial environment. Resistance could no longer be treated as an isolated and containable problem. Bacterial resistance selection on farms could be just as dangerous as resistance selection in hospitals.[99]

Although *Scientific American* had already reported on British studies of "transferable resistance"[100] in February 1966, it was not until the prestigious *NEJM* report that major US newspapers reassessed the hazards of agricultural antibiotic use. Referring to R-factor transfer as "infectious drug resistance", the *NEJM's* editorial blamed the "precipitous rise in frequency of R factors" on the "increasing use of antibiotics not only in clinical practice but also in the care and feeding of livestock."[101] According to the editorial, AGPs were "providing a constant selection pressure on R factors that can readily be transferred to man": "unless drastic measures are taken very soon, physicians may find themselves back in the preantibiotic Middle Ages."[102]

Making an intuitive connection between the *NEJM's* warnings and the established genre of chemical criticism, the *NYT* noted:

> The 'Silent Spring' dispute over agricultural use of pesticides is being matched by a somewhat similar controversy over the practice of routinely including antibiotics in animal feed. If the conclusion suggested by a growing volume of medical evidence is correct, such feeding may gravely

[98] Creager, 'Adaptation or Selection? Old Issues and New Stakes in the Postwar Debates over Bacterial Drug Resistance', p. 180.
[99] Bud, *Penicillin: Triumph and Tragedy*, pp. 175-76.
[100] 'Transferable Drug Resistance', *SciAm*, 02/1966, p. 53.
[101] 'Infectious Drug Resistance', *New England Journal of Medicine,* 275/5 (1966).
[102] Ibid.

> reduce the effectiveness of the antibiotics on which physicians rely so heavily in treating infectious diseases in humans.[103]

According to the newspaper, "the available evidence suggests that the development of such hardy microbes is greatly facilitated by the widespread feeding of antibiotics (…). Put bluntly, people may be paying for cheaper and better meat by suffering more and graver infectious diseases."[104]

Three weeks later, agricultural antibiotic use received further negative publicity when the FDA released a report from an ad hoc committee on veterinary medical and non-medical uses of antibiotics. Formed in May 1965 as a result of penicillin residues in American red meat,[105] the committee had assessed whether current agricultural antibiotic use was safe and efficacious. The committee's report confirmed fears that agricultural antibiotics were being misused and leaving residues in US meat.[106] The ad hoc committee, however, failed to comprehensively address 'infectious resistance' and instead called for an end of antibiotic food preservation, stricter punishment of residue offenders and more research on antibiotics' ecological effects. The FDA announced that it would implement these recommendations.[107]

Although media reactions were mixed, they mostly shared the report's emphasis on residue over resistance hazards. Despite describing "contagious cuddling" between bacteria, *Time* relativized warnings of pre-antibiotic Middle Ages and noted that some experts were "calmly argu[ing] that laboratories are producing new antibiotics too fast for germs to catch up."[108] Livestock could also

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[103] 'New 'Silent Spring'?', *NYT*, 12.08.1966, p. 30.
[104] Ibid.
[105] Jane E. Brody, 'FDA Seeks Curb On Drugs In Food', *NYT*, 23.08.1966, p. 36.
[106] Ibid.
[107] 'Excerpts From Report on Antibiotics Prepared for the Food and Drug Agency', *NYT*, 22.08.1966, p. 28.
[108] 'Bacteria: How Germs Learn to Live', *Time*, 26.08.1966.

be fed therapeutically irrelevant antibiotics. Drawing an analogy to Upton Sinclair's 1906 bestseller, the *Post* criticised the FDA for having allowed an "antibiotic jungle" to spread but focussed mostly on food preservation:

> Old truths must sometimes be rediscovered. Prior to 1955 the [FDA] enforced a rigid prohibition against the use of antibiotics in the processing of food. The reasons were as obvious then (…) as they are now.[109]

In the *NYT*, journalist Jane Brody also rehashed analogies between antibiotics, *Silent Spring* and the scandals of 1906.[110] One reader encouraged farmers to profit from growing consumer demand for pure meat: "There are quite a few of us who go out of our way to buy such pure foods (…) – at a price."[111]

Meanwhile, positive reports on agricultural antibiotics refused to disappear. Throughout the 1960s, the development of new antibiotics and on-going fears of global overpopulation engendered support for antibiotic-fuelled agricultural intensification. In 1962, the *NYT's* Lawrence Galton claimed that the ability to compile synthetic antibiotics would provide "potent compounds for fighting wasteful diseases of agriculture."[112] In 1963, *Scientific American* informed readers that underdeveloped countries depended on "more and better food."[113] In contrast to inefficient Soviet collectives, Western livestock production's success was built on "finely calculated diets and rations, synthetic hormones, pesticides and sanitary stalls, drugs and vaccines to control disease."[114] Fearful of communism and global overpopulation, anti-Malthusians would fight hard battles for continued chemical access. For *Scientific American*,

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[109] 'The Antibiotic Jungle', *WP*, 23.08.1966, p. A12.
[110] Jane Brody, 'Medicine. Too many Antibiotics?', *NYT*, 28.08.1966, p. 178.
[111] James Lavelle, 'Letter to the Editor', *WP*, 19.09.1966, p. A16.
[112] Lawrence Galton, 'Science Stands at Awesome Thresholds', *NYT*, 02.12.1962, pp. 39 and 90; see also: Tom Stevenson, 'Fire Blight Is Hard On Fruits', *WP*, 06.08.1961, p. G7.
[113] Nevin S. Scrimshaw, 'Food', *SciAm*, 09/1963, p. 73.
[114] Ibid., p. 75.

harmless substances did not exist: "there are only harmless ways of using them."[115]

The 1960s were thus an extremely confusing time for American consumers: their sense of risk heightened by the Kefauver Hearings, *Silent Spring*, thalidomide and various residue scandals, consumers were also exposed to an un-attenuated stream of optimistic anti-Malthusian reports. Newspaper subscribers could read about chemical dangers in one issue only to encounter praise for "pushbutton farming"[116] and "coddled swine" getting "plenty of food, shots, pills [and] antibiotics´"[117] in the next. In terms of agricultural antibiotics, pervasive fears of invisible contamination made consumers and the media prioritise risk scenarios, which focussed on residues. During the early 1960s, fears of antibiotic resistance remained mostly limited to human medicine. Newspapers only gradually connected the two spheres of resistance selection in human and agricultural settings following the *NEJM's* popularisation of British research on transferable resistance in August 1966. However, as media reactions to the 1966 FDA report show, fears of bacterial resistance remained subordinate to fears of antibiotic residues. Meanwhile, US meat consumption continued to grow. Whereas annual meat consumption per person averaged 138.2 pounds in the 1950s, it rose to 161.7 pounds in the 1960s.[118] Frustrated by her compatriots, *Post* journalist Sue Cronk noted: "the biggest worry the American

[115] Ibid., p. 79.
[116] 'Life on the Farm', *NYT*, 21.10.1961, p. 20.
[117] 'Agriculture: Phrenological Pickers & Such', *Time*, 02.10.1964.
[118] ''Profiling Food Consumption in America'', *USDA Factbook* (www.usda.gov/factobook/chapter2.pdf [accessed: 01.07.2015]).

housewife has when she shops for meat is likely to be how much it will cost – not whether it will be safe for her family to eat."[119]

[119] Sue Cronk, 'How Safe Is the Nation's Meat Supply?', *WP*, 10.02.1964, p. B5.

Chapter Two: Abundantia ex Machina – antibiotics and the farmer

For American farmers, the insecurity caused by the growing criticism of agricultural chemicals was even worse. As producers, they had become dependent on continued access to chemicals like antibiotics, DDT or DES. However, as consumers, farmers were also concerned about the potential health impact of the very same chemicals. Having pioneered 'chemical-agriculture', US farmers' reaction to chemical risks would have a significant impact on farmers in other countries.

American farmers' chemical leadership had not emerged by chance. During the interwar period, the Taylorian logic of Henry Ford's factories had begun to pervade the American countryside. A new generation of agricultural experts, officials and producers wanted to apply the principles of quantification and mechanization to US farms. Already farming larger acreages and producing more animals than their European counterparts, American interwar farmers further expanded and began to rationalise their farms. The new farms employed improved accounting techniques alongside modern technologies like tractors, hybrid seeds and pesticides to maximise production and income.[1]

So successful were these new methods that US agricultural production exceeded domestic and international demand by 1921. Attempting to maintain their incomes despite sinking commodity prices, US farmers increased their production by a further 13% between 1917 and 1929. Unsurprisingly, commodity prices continued to sink. By the end of the 1920s, the average US farmer was earning an index price of 125 for commodities but paying an index

[1] Fitzgerald, *Every Farm a Factory. The Industrial Ideal in American Agriculture*, pp. 2-8.

price of 151 for all other purchases. Unable to service their debts, many farmers suffered bankruptcy and the US farm population declined from 32.5 million in pre-war years to 30 million in 1930.[2] Because of lower production costs, only extremely efficient or very large farming operations remained profitable. When commodity prices declined by another 37% during the Great Depression, even the most efficient producers struggled for economic survival.[3]

In this situation, Franklin Delano Roosevelt's new administration launched a comprehensive federal program of agricultural aid and planning. Passed in May 1933, the Agricultural Adjustment Act (AAA) was designed to reduce surpluses, stabilise prices and enhance farmers' purchasing power.[4] In concrete terms, the AAA allowed the USDA to administer a program of adjustment payments to farmers, who in turn agreed to reduce their production of surplus commodities. Together with compensated slaughter programs, the AAA was supposed to shift the balance – or parity – between agricultural and non-agricultural commodity prices back to the level of the period between 1909 and 1914.[5] It was this logic of parity levels that would dominate American agricultural policy for the rest of the century.

As a result of two AAAs and the introduction of the Commodity Credit Cooperation (CCC) and its price-supporting loans, US farmers' subsidy-dependence grew rapidly: by 1941, one third of US gross farm income was derived from direct or indirect federal payments.[6] The New Deal measures also increased the pressure to intensify production. By paying farmers to take land

[2] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 46.
[3] Ibid., p. 63.
[4] Ibid., p. 69.
[5] Ibid., pp. 70-78.
[6] Ibid., p. 81; 83; 94.

out of production, federal programs created an incentive to produce more with the remaining assets – thereby putting larger farmers at a distinct advantage. By the early 1940s, the farms that had survived the Great Depression were culturally and economically geared to strive for factory-like efficiency, scale and technological sophistication.[7]

When commodity prices began to recover during the 1940s, the industrialised motor of US agriculture roared. Reacting to America's entry into the Second World War, Congress passed the Emergency Price Control Act and the so-called Steagall Amendment in 1942. By guaranteeing agricultural commodity prices at around full parity for the duration of hostilities and two years afterwards, legislators actively encouraged US farmers to produce as much as they could and invest in further productivity increases.[8]

In the field of meat production, the ensuing transformations were particularly dramatic: whereas New Dealers had ordered the compensated slaughter of ca. six million excess hogs in 1934, wartime price guarantees encouraged a massive rise in US meat production.[9] However, war-induced grain and labour shortages soon threatened agricultural productivity. Working for the Work Simplification Laboratory at Purdue University, agricultural scientist Damon Catron launched a systematic attempt to overcome these shortages with regards to US pork production. For Catron, existing animal production was riddled with inefficiency.[10] Pig production was still characterised by animals' biological and seasonal rhythms. Farrowed in spring, animals were fattened on pastures during summer and autumn and mass-slaughtered ahead of winter. The

[7] Fitzgerald, *Every Farm a Factory. The Industrial Ideal in American Agriculture*, p. 184.
[8] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, pp. 99-100.
[9] Finlay, 'Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture', pp. 240-41.
[10] Ibid., p. 237 & 39.

resulting pork glut often overwhelmed processing facilities and depressed prices. Meanwhile, high mortality rates and lack of standardisation further depressed animals' productivity.[11]

Breaking radically with traditional farming, Catron's vision for animal production resembled an integrated car assembly plant. Catron and his colleagues divided a pig's life into distinct stages: breeding, farrowing, weaning, rebreeding and finishing. Removed from pastures into large indoor housing facilities, animals were to be grown in optimised artificial environments. Following the principle of life-cycle feeding, scientifically assembled feeds were to replace inefficient existing nutrition.[12] Prior to their final disassembly, animals' assembly stages should be as efficient as possible.[13] Farmers themselves would also have to transform from independent all-rounders into specialised workers capable of mastering the investments and technologies of life-cycle production.

However, there were significant obstacles to overcome on the road to Fordist animal production. One of the most daunting was posed by infectious disease. Many previous attempts to increase herd densities had been stunted by the parallel growth of disease pressure: infectious diseases had wiped out entire herds and chronic infections had severely decreased animal productivity.[14]

Fortunately for Catron, sulphonamides and new antibiotics promised to reduce the threat of bacterial disease. Initially, antibiotics like penicillin were too expensive for routine farm-use. However, in 1950, sinking antibiotic prices and

[11] Ibid., pp. 237-41.
[12] Ibid., pp. 247-49.
[13] Ibid., pp. 252-53.
[14] Abigail Woods, 'Rethinking the History of Modern Agriculture: British Pig Production, C. 1910-65', *Twentieth Century British History,* 23/2 (2012), pp. 176-77.

the announcement of the antibiotic growth effect marked a turning point. Curing and preventing infections in cramped housing conditions whilst promoting growth, antibiotic feeds became the keystone holding together Catron's cathedral of bioefficiency.[15]

Economically, antibiotics' mass-introduction to agriculture could not have come at a better time. Between 1940 and 1945, farmers' average per capita net income had increased from $706 to $2,063.[16] Feeding the US and large parts of Europe throughout the 1940s and encouraged by the Korean War's promise of stable commodity prices, American farmers paid off their debts and were eager to invest in new agricultural technologies.[17]

Industry was happy to oblige. During the second half of the 1940s, US farming magazines were full of articles and adverts celebrating the latest miracle technologies and substances. Interested buyers could choose from a vast array of 'growth factors' and 'miracle additives'.[18] By 1949, magazines were advising farmers to "lick mastitis"[19] with penicillin-sulpha or streptomycin infusions and pharmaceutical producers like American Cyanamid advertised sulpha-premixes and Aureomycin tubes for disease control.[20] In the same year, vitamin B12's equation with the Animal Protein Factor (APF) led to a surge of commercials advertising enriched feeds.[21]

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[15] Finlay, 'Hogs, Antibiotics, and the Industrial Environments of Postwar Agriculture', pp. 243-51.
[16] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 100.
[17] Paul K. Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929* (Lexington: University Press of Kentucky, 2009), p. 123.
[18] 'Commercial Nutrena', *Wallaces Farmer* [in the following *WF*], 16.04.1949, p. 499-15; Jewel Shasteen French, 'Furfural – Wonder Products of Farm Waste', *Progressive Farmer* [in the following *PF*], Apr 1950, p. 65.
[19] 'Drugs Plus Sense Lick Mastitis', *WF*, 01.10.1949, p. 1143.
[20] 'Commercial Lederle', *WF*, 19.03.1949, p. 379-47; 'Commercial Lederle', *WF*, 19.11.1949, 1243-15.
[21] 'Commercial Sargent', *WF*, 02.04.1949, p. 463-55; 'Commercial Staley Milling', *WF*, 07.05.1949, pp. 599-13.

Following the announcement of the antibiotic growth effect in early 1950, feed and pharmaceutical manufacturers hastily incorporated antibiotics into their established marketing repertoire. Early antibiotic commercials were nearly identical to previous APF and sulpha commercials.

In June 1950, *Wallaces Farmer* printed its first AGP commercial: featuring a proud farmer holding a feisty piglet and captioned "Always A Leader", Gooch Feeds' advertisement reported that State Colleges and "other experimental institutions" had achieved "amazing results" with the "Aureomycin APF" "wonder-worker".[22] However, it soon emerged that Gooch Feeds' "Genuine Lederle Aureomycin APF" [23] did not contain standardised antibiotic concentrations. Two weeks after it had printed Gooch's commercial, *Wallaces Farmer* warned: "crystalline aureomycin is not available at the present time to either the feed industry or the farmer."[24] Attempting to satisfy consumer demand prior to FDA AGP-licensing, producers like Gooch were simply rebranding existing vitamin-B12 feeds, which had been produced using antibiotic fermentation wastes. Quoting the organisation of American Feed Control Officials, a competitor complained: "no statement should be made (…) concerning the presence of the antibiotic since it is naturally inherent in the ingredient."[25] Despite the confusion about early growth promoters, antibiotic-enthusiasm in the agricultural press continued unabated.[26]

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[22] 'Commercial Gooch Feeds', *WF*, 03.06.1950, p. 45.
[23] Ibid.
[24] 'What's Lowdown On Aureomycin', *WF*, 17.06.1950, p. 16.
[25] 'Commercial Ames Reliable Products Co.', *WF*, 17.06.1950, p. 20.
[26] JR Couch, 'More Chicken With Less Feed', *PF*, Sept 1950, p. 63; 'Wonder' Drugs Speed Growth', *WF*, 06.05.1960, p. 20; TJ Cunha, 'Aureomycin Doubles Growth of Pigs', *PF*, Jun 1950, p. 110; Homer Hush, 'Find Cure For Runts', *WF*, 20.05.1960, p. 8.

Even after the FDA's licensing of AGPs in 1951, the agricultural market remained characterised by a remarkable degree of ignorance regarding efficacious antibiotic use. For a while, it seemed as though farmers would buy any feed as long as it contained preferably large doses of many different antibiotics: while companies like Ful-O-Pep or Kraft advertised their own antibiotic supplements,[27] Allied Mills promised that its antibiotic feed would turn a "scrawny runt" into a "husky hog" in "just 81 days."[28] For farmers unwilling to trust only one antibiotic, a company called Occident advertised Multimycin, an unspecified "combination of miracle antibiotics" offering "up to 18% greater gains than with *single* antibiotic feeds."[29] Meanwhile, Lederle Laboratories claimed that aureomycin was "the *only* antibiotic that has been proved highly effective for swine, poultry, calves and several kinds of small animals" [emphasis in the original].[30]

In the dairy sector, farmers were equally optimistic about the mass-application of antibiotics against mastitis. Caused by many different bacteria, mastitis could taint the flavour of milk and cause human health problems ranging from septic sore throat to food poisoning.[31] In Illinois, mastitis-incurred losses were estimated to amount to $7.5 million in 1951.[32] Reacting to agricultural demand, companies like Cyanamid increased commercials for 'ready-to-use-one-treatment tube[s]' of antibiotic against mastitis.[33]

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[27] 'Commercial Ful-O-Pep', *WF*, 17.02.1951, p. 25; 'Commercial Kraft', *WF*, 20.10.1951, p. 36.
[28] 'Commercial Allied Mills', *WF*, 16.06.1951, p. 20.
[29] 'Commercial Occident', *WF*, 17.02.1951, p. 56; see also: 'Commercial Nutrena', *WF*, 16.06.1951, pp. 24-25.
[30] 'Commercial Lederle', *WF*, 01.09.1951, p. 14.
[31] Smith-Howard, *Perfecting Nature's Food: A Cultural and Environmental History of Milk in the United States, 1900-1970*, p. 218.
[32] 'Mastitis Ruins Milk Cows', *WF*, 15.09.1951, p. 75.
[33] 'Commercial Lederle', *WF*, 20.01.1951, p. 14; 'Commercial Lederle', *WF*, 03.02.1951, p. 14.

The mass-use of mastitis-ointments soon proved so popular that dairies and creameries began to complain about antibiotic residues in raw milk. According to *Wallaces Farmer,* "antibiotics not only kill mastitis germs, but also kill bacteria which ferment milk."[34] In April 1951, the 'cheese state' Wisconsin issued a ruling requiring mastitis ointments to carry labels on withdrawal times to allow antibiotics to clear cows' udders.[35] Coming well ahead of similar reports in the national media, *Wallaces Farmer* warned in May 1951 that antibiotics might result in bacterial resistance if consumed by humans via milk.[36] However, residue and resistance warnings were not enough to dampen general antibiotic-enthusiasm. By 1956, US dairy farmers used 75 tons of antibiotics like streptomycin, chlortetracycline, oxytetracycline, neomycin, polymyxin, subtilin, supromycetin, and chloramphenicol against mastitis.[37]

Meanwhile, agricultural experts strongly endorsed broadening the scope of antibiotic use.[38] In an interview from 1951, Damon Catron conceded: "we don't know why antibiotics do what the experiments indicate. But we do know that they prevent scours, increase rate of gains and reduce feed requirements."[39]

Reacting to growing antibiotic use and a plethora of new products, other articles attempted to prevent farmers from using antibiotics incorrectly. According to one expert from the University of Illinois, it was important that farmers "follow-through"[40] with antibiotic treatments – "careless insertion of

[34] 'Mastitis Drug Labeling', *WF*, 07.04.1951, p. 45.
[35] Ibid.
[36] 'Service Bureau – Throw Away Milk After 'Treating'', *WF*, 05.05.1951, p. 40; for the rise of similar warnings in the national press see Chapter One, pp. 27 and 34.
[37] Smith-Howard, *Perfecting Nature's Food: A Cultural and Environmental History of Milk in the United States, 1900-1970*, p. 220.
[38] 'Don't Need Sows' Milk', *WF*, 01.12.1951, p. 8.
[39] Homer Hush, 'Makes Hogs Of Runts', *WF*, 05.05.1951, p. 8.
[40] 'Control Mastitis', *WF*, 02.06.1951, p. 50.

medication may do more harm than good."[41] Significantly, farmers were reminded that antibiotics would only reveal their true potential on hygienic intensive farms. Using antibiotics to maintain outmoded or unhygienic husbandry systems would not pay off: "drugs can't whip old lots."[42] As such advice indicates, agricultural commentators had already integrated antibiotics into an overarching vision of modern production. Frequently referring to Damon Catron, commentators hoped that rational antibiotic use would allow farmers to step into a new agricultural age.

During the 1950s, the poultry sector seemed to approximate the ideals of this new farming age most closely.[43] Using new breeds and employing mechanization, business integration and antibiotics on an unprecedented scale, the broiler industry managed to turn chicken meat into Americans' favourite animal protein. According to historian William Boyd, the US broiler industry experienced growth rates of ca. "7 percent per year between 1950 and 1999, while real prices of chickens declined by almost a third".[44] In agricultural magazines, enthralled articles praised the ruthless application of technology to overcome biological inefficiency. In 1951, *Wallaces Farmer* informed readers about antibiotic feeds and new methods requiring only "ten seconds per bird per day" and raising "flock profits by 110 per cent."[45]

Although poultry production is an extreme example, modernisation enthusiasm also exerted considerable pressure on other livestock sectors.

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[41] Ibid.
[42] John B. Herrick, 'Drugs Can't Whip Old Lots', *WF*, 18.08.1951, p. 32.
[43] William Boyd, 'Making Meat: Science, Technology, and American Poultry Production', *42,* Technology and Culture/4 (2001), Horowitz, 'Making the Chicken of Tomorrow. Reworking Poultry as Commodities and as Creatures, 1945-1990'.
[44] Boyd, 'Making Meat: Science, Technology, and American Poultry Production', p. 634.
[45] W.R. Whitfield, 'Ten Seconds Per Bird Per Day', *WF*, 21.07.1951, p. 36.

Sponsored by meat packer Swift & Company in 1951, a full-page advert in *Wallaces Farmer* called on farmers to throw aside fears of over-production and produce as much meat as possible. While prices could vary, the new ABC's of Animal Nutrition – A standing for antibiotics – would continue to guarantee rising production and profits: "all of this adds to the supply of meat for our people, and is the farmers' and ranchers' contribution to our country's strength."[46] According to Swift: "The problem's never surplus meat – you can't raise more than we can eat." [47]

However, Swift's trust in the ever-expanding girth of American stomachs proved misguided. Following the end of the Korean War, agricultural commodity prices began to sink and the Eisenhower administration became concerned about expensive agricultural subsidies. Between 1953 and 1954 alone, the CCC purchased $1.5 billion of agricultural surpluses. However, CCC purchases were no longer enough to shield farmers from a so-called cost-price squeeze: between 1950 and the mid-1950s, US farmers' average per capita disposable income fell from ca. 58 to 48% of non-agricultural disposable incomes. Forced to maintain price subsidies, the Eisenhower administration attempted to dispose of surpluses with the 1954 Food for Peace program – an opportune side effect of prevalent anti-Malthusian sentiments.[48] The 1956 Agricultural Act recycled the New Deal idea of paying farmers to reduce production. However, US agricultural production continued to grow by an annual average of 2.1% throughout the

[46] 'Commercial Swift & Company – New ABC's of Animal Nutrition', *WF*, 01.09.1951, p. 25
[47] 'Commercial Swift & Company – A Meaty Mouthful', Ibid.
[48] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 111.

1950s.[49] Its granaries overflowing and costs exploding, the US government abandoned all production controls in 1959.[50]

In agricultural magazines, commentators reacted to the growing cost-price squeeze by stressing the prevailing gospel of intensification. Once more, there seemed to be no alternative to the survival of the largest and most efficient. Writing for the *Farm Journal* and *Country Gentleman* in 1956, M.B. Russell mused that it was only a matter of time before the "food factory"[51] replaced conventional farms altogether. The poultry sector seemed to be a sign of things to come: by the early 1960s, vertically integrated agribusiness firms controlled ca. 90% of US broiler production.[52]

Interestingly, many agricultural commentators did not blame farmers' overproduction for the cost-price squeeze. Instead, they accused the federal government of either artificially restricting the agricultural market or of failing to sufficiently subsidise and market US produce.[53]

This tendency to displace blame shows that many farmers continued to see the 'factory farm' as a *u*- rather than a *dys*-topia. Throughout the 1950s, agricultural magazines celebrated farmers beating the squeeze through ingenuity and efficiency.[54] Being able to invest in technological intensification turned into a fundamental criterion for long-term agricultural survival. According to *Farm Journal and Country Gentleman*, the farmer Hugh Fussell was getting everything right:

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[49] Ibid., p. 121.
[50] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, p. 130.
[51] M.B. Russell, 'Food Factory Replace The Farm?', *Farm Journal and Country Gentleman* [In the following *FJ*], Jan 1956, p. 13; see also: Lorad D. Reiter, 'End of A Way of Life?', *FJ*, Nov 1956, p. 133.
[52] Boyd, 'Making Meat: Science, Technology, and American Poultry Production', p. 635.
[53] 'Time To Be Aggressive', *FJ*, May 1956, p. 210; 'All of Us – Mr. McMillen', *FJ*, Sept. 1956, p. 30.
[54] Dick Braun, 'This hogman is geared to meet the squeeze', *FJ*, May 1956, p. 43.

> Detroit's automobile factories have nothing on Hugh Fussell. This Georgia farmer raises hogs on a truly assembly-line basis. Every two weeks Fussell is on the market with 50 to 60 head of No. 1 hogs.[55]

Significantly, Fussell was also a "fanatic on disease control": every day, each of his finishing barn pens was cleaned and disinfected; Fussell's pigs were vaccinated, their "feeds [were] well laced with vitamins and antibiotics."[56]

As well as highlighting the unrelenting doctrine of technological intensification, the description of Fussell's hog farm reveals the extent to which antibiotics were underpinning further intensification. No longer an expensive miracle technology, antibiotics' inclusion into animal feeds was taken for granted. Of the 2 million pounds of antibiotics produced in the US in 1954, 490,000 were fed to livestock and poultry. By 1960, ca. 1.2 million pounds of antibiotics were annually fed to livestock and poultry.[57] In magazines, farmers were regularly informed about "mighty new germ killer[s]."[58]

A signifier and enabler of agricultural intensification, antibiotics' diffusion to further areas of food production fuelled the dilemma at the heart of US farming. In 1956, agricultural commentators interpreted the advent of antibiotic food preservation as a further step down the road to universal low-cost competition: "Acronize is doing it. The cheaper broiler areas can now sell anywhere. (…) It's now one big national market with broiler prices, like water, seeking one level."[59] However, growing economic pressure meant that farmers could hardly afford to stop and consider potential alternatives to the state-subsidised logic of intensification and the technologies and substances they were employing. As a consequence, a path dependency developed: falling prices led to

[55] Henry M. Simons, 'He sells hogs 24 times a year', *FJ*, Apr 1956, p. 56.
[56] Ibid., p. 56.
[57] Boyd, 'Making Meat: Science, Technology, and American Poultry Production', p. 248.
[58] 'Mighty New Germ Killer', *FJ*, Feb 1956, p. 160.
[59] Ray Dankenbring and Ovid Bay, 'New boost for broilers', *FJ*, Sept 1956, p. 41.

greater herd densities, which led to greater antibiotic-use. The resulting overproduction then re-triggered the same sequence of events.

Worryingly, agriculture's antibiotic dependency developed without anybody – least of all farmers – really understanding antibiotics' basic mechanisms or potential hazards. When the American public became more concerned about agricultural antibiotic use towards the end of the 1950s, US farmers' on-going antibiotic enthusiasm acquired an undercurrent of desperation and dependency.

In the case of the 1956 milk scandal, farmers were eager to prevent public challenges to agricultural antibiotic access. As a consequence, articles and advertisements in agricultural magazines exhorted dairy farmers to adhere to withdrawal times and identify bacterial strains prior to using antibiotics. Not only would cows recover more quickly, farmers would also stop paying for ineffective antibiotics: "… scientists say there are as many as 22 different kinds of 'bugs' that cause mastitis."[60] Significantly, one article warned that the FDA was merely asking "farmers to cooperate": "If that doesn't work, (…) they may either order that drug companies put dyes in mastitis treatments (…) or put a ban on penicillin."[61] Bolstered by sinking residue findings[62] and blaming black sheep, dairy farmers ultimately managed to avert antibiotic restrictions and magazines' residue-awareness campaigns soon declined.

However, magazines' renewed antibiotic endorsement could not disguise the fact that a storm was beginning to brew. During the late 1950s, a growing rift began to separate agricultural and non-agricultural communities. Initially

[60] 'Is this the only way to whip mastitis?', *FJ*, Aug 1956, p. 35.
[61] 'Finger Is Pointed At Penicillin In Milk', *FJ*, Sept 1956, p. 48.
[62] Smith-Howard, *Perfecting Nature's Food: A Cultural and Environmental History of Milk in the United States, 1900-1970*, pp. 222-24.

controversies focussed on the cost of agricultural subsidies. In this situation, American farmers reacted with extreme hostility to criticism from supposed outsiders. In 1959, *Wallaces Farmer* complained: "… vicious attacks on farmers and farm programs have become a popular pastime with some city people."[63] As further articles exhorting farmers to "help tell the true story"[64] and end "myths about farming"[65] show, US farmers remained proud of their production system. Although overproduction might be a problem, commentators agreed that hard-working farmers would survive the cost-price squeeze.[66] Reporting on Soviet leader Nikita Khrushchev's 1959 tour of Iowan farms, one article noted:

> The Russians are generally short of meat and oils. It's likely that Khrushchev also sees a real opportunity for use of surplus food in the cold war. That's why he wanted to come to Iowa. He was particularly interested in seeing how 10 to 12 percent of our population can feed the entire nation and produce a surplus besides. If Khrushchev could trim size of the food-producing group in Russia to a similar percentage, he would have more people free from food production to build factories and missles [sic] – perhaps even washing machines and automobiles.[67]

Already feeling misunderstood by subsidy-hostile "city folks,"[68] American farmers were further irritated by external attacks on agricultural chemicals. Commenting on the 1959 cranberry scare, *Wallaces Farmer* accused consumers and officials of stirring a "Big Ruckus" and publicizing the "incident entirely out of proportion to the dangers involved."[69] According to *Progressive* Farmer, FDA officials were guilty of spreading "fear and disfavour for the entire production of an industry."[70] Aware of intensive agriculture's chemical dependency, other

[63] 'Let's Answer City Critics', *WF*, 20.06.1959, p. 12.
[64] 'Farm-City Week', *WF*, 21.11.1959, p. 12.
[65] 'Myths about farming', *WF*, 19.09.1959, p. 82.
[66] Dick Albrecht, 'Can we save the family farm?', *WF*, 17.01.1959, p. 13; Clarence Poe, 'Should your family move to town?', *PF*, Mar 1960, p. 144.
[67] 'Khrushchev sees Iowa agriculture', *WF*, 03.10.1959, p. 8.
[68] 'Learn about City Folks – Tell Them About Farming', *PF*, Nov 1960, p. 110.
[69] 'Chemicals and Food', *WF*, 21.11.1959, p. 12.
[70] 'Cranberries an Example', *PF*, Jan 1960, p. 98.

articles were apprehensive about political reactions to on-going reside problems. In December 1959, *Wallaces Farmer* was sure that a bigger "clamp down on all farm chemicals"[71] was only a question of time. Referring to antibiotic residue detections, the magazine warned: "a small army of FDA inspectors (…) have orders from Washington to go from farm to farm, if necessary, to find violators."[72] Another report cautioned: "congressional investigators are quietly probing the whole question of agricultural chemicals."[73]

Even after the end of the cranberry scare, agricultural magazines were concerned about the persistence of public chemical fears. In 1960, *Progressive Farmer* warned: "the nation is being harassed by a number of food cranks who insist that a food is good only if no chemicals were used in growing it." [74] Equating patriotism with nutritional plenty, the magazine asserted:

> No nation in the world has a more abundant food supply, one that is cleaner, safer, or more nutritious than ours. (…) unless farmers look out, the 'food cranks' and other misinformed people may pressure Congress into passing unreasonable restrictions – restrictions that may do serious damage to our food supply and to national welfare...[75]

Reacting to the growing number of environmentalist bestsellers in 1962, *Wallaces Farmer* proclaimed a "new battle for farmers."[76] According to the magazine's editor, "a worrisome new movement appears to be gathering steam."[77] No longer limited to cranks, the movement included ordinary "people, well-meaning for the most part, who have become overly alarmed at our growing use of chemicals in food production."[78] On-going productivity depended on

[71] 'To clamp down on all farm chemicals', *WF*, 05.12.1959, p. 8.
[72] Ibid.
[73] 'Washington Report', *WF*, 19.12.1959, p. 4.
[74] 'Food Cranks Can Hurt Us', *PF*, Nov 1960, p. 110.
[75] Ibid.
[76] 'New Battle for Farmers', *WF*, 21.07.1962, p. 10.
[77] Ibid.
[78] Ibid.

farmers staying ahead of unpredictable nature: "It looks like a case of whether we eat or the bugs eat."[79]

However, US farmers' anger against 'cranks' did not mean that they took chemical hazards lightly. Exposed to the national media's cancer and residue warnings, the agricultural community embraced strategies to reduce personal health risks without foregoing chemicals' benefits.[80] During the 1960s, articles exhorted farmers to follow labelling instructions and protect their produce and health. Coupled with the on-going push for chemical intensification, these warnings could lead to curious results. In June 1960, an issue of *Progressive Farmer* contained two very different articles: whereas one commentator advocated using various chemicals to fight "yard pests"[81] on page 76, page 78 contained an article warning about "harmful residues"[82] of similar chemicals on home-grown fruits and vegetables. In 1961, *Wallaces Farmer* described the poisoning of 50 Iowan cattle as "a grim reminder of the danger of using farm chemicals improperly."[83] Three years later, the magazine conducted a poll to see whether chemical warnings had changed farmers' habits: half of the farmers' regularly using pesticides and insecticides reported having taken more precautions because of hazards to crop, livestock and personal health.[84] One interviewee confessed: 'These chemicals are beginning to scare me to death and I wouldn't be surprised if only experts will be allowed to apply them in the near future.'"[85]

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[79] Ibid.
[80] 'ISU exhibit: The safe and profitable use of farm chemicals', *WF*, 04.09.1965, p. 64.
[81] John H. Harris, 'Fight Yard Pests With Chemicals', *PF*, Jun 1960, p. 76.
[82] 'On Fruits And Vegetables – Avoid Harmful Residues', Ibid., p. 78.
[83] 'Read the label', *WF*, Aug 1961, p. 10.
[84] 'Wallaces Farmers Poll – How farmers handle chemicals', *WF*, 20.03.1965, p. 71.
[85] Ibid.

Despite such individual concerns, an overwhelming majority of farmers continued to rely on chemical helpers. Thirty years after the Great Depression, a mental trajectory of unconditional intensification had taken root in farmers' heads. Although a limited amount of environmentalist self-criticism was possible, the community would not tolerate criticism of the intensive system as such. Increasingly, the *telos* of the farm-as-factory deprived the agricultural community of the opportunity to modify a system that was leaving more and more farmers behind.

During the 1960s, US agriculture experienced another wave of intensification. Although the 1960 election had been fought around 'family farmers', the Kennedy administration did little to protect smaller farmers. Concerned about annual CCC expenditure of $4 billion and daily storage costs of ca. $1 million,[86] Kennedy established the US food stamp program and expanded the Food for Peace and schools' lunch and milk programs. In addition to reducing the existing surplus, the Kennedy administration reduced both total US acreage and the quantity of marketed produce.[87] Once again, large producers benefited most from federal measures.[88] With polls showing that farmers themselves were upsizing their definition of a 'family farm'[89] the total number of US farms decreased from 3,710,503 to 2,730,250 and average farm size increased from 302.8 to 389.5 acres between 1959 and 1969.[90]

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[86] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 123.
[87] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, pp. 130-31.
[88] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, pp. 125-32.
[89] 'Question: How big are family farms?', *WF*, 16.01.1965, p. 9.
[90] United States Department Of Commerce, Social and Economic Statistics Administration, and Bureau Of Census (eds.), *1969 Census of Agriculture. Volume Ii General Report: Use of Land, Size of Farm* (2, 1973), p. 11.

Propagating unconditional intensification,[91] US agricultural magazines continued to feature numerous commercials praising AGPs and therapeutic antibiotic mixes. Increasingly, antibiotics were sold as risk insurance. In times of tough competition and shrinking profit margins, herd productivity was vital and disease-induced losses potentially crippling. Who could blame farmers if – for their peace of mind – they paid a little extra for the prophylactic, continuous medication of their herds with antibiotics? According to American Cyanamid commercials, 'Aureomycin crumbles' helped farmers profit "on Hogs Expected To Be Losses"[92] and worked "on any kind of ration" to "help keep your cows healthy."[93] Producing both hormones and antibiotics, Pfizer began to advertise combination feeds containing Terramycin and the carcinogenic hormone DES.[94] Companies like Merck, Elanco, Kraft, Quaker Oats, Gooch's Best, Nutrena and Murphy's marketed antibiotic "Hog Spotlights," "Pig Starting Package[s]"[95] to "slash farrowing-to-weaning cost 4 ways"[96] and "Pro-Strep" to "promote growth and protect health at lower cost."[97]

With herd sizes increasing further, the logic of antibiotics as a profit guarantee also became a prominent theme in agricultural reporting.[98] Articles reiterated Damon Catron's message that antibiotics worked best for specialised modern producers, who fed the right drug mix during every stage of animals' life cycle. According to *Wallaces Farmer*, top farmers had feed costs as low as $13.50

[91] Dick Humphrey, 'Automatic Feeding boosts Profits', *PF*, Apr 1960, pp. 104-105; 'Hunger: greater problem than the bomb', *WF*, 02.10.1965, p. 12.
[92] 'Commercial Cyanamid', *PF*, Jan 1960, p. 7.
[93] 'Commerical Cyanamid', *WF*, 21.01.1961, p. 8.
[94] 'Hormone-antibiotic combination', *WF*, 04.03.1961, p. 86.
[95] 'Commercial Nutrena', *WF*, 04.02.1961, p. 4.
[96] 'Commercial Murphy's', *WF*, 04.02.1961, p. 10.
[97] 'Commercial Merck', *WF*, 18.03.1961, p. 68.
[98] Cy Watkins, 'I was just figuring', *PF*, Feb 1960, p. 10; 'Creep feeding baby pigs', *WF*, 20.03.1965, p. 97.

per 100 pounds of hogs whereas "poorer" producers had costs of $18.60.[99] Increasingly, such a cost difference was decisive for producers' survival.

Given farmers' growing antibiotic dependency, agricultural discussions of antibiotic hazards remained rare. Most critical articles focussed on antibiotic residues. Remembering the milk and cranberry scares, the agricultural community was keen to avoid further residue scandals but criticized supposed federal paternalism.[100] In 1962, *Wallaces Farmer* complained about the "'ridiculous' (…) Delaney roadblock in the case of drugs which neither harm the animal nor leave a residue."[101] Articles addressing bacterial resistance remained rare and continued to uphold the epistemic divide between human and animal medicine. In 1961, *Wallaces Farmer* reported on antibiotic resistance in hospitals and hoped that the introduction of "a new penicillin, Staphicillin," would defeat "resistant bugs."[102] One year later, the journal had similar hopes for "Prostaphilin"[103]. Agricultural contributions to antibiotic resistance were not discussed.

Awareness of microbiological hazards resulting from agricultural antibiotic use gradually rose during the second half of the 1960s. However, even then, resistant bacteria were seen more as a management problem than a phenomenon that might challenge agricultural antibiotic use. In August 1965, *Wallaces Farmer* reported on *Salmonella* problems in the egg industry and recommended amongst other measures "preventive medication at all three

[99] 'Feed costs', *WF*, 20.02.1965, p. 48; see also: 'Tips for starting pig business – Number 8', *WF*, 04.02.1961, p. 16; 'Commercial Cyanamid – Coordinated Feed-Health Program', *WF*, 04.03.1961, p. 39; Newt Hawkinson, 'Management tips to help you. Get cattle off to a good start', *WF*, 02.09.1961, p. 26; 'Antibiotics at breeding boosts pig numbers', *WF*, 18.11.1961, p. 36.
[100] 'Can You Guarantee Milk Has No Residue?', *PF*, Aug 1960, p. 8.
[101] 'New FDA rules will affect you!', *WF*, 01.09.1962, p. 8.
[102] 'News of new penicillin', *WF*, 04.03.1961, p. 37.
[103] 'Staph Pill', *WF*, 03.11.1962, p. 43.

levels of production."[104] Farmers were assured that medicated feeds produced "little or no resistance, even when used over long periods of time."[105] Potential implications of resistant *Salmonella* for human health were not discussed. In other articles, bacterial resistance arising from agricultural antibiotic-use was only mentioned indirectly.[106] In November 1965, Iowa State University animal nutritionist Virgil Hays was convinced that "antibiotics are definitely of value in 98 percent of our farm situations."[107] Although he noted that many farmers were using higher-dosed AGPs, Hays explained rising dosages not with bacterial resistance but with sinking antibiotic prices.

Hays' sanguine attitude seemed justified following the FDA's ad hoc report on veterinary and non-veterinary antibiotics, published in August 1966. Commentators were happy to report: "scientific data now available do not show any reason for alarm."[108] Mostly unaffected by the ban of antibiotic preservatives,[109] commentators were confident that the FDA would not ban other forms of antibiotic use. Despite increasing public criticism of agricultural chemicals, the FDA's report made farmers confident that existing antibiotic use was safe. The trajectory of antibiotic-fuelled intensification remained unchallenged by farmers or regulators. A chance for reform was missed and the selection for bacterial resistance continued unchecked.

[104] 'Salmonella threaten Iowa egg industry', *WF*, 21.08.1965, p. 51.
[105] Ibid.
[106] 'Visit with your vet', *WF*, 04.09.1965, p. 30; 'Visit with your vet', *WF*, 18.09.1965, p. 75.
[107] 'Antibiotics', *WF*, 20.11.1965, p. 24.
[108] 'FDA Gets Calls, But Data Show No Need for Alarm', *Feedstuffs*, 27.08.1966, p. 1.
[109] 'Little or No Use Of Antibiotics as Preservatives Noted', Ibid., p. 8.

Chapter Three: Regulation – protecting producers from consumers

With its 1966 report on veterinary and non-veterinary antibiotics, the FDA not only indicated that the risks of US agriculture's growing antibiotic dependency could be contained. By emphasizing antibiotic residues at the expense of bacterial resistance, the FDA also confirmed concerns about the chemical contamination of food and bodies.

In many ways, this emphasis on residues came naturally to an agency whose history had been strongly influenced by the fight against toxic adulterants.[1] Since the early 20th century, US regulatory efforts were increasingly influenced by a philosophy of threshold models. Drawing analogies with bacteriology, industrial hygienists asserted that humans' inevitable exposure to chemicals only became dangerous once it toppled the body's 'natural homeostasis'. If it remained below this threshold, chemical exposure was acceptable. Competing against industry-sponsored research, officials tried to establish the point at which 'natural' chemical exposure turned into 'unnatural' exposure.[2]

In 1938, officials in the recently renamed Food and Drug Administration were significantly strengthened by the Federal Food, Drug, and Cosmetic Act (FDC). Passed in the wake of the 1937 sulphanilamide tragedy, the FDC required manufacturers to file so-called New Drug Applications (NDAs) prior to marketing drugs. NDAs would contain information on drugs' composition, manufacturing process, intended use and evidence of safety. Upon receiving NDAs, the FDA

[1] Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, p. 75 and 80.; Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, pp. 19-21.
[2] Sellers, *Hazards of the Job. From Industrial Disease to Environmental Health Science*, pp. 194-95; 198-201; 211-20, Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, pp. 21-27.

would have at least sixty days to evaluate the submitted evidence and approve or deny NDAs.[3] Transferred from the USDA to the Federal Security Agency in 1940, the FDA would thus act as a gatekeeper for US drugs. Although the FDC's NDA requirements did not cover pesticides and chemical food additives,[4] the FDA used legal grey areas to issue guidelines for animal tests to evaluate drugs' and chemicals' long-term effects.[5]

From the 1940s, Americans were thus protected by a unique organisation whose unified responsibilities for consumer protection, food security and drug regulation contrasted strongly with the fragmentation of responsibilities in other countries. Initially focussing on preventing or minimizing exposure to toxic – and later carcinogenic – substances, the FDA's regulatory framework, however, proved self-confining when it came to addressing the hazards of supposedly non-toxic or non-carcinogenic substances.[6]

The FDA's early emphasis on toxic hazards becomes evident in its policies regarding sulphonamide and antibiotic feeds. In the case of potentially toxic sulphonamide feeds, the FDA was not only eager to prevent farmers from accidentally poisoning animals and consumers but also wanted to prevent the misuse of agricultural drugs for human self-medication. Concerns about resistance selection were not expressed. In mid-1949, the FDA restricted farmers' access to pure sulphonamides, established compulsory sulpha concentrations for pre-mixed feeds and mashes to prevent toxic residues and

[3] Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, pp. 26-27. Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, pp. 73-75.
[4] Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, p. 27.
[5] Sellers, *Hazards of the Job. From Industrial Disease to Environmental Health Science*, pp. 216-20. Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, pp. 156-75.
[6] Nancy Langston and Sarah Vogel have highlighted the FDA's selective focus for other substances; see also: Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*.

attempted to educate farmers on the proper use of sulpha products via mandatory safety labels.[7] FDA officials soon applied virtually the same regulatory mould to antibiotic feeds. As the near absence of documents discussing antibiotic allergies and bacterial resistance shows,[8] the regulatory focus on toxic residues allowed non-toxic, non-carcinogenic AGPs to fly under FDA officials' hazard radar.

A similar prioritisation of hazards characterised discussions in Congress. Despite hearing evidence on bacterial resistance selection and the allergenic effects of antibiotic residues in 1950,[9] James Delaney's Select Committee on chemicals in food production did not include agricultural antibiotic use in its final report.[10]

As a consequence, the FDA's licensing of AGPs went ahead. In April 1951, the FDA legalised the already booming market for antibiotic/APF-feeds by publishing guidelines for the inclusion of penicillin, streptomycin, di-hydro-streptomycin, chlortetracycline, chloramphenicol and bacitracin into feeds in the *Federal Register*. If used solely as feed supplements and not as therapeutics, antibiotics were exempted from both NDA and batch certification requirements.[11]

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[7] FDA State Cooperation Information Letter No. 16, Jul 27, 1949, Folder 432.73-11-432.97-.10, Box 1160, FDA General Subject Files [In the following GS], Decimal Files [DF] A1/Entry 5, Record Group [RG] 88, National Archives and Records Administration, College Park [NARA].
[8] Mark Finlay also commented on the FDA's "moderate scrutiny" towards agricultural antibiotics; Mark R. Finlay, 'Battles over Agricultural Antibiotics in the United States and Western Europe', in Christoph Gradmann and Flurin Condrau (eds.), *Antibiotics* (Upcoming), p. 14.
[9] 'Chemicals in Food Products', *House Select Committee To Investigate The Use Of Chemicals In Food Products* (House of Representatives; Washington DC: Government Printing Office, 1951), pp. 129, 31, 496.
[10] Select Committee to Investigate the Use of Chemicals in Food Products, 'Investigation of the Use of Chemicals in Food Products', *Union Calendar* (Washingon DC, 1951).
[11] 16 Federal Register [in the following Fed. Reg.], 3647-3648 (Apr. 28, 1951); also see Lisa Heinzerling, 'Undue Process at the Fda', *Georgetown Public Law and Legal Theory Research Paper No. 13-016,* (2013).

Although they had already been forced to reform labelling requirements for mastitis treatments because of residues in 1951,[12] FDA officials actively supported further widening farmers' access to antibiotics in 1952. Reacting to a "movement on the part of veterinarians" to restrict laypersons' access to antibiotics, officials noted: "this Administration has always insisted that drugs for veterinary use, to the extent practicable, be not restricted to professional use."[13] According to the FDA's Deputy Commissioner George P. Larrick:

> We have consistently followed the course of placing no obstacles in the way of self-medication when the medicines employed can be safely and intelligently used by lay persons. The same principles apply to our regulation of livestock remedies.[14]

In addition to reducing veterinarians' control over the animal health market,[15] the FDA also attempted to remove regulatory barriers for feed manufacturers. Initially, each batch of an antibiotic feed "containing therapeutic levels of drugs for therapeutic purposes as a new drug"[16] had to be certified individually by the Division of Antibiotics. Because such a procedure "would be impracticable and (…) the cost to each feed manufacturer would make it prohibitive"[17], the FDA exempted low-dosed feeds for therapeutic purposes from NDA and batch certification requirements in 1953.[18]

While its licensing decisions led to a rapid expansion of the agricultural antibiotic market during the 1950s, the FDA had hardly any control over actual

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[12] J.H. Collins, 'The Problem of Drugs for Food-Producing Animals and Poultry', *Food Drug Cosmetic Law Journal* 6/November (1951), pp. 876-77.; Smith-Howard, *Perfecting Nature's Food: A Cultural and Environmental History of Milk in the United States, 1900-1970*, pp. 223-24.
[13] H.E. Moskey to George P. Larrick, Oct 2, 1952, Box 1560, GS, DF A1/Entry 5, RG 88, NARA.
[14] Geo P. Larrick to WP Bomar, Oct 3, 1952, Ibid.
[15] Susan. D. Jones, *Valuing Animals. Veterinarians and Their Patients in Modern America* (London and Baltimore: Johns Hopkins University Press, 2003), p. 104.
[16] HE Moskey to CE Lee, Jul 16, 1952, Folder 432.97.10-435, Box 1560, GS, DF A1/Entry 5, RG 88, NARA.
[17] Ibid.
[18] 18 Fed. Reg., 2335-2336 (Apr 22, 1953); Heinzerling, 'Undue Process at the Fda'.

antibiotic use and could do little more than hope that manufacturers and farmers would follow official guidelines and labels. Even if officials had evidence of feedstuff violations, US attorneys could be reluctant to prosecute offenders.[19] Securing voluntary compliance was not easy either and FDA officials could be forced to compromise rules.[20]

The FDA's regulatory position was particularly complicated in the case of antibiotic residues. Although it was neither able to monitor the national meat supply or enforce guidelines, the FDA reacted to an increasing number of licensing requests and new legislation by delineating boundaries within which antibiotic risks were proverbially 'tolerated' and became 'safe'.[21] Because there was no objective way to define the exact boundary between tolerable risk and intolerable hazard, FDA officials had to strike a delicate balance between industrial demands, consumer concerns and the cultural values attached to different agricultural products. As evidenced by divergent FDA tolerance policies for milk as opposed to meat, fish and plants, such negotiations could lead to paradoxical results.

Initially, the FDA had opposed residue tolerances. In 1953, health officials had warned that the direct or indirect addition of antibiotics to human food could be deemed an adulteration under section 402 of the FDC. However, the HEW announcement was almost immediately weakened by the passage of the 1954 Miller Pesticides Chemical Amendment. According to the Miller

[19] AE Rayfield to Atlanta District, Jul 8, 1949, Folder 432.10-432.4, Box 1160, GS, DF A1/Entry 5, RG 88, NARA; LD Elliott to St. Louis District Administration, Oct 11, 1949, ibid.
[20] HE Moskey, 'Memorandum of Interview', Apr 08, 1949, Folder 432.73-.11 – 432.97-.10, Box 1160, GS, DF A1/Entry 5, RG 88, NARA; Moseky to CE Lee, Jul 16, 1952, Folder 432.97.10-435, Box 1560, GS, DF A1/Entry 5, RG 88, NARA.
[21] For similar processes in other 'risk industries' see Boudia and Jas (eds.), *Powerless Science? Science and Politics in a Toxic World*.

Amendment, officials had to distinguish between antibiotic residues resulting from the use of antibiotics as pesticides (i.e. to control bacteria on raw agricultural commodities) and the use of antibiotics in or on processed food. In the case of raw food, antibiotics fell under the Miller Amendment and manufacturers were allowed to apply for official residue tolerances. In the case of processed foods, tolerance applications were more difficult because section 406 of the FDC required proof that an added chemical was necessary in the production of a certain food.[22]

By 'tolerating' residues on raw food, the Miller Amendment opened the door for antibiotic food preservation. Following a series of studies, the FDA legalised the preservation of poultry meat with chlortetracycline (American Cyanamid's 'Acronize') in November 1955 and with oxytetracycline (Pfizer's 'Biostat') in October 1956.[23] Tolerances of 7 parts per million (ppm) were established for both substances on raw poultry. Convinced that cooking would destroy residues,[24] regulators no longer guaranteed 'pure' meat but made consumers responsible for preparing poultry in a way that would destroy legal, yet undesirable residues. In 1959, the FDA legalised similar tolerances for the preservation of fish via antibiotic ice or dipping solutions.[25] Scallops and shrimp

[22] William A. Randall, 'Antibiotic Residues', *Proceedings First International Conference On The Use Of Antibiotics In Agriculture* (Washington DC: National Academy of Sciences - National Research Council, 1956), pp. 262-63.
[23] 20 Fed Reg., 8776 (Nov 30, 1955); 21 Fed. Reg., 8104 (Oct 23, 1956).
[24] Ibid.
[25] 'Excerpts From Report on Antibiotics Prepared for the FDA', *NYT*, 22.08.1966, p. 28; 'Proceedings First International Conference on the Use of Antibiotics in Agriculture', *First International Conference On Antibiotics In Agriculture* (National Academy of Sciences - National Research Council, 1955), p. 199.

could also be preserved via antibiotics.[26] Preservation trials for milk, beef and eggs were ultimately abandoned.[27]

Following the Miller Amendment, the FDA also licensed mostly streptomycin-based antibiotic sprays and paints for use against bacterial plant infections. Once again, the licensing-process was rapid. Following reports on potential uses of antibiotics against plant pathogens in 1952, 1953 saw the first use of streptomycin to control bacterial infections of apples and pears in Missouri.[28] By 1955, antibiotic sprays had been licensed to combat bacterial blight in apples, pears, walnuts, peaches and beans and for use against other bacterial diseases affecting tobacco, tomatoes, peppers, cherries, spinach, lettuce and potatoes.[29]

Retrospectively, perhaps the most bizarre expansion of antibiotic use was the preservation of whale meat via antibiotic injections and exploding harpoons. Tested by Pfizer in Norway and Iceland, harpoons loaded with oxytetracycline-based 'Biostat' were supposed to explode and release antibiotics into whales' circulatory system and preserve their meat. It was hoped that antibiotic-preservatives would allow whale meat to "become plentiful in [American] grocery stores."[30]

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[26] 'Excerpts From Report on Antibiotics Prepared for the FDA', *NYT*, 22.08.1966, p. 28.
[27] F.E. Deatherage, 'The Use of Antibiotics in the Preservation of Foods Other Than Fish', *Proceedings First International Conference On The Use Of Antibiotics In Agriculture* (Washington DC: National Academy of Sciences - National Research Council, 1956), p. 221.
[28] W.J. Zaumeyer, 'Improving Plant Health with Antibiotics', ibid., pp. 172-73.
[29] William A. Randall, 'Antibiotic Residues', ibid., p. 260.
[30] Trials were conducted at the Norwegian whaling station in Steinchman; 'Antibiotics Used To Preserve Food', *NYT*, 20.10.1956, p. 29; also see: WHO, 'The Public Health Aspects of the Use of Antibiotics in Food and Feedstuffs', *World Health Organization Technical Report Series* (Geneva: WHO, 1963), p. 9, Johan Nicolay Tønnessen and Arne Odd Johnsen, *The History of Modern Whaling*, trans. R.I. Christophersen (Berkeley And Los Angeles: University of California Press, 1982), p. 694.

Increasingly 'tolerated' on raw plants, fish and poultry, antibiotics' illegal presence in other foodstuffs also grew. Running on 1940's budgetary and manpower levels in 1955,[31] the FDA was unable to effectively combat illegal antibiotic residues. Bad licensing decisions compounded residue problems. In late 1955, an official from the FDA's Division of Antibiotics warned about the possible "exposure of large segments of the population to a multiplicity of antibiotics":

> …it was discovered that tens of thousands of chickens were being injected in the neck tissues with a preparation which left an insoluble residue of active drug. (…). It was further found that when such antibiotic containing tissue was baked or fried the concentration of drug was not appreciably diminished...[32]

Challenging the FDA's philosophy of acting as a licensing gatekeeper and trusting in compliance with labels and guidelines, early reports on illegal residues in meat failed to cause an uproar because of the on-going belief that health hazards resulting from exposure to low antibiotic concentrations were negligible.[33] As a result of the Miller Amendment, the years following 1953 saw the gradual normalisation of 'safe' amounts of antibiotics in or on American meat, fish and plants. As long as antibiotics degraded before being consumed, officials saw no reason to deny industry applications for antibiotic preservatives and sprays. Illegal residues were not perceived to challenge FDA policies.

In striking contrast to the gradual normalisation of residues in US meat and fish, antibiotic residues in raw or pasteurized milk remained culturally and officially taboo. The FDA had been aware of antibiotic residues in milk since 1948 and began to sample a variety of milk products for residues in 1954.

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[31] 'Fda's 1967 Look after 60 Years of Reoganization', *FDA Papers,* 1/1 (1967), p. 10.
[32] Randall, 'Antibiotic Residues', p. 262.
[33] 'Proceedings First International Conference on the Use of Antibiotics in Agriculture', pp. 277-78.

Initially, 3.2% of samples tested positive for penicillin residues.[34] One year later, 11.6% of samples tested positive. Alarmed, the FDA asked medical experts for an assessment of possible dangers.[35] In contrast to contemporary opinions regarding residues in meat, the experts warned: "the ingestion of the amounts of penicillin found in milk might conceivably cause a reaction in an extremely sensitive individual."[36] By 1957, the FDA mandated that labels on withdrawal times be printed on drug containers and limited mastitis medications to a maximum of 100,000 units per dose – instead of the 1,500,000 units per dose used by some veterinarians and farmers. Although residue detections sunk to 3.7% of samples in 1958,[37] the FDA was forced to concede that educational and labelling measures alone would not suffice and decided to pioneer a sanction-based interstate monitoring program for penicillin residues in milk in 1959.[38] The FDA's penicillin testing program was so successful that detection rates fell to 0.5% of tested samples in the late 1960s.[39]

Resulting in the installation of active enforcement and residue monitoring well ahead of other foodstuffs, the example of milk shows how cultural notions of purity strongly affected official antibiotic regulation. US scientists, consumers and farmers all agreed that antibiotic residues in milk were taboo. By contrast, residues of the same substances were 'tolerable' in meat, fish and plants because these foodstuffs were not hedged by the same cultural taboo. Far from

[34] Randall, 'Antibiotic Residues', p. 261.
[35] Henry Welch, 'Antibiotics in Food Preservation. Public Health and Regulatory Aspects', *Science,* 126/3284 (1957), p. 1160.
[36] Randall, 'Antibiotic Residues', p. 262.
[37] Smith-Howard, *Perfecting Nature's Food: A Cultural and Environmental History of Milk in the United States, 1900-1970*, pp. 224-26.
[38] Smith-Howard, 'Antibiotics and Agricultural Change: Purifying Milk and Protecting Health in the Postwar Era', pp. 339-40.
[39] W.G. Huber, 'The Impact of Antibiotic Drugs and Their Residues', *Advances In Veterinary Science and Comparative Medicine,* 15 (1971), p. 107.

'rationally' weighing substances' risks and benefits, regulatory decisions mirrored – and often strengthened – societal risk cultures.

Significantly, bacterial resistance did not fit into established cultural narratives of chemical risk and FDA officials remained under little pressure to address the selection for resistance via agricultural antibiotic use. Contemporary expert opinion did little to challenge this complacency. Speaking at the 1955 International Conference on Agricultural Antibiotic Use, the already familiar infectious disease expert and critic of fixed-dose antibiotic combinations, Maxwell Finland, upheld an epistemological divide between bacterial resistance in humans and animals: "In contrast to the human experience, disease-producing strains have not been found to emerge among the types of animals that are raised primarily for market on antibiotic-supplemented feeds."[40] According to Finland, AGPs were too low dosed to create harmful resistance.[41]

In view of his influential contemporaneous attacks on 'irrational' medical antibiotic use, Finland's uncritical view of agricultural antibiotic-use seems strange.[42] However, it can be explained by his close contacts to industry. After being asked to present a "critical review on 'Emergence of Resistant Strains in Chronic Intake of Antibiotics"[43] at the upcoming NAS conference, Finland had contacted AGP-co-discoverer Thomas (Tom) Jukes at Cyanamid's Pearl River facilities. 'Tom' was only too happy to supply 'Max' with published and

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[40] Maxwell Finland, 'Emergence of Resistant Strains in Chronic Intake of Antibiotics. A Review. ', *First International Conference On Antibiotics In Agriculture. 19-21 October 1955* (National Academy of Sciences - National Research Council, 1956), p. 251.
[41] 'Proceedings First International Conference on the Use of Antibiotics in Agriculture', pp. 265-78.
[42] Scott Podolsky has published an excellent account of Finland's regulatory impact; Scott H. Podolsky, *The Antibiotic Era: Reform, Resistance, and the Pursuit of a Rational Therapeutics* (2015 (forthcoming)), p. 283.
[43] Countway Library of Medicine [in the following CLM] Maxwell Finland Papers [in the following FP], Series VIII, Box 13, Folder 51, Paul Weiss to Maxwell Finland (Jun 10, 1955).

unpublished data, slides and a copy of his unpublished book *Antibiotics in Nutrition*,[44] which subsequently provided the "main source"[45] for Finland's bibliography. Driven from New York to Pearl River via company limousine,[46] Finland also talked to other Cyanamid researchers and was allowed to borrow company figures and slides, which he subsequently failed to return.[47] Speaking at the conference a few weeks later, Finland in effect presented a Cyanamid-review of antibiotic hazards.

Finland's case was not unique. Assembling the international *crème-de-la-crème* of antibiotic expertise, the entire 1955 conference had been lavishly financed by the pharmaceutical industry: companies sponsored cocktail receptions, hotel expenses and a seven day post-conference tour of the US for speakers with diverse recreational activities.[48] The first – and for a long time only – conference of its kind, the 1955 NAS meeting had lasting effects on perceptions of antibiotic risk and forged a community of industry-friendly experts.

With the exception of milk, the FDA was thus under little pressure to rethink agricultural antibiotic policies. In September 1958, the new Food Additives Amendment further normalised the presence of 'safe' chemical residues in American meat. Although it prohibited the use of inadequately tested or carcinogenic additives, the Amendment specifically charged the FDA with

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[44] CLM FP, Series VIII, Box 13, Folder 51, Thomas Hughes Jukes to Maxwell Finland (Jul 1, 1955); Jukes to Finland (Jul 11, 1955).
[45] CLM FP, Series VIII, Box 13, Folder 51, Finland to Jukes (Jul 14, 1955); also see CLM FP, Series VIII, Box 13, Folder 51, Finland to Damon Catron (Aug 22, 1955).
[46] CLM FP, Series VIII, Box 13, Folder 51, Margarete [Framel] (Secretary to Dr. Jukes) to Maxwell Finland (Aug 9, 1955).
[47] CLM FP, Series VIII, Box 13, Folder 51, HP Broquest to Finland (Aug 31, 1955); Finland to Jukes (undated), enclosed in: Margarete [Framel] (Secretary to Dr. Jukes) to Finland (Aug 9, 1955).
[48] CLM FP, Series VIII, Box 13, Folder 51, International Conference on the Use of Antibiotics in Agriculture. Information for Invited Participants; also see [Booklet] 'In Honor of The Participants in The International Conference On the Use of Antibiotics in Agriculture'.

establishing safe conditions of use and residue tolerances for approved additives. Any veterinary drug leaving residues in food was to be treated as an additive.[49] FDA officials were also tasked with compiling a list of substances, which were Generally Recognized As Safe (GRAS) via scientific consensus or long experience. GRAS substances would not require NDA certification.[50] A so-called 'Grandfather Clause' also exempted NDAs licensed prior to 1958 from toxicity and residue reviews.[51] Regulations for agricultural antibiotics remained unchanged with 7ppm tolerances existing for chlortetracycline and oxytetracycline residues.[52]

Although it changed little regarding agricultural antibiotics, the 1958 Amendment's attempt to create a comprehensive framework for the evaluation and regulation of food additives pushed the FDA to its organisational limits. NDAs were generally approved on a case-by-case basis and manufacturers had to file cumbersome supplemental NDAs if they changed any component of accepted NDAs. Faced with rapid pharmaceutical and chemical innovation, officials were already struggling to keep up with licensing applications. As a consequence, the additional pre-licensing data on the occurrence and harmfulness of drug residues and efficacy reviews of drugs added to food and water[53] threatened to break the back of an already overstrained licensing system.

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[49] Walter Moses to Constance Winslade, Jun 21, 1961, Folder 432.1-10 Jan-Dec, Box 3041, GS, DF A1/Entry 5, RG 88, NARA, p. 1.
[50] ''Significant Dates in Us Food and Drug Law History'', *FDA History* (http://www.fda.gov/AboutFDA/WhatWeDo/History/Milestones/ucm128305.htm [accessed: 26.09.2014]), Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 35.
[51] Walter Moses to Constance Winslade, Jun 21, 1961, Folder 432.1-10 Jan-Dec, Box 3041, GS, DF A1/Entry 5, RG 88, NARA, p. 2.
[52] Donald C. Grove to John A. Foster, Oct 2, 1961, Folder 432.1 June-Dec, Box 3040, GS, DF A1/Entry 5, RG 88, NARA; detailed residue concentrations in different tissues are listed in: §121.1014 Tolerances for residues of chlortetracycline, Subpart D – Food Additives Permitted in Animal Feed or Animal-Feed Supplements, Reissued Mar 20, 1962, Folder PA 190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, p. 7.
[53] Bill V. McFarland to Robert E. Rust, Dec 2, 1959, ibid; required data was listed in Form FD-356; Homer R. Smith to Emil Lienert, [undated], ibid., p. 1; JF Robens to Antonio Santos Ocampo, Oct

The 1958 Delaney Clause further complicated matters: although NDAs for the carcinogen DES were no longer approved, FDA officials were unable to revoke existing DES NDAs, which fell under the 'Grandfather Clause'.[54] As a consequence, manufacturers with old NDAs continued to sell DES feeds.[55] The already confused situation was not made easier by the growing divergence between federal and state laws. Prior to the 1958 Amendment, individual states had based their feed laws on the federal Uniform Feed Bill. However, controversies over DES made the Uniform Feed Bill Committee reject updated federal provisions in October 1959. As a consequence, state laws began to differ from federal laws. This in turn increased the bureaucratic pressure on FDA officials because many local feed merchants were now forced to clear their products directly with Washington.[56]

In the case of agricultural antibiotics, the combination of stricter licensing requirements, GRAS exceptions and the flood of new products resulted in a byzantine nightmare, which was further complicated by the absence of an official compendium of medicated feed rules.[57] Following antibiotics' advent, the FDA had mandated individual batch certifications for so-called certifiable antibiotics like penicillin, chloramphenicol, bacitracin, chlortetracycline and streptomycin. Batch certification requirements had been waived for most low level feeds below

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02, 1961, Folder 432.1 June-Dec, Box 3040, GS, DF A1/Entry 5, RG 88, NARA; efficacy reviews had already been required for some antibiotics under the pre-existing antibiotic regulations.

[54] Walter R. Moses to Constance Winslade, Jun 21, 1961, Folder 432.1-10 Jan-Dec, Box 3041, GS, DF A1/Entry 5, RG 88, NARA, p. 2.

[55] FW Quackenbush to Charles Durbin, July 15, 1959, Folder 432.1-432.1-11, Box 2668, GS, DF A1/Entry 5, RG 88, NARA.

[56] FW Quackenbush, 'Will New Registrations Be Accepted Next Year For Feeds Which Contain Arsenicals And Hormones?', enclosed in: FW Quackenbush to Howard J. Benson, Oct 23, 1959, ibid.; Homer R. Smith to Emil Lienert, [undated], Folder PA 190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, pp. 1 &3.

[57] Hubert S. Spungen to Brandenburg Brothers, Apr 12, 1966, Folder 88-75-1, Box 3846, GS, DF A1/Entry 5, RG 88, NARA.

50 grams/ton in 1951 and 1953.[58] Where requirements had not been waived, manufacturers had to file a so-called Form 10 with the FDA, which was identical to an NDA but required additional proof of efficacy. However, a different set of regulations applied to preparations containing non-certifiable antibiotics, which had to be licensed via an NDA. This continued to be the case for tylosin, hygromycin, novobiocin, oleandomycin and nystatin. However, in the case of oxytetracycline, neomycin and several sulphonamides, long-standing experience turned them into GRAS drugs after 1958. Producers could use these drugs according to GRAS guidelines without filing extra Form 10 or NDA applications.[59] For ordinary mortals, the distinctions between certifiable, non-certifiable and GRAS antibiotics were confusing to say the least.[60]

AGP labelling rules proved even more arcane: in order to stop producers from advertising excessive amounts of antibiotics, the FDA had banned quantitative antibiotic listings on AGP labels in October 1953.[61] However, many manufacturers did not know how AGP labels should look[62] and some used the absence of quantitative labelling to sell deficient feeds.[63]

Naturally, frustration soon ran high. After a meeting of the Pharmaceutical Manufacturers Association in April 1959, a representative noted:

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[58] 16 Fed. Reg., 3647-3648 (Apr. 28, 1951); 18 Fed. Reg., 2335-2336 (Apr 22, 1953); also see: Homer R. Smith to Emil Lienert, [undated], Folder PA 190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, p. 1.
[59] Enclosure: 'Drugs and Feed Additives', in, LaVerne C. Harold, 'Memo', enclosed in: Homer R Smith to PE Poss, Oct 29, 1962, Folder 70A190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, pp. 2 & 43.
[60] Paul M. Sanders, 'Summary of some Differences and Sources of Confusion Within the [FDA] and their Jurisdiction over Medicated Feeds', Apr 08, 1959, enclosed in: SF Kern to Commissioner FDA, Apr 14, 1959, Folder 432.1-432.1-11, Box 2668, GS, DF A1/Entry 5, RG 88, NARA, p. 2.
[61] William E. Jester to Robert S. Roe, 'Office Memorandum – Medicated Feeds', Jul 10, 1959, ibid, p. 3.
[62] Paul M. Sanders, 'Summary of some Differences and Sources of Confusion Within the [FDA] and their Jurisdiction over Medicated Feeds', Apr 08, 1959, enclosed in: SF Kern to Commissioner FDA, Apr 14, 1959, Folder 432.1-432.1-11, Box 2668, GS, DF A1/Entry 5, RG 88, NARA.
[63] Charles G. Durbin to Office of the Commissioner, Jul 5, 1960, Folder 432.1 Dec.- 432.1 July, Box 2843, GS, DF A1/Entry 5, RG 88, NARA.

"… one feels that, perhaps, the problem of medicated feeds has been regarded as a stepchild. (…) [and the] administration approach (…) has been one of 'flying by the seat of your pants."[64] Manufacturers also complained about fragmented bureaucratic responsibilities:

> … we now have the following groups of the administration (…) concerned with the medicated feeds: Front Office (Ralph Kneeland's office), Veterinary Medical Branch, New Drug Branch, Division of Antibiotics, Division of Pharmacology, State Relations Division, and, now where a tolerance in a meat product might be concerned, the Food Additives Division.[65]

According to the pharmaceutical industry, processing speeds for similar NDAs could vary by up to four weeks. With nobody but a few overworked officials in Washington able to navigate the byzantine veterinary drug and medicated feed rules, a 1959 FDA memo dreaded new regulations because there was already "so much confusion and misinformation."[66] Given the lack of controls, it was often easier for local manufacturers to ignore FDA guidelines than to pay for and file cumbersome NDAs.

Under pressure to streamline procedures, officials were occasionally tempted to appease industry by sacrificing consumer protection. In July 1959, a memo from the FDA's Division of Pharmacology warned George P. Larrick, who had been promoted to FDA Commissioner in 1954, that a reduction of new drugs would lead to misuse of existing veterinary and human drugs: it did not "take a great deal of foresight to predict (…) that a veterinarian can (and no doubt will) prescribe new drugs currently marketed for human use … " [67] Mail

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[64] Ibid.
[65] Ibid.
[66] Durbin to Quackenbush, Jul 13, 1959, Folder 432.1-432.1-11, Box 2668, GS, DF A1/Entry 5, RG 88, NARA.
[67] Division of Pharmacology and Bureau of Medicine to Office of the Commissioner, 'Veterinary Drugs Under the Food Additives Amendment', Jul 14, 1959, Ibid, p. 1

advertisements and reports on "uncontrolled studies" would result in veterinary misuse of potent pharmaceuticals – "misuse over which we (FDA) have very little (or no) control."[68] Significantly, the memo did not call for stricter enforcement but for the ability to grant exceptions from the 1958 Amendment.[69] Although penalties for feed violations remained relatively low,[70] FDA officials also stressed that they would not intensify prosecutions of feed violations. In 1959, Commissioner Larrick reassured readers of *Successful Farming* that new regulations were "definitely (…) not a 'crack down".[71]

Behind the scenes, FDA officials were, however, well aware that inadequate testing and enforcement had allowed feedstuff abuse to become rampant. In 1959, Massachusetts' Official Chemist, John W. Kuzmeski, warned:

> It is a well known fact (…) that [withdrawal warnings are] largely ignored. (…). If a farmer feeds a medicated feed to his chickens up to the day of slaughter, and undesirable residues remain in the flesh as a consequence, you, I and a host of other people will be eating those residues.[72]

Because it was impossible for officials to "stand over every farmer", it was necessary "to assume that many farmers will not heed"[73] guidelines. Before licensing drugs, FDA officials should therefore always consider "what danger to public health exists when widespread disregard of necessary warning statements has been established."[74] Officials should also insist on the availability of reliable assay methods to detect drug levels.[75] In 1957, an official review of 30 drugs had shown that "reliable methods for analysis in the finished feeds [were]

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[68] Ibid.
[69] Ibid., pp. 2-3.
[70] W.E. Glennon to Ralph F. Kneeland, Oct 19, 1959, Ibid.
[71] 'Successful Farming – December Issue (interview George P. Larrick)', enclosed in: Wallace f. Jensen, 'Memorandum for File – Interview with G.P. Larrick', Oct 15, 1959, ibid.
[72] John W. Kuzmeski to WE Glennon, Jun 10, 1959, enclosed in: John W. Kuzmeski to George P. Larrick, Jun 23, 1959, ibid.
[73] Ibid.
[74] Ibid.
[75] Ibid.

only available for less than half of them."[76] Because industry opposition had prevented the mandatory inclusion of assay methods in NDAs,[77] FDA officials were forced to ask for voluntary industry participation in a program to provide pre-licensing assay methods.[78]

By the late 1950s, it was increasingly obvious that the FDA's policy of gatekeeper licensing, voluntary industry compliance, producer education and label guidelines was failing. With the exception of milk, inadequate controls, lack of foresight, complicated rules, ignorance and wilful abuse resulted in widespread noncompliance with FDA guidelines.

Attempting to redress noncompliance and salmonellosis problems in 1960, the FDA decided to establish regular controls of feed mills.[79] However, initial surveys revealed severe problems. In 1961, 69 major violations were detected in 1,100 medicated feedstuff samples and "a large number"[80] of AGP feeds was found to be deficient in antibiotics. Another entirely accidental discovery was that antibiotics were being fed to species such as rabbits and game birds for which they had never been licensed.[81] During a 1962 meeting with industry representatives, FDA officials blamed the high volume of violations on ignorance and wilful non-compliance:

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[76] Quackenbush to Abbott Laboratories, Feb 07, 1959, enclosed in: Bill V. McFarland to Eugene H. Holeman, Dec 29, 1959, Folder 432.1-20-433.10, Box 2669, GS, DF A1/Entry 5, RG 88, NARA.
[77] Ralph Kneeland to Ollie Michael, Mar 13, 1958, ibid.
[78] Quackenbush to Abbott Laboratories, Feb 07, 1959, enclosed in: Bill McFarland to Eugene Holeman, Dec 29, 1959, ibid.
[79] WE Glennon to George Larrick, Dec 6, 1960, enclosed in: WE Glennon to Morris Yakowitz, December 7, 1960, Folder 432.1 Dec.- 432.1 July, Box 2843, GS, DF A1/Entry 5, RG 88, NARA, p. 3; CA Armstrong to Dallas District, Jan 29, 1962, Folder 70A190#96, Box 3246, GS, DF A1/Entry 5, RG 88, NARA.
[80] Theo B. Benjamin to Administration, Nov 28, 1961, Folder 432-432.80, Box 3040, GS, DF A1/Entry 5, RG 88, NARA.
[81] Parks A. Yeats to FDA, Apr 04, 1961, enclosed in: Bill McFarland to Parks A. Yeats [undated], Folder 432.1 June-Dec, Box 3040, GS, DF A1/Entry 5, RG 88, NARA; Bill McFarland to Parks A. Yeats [undated] ibid.

> A large proportion of today's complex feed industry consists of small mill operations with limited personnel and management sharing the burden of many responsibilities. (…). Their time is limited and often their capabilities to interpret the regulations (…) are also. (…), they have looked upon inspection programs with fear and distaste ...[82]

Already facing widespread ignorance about antibiotics amongst professional mill owners, FDA officials were also concerned about the growth of individual custom mixing operations. In 1962, an FDA inspector described the breakdown of FDA guidelines on integrated turkey businesses:

> Field men, most of whom are not trained veterinarians, are employed to check the flocks [of ca. 300,000 birds] daily and diagnose disease conditions, (…), the field men prescribe drugs and/or antibiotics for control or prevention. As the medicated feeds are not resold, the firm does not apparently feel it comes under the scope of the new drug or antibiotic regulations. The usual amounts of medication are not adhered to.[83]

Drugs were "frequently purchased in [as] large amounts as 25 kgs. penicillin."[84] It was not uncommon for "a coccidostat, blackhead preventive, and antibiotic (…) all [to] be fed at the same time"[85] and the occurrence of drug residues in meat was likely.

Meanwhile, FDA enforcement remained hampered by patchy legislation and bad coordination.[86] When proactive officials tried to take action against violative new drug premixes, the FDA's General Counsel warned that the FDA:

> … w[as] not on sound legal ground to take equal enforcement action against the majority of the violative shipments of new drug premixes and (…) advised (…) not [to] approve any more actions in this area until the problem could be resolved.[87]

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[82] 'Memorandum of Interview', Dec 4, 1962, Folder 432-432.80, Box 3245, GS, DF A1/Entry 5, RG 88, NARA.
[83] Robert V. Marrs to A. Harris Kenyon, Sep 26, 1962, Folder 70A190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, p. 2.
[84] Ibid.
[85] Ibid.
[86] CA Armstrong to Bureau of Field Administration, Sep 24, 1962, Folder 70A190#96, Box 3246, GS, DF A1/Entry 5, RG 88, NARA.
[87] KL Milstead to JL Harvey, May 28, 1962, Folder PA 190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA.

Considering enforcement and voluntary compliance unlikely, one memo from 1962 suggested legalising residues in order to improve FDA statistics: "consideration for requiring tolerances for drugs in meat by food additive regulations in lieu thereof, may be the only way of preventing illegal tissue residues." [88]

Ineffective FDA licensing and enforcement policies did not remain hidden from the public eye. Exacerbated by the Welch scandal and Kefauver Hearings, the FDA and Commissioner Larrick were accused of kowtowing to industry and criticised for the 'revolving door' between FDA and industry personnel.[89] In early 1962, Commissioner Larrick also made the problematic decision to support the loosening of the Delaney Clause. Failing to mention that the FDA was not actively monitoring for drug residues in meat, senior officials claimed "it would be in the public interest to amend the [Delaney Clause]" so that carcinogenic additives could be used if they did not harm animals' health and left no residues in "edible products"[90]. For an organisation whose power was built on reputation, such a careless management of public relations was dangerous.[91]

Frustration about overly friendly relations with industry also grew within the FDA. In April 1962, Charles Durbin, director of the FDA's Division of Veterinary Medicine, expressed concern about the close ties between an FDA-contracted antibiotics investigator and Eli Lilly but was "unaware of any action" the FDA could take against the researcher "or any other 'legitimate'

[88] Daniel DeCamp to Charles Durbin, 'Memorandum – Current Poultry Feeding Practices (Feed Supplies at the Farm), Sep 18, 1962, Folder 70A190#96, Box 3246, GS, DF Entry A1, RG 88, NARA, p. 3.
[89] Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, pp. 119-20, 347.
[90] John Harvey to Peter Dominick (House of Representatives), May 25, 1962, Folder PA 190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA,
[91] Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, pp. 9-11.

investigator."[92] A few months later, the FDA's Division of Pharmacology reacted furiously to what it saw as weak leadership when an AFMA bulletin announced an imminent agreement to legalise higher-dosed therapeutic or prophylactic AGPs for mature animals.[93] Exasperated with the tendency to retrospectively legalise noncompliance, experts within the FDA's Division of Pharmacology complained that the "proposed revision of guidelines sounds like a compromised committee report (…) designed "to 'overlook' certain violations of the present antibiotic regulations."[94] The Division's protest proved effective: the use of AGPS for mature animals remained banned and the wording of regulations was improved.[95]

However, internal FDA criticism and reform attempts remained spasmodic and Congressional pressure for Larrick's resignation increased steadily.[96] The 1962 Kefauver-Harris Amendment exacerbated enforcement problems by requiring the FDA to establish a distinct licensing process for veterinary drugs and mandating the official certification – and regular control – of veterinary drug manufacturers and feed mills producing medicated feeds.[97] Still struggling to fulfil the requirements of the 1958 Food Additives Amendment, the FDA's animal drug policy entered a three-year stage of regulatory atrophy.

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[92] Charles Durbin to Bureau of Enforcement (Atten: C. Armstrong), Apr 27, 1962, Folder PA 190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA.
[93] Levin to George Larrick, Nov 29, 1962, Folder 70A190#95, Box 3245, GS DF A1/Entry 5, RG 88, NARA, p. 1; contemporary FDA regulations allowed the use of AGPs for growing and mature animals, but not solely for mature animals.
[94] KJ Davis, AA Nelson and BJ Vos to Bureau of Enforcement, Attention of Mr Armstrong, 'Re-Guideline 44 – Animal Feeds Containing Certifiable Antibiotics at Growth Promoting Levels', [undated], ibid.
[95] JF Robens, 'Memorandum of Conference', Dec 6, 1962, ibid, p. 2.
[96] 'George P. Larrick - Fda Commissioners Page', *FDA History. FDA Leaders & Their Deputies. Commissioners* (http://www.fda.gov/AboutFDA/WhatWeDo/History/Leaders/Commissioners/ucm093755.htm [accessed: 22.10.2014]).
[97] CLM, FP, Series II, A. Professional Correspondence, 1929-1984, Box 2, Folder 25: FDA 1961-1965, Charles G. Durbin, 'Veterinary Drugs', in: *Proceedings. FDA Conference on the Kefauver-Harris Drug Amendments and Proposed Regulations*, Feb 15, 1963, pp. 8-9.

Meanwhile, inspection reports remained dismal: some feed manufacturers were not labelling their feeds, some were selling deficient feeds and others did not even own scales with which to measure the amount of drugs they were mixing into their feeds. Because many producers did not clean their equipment between batches, feeds were often cross-contaminated with old medication residues.[98] On farms, the situation was just as bad. Concerned about DES misuse, the FDA conducted several surveys between 1960 and 1964. Initially, 12.7% of 138 beef producers were found to misuse medicated feeds.[99] Between February 1964 and February 1965, 247 further inspections disclosed that 8.5% of inspected livestock producers were misusing medicated feeds.[100] Although Commissioner Larrick discussed further voluntary compliance measures with industry in March 1965,[101] the detected feed violations indicated that the FDA's gatekeeper approach regarding medicated feeds had failed. In addition to their legal presence, the occurrence of illegal antibiotic residues in US food was likely.

All the while, the official attention paid to the selection for bacterial resistance on farms remained minimal. In 1961, Dr. Antonio Santos Ocampo Jr. from the Arenata University in the Philippines asked the FDA for advice:

> For instance, people here are just plain crazy about the use of antibiotics to stimulate egg production and to prevent CRD. We are literally flooded

[98] Arthur M. Sommer, 'Establishment Inspection Report', Oct 07, 1963, Folder 71A-24-74, Box 3516, GS, DF A1/Entry 5, RG 88, NARA.
[99] JA Kedzior to AE Rayfield, 'Memorandum – Medicated Feeds Compliance by Beef Feeders', Mar 26, 1965, enclosed in: George Larrick, 'Memorandum of Conference', Mar 26, 1965, Folder 88-73-5#42, Box 3701, GS, DF A1/Entry 5, RG 88, NARA.
[100] Ibid.
[101] George Larrick, 'Memorandum of Conference', Mar 26, 1965, ibid.

> with literatures (of course by Pfizer people) regarding the efficacy. The Terramycin egg formula and the anti-germ 77 sells like hot cake here.[102]

However, Ocampo had "always entertained doubts as to the wisdom of the indiscriminate use of antibiotics": "I fear that the microbial flora in animals might become resistant to antibiotics and when the time comes this antibiotic will no longer have any value."[103] In response, the FDA assured Ocampo: "The fear that indiscriminate use of antibiotics will result in resistant strains of organisms has been expressed in this country. So far no one has produced any conclusive evidence that this is the case in poultry."[104]

The spectre of antibiotic resistance was raised again during a 1962 FDA meeting. Debating the already familiar question of AGPs for mature animals, an official from the FDA's Division of Veterinary Medicine mentioned a report from the British Netherthorpe committee: "… there may be a build-up of resistant organisms when adult animals are fed low levels of antibiotics continuously, Great Britain does not allow their use for this reason."[105] While this information did not provoke further discussions, the Division of Pharmacology expressed concern about pets' treatment with inadequately dosed antibiotics and "the possible danger to man from development of transmissible antibiotic-resistant strains of bacteria (particularly staphylococci) in household pets whose rations contain low-level antibiotics."[106] It was thought advisable to increase "activity (…) against those rations containing certifiable antibiotics which are marketed

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[102] Antonio Santos Ocampo, Jr. to GV Peacock, Aug 30, 1961, enclosed in: JF Robens to Antonio Santos Ocampo, Jr., Oct 2, 1961, Folder 432.1 June-Dec, Box 3040, GS, DF A1/Entry 5, RG 88, NARA.
[103] Ibid.
[104] JF Robens to Antonio Santos Ocampo, Jr., Oct 2, 1961, ibid.
[105] JF Robens, 'Memorandum of Conference', Dec 6, 1962, Folder 70A190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, p. 2.
[106] KJ Davis, AA Nelson, BJ Vos to Bureau of Enforcement, [undated], ibid.

for continuous feeding to household pets." [107] Farm animals' long-term consumption of low-dosed AGPs was not challenged.[108]

In September 1962, the FDA elaborated on its benign assessment of bacterial resistance selection in agricultural settings in response to a constituent enquiry submitted by Democrat Senator Hubert H. Humphrey.[109] The later vice-president was one of the main critics of Commissioner Larrick and co-author of the FDC's 1951 Durham-Humphrey Amendment, which introduced the distinction between so-called over-the-counter (OTC) drugs and prescription only medicines (POM).[110] Humphrey's constituent enquiry had been authored by James S. Collins, a PhD in animal breeding and former employee of the feed company Nutrena (Cargill Inc.). While he was working for Nutrena, Collins had actively campaigned against AGPs and discovered that "our animals are now carrying a heavy infection of antibiotic resistant pathogens." [111] Criticising the FDA's residue-centred view that products were safe "if no antibiotic turns up in [animals'] tissue,"[112] Collins warned:

> It would seem to me that we are not only laying our animal population wide open for disaster as well as providing reservoirs of pathogens to invade man.[113]

In his response to Senator Humphrey, Deputy Commissioner Harvey defended FDA policies: "… experts regard use of drugs and chemicals (…) as

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[107] Ibid.
[108] The FDA's benign assessment of antibiotic resistance was strengthened by the 1963 publication of a WHO report on agricultural antibiotics; Who, 'The Public Health Aspects of the Use of Antibiotics in Food and Feedstuffs', pp. 12-14.
[109] John L. Harvey to Hubert H. Humphrey (US Senate), Sep 5, 1962, Folder 70A190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, p. 1.
[110] 'George P. Larrick - Fda Commissioners Page'.
[111] James S. Collins to Senator Humphrey, Aug 8, 1962, enclosed in: John L. Harvey to Hubert H. Humphrey (US Senate), Sep 5, 1962, Folder 70A190#95, Box 3245, GS, DF A1/Entry 5, RG 88, NARA, pp. 1-2.
[112] Ibid.
[113] Ibid., p. 4.

necessary in order to (…) assure adequate food as the Nation's population increases while the acreage of productive farmland decreases."[114] Referring to the "indirect hazard" of antibiotic resistance, Harvey claimed that FDA "scientists are keeping abreast of developments in this field."[115] The FDA had also contacted the British Netherthorpe committee, which had "concluded that although there are problems resulting from the use of (…) antibiotics in animal feeds, such use should be allowed to continue."[116] Regarding OTC sales of mastitis tubes, which had been criticised by Collins, Harvey waspishly reminded Senator Humphrey of his own 1951 FDC Amendment:

> … there is nothing in the Act itself dealing specifically with the question of whether a veterinary drug may be restricted to veterinary prescription dispensing.[117]

The FDA's regulatory deadlock regarding animal drug use only began to change in 1965 when George Larrick ended his tenure as FDA Commissioner.[118] Larrick's successor, James L. Goddard, fulfilled Congressional demands for a medically qualified FDA Commissioner and had previously headed the Communicable Disease Center (CDC). Starting as Commissioner in January 1966 and soon known as "Go-Go Goddard," [119] Goddard contrasted radically with his predecessor and embarked on a fundamental restructuring of the FDA, which led to the exit of many senior officials.[120] Under Goddard, FDA drug recalls grew by

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[114] John L. Harvey to Hubert H. Humphrey (US Senate), Sep 5, 1962, ibid., p. 1.
[115] Ibid.
[116] Ibid., pp. 2-3.
[117] Ibid., p. 2.
[118] 'George P. Larrick - Fda Commissioners Page'.
[119] 'James L. Goddard - Fda Commissioners Page', *FDA History. FDA Leaders & Their Deputies. Commissioners* (http://www.fda.gov/AboutFDA/WhatWeDo/History/Leaders/Commissioners/ucm093750.htm [accessed: 22.10.2014]).
[120] 'Another Top Level Official to Leave FDA Next Week', *Feedstuffs*, 11.12.1965, pp. 2 and 75.

ca. 75% and the NAS was contracted for an efficacy review of drugs licensed prior to 1962 (the so-called Drug Efficacy Study Implementation (DESI)).[121]

The FDA's leadership change also affected the regulation of agricultural antibiotics. In February 1965, the FDA had decided to install an ad hoc Committee on the Veterinary Medical and Nonmedical Uses of Antibiotics.[122] Despite an infuriating archival gap and an elusive final report, circumstantial evidence makes it possible to reconstruct the proceedings of the ad hoc committee. According to industry sources, the committee had been formed because of the above-mentioned FDA surveys on medicated feedstuff compliance and parallel USDA detections of penicillin in American red meat.[123] FDA officials were also becoming concerned about existing antibiotic tolerances on fish and poultry.[124] As a consequence, the FDA ad hoc committee's focus was primarily residue-oriented and members initially referred to it as the "Committee to Consider the Public Health Implications of the Presence of Antibiotic Residues in Food and the Use of Antibiotics as Food Preservatives."[125]

Headed by Mark Lepper, Professor of Preventive Medicine at the University of Illinois,[126] and counting Maxwell Finland amongst its members, the ad hoc committee met for the first time in early May 1965 and submitted its final report one year later.[127] Between these two dates, major changes had occurred:

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121 'James L. Goddard - Fda Commissioners Page'.
122 31 Fed Reg., 11141 (Aug 23, 1966).
123 Roger Berglund, 'Industry Cautioned on Possible Salmonella, Chemical Residue Problems', *Feedstuffs*, 13.02.1965, pp. 8 & 73; 'Residues in Swine Not Cause for Alarm', *Feedstuffs*, 13.11.1965, pp. 6 & 87.
124 CLM, FP, Series II, A. Alphabetical Correspondence, Box 2, Folder 25: FDA 1961-1965, Clem O. Miller to Finland (Feb 11, 1965).
125 CLM, FP, Series II, A. Alphabetical Correspondence, Box 2, Folder 25: FDA 1961-1965, Finland to Clem O. Miller (Feb 18, 1965).
126 CLM, FP, Series II, A. Alphabetical Correspondence, Box 2, Folder 25: FDA 1961-1965, William W. Wright to Finland (Mar 15, 1965)
127 Ibid., see also 31 Fed Reg., 11141 (Aug 23, 1966).

in addition to Commissioner Larrick's resignation, British publications on 'infectious' resistance had greatly altered general preceptions of antibiotic risk.[128]

Because of the ad hoc committee's residue-oriented focus, British concerns about 'infectious' resistance initially had little effect on its deliberations. Although the first of the British articles on horizontal resistance had appeared three months ahead of their inaugural meeting,[129] committee members did not include it in their preparatory reading list[130] but discussed the matter later on.[131] In August 1966, the ad hoc committee's report expressed "concern" about the "possibility of microorganisms in animals developing resistance or of strains being selected that are resistant" and called for studies of "the long-term ecological effects" [132] of agricultural antibiotic use. However, the report limited immediate resistance warnings to antibiotic residues. Preservatives should no longer consist of or give rise to cross-resistance against therapeutically relevant antibiotics. Ideally, antibiotic food preservation should be banned completely. The FDA should also increase efforts to prevent antibiotic residues in edible tissues, re-evaluate dosages and withdrawal times and make

[128] Watanabe had already published on R-factor transfer in the 1950s and published a review in English in 1963; T. Watanabe, 'Infective Heredity of Multiple Drug Resistance in Bacteria', *Bacteriological Reviews,* 27/1 (1963); for the US press impact of the 1966 warnings see Chapter One, pp. 34-36: for the rise of British warnings see Chapter Four, pp. 101-103.
[129] Anderson and Datta, 'Resistance to Pencillins and Its Transfer in Enterobacteriaceae'.
[130] The list did not include Japanese publications on R-factors either; CLM FP, Series II, A. Alphabetical Correspondence, Box 2, Folder 25: FDA 1961-1965, William W. Wright to Finland (Apr 19, 1965); Finland's unchanged views become evident in his proposed reading contributions see Finland to Clem O. Miller (Feb 18, 1965); on Finland's influence also see Podolsky, *The Antibiotic Era: Reform, Resistance, and the Pursuit of a Rational Therapeutics*, pp. 17-18; 79; 127-29, 32-202.
[131] CLM FP, Series II, A. Alphabetical Correspondence, Box 2, Folder 25: FDA 1961-1965, William W. Wright to Finland, (Jul 26, 1965).
[132] 'Excerpts From Report on Antibiotics Prepared for the FDA', *NYT*, 22.08.1966, p. 28.

"'warning' statement[s] used in veterinary chloramphenicol labelling (...) more emphatic"[133] so that it was not used in food-producing animals.

The FDA subsequently committed to implement the ad hoc committee's report and used it to assuage public concerns about agricultural antibiotics. Only five days after the appearance of the 1966 *NEJM* editorial on R-factor transfer, the *Federal Register* announced the following policy measures: producers of licensed antibiotic products were to submit new data on "whether or not such antibiotics and their metabolites are present as residues in edible tissues, milk, and eggs from treated animals."[134] Should they fail to submit data within 180 days, producers could lose their product licenses.[135] Citing resistance and hygiene concerns, the FDA also banned the preservation of poultry, fish and shellfish with antibiotics in September 1966 and commissioned the NAS to organise a scientific conference on agricultural antibiotics. [136]

Taking place in 1967, the NAS symposium on "the use of drugs in animal feeds"[137] gathered many well-known antibiotic supporters. In his presentation, AGP co-discoverer Thomas Jukes attacked the "emotional phraseology used in [the NEJM editorial] (…) that led the *NYT* to (…) threaten us with the propaganda device of a new *Silent Spring".*[138] Meanwhile, Maxwell Finland maintained that there was "little evidence to implicate food as a source of infections caused by organisms resistant to antimicrobial agents."[139] Moreover, it was "difficult to

[133] Ibid.
[134] 31 Fed Reg. 11141 (Aug 23, 1966).
[135] Ibid., pp. 11141-11142.
[136] WN Swain to Robert W. Kastenmeier (House of Representatives), Dec 12, 1966, Folder 88-75-1, Box 3846, GS, DF A1/Entry 5, RG 88, NARA; Robert A. Baldwin and Laverne C. Harold, 'Ecologic Effects of Antibiotics', *FDA Papers,* 1/1 (February) (1967), pp. 23-24.
[137] 'The Use of Drugs in Animal Feeds', (Washington DC: National Academy of Sciences, 1967).
[138] Ibid., p. 60.
[139] Ibid., p. 346.

implicate"[140] AGPs in reports on enteric 'infective resistance'. Also seeing no need for antibiotic restrictions, former ad hoc committee head Mark Lepper, however, warned that current drug evaluation and antibiotic studies were too crude. While no "major catastrophe" seemed to be "around the corner", "the use of drugs in feeds could be influencing (…) the background level of organism resistance, without any of us being aware of the fact."[141]

Such a wait-and-see attitude was criticised by other attendees. In his presentation, British veterinary researcher Herbert Williams Smith noted: "There is no essential difference between the emergence of resistant strains of bacteria as a result of the use of drugs in the treatment of clinical disease and as a result of the use of drugs as feed additives."[142] According to Williams Smith, prolonged exposure to low-dosed AGPs was especially conducive to antibiotic resistance proliferation: "A strong case, therefore, exists for limiting the number of different kinds of drugs that can be used for 'nutritional' purposes."[143] However, the mostly European criticism was of no avail and the majority of attendees remained convinced that the spectre of global malnutrition justified AGPs' continued use.

Also speaking at the symposium, FDA Commissioner James Goddard stated that the FDA was taking the ad hoc committee's report seriously and was committed to analysing potential ecological hazards. However, Goddard did not dwell long on resistance and instead stressed FDA progress against antibiotic residues. Although past inaction and a lack of reliable data was hampering progress, Goddard was proud of recent FDA recalls of residue-prone antibiotic

[140] Ibid., p. 349.
[141] Ibid., p. 375.
[142] Ibid., p. 304.
[143] Ibid., pp. 315-16.; see also opposition by Dutch researcher E.H. Kampelmacher; ibid., p. 324.

products and "the denial of certification for oil-based injectable penicillin products, which required an unrealistic withholding time".[144] Goddard also remained sanguine about antibiotics' general future in US agriculture. Because it was "vital to keep the industry moving ahead (…) and to protect the supply of food,"[145] the FDA would "eliminate, wherever possible, purely administrative delays in the introduction of new drugs for animal use…"[146]

With more-or-less overt ties linking influential US experts to industry, it is unsurprising that FDA regulators were reluctant to endorse the resistance warnings purported by mostly European scientists. In the end, the 1966 report re-confirmed the FDA's existing focus on antibiotic residues but also justified expanding FDA enforcement. Motivated by its new Commissioner and public concerns about food purity, the FDA therefore decided to establish a national surveillance programme for antibiotic residues in meat in cooperation with the USDA in 1967.[147] Supported by the USDA, a mixture of targeted and random meat sampling and testing for antibiotic residues would allow the FDA to gain an overview of contamination levels. In a further step, FDA inspectors would randomly sample meat at the retail level. The FDA also launched a national educational campaign warning farmers to:

> … use medicated feeds carefully and wisely (…). Federal law prohibits harmful drug residues. Protect the public health … avoid economic loss.[148]

Coming well ahead of similar programs in other countries, the envisaged FDA-USDA antibiotic monitoring program marked a decisive break from US agencies'

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[144] Ibid., p. 7.
[145] Ibid.
[146] Ibid., p. 8.
[147] Fred J. Kingma, 'Establishing and Monitoring Drug Residue Levels', *FDA Papers,* 1/6 (July-August) (1967), p. 33.
[148] 'Use Medicated Feeds Carefully and Wisely', ibid.

past hesitancy to address problems in the medicated feedstuff sector and residue offences. However, it remained unclear whether existing tests and statutory powers would allow the effective prosecution of offenders. Moreover, the installation of the program without similar monitoring measures for resistance proliferation threatened to distract public and official attention from the proliferation of bacterial resistance on US farms.

In public, the FDA continued to claim that reducing antibiotic residues would also contain bacterial resistance. In 1967, the head of the FDA's restructured Bureau of Veterinary Medicine (BVM), CD Van Houweling, estimated that US farmers were annually using 2.7 million pounds of antibiotics in animal feeds.[149] Noting that "some bacteria have resistance to as many as nine antibiotics at once"[150] and could transmit resistance to other strains and species, Van Houweling reassured consumers: "FDA has moved to bar from marketing almost all products with antibiotic residues at time of marketing."[151] In the face of scientific uncertainty, the FDA would finance further research: "We seem to be at a stage where reasons can be advanced that there will be, or will not be, a public health hazard with continued use of medicated feeds."[152] According to Van Houweling, decisions would be made "on the basis of the best scientific evidence available."[153] Should FDA officials err, they would do so "on the side of public protection."[154] Public trust in FDA judgment would soon be put to the test.

[149] C. D. Van Houweling, 'Drugs in Animal Feed? A Question without an Answer.', ibid./7 (September), p. 12.
[150] Ibid., p. 13.
[151] Ibid., p. 14.
[152] Ibid., p. 15.
[153] Ibid.
[154] Ibid.

Part Two – Britain: From rationing to gluttony (1945-1969)

Chapter Four: Great British Antibiotics

Following the deprivations of the Second World War, Britain struggled to stem the costs of decommissioning large parts of her military while rebuilding the national industry. Trying to prevent a rise in expensive food imports following bad harvests, the British government embarked on a program of subsidized and state-controlled agricultural expansion. At the same time, national consumption was held in check by maintaining the wartime system of rationing. Ultimately, the prolonged disruption of international trade and colonial campaigns, combined with the Korean War made post-war rationing last longer than the entire Second World War and food availability actually decreased between 1946 and 1948.[1] It was only in 1954 that the British Ministry of Food (MoF) was dismantled along with its rationing system.[2] By this time, consumers were craving meat: between 1950 and 1970 UK meat consumption increased by 33.1%.[3]

The decision to end rationing coincided with the liberalisation of antibiotic use in Britain. Fearing antibiotic resistance, the British government had initially limited antibiotic use with the Penicillin Act of 1947. In accordance

[1] Ina Zweiniger-Bargielowska, *Austerity in Britain: Rationing, Control and Consumption 1939-1955* (Oxford and New York: Oxford University Press, 2002), p. 37.
[2] Ibid., p. 73.
[3] H.J.H. MacFie and H.L. Meiselman, *Food Choice, Acceptance and Consumption* (London: Blackie Academic & Professional 1996), p. 377.

with the act, antibiotics were turned into POMs.[4] However, in 1953, the Therapeutic Substances (Prevention of Misuse) Act (TSA) exempted the use of antibiotics for feed purposes from prescription requirements.

Similar to the US, most domestic observers welcomed agricultural antibiotics as a progressive way of satisfying rising levels of meat consumption and enhancing British nutritional independence. Prior to their legalisation, the politically conservative *Times* stressed agricultural antibiotics' benefits: titled "Twentieth-Century Hen", one article described subtherapeutic antibiotics as a "strange nutrition" with the potential to solve the "world-wide shortage of protein".[5] Three years after the TSA, the newspaper's optimism for agricultural antibiotics had not abated. Reporting on antibiotic food preservation, one article described it as "'the greatest advance in the field of processing perishable foods since the advent of refrigeration.'"[6]

Written during a time of great technological enthusiasm, the British media's optimism regarding agricultural antibiotics is not surprising. After all, prospects of using radioactive wastes for food preservation and breeding received equally gushing media-coverage.[7] As shown by Robert Bud, parts of the British public and the media also saw antibiotics as a quintessentially British contribution to progress.[8] When Pfizer opened a new terramycin-plant in Sandwich in 1955, Pfizer's vice-president was quick to stress the plant's

[4] Stuart Anderson, *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals* (London and Grayslake: Pharmaceutical Press, 2005), p. 248.
[5] G. R. H. Nugent, 'The Twentieth-Century Hen', *Times*, 30.07.1951, p. 5; also see 'Pigs Fattened By Antibiotics', *Times*, 01.12.1952, p. 3; 'Feeding-Stuff Experiments', *Times,* 08.07.1952, p. 3; 'Animal Nutrition', *Times*, 10.09.1952, p. 7.
[6] 'New Method Of Food Preservation', *Times*, 11.04.1956, p. 13.
[7] 'News from Industries', *Times*, 15.06.1955, p. 5.
[8] Bud, *Penicillin: Triumph and Tragedy*, pp. 67-72.

Britishness: "although the installation was financed by the United States it was partly designed and wholly built and operated by the British."[9]

Occasionally, some voiced opposition to antibiotics' mass-introduction to British food production. Critics were concerned about everything from antibiotic residues in food to potential resistance and growing industry influence over farmers. In 1951, the former Labour Parliamentary Secretary Lord Douglas of Barloch warned against the use of "poisonous chemicals in the growing and preparation of foodstuffs."[10] Focusing on antibiotics, DDT and hormones, the Barloch called "for strict control over all processes which might affect the natural quality of food."[11] In February 1953, Conservative MP Mr. Dodds asked the Conservative Minister of Agriculture Thomas Dugdale how consumers could be protected when "famous experts (…) have declared that more harm than good"[12] would result from the TSA. Seconding such concerns, Conservative MP Colonel Gomme-Duncan asked "whether we have all gone mad to want to give penicillin to pigs to fatten them?"[13] Following a report on the TSA,[14] readers of the social-liberal *Observer* also engaged in a heated exchange on AGPs.[15]

However, early public criticism of agricultural antibiotics remained rare and media coverage tended to be optimistic. Responding to readers' criticism of AGPs in the *Observer*, J. A. Wakelam from the pharmaceutical manufacturer J. Bibby & Sons noted:

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[9] 'New Antibiotic Plant Opened', *Times*, 01.10.1955, p. 4.
[10] 'Parliament. House of Lords Wednesday, July 4', *Times*, 05.07.1951, p. 4.
[11] Ibid.
[12] TNA MAF 287/299, Extract, House of Commons (P.Q. 3355), Question put on 19th Feb, 1953.
[13] Ibid.
[14] 'Fatter Pigs on Penicillin', *Observer*, 30.11.1952, p. 3.
[15] Olive Whicher, 'Penicillin for Pigs', *Observer*, 28.11.1952, p. 2; G. Pelham Reid, 'Guidance Required', *Observer*, 04.01.1953, p. 3.

> The international food situation is so desperate that we must be prepared to accept the assistance which modern science offers us and not seek by quoting individual contrary opinions to discredit the conclusion of reputable bodies such as the Agricultural Research Council, …[16]

Meanwhile, American pharmaceutical companies like Pfizer and American Cyanamid raced to satisfy growing British demand and establish factories and sales departments in Britain. In contrast to their British competitors, American companies courted potential clients both in- and outside traditional agricultural circles and placed expensive advertisements for feeds in national newspapers. In 1953, Lederle purchased an entire page of *The Times* ahead of the launch of its chlortetracycline-based feed AUROFAC 2A.[17] Experienced sales personnel was also in high demand: in 1956, a Pfizer-advertisement announced that the "world's largest producer of antibiotics" was "expanding its Agricultural Sales Force" and looking for male British personnel with an agricultural background and experience in "modern sales techniques."[18] Only three days later, Lederle announced that it, too, was looking for "top-class Sales Representatives who will sell Animal Feed additives such as Aurofac."[19] Celebrating the establishment of its Gosport plant in 1958, Cyanamid claimed that AUROFAC and other products were "bringing untold benefits to almost every sphere of life": "Cyanamid contrives to make a new discovery almost every day, transmuting the hopes of yesterday into the realities of today."[20]

Similar to the US, the late 1950s also saw antibiotic optimism begin to wear thin in Britain. British antibiotic criticism was, however, more nuanced and can roughly be divided into three strands of interrelated yet distinct concerns.

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[16] J. A. Wakelam, 'Penicillin for Pigs', *Observer*, 04.01.1953, p. 3.
[17] 'Commercial Cyanamid', *Times*, 17.07.1953, p. 5.
[18] 'Commercial Pfizer', *Times*, 26.06.1956, p. 2.
[19] 'Commercial Cyanamid ', *Times*, 29.06.1956, p. 2.
[20] 'Commercial Cyanamid ', *Times,* 16.04.1958, p. 7.

Similar to the US, one group of critics became increasingly concerned about antibiotics adulterating presence in basic foodstuffs. However, in contrast to the US media's focus on residues, a second group of British critics began to express concern about the spread of antibiotic resistance on farms, and a third group condemned antibiotics as accomplices to the deplorable conditions of animals in intensive modern housing units. Depending on one's position within the various British opposition camps, agricultural antibiotics' image could thus vary from dangerous adulterator to endangered miracle substance or partner in cruelty.

During the second half of the 1950s, a series of scandals involving the contamination of food and the environment had also affected British trust in the safety of agricultural antibiotic use.[21] Much like in the US, the adulteration of milk was seen as particularly problematic. In 1957, concerns were heightened when a severe accident at Windscale nuclear power plant contaminated ca. 200 square miles of land with significant amounts of radionuclides and resulted in a month-long ban of milk production in affected areas.[22] By the early 1960s, farmers and veterinarians were being publicly exhorted to protect consumers from drinking "diluted pus with noxious additions such as penicillin."[23] However, warnings went unheard. In 1963, the Milk and Milk Products Technical Advisory Committee reported that 14% of English and 11.6% of Scottish milk tested positive for antibiotics.[24] The report received widespread media attention and

[21] D. T. Lewis, 'Complex Chemical Control', *Times*, 20.09.1960, p. xvi.
[22] 'Farmers Given Assurance On Reactor Effects', *Times*, 23.10.1957, p. 6.
[23] 'Farm Health Problems In New Methods', *Times*, 11.09.1961, p. 7; on veterinarians' shift towards 'preventive medicine' see Woods, 'Is Prevention Better Than Cure? The Rise and Fall of Veterinary Preventive Medicine, C. 1950-1980'.
[24] 'Drug hazard in dairy milk', *Guardian*, 30.05.1963, p. 1.

triggered both criticism of intensive agricultural practices and further reports on milk security and antibiotic residues throughout the 1960s.[25]

While consumers on both sides of the Atlantic shared residue concerns, British debates on agricultural antibiotics were distinguished by an early focus on bacterial resistance proliferation. In newspapers, British veterinarians blamed rising resistance on farmers' unsupervised use of AGPs and therapeutic antibiotics – even though veterinarians themselves had prescribed and sold the latter drugs.[26] Speaking at the 1959 congress of the British Veterinary Association (BVA), the deputy director of the government's Veterinary Laboratory in Weybridge, E. L. Taylor, warned that subtherapeutic antibiotics eliminated competing microorganisms and enabled resistant pathogens to spread rapidly.[27] Four months later – and well before similar concerns arose in the US – the Agricultural Research Council (ARC) suggested a general review of medical feed additives such as antibiotics and hormones.[28] As a result of these warnings, the British government launched a joint inquiry into agricultural antibiotic use. Chaired by the recently retired president of the National Farmers' Union (NFU), James Turner – now Lord Netherthorpe – the committee sat between 1960 and 1962.[29]

In addition to antibiotic residues and resistant pathogens, animal welfare concerns constituted a third strand of distinctly British antibiotic-criticism. By the late 1950s, numerous aspects of industrialised agriculture were provoking

[25] 'Keeping Milk Free Of Antibiotics', *Times*, 30.05.1963, p. 18; Michael Winstanley, 'Cow Punch', *Guardian*, 25.06.1963, p. 6; 'Danger Of Drugs In Milk', *Times*, 04.12.1964, p. 6; 'What cures cow can harm milk', *Guardian*, 12.02.1965, p. 17.
[26] 'Farm Health Problems In New Methods', *Times*, 11.09.1961, p. 7.
[27] 'Working Out Policy For Disease Control', *Times*, 14.09.1959, p. 19.
[28] 'Farming Notes And Comments', *Times*, 18.01.1960, p. 21.
[29] Bud, *Penicillin: Triumph and Tragedy*, pp. 174-75.

the ire of animal welfare advocates.[30] Antibiotics featured prominently. In 1959, the *Observer* journalist Clifford Selly described in shocking detail the "highly artificial conditions" in which modern "ill-fated chickens" lived.[31] Never seeing daylight, broilers were "heavily drugged to keep them alive" and were victims of a system "more akin to the factory than the farm."[32] Over the next two weeks, Selly's article provoked passionate reader responses. Whereas G. B. Houston accused the "poor, deluded city dweller" of consuming "drugged and misused broiler fowls"[33], F. A. Dorris Smith recommended visits to broiler houses by women's organizations to "bring this abomination to an end."[34] In another letter, John Archer specifically blamed antibiotics for enabling harmful practices.[35]

By the mid-1960s, the three distinct strands of British antibiotic-criticism – resistance, residues and animal cruelty – were well established. However, with criticism rarely overlapping, no single issue was strong enough to challenge the well-entrenched use of agricultural antibiotics. For change to occur, antibiotic opposition needed common texts, scandals and figures to identify with. In 1964, Ruth Harrison's whistle-blower bestseller *Animal Machines* provided all of the above.[36]

A Quaker and vegetarian, Harrison was familiar with the work of Henry Salt, knew prominent animal rights activist George Bernard Shaw and had attended the Royal Academy of Dramatic Art. However, it was a letterbox-leaflet against animal cruelty that turned Harrison into an active campaigner for animal

[30] 'Concern About Toxic Sprays Persists', *Times*, 10.03.1961, p. 18; 'Editorial: Techniques in Question', *Farmers Weekly* [in the following FW], 13.03.1964, p. 43.
[31] Clifford Selly, 'Broilers Under Fire', *Observer*, 08.03.1959, p. 3.
[32] Ibid.
[33] G. B. Houston, 'Letters to the Editor: Broiler Fowls', *Observer*, 15.03.1959, p. 4.
[34] F. A. Dorris Smith, 'Letters to the Editor: Broiler Fowls', *Observer*, 15.03.1959, p. 4.
[35] John Archer, 'Letters to the Editor: Broiler Fowls', *Observer*, 22.03.1959, p. 4.
[36] Harrison, *Animal Machines*.

welfare.[37] In *Animal Machines*, Harrison combined easy-to-read summaries of scientific findings with vivid descriptions to alert readers to animals' plight in factory-like production systems. Appearing one year after the British publication of Rachel Carson's *Silent Spring* and containing a foreword by Carson herself, *Animal Machines* successfully linked the topics of animal welfare, agricultural antibiotics and dangerous food residues. Harrison's authority was further strengthened by a preface from Sydney Jennings, a former BVA-president. Claiming that "meat eating has become a hazard"[38], Harrison repeatedly pointed to the connection between modern farmers' antibiotic-dependency, animal cruelty, antibiotic residues in foodstuffs and the selection for resistance on farms.[39] For Harrison, it was

> … ironic to think that while authorities are steadily urging that antibiotics be used only with great discrimination on the grounds of dangerous resistance building up, the agricultural authorities are encouraging even wider use. Perhaps, these two should get together some time to discuss the matters, before it is too late.[40]

Building on *Silent Spring's* success and profiting from the contemporary milk scandal, Harrison successfully fused welfare criticism[41] and concerns about human health in a way that no publication had managed before. After *Animal Machines*, agricultural antibiotics were publicly associated with residues, resistance and 'factory farming'.[42]

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[37] Richard D. Ryder, 'Harrison, Ruth (1920-2000)', *Oxford Dictionary of National Biography* (http://www.oxforddnb.com/view/artcilde/74285 [accessed 16.02.2013]: Oxford University Press, 2004 [online edition May 2005]).
[38] Harrison, *Animal Machines*, p. 7.
[39] Ibid., pp. 116-20.
[40] Ibid., p. 120.
[41] Abigail Woods has analysed the rise of the term 'welfare' in British discourse in the wake of the Brambell Committee; Abigail Woods, 'From Cruelty to Welfare: The Emergence of Farm Animal Welfare in Britain, 1964-71', *Endeavour* 36/1 (2012).
[42] According to Karen Sayer, Harrison's 'factory farm' portrayal ignored the fact that intensification was not a universal reality; Karen Sayer, 'Animal Machines: The Public Response to Intensification in Great Britain, C. 1960- C. 1973', *Agricultural History,* 87/4 (2013).

While protracted negotiations prevented its publication in the US,[43] the British and European attention paid to *Animal Machines* was impressive. In Britain, the *Observer* printed excerpts of *Animal Machines*. Titled "Inside the animal factories"[44] and "Fed To Death"[45], Harrison's articles introduced readers to the main aspects of her book. In her first article, Harrison accused the "factory farmer and the agri-industrial world behind him"[46] of acknowledging cruelty only when profitability ceased. As long as growth remained stable, rearing systems were not questioned. Antibiotics were "incorporated in [animals'] feed and heavier doses of drugs given at the least sign of flagging."[47] Focussing on poultry, Harrison claimed that it was common for young birds suffering from respiratory diseases or cancer to end up on consumers' tables – the birds' ill health masked by antibiotics.[48] In her second article, Harrison focused on the intensive rearing of calves in darkened sties. Calves' diets consisted almost "exclusively of barley, with added minerals and vitamins, antibiotics, tranquilisers and hormones."[49] Living in these conditions, some calves became blind and many suffered from liver-damage and pneumonia: "their muscles become flabby and they put on weight rapidly, *but they are not healthy."*[50] Using more antibiotics to keep animals alive, farmers and veterinarians contributed to a race "between disease and new drugs."[51] Quoting veterinary practitioners and

[43] Yale Beinecke Library, Rachel Carson Papers, YCAL, MSS 46, Series II, General Correspondence, Box 103, Folder 1952, Ruth Harrison to Rachel Carson (10.07.1963); Harrison to Carson (14.10.1963).
[44] Ruth Harrison, 'Inside the animal factories', *Observer*, 01.03.1964, p. 21.
[45] Ruth Harrison, 'Fed To Death', *Observer*, 08.03.1964, p. 21.
[46] Harrison, 'Inside the animal factories', p. 21.
[47] Ibid.
[48] Ibid.
[49] Harrison, 'Fed to Death', p. 21.
[50] Ibid.
[51] Ibid.

the Netherthorpe committee, Harrison warned about antibiotic resistance and residue-laden "tasteless meat"[52] from factory farms.

Reactions to Harrison's claims ranged from furious denial to emphatic support. Seven days after publishing the second article, the *Observer* had received around 320 letters from readers.[53] Many readers were outraged by Harrison's revelations: one reader compared animals' suffering to 19th century child labour;[54] a second reader demanded labelling products from intensive farms;[55] and a third reader asked her fellow readers to imagine their pets incarcerated in factory farms.[56] While John Hall, the Chief Secretary of the Royal Society for the Prevention of Cruelty to Animals (RSPCA), praised Harrison,[57] the animal health lecturer David Sainsbury accused her of presenting a "grossly distorted picture of what is *actually* happening."[58] Meanwhile, the Dean of Llandaff in Wales compared factory farms to Nazi concentration camps and embarked on a public campaign against them: in a speech covered by both the *Daily Mirror* and the *Guardian*, the Dean warned his congregation about food-contamination with residues of antibiotics, hormones and other drugs.[59] Subsequently, similar appeals called for an end of antibiotic-abuse on "farm Belsens"[60] – thereby 'othering' factory farms as barbaric and anti-British. In parliament, the Labour MP Joyce Butler launched an inquiry into the agricultural use of chemicals and residues in food.[61]

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[52] Ibid.
[53] 'Views on animal factories', *Observer*, 15.03.1964, p. 30.
[54] Helen M. Simpson, 'Views on animal factories: Poles apart', *Observer*, 15.03.1964, p. 30.
[55] Sheila M. Mitchell, 'Views on animal factories: Label them', Ibid.
[56] Barbara Willard, 'Views on animal factories: Try it on the dog', Ibid.
[57] John Hall, 'Views on animal factories: changing the law', Ibid.
[58] David Sainsbury, 'Views on animal factories: distorted', Ibid.
[59] 'Cruelty War By Church leader', *Daily Mirror*, 10.08.1964, p. 3.
[60] 'Get rid of farm Belsen', *Observer*, 24.10.1965, p. 9.
[61] 'Hazard to health in food?', *Guardian*, 28.03.1964, p.28.

Reacting to public outrage in June 1964, the British government launched a committee to analyse animal welfare under the direction of medical scientist Professor Francis W. Rogers Brambell, whose 1965 report had a significant influence on subsequent British and European welfare policies.[62]

However, not all British newspapers joined the campaign against 'factory farming' and agricultural antibiotics. While left-wing newspapers like the *Observer* became platforms of criticism, the conservative *Times* did not take up the cause against 'factory farms' whole-heartedly. Still publishing articles titled "Feeding The World"[63], *The Times* remained influenced by the Malthusian outlook of the 1950s and stressed Britain's responsibility for feeding and improving the developing world. Published during a time of rapid decolonization, these articles mixed technological optimism with an obvious desire to find legitimate ways of maintaining British influence in the postcolonial world. Although the *Guardian* and the *Daily Mirror* featured similar reports,[64] *The Times* was unique as to their frequency.

Regarding agricultural antibiotics, *The Times* maintained an equally positive attitude and praised their role in improving and standardizing animals' growth.[65] Critical of residues in milk, *The Times* still printed the views of W. R. Trehane, chairman of the monopolist Milk Marketing Board (MMB), who claimed that public criticism was out of proportion and that the risks resulting from tainted milk were "extremely small."[66] Five months after the appearance of

[62] Woods, 'From Cruelty to Welfare: The Emergence of Farm Animal Welfare in Britain, 1964-71', pp. 18-20.
[63] 'Feeding The World', *Times*, 19.09.1962, p. ii.
[64] Arthur Smith, 'This Means Hope For Millions', *Daily Mirror*, 06.11.1964, p. 13; 'Growing role for the chemist in feeding 6,000m. by AD 2,000', *Guardian*, 03.11.1965, p. 5.
[65] 'Pig Records As Pointers To Defects', *Times*, 25.09.1961, p. 6.
[66] Verbatim speech record by W. R. Trehane in: 'Milk Marketing Board', *Times*, 19.07.1965, p. 16.

Animal Machines, *The Times'* farming section reported favourably on new preventive antibiotics for stress during livestock transports.[67] In 1965, *The Times* published an article titled "Why The American Farmer Can Cope Single-Handed."[68] Reporting on a recent visit to the American Midwest, the newspaper's agricultural correspondent enthusiastically described farms of a size that "we in England would consider impossible"[69] – antibiotics featured prominently as an enabling technology.

Throughout the 1960s, *The Times* also remained a preferred place for the antibiotic commercials of Pfizer and Cyanamid. Oblivious to reports on antibiotic resistance, companies stressed their products' dual application in humans and animals.[70] In 1961, Cyanamid started an aggressive advertisement campaign for aureomycin. Printed in April, one advertisement for Cyanamid's Aurofac-feed showed a laughing pig exclaiming "Yes, I'm A Scientific Pig" and presented agricultural antibiotics as a progressive way of improving animals' well-being and farmers' profits: "Indeed, to quote the vernacular, pigs in Britain 'never had it so good'…"[71] Further commercials featured grateful cows cured of mastitis and praised aureomycin's prevention of any "disastrous rise of mortality"[72] in poultry production.

Retrospectively, the publication of *Animal Machines* nonetheless marked a watershed in British discussions of agricultural antibiotics. In the same year that Ruth Harrison linked antibiotic resistance, residues and cruelty in the public's

[67] 'Farming Notes and Comments', *Times*, 17.08.1964, p. 6.
[68] 'Why The American Farmer Can Cope Single-Handed', *Times*, 28.06.1965, p. 14.
[69] Ibid.
[70] 'Commercial Cyanamid', *Times*, 12.01.1961, p. 5.
[71] 'Commercial Cyanamid', *Times*, 14.04.1961, p. 5.
[72] 'Commercial Cyanamid', Times, 13.10.1961, p. 5; also see: 'Commercial Cyanamid', *Times*, 22.06.1961, p. 5.

mind, the last major British outbreak of typhoid brought home the microbiological hazards of globalised food production. Occurring in Aberdeen, the 1964 *Salmonella typhi* outbreak was caused by contaminated Argentinian meat.[73] While the Aberdeen *S. typhi* strain responded to chloramphenicol,[74] experts were concerned that future outbreaks might prove resistant.

One of the concerned experts was the Public Health Laboratory Service (PHLS) bacteriologist Ephraim Saul (E.S.) Anderson, who had provided expertise both for the 1960 ARC review and the Aberdeen typhoid outbreak.[75] In 1965, Anderson and British geneticist Naomi Datta published a paper titled *Resistance to Pencillins And Its Transfer In Enterobacteriaceae* in the *Lancet.*[76] Popularising the dangers of R-factor transfer in the West, the authors discussed the 'horizontal' communication of resistance via plasmids in the case of *Salmonella typhimurium* and warned about the possible transfer of resistance between *S. typhimurium* and *Escherichia coli*. For the authors, it was clear that feeding antibiotics to animals could lead to human infections with resistant *S. typhimurium*, a close relative of typhoid-causing *S. typhi.*[77] Three months later, Anderson followed up his findings with a paper published together with M. J. Lewis in *Nature*.[78] Reporting a dramatic rise in *S. typhimurium* resistance

[73] David F. Smith et al., *Food Poisoning, Policy and Politics. Corned Beef and Typhoid in Britain in the 1960s* (Woodbridge: The Boydell Press, 2005), Lesley Diack et al., 'Departmental, Professional, and Political Agendas in the Implementation of the Recommendations of a Food Crisis Enquiry: The Milne Report and Inspection of Overseas Meat Plants', in David F. Smith and Jim Philips (eds.), *Food, Science, Policy and Regulation in the Twentieth Century. International and Comparative Perspectives* (London and New York: Routledge, 2000), Hardy, *Salmonella Infections, Networks of Knowledge, and Public Health in Britain 1880-1975*, pp. 217-18.
[74] Smith et al., *Food Poisoning, Policy and Politics. Corned Beef and Typhoid in Britain in the 1960s*, p. 22.
[75] Ibid., pp. 85-87; 132.
[76] Anderson and Datta, 'Resistance to Pencillins and Its Transfer in Enterobacteriaceae'.
[77] Ibid.
[78] E. S. Anderson and M. J. Lewis, 'Drug Resistance and Its Transfer in Salmonella Typhimurium', *Nature,* 206/4984 (1965).

between 1963 and 1964, the authors specifically focused on the particularly resistant type 29 of the bacterium. Linking the spread of type 29 *S. typhimurium* to calf transports, the authors warned against the "infective hazards of intensive farming."[79] By the end of the year, Anderson published an even more direct attack on agricultural antibiotics in the *British Medical Journal* (BMJ): between December 1964 and November 1965, Anderson had collected over 1,200 animal (mainly calf) and 500 human samples of type 29 *S. typhimurium*. Of these samples, 97.6% were drug-resistant.[80] In contrast to earlier papers, Anderson was also able to demonstrate a case of resistance transfer from animals to humans: human and animal *S. typhimurium* samples showed similar resistance levels to furazolidone, a drug used exclusively in veterinary medicine. Resistance had clearly crossed over from animals to humans. Anderson was certain that of the analysed samples "most human infections of undetermined source were bovine in origin."[81]

In contrast to US reactions to similar *NEJM* warnings one year later, the impact of Anderson's papers on the British media was impressive. Published only one year after the publication of *Animal Machines*, Anderson's warnings seemed to validate Ruth Harrison's criticism of intensive farming. In February 1965, a *Times* report on Anderson's papers suggested "that antibiotics should be kept well away from livestock food."[82] In November, the *Observer* blamed "super-farms"[83] for new cases of bacterial resistance. Following Anderson's 1966 *BMJ*

[79] Ibid., p. 583.
[80] E. S. Anderson, 'Origin of Transferable Drug-Resistance Factors in the Enterobacteriaceae', *British Medical Journal,* 2/5473 (1965), p. 1289.
[81] Ibid.
[82] 'Germ Survival in Face of Antibiotics', *Times*, 26.02.1965, p. 15.
[83] John Davy, 'New health fear on super-farms', *Observer*, 28.11.1965, p. 5.

paper, *The Times* demanded a "reappraisal of the use of antibiotics"[84] and the *Observer* published an appeal by the Farmers' and Smallholders' Association criticizing intensive agriculture's chemical dependency.[85] Warning against "factory farm bacteria"[86], the *Observer* explicitly linked the discussion about 'infective' resistance to the rhetoric of *Animal Machines*.

Responding to Anderson's findings, the British government reconvened its Netherthorpe committee. However, in January 1966, the Netherthorpe committee simply called for a new committee to re-evaluate agricultural antibiotics in general.[87] While the government was slow to react, British headlines and parliamentary inquiries[88] kept the issue of 'infective resistance' emerging on farms alive. The enduring media attention was partly due to the efforts of the *Guardian* journalist Anthony Tucker and Bernard Dixon from the *New Scientist*.[89] Dixon in particular attacked "the irritating British habit of seeking expert guidance on a technical matter and then pigeon-holing the advice when it comes."[90] Citing Anderson's work, Dixon also referred to the danger of multi-resistant *E. coli* strains causing neonatal diarrhoea in babies.[91] By December 1967, Dixon's warnings sounded tragically prophetic. Described by Robert Bud in chilling detail, multi-resistant *E. coli* 0119 and 0128 caused a severe outbreak of gastroenteritis amongst infants in the north-eastern town of

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[84] 'Reconsidering Use Of Antibiotics', *Times*, 28.02.1966, p. 13.
[85] 'Stop use of hormones', *Observer*, 30.01.1966, p. 4.
[86] 'Warning on factory-farm bacteria', *Observer*, 30.01.1966, p. 4; also see: Valerie Crofts & Margaret Cooper, 'Letters to the Editor: Factory Farming', *Observer*, 06.02.1966, p. 30.
[87] R. Braude, 'Antibiotics in Animal Feeds in Great Britain', *Journal of Animal Science,* 46 (1978), p. 1427, Bud, *Penicillin: Triumph and Tragedy*, pp. 177-81.
[88] TNA MAF 284/282 (P.Q. Mr. John Harr (Harborough), Oral, 26 Jul, 1967); TNA MAF 287/450 (House of Commons, Written Answer, Treatment of Human Infections, Exclusive Use of Certain Antibiotics, No.84/1967/68, 13 Nov, 1967)
[89] Bud, *Penicillin: Triumph and Tragedy*, pp. 177-81.
[90] Bernhard Dixon, 'Antibiotics on the farm – major threat to human health', *New Scientist* (05.10.1967), p. 33.
[91] Ibid., p. 34.

Middlesbrough. Poor hospital hygiene and transferring infected infants to other hospitals spread the infection. In the end, 15 infants died.[92]

Although there were no proven links, pre-conditioned British readers nonetheless linked the multi-resistant Teesside strains to 'factory farms' and agricultural antibiotic use. Writing to *The Illustrated London News* in late 1967, the well-known animal welfare activist Gwendolen Barter declared that one should forego factory farm meat if "one values one's health."[93] Following heated letter exchanges between veterinary science lecturers and Soil Association and Farm & Food Society members,[94] an article in the *London Illustrated News* also linked the Teesside epidemic to agricultural antibiotic use:

> … one cannot help wondering why man should take the chance of placing himself in danger of returning to conditions of the pre-antibiotic era when, for example, the death of fourteen babies from gastro-enteritis would certainly not have made news headlines.[95]

The Teesside epidemic put immense pressure on the British government to implement the Netherthorpe-suggestions and combat bacterial resistance.[96] Appointed in July 1968 and announcing its findings in November 1969, the Joint Committee on the Use of Antibiotics in Animal Husbandry and Veterinary Medicine – the so-called Swann-Committee – divided antimicrobial substances into therapeutic and nontherapeutic antibiotics.[97] While therapeutic antibiotics

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[92] Bud, *Penicillin: Triumph and Tragedy*, pp. 178-81.; for fatality numbers; House of Commons Debate 11.04.1968 vol. 762 cc1619-30, 'Gastro-Enteritis (Tees-Side) Hc Deb 11 April 1968 Vol 762 Cc1619-30', *Digitised editions of Commons and Lords Hansard, the Official Report of debates in Parliament* (http://hansard.millbanksystems.com/commons/1968/apr/11/gastro-enteritis-tees-side [accessed: 24.02.2013], 1968).

[93] Gwendolen Barter, 'Letters to the Editor: Ethics and cruelty', *London Illustrated News* [in the following *LIN*], 18.11.1967, p. 6.

[94] N. S. Barron, 'Letters to the Editor', *LIN*, 09.12.1967, p. 6; Robert Waller, 'Letters to the Editor', *LIN*, 30.12.1967, p. 4; J. Bower, 'Letters to the Editor', *LIN*, 20.01.1968, p. 31; F. Belsham, 'Letters to the Editor', *LIN*, 03.02.1968, p. 6.

[95] Tony Loftas, 'How Do Germs Learn To Resist Drugs', *LIN*, 27.01.1968, p. 17.

[96] Bud, *Penicillin: Triumph and Tragedy*, p. 181.

[97] Braude, 'Antibiotics in Animal Feeds in Great Britain', p. 1427.

were relevant to human medicine, nontherapeutic antibiotics were considered irrelevant. Only nontherapeutic antibiotics below certain doses were to be allowed in standard animal rations. Therapeutically relevant penicillin, chlortetracycline and oxytetracycline were to be banned from feeds altogether. The Swann committee, however, merely cautioned against the use of chloramphenicol AGPs and did not address veterinarians' power to prescribe therapeutic antibiotics on a prophylactic or metaphylactic basis.[98]

British media reactions to the Swann report were nonetheless mostly favourable. Although the *Guardian's* Anthony Tucker worried about the Swann committee's narrow focus,[99] a *Times*-editorial titled "What are we going to feed 'em?" [100] lauded the decision to limit laypersons' access to therapeutic substances. However, in a further article, *Times* agricultural correspondent Leonard Amey expressed criticism of veterinarians' increased power.[101] While agreeing with the Swann report in principal, Amey sagely noted that a complete ban of agricultural antibiotics would have put an end to British intensive animal production.[102] In doing so, he acknowleged the dramatic changes that had taken place since the war.

[98] Leonard Amey, 'Three antibiotics banned from animal food', *Times*, 21.11.1969, p. 2.
[99] Anthony Tucker, 'Antibiotics to be banned from animal feeds', *Guardian*, 21.11.1969, p. 20.
[100] 'What Are We Going To Feed 'Em?', *Times*, 21.11.1969, p. 11.
[101] Leonard Amey, 'A week of many moves', *Times*, 24.11.1969, p. 18; the increase of veterinarians' power coincided with a beginning slump of preventive medicine; see Woods, 'Is Prevention Better Than Cure? The Rise and Fall of Veterinary Preventive Medicine, C. 1950-1980', pp. 124-28.
[102] Leonard Amey, 'Rapid action on farm antibiotics', *Times*, 10.11.1969, p. 1.

Chapter Five: Bigger, Better, Faster – Antibiotics and British Farming

During the early 1930s, the outlook for British farming had been bleak: as inhabitants of the largest agricultural free-trade market in the world, British farmers were exposed to sinking food prices and a flood of cheap imports during the global agricultural crisis.[1] Unable to compete, employment in the agricultural sector fell and productivity decreased until 60% of British food had to be imported.[2]

Faced with the rural plight, the British government only gradually abandoned *laissez-faire* agricultural policies: the Agricultural Acts of 1931 and 1933 saw the creation of tariff walls and corporatist Marketing Boards for farm products.[3] Reacting to developments in Europe, the UK established a Food Department in 1936 and began stockpiling food and agricultural supplies. By 1939, British officials were actively propagating agricultural expansion to provide additional calories.[4] Following the outbreak of war, the new alliance between farmers and officials grew even closer: farmers were integrated into War Agricultural Executive Committees (WAEC), which were controlled by the Ministries of Agriculture and Food. At the local level, the WAECs enforced ministry directives but also advised and graded farmers' productivity. Unproductive or recalcitrant farmers could even have their land expropriated. Attempting to maximize caloric output,[5] the wartime administration prioritised plant production and introduced guaranteed prices by purchasing farmers'

[1] Martin, *The Development of Modern Agriculture. British Farming since 1931*, pp. 6-8.
[2] Ibid., p. 10.
[3] Ibid., p. 23.
[4] Ibid., pp. 29 and 33-35.
[5] Ibid., p. 51.

produce.[6] While pig and poultry stocks plummeted, British farmers increased caloric output by 50%.[7]

After the war ended, British farmers were credited with having 'fed the nation'. However, the wartime doctrine of growth and efficiency had led to changes in the very fabric of British farming. According to historian John Martin, traditional rural values had been abandoned "for short term economic advantages and unquestioning compliance."[8] Nonetheless, the majority of post-war farmers and their lobby, the National Farmers Union (NFU), were eager to continue the profitable corporatist alliance with the state. In contrast to the poverty-stricken inter-war years, most farmers' coffers had been flushed by fixed wartime prices and subsidised rural development.

The post-war economic situation made the Labour government equally willing to continue the alliance. In August 1945, the USA's termination of the Lend-Lease agreement necessitated the repayment of American wartime loans and left Britain desperately short of foreign currency. Attempting to reduce imports, the British government embarked on a program of subsidized and state-controlled agricultural expansion with the Agricultural Act of 1947. Perpetuating annual price reviews and intervention purchases, the Act was designed to give farmers and farm workers fair returns and stimulate agricultural investment.[9] The government also attempted to boost efficiency by founding the National Agricultural Advisory Service (NAAS) and providing improvement grants.[10]

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[6] Ibid., p. 38.
[7] Ibid., p. 54.
[8] Ibid., p. 61.
[9] Holderness, *British Agriculture since 1945*, pp. 12-16.
[10] Martin, *The Development of Modern Agriculture. British Farming since 1931*, pp. 91-92.

Despite growing international food availability and the end of rationing in 1954, state-involvement in agriculture continued. Ignoring accusations of feather bedding farmers,[11] successive governments supported a system of deficiency payments, which replaced former direct intervention purchases: once market prices fell below guaranteed prices defined by annual price reviews, the state paid farmers the difference between guaranteed and real prices. Similar to the US, sinking international food prices and domestic surpluses soon made the cost of state intervention rise dramatically. Attempting to curb expenditure, the Conservative government's 1957 Agricultural Act allowed limited annual reductions of price guarantees and shifted the emphasis from subsidies to improvement grants.[12] However, the underlying corporatist principle of fostering agricultural growth remained unchallenged.[13]

Trusting official subsidy promises, farmers throughout Britain invested wartime earnings and borrowed heavily to expand and improve their farms.[14] Agricultural magazines addressing 'ordinary farmers' like *Farmers Weekly* and the NFU's *British Farmer* were full of expert advice on new husbandry methods and basic economics for expanding farmers.[15] Serving as an important forum for campaigns against bovine tuberculosis and brucellosis,[16] the magazines also promoted the use of new technologies like artificial insemination, airborne crop

[11]Francis Michael Longstreth Thompson (ed.), *The Cambridge Social History of Britain 1750-1950. Volume 1: Regions and Communities* (Cambridge: Cambridge Unviersity Press, 1990), pp. 148-49.
[12] Holderness, *British Agriculture since 1945*, p. 21.
[13] On corporatism in British farming Graham Cox, Philip Lowe, and Michael Winter, 'From State Direction to Self Regulation: The Historical Development of Corporatism in British Agriculture', *Policy and Politics,* 14/4 (1986), pp. 480-88.
[14] 'Heavy Borrowing From Banks', *FW*, 06.10.1950, p. 40; also see: 'Millions More Spent On Buildings', *FW*, 13.10.1950, p. 36.
[15] 'Men and Machines', *FW*, 10.11.1950, p. 31; 'Cows kept in all year', *FW,* 20.05.1955, p. 93.
[16] 'Non-T.T. Farmers May Pay Dearly', *FW,* 25.12.1950, p. 28; on British animal health and eradication campaigns; Woods, 'Why Slaughter? The Cultural Dimensions of Britain's Foot and Mouth Disease Control Policy, 1892-2001', Woods, ',Partnership' in Action: Contagious Abortion and the Governance of Livestock Disease in Britain, 1885-1921'.

dusting and chemical growth promotion.[17] In magazines, the trope of having 'fed the nation at war' was often intermixed with scenarios of global overpopulation to justify the continuation of subsidised agricultural expansion.[18] Declared dead around 1930, British agriculture seemed geared to take on the challenges of the atomic age. Technological sophistication became an agricultural badge of pride.[19]

Profiting from soaring demand, intensification was a particularly important theme for British livestock farmers – even if this meant less '"fuss"[20] about individual animals. Similar to the US, the motto of most articles could be summarised as "never farm backwards."[21] One article claimed that while "nature intended a bird to lay only 24 eggs a season", scientific nutrition and husbandry meant that "there [was] no reason why she should not reach the 300 mark."[22] Frequently reminded to treat an animal "as a manufacturing unit,"[23] livestock producers found it hard to resist "the urge to E-X-P-A-N-D":[24] While Britain produced 762.000 tonnes of meat in 1947, it produced 1,713,000 tonnes in 1960.[25]

Not all British livestock producers were immediately won over to American-style intensification. Despite the ever-increasing prominence of intensive indoor 'life-cycle' systems, British livestock production remained characterised by a greater diversity of indoor and outdoor husbandry styles than

[17] 'AI Progress', *FW,* 22.12.1950, p. 23; 'Quicker Fattening', *FW*, 01.12.1950, p. 34; C.S. Smith, 'Pilot versus Pest', *FW*, 20.04.1951, p. 59.
[18] 'Filling the Meat Gap', *FW*, 01.12.1950, p. 33; 'World Output of Food is Up By a Quarter', *FW*, 16.09.1955, p. 76.
[19] 'Tribute to Britain', *FW*, 17.11.1950, p. 28; 'British Tractors Work Hardest', ibid., p. 36.
[20] H.L. Blackwell, 'Poultry 'Sense'', *FW*, 20.10.1950, p. 77.
[21] Jack Hargreaves, 'Never Farm Backwards', *FW*, 01.07.1955, pp. 118-119 and 121-122.
[22] Alexander Tomey, 'Not All Her Own Work', *FW,* 27.10.1950, p. 65.
[23] A. Stewart, 'Treat the Cow as Manufacturing Unit', *FW*, 30.09.1955, p. 48.
[24] 'The Urge to E-X-P-A-N-D', *FW*, 02.09.1960, p. 48.
[25] Europe: Meat Output Statistics, in: 'International Historical Statistics', (Palgrave Macmillan, April 2013).

in the US.[26] In part, this diversity had ideological reasons. While some British commentators feared that improved efficiency would increase the cultural divide between a shrinking number of farmers and the general public,[27] others feared technological alienation from animals and nature.[28] At the 1955 British Veterinary Congress, the deputy director of Weybridge Veterinary Laboratory, E.L. Taylor, warned "that man has initiated a whole host of major troubles."[29] In accordance to these troubles, Taylor divided his talk into five sections: "'Unnatural Foods', 'Unnatural Environment', 'Unnatural Concentration of Grazing Animals', 'Unnatural Geographical Position' and 'Unnatural Animals'."[30] In the same edition of *Farmers Weekly*, Taylor also claimed that modern hygiene and "supercilious dislike of some creatures and conditions (…) upset the whole delicate compensatory mechanism of nature."[31]

Despite such internal navel-gazing, British farmers shared their American colleagues' hostility towards non-agricultural critics. As one letter put it in 1955: "We as farmers are told what to do and when to do it by every Tom, Dick and Harry."[32] In Britain, animal welfare was a particularly sensitive topic. While most farmers defined welfare as animals' continued productivity, the British public was extending its definition of welfare to animals' mental wellbeing.[33] Titled

[26] Woods, 'Rethinking the History of Modern Agriculture: British Pig Production, C. 1910-65'.
[27] A.G. Street, 'Rises Without Strikes', *FW*, 13.10.1950, p. 49.
[28] Anthony Phelps, 'There's Still Money in Free Range', *FW*, 05.08.1955, p. 85.
[29] 'British Veterinary Congress – Has Man Put Animals' Health In The Balance?', *FW*, 16.09.1955, p. 76.
[30] Ibid.
[31] 'Animal Crackers', *FW,* 16.09.1955, p. 46; the second half of the 1950s was characterised by a veterinary focus on preventive health; Woods, 'Is Prevention Better Than Cure? The Rise and Fall of Veterinary Preventive Medicine, C. 1950-1980', pp. 117-20.
[32] D.W. Murrell, 'Letter to the Editor', *FW*, 02.09.1955, p. 39.
[33] Woods, 'From Cruelty to Welfare: The Emergence of Farm Animal Welfare in Britain, 1964-71', p. 21.

"Broiler Veal Not Cruel – Says NFU"[34], "Calves don't suffer – Mr. Hare"[35] and "Cruel to their Kind?"[36], agricultural articles attempted to defend intensive systems with the help of expert studies and references to high British standards. In comparison to the "pot-bellied" pre-war animals "with staring coats, housed in filthy hovels,"[37] agricultural commentators asserted that intensive systems offered modern animals a much better life.

Thrown into the maelstrom of post-war intensification, British farmers were torn between the promise of progress and an idealised rural past. While reports about technological risks made farmers wary, they also felt misunderstood by the public. As a consequence, most farmers adopted a hybrid position somewhere between the polar extremes of intensification and tradition – modernisation was always negotiation.

Antibiotics were a case in point. Spared many wartime constraints, dairy farmers belonged to the vanguard of British antibiotic users. By the early 1950s, many British dairy farmers had followed the lead of their American colleagues and relied on so-called dry-cow therapy in which sulphanilamide or penicillin udder-injections were given prophylactically at the end of cows' lactation periods.[38] However, similar to the US, problems soon emerged when residues interfered with sour milk cheese production. Whereas farmers were told to discard a minimum of two milkings following antibiotic treatment,[39] British veterinarians also reported a "changing 'clinical picture' which might follow the

[34] 'Broiler Veal Not Cruel – says NFU', *FW*, 22.07.1960, p. 38.
[35] 'Calves don't suffer – Mr Hare', *FW,* 29.07.1960, p. 40.
[36] A.G. Street, 'Cruel to their Kind?', *FW*, 30.09.1960, p. 83.
[37] Ibid.
[38] 'Questions Section: Summer Mastitis', *FW,* 27.10.1950, p. 69.
[39] 'Penicillin Spoils Milk For Cheese-Making', *FW,* 05.01.1951, p. 32.

extensive use of penicillin"[40] in 1951. Indicating a far greater awareness of bacterial resistance than in the US, British veterinarians noted, "The time [has] come for more research into the development of resistant strains and how they [can] be avoided."[41] Whereas *Streptococcus agalactiae* had caused 44% of mastitis-outbreaks in 1944, its successful treatment with penicillin had enabled resistant haemolytic *Staphylococci* to take over. Between 1944 and 1955, the percentage of mastitis outbreaks caused by *Staphylococci* rose from 10 to 30%.[42] Using resistance to legitimize their profitable control over easy-to-use dry-cow preparations, British veterinarians also lambasted US farmers' "indiscriminate use of antibiotics (…) without any veterinary supervision."[43]

Faced with reports on residues and resistance, some farmers were reluctant to allow drugs near their cows at all.[44] However, the majority of British dairy farmers believed that antibiotics' benefits continued to outweigh potential risks and could be rendered manageable by technological safeguards, improved hygiene, veterinary supervision and practitioners' education.[45]

Trust in *a posteriori* fixes also characterised the adoption of AGPs. Ahead of the 1953 TSA, the NFU was mostly concerned with lobbying for guaranteed minimum antibiotic concentrations and official guidelines for safe and efficient antibiotic use.[46] With no internal expertise on antibiotics, the NFU relied heavily on information supplied by the state. As a consequence, government experts

[40] 'Can Stockmanship Replace Dairy Hygiene?', *FW,* 09.03.1951, p. 41.
[41] Ibid.
[42] 'Is there a new Mastitis Menace', *FW*, 08.07.1955, p. 47.
[43] T. Cornell Green, 'More Milk – More Mastitis', *FW,* 21.10.1955, p. 99.
[44] Graham Brooks, ' Balance Prevents Mastitis', *FW*, 21.10.1960, p. 50.
[45] 'Our Dairymen's Hygiene Shocks an Australian', *FW*, 16.09.1955, p. 57; 'British Veterinary Congress', *FW*, 16.09.1955, p. 76.
[46] TNA MAF 287/299 (Dugdale to Turner, 29 Jul, 1953), p. 1; (Draft Regulation Therapeutic Substances Bill, Meeting, 3rd Jul, 1953).

played a crucial role in convincing initially cautious farmers to use antibiotics. Following a 1953 meeting, the NFU representative thanked officials:

> The subject was one about which he and many other farmers were relatively ignorant and he was grateful for the information and advice given. He was in general agreement (…), but felt that caution in propaganda and in the use of antibiotics was necessary...[47]

Following their introduction in late 1953, AGP sales skyrocketed: in 1954, an estimated 69,439 tons of supplemented feeds were sold directly from manufacturers to farmers. By 1959, the number had grown by over 600% to 445,706 tons.[48] On farms, AGPs' impact was equally dramatic and changed the biological rhythms at the very heart of traditional husbandry: instead of weaning piglets 56 days after birth, British farmers were now advised to wean 24-28 hour old piglets with penicillin-enriched milk powder. This way, even runts would survive and piglets would weigh ca. 40 lb. at their traditional weaning age.[49]

Celebrating progress, *Farmers Weekly* invoked an ideal of optimised nature. According to the magazine, agricultural antibiotics were a "boon to mankind."[50] Titled "Our debt to the Chemist,"[51] another article listed antibiotics, hormones, pesticides and insecticides amongst the great triumphs of 20th-century science.[52] According to the general manager of Pfizer's new factory in Kent, AGPs enabled British farmers to market pigs three weeks sooner. With pigs requiring ca. 10% less feed, 300,000 acres could be freed for growing other crops.[53]

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[47] TNA MAF 287/299 (G. Hedley, Meeting at Saughton to discuss TSA draft regulations, 4 Feb 1953), p. 4.
[48] TNA FD1/8226 (Office Note observations on aspects of the use of antibiotics supplied by the CAFSMNA (ARC 574/60)), p. 1.
[49] 'Artificial Rearing of Pigs', *FW*, 13.05.1955, p. 91.
[50] 'Antibiotics', *FW,* 20.05.1955, p. 45.
[51] 'Our debt to the Chemist', *FW,* 01.07.1955, p. 101.
[52] Ibid.
[53] 'Antibiotics Could Cut Pig Costs By Pound 5m A Year', *FW*, 07.10.1955, p. 44.

Similar to the US, pharmaceutical companies used aggressive marketing to promote their products. Despite British companies' patriotically themed commercials,[54] American dominance of the feed market was soon undeniable. By the end of the 1950s, most farmers would have been familiar with US brands like AUROFAC and Terramycin. In 1955, a Cyanamid commercial boasted:

> Last year, 1 in every 10 pigs in the United Kingdom had AUROFAC 2A Feed Supplement throughout its life (…). This year, 1 in every 7 pigs in the United Kingdom is being fed on AUROFAC 2A Feed Supplement from birth to slaughter.[55]

In contrast to mastitis medications, agricultural concerns about AGPs' safety emerged slowly. Surprised by the ARC's 1960 review announcement, *Farmers Weekly* was irritated that the report "condemns those willing to take risks for what it admits can be considerable gains."[56] However, farmers were mostly content to wait for the Netherthorpe committee's decision. In the meantime, it was business as usual. Although ways to reduce antibiotic use were addressed,[57] most articles continued to propagate generous antibiotic use and ignored indications of growing resistance.[58] In 1960, one article advised a farmer facing resistant coccidiosis to "complain to your feed merchants of the poor results you are getting and perhaps change to some other kind of medicated food."[59] Many veterinarians also remained unperturbed about AGPs. Interviewed by *Farmers Weekly*, J.D. Blaxland from the Central Veterinary Laboratory in Weybridge admitted that "the almost universal use of drugs and antibiotics"[60] was causing problems but did not condemn their use. Similar to the US, most

[54] 'ICI Commercial', *FW*, 15.07.1955, p. 96; 'Glaxo Commercial', *FW*, 20.07.1962, pp. 66-67.
[55] 'Cyanamid Commercial', *FW*, 21.10.1955, p. 76.
[56] 'ARC', *FW,* 08.07.1960, p. 46.
[57] Norman L Goodland, 'One-up – one down', *FW*, 12.08.1960, p. 87.
[58] 'Common Cold Cure', *FW,* 08.07.1960, p. 109; 'Shepherd's pocket vet', *FW*, 22.07.1960, pp. xi-xiii; 'Cold or Worse', *FW*, 16.09.1960, p. 133.
[59] 'Bugs and Drugs', *FW,* Ibid., p. 131.
[60] 'Poultry troubles multiply with expansion', *FW*, 09.09.1960, p. 57.

British farmers saw antibiotic resistance and residues as necessary evils lining the road of agricultural progress.

In the course of the 1960s, such a view became increasingly difficult to uphold. Memories of wartime farmers' "distinguished service"[61] were fading fast and the formerly cohesive modernisation ideal of the 1950s was giving way to a cacophony of agricultural booster rhetoric, hostility towards critics, melancholic reflexivity and occasional environmentalism.

A major reason for farmers' new insecurity was the crumbling promise of universal rural prosperity. Although many commentators continued to propagate agricultural expansion and intensive technologies throughout the 1960s,[62] a growing number of articles warned that small farmers would not survive the on-going cost-price squeeze.[63] Between 1951 and 1971, the number of people working in British agriculture decreased from 1,142,000 to 740,000.[64] Pointing to parallel developments in the US in 1962, an article in *Farmers Weekly* predicted an "end in sight for the family farms."[65] Two years later, delegates clashed over a resolution to limit the size of British farms at the NFU's annual general meeting. According to the resolution, the NFU should negotiate for ways to "ensur[e] that production of agricultural commodities remains with the farming industry" and "draw a line between [agricultural factories] and what is

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[61] 'Put agriculture in the front line says Sir John', *BF*, 10.05.1969, p. 7.
[62] 'Mass Production', *BF*, 20.10.1962, p. 3; Anthony Lisle, 'Untouched by Hand', *FW,* 06.07.1962, p. 99; 'A New 'Golden Age'', *FW,* 17.07.1964, p. 31; 'UK surplus for FAO food drive', *FW,* 07.09.1962, p. 51; 'World Famine Danger', *BF*, 11.02.1967, p. 15; 'World Food Deficit', *BF*, 12.02.1966, p. 82; W.G.R. Weeks, 'Gear up for the supermarket age', *FW*, 07.09.1962, p. 91.
[63] Rupert Coles, 'Points of Survival', *FW*, 17.08.1962, p. 101; Paul Atlee, 'Nobody's Too Small', *FW,* 19.10.1962, pp. 119 and 121.
[64] 'Economically Active Population By Major Industrial Groups UK', *International Historical Statistics,* p. 28.
[65] 'End in sight for the family farms?', *FW*, 10.08.1962, p. 41.

traditional agriculture."[66] However, opposition was strong: according to W. Greenhow, "the resolution was in direct opposition to progress. Hens did not need green fields to run in these days. It was important that some products be produced intensively."[67] After a heated discussion, what would have been a small revolution for British farming was defeated by 174 to 128 votes.[68]

In addition to economic concerns, British farmers were confronted with criticism from the budding environmentalist movement, which loosely combined concerns about animal welfare, human health and conservationism. Farmers' reactions varied considerably. During the 1950s, *Farmers Weekly* had already featured reports on the ideological battles between conventional experts and the fledgling organic community.[69] Although the majority of farmers remained hostile towards external criticism, the changing economic and cultural landscape resulted in more articles sympathetic to potentially divisive topics like vegetarianism and organic production methods.[70]

Mixed agricultural reactions to *Silent Spring* and *Animal Machines* are telling. Whereas farming magazines had downplayed *Silent Spring's* implications for British as opposed to US farming,[71] Ruth Harrison's *Animal Machines* was immediately seen as a far greater challenge. In March 1964, *British Farmer* complained that the *Observer* had joined the "anti-land lobby" by presenting a

[66] ''Factory' Farming', *BF*, 15.02.1964, p. 31.
[67] Ibid.
[68] Ibid.
[69] H.R. Gray, 'The artificial nightmare', *FW*, 14.10.1955, p. 93; Viscount Newport, 'Artificial Nightmare', *FW*, 21.10.1955, p. 49.
[70] Kathleen Thomas, 'Meals without Meat', *FW*, 02.11.1962, p. 105; Paul Atlee, 'No Mystery About His Muck Method', *FW,* 03.08.1962, p. 65; David Campbell, 'Man of Ag and Fish', *FW*, 12.12.1969, p. 78.
[71] 'Killer Chemicals', *FW*, 12.04.1963, p. 82.

"grossly distorted picture of British agriculture"[72] and refusing to print an NFU counter-statement. A *Farmers Weekly* editorial bemoaned:

> Townspeople (…) have been given a horrifying picture of the 'animal factories' (…). They are given a chilling picture of broiler house concentration camps and packing station Ausschwitzen [sic], of pig 'sweat-boxes'; of darkened torture-chambers for calves, and of animals going blind in intensive beef lots.[73]

If animals were truly suffering, they would die and not thrive.

However, *Animal Machines* and *Silent Spring* also struck a nerve among some farmers. Writing to *Farmers Weekly* in March 1964, one reader challenged battery systems. Why was an industry suffering from overproduction so intent on sustaining technologies producing these surpluses?[74] Titled "Obituary of a calf,"[75] a *Farmers Weekly* article by A.H. Harris described the short, sad and painful life of a male bobby calf from a first-person perspective. Once established, a steady trickle of internal criticism continued to challenge the orthodoxy of conventional intensification throughout the 1960s.[76]

Reacting to the increase of public environmentalism and internal dissent, proponents of intensive agriculture gradually moderated their rhetoric and stressed the necessity of an "informed climate"[77]. By the late 1960s, the NFU actively tried to win critics over. Building on its marketing expertise, the NFU produced documentaries titled "Press Button Farms"[78] and "Look to the Land"[79]

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[72] 'Feather Heads', *BF*, 28.03.1964, p. 1.
[73] 'Techniques in Question', *FW*, 13.03.1964, p. 43.
[74] K.M. Petter Ropewind, 'Battery Birds', *FW*, 27.03.1964, p. 41.
[75] A.H. Harris, 'Obituary of a calf', *FW* LXI/3, supplement, 17.07.1964, p. vii.
[76] Colin Tudge, 'Vets Warn of Rising Pollution Hazards', *FW*, 19.12.1969, p. 27; 'Paying for pollution', *FW*, 26.12.1969, p. 18; 'The pesticide dangers that linger in the soil', *FW*, 26.12.1969, p. 22; see also adverts for 'safe' or 'natural' products; 'Biddle Sawyer & Co. Commercial', *FW*, supplement, 14.06.1963, p. ii; Walter Strong, 'What's in the Market', *FW*, 05.12.1969, p. 99.
[77] 'Informed Climate Needed on Farm Poison Risks', *FW*, 20.03.1964, p. 64.
[78] 'NFU helped on farming film', *BF,* 10.06.1967, p. 5.
[79] 'The Union makes a film', *BF*, 04.05.1968, p. 22.

and organised joint-conferences for farmers and environmentalists.[80] In 1969, *British Farmer* invited "12,000 urban housewives to meet farmer[s]."[81] Following a joint-conference with conservationists, the magazine rejoiced: "Farmers and conservationists are on the same side."[82] Another article exhorted farmers to "out-conserve the conservators."[83]

Controversies about agricultural antibiotics accompanied many of the above-mentioned developments. Strengthened by the 1962 Netherthorpe report,[84] most farmers remained confident in agricultural antibiotics and even demanded expanded access to POMs.[85] The 1963 milk scandal did not fundamentally challenge agricultural antibiotic use either. Blaming problems on black sheep, the agricultural community endorsed the establishment of official controls and residue penalties. Similar to the US, only a minority of producers complained about "iniquitous penalties" and unnecessary "panic measures."[86] Magazines also supported government education campaigns and informed farmers about mastitis prevention and withdrawal times.[87] According to *Farmers Weekly*:

> Dairy farmers have little ground to complain over the row caused by antibiotic content of milk supplies. (…). It is obvious that the principal customers for udder antibiotics, those milk producers with chronic udder troubles in their herds, have been ignoring the quite clear instruction on the use of these drugs.[88]

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[80] 'Country conservation and the farmer', *BF*, 15.03.1969, p. 9; 'Are Farmers Raping The Countryside', *BF*, 05.04.1969, p. 21; 'Bird Damage Conference', *BF*, 18.05.1968, p. 3.
[81] '12,000 Urban Housewives To Meet Farmer', *BF*, 04.10.1969, p. 20.
[82] 'The Battle of the Hedgerows', *BF*, 02.08.1969, p. 24.
[83] 'Out-conserve the conservators, says Michael Drake', *BF*, 22.11.1969, p. 6.
[84] The report was so in keeping with the prevailing view of antibiotics that it went unnoticed by the analysed agricultural press.
[85] 'Drugs Without Vets' Move By Glos NFU', *FW*, 19.10.1962, p. 77.
[86] G.F. Robinson, 'Appalling Penalty', *FW*, 17.07.1964, p. 33.
[87] 'Axe will fall on 'antibiotic' milk', *FW*, 31.05.1963, p. 41; 'MMB sends out warnings on antibiotics', *FW*, 07.06.1963, p. 42; 'Veterinary Safety', *BF*, 22.02.1964, p. 5.
[88] 'Tube Trouble', *FW*, 07.06.1963, p. 40.

Together with the BVA, the magazine also warned that quick antibiotic cures would not solve the national mastitis-problem.[89] Meanwhile, commentators in *British Farmer* stressed that any antibiotic bans would be counterproductive. According to K.C. Sellers from the British Animal Health Trust, the government should improve veterinary preventive medicine before considering antibiotic bans.[90]

In 1964 and 1965, the publications of *Animal Machines* and Anderson's R-factor warnings posed far graver challenges for agricultural antibiotic use. Concerns about antibiotic safety were also addressed in agricultural magazines. In March 1964, veterinary investigation officer R.M. Loosmore seemingly confirmed some of *Animal Machines'* allegations to readers of *Farmers Weekly* when he complained that "indiscriminate" antibiotic use could mask disease in living and dead animals, whose carcasses were "sodden with antibiotics"[91]. While commentators condemned "selfish and careless"[92] antibiotic abuse for on-going residue detections in milk, a remarkable article in *British Farmer* linked concerns about horizontal resistance transfer to agricultural antibiotic use in 1965:

> Too many doctors and farmers are dosing human beings, pigs, calves and poultry with antibiotics for minor illnesses or as animal food additives. (…). This can mean that human beings and livestock are less easily treated for more serious epidemics, including typhoid in human beings. In short, the use of antibiotics has been overdone. [93]

According to veterinarian James Wentworth Day, there was an "urgent need for reappraisal of the use of antibiotics both in human beings and animals."[94]

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[89] 'Dairy Plague', *FW*, 07.06.1963, p. 40; 'Drugs 'no substitute for hygiene', *FW*, 07.06.1963, p. 42; Glaxo marketing 'approved' products for the duration of the scandal; 'Glaxo Commercial', *FW*, 07.06.1963, p. 54.
[90] 'Antibiotics In Milk', *BF*, 14.03.1964, p. 45.
[91] 'Misused drugs mask disease', *FW*, 06.03.1964, p. 71.
[92] 'Milk clean-up', *FW,* 21.08.1964, p. 39.
[93] James Wentworth Day, 'Misuse of Antibiotics', *BF,* 09.07.1966, p. 3.
[94] Ibid.

However, such outright criticism remained an exception. Between 1965 and 1967, *British Farmer's* only other reference to resistance problems was a report on a new AGP: containing nontherapeutic virginiamycin, 'Eskalin' was praised for answering "criticisms that continuous low level feeding of an antibiotic (…) can induce bacterial resistance."[95] At the same time, the magazine continued to print antibiotic commercials. Titled "Have Aureomycin – Will Travel,"[96] Cyanamid commercials depicted calves and pigs in front of small travelling crates and praised reductions of transport-induced scouring and mortality through prophylactic antibiotic use. Linking antibiotic-criticism to the "anti-factory farming lobby", which "always appears to get the headlines,"[97] *Farmers Weekly* complained about claims "that antibiotics such as chloramphenicol are included in the feed of laying birds as a matter of routine."[98]

Concerned about on-going attacks on agricultural antibiotic use, many farmers hoped that the Swann committee would provide clear guidelines and dissolve public and personal doubts about antibiotics' safety. By October 1969, growing apprehension about possible antibiotic bans became noticeable in the agricultural media. Informing farmers about the advantages of numerous AGPs, *Farmers Weekly* cautioned, "confident guesses rule out many antibiotics now used."[99] Titled "Drugs and Bugs,"[100] another article analysed antibiotic resistance in more detail: if preventing the spread of resistant bacteria to consumers was the main concern, then resistance transmission via meat and eggs and not

[95] 'Growth only from this antibiotic', *BF*, 08.04.1967, p. 47.
[96] 'Commercial Cyanamid', *BF,* 04.12.1965, p. 46; also see: 'Commercial Cyanamid', *BF*, 04.09.1965, p. 39.
[97] 'Sentiments and Facts', *FW,* 21.11.1969, p. 82.
[98] Ibid.
[99] 'Putting on weight', *FW* supplement, 03.10.1969, p. 27.
[100] 'Drugs and Bugs', *FW*, 17.10.1969, p. 110.

selection on farms was the problem. Better hygiene and cleaner packing stations would thus be more effective than AGP bans.[101]

Veterinarians were more outspoken in their criticism of AGPs. Asked to provide recommendations to the Swann committee, the RCVS called for stricter controls, the Veterinarians' Union (VETU) advocated a ban of all antibiotic feed supplements and the BVA supported a ban of chloramphenicol, tylosin and broad-spectrum AGPs.[102] Although out-going BVA president Peter Storie-Pugh looked forward to a time "when his profession could offer farmers an advisory service which could cost far less than a shelffull of drugs"[103], veterinarians' criticism of farmers' antibiotic use was far from self-reflexive. In 1969, the new BVA president John Parsons excluded a reform of veterinary prescription practices from demands for more state control over pharmaceuticals.[104]

By early November 1969, speculations about the Swann report had been replaced by "inspired 'leaks."[105] Complaining about "alarmist" press coverage, *Farmers Weekly* explained that the "talk of a 'new peril in food' is an exaggeration of the scientific problems presented by the increased use of these generally beneficial substances, …"[106] The editorial commiserated with intensive farmers, who felt "harassed a bit too much" about methods "which have not yet been proved to be seriously at fault."[107] Concurring, *British Farmer* claimed that potential antibiotic bans were based on "little convincing evidence"[108] and might cost farmers up to £10 million. Referring to the Manchester and Teesside

[101] Ibid.
[102] TNA AJ 3/183 (Cecil Schwartz, 'Vets advise Swann', *New Scientist*, 13.02.1969), pp. 348-349.
[103] 'Drugs: Good Servants, Bad Masters', *BF*, 04.10.1969, p. 45.
[104] Ibid.; for contemporary developments within the profession see Woods, 'Is Prevention Better Than Cure? The Rise and Fall of Veterinary Preventive Medicine, C. 1950-1980', pp. 119-25.
[105] 'Clamp on antibiotics', *FW*, 14.11.1969, p. 30.
[106] Ibid.
[107] Ibid.; 'Charter For Antibiotics Proposed', *FW*, 14.11.1969, p. 33.
[108] 'Likely Curb on Feed Drugs Worth £10 m', *BF*, 01.11.1969, p. 18.

outbreaks, another article reaffirmed that there was no evidence linking resistant gastroenteritis to farms.[109] Farmers hoped that officials would "impose a reasonable measure of control rather than (…) stop the practice altogether."[110]

Even though they complained about "purely circumstantial evidence" and lack of "real facts"[111], farmers were nonetheless convinced of the Swann committee's trustworthiness. In contrast to US farmers' later attacks on FDA expertise,[112] British farmers' post-war integration into official decision-making had allowed them to develop a thorough knowledge of and trust in the corporatist system.[113] Although the Swann decisions would also influence the pending regulation of pesticides like DDT, [114] farmers and their representatives knew that agricultural expertise would be present and heard in official committees. From experience, they also knew that compromise solutions were more likely to occur in discreet committees than during polarizing public hearings or debates. Shielded from public scrutiny, friendly experts could modify scenarios of risk without risking their prestige. Once publicly announced, a committee's findings would then profit from experts' united 'trustworthiness' and reduce the likelihood of further controversy.[115]

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[109] 'What proof?', *FW*, 14.11.1969, p. 30.
[110] Ibid.
[111] 'Little evidence', *FW,* 05.12.1969, p. 77.
[112] Chapter Eleven.
[113] Whereas European traditions of corporatism shielded individuals from public scrutiny, American political culture relied on experts' public presentation of evidence – thus making the strength of evidence dependent on experts' 'moral' authority, Krücken, *Risikotransformation. Die Politische Regulierung Technisch-Ökologischer Gefahren in Der Risikogesellschaft*, pp. 94 & 99-109; Jasanoff, *Designs on Nature: Science and Democracy in Europe & the United States.*, pp. 288-89, Sheila Jasanoff, *The Fifth Branch. Science Advisers as Policymakers* (Cambridge (Ma.) and London: Harvard University Press, 1994).
[114] Peter Bell, 'The Month', *BF*, 06.12.1969, p. 12.
[115] The concept of a confined and epistemologically fluid space in which risk models compete with each other and are subsequently communicated to a broader external public is based on Ludwik Fleck, *Genesis and Development of a Scientific Fact* (Chicago and London: University of Chicago Press, 1979), p. 124.

Following its publication in November 1969, British farmers were thus relieved to find little radicalism in the Swann report.[116] Even though it lobbied for financial compensation, *Farmers Weekly* admitted, "no sensible farmer would wish to [continue] using a drug which (…) could be a later risk to public health."[117] In a remarkable difference to US debates, the magazine warned:

> By mass use of low-dose antibiotics in farm animals we are creating a reservoir of drug-resistant bacteria. (…). Already some people have died through infection with salmonellae acquired from animals that resisted all attempts at drug therapy. (…). The range of useful antibiotics is limited: we cannot afford to devalue them. [118]

This 1969 concession of a link between AGPs and harmful bacterial resistance not only reflected British farmers' trust in the corporatist expert system but also the power of a national debate, which had focused on the dangers of resistance selection far earlier than in other countries.

In the end, British farmers were only grazed by the Swann bans.[119] AGPs were phased out slowly and substitutes were either already available or in the final stages of licensing.[120] Attempting to profit from the situation, some producers welcomed the opportunity to market British poultry as "the best and safest in the world"[121] and "turning the situation to [farmers'] advantage by such a slogan as 'British food is safe food'."[122] Although *British Farmer* joked that the "rows of bottles on some farm office shelves will be seriously depleted"[123], Swann did not challenge agricultural antibiotic use as such. Instead, it shifted the

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[116] 'Blow to Antibiotics In Feed', *BF*, 22.11.1969, p. 3.
[117] 'Drug Worry', *FW*, 21.11.1969, p. 33.
[118] Collin Tudge, 'Antibiotics – Farm Drugs With A Double Edge', *FW*, 21.11.1969, p. 41; see also: 'Opinion. Swann Song', *BF*, 06.12.1969, p. 11; Bill Message, 'Antibiotic safety', *FW*, 23.01.1970, p. 31.
[119] 'Watchdog plan for farm drugs', *FW*, 21.11.1969, p. 38.
[120] 'Same price for additives', *FW*, 28.11.1969, p. 40; Brian Chester, 'Drug Changes Will Be Made In Easy Stages', Ibid.
[121] Ibid.
[122] R.J.T. Holland, ''Safe food' promotion', *FW*, 05.12.1969, p. 49.
[123] 'Never A Dull Moment, With Drugs And Sheep And Crippling Tax', *BF*, 29.11.1969, p. 1.

balance of 'antibiotic power' in veterinarians' favour. In *Farmers Weekly*, farmer G. Armstrong drily noted: "My vet seems more pleased to sell products himself. I feel it is not in farmers' best interests for a 'closed shop' to develop."[124]

[124] G. Armstrong, ''Closed shop' drugs', *FW*, 05.12.1969, p. 49.

Chapter Six: Typing Resistance – Antibiotic Regulation in Britain

Just like farmers, British officials hoped that the 1969 Swann report would solve the escalating conflict between agricultural interests and consumer and environmental concerns.

Within official circles, AGPs had been controversial even before they were licensed in 1953. In 1951, the ARC had embarked on a series of feed experiments on government farms.[1] While US publications and positive trial results bolstered support for AGPs,[2] some officials remained apprehensive: "The difficulty seems to be that no one apparently knows what the antibiotics does [sic] and how it acts."[3] In July 1953, Thomas Dugdale, Conservative Minister for Agriculture, confided to NFU president Sir James Turner – the later Lord Netherthorpe – that he considered the mass-introduction of antibiotics to be a medical experiment.[4] A particularly contentious decision was to allow farmers to purchase diluted antibiotic substrates for home-mixing. Ministry of Health (MH) officials repeatedly warned against a possible rise of antibiotic allergies and bacterial resistance: "the whole purpose of the Penicillin Act was to prevent penicillin and other antibiotics being used indiscriminately with a consequent danger of producing penicillin resistant strains of pathogens."[5]

However, critics' concerns had little force. During relevant ministerial meetings, medical experts asserted that any "risk to health was negligible."[6] Antibiotic supporters also claimed that AGPs would reduce expensive feed

[1] TNA FD 9/1458 (E. M. B. Clements to A. A. Miles, 28 Mar, 1960), p. 1.
[2] TNA MAF 119/23 (ARC, Meeting 19 September, 1952), p. 1.
[3] TNA, MAF 119/23 (Minute Hill to Croxford, 19 April, 1952).
[4] TNA, MAF 287/299 (Dugdale to Turner, 29 July, 1953), p. 2.
[5] TNA, MAF 119/23 (Mr. Honnor, ARC, meeting 19 September, 1952), p. 3.
[6] TNA MAF 119/23 (Dr. Magee; ARC, meeting, 25 Feb, 1952), p. 2.

imports during times of currency problems and noted that the discovery of new antibiotics would surely outpace bacterial resistance development.[7] Although they were offended by their late consultation, the BVA and the Royal College of Veterinary Surgeons (RCVS) did not oppose AGPs either.[8]

In early 1953, British officials' main fear was being unable to supply projected demand. As a consequence, the British government approached US pharmaceutical companies to ensure sufficient stocks of antibiotics. Pouncing on the opportunity to extend sales of chlortetracycline, American Cyanamid's Lederle Laboratories Division offered free Aureomycin Magnasol Cake and the expertise of AGP co-discoverer Thomas Jukes. Concluding his letter, O. N. Williams, Lederle Laboratories' director, hoped that this would "be the beginning of an association which will be of mutual benefit."[9]

Two years after the FDA's licensing of AGPs, the British 1953 Therapeutic Substances (Prevention of Misuse) Act (TSA) exempted ready-mixed penicillin and chlortetracycline feeds and self-mix supplements for pigs and poultry from POM scheduling. However, many of the TSA's provisions came back to haunt Whitehall. Already recognised by contemporaries, one of the TSA's weaknesses was Britain's lack of analytical facilities for detecting antibiotics and discerning their concentration.[10] For data on residues and assays, British officials relied heavily on academic publications and foreign enforcement agencies – most notably the FDA. Meanwhile, enforcement of the TSA remained confined to the retail level and officials had no control over the use of legally purchased feeds

[7] TNA MAF 119/23 (W. G. Alexander; ARC, meeting, 25 Feb, 1952), p. 2; TNA MAF 287/299 (R. Braude; Meeting at Saughton to discuss TSA draft regulations, 4 Feb, 1953), p. 3.
[8] TNA MAF 287/299 (Veterinary Interests, Meeting RCVS and BVA with MH and MAF, 12 Feb, 1953).
[9] TNA MAF 287/299 (Williams to Moss, 5 February 1953), p. 2.
[10] TNA MAF 119/23 (Sgd. A. Eden to O. A. Robertson, 2 Nov, 1953), p. 2.

and substrates.[11] In hindsight, the 1953 TSA opened the legislative floodgates for a public health experiment of national proportions. Unfortunately, the authorities tasked with controlling this experiment were flying blind.

The reformed 1956 TSA did not improve the situation. While Part I of the TSA dealt with the licensing, manufacture and importation of medications to ensure their purity, Part II once again exempted low-dosed AGPs from POM scheduling.[12] More worryingly, the absence of mandatory POM-scheduling for new substances meant that recently discovered antibiotics – like tylosin – could theoretically be sold and used without any government control.[13] Officials and manufacturers remained surprisingly sanguine about this loophole: as Glaxo's ex-chief executive scientific officer Alfred Louis Bacharach put it, a "gentleman's agreement"[14] between manufacturers and the MAFF was sure to prevent any misuse. Until 1968, an aptly named voluntary Veterinary Products Safety Precautions Scheme merely suggested guidelines for unscheduled substances.[15]

While antibiotic enforcement withered, expert committees bloomed: because antibiotics' numerous applications transcended traditional responsibilities, a veritable jungle of committees became concerned with their use. Originally, the Medical and Agricultural Research Councils (MRC and ARC) had been responsible for advising ministers on agricultural antibiotics. However, by 1956, further committees became involved. Amongst them were the Preservatives Sub-Committee of the Food Standards Committee, the Scientific Sub-Committee of the Advisory Committee on Poisonous Substances Used in

[11] TNA MAF 287/299 (Meeting at Saughton to discuss TSA draft regulations, 4 Feb, 1953), p. 1.
[12] TNA MAF 119/23 (Draft: FG Raymond to GL Gray, 26 Nov, 1968).
[13] TNA MAF 284/281 (Minute 27, AB Bartlett, 10 Apr, 1956).
[14] A.L. Bacharach, 'Uk Position on Use of Antibiotic Food Additives', *Chemical Age* 78 (1957).
[15] TNA MAF 284/281 (Control of Antibiotics, Feb, 1969), p. 1.

Agriculture and Food Storage, and the joint Antibiotics Panel.[16] The numerous committees vied for influence and frequently disagreed with each other. As a result, departmental and expert responsibilities blurred and there was no guiding principle driving British antibiotic policy. In 1967 one official complained: "I have been quite unable to understand the relationship between these bodies."[17] Sharing his colleague's exasperation, another official admitted: "The situation is now so complicated that it is almost un-understandable."[18]

Meanwhile, the list of licensed antibiotic applications grew rapidly. In 1954, the Therapeutic Substances (Supply of Oxytetracycline for Agricultural Purposes) Regulations legalised oxytetracycline AGPs.[19] Streptomycin and oxytetracycline sprays and paints for plant production were licensed four years later. Despite the endorsement of sprays by penicillin co-developer Sir Howard Florey,[20] their licensing was criticised by MRC researcher Brandon Lush, who was concerned that antibiotic residues might alter the human gut flora and select for resistance. However, similar to the US, official equanimity prevailed: in the case of Lush, the absence of a bacteriologist on the Scientific Subcommittee on Poisonous Substances Used in Agriculture prevented further deliberations.[21] Concerned about residues rather than resistance, the recently instituted Antibiotics Panel debated whether workers' tough skin would make them less sensitive to antibiotic allergies than soft-skinned nurses.[22] In 1958, MAFF's proposed labels for antibiotic sprays and paints only recommended washing

[16] TNA MAF 101/643 (Note of Meeting held on 13.09.1956, to discuss the setting up of a Working Group on the use of Antibiotics in Agriculture and in Food Preservation).
[17] TNA MAF 287/450 (Minute, J. Hensley to Mr. Bott, 9 Jan, 1967).
[18] TNA MAF 287/450 (Minute, WD Macrae to Mr. Field, 18 Jan, 1967), p. 2.
[19] TNA MAF 284/282 (Control of Antibiotics, Appendix III: List of relaxing regulations made under Part II of the therapeutic Substances Act 1956, Feb, 1959)
[20] TNA MAF 284/281 (Minute 30, GO Lace, 30 May, 1956).
[21] TNA MAF 284/281 (Brandon Lush to GO Lace, 4 Jul, 1956).
[22] TNA MAF 260/82 (Antibiotics Panel, Meeting, 20 Dec, 1956), p. 2.

contaminated skin. Astonished, Murphy's, the manufacturer applying for the spray's legalisation, rejected MAFF labels and recommended full-body cover and face-shields for workers.[23]

US pharmaceutical manufacturers also pressed the British government to license antibiotic food preservation.[24] Lederle even sponsored preservative trials aboard the government trawler Sir William Hardy.[25] Manufacturers were only partially successful. While the absence of spoilage-indicating bacteria, resistance build-up and enforcement concerns prevented antibiotic poultry preservation, the same caveats were not applied to ice and dipping solutions for fish, which were briefly licensed in 1964.[26]

Although British officials were more hesitant than their US colleagues and voiced concerns about antibiotic resistance, a limited understanding of resistance proliferation, a lack of analytical facilities and the absence of clear bureaucratic responsibilities and policy directives resulted in the seemingly haphazard licensing of numerous antibiotic applications.

With residue problems remaining invisible, British officials were under little pressure to expand monitoring and enforcement and were proud of the low costs of the British food security system. In a 1956 submission to the Western European Union Sub-Committee on Health Control of Foodstuffs, UK delegates explained their refusal to establish residue tolerances:

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[23] TNA MAF 284/281 (EJ Miller to RS Mills, 18 Mar, 1958).
[24] TNA MAF 101/643 (Department of Scientific and Industrial Research. Preliminary report of the visit of Dr. Ella M. Barnes to the USA to investigate the use of antibiotics for food preservation, 1956), p. 1; TNA MAF 260/82 (Reports of the Antibiotic Panel, 09 Apr, 1958), p. 1.
[25] TNA MAF 101/643 (Note: Antibiotics for Fish Preservation. Pilot Scale Sea Trials, undated) – the later Rainbow Warrior.
[26] TNA MAF 284/282 (Control of Antibiotics, Appendix III: List of relaxing regulations made under Part II of the therapeutic Substances Act 1956, Feb, 1959)

> The United Kingdom feels that the problem of consumer hazard can be tackled in more than one way. (…). The successful application of the American system is dependent upon the existence of the necessary governmental machinery. (…). The United Kingdom delegation feels that cost and scientific management problems make it impossible for them to advocate a system of control of residues on prescribed tolerances.[27]

Discussing penicillin finds in US milk during its first meeting in 1956, the Antibiotics Panel noted the unfortunate lack of British residue data[28] but attempted to take a positive view of the situation:

> In view of the enormous amount of uncooked milk consumed daily by the American population and the propensity of penicillin to produce allergic reactions, it would appear that they have here a large scale experiment already completed …[29]

With only one proven non-fatal reaction to penicillin, officials argued that the US findings justified an extension of antibiotic use to food preservation.[30]

In contrast to the US, British officials' antibiotic complacency was not shaken by residues but by new data on bacterial resistance. In 1959, an article in *The Veterinary Record* presented uncomfortable findings. In their study, bacteriophage and veterinary researchers Herbert Williams Smith and W.E. Crab from Britain's Animal Health Trust in Houghton compared nasal and skin isolates of 160 tetracycline-fed pigs to those taken from an antibiotic-free control group. Of the 72% of pigs in the tetracycline-group carrying *Staphylococcus aureus*, an impressive 67% carried *Staph. aureus* resistant to tetracyclines. Interested in the spread of resistance, Williams Smith and Crab also examined pigs' human attendants: of 35 men caring for tetracycline-fed pigs, 54% carried strains of *Staph. aureus*, 11% carried strains resistant to penicillin and 34% carried strains

[27] TNA MAF 260/82 (Western European Union Sub-Committee on Health Control of Foodstuffs. Working Party on Poisonous Substances Used in Agriculture; Draft Paper by UK Delegation, 1956), pp. 6-7.
[28] TNA MAF 260/82 (Antibiotics Panel, Meeting, 20 Dec, 1956), p. 1.
[29] TNA MAF 101/643 (H.H. Taylor to WTC Berry, 9 Oct, 1957), p. 4.
[30] Ibid.

resistant to tetracyclines. An analysis of 50 additional attendants caring for tetracycline- and penicillin-fed chickens found that 48% of attendants carried *Staph. aureus*, 30% penicillin-resistant *Staph. aureus*, 14% tetracycline-resistant *Staph. aureus* and 4% penicillin- *and* tetracycline-resistant *Staph. aureus*. In most cases, the strains isolated from attendants and animals were identical.[31]

One year later, a team of government scientists under the direction of the already familiar PHLS bacteriologist Ephraim Saul Anderson found that strains of *S. typhimurium* isolated from British poultry were resistant to antibiotics used in feeds. Referring to the study before its official publication,[32] the ARC demanded a general reassessment of antibiotic feeds safety.[33] The review was to be undertaken ahead of potential expansion of AGPs to calves and layer hens.[34] Taken aback by the ARC's request, the MRC marvelled: "In fact they are seriously considering withdrawing approval of the adding of antibiotics; in other words, they are considering putting the clock back."[35]

Britain's pioneering focus on antibiotic resistance was no coincidence and can be explained by the country's leadership in resistance research and phage-typing. Expanding rapidly during the 1940s, phage-typing was a technique used to identify individual strains of bacteria with the help of bacteria-infecting viruses called bacteriophages. Because each bacteria strain is only susceptible to

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[31] Reprint in TNA MAF 260/82 (H. Williams Smith and W.E. Crab, 'The Effect of the Continuous Administration of Diets Containing Low Levels of Tetracyclines on the Incidence of Drug-resistant Bacterium coli in the Faeces of Pigs and Chickens: The Sensitivity of the Bact. coli to Other Chemotherapeutic Agents, *The Veterinary Record* 69 (1959)), p. 24; in the same year, environmental penicillin in factories and hospitals was identified as a significant contributor to resistant *Staphylococcus pyogenes;* J. C. Gould, 'Origin of Antibiotic-Resistant Staphylococci', *Nature,* 180/4580 (Aug 10 1957).

[32] B. C. Hobbs et al., 'Antibiotic Treatment of Poultry in Relation to Salmonella Typhi-Murium', *Mon Bull Minist Health Public Health Lab Serv,* 19 (Oct 1960); Anderson appears as Principal Investigator.

[33] TNA FD 9/1458 (L. S. Porter to Dr. Clements, 17 Jul, 1959)

[34] Ibid.

[35] TNA FD 9/1458 (Note on file, A.83/4, 9 Sept, 1959).

a limited amount of phages, infecting bacteria and then 'typing' phage-infection patterns is an efficient way of discerning individual strains.[36]

Originally developed in Canada, phage-typing was adopted in Britain by the bacteriologist Arthur Felix.[37] During the Second World War, Felix had been seconded to the Emergency Public Health Laboratory Service (EPHLS).[38] Based in London, the EPHLS' unprecedented centralisation of laboratory resources and health information[39] allowed Felix to use phage-typing to establish a national "finger-print bureau"[40] of chronic typhoid carriers and trace sporadic wartime outbreaks. Following the transformation of the EPHLS into the PHLS in 1945, Felix stayed on as Director of the Central Enteric Reference Laboratory and further developed British phage typing capacities.[41] By the time Felix' successor – E. S. Anderson – took over, the PHLS was a global leader in phage-typing and International Reference Laboratory for enteric phage typing.[42]

Crucially, phage-typing allowed post war PHLS researchers to discern the threat posed by antibiotic resistance. In 1954, British phage-typing had revealed the "chains of infection"[43] behind the first identified pandemic of resistant bacteria (*Staphylococcus* 80/81).[44] By the late 1950s, phage-typing enabled researchers like E.S. Anderson to link spreading bacterial resistance to antibiotic

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[36] Hillier, 'Babies and Bacteria: Phage Typing Bacteriologists, and the Birth of Infection Control', p. 735.
[37] Smith et al., *Food Poisoning, Policy and Politics. Corned Beef and Typhoid in Britain in the 1960s*, pp. 15-20.
[38] J. Craigie, 'Arthur Felix 1887-1956', *Biographical Memoirs of Fellows of the Royal Society,* 3 (1957), pp. 55-56.
[39] Smith et al., *Food Poisoning, Policy and Politics. Corned Beef and Typhoid in Britain in the 1960s*, pp. 16-17.
[40] Ibid., p. 17.
[41] Ibid., p. 18.
[42] Ibid., pp. 18-20, Hardy, *Salmonella Infections, Networks of Knowledge, and Public Health in Britain 1880-1975*, pp. 123-33.
[43] Hillier, 'Babies and Bacteria: Phage Typing Bacteriologists, and the Birth of Infection Control', p. 736.
[44] Ibid., pp. 737-41; 51-52; 60.

use on British farms.[45] The importance and advanced state of British phage-typing was later also acknowledged in a 1980 NAS-report on subtherapeutic antibiotic use in the US.[46]

Tasked with undertaking a comprehensive review of antibiotics in animal feeding, a Joint ARC/MRC committee started work in April 1960.[47] However, the so-called Netherthorpe committee's main body only met twice. During its first meeting in 1960, it installed a scientific subcommittee. Two years later, it endorsed the subcommittee's report.[48] The subcommittee itself met five times between 1960 and 1962. However, it soon became apparent that a fundamental rift divided members. While one faction consisting mostly of physicians and veterinarians attacked antibiotic feeds on the grounds of resistance, the other faction consisting of agricultural scientists and officials fiercely defended their use. In virtually every meeting, Drs. Robert Fraser Gordon (a veterinarian at the Houghton Poultry Trust) and R. Braude (an animal nutritionist at Reading's National Institute for Research in Dairying) clashed on the relative costs and benefits of antibiotic feeds.

When veterinary researcher Herbert Williams Smith was invited to give evidence in June 1960, he presented new data on the spread of antibiotic resistance from animals to workers: in one survey, 88.3% of *Staphylococcus*

[45] Anderson's co-publisher on horizontal resistance, Naomi Datta, had also worked at Colindale prior to moving to Hammersmith hospital; *Post Penicillin Antibiotics: From Acceptace to Resistance? A Witness Seminar Held at the Wellcome Institute for the History of Medicine, London, on 12 May 1998* (6; London: Wellcome Trust, 2000), p. 46.
[46] 'The Effects on Human Health of Subtherapeutic Use of Antimicrobials in Animal Feeds', (Washington DC: Committee to Study the Human Health Effects of Subtherapeutic Antibiotic Use in Animal Feeds (NRC), 1980), p. 23.
[47] Initially, the Netherthorpe Committee was supposed to sit secretly;TNA FD 9/1458 (Minute Dr. Faulkner, 7 Mar, 1960); Bayer sent a letter to the supposedly confidential committee advertising a non-therapeutic AGP; TNA FD1/8226 ((ARC/MRC Joint Committee on Antibiotics, Scient. Sub-Committee. Antibiotic for Animal Feeding Use only, Suggestion by Bayer Products Ltd., [undated]).
[48] TNA FD 23/1936 (Report of the Joint Committee on Antibiotics in Animal Feeding, 1962).

aureus strains isolated from the noses of veterinary surgeons and farmers were penicillin-resistant – 14.7% of isolates from veterinarians were also resistant to chloramphenicol.[49] Referring to these results, Williams Smith warned that even the smallest level of agricultural antibiotic use could produce resistant pathogens.[50] In response, Dr Braude asked for conclusive evidence of harm resulting from resistant farm strains. Williams Smith conceded that he was unable to supply such proof. The subcommittee therefore compromised on the following statement: "therapeutic uses of antibiotics could lead to the production of resistant strains, (…) the dangers of uncontrolled therapeutic use should be born in mind."[51]

Remarkably, evidence submitted by the NFU showed that uncontrolled use was taking place on British farms. Directly contradicting antibiotic supporters, the NFU submission contained three farmers' statements: one farmer confessed having illegally fed antibiotics to breeding pigs,[52] a second farmer stated that he used penicillin but had ignored "fashionable and extravagant claims of the broad-spectrum manufacturers"[53], and a third farmer reported "certain instances where high-level doses of antibiotics have been used in an attempt to offset bad husbandry practices."[54] At the end of the meeting, the subcommittee's minutes noted "the difference of opinion between the farming

[49] TNA FD1/8226 (ARC/MRC Joint Committee on Antibiotics, The Antibiotic Sensitivity of Strains of Staphylococcus aureus Isolated from the Noses of Veterinary Surgeons and Farmers, H. Williams Smith & W. E. Crabb)
[50] TNA FD1/8226 (ARC/MRC Joint Committee on Antibiotics, 2nd meeting Scient. Sub-Committee, 27 Jun, 1960), p. 2.
[51] Ibid., p. 3.
[52] TNA FD1/8226 (Information provided by the NFU, ARC 558/60), p. 1.
[53] Ibid.
[54] Ibid., p. 2.

members of the Joint Committee and the farmers whose opinion had been put forward as representative by the NFU."[55]

In view of its division between medical and agricultural members, the scientific sub-committee found it hard to agree on anything except the most commonplace facts. Acknowledging the subcommittee's impasse, Prof James Howie from the University of Glasgow presented three choices:

i. Complete prohibition of the addition of antibiotics to feedingstuffs (i.e. a reversion to the earlier situation, which would be very difficult)
ii. Maintenance of the present position (on the ground that the conflicting evidence did not provide any basis for a change)
iii. General permission to add antibiotics to feedingstuffs (on the ground that there was insufficient evidence to justify the withholding of such permission).[56]

Howie's phrasing was significant. By presenting only three choices – two of which were extremes – he transformed the *status quo ante* into an acceptable compromise. Both factions could subsequently claim to have prevented worse.

Yielding to Dr Braude's objections, the subcommittee agreed that evidence was insufficient to warrant restricting existing AGPs. Acknowledging an already common practice, it also recommended permitting AGPs for calves but did not endorse AGPs for layer birds and adult stock. Both sides agreed on the necessity of further research. Significantly, the medical faction also managed to push through a recommendation that new AGPs should be licensed on the basis of their irrelevance to human and animal therapy.[57] The suggested distinction between therapeutic and non-therapeutic antibiotics was not new: the

[55] TNA FD1/8226 (ARC/MRC Joint Committee on Antibiotics, 3rd meeting Scient. Sub-Committee, 18 Oct, 1960), p. 4.
[56] Ibid., p. 5.
[57] TNA FD1/8227 (ARC and MRC. Joint Committee on Antibiotics in Animal Feeding. Report of the Scientific Sub-Committee).

Antibiotics Panel had discussed such a separation as early as 1956.[58] However, by inserting the concept of two-tier licensing into the subcommittee's report, the medical faction scored a major long-term victory. Changed licensing procedures would promote the development of non-therapeutic AGPs. Once established, non-therapeutic AGPs would make penicillin and tetracycline-based feeds expendable. The medical faction's recommendation played a major role in reshaping British antibiotic policy.[59]

The Netherthorpe report's 1962 publication coincided with the unfolding milk residue scandal. Conducted in 1961 and available to officials by mid-1962, the report of the Milk and Milk Products Technical Advisory Committee on penicillin residues in British milk was not published for nearly a year.[60] Closely followed by a critical WHO report, the existence of hard residue data forced British authorities to follow the lead of the US and impose a penalty-based zero-tolerance policy for penicillin in milk.[61] One year later, even graver challenges arose. As a result of *Animal Machines*, Minister for Agriculture Christopher Soames was forced to establish the Brambell committee in April 1964. Giving evidence to the Brambell Committee in June, the BVA warned "that the limitations (…) of controlling non-nutritional additives to animal feeding-stuffs

[58] TNA MAF 284/281 (Advisory Committee on Poisonous Substances, Meeting, 13 Nov, 1956; minutes Antibiotics Panel, comment Dr. Barnes).
[59] European manufacturers of nontherapeutic AGPs saw a way to reduce US companies' dominance on the saturated AGP market; TNA FD1/8226 ((ARC/MRC Joint Committee on Antibiotics, Scient. Sub-Committee. Antibiotic for Animal Feeding Use only, Suggestion by Bayer Products Ltd., [undated]).
[60] 'Keeping Milk Free Of Antibiotics', *Times*, 30.05.1963, p. 18; TNA MAF 251/369 (Minute 11, C. E. Coffin, 20th July, 1962).
[61] Bud, *Penicillin: Triumph and Tragedy*, pp. 171-76.

constituted a threat to human health."[62] Meanwhile, typhoid was spreading in Aberdeen.

No doubt prompted by the typhoid outbreak, E.S. Anderson embarked on his study of animal and human resistance transmission in the same year. As Robert Bud has shown, Ephraim Saul – alias 'Andy' – Anderson embodied a new type of opinionated and media-savvy public expert, who challenged the discreet clubroom atmosphere of previous expert consultation. [63] Anderson had succeeded Arthur Felix as the head of the PHLS Enteric Reference Laboratory in 1953. Described in his obituary as "a hard taskmaster" with an "abrasive and perfectionist approach," [64] Anderson cultivated useful friendships with journalists like Anthony Tucker and Bernard Dixon.[65] Anderson's personality and determination to restrict agricultural antibiotics would have a significant, yet ambivalent influence on British antibiotic policy.

In the short term, Anderson's findings resulted in the 1965 reinstallation of the Netherthorpe committee. Called upon to give evidence twice and later accused of 'instigating' the whole committee,[66] Anderson passionately argued for a complete ban of AGPs. However, his lobbying had an unforeseen effect. Although the Netherthorpe committee still considered evidence insufficient to warrant AGP bans,[67] Anderson's research on resistant *S. typhimurium* in calves enabled the committee to move beyond its impasse. Because AGPs had not yet been legalised for calves, penicillin and tetracycline resistance logically either

[62] TNA AJ 3/183 (An Enquiry into the effect on Human Health on the use of Antibiotics for Intensively Reared Animals with special reference to the Swann Committee's Report of December 1969, March 1970), p. 1.
[63] Bud, *Penicillin: Triumph and Tragedy*, pp. 176-83.
[64] Anthony Tucker, 'ES Anderson', *Guardian*, 22.03.2006.
[65] Bud, *Penicillin: Triumph and Tragedy*, pp. 177-78.
[66] TNA MAF 287/450 (Minute 4, WD Macrae to Mr. Field, 18 Jan, 1967), p. 1.
[67] Ibid.

resulted from illegal AGP-use or veterinary over-prescription. Unable or unwilling to readdress AGP restrictions, committee members turned their attention towards veterinary prescriptions. In their draft report, members called for a new expert committee to investigate therapeutic antibiotic use in human and veterinary medicine. Further recommendations included rationalising bureaucratic antibiotic responsibilities and turning salmonellosis into a notifiable disease.[68]

However, reviewing all aspects of antibiotic use proved contentious: not only would a review infringe on the jealously guarded legislative boundaries between the Ministries of Agriculture and Health, it also threatened the MH's almost finalised 1968 Medicines Act.[69] In view of the fragile situation, MH officials and the influential antibiotic expert Prof. Lawrence Paul Garrod pressed for a deletion of all references to human medicine during the Netherthorpe committee's final meeting in April 1966.[70] Submitted in early January 1967, the final Netherthorpe report merely recommended a review of "the use of antibiotics in animal husbandry and veterinary medicine and its implications in the field of public health."[71] However, the subcommittee's attached report stressed that evidence for AGP restrictions was inadequate.[72] In sum, the only area to be reviewed was veterinary medicine.

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[68] TNA MAF 287/450 (Annexe, ARC 22B/66, ARC and MRC. Joint Committee on Antibiotics in Animal Feeding. Second Report of the Scientific Sub-Committee), pp. 1-2.
[69] Bud, *Penicillin: Triumph and Tragedy*, p. 181.
[70] TNA MAF 287/450 (Minute 4, WD Macrae to Mr. Field, 18 Jan, 1967), p. 2; TNA FD 7/899 (Note to Dr. Bunje, Note of a Meeting with the MAFF, February 13th, 1968).
[71] TNA MAF 287/450 (Annexe, ARC 2546/66, ARC and MRC. Joint Committee on Antibiotics in Animal Feeding) p. 1.
[72] TNA MAF 287/450 (Annexe, ARC 22B/66, Agricultural Research Council and Medical Research Council. Joint Committee on Antibiotics in Animal Feeding. Second Report of the Scientific Sub-Committee), p. 2.

Unsurprisingly, British veterinarians did not take kindly to such a review. Complaining about the Netherthorpe report's one-sided focus, the ARC blocked its publication in January 1967.[73] MAFF opinions were more nuanced: while one official downplayed the report as an uncomfortable "storm in a teacup,"[74] others anticipated "a first-class row with the Royal College and the BVA."[75] However, MAFF officials agreed that withholding publication was unwise.[76] Powerless to override the ARC, MAFF officials lobbied the MH to extend the review to both agricultural and medical aspects of antibiotic use.

In doing so, officials cited a parallel report by MAFF's Scientific Advisory Panel (SAP). Apparently anticipating problems with the Netherthorpe report, MAFF had commissioned the SAP with a separate review in 1965. The SAP was headed by Alastair Frazer, a food additives expert with close ties to industry,[77] and advised by Nobel laureate and penicillin co-discoverer Sir Ernst Boris Chain. Citing falling incidences of resistant salmonellosis,[78] the SAP endorsed agricultural antibiotics but recommended a national resistance study, a review of control measures, and more research cooperation between medical and veterinary authorities.[79]

Following further delays regarding the establishment of a new antibiotic review body, Labour's Minister of Agriculture, Frederick – 'Fred,' later Baron – Peart became involved in July 1967. During a meeting with Frazer and senior advisers, Peart agreed that the Netherthorpe report "created some unnecessary

[73] TNA MAF 287/450 (Minute, J. Hensley to Mr. Bott, 9 Jan, 1967).
[74] TNA MAF 287/450 (Minute, J. Hensley to Mr. Bott, 22 May, 1967).
[75] TNA MAF 287/450 (Minute, EH Bott to J. Hensley, 23 May, 1967).
[76] TNA MAF 287/450 (Minute, J. Hensley to Mr. Bott, 22 May, 1967).
[77] D.W. Kent-Jones, 'Obituary. Alastair Campbell Frazer', *Proceedings of the Society for Analytical Chemistry,* 6 (1969).
[78] TNA MAF 284/282 (MAFF, Scientific Advisory Panel. The Use of Antibiotics in Agriculture and Food, Jan, 1967), pp. 3-8.
[79] Ibid, p. 12.

alarm, and that [it] picked out veterinarians"[80] and consented to pressure the MH to extend the planned review to human medicine.[81] However, this only increased tensions. Referring to allegations of antibiotic overuse, an agricultural bureaucrat complained: "there has been a good deal of sniping from certain medical quarters (…), although I seem to recall something about 'people who live in glass houses.'"[82] In September 1967, all involved parties published a joint press statement acknowledging and accepting most of the Netherthorpe recommendations but rejecting monitoring plans for resistant salmonellosis.[83] However, despite pressure from the MRC, an actual antibiotic review remained unforthcoming.[84]

In the end, it took the tragic Teesside deaths to shock officials into action. Exchanged minutes reveal that concern first arose when the BBC's *Twenty-four Hours* linked fatalities to antibiotic overuse in agriculture ahead of Christmas 1967.[85] Previously postponed by an outbreak of Foot & Mouth disease, an intra-ministerial meeting was hastily scheduled for 13th February 1968. According to an internal letter, "ministers are becoming increasingly vulnerable in this business and we ought quickly to settle our lines on Netherthorpe."[86] A MAFF minute warned: "[MH] have been preparing for the 'battle'. I think we too should gather our forces."[87] However, the MH did not give way. With the support of the

[80] TNA MAF 287/450 (Minute, BHB Dickinson to Mr. Hensley, 24 Jul, 1967).
[81] Ibid.
[82] TNA MAF 287/450 (Minute, Macrae to Mr. Field, 4 Oct, 1967).
[83] TNA MAF 284/282 (Press Notice, 1 Sept, 1967).
[84] TNA FD 7/899 (Note: Harold Himsworth, Antibiotics in Animal Foodstuffs, 20 Oct, 1967)
[85] TNA MAF 287/450 (Minute, C.H.M. Wilcox to Mr. Hensley, 22 Dec, 1967; Minute, J. Hensley to TB Williamson, 29 Dec, 1967); E.S. Anderson created additional pressure by claiming that the resistant strains might have human or animal origins; TNA MAF 287/450 (Minute, TB Williamson to J. Hensley, 25 Jan, 1968).
[86] TNA FD 7/899 (TB Williamson to J. Hensley, 25 Jan, 1968)
[87] TNA MAF 287/450 (Minute, FC Parker to Mr. Bott, Mr. Field, Mr. Macrae, 1 Feb, 1968)

PHLS,[88] MH representatives argued that antibiotic overuse in human medicine was the sole concern of their ministry[89]and referred to the joint press statement's previous endorsement of the Netherthorpe report's review terms. MAFF officials later complained that the MH had treated the review's terms of reference as "a sacred cow which would not be sacrificed at any cost."[90]

Following the antibiotic review's limitation to agriculture, the next difficult question to settle was the future committee's membership. Feeling that the Netherthorpe committee had been "over-weighted scientifically on the medical and para medical sides,"[91] MAFF was keen to prevent the situation from reoccurring. Another point of contention was E.S. Anderson's role: should he be a committee member, or should he function as an adviser? Both ministries were aware of Anderson's public and scientific standing but equally wary of his vocal support of AGP restrictions and temperamental character. In order to control Anderson, the MH suggested co-nominating Sir James Howie, Anderson's superior at the PHLS.[92] However, in his eagerness to be appointed, Anderson overshot his goal: in April 1968, he publicly announced that he would refuse to give evidence should he not be appointed to the committee.[93] Anderson's attempt to pressure his way into the confidential world of official British expert consultation was bound to backfire. MAFF could now argue that Anderson would endanger the committee's objectivity and public standing:

[88] TNA FD 7/899 (Note to Dr. Bunje, Note of Meeting with the MAFF, 21 Feb, 1968).
[89] TNA MAF 287/450 (Note of Meeting 'To Discuss the Second Report of the Joint ARC/MRC Committee on Antibiotics in Animal Feeding Stuffs', 13 Feb, 1968).
[90] TNA MAF 287/450 (Minute, WD Macrae, Inter-Departmental Meeting on the Netherthorpe Committee Report, 19 Feb, 1968).
[91] Ibid.
[92] TNA MAF 287/450 (Minute, G.J.L. Avery, Joint Committee on Antibiotics, 25 April, 1968).
[93] TNA MAF 287/450 (Minute, W.C. Tame to Secretary, 29 Apr, 1968).

> If the committee's conclusions were in line with Dr. Anderson's views, there would be the charge that we had biased it with prejudiced members; if it went the other way, Dr. Anderson would no doubt issue a minority report.[94]

Even James Howie, who had previously refused to accept a committee position without Anderson's co-nomination, now changed his mind. A minute triumphantly noted: "Dr. Howie has become impatient of the Prima Donna approach of his colleague Dr. Anderson and is no longer prepared to support him."[95]

By May 1968, all membership decisions had been made: Anderson had been substituted with a public health expert from Birmingham, and the molecular biologist and vice-chancellor of the University of Edinburgh, Michael – later Baron and BBC chairman – Swann, had accepted chairmanship of the committee. Fearing attacks by Anderson, MAFF had, however, withdrawn its nomination of Alastair Frazer. In a smart move, agricultural officials convinced the MH to nominate two veterinarians in Frazer's stead. Comprised of two agriculturalists, three veterinarians and two medical scientists, the review committee was weighted slightly in favour of agricultural interests.[96] One official mused:

> I must confess that there is no adequate reason for the fact that it took us some nine months to decide to accept the report of the Joint ARC/MRC Committee to set up a Committee to go further into the matter.[97]

Commencing work in July 1968, the Joint Committee on the Use of Antibiotics in Animal Husbandry and Veterinary Medicine had to strike a

[94] TNA MAF 287/450 (G.J.L. Avery to Mr. Tame, 02 May, 1968); Anderson subsequently approached MP David Kerr to lobby for his nomination to the committee; see TNA MAF 287/450 (Dr. David Kerr (MP) to Cledwyn Hughes (MAFF), 22 May, 1968).
[95] TNA MAF 287/450 (Minute, J.G. Carnochan to Mr. Tame, 3 May, 1968).
[96] TNA MAF 287/450 (Committee on the Use of Antibiotics in Animal Husbandry and Veterinary Medicine. Proposed Members).
[97] TNA MAF 287/450 (Minute, W.C. Tame to Mr. Williamson, 6 May, 1968).

compromise between agricultural interests and public and scientific concerns and reconcile its proposals with the 1968 Medicines Act. In contrast to previous committees, the exit-strategy of maintaining the *status quo* by calling for more research was no longer available. Between December 1968 and April 1969, public pressure for antibiotic reform increased further when 30 babies died from resistant gastroenteritis in Manchester in a grotesque repeat of the Teesside outbreak.[98]

Submitted in November 1969, the so-called Swann report advised the British government to reduce antibiotic advisory bodies and install a permanent committee tasked with assessing both human and agricultural antibiotic use. It also called for a ban on antibiotic advertising to laypersons, further research and more funding of preventive veterinary medicine. Most significantly, the Swann committee recommended a separation of therapeutic and nontherapeutic antibiotics and a ban of penicillin and tetracycline AGPs. It also cautioned against agricultural uses of chloramphenicol but did not recommend a ban.[99]

While the Swann report resulted in pioneering resistance-based legislation, its proposals remained far behind critics' demands. Given its well-chosen terms of reference and membership, it had always been unlikely that the Swann committee would go against vested interests.

The Swann report's call for a permanent committee on antibiotics was neither new nor revolutionary. The 1968 Medicines Act had already replaced informal 'gentleman's agreements' with drug manufacturers' statutory obligation to apply to the newly founded Veterinary Products Committee (VPC) and the

[98] 'Action sought on antibiotics after babies' deaths', *Times*, 14.04.1969, p. 2.
[99] 'Report of the Joint Committee on the Use of Antibiotics in Animal Husbandry and Veterinary Medicine, 1969-1970.', (London, 1969).

Committee on Safety of Medicines (CSM) for product licences.[100] The envisioned new antibiotics committee would thus sit uncomfortably between the VPC and CSM. Moreover, it remained unclear what the new committee's priorities and competences would be: the Swann report called neither for the establishment of enforceable residue limits, nor for a strengthening of drug enforcement at the farm level.

Failing to endorse E.S. Anderson's calls for a total ban of AGPs, the Swann report's recommendation to restrict therapeutic antibiotics was more in keeping with the first Netherthorpe report. Although the Netherthorpe report had not endorsed AGP bans, its recommendations had ensured that nontherapeutic AGPs were readily available by 1969. Banning therapeutic AGPs would therefore not restrict general AGP use[101] and opposition to the Swann bans was likely to be voiced only by the mostly American firms dominating the therapeutic AGP market.[102] For all other parties, antibiotic business-as-usual remained intact.

Most significantly, the Swann committee missed its chance to push for stricter regulations of veterinary drug prescriptions and to regulate non-human antibiotic use holistically. Endorsed by veterinarians and the BVA,[103] restrictions on penicillin and tetracycline AGPs increased British veterinarians' control over the lucrative medicated feed market. Due to their monopoly 50% mark-up on prescribed drugs, British veterinarians made a sound profit from selling previously deregulated drugs. Even though the Swann report mentioned "ill-

[100] TNA MAF 284/281 (Control of Antibiotics, Feb, 1969), p. 1; TNA MAF 461/34 (Note of Meeting on the Future of the Joint Sub-Committee on Antimicrobial Substances, 28 Sep, 1979), pp. 1-2.
[101] Peter Bell, 'Never a dull moment, with Drugs and Sheep and Crippling Tax', *BF*, 29.11.1969, pp. 1-2.
[102] 'Antibiotic curbs 'will hit farmers'', *Guardian*, 06.01.1970, p. 4.
[103] Anthony Tucker, 'Antibiotics to be banned from animal feeds', *Guardian*, 21.11.1969, p. 20.

informed prescription in man and in animals", the BVA claimed that lacking evidence of malpractice, veterinarians "need not, then, be ashamed of [their] record in using antibiotics."[104] Discussing veterinarians' continued access to chloramphenicol, one official noted that "issues other than the purely scientific"[105] had influenced the Swann committee.

Although it did not challenge the problematic antibiotic-dependency at the heart of intensive animal husbandry, the Swann report marked the first attempt to redress the selection for bacterial resistance in agricultural settings. Following the report's release in late 1969, the question was whether Britain would use Swann as a starting point for further resistance-inspired reforms or rest on the report's international prestige.

[104] TNA AJ 3/183 (Joint Statement by the British Veterinary Association (July 1970)), p. 1.
[105] TNA FD 7/900 (Note on file: BL to Dr. Bunje and Dr. Clements, 27 Sep, 1968); also see TNA FD 7/899 (Note: 10 Oct, 1969).

Part Three – Britain: From Gluttony to Fear (1970 – 2006)

Chapter Seven: Yearning for Purity

The media pressure driving late 1960s British antibiotic reform quickly died down. Reassured by the Swann report, newspapers shifted their attention to issues other than antibiotics. Of these there was no lack: following the 1968 student protests, the early 1970s were characterised by an explosion of new activism. Dismissive of the "'softly-softly' reformism of the 1960s,"[1] a younger generation of activists operated outside traditional structures and favoured symbolic protest designed to provoke media interest.[2] Regarding intensive farming, the 1970s also saw the rise of radical and occasionally violent British animal rights activism.[3]

Meanwhile, fears of global overpopulation and environmental degradation gave rise to a number of international British bestsellers. Inspired by Paul Ehrlich's *Population Bomb*, Barbara Ward published *Spaceship Earth* in 1966. In her book, Ward argued for a fundamental ecological reform of developmental and technological politics. Responding to Ward, the editors of *The Ecologist* published *A Blueprint for Survival* ahead of the 1972 United Nations Conference on Human Environment in Stockholm. *Blueprint's* fundamental message was that the doctrine of unlimited economic growth had failed.[4] In

[1] Adam Lent, *British Social Movements since 1945. Sex, Colour, Peace and Power* (Basingstoke and New York: Palgrave, 2001), p. 97, Meredith Veldman, *Fantasy, the Bomb and the Greening of Britain. Romantic Protest, 1945-1980* (Cambridge: Cambridge University Press, 1994), p. 205.
[2] Lent, *British Social Movements since 1945. Sex, Colour, Peace and Power*, p. 100.
[3] Ibid., p. 103.
[4] Veldman, *Fantasy, the Bomb and the Greening of Britain. Romantic Protest, 1945-1980*, p. 228.

1973, Soil Association president and former Keynesian E.F. Schumacher's stoked further doubts about economic growth in *Small is Beautiful*.[5]

Agricultural antibiotics were neither high on activists' agendas nor a central issue in environmentalist bestsellers. Far from profiting from the environmentalist boom, agricultural antibiotics' status as a common denominator of protest fell victim to various single-issue campaigns.

The fragmentation of environmentalist agendas was mirrored in the British media. Previously uniting antibiotic activism, the *Guardian* and the *Observer* printed a small number of articles addressing agricultural antibiotics in the early 1970s and seemed satisfied with the post-Swann situation.[6] *The Times* expressed similar sentiments and reverted to the pre-Swann paradigm of distinguishing between medical and agricultural antibiotic use. Limiting resistance reporting to human medicine,[7] *The Times* continued to print commercials for agricultural antibiotics[8] and criticised foreign nations like Ireland or Mexico for failing to implement Swann-type legislation. When chloramphenicol-resistant typhoid emerged in Mexico, *The Times* self-righteously condemned "indiscriminate" Mexican antibiotic use and reminded readers that "few other countries"[9] had introduced Swann standards. In 1974,

[5] Ibid., p. 299.
[6] Wayland Young, 'Pollution a 'Guardian' special report', *Guardian*, 06.10.1970, p. 14; for criticism see: Alan Long, 'Food', *Observer*, 19.07.1970, p. 8; Idem., 'Farmers and Food', *Observer*, 08.02.1970, p. 23.
[7] 'The drugs doctors are reluctant to prescribe', *Times*, 02.02.1972, p. 8; 'Bacteriology: Antibiotic resistance', *Times*, 30.05.1974, p. 18; 'Public health: Resistant bacteria', *Times*, 02.09.1974, p. 14.
[8] 'Commercial Hindustan Antibiotics LTD', *Times*, 30.11.1970, p. XVIII; 'Commercial ICI', *Times*, 22.09.1972, p. III.
[9] 'Antibiotics: Resistant typhoid strain', *Times*, 04.08.1972, p. 14; also see: 'Antibiotics: 'Farm control needed', *Times*, 03.03.1972, p. 14.

The Times, however, remained remarkably sanguine when BVA opposition prevented the passing of British chloramphenicol restrictions.[10]

Public complacency regarding agricultural antibiotics only faded when studies began to indicate that the Swann bans were ineffective. Published in *Nature* in 1975, a British study of antibiotic resistance showed that all analysed pigs carried resistant organisms. In 41% of animals, all sampled organisms were resistant to restricted tetracyclines.[11] In the same year, another study in the *BMJ* blamed resistance on "indiscriminate use of antibiotics, mainly in animal husbandry".[12] One year later, former Netherthorpe committee member R. Braude claimed that Swann's "only positive achievement (…) was that it removed the public anxiety."[13] Rising British antibiotic consumption and resistance showed that Swann had failed. A major reason for this was that Swann had not addressed veterinary prescription practices.[14]

In addition to bacterial resistance, antibiotic residues garnered renewed attention. Writing for *The Times* in November 1974, French journalist and author Josée Doyère demanded "sound [safety] guarantees"[15] for feed additives, warned about farmyard pharmaceutical trading and hoped for common EEC residue limits. One year later, the British Consumers' Committee called for improved antibiotic residue monitoring of British milk. Committee members were concerned that official tests were too slow to stop contaminated milk from being

[10] Pearce Wright, 'Curb on use of an antibiotic is questioned', *Times* 01.08.1974, p. 2.
[11] H. W Smith, 'Persistence of Tetracycline Resistance in Pig *E. Coli*', *Nature,* 258/5536 (1975), pp. 628-30.
[12] C. L. Hartley and M. H. Richmond, 'Antibiotic Resistance and Survival of E Coli in the Alimentary Tract', *British Medical Journal,* 4/5988 (1975), p. 71.
[13] Braude, 'Antibiotics in Animal Feeds in Great Britain', p. 1434.
[14] Ibid., p. 1428.
[15] Josée Doyère, 'Sound guarantees needed on additives and hygiene', *Times*, 07.11.1974, p. VI.

sold.[16] A more radical generation of animal rights activists also used residue fears to draw attention to animal welfare problems by calling for bans of "antibiotics, hormones, arsenic or 'any other substance to promote unnatural development.'"[17] Adopting strategies pioneered by Greenpeace, the National Society for the Abolition of Factory Farming hired a public relations firm and used private investigators and litigation to generate publicity.[18]

However, antibiotic warnings' resurgence failed to provoke widespread protest. In addition to the fragmentation of antibiotic protest along distinct topic lines, many veteran campaigners were either genuinely satisfied with Swann or unwilling to jeopardize the hard-won compromise by calling for further reforms. Once again, it took external events to break antibiotic lethargy.

Following the late 1970s, a seemingly endless series of scandals reactivated general concern about agricultural antibiotics. In May 1979, the cover of the *Radio Times* showed a friendly piglet lying on straw. While the headline asked "Should this little piggy go to market?", a second caption in the style of cigarette packs read: "Health Warning. Meat And Poultry May Seriously Affect Your Health."[19] The health warning referred to a popular BBC programme called *Brass Tacks*, whose upcoming episode was titled "It Shouldn't Happen To A Pig."[20] Asking "whether it is time to choose between safe meat and cheap meat,"[21] *Brass Tacks* featured a Pharmaceutical Society spokesman, who claimed: "there is a substantial black market involving at least £500,000 worth of

[16] Hugh Clayton, 'Report says drugs given to cows may be in milk', *Times*, 13.02.1975), p. 3; also see: Michael Denny, 'The milk of kindness', *Observer* (Sunday Plus), 27.05.1979, p. 40.
[17] Hugh Clayton, 'Animal lovers keep their eyes on farmers', *Times*, 17.11.1975, p. 18.
[18] Hugh Clayton, 'Public relations and private eyes take on the factory farmers', *Times*, 24.05.1976, p. 17.
[19] 'Should this little piggy go to market?', *Radio Times*, 05.-11.05.1979, cover page.
[20] 'Brass Tacks: It Shouldn't Happen to a Pig', *British Film Institute National Archive* (http://ftvdb.bfi.org.uk/sift/title/154746 [12.08.2013]).
[21] Ibid.

antibiotics, compared with the estimated £20 million worth used by farmers each year."[22]

Three months later, the Government Chemist's annual report seemed to confirm *Brass Tacks'* allegations. According to the *Guardian's* Anthony Tucker, "itinerant 'con men'"[23] were endangering public health. Often operating out of plain vans, dealers sold pharmaceuticals with forged brand labels. Using mislabelled drugs could result in animals' death, residues in meat and antibiotic resistance. In 1978, antibiotics including chloramphenicol had been found in two-thirds of 350 confiscated samples of illegal merchandise.[24]

During the 1980s, the extent of the British pharmaceutical black market only seemed to increase.[25] In a 1983 interview for the *Daily Mirror*, the head of the Pharmaceutical Society's law department, Gordon Applebe, described the challenges of monitoring the black market with only 20 inspectors and 12 additional staff from MAFF.[26] In Applebe's opinion, British authorities were "probably only scratching the surface of the problem."[27] In 1984, the *Guardian* estimated that the British pharmaceutical black market was worth ca. £3 million with the bulk of supplies coming from Ireland.[28] One year later, British veterinarians were embroiled in a major scandal. Suspected of extending from the West Country to Cheshire, a raided drugs ring was accused of flooding farms with "illegal supplies of antibiotics amounting to more than £1,000 a week."[29] According to the Pharmaceutical Society's prosecutor, stopping the drugs ring

[22] Richard Norton Taylor, 'Furious farmers ready for drugs phone-in', *Guardian*, 08.05.1979, p. 2.
[23] Anthony Tucker, 'Illicit drug sales to farmers pose threat to public health', *Guardian*, 09.08.1979, p. 2.
[24] Ibid.
[25] 'Pressure to curb Irish farm drugs', *Observer*, 02.05.1982, p. 2.
[26] Denise Winn, 'Scandal of illegal farm drugs', *Daily Mirror*, 11.01.1983, p. 8.
[27] Ibid.
[28] Rosemary Collins, 'Dairy farmers overdo quotas', *Guardian*, 30.11.1984, p. 6.
[29] Andrew Veitch, 'Cattle drug ring broken in raids', *Guardian,* 26.07.1985, p. 28.

was the "biggest operation in the society's 140-year history."[30] The operation had involved half of the Society's now only 14 inspectors for over six months. By October, inspectors were investigating 54 farmers and four feed merchants.[31]

Facing old and new antibiotic resistant diseases, physicians also renewed their assault on agricultural antibiotics. In 1980, a *BMJ* paper by PHLS microbiologist and geneticist Eric John Threlfall traced the spread of multiresistant *S. typhimurium* types 204 and 193 from cattle to humans.[32] In 1979, the strains had caused 290 cases of salmonellosis and killed an elderly patient and a 3-year-old. According to Threlfall and his colleagues, agricultural advertisements had increased both veterinary antibiotic prescriptions and concomitant resistance: "current regulations have failed."[33] Referring to Threlfall, an anonymous *BMJ* editorial blamed "over-enthusiastic representatives of pharmaceutical firms", "black market operators"[34] and farmers for *S. typhimurium* resistance problems. Swann was failing because it left veterinarians and pharmaceutical advertisements unregulated.

Unsurprisingly, the *BMJ's* assault provoked angry reactions.[35] In 1980, early antibiotic reform campaigner Herbert Williams Smith accused Threlfall of unfair criticism. Because resistant salmonellosis had never been at the heart of the Swann deliberations, it was misguided to accuse the report of failing to prevent it. As the adoption of Swann by "many other countries" showed, Britain

[30] 'Animal drugs ring exposed', *Times*, 29.10.1985, p. 3.
[31] Ibid.; see also: 'Hunt for animal drugs widens', *Guardian*, 27.07.1985, p. 2.
[32] E. J. Threlfall et al., 'Plasmid-Encoded Trimethoprim Resistance in Multiresistant Epidemic Salmonella Typhimurium Phage Types 204 and 193 in Britain', *British Medical Journal,* 280/6225 (1980).
[33] Ibid., p. 1211.
[34] Anon., 'Why Has Swann Failed?', ibid., p. 1195.
[35] 'Vets blamed for spread of bacteria', *Times*, 28.05.1980, p. 1.

should "take some pleasure in having initiated it."[36] In 1981, Adam Linton took up the discussion in the *Veterinary Record*. Admitting that the "absence of simultaneous restriction[s] on the prophylactic and therapeutic use of antibiotics in both animals and man"[37] weakened Swann, Linton nonetheless considered any kind of prescription ban "unacceptable."[38] Instead of limiting prescription rights, regulators should focus on the spread of *Salmonella* via animal transports.[39]

While veterinarians and physicians accused each other of antibiotic overuse, resistant bacterial food poisoning increased. In October 1981, Bernard Rowe, director of the Central PHLS' Enteric Pathogens Division, warned that "Britain '[was] threatened by [a] food super germ'."[40] *S. typhimurium* type 204 had reached "a disgraceful level of drug resistance."[41] In 1984, *The Times* reported that notified salmonellosis cases had risen from 10,000 in 1977 to 17,000 in 1983 with resulting deaths rising from 25 in 1972 to 65 in 1982.[42] According to the newspaper, agricultural and veterinary antibiotic abuse was to blame for some of these deaths.

Because officials were slow to improve meat hygiene, expand controls or restrict additives, British public food fears grew. In 1985, the *Guardian* claimed: "food additives and residues from pesticides, hormones and antibiotics now rival AIDS as the number one health issue." [43] According to *Guardian* journalist James Erlichman, British consumers had the "gut feeling (…) that we throw too many

[36] H. Williams-Smith, 'Why Has Swann Failed?', *British Medical Journal,* 280/6230 (1980).
[37] A. H. Linton, 'Has Swann Failed?', *Vet Rec,* 108/15 (Apr 11 1981), p. 331.
[38] Ibid., p. 330.
[39] Ibid., p. 331, John R. Walton, 'Advising on Antimicrobials', *The Veterinary Record,* 108/16 (1981), p. 366.
[40] Hugh Clayton, 'Britain is 'threatened by food super germ'', *Times*, 28.10.1981, p. 3.
[41] Ibid.
[42] 'Salmonella blamed on antibiotics', *Times*, 13.09.1984, p. 3.
[43] James Erlichman, 'UK makes mincemeat of ban on hormones', *Guardian*, 15.11.1985, p. 21.

drugs and chemicals into the food we eat."[44] In a similar vein, Jan Walsh's 1986 bestseller *The Meat Machine* attacked intensive agriculture's health balance sheet. Claiming that "our grandmothers would not have touched such rubbish",[45] Walsh blamed antibiotic overuse on "the unnatural conditions of intensive rearing units" where disease spread "like wildfire."[46]

In response to growing food fears, British newspapers also increased reports about 'safe' organic produce, which was increasingly discarding its image of "dirndl, beads, sandals and an atmosphere of folkloric guitar strumming"[47]. In 1986, the *Guardian* described Wholefood Butchers in London's Paddington Street, which, until recently, had been "a lonely outpost (…), sustaining a network of small farmers whose methods seemed laughably anachronistic."[48] Now, there were at least four additional shops serving Londoners and demand was outstripping supply. Vendors' common denominator was 'antibiotic-free' meat.

By the mid-1980s, *The Times* joined the chorus of organic praise.[49] In a significant article from 1985, agricultural correspondent John Young had claimed that an alliance of "doom-mongers"[50] had exaggerated Malthusian scenarios. Citing a report by the UN World Food Council, Young noted that population growth had not outpaced cereal production. With global carryover of cereal stocks projected to reach 358 million tons in 1986, Young argued that global

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[44] James Erlichman, 'It's all very well to keep hormones out of our food – but what about pesticides?', *Guardian*, 21.12.1985, p. 17.
[45] Jan Walsh, *The Meat Machine* (London: Columbus Books, 1986), p. 13.
[46] Ibid., p. 10.
[47] Michael Dineen, 'The answer lies in preserving the soil', *Observer*, 01.11.1981, p. 21.
[48] Sheila Dillon, 'Real meat, real money', *Guardian*, 07.11.1986, p. 19; also see: 'Bringing home the bacon: Good Food Guide', *Guardian*, 15.11.1985, p. 19.
[49] Libby Purves, 'The case for an alternative cure', *Times*, 16.05.1986, p. 9; John Young, 'Bacteria is claimed to aid growth in animals', *Times*, 14.06.1986, p. 15.
[50] John Young, 'Malthus no: malnutrition yes', *Times*, 20.11.1985, p. 14.

hunger was "political, not economic."[51] Following this conceptual shift away from productivity-oriented Malthusian scenarios, *The Times* intensified criticism of conventional agriculture. In 1986, the newspaper printed a positive review of Peter Cox's *Why You Don't Need Meat*.[52] According to the Vegetarian Society's former chief executive, farmers were illegally marketing so-called casualty animals: "Dose[d] (…) up with a strong antibiotic to keep it on its feet for the next few hours"[53], sick animals were sold to inadequately controlled slaughterhouses. According to an anonymous veterinarian, antibiotics had changed his entire profession: "… once vets were people who looked after the well-being of animals, both farm and domestic. But now, we just supress the disease until it's time for the animal to be killed."[54] Focussing on bacterial resistance, *The Times* also printed a three-part series on "The Global Overdose"[55] in 1987. Titled "The bitter harvest,"[56] the third part of the series showed a piggy bank being filled with pills and accused doctors and veterinarians of shunning responsibility by blaming each other rather than tackling rising resistance.

As if on cue, 1987 also saw further unappetizing revelations about antibiotics in British milk. According to the *Guardian*, British farmers were adding the penicillin-neutralising enzyme penicillinase to milk in order to obscure residues. Hard-hit by recent EEC quota cuts, an interviewed West Country farmer noted, "I can't afford to throw away a 250 gallon tank of milk at

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[51] Ibid; on the diminishing power of global gap scenarios see John Ruxin, 'The United Nations Protein Advisory Group', in David F. Smith and Jim Philips (eds.), *Food, Science, Policy and Regulation in the Twentieth Century. International and Comparative Perspectives* (London and New York: Routledge, 2000).
[52] Denise Winn, 'One man's meat may be everyone's poison', *Times*, 28.07.1986, p. 11.
[53] Peter Cox, *Why You Don't Need Meat* (Weelingborough and New York: Thorsons Publishing Group, 1986), p. 109.
[54] Ibid., p. 110; in a sequel, antibiotics no longer featured as prominently; Peter Cox, *The New. Why You Don't Need Meat* (London: Bloomsbury, 1994).
[55] 'From wonder drug to bitter pill', *Times*, 02.03.1987, p. 10.
[56] George Hill et al, 'The bitter harvest', *Times*, 04.03.1987, p. 12.

80p a gallon. Enough penicillinase to neutralise the problem only costs me £8."[57] Although the NFU and MMB claimed that penicillinase was harmless, Joe Collier, a clinical pharmacologist at St George's Hospital in London, warned that neutralised penicillin residues could still trigger allergic reactions. Meanwhile, the chairman of the Agriculture Select Committee called for a crackdown on farmers and dairies using penicillinase.[58]

Fears about invisible and dangerous food contamination peaked in 1988. Early that year, health inspectors found antibiotic residues in 16 of 88 carcasses at a Bradford abattoir.[59] Alarmed, supermarkets Marks & Spencer and Waitrose announced that they would stop buying meat produced with antibiotic feeds.[60] One month later, the *Daily Mirror* asked, "what has gone wrong with our food laws"[61] and referred to resistant pathogens and inadequate hygiene controls before calling for a complete review of food laws.

The stage was set for a perfect storm when, on December 3rd 1988, a *Salmonella* outbreak prompted Junior Health Minister, Edwina Currie, to warn British TV-viewers to avoid "all raw egg products like mayonnaise, home-made ice cream, and even lightly cooked eggs."[62] Reacting to Currie's announcement, Richard Lacey from the VPC confirmed 450 recent cases of *Salmonella enteriditis*-induced food poisoning.[63] However, following another televised warning by Currie, Lacey corrected the number to ca. 3,000 infections with one resulting

[57] James Erlichman, 'Superbug risk from chemical use in milk', *Guardian*, 03.04.1987, pp. 1 and back page.
[58] Idem., 'Cover-up that may help the superbugs', *Guardian*, 07.04.1987, p. 29.
[59] Idem., 'Drug traces found in abattoir carcases', *Guardian*, 18.01.1988, p. 4.
[60] Idem., 'Public 'kept in dark on additives'', *Guardian*, 28.01.1988, p. 2; by the 1990s, both supermarkets had reverted to conventionally produced meat; 'Supermarkets move to ban growth-drug meat from shelves', *Guardian*, 24.04.1998, p. 4.
[61] Jan Walsh, 'Recipe for Danger', *Daily Mirror,* 04.02.1988, p. 6.
[62] 'Hen cull could halt salmonella', *Guardian*, 05.12.1988, p. 24.
[63] Ibid.

fatality every week.[64] With egg sales dropping nearly 15% ahead of Christmas, the NFU announced that it was going to sue Currie.[65] Dubbed "Eggwina"[66] by the British media, Currie was forced to resign on December 16th, 1988.[67] However, documents released in 2001 revealed that a parallel contemporary investigation confirmed "a salmonella epidemic of considerable proportions."[68]

Food safety concerns carried over into 1989. In parliament, Conservative MP Sir Richard Body accused MAFF of "turning a blind eye"[69] on pesticides, antibiotics and hormones in agriculture. Despite a promised Food Safety Act,[70] reports on "food danger[s] from 'barbaric' factory farms"[71] continued to appear and antibiotics and salmonellosis featured prominently. Titled "Not Even Fit For Our Pigs"[72] and "Cages of cruelty,"[73] the *Daily Mirror* reported on intensively reared animals:

> They are born and reared in the dark and the dirt. They are pumped full of hormones and antibiotics. (…). They are the next potential food poisoning timebomb [sic]. (…). And no Tory Government has dared to take on its masters, the agriculture lobby.[74]

However, British agriculture's biggest scandal was yet to come: during the second half of the 1980s, a new disease called *Bovine Spongiform Encephalopathy* (BSE) began to cause concern. Officially identified in 1986, BSE is believed to be caused by misfolded proteins – so-called prions – that accumulate as plaque

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[64] Idem, 'Salmonella eggs 'kill one a week'', *Guardian*, 19.12.1988, p. 1.
[65] PA Barton, 'Scrambled statistics and poached platitudes', *Guardian*, 06.12.1988, p. 22.
[66] Ibid.
[67] Smith et al., *Food Poisoning, Policy and Politics. Corned Beef and Typhoid in Britain in the 1960s*, pp. 303-04.
[68] David Milward, 'Currie 'Was Right' on Salmonella', *The Telegraph,* 26.12.2001[accessed 13 Aug 2013].
[69] Philip Webster and Sheila Gunn, 'Biggest food safety reform for 50 years', *Times*, 25.01.1989, p. 1.
[70] 'The Microbiological Safety of Food. Part Ii.', (London: Committee on the Microbiological Safety of Food (Richmond Committee), 1990), p. 6.
[71] 'Pig Sick', *Daily Mirror*, 13.02.1989, p. 1.
[72] Frank Thorne and Anna Treacher, 'Not Even Fit For Our Pigs', *Daily Mirror*, 13.02.1989, p. 5.
[73] 'Cages of cruelty', *Daily Mirror*, 13.02.1989, p. 2.
[74] Ibid.

fibres in brain tissues and cause death.[75] Significantly, BSE is transmissible to humans in the form of the equally fatal *variant Creutzfeldt-Jakob Disease* (vCJD). While there are competing theories on the origins of BSE, the disease was probably spread by feeding meat and bone meal to herbivore cattle.[76] In other words, the spread of BSE was inherently linked to intensive agriculture's factory-like (re-)processing logic.

With the Thatcher government reacting slowly to the new disease,[77] the early 1990s saw BSE fears merge with antibiotic-centred criticism of intensive agriculture. Writing for the *Guardian* in 1990, Lucy Ellmann complained that intensive farming had "given a new meaning to the term, fast food: the cattle themselves grow unnaturally fast on their diet of pig's blood, sheep offal, decaying chickens, chicken shit, hormones and antibiotics":

> Writing this piece has given me such a headache, I think I'll take an aspirin. (…). Oh, what the hell, might as well finish myself off with a chicken sandwich. [78]

Empowered by the return of significant public fears, critics intensified their assault on conventional agriculture. In 1992, Compassion in World Farming organised a well-publicised conference on "factory farming"[79] during which six veterinarians including a former RCVS president and a former MAFF assistant chief veterinary officer criticised the BVA's acquiescence to intensive farming.

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[75] S. Poser, I. Zerr, and K. Felgenhauer, 'Die Neue Variante Der Creutzfeldt-Jakob-Krankheit', *Deutsche Medizinische Wochenschrift,* 127 (2002), pp. 331-34.
[76] Mark Harrison, *Contagion. How Commerce Has Spread Disease* (New Haven and London: Yale University Press, 2012), p. 249.
[77] 'The Report of the Expert Group on Animal Feedingstuffs to the Minister of Agriculture, Fisheries and Food, the Secretary of State for Health and the Secretaries of State for Wales, Scotland and Northern Ireland (Lamming Report)', (London, 1992), pp. 5-15, Alain-Jacques Valleron, 'Estimation of Epidemic Size and Incubation Time Based on Age Characteristics of Vcjd in the United Kingdom', *Science,* 294 (2001), p. 1726.
[78] Lucy Ellmann, 'Off we all traipse like those mad cows to the slaughter', *Guardian*, 05.02.1990, p. 20.
[79] Alison Johnson, 'Kind food', *Times*, 18.01.1992, p. 44.

According to *The Times,* "the best way to squeeze factory farming is to refuse to buy its products."[80] On-going problems in British slaughterhouses were also criticised. In 1991, health inspectors found nearly 150 hygiene faults in two Welsh abattoirs. Publicised violations included, "flies in the cutting room, birds flying about in the slaughter hall, dirt on hanging meat, walls smeared in dried blood and muck, and slaughtermen with unwashed hands."[81]

Meanwhile, the comeback of scourges like tuberculosis caused a surge of articles addressing antibiotic resistance. According to the *Guardian*, strains of resistant "TB [had] acquired the sort of mythic quality Aids had in the mid-eighties."[82] Plans to introduce the genetically modified 'Flavr Savr' tomato sparked further controversies over 'artificially' induced antibiotic-resistance.[83] Although some reporters soon tired of the "media hype" surrounding the "same old story with the 'killer bug,'"[84] Hollywood movies and bestsellers fuelled general anxiety.[85]

With trust in intensive animal husbandry wearing thin, agricultural antibiotics once again functioned as a common denominator of various consumer, animal welfare, environmental and medical protest movements. While organic farmers used residue fears to promote their produce, physicians blamed agricultural antibiotics for fatal infections and activists attacked them for

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[80] Ibid.; also see: 'Do you know where your next meal came from?', *Times*, 03.10.1992, p. 10.
[81] 'A British side of beef', *Times*, 03.10.1992, p. 12.
[82] Henry Porter, 'TB in NY', *Guardian*, 27.04.1993, p. 5; also see: Tim Radford, 'Old Enemies – Bacteria', *Guardian,* 25.05.1994, p. 2; Christopher Thomas, 'Indians battle to prevent plague sweeping Bombay', *Times*, 27.09.1994, p. 15; Nigel Hawkes, 'Bacteria that eat the flesh', *Times*, 24.05.1994, p. 15.
[83] Bernard Dixon, 'We Say Tomato, They Say Flavr Savr', *Guardian*, 21.05.1994, p. 24; Polly Ghazi, 'Fried gene tomatoes', *Observer*, 25.09.1994, p. D68; Javier Lezaun, 'Genetically Modified Foods and Consumer Mobilization in the Uk', *Technikfolgenabschätzung – Theorie und Praxis,* 13/3 (2004).
[84] Thomas Stuttaford, 'It's the same old story with the 'killer bug'', *Times*, 31.05.1994, p. 15.
[85] Bud, *Penicillin: Triumph and Tragedy*, pp. 199-200.

facilitating animal abuse. Similar to the pre-Swann years, agricultural antibiotics' symbolic embodiment of controversial agricultural practices made them vulnerable to unrelated agricultural scandals.

Such a scandal occurred on March 20th, 1996, when the UK government confirmed a possible link between BSE and human vCJD. In the following weeks and months, British officials and farmers faced unprecedented outrage and embargoes that threatened to destroy the entire beef sector.[86] Writing for the *Guardian*, Patrick Holden, president of the organic Soil Association, described BSE as "testimony to the breathtaking arrogance of 20th century western agricultural science,..."[87] Significantly, Holden's subsequent criticism centred on agricultural antibiotics: "When, inevitably, the animals get sick, farmers use antibiotics to prevent infectious diseases taking hold. This is like trying to put a cork in a bottle that is actively fermenting – it cannot possibly work for very long."[88] In the *Observer,* journalists Judy Jones and Anthony Bevins also interpreted BSE as a fundamental failure of conventional animal husbandry and attacked the antibiotics at the heart of the intensive system. Problems like the rise of English and Welsh food poisoning cases from 19,242 in 1985 to 83,346 in 1995 were the logical consequence of a farming system that "force fed antibiotics".[89] According to the *Daily Mirror*, Britons had "mad farming disease."[90] BSE was described as the tip of an agro-industrial iceberg kept afloat by the extensive use of antibiotics. According to the *Mirror*, cases of resistant

[86] Javier Lezaun and Martijn Groenleer, 'Food Control Emergencies and the Territorialization of the European Union', *European Integration,* 28/5 (2006), pp. 439-40.
[87] Patrick Holden, 'Sacrificed on the Hi-Tech Altar', *Guardian*, 27.03.1996, p. 4.
[88] Ibid.
[89] Ibid.
[90] Andrew Penman, 'Cow that Proves We've Got Mad Farming Disease', *Daily Mirror*, 21.08.1996, p. 6.

food poisoning had "trebled since 1993 to more than 3,500 last year."[91] In *The Times*, Clive Aslet, editor of *Country Life*, criticised official culling programmes and noted that consumers were justified in turning to the "readily identifiable alternative to intensive agriculture – the organic movement."[92] Although the movement's focus on homeopathy was "a bit loony",[93] organic farmers had managed to reduce antibiotic use to a minimum. From the ruins of BSE, "Britain must build a system of agriculture that is acknowledged as the safest and most humane in the world."[94]

The BSE crisis thus led to the nearly unanimous opinion that agricultural reform would have to go far beyond banning meat and bone meal feeds. In this situation, agricultural antibiotics presented an easily identifiable target for activists and rueful producers alike. The outbreak of resistant pathogens like *E. coli* 0157 seemingly underlined the urgency of sweeping antibiotic reform.[95]

Winning a landslide victory in May 1997, Tony Blair's New Labour government wanted to avoid agricultural conflicts, which had damaged the previous administration, and supported EU antibiotic reform initiatives.[96] The new EU initiatives had been triggered by Sweden. Having banned AGPs in 1986, Sweden initially negotiated a three-year exemption from mandatory antibiotic compliance following its 1995 EU accession. With the three-year exemption about to expire, the Swedish government announced that it would not abolish its

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[91] Ibid.
[92] Clive Aslet, 'How to rescue British beef', *Times*, 03.05.1996, p. 16.
[93] Ibid.
[94] Ibid.
[95] Nigel Hawkes, 'Scientists fear 'ominous' spread of mutant bacteria', *Times*, 29.11.1996, p. 4; Helen Nowicka, 'World Warning Over Antibiotics', *Guardian*, 14.10.1996, p. 3; 'Beware: mother's little helper is defecting…', *Observer*, 08.12.1996, p. 21.
[96] In its 1997 election manifesto, Labour referred to the BSE scandal three times; ''New Labour – Because Britain Deserves Better'', *Friedrich Ebert Stiftung* (http://www.fes.de/fulltext/ialhi/90057/90057toc.htm [accessed 16.09.2013]).

AGP ban.[97] Following Sweden's announcement, German, Danish and Finnish ministers expressed grave concerns over AGPs during a meeting of the EU Council of Agriculture Ministers in November 1997.[98]

In Britain, pressure for antibiotic reform increased considerably following the publication of influential reports on antibiotics and antibiotic resistance in 1998.[99] Sensitive to consumer opinion, Tesco, Sainsbury's and Asda announced that they were prohibiting suppliers from using AGPs in April 1998.[100] In late 1998, the EU decided to ban four of the remaining eight AGPs.[101]

Justified with reference to bacterial resistance, the AGP bans also bore testament to EU consumers' increasing power over agricultural policy. One reason for this development was wealthy consumers' ability to vote against controversial production methods with their wallets and buy a growing selection of organic produce. Following every agricultural crisis, the popularity of organic farming grew.[102] Profiting from unified labelling, Britain's organic food market grew from £40 million in 1987 to £267 million in 1997 and was projected to grow to over £1 billion by 2000.[103] Still only accounting for ca. 1% of total British food and drink expenditure in 2000,[104] organic products' cultural influence was significant: in 1999, all analysed British newspapers featured positive reports on

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[97] Bud, *Penicillin: Triumph and Tragedy*, p. 205.
[98] 'Antibiotic Resistance. The Risk to Human Health and Safety from the Use of Antibiotics in Animal Production (Ceg 98/2)', (Consumers in Europe Group, 1998), p. 11.
[99] Chapter Nine, pp. 212-216.
[100] Paul Brown, 'Supermarkets move to ban growth-drug meat from shelves', *Guardian*, 24.04.1998, p. 4.
[101] Michael Hornsby, 'Pig feed rules may ban use of animal remains', *Times*, 13.11.1998, p. 7.
[102] Paul Heiney, 'A son of the soil in the making', *Times*, 17.03.1990, p. 17; Michael Hornsby, 'Organic farmer leads the way', *Times*, 11.08.1992, p. 5; Frances Bissell, 'The Times Cook', *Times*, 03.06.1995, p. 51.
[103] 'Planet organic', *Observer Magazine*, 27.06.1999, p. G14.
[104] FAO Economic and Social Development Department, 'World Markets for Organic Fruit and Vegetables', *FAO Corporate Document Repository* (http://www.fao.org/docrep/004/y1669e/y1669e0f.htm [accessed 12.09.2013]).

organic produce. In *The Times*, radio presenter Libby Purves smugly reflected, "In about 1992, we had John Gummer, then Agriculture Minister, in this very kitchen, laughing charmingly and pooh-poohing our organic attitudes."[105] Seven years later, "there [were], (…) signs of a genuine popular rebellion against the culture of ghastly farming and ghastly food."[106] With Waitrose and Sainsbury's stocking over 400 organic product lines in 1999, the organic boom had transformed the Soil Association from an "insignificant charity with a staff of five" to an influential organisation with a staff of 80 within "a few short years."[107]

Boosted by the 1998 ban, antibiotic critics soon began to attack the four remaining AGPs. Similar to earlier years, reformers' endeavours were aided by a series of scandals and official reports.[108] In July 1999, British and Irish authorities cracked down on illegal Irish pharmaceutical imports. According to the *Sunday Times*, price differences meant that "Irish pharmacies [were] being bombarded with requests for antibiotics from farmers in Britain."[109] The newspaper also referred to a recent BBC *CountryFile* episode in which an undercover team had purchased therapeutic antibiotics over the counter in Britain and via mail order from an Irish pharmacist. According to the Soil Association, "as many as 10,000 farms in Britain"[110] could be using antibiotics illegally. Amidst continuing concern about failing antibiotics, the *Guardian* claimed that about half of British antibiotics were given to animals.[111]

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[105] Libby Purves, 'Called to ordure', *Times*, 26.10.1999, p. 24.
[106] Ibid.
[107] 'Planet organic', *Observer Magazine*, 27.06.1999, p. G14.
[108] For the ACMSF report see Chapter Nine, pp. 215-216.
[109] 'Police probe Irish farm drugs racket', *Sunday Times*, 04.07.1999.
[110] Ibid; also see: James Meikle, 'Crackdown on animal drugs scam', *Guardian*, 07.09.1999, p. 6.
[111] 'Use and abuse', *Guardian*, 06.09.1999, p. 3.

Probably anticipating further bans, the Grampian Country Food Group, the UK's biggest chicken producer, announced that it would stop AGP use in September 1999. Having conducted secret trials, the company claimed that the withdrawal would not lead to price increases.[112] The *Guardian* commented that Grampian's initiative could "signal the biggest revolution in years in the way that animals are reared (…), and chalk up a major victory in the battle to reduce the use of antibiotics in agriculture."[113] In November 1999, Marks & Spencer announced that it would ban all poultry products produced with AGPs.[114]

The new millennium did not alter media attitudes. Referring to antibiotic overuse and BSE, *The Times'* Graham Harvey reckoned that public opinion had turned for good "against destructive industrial farming."[115] Juxtaposing the lives of the "convenience" and the "organic family", the *Daily Mirror* claimed that "organic food is less processed (…) and organic meat doesn't contain antibiotic residues."[116] Meanwhile, MPs from all political parties backed 'green topics' and the conspicuous consumption of 'antibiotic-free' organic food became an accepted way of showing 'progressive' credentials.[117]

However, once again, the seeming success of the 1998 AGP bans made agricultural antibiotics lose their status as a common denominator of protest. Although antibiotic-related scandals continued to occur and organic food's

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[112] Valerie Elliott, 'Chicken firm axes growth promoter', *Times*, 02.09.1999, p. 10; industry's 2000 Assured Chicken Production scheme (Little Red Tractor Logo) changed its guarantee in 2002 to allow preventive doses of growth promoters under veterinary supervision; the companies accounted for 85% of British poultry production in 2003; see: Andrew Purvis, 'If Max eats up all his chicken, he'll grow to be a big, strong boy', *Observer*, 10.08.2003, p. F25.
[113] James Meikle, 'Shock at food drugs ban', *Guardian*, 02.09.1999, p. 1.
[114] Idem., 'M&S phases out antibiotics in chicken', *Guardian* ,19.09.1999, p. 6.
[115] Graham Harvey, 'Good food needs green farms', *Times*, 01.01.2000, p. 16.
[116] Hilary Freeman, 'Who's healthier?', *Daily Mirror*, 28.12.2000, p. 25; the 'convenience family' was called "The Dudleys"; also see: Tracey Harrison, 'So did you enjoy your antibiotic additive with chemical trimming?', *Daily Mirror*, 26.12.2000, p. 6.
[117]Stuart Jeffries, 'True-blue green', *Guardian*, 03.12.2005, p. 31.

'purity' remained a major selling point,[118] other controversial issues became more prominent. Only the *Guardian* initially maintained its role as a platform for antibiotic protest. In 2000, the newspaper warned, "far from receding, the gaping abyss [of antibiotic resistance] now looks even more threatening."[119] Claiming that "one-off campaigns achieve little"[120], the newspaper noted that the 1998 bans were insufficient by themselves and reported on therapeutic antibiotic overuse in agriculture. However, by 2004, the *Guardian's* 20-point list of chemical threats mentioned antibiotics only in place 16.[121]

Because of re-emerging complacency, the EU's 2003 decision to phase out the four remaining AGPs received little media attention.[122] Only the *Observer* published an article titled, "If Max eats up all his chicken, he'll grow to be a big, strong boy. Unless it kills him first."[123] Revealing that large parts of the British poultry industry had reverted to 'prophylactic' growth promotion, the article reconstructed Max's contamination with resistant pathogens:

> As the chicken oozes unappetisingly on the top shelf of your fridge, (…), blood drips on to the cheddar cheese below – the classic 'cross contamination' sequence (…). Making yourself a cheese sandwich next day, you don't notice the bacteriological accompaniment – but you have inadvertently eaten uncooked enterococci.[124]

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[118] James Meikle, 'Danger warning after increase in drug residues found in eggs', *Guardian*, 14.04.2004, p. 2; Valerie Elliott, 'Shoppers duped in organic meat scam', *Times*, 15.05.2006, pp. 1-2; 'There's a little place I know … Where do Nigella, Jamie and Nigel really shop and eat', *Observer*, 08.06.2003, p. F49; Paul Johnson, 'Organic .. Fab or fad?', *Daily Mirror*, 02.09.2004, p. 40.
[119] Malcolm Dean, 'Staring into the abyss', *Guardian*, 22.11.2000, p. 7.
[120] Ibid.; also see: Dishing the dirt', *Guardian*, 28.11.2000, p. 8; James Meikle, ''Wonderdrug' losing war with superbugs', *Guardian*, 13.04.2001, p. 1.
[121] 'Chemical World', *Guardian*, 15.05.2004, Special Supplement, p. 32.
[122] (EC) No. 1831/2003.
[123] Andrew Purvis, 'If Max eats up all his chicken, he'll grow to be a big, strong boy. Unless it kills him first', *Observer*, 10.08.2003, p. F25.
[124] Ibid.

Constituting 43 of the 463 tonnes of antibiotics used on British farm animals, "growth promoters" were "only the tip of the antibiotic iceberg."[125] Banning AGPs without accompanying reforms of therapeutic use and husbandry systems would have little effect on overall resistance.

The *Observer's* warnings did not have a strong impact. When the EU AGP phase-out ended in 2006, none of the analysed newspapers reported. With agricultural antibiotic use continuing – albeit in therapeutic doses – and public interest in antibiotic reform dying down, the EU's 2006 AGP ban risks sharing the fate of the 1971 Swann bans.

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[125] Ibid.

Chapter Eight: British Farming and the Environmental Turn

In the wake of Swann, British farmers initially saw few reasons to abandon regular antibiotic use. Throughout the 1970s, farmers faced the dual challenge of fending off cheap European imports – especially in the wake of Britain's 1973 EEC membership – and justifying rising subsidy costs.[1] Meanwhile, agricultural surpluses continued to grow: between 1970 and 1980, total meat output from cattle, pigs and sheep increased from 2,100,000 tons to 2,305,000 tons.[2] However, the increasing oversaturation of meat markets depressed farm incomes[3] and forced members of the EEC's Common Agricultural Policy (CAP) to make so-called intervention purchases, which produced the notoriously expensive 'butter and meat mountains'. By 1983, Britain alone was storing 177,000 tons of intervention butter stocks.[4] Trapped in a buyers' market of expanding production and lower prices, the farmer with the cheapest product had a sales advantage. As a consequence, yield-maximizing technologies like antibiotics remained very popular amongst British farmers.[5]

It would, however, be wrong to speak of resulting chemical abandon. Despite popular stereotypes, many British farmers were torn between the technological requirements of intensification and environmentalist values. During the 1970s, both *Farmers' Weekly* and the NFU organ *British Farmer & Stockbreeder* (BFS) contained a surprising amount of self-critical contributions.

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[1] Holderness, *British Agriculture since 1945*, pp. 37-40.
[2] 'C8 - Europe: Meat Output', in Palgrave Macmillan (ed.), *International Historical Statistics* (Volume 3; DOI: 10.1057/9781137305688.0626 [accessed 02.07.2015]).
[3] Berkeley Hill, *Farm Incomes, Wealth and Agricultural Policy: Filling the Cap's Core Information Gap.* (4 edn.; Wallingford, Cambridge MA: CABI, 2012), p. 119.
[4] Martin, *The Development of Modern Agriculture. British Farming since 1931*, p. 109.
[5] Ibid., p. 103.

Titled "Look Ahead in Search of a Road out of Farming's Crisis,"[6] a 1975 article portrayed small farmers' demise and environmental problems as two sides of the same coin. A few weeks later, David Stickland, managing director of Organic Farmers & Growers, attacked conventional agriculture's focus on cheap food and presented organic methods as a cheap alternative to expensive chemicals in *Farmers Weekly*.[7] Articles on fashionable "rural self-sufficiency"[8] in magazines' household & family sections indicate that environmentalist values also entered farmers' homes.

However, there were limits to farmers' environmental enthusiasm. Throughout the 1970s, most commentators continued to see no alternative to further intensification and technologies like antibiotics.[9] According to *Farmers Weekly* commentator Michael Joughin, 1975 would see British farmers doing what they had always done: "get a few more gallons out of a few more cows on fewer acres."[10] Should the logic of intensification clash with environmental interests, most commentators' green sentiments proved skin-deep. Referring to criticism of intensive dairy farming, *BFS'* Dunstan Court "tremble[d] to think what might happen if the animal welfare lobby gets its claws into the poor old milk producer": farmers would likely face a "Brambellised set of regulations abolishing the vacuum teatcup and reinstating the bucket and fingers era." [11] In a similar vein, farmers reacted furiously to *Brass Tacks'* 1979 attack on agricultural drug use. The NFU considered taking out an injunction against the *Radio Times*

[6] 'Look Ahead in Search of a Road out of Farming's Crisis', *FW*, 17.01.1975, p. 72.
[7] David Stickland, 'Goodbye chemicals – hello, good husbandry', *FW*, 31.01.1975, p. 77; Idem., 'Organic farming has the answers', *BFS*, 15.03.1975, p. 8; ESP Raymond, 'Chemicals don't replace the hoe', *BFS*, 02.08.1975, p. 3; A.M. Allen, 'Don't ignore the 'Welfare Lobby', *BFS*, 12.10.1974, p. 5.
[8] Sheila Jenner, 'It's back to nature for smart townees', *BFS*, 24.05.1975, p. 41.
[9] John P. Mackintosh, 'Talk food and health to gain support', *FW*, 10.01.1975, p. 80; D Lort-Philips, 'World food lags behind demand', *BFS*, 21.06.1975, p. 5.
[10] Michael Joughin, 'The real wealth of Britain', *FW,* 10.01.1975, p. 75.
[11] Dunstan Court, 'Teatcup storm', *BFS*, 15.03.1975, p. 32.

and promised "to send 'hot missiles' to the BBC's chairman and director-general,"[12] the former of whom was none other than Michael Swann, the former head of the Swann Committee.

Should interests align, British farmers were, however, adept at mobilising consumer and environmentalist concerns. In 1973, the British Poultry Federation used residue concerns to pressure supermarkets to reject consignments of Dutch poultry fed with therapeutic antibiotics.[13] One year later, French AGP use featured prominently in a trade war between British and French egg producers.[14] Putting it bluntly, *Farmers' Weekly* commented: "The point at issue is not that French eggs are a health hazard to consumers. It is that the French have a way of shipping unprofitability to Britain in an unfair trading package."[15] With emotions running high, the United Kingdom Egg Producers' Association gathered money for court action against MAFF and farmers organised pickets and boycotts against French produce.[16] When new EEC rulings threatened the loss of a quarter of UK milk output due to mastitis, British commentators, however, had no problem advocating increased antibiotic dry cow therapy alongside improved hygiene.[17] *Farmers' Weekly* even published an educational song titled "Mastitis, yeh, yeh, yeh" [sic]:

> Treat all your udders with a dry cow tube
> And smile, smile, smile,
> Maybe you think the cost is pretty rude,
> But it really is worthwhile.

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[12] Richard Norton-Taylor, 'Furious farmers ready for drugs phone-in', *Guardian*, 08.05.1979, p. 2.
[13] Joan Smith, 'Health Ban On Chicken Sales', *Daily Mirror,* 08.05.1973, p. 3.
[14] Dennis Barker, 'Producers predict £1 a dozen eggs', *Guardian*, 05.08.1974, back page col 3.
[15] 'New Rules Wanted For Egg Imports', *FW*, 31.01.1975, p. 35.
[16] Ibid; J. W. Murray, 'A crack at French eggs', *Observer*, 02.02.1975, p. 1.
[17] 'Mastitis. We can do much better than this', *BFS,* 04.01.1975, p. 19; 'Milk Hygiene. Super dairymen are needed', *BFS,* 29.03.1975, p. 25.

Bugs can cause mastitis,
They always run so wild,
So treat all your udders with a dry cow tube
And smile, smile, smile.[18]

With the economic climate cooling towards the end of the 1970s, pressure for agricultural intensification increased further. Once more, many producers blamed problems on CAP and protectionist sentiments increased.[19] Angry about French import bans in 1980, British farmers attempted to deliver "a British lamb to the firmly closed French embassy" while singing "jingle jangle, Giscard dangle."[20]

The new Thatcher government did little to redress the situation. Despite halving British CAP contributions in 1984, it favoured low consumer prices by overvaluing the 'green pound', one of a number of artificial EEC currencies created to determine CAP prices in relation to national currencies.[21] As a consequence, CAP payments to British farmers were worth less. Once again, things were worst for small farmers: by 1983, 13% of British farms accounted for 50% of the industry's net output. Three years earlier, average real income had fallen to a nadir of £4894 in comparison to £12,058 in 1973.[22] Furious about the parallel "axing"[23] of lucrative school meals, agricultural commentators warned that British farmers had become "victims of the pawn game"[24] between Thatcher and the EEC.

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[18] 'Mastitis, yeh, yeh, yeh', *FW*, 17.01.1975, p. 100.
[19] Martin, *The Development of Modern Agriculture. British Farming since 1931*, pp. 142-43; also see: 'Review decisions still govern our fate', *BFS,* 01.02.1975, p. 3; 'Anger as Irish exploit their EEC advantage', *BFS,* 26.10.1974, p. 7; 'Hundreds join port pickets', *BFS*, 09.11.1974, pp. 8-9.
[20] 'A Caning From Their Lordships', *BFS*, 26.04.1980, p. 10.
[21] Martin, *The Development of Modern Agriculture. British Farming since 1931*, pp. 138-39; 42-44.
[22] Ibid., p. 149.
[23] 'School meal abolition angers farm workers', *BFS*, 16.08.1980, p. 27.
[24] 'Victims of the pawn game', *BFS*, 10.05.1980, p. 3.

In the face of economic pressure, farmers reacted particularly hostile to rising environmentalism and animal rights activism. In 1980, *BFS* proclaimed, "Animal welfare: NFU declares war."[25] Warning that "extremists" had "taken over the RSPCA" and "were attempting to do the same in the political parties", speakers at the NFU's Annual General Meeting called on the union to "counter 'emotional, misleading and inaccurate attacks (…) by the welfare lobby."[26] Criticism by environmentalists could trigger similar reactions. In 1980, *BFS*'s Monty Keen attacked *The Theft of the Countryside*, a new book by conservationist Marion Shoard. Titled "Bitching about the countryside,"[27] Keen's article urged farmers to be wary of activists' influence. Livestock producers had become particularly vulnerable to "any outcry over a food manufacturing process using allegedly objectionable substances or treatments." [28] According to Keen, European activists were importing Ralph Nader's style "as a windmill-tilting warrior":

> It's pretty easy to see what could happen if a person claiming scientific expertise were to declare some additive previously considered innocuous to have definite carcinogenic associations, (…). Generally the reports come from America, where the authorities have more than once been pressured into acting prematurely and (as subsequently transpire) unwisely, in banning substances which did more good than harm.[29]

Regarding re-emerging criticism of antibiotic overuse, agricultural attitudes were more nuanced. As astute observers, farmers took note of physicians' and veterinarians' different evaluation of agricultural antibiotic use. Reporting on the 1980 BVA congress, *BFS* noted that "despite an attack by the

[25] 'NFU Annual Meeting: Issues of concern', *BFS*, 01.03.1980, p. 25.
[26] Ibid.; also see: 'Raising the animal welfare profile', *BFS*, 06.09.1980, [sic], p. 3; 'Welfarists subdued by factory farm visit', *BFS*, 19.07.1980, p. 14; p. 41.
[27] Monty Keen, 'Bitching about the countryside', *BFS*, 22.11.1980.
[28] Ibid.
[29] Ibid.

medical profession represented by [PHLS] Dr Threlfall," the "use of antibiotics in agriculture received strong support" [30] from veterinarians. According to veterinarian Dr John Walton, "the medicos [were] wrong."[31] While Walton criticised "farmers' use of sub-standard black market drugs,"[32] he doubted that further antibiotic restrictions would prevent salmonellosis. Nonetheless, Walton cautioned veterinarians against over-prescription and leaving large quantities of antibiotics on farms.

Aware that continued pharmaceutical access depended on farmers' image, the agricultural media did not oppose new regulations governing the sale of veterinary medicines in 1980. According to the new regulations, only authorised merchants were allowed to sell medicines named on the Farmers List (or Merchants List). The regulations were designed to target "itinerant van sales" and dubious "salesmen who call 'on spec'."[33] Attempting to rally farmers against restrictions, S. Bootland from the British Distributors of Animal Medicines Association claimed that "restrictive distribution would increase [farmers' expenses] by more than 30%."[34] It was "much better that the farmer continues to benefit by purchasing from whatever qualified supplier gives the best service."[35] Fortunately, Bootland's cause did not find many supporters.

Meanwhile, mastitis and antibiotic residues continued to plague British milk production. Although new technologies such as anti-blowback devices helped reduce mastitis,[36] tougher testing revealed on-going residue problems.

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[30] 'Conflict over antibiotics', *BFS,* 04.10.1980, p. 14.
[31] Ibid.
[32] Ibid.
[33] 'Stricter controls over medicine', *BFS*, 02.02.1980, p. 25.
[34] S Bootland, 'Letter to the editor', *BFS*, 06.09.1980, p. 5.
[35] Ibid.
[36] 'Anti-blowback device could help control mastitis', *BFS*, 12.01.1980, p. 37.

During the late 1970s, testing sensitivity had increased from 0.05 to 0.02 international units of penicillin per ml. In November 1979, MMB data revealed that 900 to 1,000 of 47,000 dairy farmers regularly produced milk with excessive antibiotic residues.[37] While some producers blamed problems on the "odd cow" getting "milked by mistake"[38,] *BFS* warned:

> What is disturbing about these figures is that the incidence of test failures in the UK is 20 times that in other countries, apart from Eire, despite the fact that most use a more sensitive test: And equally most (again excluding Eire) impose more severe penalties.[39]

Reacting to antibiotic-problems, the MMB increased penalties for antibiotic residues. According to the new system, first-time offenders would be fined 5 pence per litre, second-time offenders 7 pence per litre and third-time offenders would have to pay a "swingeing rate"[40] of 9 pence per litre. However, the penalty increase was unsuccessful. Receiving 11p for every litre of uncontaminated milk, farmers continued to sell contaminated milk because the chance of incurring a fine was less problematic than foregoing earnings completely.[41] In 1982, British milk continued to contain the highest level of antibiotic residues in Europe.[42] Resistance concerns were not often discussed.

Meanwhile, overproduction and declining agricultural incomes continued to increase intensification pressures.[43] Attempting to curb overproduction, the European Community (EC) introduced dairy quotas in 1984 and forced farmers to let land lie fallow in 1986.[44] Worn down by the long economic crisis and public

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[37] Hugh Clayton, 'Milk penalties increased', *Times*, 14.11.1979, p. 3.
[38] WF Gilkes, 'Obsesses with penalties', *BFS*, 16.08.1980, p. 6.
[39] 'Mastitis medicine', *BFS*, 10.05.1980, p. 23.
[40] 'Tougher antibiotic tests for milk are coming', *BFS*, 19.07.1980, p. 14.
[41] Hugh Clayton, 'Milk penalties increased', *Times*, 14.11.1979, p. 3.
[42] Rosemary Collins, 'British milk has highest antibiotic level in Europe', *Guardian*, 27.01.1982, p. 4.
[43] Gary Corsley, 'Record margins – but small men losing out', *FW*, 02.05.1986, p. 31.
[44] Rhyddian Jones, ''Fallowing' – what a nice way of putting it', *FW,* 28.02.1986, p. 41.

criticism, many British farmers became more willing to consider alternative production methods. Following its 1984 annual general meeting, the NFU announced:

> There has been a particularly important public reaction to the impact of agriculture on the environment. Against this background it seems right to conclude that we are now at a watershed and that the era when agricultural expansion was widely accepted as a desirable goal has passed.[45]

Because of its on-going growth, organic agriculture turned into an attractive market niche for a growing number of struggling conventional producers. In 1986, Sainsbury's and Safeway started offering organic produce.[46] According to *Farmers Weekly*, dairy farms supplying the UK's first mass-produced organic soft cheese were selling their milk at 1.5 pence per litre above market price.[47] Other articles advised beef producers to profit from consumer insecurity about hormones and sell hormone-free beef at a premium price.[48]

Farmers unwilling to transition to organic agriculture also sensed that times were changing. When Britain challenged the EEC's ban of hormonal growth promoters in 1986, the conventional beef industry cautioned that unilateral action might provoke import bans and stoke consumer fears: "Privately, they believe it might be better to face the ban."[49] According to another article, environmentalism and intensive farming were not mutually exclusive: "there is no reason why we should not compete in the world's agricultural markets, (…)

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[45] Quoted according to Martin, *The Development of Modern Agriculture. British Farming since 1931*, p. 178.
[46] John Harvey, 'Ministry buries organic report', *FW*, 28.02.1986, p. 11.
[47] Robert Davies, 'Organic milk wins premium', *FW*, 09.05.1986, p. 34.
[48] 'Register for hormone-free beef', *FW,* 21.02.1986, p. 14; Michael Gaisford, 'Cutting out hormones wins premium prices', ibid, p. 16; John Harvey, 'Ministry buries organic report', *FW*, 28.02.1986, p. 11; 'Organic opportunity', *FW*, 14.03.1986, p. 13
[49] 'Hormones procedure challenged', *FW*, 14.03.1986, p. 32.

and still have a country fit for Robin Hood or Rupert Bear."[50] Writing to *Farmers Weekly* in February 1986, "suburban housewife" Audrey Curran complained:

> I am fed up of being told, as a consumer, that it is my fault if animals are being reared in these intensive units to supply me with cheap food. I don't want it and I don't know of anyone who does when made aware of what is involved. And, who asked me if it was OK to stuff them with antibiotics?[51]

One year later, *Farmers Weekly* commentator Robert Gair described the fundamental dilemma he shared with many conventional farmers: criticising attacks by "Greenpeacers" [sic] and "the anti-farming, anti-chemical brigade", Gair confessed that he, too, had "no desire to see a countryside without birds, mammals, frogs, butterflies, orchids, and the rest."[52] In order to arrest "detrimental changes in the environment", all parties should engage in a "rational examination" of factors likely to disturb the "balance of nature."[53]

The dilemma described by Gair was similar regarding agricultural antibiotics. Unwilling to forsake antibiotics, conventional farmers knew that they would eventually have to make concessions. While some experts continued to attack the "inane agitation of the lunatic fringe of the animal welfare movement,"[54] other commentators warned that "the public will buy what it wants, and not what some scientist thinks it should buy."[55] According to one contribution, agriculture existed to feed consumers and farmers and not "for the benefit of the chemical industry."[56] During the mid-1980s, articles in British agricultural magazines began advertising "no-additive feed"[57] and antibiotic-

[50] 'An utter waste of Merrie England', *FW*, 14.03.1986, p. 41.
[51] Audrey Curran, 'Don't blame buyers for your methods', *FW*, 28.02.1986, p. 52.
[52] Robert Gair, 'Hopes rise for not so silent spring', *FW*, 30.10.1987, p. 37.
[53] Ibid.
[54] Bill Weeks, 'Public must be given the full farming facts', *FW*, 23.05.1986, p. 47.
[55] Stephen R Wharfe, 'Satisfy the public – not scientists', ibid, p. 48.
[56] Ibid.
[57] 'No-additive feed', *FW*, 23.05.1986, p. 55.

reducing probiotics.[58] Concerned about resistant *Salmonella* and *E. coli*, Sheila Furniss advised farmers against feeding antibiotic-laden milk to calves.[59] Regarding mastitis, the residue-conscious advisers of the late 1980s no longer propagated extensive use of antibiotic ointments but called on farmers to use antibiotics more cautiously and keep records.[60] According to one reader, the past decades had shown that "scientists are not God and have proved very fallible"[61], farmers should remain suspicious of chemical helpers.

Attempting to win back consumer trust, the agricultural media hailed the results of the 1987 national meat surveillance scheme. According to *Farmers Weekly,* "health-conscious consumers who worry without foundation about chemical and drug contamination in meat can take comfort."[62] Nonetheless, farmers should not forget that residue fears had created a veritable testing industry "hell-bent on proving that wholesome food is positively dangerous" and capable "of sniffing down to parts per billion."[63] It was therefore important "to spread the gospel [of meat safety] before political pressures remove yet more useful pharmaceuticals from the market and restrict research."[64]

Meandering between hostility and insecurity, the controversies surrounding antibiotic residues and AGPs also primed initial reactions to BSE. In October 1987, MAFF veterinarians announced that BSE "is not of epidemic proportions, (…) and is not very significant when compared with losses from

[58] 'Probiotics soothe stressful calves', *FW*, 02.05.1986, p. 26.
[59] 'Tainted Milk', *FW*, 28.02.1986, p. 21.
[60] 'Monitoring mastitis', *FW*, 07.03.1986, p. 24; '£30 million bill for mastitis', *FW*, 06.11.1987, p. 35.
[61] Jose MacDonald, 'BST should not become end result', *FW*, 25.12.1987, p. 5.
[62] 'Drug Residues in Meat are at Absolute Rock-Bottom', *FW,* 20.11.1987, p. 3.
[63] Ibid.
[64] 'No evidence for food scaremongers', *FW,* 25.12.1987, p. 4.

other nervous disorders."[65] Meanwhile, *Farmers Weekly* warned that "BSE thrives on rumours": "Thank goodness witchcraft is out of fashion, otherwise the old lady who lives in the cottage down the lane with a black cat for company would be accused and ducked in the village pond..."[66]

However, behind a façade of prescribed calm, British farmers knew that the 1988 *Salmonella* scandal, BSE and antibiotic residue and resistance problems posed grave challenges. With environmentalism and consumer power growing throughout Europe and trust in British food safety eroding, it was likely that intensive agriculture was going to face major changes.

In 1992, the so-called MacSharry reforms provided a glimpse of things to come. Attempting to control expenses and overproduction, the reforms marked the most significant modification of CAP since its inception.[67] Instead of subsidising product prices, European Agriculture Commissioner Ray MacSharry wanted to reduce intensive overproduction with direct subsidies linked to farms' sizes and animals' age.[68] MacSharry also introduced quotas and set-aside schemes, reduced intervention prices and attempted to promote eco-friendly farming.[69] Amongst other things, regulation 2078/92/EC provided payments to reduce pollution and encourage extensification and conservation efforts.[70] Together with the 1992 EU Flora-Fauna-Habitat guidelines, the MacSharry reforms firmly embedded environmentalist principles in EU agriculture.[71]

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[65] Alan Barker, 'Don't Panic Over BSE', *FW,* 30.10.1987, p. 24.
[66] 'BSE thrives on rumours', *FW*, 20.11.1987, p. 7.
[67] Martin, *The Development of Modern Agriculture. British Farming since 1931*, pp. 163-66.
[68] Alois Seidl, *Deutsche Agrargeschichte* (Frankfurt a. M. : DLG Verlag, 2006), pp. 311-14.
[69] Martin, *The Development of Modern Agriculture. British Farming since 1931*, pp. 161-63.
[70] Ibid., p. 181.
[71] Council Directive 92/43/EEC

British farmers only gradually warmed to the MacSharry reforms[72] but were soon preoccupied by domestic issues: following the *Salmonella*-inspired 1990 Food Safety Act, British producers were exposed to an unprecedented scale of monitoring. Animals could now be inspected for forbidden substances on farms and farmers had to keep detailed medication records. Meanwhile, BSE and *Salmonella* slaughtering clauses placed enormous psychological pressure on farmers to keep herds disease-free.[73]

Although farm organisations launched supportive campaigns for livestock producers,[74] the changing socio-cultural landscape of the 1990s meant that agricultural values themselves began to change. In *British Farmer*, a 'Candid Friend' feature regularly confronted farmers with their public image. In 1991, Caroline Waldegrave, wife of Conservative MP William Waldegrave and principle of Leiths School of Food and Wine, was "delighted by the consumer lobby that is presently in full swing"[75] and expressed concern about animal welfare. One month later, *Times* agricultural correspondent Michael Hornsby related his experiences amongst the agricultural community:

> One thing that struck me at once was the extent to which farmers as a group often seem to live in [an] (…) insulated world of their own. It was astonishing at the last [NFU Annual General Meeting] to hear farmers (…) accusing a leading food manufacturer of lack of patriotism because he had dared to buy meat from abroad.[76]

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[72] 'A positive answer to MacSharry', *BF*, Feb 1991, p. 5; Sean Rickard, 'Supply Management – the right way to right the CAP', *BF*, Mar 1991, pp. 11-12.
[73] 'On-farm mixers to be listed', *BF,* Aug 1992, p. 20; 'Residues in Meat', BF, Mar 1992, p. 20; mixing rules were reformed with Veterinary Written Directions (VWD) in 1995; 'New vet rules affect feed rations', *BF* Jul/ Aug 1995, p. 5.
[74] 'Salmonella payouts', *BF*, Feb 1991, pp. 18-19; 'Levy to boost meat sales', *BF*, Apr 1995, p. 4; 'Health and Wealth', *BF*, Dec 1994/Jan 1995, p. 5; 'NFU Policy', *BF* Ibid, p. 6; 'From the President: Caring for our animals', *BF,* Nov 1991, p. 5; 'Winning hearts and minds', *BF*, Jun 1995, p. 13.
[75] Caroline Waldegrave, 'Love me, love my supermarket', *BF*, Apr 1991, p. 31.
[76] Michael Hornsby, 'A two-tier future', *BF*, May 1991, p. 31.

Ahead of the 1992 general elections, NFU president David Naish announced a new programme called *Farming for the environment*.[77] Although some commentators remained hostile towards "the greenies",[78] the agricultural media increasingly fostered environmentalism amongst farmers and their families.[79]

Changing agricultural sentiments were accompanied by the on-going growth of the British organic sector. Following EC regulation 2092/91, the UK's Register of Organic Food Standards limited the use of the term 'organic' to certified products listed on the register.[80] It was now abundantly clear that being able to label one's produce as 'organic', 'natural' or 'antibiotic-free' was a sales advantage. In June 1991, *British Farmer* announced that East Anglian Dalehead Foods was looking for "pigs from 'welfare-conscious' systems" raised on cereal-based feeds with "no antibiotic growth promoters or probiotics."[81] The only exception was medicated "creep feeds"[82] for weaners. Delivering 'green pig' products to a "southern-based supermarket chain," Dalehead offered suppliers a "generous premium."[83] In the same issue, *British Farmer* printed an advertisement for Daisy Hill Feeds' "Headstart Challenge."[84] Targeting conventional farmers, the company claimed that its antibiotic-free feed was just as good or even better than antibiotic feeds:

> Please your customers and [get] ahead of any ministry or EC legislation, (…). Give the Headstart range of piglet diets a trial against your existing supplies – (…) once you have removed the fear factor of not using

[77] David Naish, 'Farming for the environment', *BF*, Apr 1992, p. 5.
[78] R Barrow, 'Forget the greenies', *BF*, Jun 1992, p. 6.
[79] Tessa Gates, 'Carving a niche in landscape', *FW*, 24.07.1992, p. 18; 'Farming and Nature Living Side by Side', *FW*, 07.08.1992, pp. 66-67; Crafty ways of recycling waste', *FW,* 07.09.1992, Farmlife supplement, p. 7.
[80] 'New organic standards', *BF*, May 1992, p. 21.
[81] 'A Growing Niche for 'Green Pigs', *BF*, Jun 1991, p. 13.
[82] Ibid.
[83] Ibid.
[84] 'The Headstart Challenge', *BF*, Jun 1991, p. 12.

> antibiotic growth promoters you will have the confidence to remove them from your other pig feed diets. In our opinion you will not be disappointed and you will be helping dislodge an area of criticism and concern levelled at the British Pig Industry.[85]

However, in 1991, many conventional livestock producers were still a long way from completing the Daisy Hill Feeds' challenge and relinquishing drug use.

Meanwhile, the shadow of BSE loomed ever larger over British farmers. In 1992, *British Farmers'* Andrew Gordon claimed that "a billion pounds [had been] wiped off the value of the nation's cattle" [86] and 70,000 cows culled following the BSE-related death of a Bristol cat in 1990. However, Gordon remained optimistic that the "crescendo" of "unjustified public anxiety"[87] would ebb. Four years later, hopes for a recovery from the BSE-crisis were dashed by the announcement of a possible link between BSE and vCJD on March 20th, 1996. One day later, several EU countries issued unilateral bans on British beef and refused to lift them despite immediate diplomatic action by the British government. On March 22nd, the Consumer Association recommended removing beef from personal diets. At this point, some voices began calling for a complete cull of the national cattle herd.[88] Whereas domestic beef consumption fell by 50% in the first week after the announcement, it recovered to 25% below average in the second week. Meanwhile, the loss of export markets resulted in a further 30% drop of sales.[89]

In the agricultural media, reactions ranged from shock and insecurity to anti-European outrage. In *British Farmer*, NFU president Sir David Naish assured farmers that he was "deeply aware of the immense uncertainties and anxieties

[85] Ibid.
[86] Andrew Gordon, 'It must have been staggers', *BF*, Aug 1992, p. 13.
[87] Ibid.; also see: 'BSE cases decline', *BF*, Mar 1995, p. 4.
[88] 'Consumer confidence', *BF*, Apr 1996, pp. 12-13.
[89] Philip Clarke, 'Supermarket price cuts tempt back beef buyers', *FW,* 05.04.-11.04.1996, p. 21.

facing you and your families."[90] According to Naish, "the NFU [would] not rest in its efforts to restore our customers' confidence in our product."[91] Contradicting European demands, Naish announced that culling would "cause everlasting damage to the UK and its dairy and beef industries."[92] With BSE triggering the "blackest day at mart since [the] '60s,"[93] agricultural magazines warned that Britain did not have enough incinerators to cope with the proposed cull and advertised suicide helplines for struggling farmers.[94]

Ordinary farmers' reactions to BSE were mixed. According to John Pidsley from Cheshire, "media hysteria" was leading to the unnecessary "wholesale slaughter of complete herds."[95] In the opinion of a "worried farmer from Gloucestershire," "feed-makers" were "the real villains:"

> They included the meat and bone meal in the rations. We did not ask for it. Now they must pay for the damage suffered. (…). Just like the oil disasters, Baring Bank, lead in feed and thalidomide, the firms involved should be made to pay the price and suffer the consequences.[96]

According to Anthony Carter from West Sussex, "BSE must teach us all that current perceptions of safe are wrong."[97] Instead of relying on technological artifice, farmers should accept that "nature works very well on its own."[98] Following developments closely, John Newman predicted that BSE would boost sales of 'safe' and traceable organic products.[99]

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[90] David Naish, 'Letter to Readers', *BF*, Apr 1996, p. 3.
[91] Ibid.
[92] Ibid.
[93] 'Blackest day at mart since '60s', *FW*, ibid., p. 8.
[94] 'UK incinerators cannot cope', *FW*, 05.04.-11.04.1996, p. 8; 'Suicide fear grows', *FW,* 29.03.-04.04.1996, p. 10; Richard Kerkham, 'Sharing adversity', *BF,* Jun 1996, p. 30.
[95] John Pidsley, 'Total slaughter is unnecessary', *FW,* 05.04.-11.04.1996, p. 84.
[96] Worried farmer from Gloucestershire, 'Feed-makers the real villains', ibid.
[97] Anthony Carter, 'Don't tamper with nature', ibid., p. 87.
[98] Ibid.
[99] 'Setting standards', *BF*, Apr 1996, p. 15.

With consumers exercising their power and turning away from British beef, critical voices within agriculture were strengthened and a window for inner-agricultural reform opened. Mirroring the immediate attention paid to antibiotics in the national press, farmers' changed demeanour is best exemplified by their reaction to the EU's 1997 avoparcin ban. Up to 1997, avoparcin AGPs had been used by ca. 80% of British poultry producers and ca. 30% of pig and cattle producers.[100] Instead of criticising the ban, *Farmers Weekly* limited itself to preparing farmers for losing access to avoparcin. According to the magazine, Swedish farmers had been able to phase out AGPs with improved diets, hygiene and so-called all-in, all-out housing.[101]

Concerned about British support for further AGP bans in the wake of the 1997 general elections, pharmaceutical and feed companies attempted to whip up support for agricultural antibiotics amongst farmers. Representing animal health firms, the National Organisation for Animal Health (NOAH) warned that critics were "confused over the facts behind farming's role in foodborne disease, antibiotic resistance and growth promoters."[102] According to NOAH director Roger Cook, antibiotics increased food safety and were "a major factor in reducing salmonella."[103] Demanding that "all sides of the argument" be "represented accurately"[104], NOAH also mobilised counter-expertise. During a NOAH press briefing, ex-BVA president Karl Linklater reiterated that agricultural antibiotics brought "significant economic benefits", made "enormous contributions to animal welfare" and had been "used in agricultural production

[100] 'Avoparcin feed ban', *FW*, 10.01.-16.01.1997, p. 34.
[101] Jessica Buss, 'Balanced pig diets overcome effects of Swedes' GP ban', *FW*, 10.01.-16.01.1997, p. 34; 'Effective stockmanship halves vet costs', *FW*, 28.03.-03.04.1997, p. 44.
[102] Jonathan Riley, 'Leaders Reject Consumer Attack On Intensive Area', *FW*, 13.03.1998, p. 7.
[103] Idem., 'NOAH Rounds on Sweden', *FW,* 19.06.1998, p. 14;
[104] Ibid.

for 40 years without difficulty."[105] While NOAH chairman Bill Hird accused Scandinavians of exporting AGP bans to maintain "their own high cost agricultural production"[106], Roger Cook used identical arguments against the Soil Association:

> It is important to remember that the Soil Association represents organic farmers who, for years, have sought to justify the high prices they demand for their products (…). They have a vested interest in maintaining public anxiety about British food.[107]

At the European level, the Federation of Animal Health (FEDESA) presented an "independent survey"[108] showing that AGPs accounted for only 15% of total antibiotic use and claimed that powerful medical interests were displacing blame for bacterial resistance on agriculture. [109]

Significantly, both the NFU and the Meat and Livestock Commission (MLC) joined industry campaigns against AGP bans.[110] Comparing antibiotic fears to "the hysteria that surrounded BSE," Grenville Welsh from the British Pig Association (BPA) called on "both industry and retailers" to "work together to educate the consumer." [111] In siding with NOAH, the NFU, however, overestimated agricultural opposition to AGP bans. According to Jim Reed, director of the United Kingdom Agricultural Supply Trade Association, "it was time for the industry to find out exactly what the consumer wanted. And if that meant a ban on certain in-feed antibiotics then so be it."[112] Meanwhile, magazines like *Farmers Weekly* began promoting antibiotic alternatives as well

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[105] Ibid.
[106] Ibid.; also see Philip Clarke, 'Antibiotic Use As Growth Promoters Set To Be Banned', *FW*, 20.11.1998, p. 8.
[107] Shelley Wright, 'MAFF's Antibiotic 'Smokescreen'', *FW,* 31.07.1998, p. 13.
[108] Philip Clarke, 'FEDSA Refutes Antibiotic Claim', *FW*, 11.09.1998, p. 10.
[109] Idem., also see: 'Antibiotics For Growth Attack', *FW*, 18.09.1998, p. 14.
[110] Jonathan Riley, 'Leaders Reject Consumer Attack On Intensive Area', *FW*, 13.03.1998, p. 7; 'Industry Says Yes To Use Of Antibiotics For Growth', *FW*, 22.03.1998, p. 42.
[111] Simon Wragg, 'Industry Says Yes To Use Of Antibiotics For Growth', *FW*, 22.05.1998, p. 42.
[112] Ibid.

as improved husbandry systems. With supermarkets like Waitrose and Tesco demanding pigs produced without AGPs, particular attention was paid to farmers already employing alternative rearing systems.[113]

However, even the most open discussions about AGP-bans did not address potential reductions of therapeutic antibiotic use. Throughout 1998, articles continued to recommend generous antibiotic regimes for infected animals and herds.[114] Despite sharing general concerns about antibiotic resistance, most commentators did not aim to convert conventional farmers to organic agriculture. Wedged between the positions of NOAH and the Soil Association, the majority of conventional British farmers committed to a 'Third Way' by reducing antibiotic use but maintaining intensive production systems. As a consequence, NOAH's strategy of raising an agricultural storm against AGP bans failed. Despite rebranding AGPs as environmentally friendly "digestive enhancers,"[115] pharmaceutical interests were unable to prevent the EU's ban of virginiamycin, tylosin, zinc bacitracin and spiramycin AGPs in December 1998. Together, these substances accounted for ca. 80% of AGPs used in EU pig and poultry rations.[116]

Following the announcement of the 1998 bans, MAFF and the MLC commenced feeding trials with alternative growth promoters.[117] In *Farmers Weekly,* nutritionist Martin Owers estimated that AGP bans would cost between

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[113] Simon Wragg, 'Conversion Is Now Name Of The Game', *FW*, 04.09.1998, p. 47; Emma Penny, 'Pre-Empting Antibiotic Cut', *FW*, 18.09.1998, p. 14; Emma Penny, 'Waitrose In Discussion With Suppliers', *FW,* 08.05.1998, p. 42; Jeremy Hunt, 'Homeopathy Lends A Hand At Birth Time', *FW*, 23.01.1998, p. 53; Emma Penny, 'Teatsealscan Target Disease', *FW,* 22.05.1998, p. 16; Jessica Buss, 'You've Already Missed The Boat If You Have To Cull For Lameness', *FW*, 13.02.1998, p. 12.
[114] Emma Penny, 'Beware Virulent Foot-Rot', *FW*, 06.02.1998, p. 40; Jessica Buss, 'Summer Mastitis', *FW*, 14.08.1998, p. 37; 'John Alpe', *FW*, 06.03.1998, p. 2
[115] Jonathan Riley, 'Antibiotic Restrictions Are Urged', *FW*, 11.12.1998, p. 6.
[116] Philip Clarke, 'Antibiotic Use As Growth Promoters Set To Be Banned', *FW*, 20.11.1998, p. 8.
[117] 'Go-Ahead For Work On Fermented Feed', *FW*, 25.12.1998, p. 27; James Garner, 'MLC To Spell Out Advice On AGP Replacements', *FW*, 23.04.1999, p. 39.

50 pence and £1 per pig: "we hope to claw at least half of that back."[118] More radically, Jasper Renold, pig unit manager on Easton Lodge Farm – *Farmers Weekly's* experimental farm – questioned the entire economic reasoning behind AGPs:

> I think we see them as necessary to safeguard performance, particularly in weaners. But if you were to ask me how much benefit they give, I couldn't tell you. (…). I think we're continuing to use them because they're seen as a relatively cheap form of insurance.[119]

Not only did Renold's statement contradict NOAH and NFU claims, it also revealed how credulous experts at the very heart of the agricultural knowledge system had been regarding industry efficacy claims. While *Farmers Weekly* began to test remaining AGPs' economic value, Easton Lodge's veterinarian Richard Potter claimed that he "wouldn't be at all surprised if there was no dip in grower performance following AGP removal, given the right management and hygiene."[120]

Even though some farmers and industry representatives remained opposed to the 1998 bans,[121] most agricultural observers acknowledged that the end of OTC antibiotic access was nigh.[122] Speaking to *Farmers Weekly* during the 1999 Pig and Poultry Fair at Stoneleigh, Tesco's agricultural manager Chris Ling announced: "it's no longer a question of if there's a total ban on use of AGP's for pig production but when."[123] Tesco therefore encouraged suppliers to "remove

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[118] Sue Rider, 'Don't Look For One Alternative. AGPs', *FW*, 21.05.1999, p. 52.
[119] Simon Wragg, 'Questioning The Need For AGPs Warning About Weaners', *FW*, 05.02.1999, p. 38.
[120] Ibid.
[121] Teddy Maufe, 'Farmerfocus', *FW,* 25.06.1999, p. 66; Philip Clarke, 'EU's Antibiotic Ruling Remains', *FW*, 09.07.1999, p. 12.
[122] Jonathon [sic] Riley, 'Action on Antibiotics Expected', *FW*, 28.05.1998, p. 7; Philip Clarke, 'EU Scientists Push For End Of AGP Use', *FW*, 04.06.1999, p. 8;
[123] 'Don't Look for One Alternative AGPs', *FW*, 21.05.1999, p. 52.

prophylactic use of AGPs", "the quicker the better."[124] For pig consultant Vernon Fowler, it was "prudent to assume that only prescription antibiotics will be permitted in the long-run."[125]

Fowler's guess came true. In April 2002, the EU Commission proposed phasing out the remaining monensin sodium, salinomycin, avilamycin and flavophospholipol AGPs.[126] Weakened by the European Court's confirmation of existing bans in September 2002, pharmaceutical companies – now organised in the Responsible Use of Medicines in Agriculture Alliance (RUMA), which also listed the BVA and NFU as members – continued their opposition.[127] However, in 2003, EU Agriculture Ministers confirmed the phasing out of the last AGPs by January 1st, 2006 with regulation 1831/2003/EC.[128]

With AGPs' fate sealed but resistance levels continuing to rise, the use of therapeutic antibiotics in agriculture attracted a growing amount of public criticism. Unsurprisingly, conventional farmers were reluctant to address this issue and the agricultural press only printed a few articles addressing it during the early 2000s.[129] In 2004, *Farmers Weekly* offered a brief glimpse into the reality of agricultural antibiotic use when veterinarian Sam Leadley comically addressed common mistakes on the farm in a feature for the magazine:

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[124] Ibid.
[125] Ibid.
[126] Hannah Velten, 'GP Ban Could Cost Dear', *FW,* 05.04.2002, p. 43.
[127] Philip Clarke, 'Euro Briefs', *FW*, 13.09.2002, p. 8.
[128] 'Ban on Antibiotics as Growth Promoters in Animal Feed Enters into Effect', *EU Press releases database* (http://europa.eu/rapid/press-release_IP-05-1687_en.htm [accessed: 02.10.2013], 2006).
[129] Hannah Velten, 'Antimicrobial Sales Rise Seen As A Warning', *FW*, 15.03.2002, p. 39; Jonathan Long, 'Loophole In Law Makes Mockery Of Ban On AGPs', *FW*, 05.09.2003, p. 3; Richard Allison, 'Using Antibiotics For The Routine Treatment Of Mastitis In Cows Does Not Lead To Increases In Antibiotic Resistance', *FW*, 10.10.2003, p. 2; 'Growing threat of antibiotic resistance', *FW,* 11.-17.02.2005, p. 31.

> Pickup-itis
>
> When after purchase, antibiotic remains in the pickup and was never given to the sick animals.
>
> Too-much-water-itis
>
> Directions for reconstituting a powder were not followed – allowing treatment of three calves instead of two. But each injection then carries too little active drug to do the job.
>
> Store-the-syringe-in-the bottle-itis
>
> You always need a needle handy, so just stab the contaminated needle back into the bottle. (…).
>
> Under-dosing-itis (…).
>
> Windowsill-itis
>
> Exposure to strong sunlight and heat destroyed much of the antibiotic's potency when it was left on the barn windowsill.
>
> Quit-treating-too-soon-itis (…).[130]

Other 'itis'-types included "one-drug-fits-all-itis" and "virus-itis",[131] which meant squandering antibiotics against viral infections. Occurring frequently enough to be addressed in comic form, the described practices were the logical consequence of a system that entrusted therapeutic substances to laypersons, whose economic interests did not necessarily align with those of public health.

Meanwhile, pharmaceutical companies did their best to promote sales of therapeutic antibiotics. In 2001, Schering-Plough sponsored a prize quiz on calf pneumonia in *Farmers Weekly*. Winners were awarded £1250 worth of weighing equipment.[132] In its three 'quiz' articles, Schering-Plough stressed that farmers should treat calf pneumonia early and "trust an antibiotic that is effective against all three main pneumonia-causing bacteria."[133] Fortunately, Schering-Plough's Nuflor was just such a "proven first-line antibiotic for pneumonia", "effective against all major bacterial causes of pneumonia," with "no recorded

[130]Leadley, Sam, 'Understanding why antibiotics fail', *FW*, 24.-30.12.2004, Livestock, p. 27.
[131] Ibid.
[132] 'Your Pneumonia Know-How Could Win Weighing Kit', *FW*, 16.11.2001, p. 44.
[133] Ibid.

resistance"[134] and "now available in extra-value 250ml bottles."[135] Winners of the prize weighing-kit could use it to "monitor how well cattle recover after treatment with Nuflor."[136] In 2005, pharmaceutical companies also sponsored 'Farmers Weekly Academy', a feature 'educating' farmers about treatments against mastitis, metritis and other conditions. Antibiotics produced by the sponsor were conveniently mentioned below the article.[137]

The commercials seem to indicate on-going agricultural demand for easy-to-use therapeutic antibiotics amongst British farmers. Although BSE weakened farmers' opposition to AGP bans, their on-going reliance on therapeutic antibiotics has so far escaped effective reform.

[134] Ibid.
[135] 'Your Pneumonia Know-How Could Win Weighing Kit', *FW*, 23.11.2001, p. 38.
[136] 'Your Pneumonia Know-How Could Win Weighing Kit', *FW*, 30.11.2001, p. 43.
[137] Andrew Bradley, 'Farmers Weekly Academy: Learning For Your Farming Future', *FW*, 16.09.2005, pp. 52-53.

Chapter Nine: Swann Song

In late 1969, public pressure and an upcoming election had forced Cledwyn Hughes, Labour's Minister of Agriculture, to commit his ministry to the Swann report's implementation.

As a consequence, MAFF officials were surprised when three weeks ahead of the 1970 general elections a minute suddenly announced that the decision to ban tetracycline and penicillin AGPs by July 1st was "off."[1] Officials had spent the past months negotiating the July deadline with all interested parties. However, behind closed doors, industry opposition to elements of the Swann report remained strong and the NFU insisted on the "need to use antibiotics for 'stress."[2] Writing to Parliamentary Secretary John Mackie in May 1970, Cyanamid International President Ernest G. Hesse warned that Britain had taken on a "heavy responsibility in introducing legislative controls."[3] Having "pioneered the concept of antibiotics in animal husbandry,"[4] Cyanamid considered resulting resistance insignificant.

Cyanamid also decided to generate public pressure against Swann. In early 1970, the company sponsored a symposium at the Royal Society for Medicine and flew in two loyal ex-Cyanamid employees from the US. Having both cut their teeth in campaigns against Rachel Carson's *Silent Spring*,[5] Thomas

[1] TNA MAF 416/67 (Minute, E Doling to Mr Cruickshank, 28 May, 1970).
[2] TNA MAF 416/67 (Submission to Minister, Swann Report – Current Position and Further Action, Appendix III: Consultations About Withdrawal Date For Penicillin And The Tetracyclines, 13 Jul, 1970), p. 2.
[3] TNA MAF 416/67 (Ernest G. Hesse to John Mackie, 20 May, 1970), p. 1.
[4] Ibid.
[5] Both scientists had already cut their teeth battling the claims of *Silent Spring*; Kroll, 'The 'Silent Springs' of Rachel Carson: Mass Media and the Origins of Modern Environmentalism', pp. 414-15.; Thomas H. Jukes, 'The Right to Be Heard', *BioScience,* 18/4 (1968), Thomas H. Jukes, 'Ddt

Jukes, the discoverer of the antibiotic growth effect and now a molecular biologist at UC Berkeley, and Rutgers biochemist Robert White-Stevens acted as proverbial bio-chemical 'merchants of doubt'[6] by campaigning against any perceived public or scientific threat to technologies safeguarding intensive agricultural abundance.

Following the symposium, Cyanamid distributed summaries of both scientists' statements to the press. Claiming to speak for large parts of "the scientific community," "British-born" White-Stevens attacked the Swann report as the most recent manifestation of a "tendency to provoke pessimism over scientific progress" and "'loudly [bewail] the usually quite insignificant side-effects of technology.'" [7] Convinced that "scientific agriculture must 'hold a finger in the dike' against starvation,"[8] White-Stevens urged authorities to "maintain meat production at its highest level."[9] In a similar vein, Thomas Jukes "flatly rejected"[10] Swann. Referring to "an exploding human population", Jukes claimed that the report was not based on "facts":

> 1) Antibiotics have retained their effectiveness for the production of growth of farm animals after continuous use for nearly 18 years'.
>
> 2) There is no evidence that the use of antibiotics in animal feeds has led to an increase in resistance either in animal or human pathogens.[11]

Affluent Enemy or Beneficial Friend', *BioScience,* 19/7 (1969), Thomas H. Jukes, 'Jukes in Defense of Borlaug', *BioScience,* 22/11 (1972).

[6] The concept of 'Merchants of Doubt' was originally created to describe the campaigning of a small group of Cold War physicists against industry-hostile science from tobacco to climate change; Oreskes and Conway, *Merchants of Doubt. How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*.

[7] TNA MAF 284/283 (Press Information. Cyanamid of Great Britain Limited, 'Scientists Deplore 'Instant Decision' By Governments', 20 Jan, 1970), p. 1.

[8] Ibid.

[9] Ibid, p. 2.

[10] TNA MAF 284/283 (Press Information, Cyanamid of Great Britain Limited, 'New Evidence Casts Doubt On Link Between Farm Antibiotics and Human Disease', 20 Jan, 1970), p. 1.

[11] Ibid.

However, the 1970 campaign by Cyanamid's PR firm, the Graham Cherry Organisation, backfired. Both Cyanamid and the Graham Cherry Organisation had underestimated Whitehall's corporatist abhorrence of public controversy and the fact that large parts of the British public and media were proud of the Swann report. Having attended Cyanamid's press briefing, a MAFF official reported that the "press representatives present" had been "surprisingly hostile."[12] Journalists had wanted to know "why they should believe what the two doctors had said in preference to Swann's report."[13] In the end, "only the Guardian (…) covered [the] story."[14] Referring to Cyanamid's failed campaign, MAFF's Animal Health Division was relieved to note that other manufacturers were "not prepared to use the publicity methods adopted by Cyanamid."[15]

Nonetheless, MAFF's position remained difficult. Officials complained, "it is not possible to produce conclusive scientific evidence to justify fully either accepting the proposals or rejecting them."[16] An internal report noted, "in view of the uncertainties we cannot afford to wait until [the debate is over] – if ever."[17] Publicly committed to the Swann report, MAFF officials, however, attempted to maintain a good relationship with farmers and manufacturers by offering "as smooth a transition as possible" [18] and thus postponed implementation deadlines, first to October 1970[19] and then to January 1971.[20]

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[12] TNA MAF 284/283 (Minute, I Armstrong to Mr Dawes, 21 Jan, 1970).
[13] Ibid.
[14] Ibid.
[15] TNA MAF 416/67 (Submission to Minister, Swann Report – Current Position and Further Action, Appendix: Background (Animal Health Division II, 8 Jul, 1970), p. 3.
[16] Ibid., p. 13.
[17] Ibid., p. 7.
[18] Ibid., p. 12.
[19] TNA MAF 284/283 (Minute, E Doling to D Evans, 26 May, 1970).
[20] TNA MAF 416/67 (Submission to the Minister, Swann Report – Current Position and Further Action, 13 Jul, 1970), p. 2.

Following the general elections of July 1970, implementing the Swann report became even more complicated. As a result of the Conservatives' victory, James – later Baron – Prior was appointed Minister of Agriculture. Initially, Prior "agreed that failure to implement the Swann recommendations would be very difficult to defend politically."[21] However, despite officials' warning that "too many deadlines had been breached in the past,"[22] Prior soon began to waver. Six days after meeting his officials in August 1970, MAFF further postponed the implementation date of the Swann bans to March and finally to August 1971.[23]

The decision to postpone bans might have been due to industry influence. Three days before the August meeting, Prior received a letter from Cyanamid Britain's Keith P. Grainger. The intimate tone of Grainger's letter to Prior is striking. After congratulating "dear Jim" for "[getting] off to a very good start!! [sic],"[24] Grainger immediately broached the topic of the Swann bans: "Obviously, I would be considered to be biased, but there is little doubt that this Report caused considerable comment in scientific circles and some outstanding figures have taken issue with Professor Swann."[25] Furthermore, Grainger warned that the "practical problems and the cost of fully implementing 'Swann' would be immense."[26] Casting doubt on existing R-factor expertise, Grainger was sure that Prior would not "wish farmers and veterinary surgeons to be made the scapegoats for a subject which has much wider implications."[27] While Grainger

[21] TNA MAF 416/67 (Minute, PW Murphy to Mr. Doling, 14 Aug, 1970).
[22] Ibid.
[23] TNA MAF 416/67 (Press Notice, Antibiotics, Further Implementation of Recommendations of the Swann Committee, 20 Aug, 1970), p. 1.
[24] TNA MAF 416/67 (K.P. Grainger to Jim M.L. Prior [sic], 10 Aug, 1970), p. 1.
[25] Ibid.
[26] Ibid., p. 2.
[27] Ibid.

appreciated that "Jim" had "inherited this particular 'hot potato' from [his] predecessor,"[28] he was eager to provide Prior with further information.

Signing with his first name, Keith also invited MAFF to send representatives to an upcoming symposium on the "The Problems of Drug Resistant Pathogenic Bacteria"[29] in New York's Waldorf-Astoria Hotel. After a brief discussion, MAFF decided to send A.B. Paterson, director of the Central Veterinary Laboratory in Weybridge. A ministry official noted:

> First, and this is as it were a public relations reason, in view of the strong attack which has been made on the Swann Committee recommendations we ought to make it abundantly clear that we are prepared to listen to all the views which are being put forward; (…). Second, (…), we ought in fact make sure that we are in touch with the latest developments.[30]

However, instead of promoting clarity, the New York symposium exposed on-going divisions between European and US attendees. Contradicting recent European warnings,[31] scientists associated with the pharmaceutical industry downplayed the dangers of resistance transfer. While the omnipresent Thomas Jukes repeated familiar arguments, [32] Harold Jarolmen from Cyanamid's Agricultural Division claimed that R-factor transfer in live animals was negligible. In the rare cases that *in vivo* transfer did occur, bacterial strains supposedly lost their "virulence" and the bacterium was put "at a competitive disadvantage with its drug-sensitive parent."[33]

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[28] Ibid.
[29] Ibid., attachment, p. 1.
[30] TNA MAF 416/67 (Minute, E. Doling to Mr. Carnochan, 15 Jun, 1970).
[31] Chapter Three, pp. 86-87; Chapter Four, pp. 102-103; Chapter Six, pp. 132-134
[32] Thomas H. Jukes, 'The Present Status and Background of Antibiotics in the Feeding of Domestic Animals', *Annals of the New York Academy of Sciences,* 182 (1971), pp. 362-64; 76.
[33] Howard Jarolmen, 'Experimental Transfer of Antibiotic Resistance in Swine', ibid., p. 79.

The New York symposium also gave British and US officials the opportunity to discuss policy strategies. Presenting at the symposium, the head of the FDA's Bureau of Veterinary Medicine (BVM), C. D. Van Houweling noted:

> There are important differences in the uses of antibiotics in animals in Great Britain and in the United States. We believe that through our new drug approvals (…), we have controls that they do not have in Great Britain. However, we do recognize that the continuous or prolonged use of antibiotics in feed does cause gramnegative organisms to develop resistance.[34]

Writing to Van Houweling one week later, Weybridge-director Paterson looked forward to reading the report of a contemporary FDA Task Force on Antibiotics in Feeds, "which can perhaps be described as the 'U.S. Swann'."[35] Having learnt "a good deal" while in the US, Paterson promised to send Van Houweling British material on the development of resistance under "feedlot conditions."[36] However, Paterson also warned Van Houweling that containing bacterial resistance was distinct from regulatory efforts against residues:

> At the Conference itself I felt that quite unwittingly we were talking rather at cross-purposes in that the FDA has concerned itself very largely with the problem of residues and the possible effect of these residues on the human population, whilst Swann is almost entirely concerned with the possible development of antibiotic resistant strains and their significance in outbreaks of disease in both animals and humans.[37]

Committed to AGP bans by Cledwyn Hughes, MAFF finally banned the use of penicillin and tetracycline AGPs in August 1971. However, official reform efforts quickly ebbed when it came to other aspects of the 1969 Swann report.

In the case of the proposed expert committee on all uses of antibiotics, official inaction was partially due to internal power struggles. It had already

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[34] C. D. Van Houweling, 'The Food, Drug, and Cosmetic Act, Animal Drugs, and the Consumer', ibid., p. 412.
[35] TNA MAF 416/67 (AB Paterson to Dr. van Houweling, 22 Oct, 1970).
[36] Ibid.
[37] Ibid.; for the 1970-1972 FDA Task Force see Chapter Twelve, pp. 278-281.

been clear in 1969 that the new committee would sit uncomfortably between the recently founded Veterinary Products Committee (VPC) and the Committee on Safety of Medicines (CSM).[38] Despite MAFF and DHSS pressure,[39] strong VPC and CSM opposition to the new committee even led to a temporary breakdown of British antibiotic licensing. Following the dissolution of the Antibiotics Panel in 1970,[40] it took involved parties two years to decide to establish a joint advisory committee, whose advice would be non-binding.[41] Action was delayed even further until companies that could not license new products exerted significant pressure on the VPC.[42] In 1973, a VPC official informed the CSM: "… because of the number of antibiotic applications awaiting scrutiny (…) I should be most grateful if everything possible could be done (…) to save any further embarrassment."[43]

The Joint Sub-Committee On Antimicrobial Substances (JSC) finally started work on July 2nd, 1973 and was chaired by PHLS director James Howie.[44] The JSC also included other familiar names: officially reconciled with MAFF in 1972,[45] E.S. Anderson served alongside University of Liverpool veterinarian J.R. Walton and the already familiar Houghton veterinarian and early antibiotic critic

[38] TNA MAF 260/678 (NW Taylor to Departments – MAFF, 24 Aug, 1971), p. 1; Chapter Six, pp. 144-145.
[39] TNA MH 149/2484 (DHSS Medicines Division, Paper A: Medicines Act – Proposed Orders As To Antibiotics, First Draft, 16 May, 1972), pp. 3-4.
[40] TNA MH 149/2484 (A Note of A meeting Held to Discuss the Establishment of a Committee on Antibiotics Held in Finbury Square, 20 Mar, 1972).
[41] TNA MAF 260/678 (NW Taylor to Departments – MAFF, 24 Aug, 1971), p. 2; TNA MAF 461/34 (Note of Meeting on the Future of the Joint Sub-Committee on Antimicrobial Substances, 28 Sep, 1979), pp. 1-2; TNA MH 149/2484 (CSG Russell (VPC) and EF Scowen (CSM) to Sir James Howie, 12 Dec, 1972); (Medicines Commission: Antibiotics, Second Draft, 9 Jun, 1972), p. 4.
[42] TNA MH 149/2484 (AMR Nelson to CSG Grunsell, 14 Mar, 1973).
[43] TNA MH 149/2484 (RJ Blake to JB Brown, 27 Mar, 1973).
[44] TNA BN 116/71 (Joint Sub-Committee on Antimicrobial Substances, 1st meeting, 2 Jul, 1973); TNA MAF 461/34 (Minute, Pamela Green to members of meeting between MAFF and MH, Sep, 1979), p. 1.
[45] Only in 1972 did MAFF break its policy of silence towards E.S. Anderson; cf. TNA MAF 416/85 (Minute, Mr. Barker, 3 Feb, 1972).

Herbert Williams Smith.[46] However, JSC members soon noticed that they lacked real power when pharmaceutical manufacturers repeatedly refused to provide basic sales data.[47] Relations with the CSM and VPC also proved difficult. Because the CSM preferred to consult its own experts, JSC members gradually turned into VPC licensing consultants without access to confidential licensing information. In September 1979, members sent a list of grievances to the VPC and CSM. While some distinguished members had simply stopped attending JSC meetings, remaining members were frustrated by their inability to properly examine often poorly submitted licensing applications. JSC members "not unreasonably consider[ed] that they are too often being invited [to VPC meetings] merely to hazard a guess about the value or safety of the products under consideration."[48] Referring to parallel reports on the pharmaceutical black market, the JSC noted that its attempts to "secure rational use of anti-microbial substances"[49] had failed.

Although some officials considered it unwise to disband the JSC due to the "emotive area"[50] it dealt with, the VPC and CSM were unwilling to strengthen it. According to the CSM and DHSS, "little would be lost if [the JSC] were disbanded."[51] Unwilling to fund the JSC by itself, the VPC agreed to disband the committee.[52] Although members deplored their dismissal, the JSC was disbanded

[46] TNA MH 149/2484 (Terms of Reference of the Joint Sub-Committee on Antimicrobial Substances).
[47] TNA BN 116/71 (Appendix A, ML 11, Extract from the report of the Joint Committee on the Use of Antibiotics in Animal Husbandry and Veterinary Medicine).
[48] TNA MAF 461/34 (James Howie to Chairmen of Committee on Safety of Medicines (CSM) and Veterinary Products Committee (VPC), 7 Aug, 1979, p. 2.
[49] Ibid., p. 2.
[50] TNA MAF 461/34 (Minute, Paul Ditchfield to Mr. Lawson (14 Apr, 1980).
[51] TNA MAF 461/34 (Note of Meeting on the Future of the Joint Sub-Committee on Antimicrobial Substances, 28 Sep, 1979), p. 2.
[52] Ibid., pp. 2-4.

on December 31st, 1980[53] and Britain returned to the pre-1969 separation of official responsibilities for agricultural and medical antibiotic use.

The JSC was not the only Swann recommendation to suffer from lacklustre official support. MAFF and DHSS were also reluctant to commit funds to antibiotic resistance monitoring. While farmers supported protectionist monitoring,[54] officials feared that it might necessitate the "drastic step"[55] of import rejections. According to MAFF, resistance monitoring would surely reveal "major difficulties"[56] with continental and Irish imports. Constrained by funding and trade considerations, officials decided to appease farmers with a pilot survey of meat imports. The survey was to be evaluated by an interdepartmental committee and conducted by E.S. Anderson, who – with characteristic bluntness – had already stated that it was "eyewash"[57]. Unperturbed by Anderson's views, officials planed to use the survey to dissuade other countries from using therapeutic AGPs for British-bound animals and to avoid an expensive permanent domestic monitoring programme.[58] By September 1970, Britain's programme of "spreading the Swann gospel"[59] was, however, officially put on hold.[60] Because of renewed EEC membership negotiations,[61] officials argued that Britain should put its "own house in order"[62] instead of monitoring imports.

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[53] TNA BN 116/119 (Joint Sub-Committee on Antimicrobial Substances, Minutes of Meeting on December 3rd, 1980), p. 7; also see: John Harvey and Liz Mason, *The Use and Misuse of Antibiotics in Uk Agriculture. Part 1: Current Usage* (Bristol: Soil Association, 1998), p. 10; (Joint Sub-Committee on Antimicrobial Substances, Minutes of Meeting on 3 Dec, 1980), p. 3.
[54] TNA MAF 416/85 (Minute, E. Doling, 24 Apr, 1970), p. 1.
[55] TNA MAF 416/85 (Minute, F.C. Parker to Mr. Doling, 23 Feb, 1970).
[56] TNA MAF 416/85 (Minute, E. Doling, 24 Apr, 1970), p. 2.
[57] TNA MAF 416/85 (Minute, J.G. Carnochan, 30 Apr, 1970).
[58] TNA MAF 416/85 (Minute, R.J. Blake, 27 Aug, 1970).
[59] TNA MAF 416/85 (Minute, E. Doling, 1 Sep, 1970).
[60] TNA MAF 416/85 (Minute, E. Doling, 18 Nov, 1970), pp. 1-2.
[61] TNA MAF 416/85 (Minute, E. Doling, 24 Apr, 1970), p. 4.
[62] TNA MAF 416/85 (Minute, D. Stoker, 16 Jun, 1971).

Behind the scenes, E.S. Anderson was, however, allowed to conduct a limited survey. Following EEC membership, officials wanted "to confront countries with a vested interest in antibiotics with scientific facts but we would prefer to keep quiet until such data are available."[63] Reporting in April 1972, Anderson confirmed ministerial suspicions. Between February and October 1971, a team of veterinarians had collected samples of Irish beef and pork and US sheep and lamb livers at British ports.[64] In the case of US samples, 29 of 32 lamb livers and two of seven sheep livers contained resistant *E. coli*.[65] Despite cleansing by high-pressure hosing, 57.8% of Irish beef samples and 75.6% of Irish pork samples were contaminated with *E. coli*. 25.2% of isolated *E. coli* from beef and 94.9% of isolated *E. coli* from pork were antibiotic resistant.[66] Furthermore, it was "relatively common" for isolated Irish *E. coli* to be "resistant to combinations of the 'therapeutic' drugs ampicillin, chloramphenicol, neomycin-kanamycin, streptomycin and sulphonamides."[67] According to Anderson, the results were not surprising, "since the Irish farmer has free access to all therapeutic antibiotics."[68]

Anderson's confidential study was received with interest by British and US regulators.[69] Writing in May 1972, a MAFF official believed that Anderson's study would help pressure the Republic of Ireland to block antibiotic sales into

[63] TNA 416/86 (Minute, JN Jotchan, 20 Sep, 1972).
[64] TNA MAF 416/86 (E.S. Anderson to J. Jotcham, 17 Apr, 1972; attached, Interdepartmental Working Party on the implementation of the Swann Report. Examination of imported meat for contamination with drug-resistant Escherichia coli), pp. 2-3.
[65] Ibid., p. 8; attached, Table 1: E. coli from Irish beef and pork carcasses.
[66] TNA MAF 416/86 (E.S. Anderson to J. Jotcham, 17 Apr, 1972; attached, Interdepartmental Working Party on the implementation of the Swann Report. Examination of imported meat for contamination with drug-resistant Escherichia coli), p. 3.
[67] Ibid., p. 9.
[68] Ibid.
[69] TNA MAF 416/86 (Minute, ARM Kidd to WT Barker, 1 Jun, 1972; WT Barker to ES Anderson, 20 Jun, 1974).

Northern Ireland.[70] One month later, the Working Group on the Monitoring of Imported Meat for Antibiotic Resistant Enterobacteria pressed for further studies of French and Dutch imports, as both countries had "a vested interest in the use of antibiotics in animal husbandry."[71]

However, monitoring aspirations received a blow in January 1973 when internal studies indicated problems with Britain's own meat supply. Between 1971 and 1972, streptomycin resistance amongst isolated *E. coli* strains had risen from 47 to 50%, tetracycline resistance from 44 to 50% and ampicillin resistance from 49 to 56%.[72] The results contradicted projected Swann outcomes. Afraid of jeopardizing the 'Swann gospel', British officials stopped commissioning resistance studies. In 1973, a MAFF official noted that large-scale resistance surveys could "only be done on the basis of a free exchange of information."[73] However, "this might rob us of some of our advantage during the 5-year derogation from EEC practice (…), in the course of which we hope that the Community will align with us."[74] Additional surveys might further undermine the "Swann Doctrine."[75]

Following the mid-1970s, there were only sporadic British attempts to monitor bacterial antibiotic resistance in food production. In the same year that farmers protested against French egg imports, a survey compared resistance in

[70] TNA MAF 416/86 (RW McQuiston to WT Barker, 8 May, 1972).
[71] TNA MAF 416/86 (Working Group on the Monitoring of Imported Meat for Antibiotic Resistant Enterobacteria, Meeting, 13 Jun, 1972), p. 2.
[72] TNA MAF 416/86 (ARM Midd, Antibiotic Resistance in the UK and Belgium, 13 Jan, 1973), p. 1.
[73] TNA MAF 416/86 (JN Jotcham to AB Paterson, 9 Apr, 1973).
[74] Ibid.
[75] Ibid.

French and British eggs. However, the 1975 comparison revealed no difference of resistance levels and further undermined Swann-inspired protectionism.[76]

With British officials stopping studies rather than endangering an ossified and ineffective doctrine, the Swann report's *raison-d'être* of curbing antibiotic resistance was effectively forsaken within four years of its publication. An effective adaptation of British antibiotic policy to an increasingly resistant microbial ecology receded into the distant future.

In addition to resistance monitoring, British officials failed to enact the Swann report's proposed ban of antibiotic advertisements to farmers. In a 1972 recommendation, MAFF's Animal Health Division noted that the BVA, RCVS and Pharmaceutical Society all favoured such a ban:

> They argue that [veterinarians'] (…) task should not be made more difficult by uninformed pressures from clients responding to advertising. Also they think that (…) there is a danger that some clients whose interest has been aroused will obtain supplies illicitly.[77]

However, the ABPI, the NFU and the British Poultry Federation opposed advertising bans: "They argue that the prescription requirement gives control to veterinarians and that the Government should not 'molly-coddle' them..."[78] Following several inconclusive meetings, MAFF's Animal Health Division noted that the "proper course would be to accept the logic of the Swann recommendation" and announce "the intention to make regulations in the absence of an effective voluntary scheme."[79]

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[76] TNA MAF 282/186 (Steering Group on Food Surveillance, Sub-Group on Antibiotic Residues in Food, Secretariat, Jun 1975).
[77] TNA MAF 416/70 (Submission to Minister, Swann Report – Recommendation on Advertising, January 1972).
[78] Ibid.
[79] TNA MAF 416/70 (Submission to Minister, Swann Report – Recommendation on Advertising, Jan 1972).

Once again, Conservative Minister of Agriculture James Prior did not heed officials' advice. Despite appeals by Junior Health Minister Lord Aberdare, Prior referred the matter to the still non-existent JSC. In a draft letter to Lord Aberdare, Prior stated:

> As you know, I do not subscribe to the view that the veterinary profession is not strong enough to resist pressure from its farmer clients; and although the drug manufacturers are obviously keen to sell I am not sure that advertising necessarily increases overall demand.[80]

A savvy politician, Prior was, however, "glad to accept [Aberdare's] proposals that we leave it to officials to notify the interested organisations."[81]

Following Prior's promotion to Leader of the House of Commons, the issue resurfaced in 1974 when both the JSC and VPC supported advertisement bans.[82] However, Prior's successor failed to address the matter ahead of the 1974 general elections. Following the Conservatives' defeat, officials duly resubmitted the proposed restrictions to their new Labour ministers.[83] A frustrated official noted:

> My own view is that, while in matters of this sort there is often much to be said for leaving well alone, in this case we cannot ignore the advice of 3 official committees nor swallow the assertion of the manufacturers that they do not seek to enlist the support of the farmer in building up an even bigger market in therapeutic antibiotics, regardless of true need.[84]

However, the politically opportune moment had passed and the matter was quietly dropped after technicalities further delayed restrictions.[85]

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[80] TNA MAF 416/70 (Draft for the Minister's Signature to Lord Aberdare (DHSS)); also see Aberdare's corroboration of the correspondence; TNA MAF 416/70 (Lord Aberdare to James Prior, 21 Mar, 1972).
[81] TNA MAF 416/70 (Draft for the Minister's Signature to Lord Aberdare (DHSS)).
[82] TNA MAF 416/71 (Minute John H Drury to Mr Nelson, 23 Jan, 1974); TNA MAF 416/71 (Minute RJ Blake to Mr WT Barker, 17 Apr, 1974).
[83] Ibid.; TNA MAF 416/71 (Submission to the Minister, Swann Report – Recommendation On Advertising, 20 Jun, 1974), p. 5.
[84] TNA MAF 416/71 (Minute, CH Shillito to Miss Evans, 9 Jul, 1974).
[85] TNA MAF 416/71 (Minute, Mr Nelson to RJ Blake, 9 Jan, 1975).

Initially, it looked as though Swann proposals for antibiotic residue regulation would also share the fate of resistance monitoring and advertising bans. Even though the VPC supported residue monitoring in April 1971,[86] residue tests remained unstandardized and results could vary by up to 50%.[87] The only exception was the standardised test for penicillin in milk. Testing for rather generous penicillin residues, the MMB's penalty scheme had reduced residue finds in milk from 10% in 1960/61 to ca. 1% in the mid-1970s.[88] However, British authorities remained blissfully ignorant regarding the contamination of produce other than milk. With no data forcing authorities to act, consumer protection remained based on the 1955 Food and Drugs Act and the Preservatives in Food Regulations, which prohibited adding antibiotics to food, except in the temporary case of nisin and oxytetracycline preservatives.[89] However, there was no legislation outlawing the sale of produce in which antibiotics were 'present' as opposed to 'added'.[90]

As a consequence, consumers' only protection from residues lay in the wording of Section Two of the 1955 Food and Drugs Act. According to the 1955 Act, it was an offence "to sell to the prejudice of the purchaser any food which is not of the nature, substance or quality demanded."[91] In a few cases, local Food and Drug Authorities used Section Two to exert pressure on producers and

[86] TNA MAF 416/85 (D. Stoker to Dr. B.A. Rose, 28 May, 1971).
[87] TNA MAF 284/282 (Committee on Medical Aspects of Food Policy, meeting, 4 Mar, 1968).
[88] TNA MAF 461/67 (Steering Group on Food Surveillance, Sub-Group Antibiotic Residues in Food, Antibiotics Price Deduction Scheme, Jan, 1976).
[89] The practice of preserving food with antibiotics other than nisin was no longer endorsed in 1975; TNA MAF 282/186 (SGFS, Sub-Group on Antibiotic Residues in Food. Minutes of the 1st meeting of the Sub-Group held on 30 Apr, 1976), p. 3.
[90] TNA MAF 284/282 (L.C. Gaskell to Mr. J.G. Kelsey, 19 Sep, 1968).
[91] TNA MAF 260/678 (E.J. Mehen to NW Taylor, 2 Sep, 1971).

MAFF to reduce residues and restrict antibiotics for culturally sensitive products like eggs and milk.[92]

However, from the mid-1970s onwards, lax British residue regulations came under significant pressure. Reacting to the increasing international emphasis on laboratory-based residue tests,[93] officials decided to conduct a pilot survey of residues in British meat via a Steering Group on Food Surveillance (SGFS).[94] Between October and December 1975, the Laboratory of the Government Chemist analysed 789 pig kidney and chicken liver samples. Of these, 25.5% tested positive for antimicrobial residues.[95] However, testing methods proved unreliable: only 27.8% of positive kidney and 44.5% of positive liver samples showed inhibition zones matching those of spiked control samples. Because nobody had told the government chemist which antibiotics to test for, residue tests had been designed only for penicillin and tetracyclines and did not reliably detect other antibiotic residues.[96] Moreover, limited electrophoresis capacities allowed the processing of only 15-20 samples per week even though residues' antimicrobial activity decreased during storage.[97] Seen in this light, the five samples conclusively testing positive for penicillin or tetracycline via electrophoresis said little about the overall contamination of British meat.[98]

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[92] TNA MAF 260/678 (S. Simmons to WJD Williams, 9 Aug, 1971); (LR Maddock to WJD Williams, 4 Feb, 1971.

[93] For the pioneering role of the US regarding antibiotics in the 1960s see Chapter Four, pp. 66-67; 87-88; Chapter Twelve, pp. 297-298); also see Peter A. Koolmes, 'Veterinary Inspection and Food Hygiene in the Twentieth Century', in David F. Smith and Jim Philips (eds.), *Food, Science, Policy and Regulation in the Twentieth Century. International and Comparative Perspectives* (London and New York: Routledge, 2000), pp. 60 and 62.

[94] TNA MAF 461/67 (D. Tingle/ John Fitzgerald to R.J. Blake, 31 Oct, 1975; attached note), pp. 1-2.

[95] TNA MAF 461/67 (SGFS Sub-Group on Antibiotic Residues in Food: Further Results on the Survey Of Residues in Poultry and Pigmeat, March, 1976), pp. 1-6.

[96] TNA MAF 461/67 (SGFS Sub-Group on Antibiotic Residues in Food, 1st Meeting, 20 Apr, 1976), p. 5; (Secretariat, Incidence of Antibiotic Residues in Food, Mar, 1976), p. 2.

[97] Ibid., p. 1 [handwritten note] -2 and 6.

[98] TNA MAF 461/67 (SGFS, Sub-Group on Antibiotic Residues in Food, 1st Meeting, 20 Apr, 1976), p. 5.

Pressure for further surveys soon increased. Following Britain's EEC-accession, Directive 64/433/EEC initially allowed national food safety rules to differ.[99] However, by the mid-1970s, several EEC members were calling for unified monitoring. According to EEC Draft Directive 72/462, residue contaminated non-EEC meat imports were to be banned.[100] Similar demands were also voiced for the intra-EEC trade and West-German authorities rejected three consignments of residue-tainted British meat in 1975 and 1976.[101] Following further rejections by US, Dutch and Scandinavian authorities, MAFF scrambled to restore trust in £150 million of annual British meat exports:

> If we are to avoid placing our export meat trade in jeopardy, and one could argue that it is already on the brink, (…), it is imperative that a more positive policy on 'residues in meat' be formulated...[102]

SGFS subsequently tasked a Sub-Group on Antibiotic Residues to establish a national meat-monitoring programme.[103] In April 1976, SGFS Sub-Group members launched a second limited survey: meat samples were to be screened using standard EEC bacterial inhibitor tests – so-called 'frontier post tests'. Should bacterial growth be inhibited on test dishes, electrophoresis screening would identify inhibiting substances.[104]

However, by 1977, the Sub-Group had managed to establish only a preliminary export-monitoring programme of four samples per week. The group

[99] TNA MAF 461/67 (J.A. Davies to J.E. Tugwell, 16 Nov, 1977), p. 1.
[100] TNA MAF 282/186 (SGFS, Sub-Group on Antibiotic Residues in Food, Secretariat, March 1976), p. 19; adoption was planned for January 1977.
[101] TNA MAF 461/67 (SGFS, Sub-Group on Antibiotic Residues in Food, 1st Meeting, 20 Apr, 1976), pp. 5 and 7; TNA MAF 282/186 (Norman D Baird to RV Blamaire, 'Residues in Meat – Some Pertinent Facts', 4 Aug, 1976), p. 2.
[102] TNA MAF 282/186 (Norman D Baird to RV Blamaire, 'Residues in Meat – Some Pertinent Facts', 4 Aug, 1976), p. 4; also see: TNA MAF 461/67 (J.A. Davies to J.E. Tugwell, 16 Nov, 1977), p. 1.
[103] TNA MAF 461/67 (SGFS, Sub-Group on Antibiotic Residues in Food. Draft Terms of Reference, Mar, 1976); the sub-group later seems to have merged with the Working Party on Veterinary Residues in Meat and Meat Products of the SGFS; MAF 461/68 (Minute, A.W. Hubbard to W. Barker, 1978), p. 2.
[104] Ibid., p. 7.

was denied statutory access to abattoirs and the Port and Air Health Authorities sent only 40 samples in four months instead of the promised 50 weekly samples.[105] Unable to trace residues back to producers,[106] analysts were also denied access to confidential VPC information on residue assays.[107] In mid-1978, the renamed Working Party on Veterinary Residues in Meat and Meat Products presented results: between July 1977 and March 1978, scientists had analysed 933 samples. Voluntarily selected and sent by 23 of the UK's export abattoirs, samples had been tested using EEC frontier post tests. According to the study, the incidence of positive tests was below 0.3%.[108] However, an attached note warned that results were compromised. In the case of 153 samples sent from Smithfield, analysts reported:

> Many liver and a proportion of the kidney and beef samples were of extremely poor quality (…). Certain livers were green and strong smelling, and really should not have been tested.[109]

Other samples had thawed before reaching analysts and did not include kidneys or livers – key organs for residue tests.[110]

Despite the questionable nature of the second survey's results, MAFF representatives used them to reassure trade partners. During a meeting with American and Canadian representatives in 1978, MAFF officials admitted that there "was the possibility of certain unauthorised use of antibiotics"[111]. However,

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[105] TNA MAF 461/67 (Notes of meeting, UK Drug Residue Monitoring Programme, 1977), p. 1.
[106] Ibid., p. 2; also see: MAF 461/69 (Minute, A.W. Hubbard to W. Barker, 1978), p. 2-3.
[107] TNA MAF 461/68 (SGFS, Working Party on Veterinary Residues in Meat and Meat Products, 1st Meeting, 29 Jul, 1977), p. 3.
[108] TNA MAF 461/68 (Working Party on Veterinary Residues in Meat and Meat Products. Antibiotic Residues in Meat Taken from Export-Licensed Abattoirs in UK)
[109] Ibid.; Annexe: Antibiotic Residues in Imported Meat), p. 1.
[110] TNA MAF 461/68 (Working Party on Veterinary Residues, Draft Report to the SGFS, Note of 2nd meeting, 17 Jul, 1978).
[111] TNA MAF 461/67 (Minute, J. Morey to Mr. Giles, 30 Jan, 1978), p. 1.

"the industry was a closely integrated one [and] any widespread abuse would (…) be quickly publicised."[112] With surprising confidence, one official later noted:

> It clearly came as something of a surprise to the American and Canadian delegates to realise the extent to which a combination of administrative and legal provisions could be effective. They had clearly heard, although they did not say (…) that the so-called loop-holes in the law, plugged only by administrative recommendations, were less than effective.[113]

Such attitudes were, however, not shared by EEC partner states. During the second half of the 1970s, West Germany and Denmark pressed for unified EEC residue monitoring, which would analyse a fixed percentage of meat imports and intra-community trading.[114] Meanwhile, British officials favoured the USDA's contemporary residue-monitoring program, which was based on binominal probability theory and used a much smaller number of supposedly random samples to extrapolate the probable degree of total meat contamination. Should residues be found, a second stage of intensive sampling would reveal local offenders.[115] For British authorities, this meant that instead of annually analysing 5,200 samples under the proposed percentage scheme, they would have to analyse only ca. 1,800 samples and deploy far less personnel.[116]

Reporting on a meeting of the residue sub group of the EEC's working party on veterinary legislation in May 1978,[117] a British delegate noted that the idea of probability-based sampling had led to a "good deal of acrimonious

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[112] Ibid., p. 1-2.
[113] Ibid., p. 2.
[114] TNA MAF 282/198/1 (Submission to the Parliamentary Secretary, MAFF National Meat Residue Monitoring Programme, Food Science Division, Appendix C, February 1980); also see draft directives 4850/VI/77 (1977) and 728/VI/78 (1978).
[115] TNA MAF 461/67 (Notes of meeting, UK Drug Residue Monitoring Programme, 1977), p. 1; also see: Chapter Twelve, pp. 297-298.
[116] TNA MAF 461/67 (Minute, E. Owen to J. Morey, 16 Dec, 1977), p. 1; cf. also (Minute (undated), Monitoring of Drug Residues, FCN 228); TNA MAF 461/68 (Meat Residue Monitoring Programme), p. 3.
[117] The UK's position had been pre-determined by MAFF in April 1978; TNA MAF 461/68 (Minute, J. Ardley to R.D. Martin, April 1978).

discussion with the German representative proving the most vocal."[118] Continental opponents had talked "a good deal of nonsense (…) about the willingness of consumers to pay for extra protection."[119] During the meeting, Britain also lobbied to prevent mandatory drug withdrawal periods, monitoring of meat products – as opposed to fresh meat – and tests for pesticide and heavy metal residues.[120] While Britain successfully toppled pesticide monitoring and residue limit proposals, delegates compromised by mandating preliminary probability–based residue surveys, which would indicate whether more extensive testing was necessary. Unilaterally, member states could, however, monitor more extensively.[121]

British pilot testing in pre-selected slaughterhouses began in 1980.[122] In the absence of statutory regulations, voluntarily participating slaughterhouses could theoretically manipulate results by preselecting uncontaminated samples for testing by Reading's Veterinary Investigation Centre.[123] Meanwhile, MAFF reassured industry that monitoring was "simply an attempt to gain representative data with which to negotiate effectively and ensure that there are no more controls than are absolutely necessary."[124] In total, measures were projected to cost £20,000 p.a. with additional resources required for exports to countries with tougher requirements such as West-Germany, Italy, Cyprus and

[118] TNA MAF 461/68 (EEC, Summary Report of Meeting with Representatives of Community Institutions or Of Member Governments, ‚Working Party ‚Veterinary Legislation' Sub-Group ‚Residues' (25-26.05.1978), 'Draft Directives on Undesirable Residues in Fresh Meat', 30 May, 1978), p. 2.
[119] Ibid.
[120] Ibid., pp. 1-4.
[121] TNA MAF 282/198/1 (Submission to the Parliamentary Secretary, MAFF National Meat Residue Monitoring Programme, Food Science Division, Appendix C, February 1980).
[122] TNA MAF 282/198/1 (Submission to the Parliamentary Secretary, MAFF National Meat Residue Monitoring Programme, Food Science Division, February 1980), p. 2.
[123] Ibid.
[124] TNA MAF 282/198/1 (Sampling of meat for Residue Investigations).

the Netherlands.[125] A decade after Swann, meat destined for foreign tables was subject to stricter controls than meat destined for British tables.

Submitted in 1982, the first national residue survey claimed with 95% certitude that less than 1% of cattle, calf, sheep and pig kidneys and meat contained antimicrobial agents above permitted tolerance limits. Sulphadimidine was probably present in less than 4% of British meat. Antimicrobial residues in poultry products were not measured.[126] However, the report's projections had to be taken with a grain of salt. In a parallel study of German-bound meat exports, 19 of 61 samples (31.2%) tested positive for antibiotics. A previous survey of 88 samples had found 7 positive results (ca. 8%).[127]

With subsequent national residue surveys revealing higher contamination rates and media reports disclosing illegal drug trading on farmyards,[128] the performance of British monitoring and enforcement was subjected to greater public scrutiny. However, state-employed MAFF veterinarians, who were responsible for sampling, were often afraid of jeopardizing relationships with local farmers and slaughterhouses.[129] In 1983, a veterinary officer complained about "field donkey work"[130] and having to report "lot numbers, size of batches,

[125] TNA MAF 282/199 (Minute, LG Mitchell to Mr Fry, Attached: Meat Inspection Review. State Veterinary Service National Surveillance Scheme for Residues in Meat, 10 Aug, 1984), p. 3.
[126] TNA MAF 461/70 (Working Party On Veterinary Residues In Meat And Meat Products, National Meat Monitoring Programme Year 1 Results, 13 Oct, 1982), p. 7
[127] TNA MAF 461/70 (Working Party on Veterinary Residues in Meat And Meat Products, Antimicrobial Agents in Muscle and Kidney, results from Abattoirs exporting to West Germany); also see TNA MAF 461/70 (Laboratory Report No. 82/11), p. 2.
[128] TNA MAF 282/199 (Antimicrobial and Hormone Residues in meat, Submission to the Parliamentary Secretary, Food Science Division, Meat Hygiene Division, Sep 1983); Chapter Seven, pp. 150-152.
[129] TNA MAF 282/199 (Memorandum: From DVO MAFF to Mr JA Grisedale, DRVO (Reading) and Mr JM Threlkeld, RVO (Reading), 9 Feb, 1983).
[130] TNA MAF 282/199 (RS Beynon to Mr Jenkinson, 18 Feb, 1983), p. 1.

information on farm of origin, etc."[131] Afraid of straining "existing relations," the official wanted to pay for samples and threatened sabotage:

> If I sample a pig and I (…) know that antibiotics will be present, can I have a guarantee that there will be no request for an approach to the farmer? If not, I am going to be selective in my samples. If a guarantee can be given, then there is no point in giving the origin of the sample.[132]

However, such protest was of no avail and 1983 brought new EEC directives for intra-community meat monitoring.[133] Starting work in 1984, the State Veterinary Service's (SVS) National Sampling Scheme (NSS) initially continued to rely on random sampling and the voluntary provision of samples and product information.[134] However, by the end of the year, new EEC requirements mandated traceable samples, follow-up sampling and the outlawing of the slaughtering of residue-laden animals.[135] For the SVS, the new EEC proposals were "excessive", "costly to operate" and might "cause problems for our export trade."[136] Although the UK successfully delayed their introduction for four years, the new EEC regulations ultimately forced Britain to expand mandatory meat sampling to 28,000 samples in 1989.[137] In the same year, the new Veterinary Medicines Directorate (VMD) was placed in charge of veterinary licensing, enforcement and meat surveillance.[138] Critics later bemoaned that the VMD was financed by the very industry it was supposed to monitor.[139]

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131 Ibid.
132 Ibid., p. 2.
133 TNA MAF 282/199 (Minute, LG Mitchell to Mr Fry, 10 Aug, 1984; attached, Meat Inspection Review, EEC proposals to Control Residues in Meat for Intra-Community Trade), pp. 1-2.
134 Ibid.; attached, Meat Inspection Review, SVS National Surveillance Scheme for Residues in Meat), pp. 1-4.
135 Ibid.; attached, Meat Inspection Review, EEC proposals to Control Residues in Meat for Intra-Community Trade), pp. 1-3.
136 Ibid., p. 4.
137 James Erlichman, 'Drug traces found in abattoir carcases', *Guardian*, 18.01.1988, p. 4.
138 'Report on Microbial Antibiotic Resistance in Relation to Food Safety', (London: Advisory Committee on the Microbiological Safety of Food, 1999), p. 146.; Richard Young et al., *The Use and Misuse of Antibiotics in Uk Agriculture. Part 2: Antibiotic Resistance and Human Health* (Bristol: Soil Association, 1999), p. 42; 'The Report of the Expert Group on Animal Feedingstuffs to the

While domestic scandals and international pressure gradually forced them to address residue problems, 1980s UK officials rarely debated the failure of Swann-style AGP restrictions to curb overall agricultural antibiotic use or resistance proliferation.

By contrast, the 1990s saw pressure for resistance-focussed antibiotic reform increase again. Whereas a comparative paucity of data had previously made it easy to downplay problems, the 1990s saw improved residue and resistance data increase the cost of political inaction: the more one knew, the more one had to do. Initially opposing rather than shaping them, British officials soon found themselves forced to enact European antibiotic reforms.

In Britain, the Expert Group on Animal Feedingstuffs had already called for agricultural antibiotic reform in 1992. Headed by University of Nottingham animal physiologist Prof. George Eric Lamming, the so-called Lamming committee identified "gaps in legislation and its enforcement."[140] Regarding antibiotic residues, the Lamming committee criticised insufficient official oversight and assay methods.[141] Although EC Directive 70/524 obliged manufacturers to publicize information on the detection of antibiotic feed additives, similar regulations did not exist for POMs. In Britain, manufacturers were obliged to inform the VPC about POM assays but this confidential

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Minister of Agriculture, Fisheries and Food, the Secretary of State for Health and the Secretaries of State for Wales, Scotland and Northern Ireland (Lamming Report)', p. 43.

[139] Young et al., *The Use and Misuse of Antibiotics in Uk Agriculture. Part 2: Antibiotic Resistance and Human Health*, pp. 42-43.

[140] 'The Report of the Expert Group on Animal Feedingstuffs to the Minister of Agriculture, Fisheries and Food, the Secretary of State for Health and the Secretaries of State for Wales, Scotland and Northern Ireland (Lamming Report)', p. 3.

[141] Ibid., p. 75.

information was not communicated to enforcement authorities, a problem already encountered by the JSC in the 1970s.[142]

Significantly, the Lamming committee also warned about rising antibiotic resistance in bacterial isolates of animal origin. Between 1981 and 1990, multi-resistance amongst isolated *S. typhimurium* strains had risen from 15 to 66% in the case of cattle and from 2 to 8% in the case of poultry.[143] Alarmed by this increase, the Lamming Committee recommended expanding routine resistance monitoring to human *E. coli* isolates.[144] In conjunction with the VPC, the Lamming committee also recommended discouraging the "prophylactic use of antibiotics with cross-resistance to those used in human medicine."[145] Another recommendation was the changing of rules allowing manufacturers to send diluted drug substrates to farmers for home-mixing.[146]

Published prior to the 1996 BSE crisis, the Lamming report failed to arouse significant public or political interest. In 1993, officials ignored the committee's concerns about cross-resistance and approved agricultural uses of the fluoroquinolone antibiotic enrofloxacin (Baytril), which could select for resistance against important reserve antibiotics.[147] The risks of agricultural fluoroquinolone use were already known. After their introduction to German agriculture in 1988, fluoroquinolone-resistant variants of *S. typhimurium* DT204c reached "a prevalence of 50%"[148] in calf isolates in certain areas. As

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[142] Ibid., p. 70.
[143] Ibid., p. 47.
[144] Ibid., p. 48.
[145] Ibid.
[146] Ibid., pp. 45-47.
[147] 'The Path of Least Resistance', (Standing Medical Advisory Committee. Subgroup on Antimicrobial Resistance, 1998), p. 78; for enrofloxacin's fate in the US see Chapter Ten, pp. 244-246; and Chapter Twelve, pp. 309-313.
[148] 'Use of Quinolones in Food Animals and Potential Impact on Human Health. Report of a Who Meeting, Geneva, Switzerland, 2-5 June 1998', (1998), p. 7.

primary causes of bacterial gastroenteritis, fluoroquinolone resistant *S. typhimurium* DT104 and *Campylobacter* soon emerged as public health threats.[149]

However, times were changing. In a sign of critics' growing influence, the EU established a Commission to reassess agricultural antibiotics in 1992.[150] Following EU measures against agricultural chloramphenicol use in 1994,[151] reports of cross-resistance between avoparcin and the reserve antibiotic vancomycin prompted Germany, Denmark and the Netherlands to veto a British licensing request for avoparcin in dairy cow feeds. With Denmark and Germany subsequently banning all avoparcin AGPs in 1996, other EU states began to support EU-wide avoparcin restrictions.[152]

But Britain did not follow suit. Unable to lift European BSE embargoes, the Major government was reluctant to commit itself to EU-driven antibiotic reform just ahead of the general elections on May 1st, 1997. Within the EU, Britain's position was supported by the Scientific Committee for Animal Nutrition (SCAN), which called for more research ahead of bans. By contrast, the Committee of Experts on Feed Additives and the EU Commission both supported a ban and considered evidence linking avoparcin to vancomycin resistance

[149] Ibid., pp. 6-7.
[150] Uwe Petersen, 'Entwicklungen Im Deutschen Futtermittelrecht', in Bundesforschungsanstalt Für Landwirtschaft (Fal) (ed.), *Meilensteine Für Die Futtermittelsicherheit: Vortragsveranstaltung Im Forum Der Fal Am 16./17. November 2006* (Braunschweig: Petersen, Uwe et al. , 2007), p. 6.
[151] Ackermann Dettenkofer, M.; Eikenberg M.; Merkel H., *Auswirkungen Des Einsatzes Von Antibiotika Und Substanzen Mit Antibiotischer Wirkung in Der Landwirtschaft Und Im Lebensmittelsektor. Ein Literatur-Review* (Ernährungs Wende Produkte, Materialienband Nr. 4; Freiburg: Institut für Umweltmedizin und Krankenhaushygiene am Universitätsklinikum Freiburg, 2004), p. 24.
[152] Petersen, 'Entwicklungen Im Deutschen Futtermittelrecht', p. 6.; 'Written Answers to Questions (10.06.1996)', *Commons Hansard Written Answers* (London, 1996), p. Column 10.

sufficient.[153] In a far cry from its post-Swann pioneering role, Britain was overruled and the EU banned avoparcin AGPs on April 1st, 1997.[154]

After May 1st, the New Labour government took action to restore trust in British regulations and food by ending MAFF's institutionalised conflict between business and consumer interests. Responsible to the Department of Health, an independent Food Standards Agency (FSA) started work in April 2000. In 2001, MAFF itself was dissolved and turned into the Department for Environment, Food and Rural Affairs (DEFRA). While the VMD retained responsibility for residue monitoring, DEFRA was responsible for the control of food-borne zoonosis.[155]

Meanwhile, a proliferation of high profile international and domestic reports reinforced calls for antibiotic reform. In 1997, a WHO meeting on "The Medical Impact of Antimicrobial Use in Food Animals"[156] called for improved and standardized international resistance monitoring and specified monitoring requirements for *Salmonella, E. coli*, *Campylobacter jejuni* and *Enterococcus*.[157] After a second WHO meeting expressed concern about "non-medical uses of antimicrobials"[158] in April 1998, a third WHO meeting on agricultural quinolone use admonished veterinarians to reduce prescriptions and warned against using quinolones "for performance enhancement"[159] in June 1998.

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153 'The Path of Least Resistance', p. 78.
154 Bud, *Penicillin: Triumph and Tragedy*, p. 205.
155 Smith et al., *Food Poisoning, Policy and Politics. Corned Beef and Typhoid in Britain in the 1960s*, pp. 307-08.
156 'The Medical Impact of Antimicrobial Use in Food Animals. Report of a Who Meeting. Berlin, Germany, 13-17 October 1997. ', (1997).
157 Ibid., p. 13.
158 'Antimicrobial Resistance Monitoring: Information Exchange and Opportunities for Collaboration. Report of the Second Joint Who/Ifpma Meeting, Geneva 2-3 April 1998', (1998), p. 1.
159 'Use of Quinolones in Food Animals and Potential Impact on Human Health. Report of a Who Meeting, Geneva, Switzerland, 2-5 June 1998', p. 17.

In Britain, the House of Lords also published an influential report in 1998. Mostly concerned with human medicine, the Lords acknowledged "a continuing threat to human health from imprudent use of antibiotics in animals."[160] The sections of the Lords' report that did discuss agricultural antibiotics bore a strong resemblance to the 1969 Swann report. This was no coincidence. Veterinarian Lord Soulsby, the committee's leader, had been a close friend of the late Michael Swann.[161] According to the Lords, Britain had once "led the world in addressing the threat to human health posed by antibiotic use in farming practices with the Swann Report in 1969."[162] However, important parts of Swann had been watered down. Criticising the JSC's dissolution and inadequate monitoring, the Lords warned, "departmental and agency boundaries must not be allowed to prevent the Government from getting a grip on the whole of this issue."[163] The Lords also recommended phasing out virginiamycin AGPs because of cross-resistance to the new antibiotic dalfopristin/quinupristin (Synercid) and noted that the "mass-treatment of herds (…) and flocks (…) with [antibiotic] agents cannot be best practice..."[164] Veterinarians should reduce antibiotic use: "we recommend self-regulation in preference to legislation."[165]

The Lords' attack on agricultural antibiotic use was just the beginning. Shortly afterwards, the House of Commons Select Committee on Agriculture was more severe in its assessment of the situation and recommended:

> … a ban on the use of antibiotics in farming as growth promoters, and tighter restrictions on their use for subtherapeutic or prophylactic

[160] 'Resistance to Antibiotics and Other Antimicrobial Agents', (London: House of Lords - Select Committee appointed to consider Science and Technology 1998), p. 11.18.
[161] Bud, *Penicillin: Triumph and Tragedy*, p. 203.
[162] 'Resistance to Antibiotics and Other Antimicrobial Agents', p. 11.19.
[163] Ibid., p. 11.23.
[164] Ibid., p. 11.21.
[165] Ibid.

> purposes. Every effort should be made to develop vaccines as alternatives to antibiotics for therapeutic purposes.[166]

Commissioned by the UK's Chief Medical Officer Sir Kenneth Calman in July 1997, the Standing Medical Advisory Committee (SMAC) also published a report titled "The Path of Least Resistance"[167] describing AGPs as "a major concern (…) undermining new antibiotics (…) even before these enter human use."[168] SMAC also criticised veterinary prescription practices: "…'fire-brigade' responses without consideration of preventive measures are no longer acceptable."[169] According to a parallel Soil Association report, British tetracycline use had increased 1500% and penicillin use 600% in the past 30 years whereas the incidence of tetracycline-resistant *Salmonella* had risen to over 80% in 1998. [170]

Reacting to resistance concerns, the EU organised a conference on "The Microbial Threat"[171] in Copenhagen in September 1998. With European CMOs attending, the over 400 participants stressed the necessity of reliable data on antibiotic consumption and bacterial resistance.[172] Fourteen days after the conference, the EU passed Decision No 2119/98/EC,[173] which established the European Antimicrobial Resistance Surveillance System (EARSS) for resistance in humans and animals.[174] On December 17th, 1998 – three months after the

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[166] Select Committee On Agriculture, 'Fourth Report. Food Safety', (London: House of Commons, 1998), p. IV.123.m.
[167] 'The Path of Least Resistance', p. 7.
[168] Ibid., p. 8.
[169] Ibid., p. 80.
[170] Harvey and Mason, *The Use and Misuse of Antibiotics in Uk Agriculture. Part 1: Current Usage*, p. 3 & 8.; AGP bans and reductions of antibiotic-prophylaxis were also recommended in 'Antibiotic Resistance. The Risk to Human Health and Safety from the Use of Antibiotics in Animal Production (Ceg 98/2)', p. 4.
[171] Tore Midtvedt, 'The Microbial Threat. The Copenhagen Recommendation', *Microbial Ecology in Health and Disease,* 10 (1998), p. 66.
[172] Ibid., p. 67.
[173] 'Decision No 2119/98/Ec', *Official Journal L 298* (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998D2119:EN:HTML [accessed: 25.10.2013], 03.10.1998).
[174] The organisation is now responsible to the European Centre for Disease Control (ECDC) and is known as EARS-Net; 'About Ears-Net ',

Copenhagen conference – the EU Commission made the even more significant decision to ban four of the most popular AGPs (virginiamycin, zinc bacitracin, spiramycin and tylosin phosphate) with Directive (EC)2821/98. Britain endorsed the ban.

In its 1999 "Report on Microbial Antibiotic Resistance in Relation to Food Safety"[175], the UK's Advisory Committee on the Microbiological Safety of Food (ACMSF) upheld the 1998 AGP bans. Although they opposed further AGP bans,[176] committee members recommended monitoring the transmission of antibiotic resistance between animals and humans[177] and drew attention to veterinary prescription practices:

> The sources of income in veterinary practice have changed considerably since World War II. (…), veterinary charges were skewed so that the decline in income from professional fees was offset by an increase in income from drug sales. (…). Drug sales account for possibly some 40 per cent of income.[178]

While the ACMSF had no "evidence that UK veterinarians are abusing prescribing practices,"[179] it noted that Swedish veterinarians were prohibited from selling what they had prescribed. However, a Swedish system might lead to the closure of British veterinary practices. Inadequate controls and recordkeeping on farms were also criticised by ACMSF:

> Despite the statutory obligations (…), unpublished 1994 MAFF data throw serious doubts upon the effectiveness of the current arrangements. (…). In all, only 25 per cent of the total farms visited had livestock farm medicine books that were completed and up to date.[180]

(http://www.ecdc.europa.eu/en/activities/surveillance/EARS-Net/about_network/Pages/history.aspx [accessed: 02.07.2015]).
[175] 'Report on Microbial Antibiotic Resistance in Relation to Food Safety'.
[176] Ibid., pp. 172-73.
[177] Ibid., p. 132.
[178] Ibid., p. 151.
[179] Ibid., p. 152.
[180] Ibid., p. 147.

The ACMSF also criticised on-farm mixers' exemption from medicated feedstuff provisions and the illegal recycling of medicated feed materials.[181]

Stimulated by such reports, the Labour administration founded DEFRA Antimicrobial Resistance Coordination (DARC) in 1999. Working alongside the ACMSF and the Advisory Committee on Antimicrobial Resistance and Health Care Associated Infections, DARC was tasked with encouraging prudent antibiotic use and reviewing expanded resistance monitoring.[182] After 1998, Britain commenced susceptibility testing of veterinary pathogens and commensal organisms. Since then, EU Council Directives 2003/99/EC and 2007/407/EC have mandated resistance monitoring of *Salmonella* and *Campylobacter* isolated from food and animals, and the European Food Safety Authority regularly controls national reports. The UK also provides monitoring data on *E. coli* and *Enterococci* resistance.[183]

Readdressing antibiotic residues in 2001, the British government installed an independent Veterinary Residues Committee (VRC) to advise the VMD and FSA. In the same year, the EU's Veterinary Medicinal Products Directive (2001/82/EC) fostered harmonised controls for the manufacture, authorisation, marketing and distribution of veterinary medicines and laid the foundation for the British Veterinary Medicines Regulations (VMR). Coming into force in October 2005, the VMR consolidated the plethora of controls previously

[181] Ibid., pp. 163-64.
[182] 'Defra Antimicrobial Resistance Coordination (Darc) Group', (http://www.vmd.defra.gov.uk/public/antimicrobial_darc.aspx [accessed: 27.10.2013]).; responsibility for animal antimicrobial resistance policy passed to the VMD in 2011.
[183] I am indebted to the VMD for answering my questions regarding current antibiotic legislation following my correspondence with them on September 2nd, 2013.

contained in the 1968 Medicines Act and over 50 amending Statutory Instruments.[184]

Since 1999, the VMD has also compiled antibiotic sales data. Initially, industry figures were collected via voluntary arrangements. However, following 2005, statutory data submission requirements were introduced.[185] According to the VMD, sales of veterinary antimicrobial products rose sharply from 475 tons in 1993 to 629 tons in 1996. Following the avoparcin ban, sales fell to 522 tons in 1998.[186] Between 1993 and 1998, 83-90% of antibiotics were sold for therapeutic purposes and 10-17% for growth promotion.[187] After 1998, AGP-use sunk from 67 tonnes in 1999 to 36 tonnes in 2003.[188] Initially, therapeutic antibiotic sales also decreased: In 1998, ca. 433 tonnes of active therapeutic antibiotics had been sold.[189] By 2006, sales had decreased to 356 tonnes.[190] Since then, sales of agricultural therapeutic antibiotics have fluctuated and accounted for 355 tonnes in 2013.[191]

By establishing regular and independent monitoring and by granting statutory powers to enforce compliance and access industry data, the British government has fulfilled key demands of antibiotic critics. In 2003, the Labour

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[184] Personal correspondence with VMD.
[185] 'Sales of Antimicrobial Products Authorised for Use as Veterinary Medicines in the Uk in 2011', (Veterinary Medicines Directorate, 2012), p. 8.
[186] 'Sales of Antimicrobial Products Used as Veterinary Medicines, Growth Promoters and Coccidiostats in the Uk from 1993-1998', (http://www.vmd.defra.gov.uk/vet/antimicrobial_pubs.aspx [accessed: 21.10.2013]: Veterinary Medicines Directorate).
[187] Ibid.
[188] 'Revised Figures for Sales of Antimicrobial Products Used as Growth Promotes in the Uk', (http://www.vmd.defra.gov.uk/vet/antimicrobial_pubs.aspx [accessed: 20.10.2013]: Veterinary Medicines Directorate).
[189] 'Sales of Antimicrobial Products Used as Veterinary Medicines, Growth Promoters and Coccidiostats in the Uk from 1993-1998'.
[190] 'Sales of Antimicrobial Products Authorised for Use as Veterinary Medicines in the Uk in 2011', p. 11.
[191] 'Uk Veterinary Antibiotic Resistance and Sales Surveillance (Uk-Varss 2013)', (Addlestone (Surrey): Veterinary Medicines Directorate, 2014), p. 10.

government also supported the EU's decision to ban the remaining four AGPs with Regulation (EC) No 1831/2003. Because of the regular supply of data on antibiotic resistance, residues and usage and clear bureaucratic responsibilities, it has become far easier to identify and resolve antibiotic-related problems both within agriculture and corresponding bureaucracies.

However, in other respects, Britain has remained tardy. In 2011, the EU Commission criticised Britain for infringing Directive 2001/82/EC by continuing to permit antibiotic advertisements to farmers. While the practice has since been banned and farmers are more regulated than ever,[192] veterinarians remain surprisingly immune to tighter regulations and there exists no national data collection and evaluation system of veterinary prescription practices. Initiatives to separate veterinarians' prescription rights from the right to sell drugs – something long-since achieved in human medicine – have so far failed to win political support.

Meanwhile, bacterial antibiotic resistance remains a major problem. In Spring 2013, the UK's CMO, Dame Sally Davies, warned that resistance was "as big a risk as terrorism"[193] and should be added to the national register of civil emergencies. Unfortunately, Davies's warnings may well prove Cassandra-like should they fail to rouse interest outside of expert circles.

As this study has shown, British antibiotic reform resulted from two periods of upheaval during the 1960s and 1990s when agricultural antibiotics turned into focal points attracting and bundling public fears. With memories of

[192] 'Veterinary Medicines Regulations', (http://www.vmd.defra.gov.uk/public/vmr.aspx [accessed: 27.10.2013]), 'Veterinary Medicines Regulations - Changes to Advertising Rules', (http://www.vmd.defra.gov.uk/pdf/vmr_letter1012.pdf [accessed: 27.10.2013], 11.10.2012).
[193] Fergus Walsh, 'Antibiotics Resistance 'as Big as Terrorism' - Medical Chief', *BBC News* (http://www.bbc.co.uk/news/health-21737844 [accessed: 24.09.2014], 11.03.2013).

BSE fading, it is easy to forget that some of the most dangerous aspects of agricultural substance use remain unsolved.

Part Four – USA: The Problem of Plenty (1967-2013)

Chapter Ten – The Public – Antibiotics, Failed Bans and Growing Fears

Whereas a combination of residue scandals, animal welfare issues and bacterial resistance warnings led to a partial phasing out of AGPs in Britain and the EEC, the same was not true in the US. In 1965, long-standing fears of chemical residues had resulted in the formation of the FDA's ad hoc committee on veterinary and non-veterinary antibiotics. However, the committee's 1966 report did not lead to a Swann-like ban of therapeutic antibiotics. Despite contemporary British publications on 'infectious resistance', the American ad hoc committee's report focussed mainly on the prevention of antibiotic residues in food rather than on resistance proliferation. Having banned antibiotic preservatives and established a national antibiotic residue-monitoring program, the FDA publicly equated combatting antibiotic residues with combating bacterial resistance. In doing so, officials avoided challenging US farmers, who might be concerned about risks to their personal health but felt unable to break the antibiotic-fuelled cycle of agricultural intensification. The US media also remained divided in its assessment of agricultural antibiotics.

In the case of medical antibiotic use, the popularisation of horizontal resistance transfer by *NEJM* and pre-existing criticism of antibiotic overuse meant that all major US newspapers agreed that excessive antibiotic use by physicians and patients had to end.[1] Similar to Britain, particular attention was

[1] 'Infectious Diseases: Trying Too Hard For The Fast Knockout', *Time*, 06.01.1967; 'Germ Resistance To Drugs Studied', *NYT*, 26.03.1967, p. 23; on the 1960s fight against 'irrational' prescriptions in human medicine see Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics*, pp. 112-19.

paid to the emergence of methicillin-resistant *Staph aureus* and resistant Venereal Diseases like syphilis and gonorrhoea.[2] However, the extent of the health threat posed by transferable resistance remained contested. While Vernon Knight of Baylor University claimed that there "was no compelling evidence that a dark age of medicine, bereft of antibiotics, lies ahead"[3], R-factor discoverer Tsutomu Watanabe predicted a "pre-antibiotic" [4] era.

Disagreeing about the threat posed by antibiotic resistance in medical settings, commentators were even more divided about the threat posed by bacterial resistance in agricultural settings. Following the 1967 NAS symposium, the *Post* referred to AGPs' economic benefits before noting that regulators would have to prove concrete harm resulting from agricultural antibiotic use prior to restricting substances.[5] The *NYT* published a more sceptical summary of the symposium. Although the article ended by quoting ex-Cyanamid employee and outspoken antibiotic supporter Thomas Jukes, it noted the international disagreement regarding AGPs: "Scientists from Britain and the Netherlands reported specific cases of the emergence of drug-resistant strains of bacteria in animals receiving low levels of antibiotics in their feeds."[6] In *Scientific American*, Tsutomu Watanabe explicitly blamed agricultural antibiotics for contributing to bacterial resistance.[7] In 1968, the *NYT* listed resistant bacteria as a major threat to "Spaceship Earth"[8] and David H. Smith from Boston's Children's Hospital

[2] 'Public Health: VD Detectives', *Time*, 01.09.1967; 'UN Agency Warns Drugs Alone Can't Wipe Out VD', *NYT*, 25.01.1968, p. 13; Ian Maclean Smith, 'Death from Staphylococci', *SciAm* (02/1968), pp. 84-94.
[3] Harold M. Schmeck, 'Medicine: Now Bacteria Fight Back', *NYT*, 28.05.1967, p. E8.
[4] Martin Weil, 'New Chemical Is Said to Breed Resistance to Potent Drugs', *WP*, 10.12.1967, p. A10.
[5] Ovid A. Martin, 'US Studies Additives in Animal Feeds', *WP*, 09.07.1967, p. A13.
[6] Harold M. Schmeck Jr., 'Scientists Study Feed Antibiotics', *NYT*, 11.06.1967, p. 54.
[7] Tsutomu Watanabe, 'Infectious Drug Resistance', *SciAm* (12/1967), pp. 26-27.
[8] 'To Save Spaceship Earth', *NYT*, 02.06.1968, p. E10.

Medical Center warned about low-dosed AGPs' 'infectious hazard' for human health.[9]

However, one year later, the *NYT* was the only major newspaper to report extensively on the British Swann report. Criticising the FDA for its lack of action,[10] the *NYT* cited Britain's Minister of Agriculture Cledwyn Hughes: "We are the first country in the world to tackle this problem. (…). We do not accept (…) that 20 years of experience goes to show that there are no serious ill-effects from giving antibiotics to animals'…"[11] According to another article: "the British are taking a giant step forward in a controversial area."[12] No other newspaper took up this rallying cry.

By the end of the decade, individual warnings by Anderson, Watanabe, David Smith and British officials had thus failed to provoke a prolonged US public campaign for antibiotic reform. In the media, concerns about bacterial resistance remained mostly limited to human medicine. In the *Post*, animal health columnist Dr. Frank Miller remained remarkably unperturbed when readers wanted to feed AGPs to kittens or enquired whether antibiotic overuse for pets could contribute to resistance.[13]

Although they disagreed about the risks of bacterial resistance selection on farms, American media commentators remained united in their criticism of chemical residues in food.[14] Fitting the description of 'unnatural' additives, agricultural antibiotics were affected by what historian Sarah Vogel terms the US

[9] 'Animals Eat Into Antibiotics', *WP*, 06.10.1968, p. F5; Smith was a developer of the meningitis vaccine and later board member of the Environmental Defense Fund; Karen Freeman, 'David H. Smith, 67, Developer of Vaccine Against Meningitis, *NYT*, 01.03.1999.
[10] 'US Has One Restriction', *NYT*, 21.11.1969, p. 17.
[11] Alvin Shuster, 'Britain to Curb Antibiotic Feed', *NYT*, 21.11.1969, p. 17.
[12] Lawrence K. Altman, 'Drug Use in Feed Arouses Concern', *NYT*, 23.11.1969, p. 81.
[13] Frank Miller, 'The Wonderful World of Animals', *WP*, 12.09.1970, p. C10; Idem, 'The Wonderful World of Animals', *WP*, 30.09.1970, p. B10.
[14] Sandra Blakeslee, 'Food Safety a Worry In Era of Additives', *NYT*, 09.11.1969, p. 1.

"toxicity crisis of the 1960s and 1970s."[15] In newspapers, commentators were particularly concerned about the lack of residue controls for American meat. In July 1967, the *Post* warned that the "meat lobby" was attempting "to sidetrack or modify a bill providing for the inspection of meat, some of it unfit for human consumption, which has been peddled off on unsuspecting housewives for a good many years."[16] According to the *Post*, this 'peddling' was possible because federal inspections did not target meat sold within state borders where officials were working "hand in glove with the meat packing interests":

> [Meat] has been processed with such extras as hog's blood, which is prohibited in Federally inspected meat. Even eyeballs, lungs, and chopped hides have been used in processed ham to increase its protein content. Detergents have also been used to freshen up the meat, while such antibiotics as aureomycin have been injected as a substitute for sanitation.[17]

Media concerns about drug residues in food soon merged with general allegations of FDA kowtowing to industry. In 1967, *Post* reporter Morton Mintz warned that a "thundering silence of drug consumers" was enabling industry to subvert consumer protection:

> Who speaks for the fetus, whose concern with chemicals extends beyond drugs to food additives and pesticides among other things? In a technical area as complex as the advertising of prescription drugs, how much voice do consumers have?[18]

Mintz was especially concerned about physicians' overuse of chloramphenicol.[19] Although the link had been known since the 1950s,[20] 1960s data suggested that aplastic anaemia occurred ten times more frequently after chloramphenicol use

[15] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 43.
[16] Drew Pearson and Jack Anderson, 'Lobby Battling US Meat Inspection', *WP*, 18.07.1967, p. B11.
[17] Ibid.
[18] Morton Mintz, 'The Thundering Silence of Drug Consumers', *WP*, 26.11.1967, p. B2.
[19] 'Senate Witnesses Charge Antibiotic Killed Children', *NYT*, 29.02.1968, p. 39.
[20] JEB, 'When a Cure is a Killer', *NYT*, 03.03.1968, p. E8.

than previously thought.[21] Worryingly, the FDA seemed powerless to effect change. After the FDA's failure to ban chloramphenicol in early 1968,[22] FDA Commissioner Goddard claimed to be at his "wit's end"[23] and was widely criticised.

Succeeding Goddard in July 1968, Commissioner Herbert Ley launched withdrawal procedures against 49 fixed drug combinations including Upjohn's Panalba.[24] However, in the midst of Ley's battle against inefficacious antibiotic combinations, the FDA was severely compromised by a memo alleging that it had manipulated and overlooked data on cyclamate sweeteners' carcinogenicity.[25] The memo seemingly confirmed suspicions about compromised FDA consumer protection. Despite his campaign against Panalba, Ley's initial hesitancy to proceed against cyclamates provoked further ire and resulted in his effective sacking by HEW Secretary Robert Finch.[26] Ley later claimed that he had been under "constant, tremendous, sometimes unmerciful pressure", sometimes spending "as many as six hours fending off representatives of the drug industry."[27]

Responding to the FDA's crisis, the Republican Secretary of Health, Education, and Welfare, Robert Finch, appointed former Booz Allen Hamilton consultant Charles D. Edwards as FDA Commissioner. Edwards was experienced

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[21] Morton Mintz, 'Antibiotic's Danger Seen as Underrated', *WP*, 12.11.1967, p. F7.
[22] 'FDA Bars Antibiotic From Market, Asks Recall', *WP*, 20.01.1968, p. E17.
[23] Morton Mintz, 'FDA Concedes Drug Curb May Fail', *WP*, 01.03.1968, p. A3; on chloramphenicol see Thomas Maeder, *Adverse Reactions* (William Morrow & Co, 1994).
[24] Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics*, pp. 105-11.
[25] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 51.
[26] Barbara Resnick Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s* (New York: City University of New York (Dissertation), 1996), pp. 31-52.
[27] Richard D. Lyons, 'Ousted FDA Chief Charges 'Pressure' From Drug Industry', *NYT*, 31.12.1969, p. 1; Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 53.

in public relations and announced a revitalisation of the FDA: drug recalls would be accelerated, consumer involvement increased, bad advertising and prescription habits targeted and inner-agency science strengthened.[28] However, the crisis of public trust in FDA consumer protection was not over.

In 1970, newspapers reported the results of the USDA's survey for antibiotic residues in American meat. While overall statistical monitoring seemed to indicate low contamination rates, more targeted testing had revealed antibiotic residues of sufficient concentration to trigger allergic reactions. The *Post* warned: "At the present time a farmer or any lay person can purchase many of these drugs in any quantity and without any restrictions."[29] However, C.D. Van Houweling, the head of the FDA's Bureau of Veterinary Medicine (BVM), cautioned, "You can't put an inspector at the shoulder of every farmer, veterinarian and meat packer in the country."[30] Only five months later, media commentators reacted against the announcement that monitoring programs for antibiotic residues were to be cut by 74% and those for DES by 50%.[31] In 1971, the *NYT* summarised consumer feelings: "These days [the FDA is] just lurching from crisis to crisis":

> In the last year, headlines have proclaimed mercury in fish, botulism in pizzas, pesticides in turkeys, arsenic in chickens, antibiotics in cheese, hormones in meat, salmonella in soup, cyclamates in soft drinks and DDT in practically everything.[32]

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[28] Morton Mintz, 'New Commissioner Determined To Remake the Troubled FDA', *WP*, 22.02.1970, p. F1.
[29] David Wallace, 'Antibiotics Used in Meats Spur Study: Enough Regulation?', *WP*, 14.06.1970, p. K3.
[30] Ibid.
[31] Idem., 'Monitoring of Meat Is Reduced Sharply', *WP*, 22.11.1970, p. A2.
[32] Richard D. Lyons, 'FDA: These Days It's Just Lurching From Crisis to Crisis', *NYT*, 10.01.1971, p. E2.

According to consumer activist Ralph Nader's 'Raiders', the "food side of the FDA was a shambles."[33] The FDA was seeking the "advice of groups, such as the [NAS] (…). Yet (…) some of the advisers involved are themselves either employed by or consultants to the food industry, …"[34] In a 491-page report, the 'Raiders' warned that diseased or contaminated meat was still reaching consumers:

> Stuffed with chemicals that make them fatten fast, animals end their lives in overpacked feed lots. (…). Since overcrowding promotes stress (….), the operators pour tranquilizers and antibiotics into feed troughs. The problem is that residues of many invisible chemicals remain in the meat, …[35]

In the same year, the *Post's* Ruth Winter described how her young daughter had "suffered from a severe, intractable case of the hives"[36] because of antibiotic-tainted milk. Two years later, the *Post* reported rising residue detections:

> Illegal drug residues were found in 2.7 per cent of the meat and poultry product samples tested in a nationwide (…) sampling program in the second quarter of this year. (…). Antibiotic residues in 3 per cent of the cows and 9 per cent of the calves tested.[37]

Rising residue detections in US meat coincided with a further public relations crisis for the FDA, which was being forced to ban carcinogenic DES as a result of Congressional investigations. Media reports highlighted that the FDA had earlier supported exempting DES from the 1958 Delaney Clause and described the agency's gatekeeper policy for feed additives as a "debacle":

> When the FDA insisted that DES residues wouldn't end up in the meat (…) it meant that tests showed that there would be no residues of the drug

[33] Ibid.
[34] Ibid.
[35] 'Environment: Nader on Food', *Time*, 02.08.1971; also see: James Turner, *The Chemical Feast. Ralph Nader's Study Group Report on the Food and Drug Administration* (New York Grossman Publishers, 1970). Although the report dealt extensively with residues and food-borne pathogens, it did not deal with antibiotic resistance.
[36] Ruth Winter, 'Whatever Happened To Natural Food?', *WP*, 21.03.1971, p. B2.
[37] 'Drug Traces in Meat Rise', *WP*, 12.08.1973, p. B8.

> according to directions 'reasonably certain to be followed in practice.' (…). It's the same story with Synovex, or the nitrofurans, or any other drug.[38]

Meanwhile, veterinarians painted a disturbing picture of drug use on US farms:

> 'Over 60 per cent of the animal drugs are not used in the trained, skilled hands of vets but by lay farmers, (…). Hell, just recently a farmer out here got DDT in his cattle – the damn fools used it for lice.[39]

Similar to the UK, the US organic market was the main profiteer of regulatory agencies' failure to guarantee food 'safety' and – more importantly – 'purity'. Described by historian Warren Belasco, the late 1960s saw the fusion of the established organic sector with young counter-cultural and environmentalist movements. Throughout the US, co-ops and communes with names like the "Hip Salvation Army"[40] began producing and selling 'organic' or 'natural' food. Like their British counterparts, American producers and consumers of 'natural' and 'organic' food were united in their concern about the denaturation and 'poisoning' of food, bodies and the environment by 'unnatural' chemicals. However, in the US, organic food's *ex negativo* identity was further strengthened by a Jeffersonian dimension, which united older organic followers and young counter-cultural elements.[41]

In major newspapers, articles explored the phenomenon of organic food and its alleged 'purity'.[42] Commentators were also intrigued by the movement's eclectic composition and occasional 'weirdness'. In a 1971 article on the "Guru of the Organic Food Cult" and founder of the Rodale Press, Jerome I. Rodale, the *NYT* described the many groups "loosely clustered under the organic movement's antichemical umbrella":

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[38] Daniel Zwerdling, 'The Meat Risks', *WP*, 13.05.1973, p. C5; on the history of DES see Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*.
[39] Daniel Zwerdling, 'The Meat Risks', *WP*, 13.05.1973, p. C5.
[40] Belasco, *Appetite for Change. How the Counterculture Took on the Food Industry*, p. 18.
[41] Ibid., pp. 18-28; 41; 76; 93-108.
[42] Jacquin Sanders, 'Organic Food: A Growing Market', *WP*, 28.06.1970, p. H3.

> … food cultists, from old-line vegetarians to youthful Orient-oriented 'macrobiotic' dieters (…), plus reactionaries yearning to turn back all clocks, urban dropouts (…), ecologists (…), Dr. Strangelove paranoids who read poison plots on ingredient labels (…) and, increasingly, rather ordinary [people] to whom pronouncements about [chemical perils] (…), have stirred a wariness about all man-made chemicals …[43]

In 1973, the newspaper printed a similar feature on 69-year old nutritionist Adelle Davis, "chief showwoman for health foods, a $1-billion-a-year business catering (…) to a rapidly growing 'organic nation' of health-food devotees."[44] According to the *NYT*, Davis's health foods vision of 'pure food' and controversial emphasis on vitamins was increasingly representative of the "two archetypes of South California, the little old lady in tennis shoes and the young, barefoot, bearded ex-radical."[45]

Another sure sign that concerns about chemical residues and 'unnatural' lifestyles were becoming mainstream was that they also appeared in *Vogue*. Proving that the organic movement was by no means only a 'hip' movement driven 'from below', the 1960s saw *Vogue* begin to feature a growing number of reports on 'organic' products.[46] Celebrity organic devotees featured by *Vogue* included the Marchesa Alessandro di Montezemolo, Yehudi Menuhin, the Marquess of Londonderry, Habib Bourguiba, Bruno Walter and Adelle Davis.[47] Ordering meat only from a farm "where they use no sprays and chemicals", performer Carol Channing noted, "Princess Margaret was dying to have my plain roast lamb (…), and I think the Kennedys invited me to the White House just to see what I would bring."[48] According to *Vogue* and large parts of the US

[43] Wade Greene, 'Guru of the Organic Food Cult', *NYT*, 06.06.1971, p. SM30.
[44] Daniel Yergin, 'Supernutritionist', *NYT*, 20.05.1973, p. 286.
[45] Ibid.
[46] 'Beauty: Food Beautiful Food – Purely Personal Regimes', *Vogue*, 01.06.1965, pp. 108-109.
[47] Ibid., pp. 160-161, 164.
[48] 'Beauty and health: The Health Eaters', *Vogue*, 01.05.1971, p. 168.

mainstream media, organic was healthy, rejuvenating, fashionable – and antibiotic-free.[49]

Unsurprisingly, supporters of intensive agriculture were not prepared to accept organic supporters' criticism without opposition. While *Scientific American* remained optimistic about agricultural antibiotics and Western food production,[50] US Secretary of Agriculture Earl Butz launched a notorious attack on organic producers in 1971:

> Without the modern input of chemicals of pesticides, antibiotics, of herbicides, we simply couldn't do the job. (…). Before we go back to an organic agriculture in this country somebody must decide which 50 million Americans we are going to let starve or go hungry and I don't want to make that decision.[51]

Despite mourning the demise of Jeffersonian family farmers,[52] the conservative *National Review* was equally sceptical:

> The Topsy-Turvy labors of the Whole Earth Catalog [sic] brigade go on and on, with no apparent end in sight. We have become accustomed (…) to the efforts of ecologists and their friends in government to slap every conceivable sort of regulation on American business in the name of preserving the environment. (…). Some of the horror stories previously noted (…) include the ban on leaded gasolines [sic], the holy war against DDT, and a rather improbable attack on penicillin ...[53]

Influential within the budding neoconservative movement, the magazine's equation of environmentalism with leftist regulation-excess did not bode well for a bipartisan greening of the US.

Significantly, US clashes over organic food remained focussed on invisible contaminants in food. In contrast to Britain, US newspapers showed little signs of

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[49] Nancy L. Ross, 'It Tastes Like Meat Should', *WP*, 14.12.1972, p. M1; Roy Reed, 'Little Spring Farm', *WP*, 05.03.1972, p. H2; Leo Lerman, 'Food: Where to eat now – Healthworks', *Vogue*, 01.06.1977, p. 24.
[50] Sterling Wortman, 'Agriculture in China', *SciAm* (06/1975), p. 18; Roger Revelle, 'The Resources Available for Agriculture', *SciAm* (09/1976), pp. 164-178.
[51] Hedley Burrell, 'Butz hopes for Sales to China', *WP*, 13.12.1971, p. A3.
[52] George F. Will, 'Embattled Farmers', *National Review* [in the following *NR*] (03/1973), p. 302.
[53] M. Stanton Evans, 'At Home', *NR* (02/1973).

using agricultural antibiotics to merge concerns about residues, animal welfare and bacterial resistance.

The lull in the media's attention to bacterial resistance selection in agricultural settings coincided with the publication of an FDA Task Force report on agricultural antibiotics. On January 31st, 1972, the FDA announced that it would install a "program that should lead to removing some antibiotics from animal feeds as dangers to human beings."[54] Amidst rumours that the 16-member Task Force had argued bitterly about agricultural antibiotics' risks and benefits, manufacturers were given two years to prove that drugs were safe. Speaking at a press conference together with Commissioner Edwards, BVM director C.D. Van Houweling announced that these deadlines could also "be extended depending on the drift of safety research in progress."[55] Commissioner Edwards himself cautioned that "the agency had no information that would warrant calling the feeds an 'imminent' hazard."[56] Senior officials' hesitancy to endorse Task Force bans at the press conference was noted by the *Post*:

> The task force's formal conclusions sound more definite. They say: Human illnesses and death have been reported due to antibiotic-resistant bacteria of animal origin, and food animals are a major reservoir of some bacteria dangerous to man.[57]

Hesitancy to endorse the Task Force report also characterised many media reactions. In the *NYT*, the president of the pro-industry Animal Health Institute (AHI), James G. Affleck, maintained that the AHI did not know of "a

[54] Victor Cohn, 'FDA Proposes Antibiotic Ban in Animal Feed', *WP*, 01.02.1972, p. A6; 'Use of Antibiotics on Farms Studied', *NYT*, 04.06.1970, p. 36.
[55] Victor Cohn, 'FDA Proposes Antibiotic Ban in Animal Feed', *WP*, 01.02.1972, p. A6.
[56] Harold M. Schmeck Jr., 'Limitation on Antibiotics in Feed For Livestock Urged by FDA', *NYT*, 01.02.1972, p. 19.
[57] Cohn, 'FDA Proposes Antibiotic Ban in Animal Feed', *WP*, 01.02.1972, p. A6.

single case of untreatable bacterial disease in man"[58] caused by AGPs. A short while later, another article in the newspaper compared the agricultural selection of resistant bacteria to the pandemics recently conjured in Michael Crichton's bestselling thriller, *The Andromeda Strain*:

> Last week, the [FDA] constructed a real-life scenario in which the germs that live in the intestines of cows, pigs and chickens play the potential man-killers. And it is the human quest for cheap meat that made them so.[59]

Quoting industry estimates of ca. $500 million annually saved through antibiotic use, the *NYT*, however, failed to reach a definite verdict on antibiotic bans.[60] Casting further doubt on Task Force warnings, Thomas Jukes repeated well-known assertions that AGPs remained effective, profitable and safe.[61]

The jury on AGP bans remained out and media interest faded fast. By the end of the year, articles on R-factor transfer and antibiotic overuse reverted to ignoring the agricultural dimension of resistance selection[62], and the 1973 announcement of an unspecified delay of FDA antibiotic bans received little media attention. During the FDA's 1973 press conference, Van Houweling announced that data submitted so far "ha[d] not been developed either to prove or disprove the existence of a serious threat."[63] Ignoring WHO and European warnings, the famous fourth estate seemed content with FDA assurances and

[58] Schmeck., 'Limitation on Antibiotics in Feed For Livestock Urged by FDA', *NYT*, 01.02.1972, p. 19.
[59] Earl Ubell, 'Are We Breeding an 'Andromeda Strain?'', *NYT*, 06.02.1972, p. E7.
[60] Ibid.
[61] Thomas H. Jukes, 'Antibiotics and Meat', *NYT*, 02.10.1972, p. 37.
[62] Morton Mintz, 'Physicians Accused Of Antibiotic Misuse', *WP*, 08.12.1972, p. A1; Royston C. Clowes, 'The Molecule of Infectious Drug Resistance', *SciAm* (04/1973), pp. 18-27.
[63] Morton Mintz, 'Safety Test Ordered On Animal Feed Drug', *WP*, 19.04.1973, p. A4.

reinstated the familiar epistemological divide between agricultural and medical antibiotic use.[64]

Media interest in 'infectious' bacterial resistance reawakened only after the 1975 Asilomar conference on recombinant DNA.[65] Using restriction enzymes and plasmids, researchers were now able to insert foreign DNA into bacteria.[66] While antibiotic resistance turned into a valuable tool in the laboratory, framing it as a potentially uncontainable environmental risk allowed activists to stoke public concerns both about 'mutant lab bacteria' and agricultural antibiotic use.[67] Reporting on Asilomar in March 1975, the *Post's* Stuart Auerbach quoted E.S. Anderson: "the normal pickup of antibiotic-resistant strains of germs is more dangerous than the possibility that genetic engineering will create new strains."[68] Anderson repeated that the "widespread use of antibiotics in agriculture, where they are used in fertilizer and food to protect plants and livestock from infection"[69] was particularly dangerous.

Three months later, the *Post* reported alarming findings by a team of researchers under microbiologist Stuart Levy at Tufts University. Levy, who had trained under Tsutomu Watanabe,[70] had traced the spread of bacterial tetracycline resistance from animals to a farm family with the help of biochemical markers. Initially funded by Pfizer, the experiment had ended in

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[64] 'Medicine: The Disease Detectives', Time, 11.02.1974; 'Penicillin Does Not Cure 12 New Gonorrhea Cases', *WP*, 03.10.1976, p. 8.
[65] This chronology roughly fits roughly Podolsky's description of the link of bacterial resistance with environmental concerns during the 1970s; Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics*, pp. 155-60.
[66] Victor K. McElheny, 'World Biologists Tighten Rules On 'Genetic Engineering' Work', *NYT*, 28.02.1975, pp. 1 and 38.
[67] Liebe F. Cavalieri, 'New strains of life – or death', *NYT*, 22.08.1976, p. 173.
[68] Stuart Auerbach, 'Drug Resistant Bacteria Making Inroads', *WP*, 02.03.1975, p. 3.
[69] Ibid.
[70] Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics*, p. 162.

spring 1975, and the studied family had been invited to a barbecue "using the chickens raised during the project."[71] Some neighbours had, however, "balked at eating the chickens because they feared they would develop a resistance to antibiotics."[72]

Amidst a fresh burst of reports on resistant pathogens and GMOs,[73] the FDA's new Commissioner Donald Kennedy announced a ban of penicillin and tetracycline AGPs in April 1977. Significantly, Kennedy announced that the bans "should be viewed as a first step towards FDA's ultimate goal of eliminating, to the extent possible, the nontherapeutic use in animals of any drugs needed to treat disease in man."[74] According to the *Post's* Morton Mintz, the bans reflected "a stricter regulatory stance brought to the FDA by Commissioner Kennedy."[75] The FDA estimated that switching from therapeutic to nontherapeutic AGPs would annually cost 5¢ per person but cautioned that industry opposition might delay bans.

The prediction of opposition was correct. Since the early 1970s, supporters of deregulation had blamed excessive FDA regulation for creating a so-called 'drug lag' in the US. According to the *National Review*, the thalidomide and DDT scares had produced "something akin to hysteria" in the FDA:

> Professor Milton Friedman recently called attention to a cost analysis of the FDA's program done by Professor Sam Peltzman of UCLA, (…). [Peltzman] insists that there is at least a two-year time lag directly traceable to the FDA's fanaticism.[76]

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[71] Stuart Auerbach, 'Drug In Chicken Feed Is Traced In Humans', *WP*, 01.06.1975, p. 10.
[72] Ibid.
[73] Harold Schmeck Jr. 'A Leapfrog War Between Drugs and Their Targets', *NYT*, 23.01.1977, p. 145; Victor Cohn, 'Genetic Experiment Raises Questions of A Federal Loophole', *WP*, 12.06.1977, p. 44.
[74] 'FDA to order Big Cuts In Penicillin for Animals', *NYT*, 16.04.1977, p. 12.
[75] Morton Mintz, 'FDA to Forbid Penicillin Use In Farm Feed', *WP*, 30.08.1977, p. A3.
[76] 'The Need For New Drugs', *NR* (08/1973), p. 859; also see: M. Stanton Evans, 'Taming the FDA', *NR*, 17.02.1978, p. 219.

Stagnating economic growth and rising inflation – so-called 'stagflation – made criticism of 'stifling' FDA regulations spread to more liberal publications.[77] Forced by the Delaney Clause to proceed against saccharin sweeteners and DES, which had been relicensed following a 1974 court decision, Kennedy's AGP bans won him few friends within the increasingly regulation-weary US public.[78]

The FDA's loss of public support was exacerbated by a coordinated industry campaign of casting doubt on the risks posed by bacterial resistance selection on farms. In the US, the campaign was led by the Council for Agricultural Science and Technology (CAST). Founded in 1972, CAST supplied industry-friendly research to counter regulatory threats to conventional agriculture. With two-thirds of its $265,000 budget consisting of industry donations, CAST organized panels of external experts, whose reports were then submitted to a small group of core staff for final editing and publishing.[79]

However, in the case of AGPs, CAST's approach backfired after the six microbiologists invited to a 1977 panel on AGPs noticed that CAST's use of their findings and prestige was biased.[80] Following a critical 1978 ABC documentary on AGPs, CAST's vice-president Charles Black published a "rambling white paper"[81] attacking the broadcaster without clarifying that CAST's expert panel did not share his views. While this incident already led to tensions, a full-blown éclat occurred one year later when an edited version of the panel's report contained misleading information that had been added without experts' consent.

[77] 'Medicine: The Drug Lag', *Time*, 29.09.1975; cf. also: Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, pp. 64-68.
[78] Ibid., pp. 57; 66-68.
[79] Eliot Marshall, 'Scientists Quit Antibiotics Panel at Cast', *Science,* 203/4382 (1979), p. 733.
[80] The group consisted of Roy Curtiss 3rd; Julian E. Davies; Richard Novick; Michael J. Haas; Raul Goldschmidt and Vickers Hershfield; cf. Bayard Webster, '6 Scientists Quit Panel in Dispute Over Livestock Drugs', *NYT,* 23.01.1979, p. C2.
[81] Finlay, ''Consumerist Terrorists': Battles over Agricultural Antibiotics in the United States and Western Europe', p. 22.

Alarmed by the misuse of their findings, the microbiologists resigned and drew attention to CAST's dubious practices in national and scientific publications.[82] A resulting high-profile controversy between CAST-member Thomas Jukes and Richard Novick, one of the six microbiologists on the CAST panel, further damaged CAST.[83]

However, rifts amongst US experts and skilful lobbying meant that sufficient doubt had been cast on FDA science to convince Congress that more research on AGPs' effects was necessary. In 1978, a Congressional moratorium stalled Kennedy's AGP bans and the NAS was commissioned with a new AGP review. Noting Kennedy's loss of political momentum in June 1979, the *Post* reported that "many farm state congressmen" were questioning "the need for any FDA action"[84] at all. In the same month, a frustrated Commissioner Kennedy announced his resignation. According to the *NYT*, the FDA had "lost its best commissioner in a long time."[85] When Kennedy had come to the FDA in 1977, the "agency was torn by internal dissension and charges (…) that it had become chummy with the industries it regulates. Morale has been raised and the FDA's reputation is decidedly one of independence."[86] However, such independence had come at a price:

> [Kennedy] lost some big battles of regulation. Congress refused to let him ban saccharin. It impeded his drive against the indiscriminate use of antibiotics in animal feeds. [HEW] Secretary Califano (…) blocked (…)

[82] Marshall, 'Scientists Quit Antibiotics Panel at Cast', pp. 732-33, J.F. Carter et al., 'Cast Profile Evokes Avid Responses ', *BioScience,* 29/5 (1979); while Virgil Hays was responsible for the editing process, there is evidence that Maxwell Finland was either directly involved in the editing or had prior knowledge of it alongside Cyanamid representatives; CLM FP, Series VI, B. Veterans' Administration Committees and Projects Records, Folder 9, Finland to Thomas H. Jukes (13.12.1977); JS Kiser to Finland (12.12.1977); Finland to Virgil W. Hays (18.12.1978).
[83] Thomas H. Jukes, 'Antibiotics in Feeds', *Science,* 204/4388 (1979), p. 8, Richard Novick, 'Use in Animal Feed', ibid./4396, p. 908, Bud, *Penicillin: Triumph and Tragedy*, p. 186.
[84] Victor Cohn, 'Antibiotics in Feeds Found Health Risk', *WP*, 25.06.1979, p. A2.
[85] 'Two hands for Donald Kennedy', *NYT*, 02.07.1979, p. A16.
[86] Ibid.

> efforts to phase out nitrites in meat. Several states ignored his warnings against laetrile (…). [Kennedy] was probably right on all these issues.[87]

Yet, being right was not the same as being politically effective. Kennedy had attempted too much in too short a time. Hurt by the failed saccharin and nitrite bans and 'stagflation' fears, the FDA had been unable to transform concern about antibiotic and chemical residues into concern about bacterial resistance. Coming to power in 1981, the neoconservative Reagan Administration doused hopes for AGP bans. In a complete change of policy, the new FDA leadership reverted to expanding agricultural antibiotic use "for the first time in a decade"[88] in February 1982.

However, the regulatory rollback did not mean that the public campaign for antibiotic reform was over. Instead of the weakened FDA,[89] campaigning increasingly originated from non-governmental circles and publications like the *NYT* and *Time*.[90] Outspoken scientists like Stuart Levy and Richard Novick also continued to campaign against medical and agricultural antibiotic overuse. In August 1981, Stuart Levy organised a conference and multi-national press conference during which 150 doctors from 25 nations warned about bacterial resistance development with AGP criticism featuring prominently.[91] Not even the discovery of new antibiotics could rekindle the liberal media's enthusiasm for unrestricted antibiotic use. In 1982, the *NYT's* Lawrence Altman remarked that

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[87] Ibid.
[88] Cass Peterson, 'Ban Urged on 2 Antibiotics in Animal Feed', *WP*, 25.10.1983, p. A17.
[89] Idem., 'FDA Moving to Shut Antibiotic Testing Lab', *WP*, 16.07.1982, p. A13; Carpenter, *Reputation and Power. Organizational Image and Pharmaceutical Regulation at the Fda*, pp. 380-82.
[90] 'Medicine: Drugged Cows', *Time*, 10.09.1979; Robert Reinhold, 'New Worry Over Drugs in Animals', *NYT*, 17.06.1980, p. C1.
[91] Bud, *Penicillin: Triumph and Tragedy*, p. 189; Victor Cohn, 'Worldwide Abuse of Antibiotics Poses Threat', *WP*, 05.08.1981, p. A2.

without effective restrictions even cephalosporin antibiotics would eventually succumb to resistance "in the old bacteria war".[92]

Signed by 300 governmental and non-governmental experts, the National Resources Defence Council (NRDC) sent a petition to President Reagan in 1983 requesting the enactment of the FDA's proposed AGP bans because of imminent harm.[93] Ties between resistance selection on farms and human health hazards finally seemed confirmed in 1984 when Centres for Disease Control (CDC) epidemiologist Scott Holmberg published two papers in *Science* and the *NEJM*.[94] Whereas his *Science* paper presented a long-term epidemiological investigation of US *Salmonella* outbreaks,[95] Holmberg's *NEJM* article linked resistance selection on farms to a concrete case of human harm. In early 1983, Holmberg's team had identified 18 persons infected with a multi-resistant strain of *Salmonella Newport*. 11 patients had been hospitalized and one had died. Holmberg's team then compared plasmid profiles of all human *S. newport* isolates from the six-state area and US animal isolates for 18 months and linked infections to hamburgers made from South Dakota beef cattle that had been fed AGPs.[96] In the *NEJM*, Stuart Levy used Holmberg's findings to renew calls of US AGP bans:

> Every animal or person taking an antibiotic (…) becomes a factory producing resistant strains (…). Since there are two or three time more livestock than people in the United States, the number of animals fed

[92] Lawrence Altman, 'New Antibiotic Weapons In the Old Bacteria War', *NYT*, 10.01.1982, p. E9.
[93] Cass Peterson, 'Ban Urged on 2 Antibiotics in Animal Feed', *WP*, 25.10.1983, p. A17.
[94] Scott D. Holmberg et al., 'Drug-Resistant Salmonella from Animals Fed Antimicrobials', *New England Journal of Medicine,* 311/10 (1984), Scott D. Holmberg, Joy G. Wells, and Mitchell L. Cohen, 'Animal-to-Man Transmission of Antimicrobial-Resistant Salmonella: Investigations of Us Outbreaks, 1971-1983', *Science,* 225/4664 (1984).
[95] Holmberg, Wells, and Cohen, 'Animal-to-Man Transmission of Antimicrobial-Resistant Salmonella: Investigations of Us Outbreaks, 1971-1983', p. 833.
[96] Holmberg et al., 'Drug-Resistant Salmonella from Animals Fed Antimicrobials', p. 617; 'Poisoning Linked To Cattle Germs', *NYT*, 06.09.1984, p. A20; 'Beware the Beef', *SciAm* (11/1984), pp. 74-75.

> antibiotics at subtherapeutic levels (…) is enormously greater than the number of people taking antibiotics in therapeutic amounts (<1 per cent). (…). We must reserve these resources for fighting microbial disease.[97]

Despite media pressure, a bestselling attack on the FDA and industry science by activist and writer Orville Shell's *Modern Meat*,[98] and Congressional Hearings on antibiotic resistance,[99] the US Secretary of Health and Human Services (HHS) Margaret M. Heckler rejected the NRDC petition in November 1985. According to Heckler, studies had failed to reveal an "imminent hazard" requiring "emergency action."[100] Seemingly confirming fears that the Reagan administration was allowing industry to subvert consumer protection,[101] Heckler's decision did not end the AGP controversy. Published in *NEJM* in 1987, a CDC study provided a further link between human illness and AGPs' selection for multiple resistance in *S. Newport*. Having detected chloramphenicol resistance, the study also cited data according to which "less than 1 percent of the 28,987 kg" of oral chloramphenicol solutions sold had been "used for the intended species"[102] in 1981. The study triggered new – ultimately abortive – bills by Republican Senator John H. Chafee and the already familiar John D. Dingell.[103]

Although the perceived weakness of FDA consumer protection made food safety concerns grow, US consumers remained more concerned about residues than about bacterial resistance. According to a 1985 survey of 500 households by the National Live Stock and Meat Board, most consumers stated "either a mild or strong health concern about antibiotics in meat":

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[97] Stuart Levy, 'Playing Antibiotic Pool: Time to Tally the Score', ibid., p. 664.
[98] Schell, *Modern Meat. Antibiotics, Hormones and the Pharmaceutical Farm*, pp. 18-118.
[99] Finlay, ''Consumerist Terrorists': Battles over Agricultural Antibiotics in the United States and Western Europe', pp. 1 & 22-27; Chapter Twelve, p. 302.
[100] 'Decision on Feed Additives Angers Environmental Group', *WP*, 22.11.1985, p. A21.
[101] Martin Burros, 'Saga of a Food Rule: 25 Years, No Decision', *NYT*, 13.02.1985, p. C1.
[102] John S. Spika et al., 'Chloramphenicol-Resistant *Salmonella Newport* Traced through Hamburger to Dairy Farms. ', *New England Journal of Medicine,* 316/10 (1987), p. 568.
[103] Irvin Molotsky, 'Animal Antibiotics Tied To Illnesses in Humans', *NYT*, 22.02.1987, p. 22.

> [Antibiotics] ranked near the middle of 13 concerns. (…). Sixty percent of the respondents said they had a strong health concern about antibiotics. However, only 15% were concerned about the bacteria developing resistance. Other facts uncovered include: 17% mentioned no specific concern, 9% were concerned about transfer of antibiotics to humans through meat, and 17% wanted more information. Only 21% reported some familiarity with the issue.[104]

Reacting to on-going reports on food hazards,[105] more residue-wary consumers turned to organic food and soon stretched the US organic supply chain to its limits.[106] During the 1970s, organic food had been a hip lifestyle choice. By the 1980s, going organic was not only conspicuously *chique*, it also seemed like a wise response to dubious regulatory protection. Whereas the Reagan Administration used free market arguments to reduce 'restrictive' pharmaceutical and agricultural regulations, free consumers were deciding to finance an 'organic' market in which highly 'restrictive' rules guided production. However, in contrast to official action, which would have allowed all consumers to profit from stricter food regulations, access to 'pure' food was now dependent on consumers' wallets.

In 1990, a large residue scandal further damaged trust in official food safety guarantees. In 1988, investigations by the *Wall Street Journal* had found 38% of 50 milk samples tainted with antibiotics and sulphonamides. In response, the FDA had made limited use of a new test called CHARM II, which could detect a wide range of antibiotics at levels as low as 5ppb.[107] Of 70 supermarket milk

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[104] LuAnne Metzger, 'Cattlemen still oppose antibiotics ban', *WF*, 23.03.1985, p. 2.
[105] Cf. Keith Schneider, 'FDA Faulted in Threat From Animal Drugs', *NYT*, 13.01.1986, pp. A1&13; 'What's Wrong With Thanksgiving Dinner', *WP*, 26.11.1987, p. G9; Marjorie Williams, 'Don't Touch That Fork!', *WP*, 23.03.1989, pp. D1 and D6.
[106] Nancy Harmon Jenkins, 'Nutrition And the Young Chefs', *NYT*, 16.04.1989, pp. SMA50-51; Keith Schneider, 'Maine Fair Promotes Pure Food and Rural Values', *NYT*, 25.09.1989, p. B6; Carole Sugarman, 'Giant's Natural Beef On Hold', *WP*, 11.02.1987, p. E12; also see: Belasco, *Appetite for Change. How the Counterculture Took on the Food Industry*, p. 180 & 201.
[107] Colman McCarthy, 'Don't Drink Your Milk!', *WP*, 17.02.1990, p. A29.

samples, the FDA found over 50% to be contaminated.[108] A further FDA study revealed that 74% of 49 milk samples were contaminated with potentially carcinogenic sulfamethazine (SMZ), which had been illegally given to lactating cows. Problematically, the FDA then decided to revaluate CHARM II positives using High-Performance Liquid Chromatography (HPLC),[109] which could detect only a limited amount of sulphas between 5 and 20 ppb – thereby negating CHARM II positives and presenting US milk as pure.[110]

Both the residue detections and subsequent FDA actions led to public criticism. During Congressional hearings, it emerged that standard residue testing was not good at detecting antibiotics other than penicillin. In his statement, FDA chemist Joseph Settepani accused his agency of obscuring the truth and "ignor[ing] reliable tests"[111]. Trust in FDA sincerity was further shaken by a memorandum from the Associate Director for Surveillance and Compliance to the Director of the FDA's Center for Veterinary Medicine ((CVM) the former BVM): "The HHS goals are to end media interest in drug-residue tainted milk as soon as possible and avoid criticism of HHS or any other Government agency."[112] Although commentators were uncertain whether detected residue concentrations posed a health hazard,[113] officials' handling of the affair failed to reassure consumers.[114]

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[108] Philip J. Hilts, 'FDA Chemist Asserts Agency Is Stalling on Tests for Milk Purity', *NYT*, 07.02.1990, p. A22;
[109] 'Fda's Regulation of Animal Drug Residues in Milk', *Human Resources And Intergovernmental Relations Subcommittee of the Committee on Government Operations* (House Of Representatives; Washington US Government Printing Office, 1990), pp. 117-27.
[110]Ibid., pp. 133-34.; cf. FDA claims about CHARM II false positives; 'US Calls Milk Free of Antibiotics', *NYT*, 06.02.1990, p. C13.
[111]'FDA Chemist Asserts Agency Is Stalling on Tests for Milk Purity', *NYT*, 07.02.1990, p. A22.
[112] Quoted according to: Ibid.; cf. also: Chapter Twelve, pp. 306-307.
[113] Malcolm Gladwell, 'House Probes Milk's Safety After Contamination Is Alleged', *WP*, 07.02.1990, p. A2.
[114] Colman McCarthy, 'Don't Drink Your Milk!', *WP*, 17.02.1990, p. A29.

Faced with dozens of reports on chemical residues,[115] consumer trust in US food safety plummeted further. In 1992, the Food Marketing Institute's annual Trends Survey found that only 12% of consumers were completely confident that food was safe: while consumers were most concerned about pesticide and herbicide residues in food, these concerns were closely followed by concerns about antibiotic and hormone residues in poultry and livestock, ahead of nitrites, irradiated foods, preservatives and artificial colouring.[116]

Once again, the organic sector profited from the insecurity about US food safety and divisive new biotech products.[117] Although 'organic' and 'natural' remained ill-defined categories, organic producers were overcoming their teething troubles: in addition to establishing reliable supplies for supermarkets, production was increasingly consolidated in larger firms or cooperatives, and prices for organic food fell.[118] Between the beginning of USDA efforts to define 'organic' in 1990 and a legally binding definition in 1997, sales of organic food in the US grew by 250% from ca. $1 billion in 1990 to $3.5 billion in 1996.[119]

Trusting the 'purity' promises of organic food, many US consumers reacted warily to attempts to water down 'organic' definitions. In 1997, the USDA's new organic standards permitted the use of biotechnology, irradiation, sludge and a limited amount of antibiotics; organic labels would also contain no

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115 'Tests for Drugs in Milk Still Lag, GAO Says', *NYT*, 06.08.1992, p. D20; 'Dr. Spock Joins Milk's Detractors', WP, 30.09.1992, p. A3; Carole Sugarman, 'Cattle Battle', *WP*, 23.06.1993, pp. E1 & E12-13; Sharon Walsh, 'Va. Cattle Seller in Court Case Over Adulterated Beef', *WP*, 22.04.1996, p. A8.
116 Carole Surgarman, 'Paradox Over Produce Safety', *WP*, 12.05.1992, p. 20.
117 'Udder Insanity', *Time*, 17.05.1993, p. 52; 'The Milk Brouhaha', *NYT*, 10.02.1994, p. A22; Kathleen Day, 'Hormone Hubbub Hinders Hinders Program', *WP*, 15.03.1994, pp. D1 and D5.
118 Candy Sagon, 'Store Wars: A Healthy Competition', *WP*, 31.01.1996, pp. E1 & E10; Penny Singer, 'Health Food Stores Expand With Demand', *NYT*, 12.10.1997, p. WE10.
119 Carole Sugarman, 'Organic? Industry Is Way Ahead of Government', *WP*, 31.12.1997, p. E1.

information on the actual production methods employed.[120] The USDA was surprised by the resulting protest: during a four-month comment period, 150,000 consumers sent letters and cards to the USDA, forcing Secretary of Agriculture Dan Glickman to promise a revision of organic standards.[121] By 2000, sustained public opposition led to the National Organic Program (NOP), which banned the use of genetic engineering, irradiation and sewage sludge in organic food production. The new regulations also banned organic livestock from receiving antibiotics of any kind. Should an animal fall sick, it could be treated with antibiotics but could no longer be sold as organic. Following 2013, at least 5% of organic producers' products had to be tested for residues.[122] Guaranteeing that meat and milk were free of GMOs, hormones, pesticides, and antibiotics, the 2000 NOP assuaged traditional residue fears. For people wealthy enough to afford it, officially guaranteed purity could now be purchased in the absence of similar regulations for conventional produce. However, as public health experts like Stuart Levy noted, "The residues in meat should be of least concern to most people."[123]

While US residue fears were instrumental to the success of the NOP, warnings about bacterial resistance did not lead to a regulatory success. Similar to Britain, the 1990s saw a surge of US newspaper articles warning about the spread of deadly infections by homeless people, postal workers and flight attendants, with frequent references to the death of Muppets-inventor Jim Henson from a resistant 'flesh eating' *Streptococcus* infection (necrotizing

[120] Peter Hoffman, 'Going Organic, Clumsily', *NYT*, 24.03.1998, p. A23; Marrian Burros, 'US to Subject Organic Foods, Long Ignored, to Federal Rules', *NYT*, 15.12.1997, pp. A1 and A14.
[121] Rick Weiss, ''Organic' Label Ruled Out For Biotech, Irradiated Food', *WP*, 01.05.1998, p. A02.
[122] 'National Organic Program', (http://www.ams.usda.gov/AMSv1.0/NOPOrganicStandards [accessed: 13.03.2015]).
[123] Marrian Burros, 'Shopping for Antibiotic-Free Meat', *NYT*, 17.01.2001, p. F2.

fasciitis).[124] Many articles also focussed on resistance proliferation resulting from agricultural antibiotic use. According to *Newsweek*, farmers were the biggest antibiotic abusers in the US:

> For sheer over prescription, no doctor can touch the American farmer. Farm animals receive 30 times more antibiotics (mostly penicillins and tetracyclines) than people do. (…). Resistant strains emerge just as they do in humans taking antibiotics- and remain in the animal's flesh even after it winds up in the meat case.[125]

Fears of agricultural resistance selection were further heightened by fatal foodborne outbreaks of *E. coli* 0157:H7. The outbreaks not only highlighted hygiene problems in US meat production but also revealed legislative gaps (e.g. it was unclear whether pathogens in meat were a 'natural occurrence' or constituted adulteration).[126] Undercooked meat at Jack-in-the-Box restaurants caused a 1993 outbreak of *E. coli* 0157:H7 making 600 people become ill and killing several children.[127] One year later, the *Post* reported that *E. coli* 0157:H7 was responsible for at least 20,000 annual infections in the US.[128] By 1995, new concerns about foodborne pathogens emerged following the spread of resistant *S. typhimurium* DT104 from Britain to the US.[129] With resistant pathogens also spreading in hospitals and reserve antibiotics failing, American media

[124] Andrew Purvis and Dick Thompson, 'TB Takes a Deadly Turn', *Time*, 02.12.1991, p.85; Sevgi O. Aral and King K. Holmes, 'Sexually Transmitted Diseases in the AIDS Era', *SciAm* (02/1991), pp. 62-68; Leef Smith, '114 Postal Workers Test Positive for TB', *WP*, 06.05.1993, p. CVA_9; William H. McNeill, 'The Killer That Didn't Go Away', *WP*, 06.06.1993, pp. 1 and 14; Sandra Boodman, '45 Infected With TB By Homeless Man', *WP*, 15.08.1995, p. 11.
[125] Sharon Begley and Martha Brant, 'The End Of Antibiotics', *NW*, 28.03.1994, pp. 46-52; also see: Carole Sugarman, 'The Argument Over Antibiotics', *WP*, 23.06.1993, p. E13; Dick Thompson and Madeleine Nash, 'Attack Of The Superbugs', *Time*, 31.08.1992, p 62.
[126] Marrian Burros, 'Agriculture Dept. Policy Blamed for Tainted Food', *NYT*, 03.03.1993, pp. C1 and C4.
[127] Carole Sugarman, 'A Disease That's a Bite Away', *WP*, 13.02.1994, pp. A1 and A23.
[128] Ibid.; Jones, *Valuing Animals. Veterinarians and Their Patients in Modern America*, pp. 151-52.
[129] 'Resistant Salmonella Reaches United States', *NYT*, 11.04.1997, p. A18.

commentators were just as concerned about a predicted post-antibiotic age as their British colleagues.[130]

However, US public pressure for agricultural antibiotic restrictions never reached the fever pitch that gripped European newspapers following the BSE crisis. Whereas residue, resistance and occasional animal welfare[131] concerns were all present in US newspapers throughout the 1990s, they never congealed into the wholesale criticism of intensive agriculture that confronted BSE-stricken European farmers in 1996.

Resistance-focused US critics' lack of power was put into stark relief in the mid-1990s, when the FDA followed European countries in licensing the fluoroquinolones sarafloxacin and enrofloxacin (Baytril) for *E.coli*-affected chickens despite known cross-resistance to vancomycin.[132] Although it announced that resistance would be monitored and fluoroquinolones banned if necessary,[133] the FDA's licensing decision provoked media criticism. According to the *NYT*, officials' focus on human medicine and neglect of the agricultural dimension of resistance proliferation was foolhardy.[134] By late 1997, the Minnesota Department of Health reported that 70-90% of raw poultry samples from supermarkets were contaminated with *Campylobacter* strains, 25% of which were resistant to fluoroquinolones.[135]

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[130] Nicholas Wade, 'Pax Antibiotica', *NYT*, 15.10.1995, p. SM30; Paul R. Epstein and Ross Gelbspan, 'Should We Fear A Global Plague?', *WP*, 19.03.1995, p. C1.
[131] Rebecca Reisner, 'A Leader in the Battle for Animal Rights', *NYT*, 22.03.1992, p. 3; Matthew Scully, 'Animal Spirit. Respect for God's creatures should be a conservative impulse', *NR*, 09.11.1998, p. 36.
[132] Chapter Twelve, pp. 309-311; enrofloxacin was licensed in the UK in 1993; Chapter Nine, p. 211.
[133] Dick Thompson, 'Drugged Chicks Hatch A Menace', *Time*, 31.05.1999, p. 81.
[134] 'The Bacterium and the Chicken', *NYT*, 21.10.1997, p. A26; cf. also: Susan Gilbert, 'Overuse of Antibiotics', *NYT*, 18.06.1997, p. C11; 'Drug-Resistant Germ Shows Up in US', *NYT*, 22.08.1997, p. A20.
[135] Sandra G. Boodman, 'Poultry Peril', *WP*, 09.12.1997, p. 13.

By 1998, US media commentators began to take note of the growing discrepancy between EU and US antibiotic regulation. According to Stuart Levy, "the US has to join the [EU] on [banning AGPs]. We look a little silly."[136] Although the FDA announced that it planned to require manufacturers to test new livestock drugs for resistance selection, Patricia Lieberman of the Center for Science in the Public Interest warned that the FDA's proposals would take a long time to realise and did not target already licensed drugs.[137] Too weak to win the support of environmentalist and consumer groups, the mild FDA proposals were immediately opposed by industry.[138] Subsequently, the familiar protracted series of hearings and debates soon made media interest shift to other subjects like bioterrorism, and public pressure waned.[139]

Unfortunately, bacterial resistance did not cease to be a problem. In 2000, newspapers reported that the efficacy of synercid (quinupristin-dalfopristin), the new hope against VRE, was endangered prior to its licensing because of its close relation to virginiamycin, a 'nontherapeutic' antibiotic used in US agriculture since 1974: as much as 50% of supermarket chicken, turkey and pork already carried virginiamycin-resistant bacteria strains.[140] Meanwhile, concerns about quinolone resistance made the FDA propose bans on the use of fluoroquinolones for turkeys and chickens. According to FDA data, resistance had been negligible

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[136] Denise Grady, 'A Move to Limit Antibiotic Us in Animal Feed', *NYT*, 08.03.1999, p. A13; also see: 'US Antibiotics Countered', *NYT*, 20.05.1999, p. A20; David Brown, 'Drug Resistance in Food Chain', *WP*, 20.05.1999, p. A02; Dick Thompson, 'Drugged Chicks Hatch A Menace', *Time*, 31.05.1999, p. 81.

[137] Patricia B. Lieberman, 'Control Antibiotic Use', *NYT*, 07.11.1999, p. WK14; the Clinton administration reacted to the EU measures by strengthening US resistance monitoring; Robert Pear, 'Clinton Plans $25 Million Initiative on Infectious Diseases', *NYT*, 27.12.1998, p. 26.

[138] Marc Kaufman, 'Worries Rise Over Effect of Antibiotics in Animal Feed', *WP*, 17.03.2000, p. A01.

[139] 'Military Minds Turn to Outbreak', *NYT*, 11.10.1999, p. B4; 'A Plague of Publicity', *WP*, 16.08.1999, p. A15.

[140] Marc Kaufman, 'Worries Rise Over Effect of Antibiotics in Animal Feed', *WP*, 17.03.2000.

in 1996 but had risen to 13% of surveyed strains in 1998 and 18% in 1999. However, the German Bayer Corporation challenged the FDA in court and kept its product Baytril on the market.[141]

Because of Baytril's similarity to Bayer's profitable reserve antibiotic Ciprofloxacin (Cipro),[142] the Baytril case became a matter of national security following the 9/11 attacks. Later described as "Cipromania"[143], a series of letters containing anthrax spores led to mass purchases of gasmasks, vaccines and the entire national stock of Cipro, which was effective against anthrax. Worryingly, many Americans took Cipro prophylactically to ward off mostly illusive anthrax spores.[144] While unnecessary human use already fostered bacterial resistance, an *NEJM* editorial urged that fluoroquinolones like Baytril and third-generation cephalosporins should be removed from the agricultural market so as not to further compromise the treatment of actual anthrax victims.[145] Despite widespread media interest and its ability to invoke national security concerns, the FDA was able to ban Baytril only in 2005.[146]

Once again, regulators' inability to mandate comprehensive antibiotic restrictions resulted in the creation of a market niche. Starting in the early 2000s, purveyors of conventional food like Tyson Foods, Purdue Farms, Foster Farms, McDonald's and Chipotle Grill attempted to attract wealthy,

[141] 'Wonder Drugs at Risk', *WP*, 19.04.2001, p. A18.
[142] Andrew Pollack, 'Antibiotics Business Is Again Popular', *NYT*, 13.11.2001, p. B6.
[143] Christopher Wanjek, 'Cipromania', *WP*, 23.10.2001, p. F01.
[144] Rick Weiss, 'Demand Growing for Anthrax Vaccine', *WP*, 29.09.2001, p. A16; Justin Gillis and Ceci Connolly, 'Emphasis on Cipro Worries Officials', *WP*, 19.10.2001, p. A17; Shankar Vedantam, 'Prescribing Cipro Is 'Uncontrolled Experiment', *WP*, 03.11.2001, p. A15.
[145] S.L. Gorbach, 'Time to Stop', *New England Journal of Medicine,* 345/16 (2001).
[146] Christine Gorman et al., 'Playing Chicken With Our Antibiotics', *Time*, 21.01.2002, p. 98.

environmentally and health conscious consumers by partially phasing out[147] – or at least claiming to phase out[148] – AGPs. For the companies themselves, phasing out AGPs without subscribing to the stricter organic rules governing therapeutic antibiotic use is an effective way of demanding higher prices whilst maintaining production costs.

US antibiotic restriction initiatives regained ground only following the 2008 elections. In 2009, microbiologist and Democrat Representative Louise Slaughter reintroduced legislation against agricultural antibiotics.[149] Slaughter's move received outspoken support from the *NYT* and *Scientific American*, whose editors accused the US food production system of protecting "a narrow set of interests over the nation's public health."[150] Endorsed by the American Medical Association, the Obama administration also supported the proposed AGP bans in July 2009.[151] However, industry opposition and legal objections soon threatened to stall the Preservation of Antibiotics for Medical Treatment Act (PAMTA). In April 2010, former FDA Commissioner Donald Kennedy warned *NYT* readers:

> More than 30 years ago, when I was [FDA commissioner], we proposed eliminating the use of penicillin and two other antibiotics to promote growth in animals raised for food. When agribusiness interests persuaded Congress not to approve that regulation, we saw firsthand how strong politics can trump wise policy and good science. (…). It's 30 years late, but Congress should now pass [PAMTA], (…) we don't have the luxury of waiting any longer to protect those at risk of increasing antibiotic resistance.[152]

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147 'Antibiotics in the Poultry Industry', *NYT*, 13.02.2002, p. A30; Marrian Burros, 'McDonald's Takes Steps On Its Antibiotics Promise', *NYT*, 12.01.2005, p. F2; 'A Chain That Pigs Would Die For', *NW*, 12.05.2008, pp. 45-46.
148 'US Withdraws Approval for Tyson's Antibiotic-Free Label', *NYT*, 20.11.2007, p. C9.
149 Nicholas D. Kristof, 'Pathogens In Our Pork', *NYT*, 15.03.2009, p. WK13.
150 'Healthy Growth for US Farms', *SciAm* (04/2009), p. 32.
151 Gardiner Harris, 'Administration Seeks to Restrict Antibiotics in Livestock', *NYT*, 14.07.2009, p. A18.
152 Donald Kennedy, 'Cows on Drugs', *NYT*, 18.04.2010, p. WK11.

However, following the publication of a weak "draft guidance"[153] in June 2010, it became clear that the FDA was not supporting PAMTA, and concerns grew that antibiotic regulations under Commissioner Margaret Hamburg would be "extremely modest."[154] Although CDC director Thomas R. Frieden confirmed to Congress "the clear link between antibiotic use in animals and antibiotic resistance in humans",[155] the FDA merely intended to issue voluntary guidances. According to the *NYT*, FDA timidity resulted from significant pressure by USDA Secretary Tom Vilsack, who upheld that "antibiotics need to be used judiciously, and we believe they already are."[156]

After 45 years of on-going alarm, it seems as though US consumers will have to continue waiting for effective and holistic regulations against bacterial resistance proliferation. In the absence of a macro-crisis similar to the European BSE crisis, which saw AGP restrictions turn into a unifying cornerstone of reform demands, antibiotic regulation remains a single-issue topic in the US. Reappearing every few years as a hot topic, the convoluted judicial procedures necessary to withdraw antibiotics and a hesitant FDA usually lead to a waning of public pressure before restrictions can be enacted. The fact that 'green' topics like AGP bans have fallen victim to the partisan divide of US politics also means that conservative media and politicians rarely rally behind the subject. Meanwhile, antibiotic manufacturers and users profit every year that therapeutic and non-therapeutic antibiotics remain a standard component of intensive American livestock production. Without sustained and unified criticism by the

[153] 'Antibiotics and Agriculture', *NYT*, 30.06.2010, p. A30.
[154] 'We Are What We Eat', *NYT*, 22.09.2010, p. A24.
[155] Ibid.
[156] Ibid.

US media and public, companies' opposition to regulations and financing of counter-science is unlikely to stop.

Successful agro-pharmaceutical opposition to monopolistic state controls of the antibiotic market has also allowed a private market for 'security' to flourish. As the growth of organic sales following residue scandals and revelations about defunct controls shows, the absence of regulation does not mean that US consumers have become less concerned about food 'purity'. Instead, the steady increase in organic sales since the 1980s indicates a growing privatisation of purity and security demands. This tendency approximates the Beckian model of risk as a new category of social order.[157] The state's inability to guarantee 'pure' – and in some cases even 'safe' – food gives rise to a socio-economic divide between consumers whose risk perception and income allows them to buy 'purity' and those who cannot. This divide can also be spatial. You would be hard-pressed to find a Whole Foods supermarket in Chicago's poor Southside. Although this differentiation of risk consumption is far less effective for bacterial resistance than for residues, the repeated failure of US antibiotic reform has resulted in a similar commercial differentiation of risk exposure. In an attempt to upscale their clientele and speak to the values of the affluent (white) middle-class, restaurants, fast food chains and supermarkets have created 'antibiotic-free' conventional products, which are clearly differentiated by price. Something that EU states provide for 'free' as a 'right' to citizens is commercially available for a price in the US.

[157] Beck, *Risikogesellschaft. Auf Dem Weg in Eine Andere Moderne*, pp. 14; 17-19; 29-31 & 35.

Chapter Eleven – US farmers – Hostility In Sinking Numbers

For US farmers, the USDA's 2013 victory over antibiotic critics may yet prove pyrrhic. Stuck in the boom and bust cycles of intensive production, many small- and middle-sized farmers have been forced to leave agriculture. In 2014, four companies controlled 85% of the US beef market.[1] As one of the main tools used to maintain high herd densities, on-going access to antibiotics ultimately serves large-scale corporations more than ordinary farmers. So why do US farmers and their powerful lobby continue to support technologies which ultimately contribute to many farmers' demise? Answers to this question can be found in the emergence of the 1970s partisan divide on environmentalism and regulation.

Because of the subsidy reforms of the Kennedy era and improving global markets, US farm incomes had improved significantly during the late 1960s.[2] One year after Congress enshrined federal support in the Agriculture Act of 1970, the energetic new USDA secretary Earl Butz secured an unprecedented federal appropriation of $8.1 billion. Emboldened by Malthusian scenarios of global overpopulation, federal support and the 1972 Soviet grain purchase, Butz exhorted US farmers to plant "from fencerow to fencerow".[3] This message was passed on via farm magazines. In *Progressive Farmer*, one commentator speculated that the 1970s would "become the era of agricultural capitalism" and "the time when American agriculture strikes out on a bold new course of

[1] Bernice Napach, 'How Four Companies Control Nearly All of the Meat You Eat', *Yahoo Finance* (http://finance.yahoo.com/blogs/daily-ticker/how-four-companies-control-the-supply-and-price-of-beef--pork-and-chicken-in-the-u-s-eat-prices-224406080.html [accessed: 28.05.2014], 19.02.2014).
[2] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, p. 131.
[3] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, pp. 132-33.

influence and prosperity."[4] Family farmers would, however, "retain their dominance in agriculture" only if they fully engaged in "a new, aggressive, agricultural capitalism",[5] invested their assets and became more efficient and self-reliant.

Seemingly contradicting such calls for intensification was the increasing prominence of environmental topics in Washington. Sponsoring the Earth Day celebrations, establishing the Environmental Protection Administration (EPA) and declaring a national 'war on cancer', the Nixon administration did its best to enhance its environmental and public health credentials during the early 1970s.[6] Although the greatly empowered Office of Management and Budget (OMB) tempered many measures,[7] Nixon's environmental policies caused irritation amongst farmers.

Potential DDT bans were a particularly contentious subject. Clashing with demands for intensification but speaking to farmers' personal concerns, the agricultural community resorted to cost-benefit thinking: DDT and other chemicals might be dangerous, but if used responsibly, benefits outweighed risks. *Progressive Farmer* claimed, "millions of people now living in good health would be dead or anaemic cripples if it were not for DDT."[8] Existing alternatives were either inefficacious or dangerous:

> The decision for or against a pesticide should be made on the principle of its benefit in producing food and fiber (…) versus its risk of environmental pollution.[9]

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[4] C.G. Struggs, 'Will the 1970's become the Era of Agricultural Capitalism', *PF*, Jan 1970, p. 23.
[5] Ibid.; in the analysed journals, scepticism of this course was limited to the National Farmers Union; Tony T. Dechant, 'Farm Conglomerates Are Dangerous', *PF*, Feb 1970, p. 25.
[6] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 59.
[7] Ibid., p. 63.
[8] 'Agriculture Has Big Stake in Crackdown on Pesticides', *PF*, Feb 1970, p. 152.
[9] Ibid.

Despite occasional internal disagreement,[10] agricultural criticism of anti-chemical consumer sentiments intensified as a result of the EPA's 1972 DDT ban.[11] According to the American Farm Bureau, the "disaster lobby" was "working overtime" [12] to deprive up to 50 million Americans of food by banning chemical pesticides, herbicides, fertilizers and drugs. Meanwhile, *Progressive Farmer* warned that the DDT ban might be the first step towards federally mandated "'organic' farming."[13] Despite private concerns about health and environmental degradation, most conventional US farmers could envision no future apart from a further chemical-enabled intensification of production.

Similar attitudes characterised debates about AGP restrictions. Since the 1960s, antibiotics had only grown in popularity amongst US farmers. In 1960, 4.16 million pounds had been produced in the US of which ca. 1.2 (ca. 29%) million pounds were added to feeds. Ten years later, ca. 7.3 million pounds of antibiotics (ca. 43.1% of total production) were added to feeds. By 1975, industry figures indicated that 'nonmedicinal' antibiotic use amounted to 48.6% of total US antibiotic production.[14]

Far more ambitious than the Swann report, the FDA's 1972 ban announcements therefore took many agricultural commentators by surprise. Unless they were proven safe and effective, tetracycline, penicillin, streptomycin, dihydrostreptomycin and sulphonamide AGPs would be banned on Jan 1st, 1973 for poultry and on July 1st, 1973 for sheep, cattle and swine. The bans would be

[10] Abraham L. Fairfax, 'Favors DDT Ban', *PF*, Dec 1972, p. 1; Clarence Van Sant, 'Voice of the Farm – Says Press Is Unfair To Organic Farming', *WF*, 08.04.1972, p. 62; Alex Bower, 'The Mailbox – Kentuckians Differ on DDT', *PF*, Oct 1975, p. 14.
[11] 'Farm Chemicals', *WF*, 08.04.1972, p. 72; 'The DDT Ban – What Does It Mean To You', *PF*, Sept 1972, pp. 20 and 42.
[12] 'Hood says fertilizers, chemicals are essential to food production', *FBNews*, 13.03.1972, p. 43.
[13] 'DDT, a victim of Ecological Fanatics', *PF*, Sept 1972, p. 90.
[14] 43 Fed Reg. 3034 (Jan. 20, 1978).

extended to all other antibiotics also used by humans after December 31, 1973. Substances such as chloramphenicol, semisynthetic penicillins, gentamicin and kanamycin would remain prohibited from use as AGPs.[15] Although it reported that seven of the 16 task force members had disagreed with the report's final risk assessment, the *Wallaces Farmer* acknowledged, "Evidence indicates using antibiotics in food-producing animals promotes Salmonella and the development of the R factor (resistant) bacteria."[16] According to the magazine, there seemed little hope that bans could be averted by industry safety trials: "Though it's possible, it doesn't seem likely that FDA will back off much."[17] Meanwhile, Iowa State University swine nutritionist Vaughn Speer went so far as to say: "I think the recommendations that certain antibiotics be reserved for human use is a good one. I can't argue with that."[18]

However, similar to DDT, it did not take long for a pre-formulated protest matrix to emerge.[19] After "reaffirming their abiding faith in American constitutional government, the private enterprise system, and man's inalienable right to worship God" in February 1972, members of the powerful American Farm Bureau's national assembly voted to oppose, "a complete ban on the use of any agricultural drug and chemical unless it can be demonstrated positively by prolonged and responsible research that the use of such product represents a clear and present danger to health or that such use would seriously jeopardize our environment."[20] While farming magazines began to supply readers with

[15] 'FDA proposes ban on antibiotics', *FBNews*, 07.02.1972, p. 24.
[16] 'Feeders face stricter antibiotic rules', *WF*, 26.02.1972, p. 12-13
[17] Ibid., p. 12.
[18] 'Feeders face stricter antibiotic rules', *WF*, 26.02.1972, p. 13.
[19] 'Beef producers say … Base drug laws on fact, not opinions', *WF*, 26.02.1972, p. 74.
[20] 'Farm Bureau – For and Against', *PF*, Feb 1972, p. 63.

addresses for protest letters,[21] the formerly concerned swine nutritionist Vaughn Speer suddenly claimed, "[the] possibility [of resistance transfer] has been thoroughly examined and there is no scientific evidence that resistance is transferred this way."[22]

Initially, it seemed as though agricultural protests would fail.[23] In July 1972, *Progressive Farmer* warned, "stricter regulation of antibiotics in feed look[s] 99% certain."[24] Attempting to win consumers over but confusing residue and resistance concerns, some *Farm Bureau* members even proposed a mandatory certification program for drug compliance:

> Federal authorities have taken DDT away from your use completely. The same thing can happen to animal feed and health materials. (…). When livestock producers first heard about drug residues and withdrawal periods, they tended to ignore the whole thing. (…). If livestock producers are to continue benefitting from animal health products, they must use them properly and certify that they are doing so. England's Swann Report and the United States' FDA Task Force Report challenged the ability of farmers and ranchers to carry out this responsibility. (…). Certification is the best way to plead our case effectively.[25]

However, all was not lost. Observers soon began to discern cracks in federal agencies' willingness and ability to impose substance restrictions. Although DDT was eventually banned, the FDA's indecisive handling of DES renewed agro-industrial confidence in the potential of organized popular and judicial opposition to federal action.[26] Bombarding the FDA and politicians with

[21] 'Animal Health …', *WF*, 11.03.1972, p. 44; 'Animal Health …', *WF*, 08.04.1972, p. 42.
[22] 'Hogmen could lose some feed additives', *WF*, 23.09.1972, p. 39.
[23] Anderson, *Industrializing the Corn Belt. Agriculture, Technology and Environment, 1942-1972*, pp. 194-95.
[24] 'What's New In Washington', *PF*, Jul 1972, p. 6.
[25] 'Drug Certification Does Apply to You', *PF*, Sept 1972, pp. 62-63.
[26] 'What's New in Washington', *PF*, Aug 1972, p. 8; Langston, *Toxic Bodies. Hormone Disruptors and the Legacy of Des*, pp. 97-100; 05-07.

letters, agricultural circles were relieved to see that this strategy also seemed to work for AGPs when the FDA postponed bans in 1973.[27]

Farmers did not have long to enjoy their victory over the FDA. Despite the reestablishment of 'target prices', inflation and the 1973 oil crisis brought a return of the cost-price squeeze and farmers' net income declined from $34.3 to $25.5 billion between 1973 and 1975. Once again, many smaller producers were forced out of business.[28] Faithful to Earl Butz's motto 'get big or get out', remaining farmers participated in a further round of agricultural intensification.[29] Similar to the UK, worsening economic circumstances increased US farmers' hostility towards 'nanny state' regulations despite their on-going – and in many cases increasing – reliance on federal subsidies.[30] Commenting on the appointment of the executive director of the Consumer Federation of America, Carole Foreman, as Assistant Secretary of Agriculture in May 1977, *Wallaces Farmer* noted, "… it's tempting to see her appointment as a slap at the American farmer."[31] By the late 1970s, the previously uneasy agricultural balance between private consumer and environmentalist concerns and hostility towards federal interventions had toppled.

Changing political attitudes also entrenched farmers' hostility towards potential AGP restrictions. Since 1972, intensification pressure had only increased farmers' antibiotic reliance. In February 1977, *Wallaces Farmer* published a poll inquiring about readers' antibiotic use. Of the farmers polled,

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[27] For FDA reactions to industry and scientific pressure see Chapter Twelve, pp. 281-284
[28] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 134.
[29] Anderson, *Industrializing the Corn Belt. Agriculture, Technology and Environment, 1942-1972*, p. 195.
[30] Regarding environmental interventionism, this contradicts the positive correlation between crisis and economic interventionism in Linda M. Lobao and Pamela Thomas, 'Political Beliefs in an Era of Economic Decline: Farmers' Attitudes toward State Economic Intervention, Trade, and Food Security', *Rural Sociology,* 57/4 (1992).
[31] 'Consumer advocate to ag department', *WF*, 14.05.1977, p. 18.

67% regularly fed 'drugs' to growing pigs and only 7% did not feed drugs at all.[32] One of the polled farmers stated: "I need drugs to help with production. Keeping the hogs healthy is the only way we can make a living and provide consumers with meat..."[33] While farming magazines actively cooperated with the FDA to reduce antibiotic and sulfa residues,[34] they mostly ignored growing concerns about antimicrobial resistance. According to E.G. Eggert from American Cyanamid, antibiotics were absolutely "vital for food production":

> Without antibiotics, Americans would spend an extra $2 million each year for food, (…). Farmers would have to grow an extra 103 million bushels of corn and 23 million bushels of soybeans to produce the same amount of meat without antibiotics …[35]

The basic premises of antibiotic-intense production remained unquestioned.

In June 1977, *Wallaces Farmer* warned readers about Donald Kennedy's plans to "withdraw penicillin and chlortetracyclines [sic]":

> … subtherapeutic levels of antibiotics have been used for 25 years,' – and as yet they have not created a human health hazard. (…). What these antibiotics have done is increase animal protein production at least 5% to 10%. (…). The need for food is more important than any other factor in our present society.[36]

With only a few readers expressing concerns about potential health hazards,[37] the following weeks saw articles reinforce the impression that scientists were uncertain whether AGPs were harmful but certain that AGP substitutes were inferior.[38] Stoking inflation fears, the Farm Bureau announced that current antibiotic use saved "farmers about $2 billion a year which otherwise would

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[32] Monte Sesker, 'Disease problems plague Iowa's hog producers', *WF*, 26.02.1977, pp. 10-11.
[33] Ibid.
[34] 'Antibiotic Residues Under Fire', *PF*, Jun 1975, p. 36D; 'Could it happen to you?', *WF*, 22.01.1977, p. 10; 'FDA steps up Sulfa testing', *WF,* 09.07.1977, p. 29; 'Speed up drug residue monitoring in meat', *WF*, 23.04.1977, p. 43.
[35] 'Antibiotics vital for food production', *WF*, 26.02.1977, p. 93.
[36] Monte Sesker, 'Another Threat to Livestock Producers', *WF*, 25.06.1977, p. 18.
[37] 'Animal health', *WF*, 23.07.1977, p. 29.
[38] 'Researchers can't agree … Penicillin substitutes in animal feed', *WF*, 08.10.1977, p. 19.

have to be passed on to consumers."[39] Meanwhile, *Wallaces Farmer* claimed that there were insufficient veterinarians to compensate for antibiotic restrictions and demanded regulation changes allowing "feed manufacturers to file prescriptions at doses not prescribed by law."[40]

After Congress stalled Donald Kennedy's antibiotic bans, the mood in agricultural magazines became even more defiant. By 1979, articles encouraged farmers to pressure political representatives to oppose all planned bans on nitrites, DES and antibiotics whilst stoking fears of inflation and discrediting FDA health concerns.[41] *Farm Journal* launched a strongly worded attack on the FDA for abolishing Americans' "freedoms"[42] and cited a survey by the Forum on Regulation (FOR). Eliciting over two million voluntary written responses, the FOR survey reported that 41% of respondents claimed to be worse off as a result of federal laws protecting people from impure foods and dangerous drugs and only 35% claimed to be better off. According to *Farm Journal*, the FOR survey held "an unmistakable warning for the future. If government keeps on piling on new regulations, it will further erode citizen support for laws already on the book."[43]

Farmers also began to criticise 'excessive' federal residue monitoring. Between 1973 and 1979, 10-15% of hogs controlled by federal inspectors contained sulphonamide residues above the tolerated 0.1ppm level. The swine industry was particularly affected by SMZ residues because of SMZ's inclusion in

[39] 'Vows antibiotics ban in livestock feed', *WF*, 22.10.1977, p. 18.
[40] Monte Sesker, 'Another Threat to Livestock Producers', *WF*, 25.06.1977, p. 18; US veterinarians' 20th century decline was partially linked to farmers' antibiotic access; Jones, *Valuing Animals. Veterinarians and Their Patients in Modern America*, pp. 8; 104-06; 11-14.
[41] 'Regulating Mother Nature', *FJ*, Jan 1979, p. Hog32; 'Nitrite ban would boost inflation', *FJ*, Jan 1979, p. Beef2; 'What if they ban feed drugs', *FJ*, Jan 1979, p. Beef2.
[42] ''Worse off' – from regulation', *FJ*, Mid-March 1979, p. 40.
[43] Ibid.

a popular feed mix called ASP-250.[44] After violation rates rose to 17.2% in June 1977, the FDA announced that it would consider limited restrictions if violation rates did not drop to 1% by September 1979. Arguing that the action level of 0.1ppm provided a 2,000-fold safety margin for humans, the NPPC lobbied to raise tolerance levels from 0.1 to 0.3ppm in liver and kidney samples. However, USDA-data showed that raising tolerances to 0.3ppm would merely lead to a 50% drop of violations.[45] Even hostile commentators became concerned when violation rates refused to sink ahead of 1979 and warned that ignorance and sloppiness could harm the entire agricultural community.[46] Experts also expressed concern about new residue tests for meat from dairy cows: "USDA surveys show that 10% to 30% of the dairy cows going to slaughter have 'specific disease conditions at time of slaughter and have antibiotic residues in violation of tolerances,' …"[47] Although they might disagree about tolerance levels, the vast majority of commentators ultimately agreed that residues in animal produce were undesirable and necessitated a modicum of federal controls.

This consensus did not hold for federal attempts to combat the proliferation of bacterial resistance. In 1979, many commentators continued to deny that resistance selection on farms could later harm humans. Despite attempts by the FDA's new Director of the Center for Veterinary Medicine (CVM), Lester Crawford, to convince Farm Bureau members of antibiotic restrictions,[48] the farming media prioritised information supplied by CAST-member and

[44] 'Synopsis of Meeting', Nov. 18, 1976, enclosed in: Maryln Perez to Berkley Bedell, Feb 07, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA, p. 1.
[45] James R. Jones, 'Can We Lower Sulfa Violation Rates?', *FJ*, Mar 1979, pp. Hog8-9.
[46] Ibid.; 'Sulfa tolerance 'too restrictive', *FJ*, Apr 1979, p. Hog2.
[47] 'Today in the East', *FJ,* Mar 1979, p. 30.
[48] 'Regulators Talk Tough', *FJ*, Nov 1979, p. Hog28.

University of Kentucky animal nutritionist Virgil Hays, who did not "cotton much to the theoretical possibility that resistant organisms (…) may be transferred to man."[49] Even agricultural features addressing drug overuse or the difficulties of treating resistant bacteria on farms did not problematize the reasons behind resistance and mostly limited themselves to advocating improved hygiene and nutrition or a switch to different antibiotics.[50]

By the end of 1979, the strategy of ignoring resistance problems seemed validated. After two years of intense conflict with Donald Kennedy's FDA over hormones, nitrates, sulphas and antibiotics, farmers had lost only the battle over DES. Although the USDA announced that it would intensify its residue testing, *Farm Journal* triumphantly noted, "Low-level feeding of antibiotics (…) will almost certainly be allowed for another two years – possibly as many as five."[51] A CAST study attempted to drive a further nail into the coffin of regulatory activism:

> Of the 84 [recent] regulations, 36 showed a net positive social benefit, (…), the proposed ban on use of penicillin in animal feeds would have costs as well as benefits (…). But the net social payoff is judged to be insignificant.[52]

Republican Congressmen subsequently accused the USDA and FDA of "inept handling"[53] of regulatory measures and proposed independent chemical risk assessment panels and mandatory cost-benefit evaluations ahead of new regulations.[54] The next year brought further good news on the antibiotics front. In April 1980, *Farm Journal* announced that the NAS review had concluded that

[49] Ibid.
[50] 'Are bacterial infections the culprit in MMA?', *FJ*, Apr 1979, p. Hog26; JP Kunesh, 'A veterinarian looks at … Building systems', *FJ*, Apr 1979, p. Hog30; 'Can You Say Good-Bye To Sulfa', *FJ*, Oct 1979, p. Hog3.
[51] 'Outlook/ Washington', *FJ*, Dec 1979, p. 10.
[52] 'CAST considers regulations', *FJ*, Dec 1979, p. Beef2.
[53] 'Who would decide cancer risk?', *FJ*, Dec 1979, p. Hog38.
[54] Ibid.

"the test probably doesn't exist that can prove or disprove the safety of using low levels of penicillin or tetracyclines."[55] It seemed unlikely that the FDA would be able to defend AGP bans in court or Congress.

However, the victory over FDA Commissioner Donald Kennedy's AGP bans did not lead to long-term prosperity. For farmers, the 1980 election victory of Ronald Reagan was a mixed blessing.[56] Although he staunchly opposed direct regulatory involvement in the market, a prolonged and dire economic crisis for US agriculture repeatedly forced Reagan to abandon neoliberal principles and expand subsidies. Between 1980 and 1985, the total cost of the US farm program rose to more than $20 billion. However, CCC deficit purchases and storage programs did not raise commodity prices and stimulated further overproduction. Saddled with debts from the 1970s and told to intensify even further, the familiar tale of rural mass impoverishment and exodus repeated itself.[57] Whereas farm debt had totalled $60 billion in 1972, it totalled an astonishing $216 billion in 1983.[58] The agricultural crisis began to recede only following further subsidies and recovering prices during the second half of the 1980s.[59] By this time, the fabric of US agriculture had changed: similar to the Dust Bowl era, 42% of US farmland was operated under rental agreements and only larger conventional producers were making a profit.[60]

[55] 'Outlook/Washington', *FJ*, Apr 1980, p. 6.
[56] Monte Sesker, 'Bad joke, poorly told', *WF*, 13.04.1985, p. 14.
[57] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, pp. 132-34.
[58] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 138.
[59] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, pp. 132-34.
[60] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, p. 150.

Although most conventional farmers continued to defend the chemical *status quo*,[61] the severity and length of the economic crisis made an increasing number of producers cast envious looks at on-going profits in the organic sector. In 1981, *Indiana Prairie Farmer* warned readers to no longer "dismiss organic farming as merely a fad or joke"[62] The magazine praised the potential of organic technologies like integrated pest management and conservation tillage to save expenditure on "insecticides, herbicides, growth regulators, and fertilizers."[63] Although the article avoided discussions of organic philosophy, other commentators questioned whether the existing agricultural system would allow 'ordinary' farmers to survive both economic hardship and growing popular environmentalism. In 1981, one article predicted that the 1990s would not only bring further intensification but also reduced access to pharmaceuticals:

> … less drugs will be available for everyday, continuous use due to pressure from consumers and FDA actions. Less drugs will force improved management techniques for successful hog production.[64]

Nonetheless, it remained clear that farmers would bitterly oppose any federally mandated substance restrictions because of fears that these would lead to further restrictions. Reacting to the NRDC's 1983 petition and the seeming 1984 link by CDC epidemiologist Scott Holmberg's 1984 between agricultural antibiotic use and human illness, the well-oiled machinery of agro-pharmaceutical opposition sprung to life. *Farm Bureau News* (*FBNews*) questioned Holmberg's study: "… other factors could have caused the outbreak, (…) a direct link was never shown (The resistant Salmonella apparently came

[61] 'Farmer feels a tightening noose from public outcry over chemicals', *FBNews*, 29.07.1985, p. 2.
[62] 'Conventional farmers using organic farming principles', *IPF*, 16.05.1981, p. 47.
[63] Ibid.
[64] Al Morrow, 'How you may produce hogs in the 1990s', *IPF* Farm Progress Hog Producer, Sept 1981, p. H18.

from an adjacent dairy farm, where no antibiotics were used.)."[65] Resistance "[was] probably more due to [antibiotics'] prolific use for treating and preventing human infection."[66] In Congress, Farm Bureau representatives claimed that farmers would immediately abandon AGPs if their harmfulness were proven: "'If the potential hazard to humans is as great as some people claim, why haven't there been more cases of human illness."[67] According to *FBNews*, it seemed inconsistent to merely ban AGPs whilst leaving therapeutic antibiotic use in human and animal medicine untouched. The magazine also used the example of the Swann report to argue against US AGP bans: "Some scientists say there has been no increase in antibiotic-resistant bacteria, nor a decrease in such viruses [sic!] in Great Britain."[68]

However, economic duress also created rifts amongst conventional producers. Relying less on AGPs than other producers, the National Cattlemen's Association (NCA) announced in spring 1985 that it would discontinue the feeding of tetracyclines – but not of penicillin – "until it can be resolved whether their use causes health problems in humans."[69] Eliciting mixed responses from other livestock groups,[70] the NCA stressed that it would, however, continue to oppose federal AGP bans because of concerns that they would encourage further anti-chemical campaigns: "If a product can be taken off the market by inference instead of fact, why would anybody invest another $70 million to create a new product?"[71]

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[65] 'Call to ban antibiotics in feed gets FDA hearing later in month', *FBNews*, 07.01.1985, p. 3.
[66] Ibid.
[67] 'FDA, says FB, needs more evidence on antibiotics in feed question', *FBNews*, 28.01.1985.
[68] Ibid.
[69] 'Status Report', *FBNews*, 29.04.1985, p. 3.
[70] Sara Wyant, 'What's behind the salmonella scare', *WF*, 25.05.1985, p. 14.
[71] LuAnne Metzger, 'Cattlemen still oppose antibiotics ban', *WF*, 23.03.1985, p. 2.

While HHS Secretary Margaret Heckler's 1985 rejection of the NRDC petition was a major victory for the farm lobby, US farmers experienced growing cultural and political pressure to endorse environmentalist measures throughout the 1980s and early 1990s.[72] In 1990, *Wallaces Farmer* conducted a survey of 200 farmers' pesticide use. Of the 85% who reported a change in pesticide management, 94% claimed to have done so for economic reasons; environmental concerns were listed by 80% and health concerns by 79% of the respondents.[73] In the same year, *Wallaces Farmer* also printed an article in which Kansas swine veterinarian Steve Henry noted that new livestock facilities would have to adapt more to animals' physiological, nutritional and genetic factors. In an almost revolutionary statement, Henry acknowledged that the same was also true for animals' micro flora:

> The time is long overdue for us to accept the presence of organisms with pathogenic potential in all growing and finishing herds of swine. We need to adapt facilities, diets, labor, and efforts toward the peaceful cohabitation of pigs, microbes, and people. Necessarily, this will mean less reliance on drugs for microbial elimination…[74]

Yet, it would be wrong to speak of an agricultural Saul to Paul transformation. Despite their victory over many environmental and consumer initiatives in the 1980s, conventional farmers had realised that it was better to be – or at least appear to be – 'green' than to provoke public environmentalist sentiments. Farmers readily adopted green measures that could be incorporated into the enduring logic of intensification[75] and farm organisations launched

[72] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, p. 134.
[73] 'Farmers willing to reduce pesticide, fertilizer use', *WF*, 10.07.1990, p. 28.
[74] 'News & Notes', *WF*, 13.03.1990, The Hog Producer, p. H3.
[75] 'Survival strategies for the '90s', *WF*, 13.03.1990, The Hog Producer, p. H23.

major efforts to promote the public image of 'green' and 'responsible' farmers.[76] According to *FBNews*, farmers should redefine the meaning of being an environmentalist: whereas the term was usually used to label "someone who favors locking up natural resources and opposes the use of chemicals", it also meant "someone who cares about the environment": "Then certainly you could apply the term to farmers and ranchers." [77]

All the while, agricultural magazines and organisations continued to oppose external interference in farming practices. Holding fast to its 1970s domino theory of chemical bans, the wider agricultural community remained united in its rejection of "environcra[t]" [78] bans and regulations. Barely mentioning the 1990s milk residue scandal, [79] agricultural commentators attacked 'excessive' public health fears:

> Traces of this. Traces of that. This may cause cancer, so might that. (…). Ours is a reactionary society, sometimes overreactionary [sic] in our constant pursuit of 'idealism'.[80]

The default position seemed to be that America had "the safest, the healthiest, and the most abundant food supply in the world..."[81]

When Newt Gingrich's 1994 'Republican Revolution' ended the Democrats' 52-year hold on Congress, the American Farm Bureau also worked to roll back existing restrictions.[82] Speaking in front of the Senate Agriculture Committee in February 1995, Farm Bureau representatives blamed farming's decline on a "federal regulatory juggernaut":

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[76] 'National Agriculture Week TV program', *WF*, 13.03.1990, pp. 16-17
[77] 'Farmers as environmentalists', *FBNews*, 07.05.1990, p. 2; also see: JoAnn Alumbaugh, *WF*, 09.01.1990, The Hog Producer, p. H1.
[78] Keith Propst, 'Avoid selective information from alternative ag study', *FBNews*, 01.01.1990, p. 8.
[79] 'Commodity Briefs – Dairy', *FBNews*, 25.02.1990, p. 2.
[80] Monte Sesker, 'Put problems in perspective', *WF*, 08.05.1990, p. 5.
[81] Ibid.
[82] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 121.

> AFBF supports four major regulatory reforms: risk assessment (…); cost-benefit analysis (…); private property compensation when Congress decides to override private interests in favor of the general public; and redirection of regulatory resources into worthwhile private sector incentives...[83]

With Republicans controlling both Houses, some of the most formidable milestones of US consumer protection were successfully challenged. In 1996, Congress passed the Food Quality Protection Act (FQPA) and abolished the Delaney Clause. As described by historian Sarah Vogel, the FQPA was supported by environmental and consumer advocates because it ended the distinction between chemical residues on raw and processed food; lowered tolerances to a one-in-a-million cancer risk; introduced right-to-know provisions and required reviews of existing standards. However, the FQPA also marked a significant victory for industry because it simplified regulatory procedures and ended zero-tolerance regulations in favour of negotiable risk-benefit calculi.[84]

However, once again, chemical – and economic – deregulation did not improve most farmers' economic situation. In 1996, two years after the so-called Uruguay round of the General Agreement on Tariffs and Trades (GATT) stipulated an annual farm support ceiling of $19 billion,[85] the US government passed the Federal Agricultural Improvement and Reform Act (FAIR).[86] FAIR eliminated nearly all acreage controls and effectively ended surplus purchases by introducing CCC loans at or below market prices. However, FAIR's so-called 'production flexibility contract payments' allowed politicians to bypass the subsidy ceiling. By 2000, unofficial US farm support grew to $11 billion and total subsidies amounted to $25 billion, which constituted ca. 47% of farmers' net

[83] 'Regs hurting agriculture Farm Bureau tells panel', *FBNews*, 20.02.1995, p. 1.
[84] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 122.
[85] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, pp. 134-37.
[86] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, pp. 150-52.

income.[87] With subsidies and deregulation again mostly benefitting large producers, the number of US farms fell to 2,190,070 in 1999.[88] Subsidy-fuelled intensification and farm decline further increased under the Bush administration.[89]

Agricultural reactions to these developments were again divided. On the one hand, commentators' hostility against regulatory restrictions, ivory tower 'agri-intellectuals' and 'uncomfortable truths' like climate change reached new heights.[90] Leaving little room for consensual and constructive negotiations over pollution, antibiotic overuse and animal welfare, organisations like the Farm Bureau in effect hardened the attitudes of their mostly liberal critics.

On the other hand, medium-sized farmers' demise gave rise to a contradictory set of articles. In 1998, *Wallaces Farmer* published a survival guide for small pig producers:

> This is a difficult column to write. We've always tried to keep a positive attitude and present ways producers can become more efficient, productive or profitable. But nothing we print will change the fact that the pork industry is going through a critical time. There is more pork than there are consumers to eat it, (…). One option (…) is to pursue speciality markets. (…) some producers are finding a high-value niche for organically-raised, antibiotic-free pork. It's not for everyone, but it may be an idea to consider.[91]

[87] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, pp. 136-38.
[88] Hurt, *Problems of Plenty. The American Farmer in the Twentieth Century*, pp. 155-56.
[89] Conkin, *A Revolution Down on the Farm. The Transformation of American Agriculture since 1929*, pp. 140-41.
[90] Blake Hurst, 'The Omnivore's Delusion', *FBNews*, 24.08.2009, pp. 2; 5-6; Tim Ball, 'Climate data may be an inconvenient truth for global warming advocates', *FBNews*, 02.04.2007, p. 4; Paula Mohr, 'Book debunks organic food myths', *PrFa*, Mar 2008, p. 69; John Vogel, 'Animal rights groups are watching you', *PrFa*, Feb 2009, p. 44.
[91] Joann Alumbaugh, 'Stay committed – come out stronger', *WF*, Oct 1998, p. H1.

Magazines also began to publish advice on how to do without antibiotics and highlighted the advantages of organic intensification and integration.[92] The organic market's on-going growth seemed to confirm the validity of such advice. Between 2000 and 2011, the number of certified US organic beef cows rose from 13,829 to 106,181; the number of organic milk cows rose from 38,196 to 254,771 and the number of organic broilers rose from 1,924,807 to 28,644,354.[93] Although overall numbers remained paltry in comparison to conventional production, the organic sector's stable double-digit growth provided a much-needed perspective of future prosperity, which many small producers no longer found in conventional production.

Contradictory attitudes also governed reporting on AGPs. Despite highlighting ways for smaller producers to go antibiotic-free, *Wallaces Farmer* maintained that there was no "conclusive evidence of human health hazards"[94]:

> The animal health industry already has a reasonable and comprehensive approach to addressing antibiotic resistance. Representatives of AHI feel the "framework" document proposed by CVM is unsupported by scientific evidence and based on too many faulty assumptions.[95]

Following the delay of the FDA's 1999 reform attempts, concerns about bacterial resistance were, however, soon forgotten and farm magazines refocused on other meat safety issues.[96] In April 2002, *FBNews* noted:

> There's been a lot of clucking in recent years that livestock and poultry producers are using antibiotics willy nilly so they can crowd their animals

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[92] 'Interest in organics keeps growing', *WF*, Apr 2000, p. 43; 'Can non-antibiotic mastitis treatments work?, *WF*, Jun 1998, p. D2; 'Prevent sickness au naturel', *WF* Beef Producer, Mar 2007, p. BP9; 'More money in organic hogs?', *WF*, Aug 2009, p. 67.
[93] 'Table 3 - Certified Organic and Total Us Acreage, Selected Crops and Livestock, 1995 and 2011', *USDA Economic Research Service - Organic Production - Overview* (http://www.ers.usda.gov/data-products/organic-production.aspx#25762 [accessed: 23.03.2015]).
[94] Shannon Linderoth, 'Prudent practices in the cross-hairs', *WF*, Apr 1999, p. D4.
[95] JoAnn Alumbaugh, 'New animal drug guidelines questioned', *WF*, Apr 1999, p. H7.
[96] Cf. Neil Smith, 'We all need safe meat inspection', *WF*, Nov 2000, p. 40; Alan Newport, 'Doctor's orders: Eat more meat', *WF*, Oct 2008, p. BP12.

> together and farm on the cheap. The fact is antibiotics, like most drugs, aren't cheap. (…). Farmers use [antibiotics] when they're needed, and they should be able to continue doing so.[97]

In a vast understatement, the magazine claimed that AGPs constituted only 6.1% of total US antibiotic use and exhorted farmers to educate consumers on the benefits of modern agriculture and chemical use.[98]

Although smaller farm organisations supported guarantee schemes for meat produced without GMOs, antibiotics or hormones,[99] the powerful *Farm Bureau* continued to advocate routine antibiotic use and oppose federal restrictions throughout the 2000s. Reacting to new restriction initiatives under the Obama administration in April 2009, *FBNews* continued to question links between agricultural antibiotic use and resistant bacteria on US meat. While Farm Bureau President Bob Stallman claimed that "the possibility of resistance from antibiotics in livestock is declining", *FB News* reported that Danish AGP bans had "resulted in more death and disease among animals and greater amounts of antibiotics used to treat animal diseases."[100] Conflating resistance and residue concerns, the Farm Bureau significantly used previously decried organic philosophies to claim that the market could resolve the situation by itself:

> If, however, a consumer still does not trust food from animals treated with antibiotics, there's already a way to avoid it. To be certified organic under USDA's National Organic Program, animals can't be given

[97] Lynne Finnerty, 'Clucking about agricultural antibiotics is overblown', *FBNews*, 28.04.2002, p. 3.
[98] Ibid.; for more realistic data see Chapter Twelve, pp. 317-318.
[99] 'New Association of Family Farms Joins Forces with NFU', *NFU News Release*, 27.11.2006; for parallel battles over r-BST free labels cf. 'Ohio FB: Revised dairy label rules may be improvement', *FBNews*, 19.05.2008, p. 7.
[100] 'Farm Bureau: Antibiotics are needed to keep animals healthy, food safe', *FBNews*, 06.04.2009, p. 3.

> antibiotics. (…) if someone just wants to avoid products from animals that have been given antibiotics, they can already do that.[101]

Magazines, which also addressed smaller farmers, expressed more nuanced views. In *Wallaces Farmer*, one commentator advised farmers to "respect caution by consumers, but keep telling our story":

> …antibiotic resistance in bacteria is a natural part of the evolutionary process. (…). But we also know that underdosing, incomplete treatment or choosing the wrong antibiotic for the problem bacteria can increase the rate of resistance. (…). The same thing happens with well-executed antibiotic use, but at an arguably lower level. [102]

Should farmers find themselves "defending an indefensible position", then it was time to "take a serious look at abandoning that particular practice"[103]. Responding to a reader, who feared that AGP bans might "erase my profit margin and force me out"[104], the magazine's three agricultural experts were surprisingly relaxed: two experts reminded the producer that therapeutic antibiotic use remained legal, and the third expert noted that hogs were still "being produced profitably in European countries."[105] In April 2011, the magazine printed an article in which veterinarian Mike Apley predicted an end of "over-the-counter sales of antibiotics for food animals, and more veterinarian involvement"[106]

By 2013, new data and rising resistance warnings made even major agro-pharmaceutical interest groups like the Animal Health Institute (AHI) acknowledge that antibiotic reform could not be postponed indefinitely. In April 2013, *Wallaces Farmer* reported that the AHI was pressing for voluntary

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[101] Ibid.
[102] Alan Newport, 'Let's get argument about antibiotics right', *WF* Beef Producer, Apr 2010, p. BP8.
[103] Ibid.
[104] 'Raise hogs without antibiotics?', *WF*, Dec 2010, p. 61.
[105] Ibid.
[106] Alan Newport, 'Pressure is mounting on animal antibiotic use', *WF* Beef Producer, Apr 2011, p. BP8; also see: 'It's not the residues' & 'Two resistances, one worry', *WF* Beef Producer, Apr 2011, p. BP9; Alan Newport, 'Humans and animals share their diseases', *WF* Beef Producer, Apr 2013, p. BP7; 'University research finds antibiotic resistance to BRD', *PrFa*, Sept 2013, p. 91.

compliance with the formerly suspect FDA guidances in order to avert "what happened 10 years ago in the European Union, when the use of antibiotics for growth promotion was stopped via regulation."[107] However, a *Wallaces Farmer* commentator doubted that such a rollback was wise and compared it to Israel's contemporary withdrawal from Gaza – thereby indirectly comparing antibiotic critics to Hamas:

> Can it be a successful strategy when dealing with so many radicals in the anti-antibiotic crowd? Ceding ground to radicals always worries me. It has never worked for Israel, for example.[108]

Although the AHI's strategy seems validated given the FDA's renewed emphasis on voluntary instead of statutory bans,[109] agricultural commentators remain concerned about future bans. During Iowa's 2014 annual swine day, former USDA Undersecretary of Food Safety Richard Raymond complained about one-sided media reports and claimed that 'natural' bacterial resistance could not be blamed on agricultural antibiotic use: "… there is no proof that low doses are any more likely to cause resistance than high doses of antibiotics."[110] The American Farm Bureau also maintains that agricultural antibiotic use is unproblematic. In a policy statement from March 2015, the Farm Bureau expresses:

> …serious concerns about the effects of removing important antibiotics and classes of antibiotics from the market, which would handicap veterinarians and livestock and poultry producers in their efforts to maintain animal health and protect our nation's food supply.[111]

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[107] Alan Newport, 'Is ceding ground in antibiotics fray smart?', *WF* Beef Producer, Apr 2013, p. BP3.
[108] Ibid.
[109] Robert Fears, 'Make wise use of antibiotics', *WF* Beef Producer, Apr 2014, p. BP6.
[110] Christina Dittmer, 'The reality of antibiotic resistance', *WF*, Aug 2014, p. 74.
[111] 'Preserving Antibiotic Access', *American Farm Bureau Federation - Priority Issues Antibiotics* (http://www.fb.org/issues/docs/antibiotics15.pdf [accessed: 24.03.2015], Mar 2015).

Over half a century after E.S. Anderson's studies, agricultural commentators' and ex-officials' continued description of resistance transfer from bacteria on farms to bacteria in humans as "hypothetical"[112] does not bode well. Despite more nuanced views by smaller producers, domino thinking seems to underlie on-going agricultural opposition to federal restrictions. Since DDT, any concession to 'activists' or 'Washington' is interpreted as a threat to farmers' freedom. Meanwhile, farm organisations have been happy to abandon zero-sum regulation hostility if stricter standards are imposed by commercial actors: while public antibiotic critics are compared to Hamas, moves by Tyson and McDonalds to phase out antibiotics have not attracted similar criticism and the organic market has become an acceptable haven for struggling conventional producers.[113] Even though consumers' changing preferences will probably lead to antibiotic restrictions in the long term, agro-pharmaceutical opposition to federal intervention has been remarkably successful in the US.

For the millions of producers forced out of farming by intensification, their industry's resounding victories over federal regulations have, however, proven pyrrhic. Opposition to antibiotic restrictions has benefited pharmaceutical manufacturers more than individual farmers. The persistent 'othering' of critics has led to a situation where the constantly shrinking group of farmers has become publicly othered itself. Whereas it is up to US farmers to decide whether they can morally condone the use of strategies to cast doubt on credible public health hazards, it is undeniable that holding fast to controversial technologies is unwise in the long term. Meanwhile, EU farmers are steadily

[112] Fears, 'Make wise use of antibiotics', *WF* Beef Producer, Apr 2014, p. BP6.
[113] 'Mcdonald's to Cut Use of Antibiotics in Chicken', *BBC News* (http://www.bbc.co.uk/news/business-31743764 [accessed: 24.03.2015], 05.03.2015).

increasing their head start in a consumer-driven market where meat is produced without AGPs and a shrinking amount of therapeutic antibiotics.

Regarding health hazards to themselves or their families, farmers have tended to compartmentalise the antibiotic problem. Antibiotic residues and bacterial resistance selection were usually discussed separately: while residues were mostly blamed on 'black sheep', concerns about (horizontal) bacterial resistance were either dismissed with reference to AGPs' continued efficacy or limited to a discussion of the selection for resistant pathogens on individual farms and the supposed absence of direct proof of harm – and guilt. This compartmentalisation makes agricultural antibiotic use seem reformable. However, it ignores the fundamental problem at the heart of resistance proliferation: the mass use of agricultural antibiotics has, does and will select for bacterial resistance on an ultimately planetary scale. By generally increasing the amount of resistant organisms and R-factors in the environment, farmers are continuously increasing the chance that harmless bacteria will turn into pathogens or 'teach' pathogens to resist antibiotics Stalling regulatory action by insisting on proof of harm in court is a hazardous strategy.

Chapter Twelve – The Government – Failing to Regulate

So why has the FDA failed to implement mandatory AGP restrictions? As the two previous chapters have shown, the FDA's inability to push bans past Congress was in part due to the rise of American neoliberalism and consumers who feared residues in food more than resistance in bacteria. It was also partially caused by the agro-pharmaceutical industry's skilled use of counter-science and the legal system to defeat potential bans. However, as this chapter shows, the FDA's ambivalent record regarding antibiotic regulation was also caused by internal factionalism and the agency's fundamental weakening during the 1980s.

Following FDA Commissioner George Larrick's resignation in 1965, heightened FDA responsibilities and growing political interference resulted in a rapid succession of Commissioners and bureaucratic turmoil.[1] Characterised as a "wild-eyed crusader with a battle-ax flailing boldly"[2], Larrick's successor, Commissioner James Goddard, quickly found himself isolated and was damaged by the chloramphenicol scandal.[3] Following Goddard's resignation in 1968, the trained physician and bacteriologist Herbert Ley became the last FDA Commissioner to have risen through the ranks but was replaced in late 1969 as a result of the cyclamate scandal.[4]

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[1] Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s*, pp. 14-15 & 18.
[2] Douglas Martin, 'James L. Goddard, Crusading FDA Leader, Dies at 86', *NYT Health*, 01.01.2010, URL: http://www.nytimes.com/2010/01/02/health/02goddard.html?_r=0 (accessed: 31.03.2015).
[3] Chapter Ten, pp. 223-224.
[4] Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s*, pp. 1-3; 31-52.

Following the cyclamate scandal, HEW Under-Secretary Frederic V. Malek recommended a fundamental reorganisation of the FDA along product rather than function lines. The FDA's Bureaus of Science, Medicine and Compliance were subsequently replaced with the Bureaus of Drugs, Foods, Pesticides and Product Safety.[5] Although regulatory responsibility for antibiotics was now divided between three different Bureaus, the Bureau of Veterinary Medicines (BVM), which had been made independent of the Bureau of Drugs in 1967, held the most responsibility for the regulation of agricultural antibiotics.[6]

Under Commissioner Ley, Bureau of Veterinary Medicine (BVM) director C.D. Van Houweling had already focused efforts on enforcing compliance, improving feed labels, reducing the *Salmonella* contamination of feeds and combating antibiotic residues.[7] However, early attempts to prosecute residue offenders and ban or extend withdrawal times for residue-prone medications had not been very effective.[8] In 1966, initial USDA testing had revealed the contamination of 15.9% of analysed meat samples with antimicrobial substances of which only ca. 1% could be positively identified.[9] Despite internal warnings

[5] Ibid., pp. 56; 63-65.
[6] 'Oral History Interview of Cd Van Houweling by Ronald T. Ottes', *History of the US Food and Drug Administration - FDA Oral History Transcripts* (http://www.fda.gov/downloads/AboutFDA/WhatWeDo/History/OralHistories/SelectedOralHistoryTranscripts/UCM264576.pdf [accessed: 13.04.2015], 18.06.1990), pp. 1-3.
[7] Van Houweling to Paul A. Pumpian, Dec. 21, 1967, Folder A24B 88-75-3, Box 3966, GS, DF A1/Entry 5, RG 88, NARA; Herbert L. Ley to CC Johnson, 15.08.1969, Box 4214, GS, DF A1/Entry 5, RG 88, NARA.
[8] Van Houweling, 'Memorandum of Telephone Conversation', Dec. 13, 1967, Folder A24B 88-75-3, Box 3966, GS, DF A1/Entry 5, RG 88, NARA; 'Fda Consumer Protection Activities - Fda Reorganization', *Subcommittee on Public Health and Welfare of the Committee on Interstate and Foreign Commerce* (House of Representatives; Washington DC: US Government Printing Press, 1970), p. 274; 'Regulation of Food Additives and Medicated Animal Feeds', *Subcommittee Of The Committee On Government Operations* (House of Representatives Washington DC: US Government Printing Office 1971), p. 174.
[9] 'Biological residue (supplement)', Mar. 6, 1969, Folder 88-76-80, Box 4215, GS, DF A1/Entry 5, RG 88, NARA

about significant residue problems,[10] Commissioner Ley reported a surprisingly good contamination rate of 0.63% to Congress three years later.[11] Ley was not asked to clarify testing methods nor how high detected residues were and attempted to smooth over the fact that the FDA had failed to prosecute any offenders.[12]

Feed industry compliance also remained dismal. In one case, a feed manufacturer ignored FDA cautions for ca. 7 years rather than lose customers.[13]Meanwhile, the State-Federal Medicated Feed Program had virtually disintegrated. Writing to Commissioner Ley in April 1969, Van Houweling warned that attempts to free resources by handing over bi-annual inspections of medicated feed manufacturers to states had backfired. The FDA had conducted only 251 inspections during the first half of the 1969 fiscal year and state inspectors had inspected only 799 of the 8,567 registered manufacturers in the preceding fiscal year.[14] Meanwhile, over 45% of inspected manufacturers were failing to assay feeds and 25% of conducted assays were violative. Van Houweling was "concerned that, lacking [controls], our approving medicated feed applications represents little more than a 'rubber stamp' operation."[15] Relaxed controls were already resulting in "numerous batches of feeds not containing the labelled potency of drugs" and "various drug residues in

[10] Van Houweling to Herbert Ley, Apr. 17, 1969, Folder 88-76-80, Box 4214, GS, DF A1/Entry 5, RG, NARA, p. 4.
[11] 'Fda Consumer Protection Activities - Fda Reorganization', p. 274.
[12] Ibid.
[13] Daniel Kleber to General Counsel, Feb 28, 1968, Folder 88-76 5V, Box 4103, GS, DF A1/Entry 5, RG 88, NARA.
[14] Van Houweling to Herbert Ley, Apr. 17, 1969, Folder 88-76-80, Box 4214, GS, DF A1/Entry 5, RG, NARA, pp. 1-2.
[15] Ibid., pp. 3-4.

carcasses".[16] The medicated feed program urgently needed additional resources to protect US consumers and ensure compliance.

Help was not forthcoming. During an internal conference in May 1969, Ley "appreciated having this information" but "added (…) that under the budget constraints (…), the severe personnel shortage does not permit more emphasis to the program at this time."[17] Amounting to ca. 4% of FDA manpower and ca. 3% of the FDA's budget, the 166 man-years and $2.4 million devoted to the control of veterinary drugs marked a low point for the BVM.[18]

Given such problems, it is unsurprising that despite their interest in British research, BVM officials were hesitant to devote limited resources to combatting bacterial resistance. Responding to an inquiry in 1967, the FDA's Director of Legislative and Governmental Services clarified:

> At present there is only one antibiotic available for animals which is not used in humans. Even this antibiotic causes cross-resistance (…), however, there is no definitive evidence linking antibiotic resistant organisms of animal origin to human disease or allergies. Consequently, we are not contemplating any [antibiotics bans].[19]

Without proof of concrete or imminent harm from 'infectious resistance', FDA officials continued to believe that reducing human antibiotic-exposure in the form of residues was the most effective way to contain bacterial resistance. In order to determine the "real hazard to man"[20] [emphasis in the original] in 1968,

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[16] Ibid.
[17] James Gesling, 'Memorandum of Conference', May 19, 1969, Folder 88-76-80, Box 4214, GS, DF A1/Entry 5, RG 88, NARA, p. 1.
[18] 'Fda Consumer Protection Activities - Fda Reorganization', p. 478.
[19] Paul A. Pumpian to Birch Bayh, Nov. 21, 1967, Folder A24B 88-75-3, Box 3966, GS, DF A1/Entry 5, RG 88, NARA, pp. 1-2.
[20] Robert A. Baldwin to CD Van Houweling, Feb. 13, 1968, Folder 88-76 5V, Box 4103, GS, DF A1/Entry 5, RG 88, NARA.

the FDA authorized $25,000 for a study of "resistant organisms resulting from medicated animal feeds".[21]

With industry representatives following developments closely in the run-up to the British Swann report,[22] the BVM's wait-and-see attitude was controversial amongst other FDA Bureaus. In September 1968, *FDA Papers* published an attack on AGPs by David Smith. Questioning AGPs' efficacy and summarising agricultural antibiotics' risk,[23] Smith warned that resistant *Salmonella* were already causing problems:

> All strains of S. typhimurium isolated before 1948, when antibiotics were seldom used on farms, were sensitive to tetracycline; 30 percent of strains isolated from poultry in 1962 were resistant to tetracycline, while 94 percent and 57 percent of strains isolated from cattle and hogs were resistant to tetracycline.[24]

Following the publication of the Swann Report one year later, Van Houweling summarised the regulatory situation for his superiors:

> It is reliably estimated that approximately 40 million tons of animal feed containing drugs was consumed in 1968. Also, that almost 80% of the meat, milk, and eggs consumed in the United States comes from animals fed medicated feeds. The [AHI] reported that $72.5 million of antibiotics went into animal feed last year.[25]

While the Bureaus of Science and Medicine were "acutely aware" of "the possible ecological effects of using these large amounts of antibiotics in animal feeds"[26], there was no evidence that "such resistance has caused difficulties in treating

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[21] Note, 'Budget, Bureau of [432.1], Filed 251', 20.02.1968, Ibid.
[22] Fred J. Kingma to Warren M. Reynolds, Feb. 20, 1968, Ibid.
[23] David H. Smith, 'Antibiotics in Agriculture and the Health of Man', *FDA Papers* (09/1968), p. 12.
[24] Ibid., p. 11; the FDA's Division of Microbiology later severely criticised AGPs' continued availability during the 1970-1972 Task Force review; cf. Robert Angelotti to Herman F. Kraybill and Through Keith H. Lewis, Mar. 27, 1970, Folder #128 1975 May-July 432.1, Box (FRC) 25, FDA GS, DF UD-WW/Entry 4, RG 88, NARA. [all individual documents in this folder are attached to each other], p. 2.
[25] CD Van Houweling to Dale R. Lindsay, Nov. 26, 1969, Folder 88-76-80, Box 4214, GS, DF A1/Entry 5, RG 88, NARA, p. 1.
[26] Ibid.

diseases in animals or man in the United States".[27] Two studies were under way to assess hazards: the FDA itself was attempting to trace resistant *Salmonella* back to three farms but had been unable to "process all the culture received"; and William G. Huber at the University of Illinois' College of Veterinary Medicine was attempting to "correlate antibiotic resistant bacteria found in animals and people in contact with these animals on the farms and in slaughtering houses."[28] However, no concrete proof harm had emerged and Van Houweling recommended that the FDA leave AGP policies unchanged "until there is evidence that the practice is contributing to a health problem either in man or animals."[29]

Taking over as FDA Commissioner shortly after Van Houweling's antibiotic memorandum, the trained surgeon and former consultant Charles Edwards inherited a difficult situation:[30] medicated feedstuff controls and enforcement had broken down, antibiotic abuse was causing residues in food and the Swann report fundamentally challenged existing antibiotic policies.

Responding to Swann, Edwards installed a Task Force on Antibiotics in Animal Feeds. The Task Force had been recommended by the Commissioner's Science Advisory Committee[31] and corresponded with a general increase of FDA reliance on external expertise to supplement resources and enhance the agency's

[27] Ibid., p. 2.
[28] Ibid., p. 3.
[29] Ibid.
[30] Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s*, pp. 56; 63-65. Lucas Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal* (Lanham et al.: Lexington Books, 2014), p. 26.
[31] Charles C. Edwards to the Assistant Secretary of Health and Scientific Affairs, May 5, 1970, Folder #128 1975 May-July 432.1, Box (FRC) 25, FDA GS, DF UD-WW/Entry 4, RG 88, NARA, p. 1.

credibility.[32] Chaired by Van Houweling and announced in April 1970, the Task Force was composed of officials; experts on infectious disease, bacteriology, microbiology and veterinary medicine; and industry representatives. Consumer representatives were not invited. The Task Force was charged with undertaking an "in-depth review of the usage and actual value of antibiotics in animal feed"[33] and assessing potential human health hazards.

Between 1970 and 1972, the Task Force met nine times. During its first meeting, Task Force members decided "that while there was not enough evidence to indicate an imminent and immediate health hazard, there was sufficient data to assure that there is a potential, if not probable, health hazard associated with feeding of antibiotics to animals."[34] During the meeting, members formed separate groups dealing with antibiotic research, human health problems, animal health problems and antibiotic effectiveness. They also called for a moratorium on AGP licensing for the duration of their review. The Task Force subsequently gathered evidence across the country and listened to presentations from the AHI, AFMA, NPPC and other agricultural organisations. In October 1970, Task Force members also attended the aforementioned New York Conference on the problems of resistance.[35] During the conference, Task Force members met with British geneticist Naomi Datta, British veterinarian John R. Walton and other European experts as well as with Thomas Jukes and senior industry representatives. In early February 1971, eight members of the Task Force travelled to England where they met with prominent British antibiotic

[32] Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s*, pp. 76-79.
[33] 'Report to the Commissioner of the Food and Drug Administration by the Fda Task Force on the Use of Antibiotics in Animal Feeds', (Rockville (Md.): FDA, 1972), p. 2.
[34] Ibid., p. 12.
[35] Chapter Nine, pp. 192-194.

critics such as Herbert Williams Smith and Ephraim Saul Anderson as well as with representatives of the BVA, NFU, the Swann committee, MAFF, DHSS and industry.[36] Following the delegation's return, the Task Force drafted an intermediate report in late February and a final report in October 1971.[37]

Signed by all members, the final Task Force report was released in January 1972. Regarding antibiotics' economic benefits, it cautioned that the "efficacy and safety of long-term feeding of subtherapeutic levels of antibiotics for animal disease control and prophylaxis [had] not been adequately demonstrated."[38] As a consequence it was difficult to quantify antibiotics' economic benefits. According to the Task Force, antibiotics were worth $414,135,000 to livestock producers in 1970. The pharmaceutical industry had earned $64,030,323 from selling agricultural antibiotics between 1968 and 1969. However, it was "not possible (…) to estimate the economic impact of restricting antibiotics" because "some antibiotics will undoubtedly continue to be available for growth promotion purposes." [39]

Regarding potential health hazards, the Task Force concluded that AGPs' selection for bacterial resistance was a threat:

> Evidence suggests that the use of certain antibiotics in food-producing animals promotes an increase in the animal reservoir of Salmonella (…), the use of some antibiotics in animals produces a marked increase in the prevalence of R-factor containing bacteria which may be transmissible to man's enteric flora. These observations lead to the logical conclusion, though not fully documented, that such practices give rise to a human health hazard.[40]

[36] 'Report to the Commissioner of the Food and Drug Administration by the Fda Task Force on the Use of Antibiotics in Animal Feeds', p. 14.
[37] Ibid., p. 15.
[38] Ibid., p. 8.
[39] Ibid., p. 9.
[40] Ibid., p. 8.

It was "the consensus of the Task Force that it would be highly desirable that in the future, a group of antibacterial agents be reserved exclusively for human use."[41] The Task Force advised restricting tetracyclines, dihydrostreptomycin, sulphonamides, penicillins and "all other approved antibiotics"[42] to POM-status if producers failed to prove that they could be used safely and efficaciously. The Task Force also endorsed existing feed restrictions for chloramphenicol, semi-synthetic penicillins, gentamicin and kanamycin and called on the FDA to revoke quantitative labelling exemptions for antibiotic levels below 50g/ton.[43] Regulation proposals based on the Task Force report were published in the *Federal Register* on February 1st, 1972.[44]

Unsurprisingly, the Task Force endorsement of AGP restrictions spawned scientific controversy. Although they had also signed the final report, some Task Force members published a minority report questioning E.S. Anderson's findings and whether AGP use constituted a human health hazard.[45] An NAS ad hoc committee chaired by Boston City Hospital infectious disease specialist Maxwell Finland also challenged the Task Force report. His prestige enhanced by the Kefauver-Hearings and the success of his campaign against fixed-dose combination antibiotics, Finland "remain[ed] unconvinced"[46] that research on 'infectious resistance' proved danger resulting from agricultural antibiotic use. In June 1972, Duke Trexler, Executive Secretary of the NRC-NAS Drug Research

[41] Ibid., p. 9.
[42] Ibid., p. 10.
[43] Ibid.
[44] 37 Fed. Reg., 2444-2445 (Feb 1, 1972).
[45] 'Abstract: Minority Report from Members of the FDA Task Force on Antibiotics in Animal Feeds', Feb 29, 1972, enclosed in: FDA FActSheet – Summary Of The Report By The FDA Task Force, Folder #128 1975 May-July 432.1, Box (FRC) 25, GS, DF UD-WW/Entry 4, RG 88, NARA, pp. 1-2.
[46] CLM, FP, Series II, A. Alphabetical Correspondence, Box 2, Folder 26, Finland to Van Houweling (22.06.1970).

Board (DRB), asked Finland whether he could head an ad hoc committee on antibiotics in feeds. The NAS Division of Biology and Agriculture had already published a critical 'position paper'. However, NAS President Handler wanted the DRB to review the paper ahead of sending it to the FDA. Finland would be able to nominate committee members and be supplied with Task Force files and a hostile review, which Thomas Jukes had sent to the FDA as a member of the President's Science Advisory Committee (PSAC).[47] Finland agreed. After less than four months, his committee submitted a report to the NAS in October 1972. The report recommended that the NAS approve the Division of Biology and Agriculture's 'position paper', opposed AGP bans and advocated further studies and the development of new antibiotics solely for agriculture.[48]

Finland's report increased tensions within the US infectious diseases community and attracted criticism not only from former Task Force members but also from Profs. George Mandel (a pharmacologist at George Washington University) and Werner Kalow (a German-borne pharmacologist at the University of Toronto), who had themselves been members of Finland's committee.[49] In 1973, Jukes and Finland discussed the degree to which their colleagues were ignoring the 'facts'. Jukes particularly disliked the "zealot"[50] David H. Smith, who had headed the Task Force's Human Health Hazards Committee. Finland agreed: "It was only after [David Smith] joined the Task

[47] CLM, FP Series VI, B. Veteran's Administration Committees and Projects Records, 1950-1983, Box 12, Folder 8, Duke Trexler to Finland (12.06.1972); Finland to Trexler (22.06.1972).
[48] CLM, FP Series VI, B. Veteran's Administration Committees and Projects Records, 1950-1983, Box 12, Folder 8, 'Recommendation Submitted for Approval of Ad Hoc Committee', enclosed in: Finland to Trexler (19.10.1972).
[49] CLM, FP Series VI, B. Veteran's Administration Committees and Projects Records, 1950-1983, Box 12, Folder 8, H. George Mandel, 'Report To The Drug Research Board' (18.10.1972); W. Kalow to Trexler (22.11.1972); Kalow to Finland (16.02.1973).
[50] Jukes to Edwards, Jan. 17, 1973, enclosed in: Edwards to Jukes, Mar. 2, 1973, Folder #145 432.1 Jan-Mar, Box 4820, GS, DF A1/Entry 5, RG 88, NARA, pp. 1-2.

Force that he was 'converted' or perhaps brainwashed."[51] Finland blamed Smith's brainwashing on the British antibiotic critics Ephraim Saul Anderson and Herbert Williams Smith.[52]

The split of the infectious diseases community caused significant problems for FDA reformers, who were already facing severe industrial and political opposition to AGP bans. Following the bans' 1972 announcement, the FDA received over 380 responses within the 60-day comment period.[53] In August 1972, Commissioner Edwards was asked by NAS President Philip Handler to defer regulatory action until Finland's ad hoc committee had completed its work.[54] Worried by the extent of industry protest, Edwards informed the NAS that he was deferring bans and willing to consider the NAS committees' conclusions two months later. According to DRB Secretary Trexler, Edwards's move was a "volte face."[55]

Faced with contradictory expert reports but committed to the 1972 *Federal Register* announcement, Edwards faced a dilemma: reneging on bans would alienate consumers, but implementing them would enrage industry. The only way out seemed to be a loophole in the Task Force report itself. The report had proposed that manufacturers should prove that their products would not cause a significant increase of resistant pathogenic and multiple resistant

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[51] CLM, FP Series VI, B. Veteran's Administration Committees and Projects Records, 1950-1983, Box 12, Folder 8, Finland to Jukes (03.12.1973).
[52] CLM, FP Series VI, B. Veteran's Administration Committees and Projects Records, 1950-1983, Box 12, Folder 8, Jukes to Finland (11.12.1973).
[53] 38 Fed. Reg.,9811-9812 (20.04.1973).
[54] Philip Handler to Charles C. Edwards, Aug. 3, 1972, Folder #128 1975 May-July 432.1, Box (FRC) 25, FDA GS, DF UD-WW/Entry 4, RG 88, NARA.
[55] CLM, FP Series VI, B. Veteran's Administration Committees and Projects Records, 1950-1983, Box 12, Folder 8, Duke Trexler to Maxwell Finland (03.10.1972); Edwards was acting on an earlier recommendation of the FDA's Commissioner for Planning and Evaluation; Gerald L. Barkdoll to The Deputy Commissioner, 22.06.1972, Folder #128 1975 May-July 432.1, Box (FRC) 25, GS, DF UD-WW/Entry 4, RG 88, NARA.

bacteria in humans, animals and feed or prolong the shedding of resistant bacteria, increase their pathogenicity and produce cross-resistance to other therapeutics.[56] However, decisions over concrete testing procedures were left to the FDA, which drastically limited safety reviews' scope following a BVM draft proposal from December 11th, 1972. According to the FDA Associate Commissioner for Medical Affairs:

> The previous documents (…) approach the problem in a broad way, considering that antibiotics per se in this particular use might constitute a hazard (…). The [BVM draft] narrows this scope considerably by restricting the studies of human hazard (aside from the possibility of salmonella reservoir increase) to drugs which are (1) used in human clinical medicine, and (2) which promote gram negative transferable resistance.[57] [emphasis in the original]

The new drug safety studies would be conducted on a product-by-product basis by manufacturers themselves.[58]

The modified safety trials were announced in the *Federal Register* in April 1973. In its announcement, the FDA noted that consulted experts had only been able to agree that AGPs constituted an imminent hazard if they significantly increased the *Salmonella* reservoir in animals and food.[59] There was "less agreement on the hazard to human health presented by other animal-source bacteria (e.g. coliforms)"[60] and R-factor transfer. Referencing Finland's NAS-committee, the FDA therefore noted that, "upon the basis of all of the evidence currently available", AGPs were still regarded as "safe under the conditions of use"[61]. Manufacturers were given a year to produce "an assessment of the effects

[56] 'Report to the Commissioner of the Food and Drug Administration by the Fda Task Force on the Use of Antibiotics in Animal Feeds', pp. 4-7.
[57] John Jennings to the Commissioner, Dec. 18, 1972, Folder #128 1975 May-July 432.1, Box (FRC) 25, FDA GS, DF UD-WW/Entry 4, RG 88, NARA.
[58] R. Moure to Assistant Commissioner for Planning and Evaluation, May 11, 1972, Ibid.
[59] 38 Fed. Reg.,9811-9812 (20.04.1973).
[60] Ibid., 9812.
[61] Ibid.

of subtherapeutic levels of [tetracyclines, streptomycin, dihydrostreptomycin, the sulfonamides, and penicillin] on the salmonella reservoir."[62] Producers would also have to submit studies "concerning (1) the colonization and R-factor transfer from animals to man and (2) increased pathogenicity due to toxin-linkage with R-factor"[63].

In the absence of popular protest against the *Federal Register* announcement, industry and the FDA effectively postponed a serious engagement with 'infectious resistance' in agricultural settings.

Within a year, FDA scientists began to express serious concerns about the quality and trustworthiness of industry-conducted antibiotic studies. By August 1974, eight manufacturers had submitted a total of 21 *in vivo* studies on AGPs' impact on the *Salmonella* reservoir.[64] The received studies were in a bad shape: "… omissions, deficiencies, or areas which raise questions [existed] in almost every study."[65] A brief review of three industry studies by University of Maryland microbiologist Merill Snyder was equally damming: existing studies provided no suitable base for regulatory action, and additional data would do little to resolve the situation.[66] Having reached a similarly pessimistic conclusion about four extra-mural studies in March 1974,[67] FDA and Canadian officials travelled to Britain to enquire after the Swann bans' impact. Although officials met with E.S.

[62] Ibid., 9813.
[63] Ibid.
[64] Van Houweling to the Commissioner, 'Salmonella Reservoir Data. Antibacterials in Animal Feeds – Action', Aug 28, 1974, Folder 432.1 July-Sept, Box 4983, GS, DF A1/Entry 5, RG 88, NARA, p. 1.
[65] Ibid., p. 2.
[66] Gerald B. Guest, 'Memorandum of Conference – Salmonella Reservoir Studies', Aug. 23, 1974, enclosed in: ibid.
[67] Van Houweling to L Paul Williams, Jan 30, 1974, Folder 432.1 Jan-March, Box 4985, GS, DF A1/Entry 5, RG 88, NARA; 'Memorandum of Conference – Critique of Working Group Meeting on Antibacterials in Animal Feeds', Mar. 15, 1974, Folder #128 1975 May–July 432.1, Box (FRC) 25, GS, DF UD-WW/Entry 4, RG 88, NARA.

Anderson and other scientists,[68] the stagnation of British monitoring efforts dashed FDA hopes for supportive data. Although efficacy reviews led to the withdrawal of streptomycin and dihydrostreptomycin AGPs,[69] the BVM decided that it would be unable to take regulatory action based on bacterial resistance in late August 1974.[70]

However, inconclusive proof of harm was not the same as proof of safety. Wary of cumbersome regulatory pathways, the FDA chose a more creative approach for its second attempt to restrict AGPs: during the late 1960s and early 1970s, the FDA had created national advisory committees to enhance transparency and consumer trust. The committees were composed of officials, experts and consumer and industry representatives. If staffed 'correctly', the committees offered a covert way to push for change.

In a memorandum to the new FDA Commissioner Alexander Schmidt from February 1975, Van Houweling noted that "preliminary discussions" had led to the conclusion "that the time involved in chartering and naming a new committee was prohibitive."[71] FDA General Counsel Peter Hutt had suggested using the National Advisory Food and Drug Council (NAFDC) to circumvent normal procedures.[72] The NAFDC's 'neutral evidence' could also be used to fend off external challenges to FDA decisions: "We anticipate that some of this

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[68] Van Houweling to the Commissioner, 'Memorandum – Report of Joint US/Canadian Fact Finding Visit to the United Kingdom – Action, Jul 17, 1974, enclosed in: Van Houweling to Larry E. Stenswick, Aug. 23, 1974, Folder 432.1 July-Sept, Box 4983, GS, DF A1/Entry 5, RG 88, NARA.
[69] Richard t. Hunt to Peter B. Hutt, Oct. 25, 1973, Folder #142, Box 4818, GS, DF A1/Entry 5, RG 88, NARA.
[70] Van Houweling to the Commissioner, 'Salmonella Reservoir Data. Antibacterials in Animal Feeds – Action', Aug 28, 1974, Folder 432.1 July-Sept, Box 4983, GS, DF A1/Entry 5, RG 88, NARA, p. 3.
[71] Van Houweling and William V. Whitehorn to the Commissioner, May 14, 1975, Folder #128 1975 May–July 432.1, Box (FRC) 25, GS, DF UD-WW/Entry 4, RG 88, NARA, p. 1.
[72] Special Assistant to the Director (BVM) to Assistant Commissioner for Professional & Consumer Programs, Apr. 21, 1975, Ibid., p. 1.

criticism will come in the form of formal litigation, still other in the form of Congressional inquiries and committee hearings."[73] The NAFDC subcommittee would be staffed with three NAFDC members and several select external consultants.[74]

Chaired by FDA Commissioner Schmidt, the NAFDC established an Antibiotics in Animal Feeds Subcommittee (AAFC) in June 1975.[75] In its report from January 1977,[76] the AAFC recommended banning tetracycline and penicillin AGPs. Penicillin was also to be banned from use in disease prevention if effective substitutes were available. Tetracycline and sulfaquinoxaline use was to be limited "to those periods of time for which the presence of the drug in the feed (…) is necessary due to the threat of animal disease."[77] Although it differed from BVM calls for a complete restriction of tetracyclines to therapeutic treatments,[78] the AAFC report seemed to provide the long-awaited endorsement of FDA antibiotic restrictions.

However, in a severe blow to the FDA, the main NAFDC rejected the AAFC's recommendations. During a one-day session just a week after the AAFC report was published, the NAFDC accepted the AAFC's recommendations regarding penicillin and sulfaquinoxaline but rejected tetracycline restrictions for growth promotion and preventive medication. Instead, the NAFDC called for more research and recommended that the FDA's position be "reevaluated within

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[73] Ibid., p. 2.
[74] Ibid., p. 3.
[75] Robert C. Wetherell, Jr. to Carl T. Curtis (US Senate), Aug. 19, 1975, Folder #127 1975 432.1 Aug-Dec, Box (FRC) 25, GS, DF UD-WW/Entry 4, RG 88, NARA.
[76] Gerald B. Guest to Caro Buckler, 'Memorandum of Telephone Conversation – Antibiotics in Animal Feeds Subcommittee', Dec. 6, 1976, Folder #103 1926 431.81–432.24, Box (FRC) 20, GS, DF UD-WW/Entry 15, RG 88, NARA.
[77] 'For Presentation by Donald Kennedy, Commissioner of FDA to the NAFDC, 'Antibiotics Used in Animal Feeds'', Apr. 15, 1977, enclosed in: David D. Martin to Dick C. Clark (US Senate), May 02, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/ Entry 8, RG 88, NARA, p. 2.
[78] Van Houweling to Acting Commissioner, Mar. 07, 1977, Ibid., pp. 4-5.

three years"[79]. According to one observer, three people had influenced the NAFDC's decision: "(one the Chairman of the Board of a drug firm, another the President of a feedlot) whose sweeping generalities were not based on scientific fact and nevertheless went unchallenged."[80] FDA microbiologist Rosa M. Gryder recalled how she had "listened with some consternation as [the NAFDC] rejected the [AAFC]'s recommendation regarding (…) tetracycline."[81] Ahead of the meeting, some NAFDC members admitted not having "read the background material supplied to them" while "others did not clearly understand it".[82] Microbiologist and former AAFC consultant Dr. Stanley Falkow fumed:

> Without mincing words, to accept the recommendations on the restriction of penicillin and sulphonamide and to table the Subcommittee's recommendations on tetracycline simply reflects the ignorance of the full Committee (…), the action of the full Committee was an insult to [AAFC members], (…), it is no exaggeration to say that the ecology of the enterobacteria, and recently other bacterial groups (…) has been changed by the pattern of antibiotic usage in man and his domestic animals.[83]

For the FDA, the NAFDC's partial rejection of the AAFC recommendations could hardly have come at a worse time: after Commissioner Schmidt's resignation in the wake of Jimmy Carter's 1976 election victory, the agency was headed by an interim commissioner, and resources were strained by the fact that the Delaney Clause was forcing the FDA to proceed against popular saccharin sweeteners.[84]

Taking office in April 1977, it was clear that Stanford biologist Donald Kennedy would have a tough time as Commissioner. In Congress, fears of

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[79] Ibid.
[80] Richard P. Silver to Acting Commissioner, Feb. 07, 1977, enclosed in: ibid., p. 4.
[81] Rosa M. Gryder to Acting Commissioner, Feb. 07, 1977, enclosed in: ibid., p. 1.
[82] Ibid., p. 3.
[83] Stanley Falkow to Sherwin Gardner, Feb 14, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/ Entry 8, RG 88, NARA.
[84] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 68.

'stagflation' and the 'drug lag' were tempting an increasing number of politicians to attack FDA regulations.[85] The new Carter administration further complicated things by strengthening external oversight and introducing fiscal restraints such as a mandatory system of inflation impact assessments for any regulatory action projected to cost more than $100 million. Some observers soon worried whether Kennedy, who had no prior political experience, would be able to strike a workable balance between regulatory action and the administration's goal of reducing the bureaucratic footprint.[86] Kennedy's AGP policy heightened such concerns.

Only eleven days after taking office, Kennedy announced that he considered the NAFDC's decision non-binding and would ban penicillin and tetracycline AGPs. Justifying his course to the NAFDC, Kennedy referenced ecologist Garett Hardin's 'tragedy of the Commons':[87]

> In short, the evidence indicates that enteric microorganisms in food animals and man, their r-plasmids and human pathogens form a linked ecosystem of their own in which action at any one point can affect every other. Viewed in this light, the vulnerability of microorganisms to antibiotics is a kind of 'commons' – a resource which if we consume it by the use of antibiotics for non-medical purposes in animals, is diminished in man.[88]

In the long term, the benefits of restricting antibiotic access outweighed the costs. Kennedy explicitly linked the AGP controversy to parallel regulatory efforts regarding recombinant DNA research.[89]

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[85] Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s*, pp. 245-46.
[86] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 28; 55-59.
[87] Garrett Hardin, 'The Tragedy of the Commons', *Science,* 162/3859 (1968).
[88] 'For Presentation by Donald Kennedy, Commissioner of FDA to NAFDC, 'Antibiotics Used in Animal Feeds'', Apr. 15, 1977, enclosed in: David D. Martin to Dick C. Clark (US Senate), May 02, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/ Entry 8, RG 88, NARA, p. 5.
[89] Ibid.

Kennedy's AGP policy was supported by the BVM according to whom banning all non-prescribed uses of penicillin and the tetracyclines would "have the approval of that segment of society represented by the consumer activist, scientists and those members of the medical profession who feel that action should be taken" [90]. However, such action also had the "potential for causing the greatest [sic] change in US animal food production."[91] Wary of such disruptions, CD Van Houweling reported: "five out of seven scientists from the staff of the BVM Antibiotics in Feeds Group and the Veterinary Research Division are willing to compromise and adopt the recommendations of the [AAFC]."[92] One person in the BVM supported the NAFDC position, "while another individual and the FDA Office of Science"[93] preferred total restrictions. Advising that the FDA follow the AAFC's recommendations, Van Houweling noted: "Politically, the Subcommittee position lies between the extremes desired by different segments of the American public."[94] Some officials, however, remained sceptical whether the FDA's position was strong enough to push AGP restrictions through a congressional and judicial system that continued to insist on proof of concrete or imminent harm. In June 1977, a memorandum warned "we may not have enough [evidence] to avoid a hearing since there may well be substantial and material issues of fact."[95]

Industry protest was impressive. Between 1977 and 1979, the FDA's general correspondence files are close to bursting with private, industrial,

[90] Van Houweling to Acting Commissioner, Mar. 07, 1977, Ibid, p. 4.
[91] Ibid., p. 7.
[92] Ibid.
[93] Ibid.
[94] Ibid.
[95] Richard E. Geyer to Edward Allera, Jun 16, 1977, Folder #109 1977 432.1 June, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA, p. 6.

congressional – and occasionally USDA[96] – letters opposing AGP restrictions.[97] In April 1977, a *Cyanamid News Release* claimed that "banning antibiotics"[98] – not only penicillin and the tetracyclines – would annually cost US consumers a staggering $2.1 billion. According to Cyanamid, Britain's Swann bans had increased animal disease and therapeutic antibiotic use. Readers were asked to make their "voice heard"[99] and write to their political and trade representatives. Cyanamid also provided a list of arguments and writing tips:

- Make it known at the start of your letter that you think the proposal is harmful, and that you disagree with it.
- Tell how long you have used tetracycline antibiotics on your farm, and the benefits you have reaped that could not have come from any other source.
- Stress that you have seen no indication of adverse effects, to either animal or human, from tetracycline use.
- Say that you want to keep using tetracycline antibiotics, and what your operation would be like without them.
- When writing your Congressman and Senator, urge him to protect his constituents' interest.
- You should also consider writing to your state Commissioner of Agriculture. (…). When writing a letter to a Representative, Senator, or any government official, there are rules of etiquette (…). When writing a Congressman, the envelope is properly addressed to 'The Honorable'…[100]

Agro-industrial letter campaigns like Cyanamid's were extremely effective. In June 1977, Commissioner Kennedy complained about the amount of hostile

[96] FDA complaints about RC Fish, the USDA's Acting Administrator for Livestock and Veterinary Sciences in the ARS; Robert C. Wetherell Jr. to Bill Nichols (House of Representatives, Jul. 07, 1977, Folder #108 432.1 1977 July, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA.
[97] See amongst many others Senator John Tower to Donald Kennedy, May 05, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/ Entry 8, RG 88, NARA; Donald Kennedy to Allan Grant (president AFBF), Jun 15, 1977, Folder #109 1977 432.1 June, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA.
[98] 'News from Cyanamid (American Cyanamid Company) – For Immediate Release', 22.04.1977, ibid., p. 3.
[99] Ibid., p. 5.
[100] Ibid., p. 7.

correspondence he was receiving: "The majority originate from a campaign orchestrated by a major antibiotics producer."[101]

According to a BVM memo, fierce industry opposition to AGP restrictions was predictable. The US AGP market was estimated to be worth ca. $118.1 million with tetracycline feeds accounting for ca. 60-70% of this market. Due to tough competition in the pharmaceutical sector, it was easy to see that "companies such as American Cyanamid Company, Pfizer, Inc. and others (…) are likely to vigorously resist any change in use"[102]. Industry was also opposed to FDA regulations because of the "belief that this is a prelude to other restrictions and more control by the government"[103]. Companies had already spent much "time and money" on "defensive research" and had anticipated FDA action "since about 1970 when the Antibiotics Task Force was formed" – "what to do when the change comes, has probably been in the planning for several years."[104]

FDA penicillin and tetracycline bans were announced in the *Federal Register* in August and October 1977.[105] However, by this time, the FDA's AGP initiative was already showing signs of stalling: Congress had just indicated its readiness to intervene in FDA affairs by mandating a 15-month 'breathing space' on saccharin regulations;[106] Canada had reneged on its parallel AGP bans;[107] and the FDA's antibiotic expertise was under threat of dilution by a profusion of

[101] Donald Kennedy to James T. Broyhill (House of Representatives), Jun. 21, 1977, ibid.
[102] Van Houweling to The Commissioner, Jun. 08, 1977, Folder #10 1977 4321.16-1-77/6-9-77, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA, p. 1.
[103] Ibid., p. 2.
[104] Ibid.
[105] 42 Fed. Reg., 43769-43793 (Aug. 30, 1977); 42 Fed Reg. 56253-56289 (Oct. 21, 1977).
[106] Troetel, *Three-Part Disharmony: The Transformation of the Food and Drug Administration in the 1970s*, pp. 256-59.
[107] Van Houweling to The Commissioner, Apr. 23, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/ Entry 8, RG 88, NARA

hearings and reports from other government and, in the case of CAST, non-governmental organisations.

Similar to Finland's 1972 NAS ad hoc committee, the establishment of competing expert groups constrained the FDA's ability to make authoritative and rapid decisions in the name of public health. Competing expert groups also deflected public and Congressional attention from FDA and CDC warnings about horizontal resistance towards the short-term economic costs. Whereas the USDA created a Task Force on AGP restrictions' economic effects in October 1977,[108] the Senate Committee on Agriculture, Nutrition and Forestry requested that the Office of Technology Assessment (OTA) review drug and chemical feed additives in early autumn 1977.[109] By November 1977, the agency expected final actions to be delayed "until late 1978 at the earliest."[110]

Aware that time was not working in its favour, the FDA attempted to create a *fait accompli* by establishing a new category of prescription-only feeds, which included penicillin, chlortetracycline and oxytetracycline. Although cost projections showed that the measures would cost $15.6 million – "well below the criterion for a major economic impact"[111] – it was clear that Congress would interpret such a measure as an attempt to bypass its authority. During informal hearings following the publication of the so-called Controls Document in January

[108] Bob Bergland to Clark Burbee, Robert Brown, Roger Gerrits, Jon Spaulding and Howard Teague, Oct 28, 1977, Folder #105 432.1 1977 Oct-Dec, Box (FRC) 21, GS, DF UD-WW/Entry 8, RG 88, NARA.
[109] JB Cordaro to Joseph A. Califano, Aug 8, 1977, Folder #106 1977 432.1 Sept, Box (FRC) 21, GS, DF UD-WW/Entry 8, RG 88, NARA, p. 1.
[110] Robert C. Wetherell, Jr. to John C. Culver, Nov. 01, 1977, Folder #105 432.1 1977 Oct-Dec, Box (FRC) 21, GS, DF UD-WW/Entry 8, RG 88, NARA.
[111] Van Houweling to the Commissioner, Dec. 07, 1977, p. 4.

1978,[112] prominent critics attacked FDA antibiotic restrictions.[113] In the end, 174 witnesses opposed restrictions and only 15 supported them.[114]

Alarmed by the Controls Document, Congress also moved to block FDA action. In February 1978, a resolution was introduced to the Senate directing the FDA to refrain from taking action against AGPs pending the outcome of further studies. At first the FDA attempted to appease Congress through extending the period of comments on its Controls Document to June 19th. However, the BVM soon warned that delays would not be enough "in view of Congress' increasing tendency to [take] action where administrative agencies have taken unpopular stands on issues having significant public impact."[115]

The BVM prediction proved correct: by mid-1978, the FDA had been trumped. By playing on inflation fears and drowning out resistance warnings, antibiotic supporters won over Capitol Hill and regulatory agencies' function as expert arbiters was effectively taken over by Congressmen and Senators with no expertise in relevant areas. Following a three-day hearing during which 26 of 29 witnesses rejected AGP restrictions, Charles Rose, Chairman of the Subcommittee on Dairy and Poultry of the House Committee on Agriculture, proposed a resolution to stall FDA action on July 14th, 1978.[116] The resolution would force the FDA to await the outcome of OTA and USDA studies as well as a

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[112] 43 Fed Reg. 3032-3045 (Jan. 20, 1978).
[113] G. Brayn Patrick, Jr. to Hearing Clerk FDA, Apr. 07, 1978, Folder #93 432.1 1978 Apr-May, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA.
[114] US House of Representatives, Committee on Agriculture: Committee Resolution – Relative To The Use Of Antibiotics in Animal Feeds, enclosed in: Joseph A. Califano, Jr. to Thomas S. Foley, Sept. 07, 1978, Folder #91 432.1 1978 Aug-Sept, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA, p. 2.
[115] Van Houweling to The Commissioner, May 18, 1978, Folder #93 432.1 1978 Apr-May, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA, p. 2.
[116] Susan E. Feinman to Robert Wetherell, enclosed in: Wetherell to the Commissioner, Jul. 27, 1978, Folder #92 432.1 1978 June-July, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA, ibid., pp. 1-2.

new NAS study for which the House Appropriations Committee had earmarked $250,000 two months earlier.[117] Ahead of the final vote, Rose showed a film highlighting the costs of FDA action and featuring experts like CAST's Virgil Hays. Rose claimed that the FDA's proposed actions would annually cost ca. $2 billion. Rose's resolution was passed unanimously.[118]

Following the US Senate's endorsement of the House Resolution in September 1978,[119] FDA officials could only hope for favourable evidentiary hearings and external studies and became embroiled in a battle of numbers. Writing to the House Agriculture Committee in August 1978, FDA Commissioner Kennedy attacked figures released by Cyanamid and an article in the *Journal of Animal Sciences* alleging that restricting all AGPs would trigger a $801.7 million increase of costs.[120] Instead, Kennedy upheld 1976 data from the Office of Planning and Evaluation, which estimated that producers using substitute antibiotics would incur a cost increase of only $74 million and concluded:

> The OMB cost threshold for a 'major' impact is $100 million in the aggregate or $80 million on any one industry sector. (…). Unless our estimated combined impact is in error by several orders of magnitude, a detailed study of macroeconomic effects is unlikely to support the view that our actions will measurably affect inflationary trends.[121]

Released in 1979, the OTA's external review supported FDA positions. The report cautioned against relying too strongly on cost-benefit estimates when

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[117] US House of Representatives, Committee on Agriculture: Committee Resolution – Relative To The Use Of Antibiotics in Animal Feeds, enclosed in: Joseph A. Califano, Jr. to Thomas S. Foley, Sept. 07, 1978, Folder #91 432.1 1978 Aug-Sept, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA.
[118] Feinman to Robert Wetherell, enclosed in: Wetherell to the Commissioner, Jul. 27, 1978, Folder #92 432.1 1978 June-July, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA, pp. 1-2.
[119] 'Drugs in Livestock Feed', (I - Technical Report; Washington DC: Office of Technology Assessment, 1979), p. 20.
[120] Henry C. Jr. Gilliam and Rod Martin, 'Economic Importance of Antibiotics in Feeds to Producers and Consumers of Pork, Beef and Veal', *Journal of Animal Science,* 40/6 (1975).
[121] Donald Kennedy to Thomas S. Foley (House of Representatives) Jun. 09, 1978, enclosed in: Robert C. Wetherell, Jr. to Associate Commissioner for Planning and Evaluation, Aug. 04, 1978, Folder #91 432.1 1978 Aug-Sept, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA.

regulating drugs: "Once removed from the structured experimental setting, these numbers retain an aura of legitimacy that may not be warranted."[122] The OTA noted, "… risks and benefits cannot be approached through a simple balance-sheet type of assessment. No common denominator is generally acceptable for comparing human illness and death with pounds of meat (…) Americans eat too much meat anyway."[123] Regarding antibiotics, Congress had four options: (1) allow the FDA to decide, (2) enact legislation requiring economic as well as scientific assessments of benefits and risks, (3) force the FDA to decrease therapeutic use of antibacterials in human and veterinary medicine as well as in food production, (4) approve future drugs only if they are more or equally effective than those already approved.[124]

The USDA's December 1978 review was more hostile. Although it clearly contradicted industry warnings of a post-ban economic collapse, the report was based on the curious assumption that the FDA was attempting to ban all AGPs at once. [125] According to the USDA, "farm and food prices would increase initially", but the economic system would generally "be quite resilient to a more restrictive policy on animal drug use."[126] Farm incomes might even increase as a result of reduced animal numbers.[127]

Although FDA officials subsequently attempted to use both reports to push for Congressional approval, the activism of the early Kennedy years had

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[122] 'Drugs in Livestock Feed', p. 8.
[123] Ibid.
[124] Ibid., pp. 11-13.
[125] 'The Economic Effects of a Prohibition on the Use of Selected Animal Drugs', (Washington DC: USDA Economics, Statistics and Cooperative Service, 1978).
[126] 'Antibiotics in Animal Feed. Hearings before the Subcommittee on Health and the Environment on H.R. 7285', *Subcommittee on Health and the Environment of the Committee on Interstate and Foreign Commerce* (House of Representatives; Washington DC: US Government Printing Office, 1980), p. 432.
[127] 'The Economic Effects of a Prohibition on the Use of Selected Animal Drugs'.

dissipated and officials were further demoralised by having to wait for the outcome of the 1980 NAS study. Frustrated, Commissioner Kennedy left the FDA to become President of Stanford University in June 1979. 17 years later, Kennedy reflected:

> I felt that the evidence was plenty good enough [sic] to justify ruling [AGPs] out, but we lost that fight then, although plainly we were right, and that's something that has turned out since to have been a real worry. I'm glad we tried to take action on it and at least got it on the table...[128]

While resistance-inspired AGP restrictions failed to pass Congress, rising external oversight during the late 1970s did force the FDA to readdress feed mill compliance and residue reductions.

Reacting to on-going feedstuff violations and inadequate official controls,[129] an FDA medicated feed Task Force was established in June 1978. The Task Force subsequently recommended substantial reforms of monitoring and licensing[130] and criticised internal rivalries between the FDA's BVM and Bureau of Foods (BuFo). Problematically, C.D. Van Houweling's BVM had been allowed to overrule BuFo decisions even if the BuFo had concerns about products' effect on food security: "… each bureau has become suspicious and critical of the other."[131] Perhaps referring to qualms about Van Houweling, Donald Kennedy noted that reducing BVM powers would "be a useful political signal at this time, given the

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[128]'Oral History Interview of Donald Kennedy by Robert A. Tucker ', *History of the US Food and Drug Administration - FDA Oral History Transcripts* (http://www.fda.gov/downloads/AboutFDA/WhatWeDo/History/OralHistories/SelectedOralHistoryTranscripts/UCM265233.pdf [accessed: 13.04.2015], 17.06.1996), p. 12.

[129] 'Second Generation of Medicated Feeds. Medicated Feed Task Force Report and Recommendations', Dec. 1978, Folder#94 432.1 1978 Jan-March, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA.

[130] 'FDA Talk Paper', Dec. 15, 1978, Folder #90 1978 432.1 1978 Oct-Dec, Box (FRC) 17, GS, DF UD-WW/Entry II, RG 88, NARA.

[131] 'Action Plan for the [BF] Animal Drugs Program', Feb. 13, 1978, enclosed in: Joseph P. Hile and Van Houweling to Commissioner, Jun. 07, 1978, Folder #92 432.1 1978 June-July, Box (FRC) 18, GS, DF UD_WW/Entry II, RG 88, NARA, p. 5.

range of animal drugs problems we're facing."[132] Although inspection programs were subsequently improved, the $850,000 joint-inspection budget and Kennedy's resignation made the long-term success of feedstuff reforms doubtful.[133]

During the 1970s, noncompliance in the feedstuff sector also exacerbated residue problems. However, in contrast to previous decades, residues were now being highlighted by expanded USDA monitoring. Although the early 1970s saw ca. 80 million hogs and over 35 million cattle and 3 billion poultry annually slaughtered in the US,[134] the USDA had tested only 1249 meat samples for antibiotic residues in 1970.[135] Hoping to "[put] the fear of God or FDA into"[136] producers, monitoring efforts were gradually expanded throughout the 1970s, causing problems for an ill-prepared FDA.[137] Despite reports from concerned consumers and parents whose children had experienced severe reactions to drug residues in their food,[138] officials had done little to improve enforcement. In 1975, it was revealed that the FDA was unable to assay 27 licensed animal drugs in meat. During subsequent Congressional hearings, it emerged that Van Houweling, who was later forced to resign by Commissioner Kennedy and became a consultant for the pork lobby (NPPC), had pressured staff to license

[132] Ibid., enclosed: Action Item 2: Function of the Bureau of Foods Director & Action Item 4: Bureau of Foods Organization Unit for Animal Drug Program Management.
[133] Donald C. Healton, 'Memorandum – BVM Proposed Letter to State Governors – Re: Medicated Feed Contract Program', Sep. 12, 1979, Folder #97 432.1-432.1 Sept-Oct 1979, Box (FRC) 19, General Correspondence [in the following GC], DF UD-WW/Entry 26, RG 88, NARA, p. 2.
[134] H. C. Mussman, 'Drug and Chemical Residues in Domestic Animals', *Federation Proceedings (Federation of American Societies for Experimental Biology),* 34/2 (1975), p. 197.
[135] 'Regulation of Food Additives and Medicated Animal Feeds', p. 183.
[136] Ibid., p. 585.
[137] Mussman, 'Drug and Chemical Residues in Domestic Animals', p. 200.
[138] Sandra Eckman to Jimmy Carter, Jun. 02, 1977, Folder #108 432.1 1977 July, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA; Patricia McQueen to Aaron Finkelman, Nov. 2, 1977, Folder #105 432.1 1977 Oct-Dec, Box (FRC) 21, GS, DF UD-WW/Entry 8, RG 88, NARA.

drugs for which there were no assay methods.[139] Van Houweling also used his influence to moderate the FDA's response to SMZ residues in pork.[140]

Meanwhile, prosecutions of residue offenders remained rare. During the 1970s, most offenders merely received a letter informing them that their animals' carcasses had contained illegal residues.[141] Between January 1972 and January 1978, the FDA conducted only 282 follow-up investigations as a result of oxytetracycline, chlortetracycline, tetracycline and/or penicillin residue detections.[142] Given such toothless enforcement, farmers continued to ignore drug guidelines. In early 1977, the USDA informed a woman who was allergic to antibiotics that it was best to avoid all conventional US meat and milk and switch to alternative drug-free producers.[143] Authorities could not guarantee that conventional US produce was 'safe'.

With faster and more effective USDA residue tests leading to a rapid increase of sampling and residue detections during the late 1970s and early 1980s,[144] FDA authorities were under sever pressure to adapt. Writing to Commissioner Kennedy in 1978, Van Houweling's successor as BVM director, Lester Crawford, suggested adopting a two-pronged strategy: while it would continue to publish assurances that US meat was safe and refrain from expanding enforcement, the FDA would focus on securing the successful

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[139] 'Oral History Interview of Cd Van Houweling by Ronald T. Ottes', p. 16.
[140] Maryln Perez to Berkley Bedell, Feb 07, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA, p. 1.
[141] James Tessmer to Idaho Feed Lot, Jul. 22, 1977, Folder #108 432.1 1977 July, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA.
[142] Catherine W. Carnevale to Philip J. Frappaolo, Nov. 03, 1978, Folder #90 1978 432.1 1978 Oct-Dec, Box (FRC) 17, GS, DF UD-WW/Entry II, RG 88, NARA.
[143] LV Sanders to Evelyn Levy, Feb. 07, 1977, Folder 111 1977 432.1 Jan-May, Box (FRC) 22, GS, DF UD-WW/Entry 8, RG 88, NARA, p. 2.
[144] Sarah Hartman, Donna V. Porter, and Elizabeth R. Withnell, 'Food Safety Policy Issues', (Washington DC: Congressiional Research Service, 1981), pp. 74-76.

prosecution of a limited amount of offenders and develop assays capable of upholding these prosecutions in court.[145] However, little happened.

The 1980s were a time of regulatory frustration not only for residues but also for resistance-based substance restrictions. Published in March 1980, the congressionally mandated NAS study did not endorse AGP bans. The study's negative outcome was in part due to problematic terms of reference. Already tasked with assessing "the scientific feasibility of additional epidemiological studies"[146] and focussing exclusively on the historically vague category of 'subtherapeutic' penicillin and tetracycline use, it was to be expected that the NAS committee would call for further research. Unsurprisingly, the final report concluded, "…that the postulated hazards to human health from the subtherapeutic use of antimicrobials in animal feeds were neither proven nor disproven."[147] Taking care to limit discussions to subtherapeutic antibiotic use, the NAS also cautioned that conclusive data on harm was unlikely to emerge in the future:

> … it is not possible to conduct a feasible, comprehensive epidemiological study of the effects on human health arising from the subtherapeutic use of antimicrobials in animal feeds, ...[148]

This last assessment was, however, ignored by the House Appropriations Committee, which provided funds for "a definitive epidemiologic study of the antibiotics in animal feeds issue"[149] and prolonged the existing moratorium on FDA action.

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[145] Lester Crawford to The Commissioner, Aug. 18, 1978 Folder #91 432.1 1978 Aug-Sept, Box (FRC) 18, GS, DF UD-WW/Entry II, RG 88, NARA, p. 4; also see: ibid., p. 79.
[146] 'The Effects on Human Health of Subtherapeutic Use of Antimicrobials in Animal Feeds', p. vii.
[147] Ibid., p. xv.
[148] Ibid.
[149] 'Antibiotic Resistance', *Subcommittee on Investigations and Oversight of the Committee On Science and Technology US House of Representatives* (December 18, 19, 1984 edn., US House of Representatives; Washington DC, 1985), p. 81.

Unwilling to accept a prolongation of the *status quo*, Democrat Representatives Henry A. Waxman and John Dingell proposed a bill (H.R. 7285) that would allow the Secretary of Health to limit antibiotics in animal feeds if they did not meet a 'compelling need'.[150] In June 1980, the House Committee on Interstate and Foreign Commerce's Subcommittee on Health and the Environment held hearings on AGPs. Testifying experts remained divided. According to American Medical Association vice-president Asher J. Finkel, his organisation could not "state at this time that there is sufficient evidence of the transfer of disease-causing antibiotic resistant bacteria from animals to humans to warrant alarm..."[151] By contrast, OTA Assistant Director Joyce Lashof noted:

> Our [1979] conclusion was that the increasing pool of resistant bacteria is a serious health risk to humans, and that the contribution from low-level antibacterial use in animal feeds played a significant part in increasing the general pool of genetically resistant organisms. (…). We also pointed out that it was not relevant that the therapeutic use in humans of these same antibacterials may be a larger contributor to the development of resistance, as long as animal feed use was in itself a significant contributor to resistance. (…). Furthermore, at any point in time the number of animals exposed to antibiotics far exceeds the number of humans exposed, …[152]

The FDA's Lester Crawford also supported HR7285.[153]

However, HR7285 failed to pass Congress, and chances for antibiotic restrictions decreased dramatically after the election of Ronald Reagan in late 1980. Between 1981 and 1989, the FDA's workload grew significantly while its budget stagnated and its overall workforce declined from 8,089 to 7,398. Reverting to voluntary industry compliance, the number of FDA enforcement

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[150] 'Antibiotics in Animal Feed. Hearings before the Subcommittee on Health and the Environment on H.R. 7285'.
[151] Ibid., p. 344.
[152] Ibid., p. 353.
[153] Ibid., pp. 427-28; 34; Dingel even sent a letter to *Science*; John D. Dingell, 'Animal Feeds: Effect of Antibiotics', *Science,* 209/4461 (1980).

actions dropped from an average of ca. annual 1041 actions between 1977 and 1980 to 577 actions in 1981.[154] Meanwhile, CDC personnel at the National Center for Infectious Diseases decreased by 15% between 1985 and 1988.[155]

The Reagan administration also changed basic decision-making pathways within the renamed Department of Human and Health Services (HHS). Taking over as HHS secretary in 1981, former Republican Senator Richard Schweiker interfered directly in FDA decision-making and usurped significant powers. Following 1981, FDA regulations had to be personally signed by the HHS Secretary. Intent on reducing 'overregulation' and the 'drug lag', it was extremely unlikely that Secretary Schweiker would agree to AGP restrictions. FDA Commissioner Arthur Hull Hayes was equally unlikely to push for bans. Appointed by the Reagan administration, Hayes enjoyed a close relationship with pharmaceutical producers and later had to resign because of accepting financial honoraria.[156] But even if Hayes and Schweiker had approved AGP restrictions, it was unlikely that they would have passed the OMB. In February 1981, Ronald Reagan's Executive Order 12291 turned the OMB into an extremely powerful organisation by requiring all federal agencies to submit cost-benefit analyses to the OMB. According to Lucas Richert, "E.O. 12291 soon made an impact on regulation-making at the FDA"[157] and decreased the transparency of decision-making.

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[154] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 97-98; 101.
[155] Podolsky, *The Antibiotic Era. Reform, Resistance and the Pursuit of a Rational Therapeutics*, p. 167.
[156] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 83-91.
[157] Ibid., p. 95.

Although the NRDC's 1983 petition and Scott Holmberg's 1984 *Salmonella* studies briefly reignited hopes for AGP restrictions,[158] chances for AGP restrictions under the Reagan administration were extremely slim. HHS and OMB oversight remained in place even after Hayes' and Schweiker's 1983 resignations and new FDA Commissioner Frank Young showed little enthusiasm for AGP bans.[159] During hearings on antibiotic resistance by Democrat Representative Al Gore's Subcommittee On Investigations And Oversight in December 1984, Lester Crawford also displayed markedly less enthusiasm for antibiotic restrictions than four years earlier.[160] In 1985, HHS Secretary Margaret Heckler's rejection of the NRDC petition thus came as no great surprise. Heckler based her decision on an FDA review, which stated that the NRDC had not proven that *Salmonella* posed an imminent hazard. Although Heckler's decision did not prevent the FDA from proceeding with formal withdrawal procedures, it effectively ended the 1970s ban attempts.[161]

Following 1985, CDC experts, non-governmental scientists and critical politicians played a crucial role in keeping the subject alive on Capitol Hill. In December 1985, Democrat Congressman Ted Weiss's Intergovernmental Relations and Human Resources Subcommittee published a scathing review of FDA medicated feed market oversight. According to the subcommittee, internal FDA estimates believed that "as many as 90 percent or more of the 20,000 to 30,000 new animal drugs estimated to be on the market" had not been approved

[158] Chapter Ten, pp. 237-238.
[159] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 116-21; 28-30.
[160] 'Antibiotic Resistance', pp. 83-96.
[161] Stuart Levy, *The Antibiotic Paradox: How the Misuse of Antibiotics Destroys Their Curative Powers* (Cambridge MA: Perseus Publishing, 2002 [2001]), pp. 298-99.; cf. also the description of the run-up to the decision in William A. Moats (ed.), *Agricultural Uses of Antibiotics* (American Chemical Society Symposium Series 320, Washington DC: American Chemical Society, 1986), pp. 104-09.

as safe and effective and were "marketed in violation of the new animal drug approval requirements of the [FDC]."[162] Noncompliance encompassed "the entire agribusiness community"[163]:

> Illegal veterinary drug sales are of such magnitude and pervasiveness that they threaten the 'credibility of the veterinary drug approval and regulatory process.' On one two-week road trip in Iowa, for example, an FDA investigator was able to make 40 illegal buys out of 43 attempts.[164]

Weiss' subcommittee also attacked recent FDA licensing decisions. According to a CVM official, political pressure for speedy drug approvals had fostered dubious FDA licensing and a problematic weakening of the BuFo.[165]

Two years later, on-going concerns about antimicrobial resistance forced the FDA to commission a further review of agricultural antibiotics with the NRC's Institute of Medicine (IoM). Not tasked with making policy recommendations, the IoM's terms of reference were limited to performing a quantitative assessment of the risks associated with feeding penicillin and tetracyclines at subtherapeutic levels.[166]

Unsurprisingly, the 1988 IoM report restated that "unequivocal direct evidence linking mortality to the postulated initial events is not available – certainly not in sufficient quantity to establish a cause-and-effect relationship."[167] Regretting the absence of UK data on *Salmonella* resistance development,[168] the IoM committee used US salmonellosis data to quantify human health hazards. Ca. 15% of the 50,000 salmonellosis cases annually

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[162] Committee on Government Operations, 'Human Food Safety and the Regulation of Animal Drugs', *Union Calender* (Washington: House of Representatives, 1985), p. 2.
[163] Ibid.
[164] Ibid., p. 5.
[165] Ibid., p. 8.
[166] 'Report of a Study. Human Health Risks with the Subtherapeutic Use of Penicillin or Tetracyclines in Animal Feed. 1988.', (Washinton DC Committee on Human Health Risk Assessment of Using Subtherapeutic Antibiotics in Animal Feeds (IoM), 1989), pp. iii-iv.
[167] Ibid., p. v.
[168] Ibid., p. 7.

reported in the US were resistant to penicillin and the tetracyclines. Total mortality from resistant *Salmonella* was ca. 1%. Of the ca. 70% of fatal salmonellosis cases associated with strains of farm origin, 88% were attributable to the general agricultural use of subtherapeutic antibiotics and ca. 90% to the use of penicillin/ampicillin and tetracyclines. Following these arcane calculations, the IoM estimated that there were ca. 40 annual deaths in the US attributable to the subtherapeutic use of penicillin and tetracyclines for prophylaxis and growth promotion.[169]

Calling for improved data provision and resistance monitoring,[170] the IoM committee itself cautioned that its estimate was not very robust. The committee had not considered human morbidity, the effects of other AGPs, therapeutic antibiotic doses and the health hazards from other resistant organisms like *Campylobacter jejuni, enterohemorrhagic E. coli* and *Yersinia enterocolitica*.[171] Although no causal link between AGPs and human death or disease had been found, there was "ample evidence" documenting the "high prevalence" of resistance "among isolates of salmonellae from farm animals":

> The frequency of resistance to any of the commonly tested antimicrobials among farm-animal isolates of salmonellae ranges from 69 to 80%; (…). These frequencies of resistance (…) are 3-5 times greater than those among strains isolated from human beings.[172]

However, the attention paid to the IoM report and a parallel CAST report was minimal.[173] In part, this was due to a major corruption scandal within the FDA's Generic Drugs Division, which peaked between 1989 and 1990. The

[169] Ibid., pp. 8-9.
[170] Ibid., p. 207.
[171] Ibid., pp. 10-11.
[172] Ibid., p. 3.
[173] Virgil W. Hays and Charles A. Black, *Antibiotics for Animals: The Antibiotic Resistance Issue. Comments from Cast* (Iowa: Council for Agricultural Science and Technology (CAST), 1989), p. 1.

scandal resulted in the arrest of over 40 people and Commissioner Young's transfer to HHS. In early 1990, the Bush Administration ordered a committee chaired by ex-FDA Commissioner Charles Edwards to conduct a complete review of the FDA. The committee found that the Reagan administration had compromised FDA consumer protection by allowing HHS and OMB to usurp decision-making. Strengthened by a Supreme Court ruling against OMB countermanding of agency decisions, the committee's report also recommended ending HHS approval requirements and marked the beginning of a relative strengthening of the FDA.[174]

Appointed in August 1990,[175] reforming FDA Commissioner David A. Kessler immediately faced the scandal surrounding CHARM II detections of SMZ in culturally sensitive and already extensively monitored milk.[176] Having already conducted the scathing 1985 FDA review, Democrat Congressman Ted Weiss accused FDA officials of not "really keeping up with scientific advances" and not being "diligent enough nor aggressive enough in pursuing those people who use and prescribe those drugs, unlawfully, …"[177] For Weiss, the CVM's failings were amplified by the fact that it had known that SMZ might be carcinogenic since 1980 and had failed to act on this information.[178]

However, FDA monitoring reforms remained tardy. In 1992, the biochemist and microbiologist Stanley E. Katz, who had been involved in revealing the original SMZ scandal, published a paper on residues together with

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[174] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 167-78, Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, p. 167.
[175] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 179-82.
[176] Chapter Ten, pp. 239-240; 'Fda's Regulation of Animal Drug Residues in Milk', pp. 114-15.
[177] Ibid., p. 131.
[178] Ibid., p. 143.

Marietta Sue Brady. According to Katz, reformed FDA milk surveys were merely "snapshots":

> Fifty-three drugs have been approved by FDA for use in dairy animals; 25 drugs have been reported to be used in an extra-label fashion. Only a small number of drugs are looked for in the milk supply; of these, only 6 drugs have confirmatory procedures. (…), it is not beyond reasonable logic to assume that market milk contains low concentrations of residues, at frequencies that vary. [179]

After a GAO report criticised existing extra-label drug use policies and on-going testing problems,[180] FDA CVM official Gerald Guest promised improvements but also defended the FDA policies in front of Weiss' Subcommittee in August 1992:

> [The 1968 FDC reform] required us in the approval process to make drugs available to lay persons, if adequate directions for use could be written. So 90 percent of the therapeutic drugs for use in food-producing animals are legally sold over the counter. [181]

Initially allowing veterinarians to use "whatever he or she could legally obtain"[182], voluntary 1984 FDA guidance advised extra-label drug use only when an animal was suffering or its life was threatened. By 1992, veterinarians were also supposed to inform farmers about responsible drug use and withdrawal times. Guest defended this policy:

> I'm quite willing to come down real hard on a veterinarian if he or she creates a drug residue because of that. I'm not near so willing to tell a veterinarian they cannot treat a sick animal.[183]

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[179] Stanley E. Katz and Marietta Sue Brady, 'Incidence of Residues in Foods of Animal Origin', in Vipin K. Agarwal (ed.), *Analysis of Antibiotic/ Drug Residues in Food Products of Animal Origin* (New York and London: Plenum Press, 1992), p. 18.
[180] 'Food Safety and Quality. Fda Strategy Needed to Address Animal Drug Residues in Milk', (Washington: United States General Accounting Office (GAO), 1992 August).
[181] 'Problems with Fda Monitoring for Animal Drug Residues: Is Our Milk Safe?', *Human Resources and Intergovenrmental Relations Subcommittee of the Committee on Government Operations* (Second Session edn., House of Representatives; Washington: US Government Printing Office, 1992), p. 69.
[182] Ibid., p. 70.
[183] Ibid.

Despite its inability to devise assays for many licensed drugs, [184] the FDA did not consider substance bans, which might have alleviated the need for expensive tax-funded monitoring programs.

Concerns about US food safety refused to die down. In the wake of the Jack-in-the-Box food poisoning scandal, a 1994 GAO report pressed for risk-based Hazard Analysis Critical Control Point (HACCP)-inspections that focussed on a biological, physical, and chemical assessment of neuralgic points of food production. The report also called for a shift of emphasis from chemical to microbiological contaminants:

> FSIS' meat and poultry inspection system does not efficiently and effectively use its resources to protect the public from the most serious health risks associated with meat and poultry – microbial contamination.[185]

Five months later, a second GAO report criticised the USDA's National Residue Program. Not only were there no testing methodologies for up to two-thirds of "367 compounds already identified as being of potential concern"[186], but also the random sampling at the heart of USDA monitoring efforts was flawed. According to the report, the USDA's FSIS "did not consistently follow random sampling procedures" and did "not adjust its sampling of some species to compensate for climatic/geographic and seasonal changes in slaughter rates and animal drug use." [187] The averaging of residue finds from different species further compromised the validity of national residue reports.[188]

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[184] Ibid., pp. 93-95.
[185] 'Food Safety. Risk-Based Inspections and Microbial Monitoring Needed for Meat and Poultry', (Washington DC: United States General Accounting Office, 1994 May), p. 2, Jones, *Valuing Animals. Veterinarians and Their Patients in Modern America*, p. 151.
[186] 'Food Safety. Usda's Role under the National Residue Program Should Be Reevaluated.', (Washington DC: United States General Accounting Office, 1994 September), p. 3.
[187] Ibid., p. 4.
[188] Ibid., p. 24.

A reform of the National Residue Program was possible, but it would be more effective to overhaul the entire monitoring system.[189] In addition to monitoring, the GAO also criticised FDA enforcement. Between 1989 and 1992, the FDA had only investigated ca. 20% of the 21,439 residue violations reported by FSIS. Whereas "almost 2,300 violators were reported during that period,"[190] only one prosecution, 12 injunctions and 383 warning letters had resulted from FDA investigations[191]

Over forty years after antibiotics' mass-introduction to US agriculture and numerous warnings, authorities continued to have little control over the medicated feed market and the contamination of US food and milk. Meanwhile, the regulatory *status quo* regarding resistance-motivated antibiotic restrictions continued. In 1994, Congress asked the OTA for an assessment of hazards resulting from antimicrobial resistance.[192] The OTA's Advisory Panel included antibiotic activists like Stuart Levy and Nobel-laureate Joshua Lederberg as well as senior industry representatives. Identifying resistance as a serious economic and political hazard in its September 1995 report, the OTA also devoted a chapter to 'Antibiotics in Animal Husbandry.' Although studies showing "a direct connection between agricultural use of antibiotics and human illness or death" remained "sparse and difficult to obtain"[193], the report noted that antimicrobial resistance originating in agricultural settings could be dangerous. Over 40% of the population harboured resistant bacteria in their colon, which could cause harm following antibiotic-ingestion for other reasons. Resistant food-borne

[189] Ibid., p. 5.
[190] Ibid., p. 6.
[191] Ibid., pp. 4 & 32.
[192] 'Impacts of Antibiotic-Resistant Bacteria', (Washington DC: Office of Technology Assessment. Congress of the United States, 1995 September), p. 2.
[193] Ibid., p. 156.

pathogens like *Campylobacter jejuni* and *Salmonella* were already difficult to treat. Agricultural antibiotic use could also turn farmers into carriers of resistant bacteria and select for environmental bacterial resistance.[194]

The OTA also warned against following the example of European states by licensing agricultural uses of fluoroquinolones.[195] However, with the FDA under political pressure to reduce regulatory hurdles,[196] considerations of resistance did not prevail and the fluoroquinolones sarofloxacin and enrofloxacin (Baytril) were licensed for agricultural purposes in 1995 and 1996. In a statement before Congress, FDA Deputy Commissioner Michael Friedman defended fluoroquinolones' licensing by announcing that the FDA would monitor whether bacterial resistance patterns changed and take action if necessary.[197]

Pressure on FDA officials to reduce regulatory barriers for new drugs only increased over the next four years. Fully enacted in 1999, the 1997 Food and Drug Administration Modernization Act (FDAMA) was designed to tighten NDA deadlines and speed up licensing. However, consumer groups soon criticised FDAMA's risk-based priority assessments and the reduced time allowed for FDA drug analysis.[198] Two years later, Republican Senator Richard Shelby made a two-line addition to a large omnibus bill. Sounding good on paper, the Shelby Amendment allowed Freedom of Information Requests for federally sponsored research but in effect opened a further door for industry to delay or cast doubt on uncomfortable research. In 2000, the Information Quality Act

[194] Ibid., pp. 159-62.
[195] Ibid., p. 165.
[196] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, pp. 181-85.
[197] 'Impacts of Antibiotic-Resistant Bacteria', pp. 30-32.
[198] Richert, *Conservatism, Consumer Choice, and the Food and Drug Administration During the Reagan Era: A Prescription for Scandal*, p. 185.

(Data Quality Act) – developed with the help of Philip Morris – was passed via a similarly large appropriations bill. Supposed to standardize the quality, utility and integrity of scientific reviews and risk assessments, the Act re-empowered OMB economists to control regulatory agencies' scientific output.[199]

The three pieces of legislation were bad news for critics of agricultural antibiotic use. In an age of institutionalised cost-benefit assessments, it remained virtually impossible to estimate agricultural antibiotics' costs and easy to highlight antibiotics' economic benefits in already antibiotic-dependent production systems.

With its regulatory options severely limited, FDA reactions to the EU's 1998 AGP bans remained limited to a draft framework for 'evaluating and assuring the human safety of the microbial effects of antimicrobial New Animal Drugs'.[200] According to the draft framework, license applicants would have to submit data on antibiotics' effects on resistant bacteria in animals' intestines and estimate resulting human exposure to resistant bacteria, R-factors and pathogens.[201] The FDA would then conduct post-licensing surveillance. The draft framework would apply to already licensed drugs "only to the extent resources allow."[202]

In practice, the proposed post-marketing surveillance of new products was already proving problematic. Since 1996, the National Antimicrobial Resistance Monitoring System's (NARMS) Enteric Bacteria program had tested

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[199] Vogel, *Is It Safe? Bpa and the Struggle to Define the Safety of Chemicals*, pp. 168-69.
[200] 'Food Safety. The Agricultural Use of Antibiotics and Its Implications for Human Health', (Washington United States General Accounting Office 1999 April), p. 3.
[201] Donna U. Vogt and Brian A. Jackson, 'Antimicrobial Resistance: An Emerging Public Health Issue', *CRS Report for Congress* (Congressional Research Service. Library of Congress, 2001 January 24th), pp. CRS 24-25.
[202] 'Food Safety. The Agricultural Use of Antibiotics and Its Implications for Human Health', p. 3.

Salmonella – and from 1997 *Campylobacter* – as a sentinel organism for susceptibility to 17 antibiotics.[203] However, two years later, rising fluoroquinolone resistance had failed to prompt regulatory action, and the FDA even considered expanding agricultural fluoroquinolone use in 1998.[204]

By the end of the millennium, it seemed as though US antibiotic regulation would continue to stagnate in its post-1966 moorings. Proposed in 1999, a Preservation of Essential Antibiotics for Human Diseases Act failed to pass Congress. Although resistance data resulted in FDA action against enrofloxacin and sarafloxacin in late 2000, the resulting five-year legal battle with Bayer over enrofloxacin highlighted the FDA's statutory weakness. Meanwhile, other federal initiatives against antimicrobial resistance simply ignored agricultural antibiotic use. In 2000, the Public Health Improvement Act (PHIA) gave statutory power to an Interagency Task Force on Antimicrobial Resistance (ITFAR) and authorized $40 million to foster drug development, resistance monitoring and the prudent use of antibiotics in medicine.[205]

With companion bills for AGP bans once again failing in 2003 despite a supportive WHO report,[206] FDA attempts to reduce agricultural antibiotic use remained limited to voluntary and educational measures. Similar to the 2003 'Get Smart: Know When Antibiotics Work' campaign for human medicine, the CVM developed prudent antibiotic use principles for livestock producers. In

[203] Ibid., p. 7; by 2006, NARMS was testing for resistance in *Salmonella* ser. Typhi, *Shigella*, *Campylobacter*, and *E. Coli* 0157; Geoffrey S. Becker, 'Antibiotic Use in Agriculture: Background and Legislation', *CRS Report for Congress* (Washington DC: Congressional Research Service, 2009 July 30th), p. 7.
[204] 'Food Safety. The Agricultural Use of Antibiotics and Its Implications for Human Health', p. 12.
[205] Vogt and Jackson, 'Antimicrobial Resistance: An Emerging Public Health Issue', pp. CRS 1-2.
[206] Geoffrey S. Becker, 'Animal Agriculture: Selected Issues in the 108th Congress', ibid.(2003 October 15th), pp. CRS 25-26, 'H.R. 1549, Preservation of Antibiotics for Medical Treatment Act (Pamta)', *Committe on Rules US House of Representatives* (First Session Monday July 13, 2009 edn., US House Of Representatives; Washington DC: UNS Government Printing Office, 2009), p. 12.

2003, the FDA also released voluntary Guidance #152 for 'Evaluating the Safety of Antimicrobial New Animal Drugs with Regard to Their Microbiological Effects on Bacteria of Human Health Concern'. Based on the 1998 draft framework, Guidance #152 instructed animal drug sponsors on preparing a hazard characterization of their product with regards to antimicrobial resistance. FDA and producers would then co-develop a risk assessment of the new antimicrobial product and the FDA would subsequently determine appropriate conditions of use and potential further evaluations. While FDA risk management could also include post-approval resistance monitoring, hazards such as agricultural runoff remained unaddressed.[207]

Following criticism of the glacial development of US antibiotic reform by a 2004 GAO assessment,[208] a brief window for reform opened in July 2005 when Lester Crawford was appointed as FDA Commissioner. Passionately arguing for AGP bans in 1980, Crawford had toned down his rhetoric under the Reagan administration but announced a withdrawal of Baytril ten days after his inauguration.[209] However, only two months later, Crawford was forced to resign after pleading guilty to a conflict of interest as a shareholder of FDA-regulated companies.[210]

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[207] 'Guidance for Industry #152: Evaluating the Safety of Antimicrobial New Animal Drugs with Regard to Their Microbiological Effects on Bacteria of Human Health Concern', (Washington DC, 2003 October).
[208]'Antibiotic Resistance. Federal Agencies Need to Better Focus Efforts to Address Risk to Humans from Antibiotic Use in Animals ', (Washington United States General Accounting Office, 2004 April), p. 6.
[209] 'Fda Announces Final Decision About Veterinary Medicine', *FDA News Release, P05-48* (http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2005/ucm108467.htm [accessed: 17.04.2015], 28.07.2005).
[210] 'Lester M. Crawford - Fda Commissioners Page', *FDA History. FDA Leaders & Their Deputies. Commissioners* (http://www.fda.gov/AboutFDA/CommissionersPage/ucm110706.htm [accessed: 17.04.2015]).

Following the 2007 election and the reintroduction of PAMTA (H.R. 962),[211] supporters and critics rallied for what seemed a decisive debate on agricultural antibiotics. Politically, the context for restrictions had not been so promising since the 1970s. In 2008, a Democratic president could count on the support of two Democrat-controlled Houses. In the same year, restrictions were endorsed by a PEW report on Industrial Farm Animal Production, which recommended that antimicrobial licensing for nontherapeutic uses in food animals be stopped and older licensing decisions reinvestigated. According to the PEW report, all nontherapeutic antibiotic uses in food animals should ultimately be phased out. The report also recommended significant improvements in agricultural, medical and environmental antimicrobial resistance monitoring and in official data collection on antibiotic consumption.[212]

Although old frontlines re-emerged during subsequent hearings and the new CVM Director Bernadette Durham remained remarkably cool regarding the prospect of EU-style AGP bans,[213] legislative change seemed forthcoming. In 2008, Congress added a provision to the Animal Drug User Fee Amendments requiring drug sponsors to submit an annual report to the HHS for each approved antimicrobial drug sold or distributed for use in food-producing animals. Reports had to contain information on the amount of active ingredient

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[211] Geoffrey S. Becker, 'Food Safety: Selected Issues and Bills in the 110th Congress', *CRS Report for Congress* (Washington: Congressional Research Service, 2007 September 4), p. CRS 12.
[212] 'Putting Meat on the Table: Industrial Farm Animal Production in America', (PEW Commission on Industrial Farm Animal Production, 2008), pp. 61-67.
[213] 'Hearing to Review the Advances of Animal Helath within the Livestock Industry', *Subcommittee On Livestock, Dairy, And Poulty of the Committee on Agriculture* (Second Session, September 25, 2008 edn., House of Representatives; Washington DC: US Government Printing Office, 2009), pp. 22-32; 73-90, 'Emergence of the Superbug: Antimicrobial Resistance in the United States', *Committee On Health, Education, Labor, And Pensions* (United States Senate; Washington DC: US Government Printing Office, 2010).

distributed. For the first time, officials would know how much antibiotics were being used on US farms.[214]

One year later, Democrat Representative Louise McIntosh Slaughter and Democrat Senator Harry Reid introduced updated versions of PAMTA (H.R. 1549; S. 619). HHS would be required to withdraw, within two years, the approval of any 'nontherapeutic use' in food-producing animals of a 'critical antimicrobial animal drug.' Drug manufacturers would have the burden of proving that a drug was harmless. 'Critical antimicrobial animal drugs' were composed wholly or partly of any kind of penicillin, tetracycline, macrolide, lincosamide, streptogramin, aminoglycoside or sulphonamide.[215] FDA Principal Deputy Commissioner Joshua Sharfstein stated, "… both [FDA Commissioner Margaret Hamburg] and I strongly support action to limit the unnecessary use of antibiotics in animals to protect the public health."[216] For Sharfstein, it was clear that "the use of antimicrobials should be limited to those situations where human and animal health are protected." [217] Sharfstein also called for a restriction of prophylactic antibiotic use to situations where there was veterinary supervision, evidence of efficacy and no "reasonable alternativ[e]"[218]. Although he did not explicitly endorse PAMTA, Sharfstein noted that PAMTA could provide significant regulatory relief given the prospect of "burdensome"[219] statutory drug withdrawals.

[214] Becker, 'Antibiotic Use in Agriculture: Background and Legislation', p. 5.
[215] Ibid., pp. 1-2.
[216] 'H.R. 1549, Preservation of Antibiotics for Medical Treatment Act (Pamta)', p. 9.
[217] Ibid.
[218] Ibid.
[219] Ibid., p. 10.

After agricultural and political opposition prevented PAMTA from passing beyond the hearing stage, the FDA reverted to a policy of voluntary measures.[220] In April 2012, the FDA released Guidance For Industry #209 (GFI #209) on the 'Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals" [221], which extended the voluntary pre-licensing principles of GFI #152: already licensed products containing medically important antibiotics should be limited to uses "necessary for assuring animal health" under "veterinary oversight or consultation."[222] In December 2013, Guidance for Industry #213 (GFI #213) recommended voluntary label changes for medicated feeds and drinking water so that they could be used only under veterinary supervision. Claims for increased weight gain or feed efficiency were no longer considered suitable.[223] To facilitate the end of OTC antibiotic feeds, the FDA planned to reform the 1999 Veterinary Feed Directive, which mirrored the failed 1978 Controls Document and allowed the restriction of feeds to veterinary oversight.[224] Officials threatened to consider "further action under the existing provisions of the FD&C" if, after three years, "we determine that adequate progress has not been made".[225]

It was easy to forget that all of the Guidances were entirely voluntary. Even if manufacturers adhered to them, some AGPs would remain available OTC

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[220] Chapter Ten, pp. 247-248; Renée Johnson, 'Food Safety Issues for the 112th Congress', *CRS Report for Congress* (Washington DC: Congressional Research Service 2012 January 9), p. Summary.
[221] 'Guidance for Industry #209: The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals', (2012 April).
[222] Ibid., pp. 21-22.
[223] 'Guidance for Industry #213: New Animal Drugs and New Animal Drug Combination Products Administered in or on Medicated Feed or Drinking Water of Food-Producing Animals: Recommendations for Drug Sponsors for Voluntarily Aligning Product Use Conditions with Gfi #209', (2013 December), p. 5.
[224] Ibid., pp. 4-8.
[225] Ibid., p. 9.

and access to restricted AGPs remained possible via veterinary prescriptions. Speaking at the Royal Institute of International Affairs' One Health Colloquium in 2014, Commissioner Hamburg nonetheless claimed that FDA Guidances were a success: 26 pharmaceutical companies were in the process of revising labels and 30 individual OTC preparations had already been withdrawn. Aware of considerable scepticism, Hamburg attempted to present the Guidances as a victory of pragmatism:

> Experience has shown us that this in fact, is the quickest, most efficient way to reach our collective goal – considerably faster than a mandatory ban that would have required dozens of individual legal proceedings on each product.... [226]

However, Hamburg remained vague on how the FDA would ensure label compliance. Instead of creating statutory regulations for AGPs, which might one day be extended to therapeutic antibiotic use, Hamburg's FDA hoped to contain bacterial resistance with voluntary compliance, new drugs and improved surveillance.

Having stepped down in April 2015, Commissioner Hamburg's optimism has been criticised by senior politicians and the media. In September 2014, a *Reuters* report reviewed over 320 'feed tickets', which detailed practices in Tyson Foods, Pilgrim's Pride, Perdue Farms, George's and Koch Foods:

> The documents show that antibiotics were given as standard practice over most of the life of the chickens, (…). In every instance of antibiotic use identified, the doses were at the low levels that scientists say are especially conducive to the growth of so-called superbugs ... [227]

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[226] Margaret Hamburg, 'Fda Strategies for Combatting Antimicrobial Resistance', *Speeches by FDA Officials* (http://www.fda.gov/NewsEvents/Speeches/ucm427312.htm [accessed: 17.03.2015]).
[227] Brian Grow and P.J. Huffstutter, 'Us Lawmakers Wants to Curb Antibiotic Use on Farms'', *Reuters* (http://www.reuters.com/article/2014/09/16/us-farmaceuticals-chicken-congress-idUSKBN0HB1YZ20140916 [accessed: 17.04.2015], 16.09.2014).

In December 2014, Democrat Senators Elizabeth Warren, Kirsten Gillibrand and Dianne Feinstein expressed concern

> … that FDA may lack the authority to ensure veterinarians adhere to the criteria for determining an appropriate preventive use laid out in its guidance documents, that the FDA does not have a clear mechanism for collecting the data necessary to evaluate whether its policies effectively reduce the public health threat, and that the administration has no clear metrics or benchmarks that will be used to determine success or a need for future action.[228]

In April 2015, the FDA published a summary report of 'antimicrobials sold or distributed for use in food-producing animals' in 2013. In total, 14,788,555 kg of antibiotics had been sold for use in food-producing animals. The majority of sales consisted of ionophores (30%), tetracyclines (44%) and penicillins (6%). Of the antibiotics sold for use in food-producing animals, 62% were considered medically important. Only 28% of medically important antibiotics (17% of grand total) had been administered for therapeutic indications, the rest (45% of grand total) had been administered for production or production/therapeutic indications.[229] Given such numbers, US citizens may well ask whether the Obama administration's substantial recent investment in drug development is wise if the FDA remains unable to statutorily regulate future drugs' subtherapeutic and therapeutic use.[230]

Allowing antibiotics' mass-introduction to agriculture during a time of technological euphoria, the FDA has struggled to assert its authority over these

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[228]'Three Senators Have Questions for Interagency Antibiotics Task Force', *Food Safety News* (http://www.foodsafetynews.com/2014/12/senators-have-questions-for-interagency-task-force-for-combating-antibiotic-resistant-bacteria/#.VTEPAWZqcds [accessed: 17.04.2015], 17.12.2014).

[229] '2013 Summary Report on Antimicrobials Sold or Distributed for Use in Food-Producing Animals', (Food and Drug Administration. Department of Health and Human Services, 2015 April), pp. 25; 27-29.

[230] Lena H. Sun, 'White House announces plan to fight antibiotic-resistant bacteria', *WP*, 27.03.2015, URL: http://www.washingtonpost.com/news/to-your-health/wp/2015/03/27/white-house-announces-plan-to-fight-antibiotic-resistant-bacteria/ (accessed: 17.04.2015).

substances for over half-a-century. Its failure to do so has partially been due to skilful lobbyism, counter science, Congressional interference and growing hostility against federal regulation. However, the FDA itself was often half-hearted and contradictory in its regulatory efforts. Top officials' close ties to industry and inadequate feed mill controls and residue and on-farm enforcement not only meant that the FDA failed to fulfil legal duties but also had little power to address the amorphous challenge posed by bacterial resistance.

Conclusion

After 65 years of use as feed additives and an even longer career as veterinary therapeutics, antibiotics' presence on farms has seemingly become the norm. No active farmer today remembers a time when antibiotics were not at hand.

However, early antibiotic use was mostly uncontrolled. In the US, the discovery of the antibiotic growth effect led to a profusion of antibiotic feeds for over a year before the FDA retrospectively legalised the practice. As the leading cultural and economic power of the post-war era, the US's path had a profound impact on other countries. In Britain, more cautious officials studied the results of US trials and listened to American advice before reversing previous penicillin restrictions and legalising AGPs in 1953. By licensing agricultural antibiotics, authorities were also subscribing to an American vision of industrialised livestock production.

Unfortunately, both British and US regulatory systems were ill-prepared for the challenges posed by agricultural antibiotics. Maintaining their traditional focus on preventing toxic substances in food, post-war regulators were unfamiliar with the hazards of bacterial resistance proliferation and non-toxic antibiotic applications mostly escaped regulatory scrutiny. Even after concerns about agricultural antibiotics increased, regulators' primary focus remained the prevention of residues rather than bacterial resistance. In Britain, the regulatory situation was further complicated by fragmented bureaucratic responsibilities and a tradition of informal 'gentlemen's agreements' with industry. Things were only marginally better in the US. Although the FDA was responsible for

antibiotics in human medicine and agriculture, inadequate funding, lacking expertise and insufficient statutory powers made the agency favour a gatekeeper policy based on licensing and voluntary compliance. With no data on sales, residues and resistance, officials on both sides of the Atlantic initially regulated antibiotics blindly and drug enforcement and producer controls remained rare. The only exception was milk. Hedged by strong cultural taboos, detections of penicillin in milk resulted in US and British milk monitoring programs by the 1960s.

Despite knowing about bacterial resistance and antibiotic allergies, the majority of transatlantic media commentators did not object to agricultural antibiotics either. Commentators' relative tranquillity stemmed from antibiotics' benign medical image, the perception that substances like antibiotics were crucial to overcoming the Malthusian trap and the belief that resistance could proliferate only 'vertically'.

An early transatlantic rift in antibiotic perceptions was most evident between British and US farmers. In the US, post-war farmers already had substantial experience with agricultural intensification and were familiar with manufactured feeds containing sulphas and vitamins. As a consequence, they did not think twice about adding fungal antibiotics to feeds. Because of their remarkable efficacy in fighting and preventing infections and fostering animals' growth, antibiotics quickly became a keystone holding together the dramatic intensification of post-war US livestock production. By contrast, British farmers were more wary of antibiotics. During the Second World War, animal production had decreased dramatically and British livestock production remained more diverse and small-scale than in the US. Many British farmers were wary of

antibiotic feeds and the associated American system of factory-like animal husbandry. However, rising meat demand and official pressure to reduce the balance of payments deficit gradually convinced British producers to adopt intensive US production systems, increase herd sizes and use antibiotics.

Wholesale public support for agricultural antibiotics was short-lived. By the late 1950s, concerns began to grow about antibiotic residues, antibiotic-enabled welfare problems and bacterial resistance. However, concerns grew unevenly on both sides of the Atlantic.

In the US, public concerns centred most on residues in food. In addition to the 1956 scare about antibiotics in milk, antibiotics' status as 'chemicals' made their reputation vulnerable to long-standing concerns and scandals involving unrelated carcinogenic or toxic chemicals. With attention focussed on dangerous adulterants and trust in the FDA shaken by the Welch scandal and a series of critical bestsellers, public concerns about residues forced US officials to pioneer residue monitoring programs for milk in the early 1960s and for meat in the mid-1960s. However, there was little public pressure for the FDA to address rising bacterial resistance in non-human settings.

Although residue fears were also influential, British concerns about bacterial resistance and animal welfare were far more important in changing perceptions of agricultural antibiotics than in the US. Whereas toxicologists, the Delaney Hearings and *Silent Spring* focussed US attention on invisible contaminants, British PHLS researchers tracked the spread of bacterial resistance via phage-typing and attacked the epistemic barrier separating discussions of resistance in agricultural and medical settings. In response, the British government installed the Netherthorpe committee to review AGPs in

1960. Prefiguring four decades of committee debates, the committee's medical experts were unable to prove direct harm resulting from antibiotic use on farms. Although the final 1962 report reflected this stalemate, medical experts inserted a passage calling for no further licensing of 'therapeutically' relevant AGPs. The 1962 distinction between therapeutically relevant and irrelevant antibiotics would prefigure debates and legislation in Europe and the US for the next 50 years.

One year after Britain experienced its own milk residue scandal in 1963, Ruth Harrison's *Animal Machines* fused concerns about antibiotic residues and bacterial resistance with deep-seated cultural concerns about animal welfare on 'factory farms'. One year later, research by E.S. Anderson highlighted the dangers of 'infectious' resistance and triggered the recall of the Netherthorpe committee, which in turn led to the Swann committee. Following the tragic 1967 Teesside deaths, calls for antibiotic reform were voiced by both left-wing and conservative newspapers, and agricultural antibiotics increasingly functioned as a negative symbol of 'factory farming'. In November 1969, the so-called Swann Report called for a ban of therapeutically relevant antibiotics in AGPs.

Britain's Swann-inspired 1971 penicillin and tetracycline AGP bans were indeed pioneering pieces of legislation. However, the Swann model of restricting 'therapeutic' AGPs whilst leaving other uses of the same antibiotics unregulated was ineffective. Not only did the Swann model ignore the fact that veterinarians had a financial incentive to prescribe and sell the same drugs in higher doses, it also left agricultural antibiotic dependency unchallenged and failed to address cross-resistance resulting from nontherapeutic AGPS. Despite a short-term

reduction, overall antibiotic use in British and European agriculture quickly rebounded alongside bacterial resistance.

With calls for Swann-style antibiotic restrictions also being voiced in the US, farmers on both sides of the Atlantic faced a dilemma. During the 1950s, easy antibiotic access had led to the development of a path dependency whereby every further wave of agricultural intensification within the already antibiotic-dependent system necessitated more antibiotic use. Although more and more farmers were unable to afford on-going intensification and many shared the general public's environmental and health concerns, farmers' earlier investment in antibiotic-dependent production systems made them wary of moves to restrict antibiotics – especially during times of economic insecurity. Although their integration into corporatist decision-making and their acceptance of scientific concerns about resistance made British farmers accept the relatively mild Swann bans, they remained opposed to further restrictions that might threaten conventional intensive production. In the US, agricultural hostility towards substance restrictions and federal controls increased markedly following the 1972 DDT ban. Opposing AGP bans, US agricultural commentators invoked a type of domino-thinking whereby any concession to the government would entail further substance bans.

Luckily for conventional farmers, the early 1970s saw public concerns about agricultural antibiotics and resistance ebb on both sides of the Atlantic – although residue fears fuelled the growth of the rejuvenated organic sector. In Britain, the Swann report's supposed success made agricultural antibiotics lose their status as a common denominator and rallying point for animal welfare, residue and resistance warnings. Widespread British interest in antibiotic

regulations would re-emerge only in the late 1970s when studies showed that Swann was failing and investigations revealed a thriving black market for agricultural therapeutics.

Meanwhile, US debates continued to ignore bacterial resistance proliferation on farms. Despite brief spurts of publicity following the 1966 *NEJM* resistance warnings and the 1969 Swann report, agricultural antibiotics never turned into unifying symbols of public protest against intensive agriculture. Instead, media commentators focussed on the residue and cancer-centred problems of DDT and DES. Concerns about resistance resulting from agricultural antibiotics only gained sustained public prominence when newspapers like the *New York Times* and *Washington Post* turned into platforms of protest during the mid-1970s. However, by this time, concerns about 'stagflation' and the 'drug lag' led to significant opposition to regulatory intervention from conservative organs like the *National Review* and parts of the liberal press.

The resulting lull in public attention harmed regulatory efforts to control antibiotic use, residues and resistance on both sides of the Atlantic. Uncommented upon by the British media, British officials significantly weakened the Swann report. Permanent programs for resistance and residue monitoring were not established, and the proposed central authority for antibiotic use, the JSC, was worn down by interdepartmental rivalries. Although British officials fostered public pride in Swann, they remained ignorant of total antibiotic use and whether regulations were really protecting public health. Whereas EEC pressure forced Britain to adopt basic residue monitoring programs in the late 1970s, the neoliberal Thatcher administration subsequently opposed attempts to upgrade and expand monitoring.

Britain's hollowing out of Swann also damaged US attempts to install resistance-inspired regulations. In 1966, an FDA ad hoc committee had addressed concerns about antibiotic residues in meat but limited discussions of resistance to residues' immediate presence. Although an FDA Task Force reacted to Swann by calling for therapeutic AGP bans in 1972, Task Force members remained divided on whether AGPs posed an imminent hazard and made bans dependent on drug safety and efficacy trials. Bogged down by diverse regulatory battles, the FDA subsequently yielded to pressure from the NAS and industry, narrowed drug reviews' scope and allowed manufacturers to review their own products. Unsurprisingly, industry data failed to provide evidence of imminent harm. Following the failure of a second attempt to install AGP bans via a favourably composed NAFDC subcommittee, FDA Commissioner Donald Kennedy overrode NAFDC opposition and announced bans of therapeutic AGPs in 1977. However, in the absence of strong public support, the FDA was unable to convince Congress to restrict AGPs. Ultimately, Congressional insistence on proof of harm and counter science produced by CAST and industry-friendly researchers stalled Kennedy's AGP bans. In 1978, Congress imposed a moratorium and mandated additional studies. By using Congress and the judicial system to bypass the FDA, antibiotic supporters won a major victory.

For antibiotic critics, the failure of FDA AGP bans brought the realisation that the US legal system's insistence on proof of direct or imminent harm was problematic in the case of bacterial resistance. Critics were at pains to convince politicians that, from an environmental and public health standpoint, providing clear judicial proof of harm resulting from resistant 'agricultural' bacteria was rationally irrelevant: by 1980, it was clear that farmers' mass-use of antibiotics

was substantially contributing to a 'resistance friendly' manmade ecology favouring resistance proliferation via bacteria, plasmids or transposons. Over time, resistance was bound to – and most likely already had – spread to bacteria, which harmed humans.[1] Because of lacking monitoring data and the global and interconnected nature of resistance, it was also virtually impossible to provide incontrovertible proof of harm on a judicial cause and effect basis. Despite the absence of such 'proof', it was evident that selection pressure for resistance would only be decreased by a permanent reduction of general and non-human antibiotic use.

Although both the Thatcher and Reagan administrations were sceptical of increased state intervention, the 1980s saw regulatory differences on both sides of the Atlantic widen.

In the EEC, policies increasingly invoked the precautionary principle, which held that proof of likely harm was enough to ban a substance. Although British officials initially opposed more extensive EEC food and antibiotic reforms, their resistance was weakened by the 1980s *Salmonella* crisis and crumbled in the wake of the 1996 BSE crisis, which resulted in the questioning of many fundamental tenets of intensive agriculture. Antibiotics' old status as a common denominator of agricultural criticism placed AGPs at the heart of reform demands. Following the 1997 election, the New Labour government changed Britain's antibiotic policy. Buoyed by a series of domestic and international expert reports, Britain supported EU AGP restrictions in 1998 and 2003 as well

[1] Landecker, 'Antibiotic Resistance and the Biology of History', pp. 14-24.; for a new view of the binary divide pathogenic vs. non-pathogenic organisms, cf. Pierre-Olivier Méthot and Samuel Alizon, 'What Is a Pathogen? Toward a Process View of Host-Parasite Interactions', *Virulence,* 5/8 (2014).

as the establishment of EU resistance monitoring. Public support for the reforms was significant and agricultural opposition small.

By contrast, the principle of proven harm continued to dominate US regulation, and the cause for antibiotic restrictions was further weakened by the imposition of HHS oversight over the FDA. Although CDC and non-governmental experts continued to campaign for AGP restrictions, it came as no surprise that the FDA rejected the 1983 NRDC petition to ban AGPs despite CDC studies linking resistance selection on farms to human illness. In the absence of a crisis like BSE, the changing political landscape of the 1990s resulted in a series of industry-friendly legal reforms, which institutionalised cost-benefit based policies for most substances. Meanwhile, public pressure for antibiotic reform remained weak. In contrast to Europe, agricultural antibiotics never emerged as a unifying rallying point against the abstract system of intensive agriculture. Antibiotic support also remained strong amongst US farmers, who did not experience the same crisis of trust in intensive production systems as their EU colleagues during the 1990s.

A potential moment of AGP reform seemed reached in late 2007. With Democrats regaining control of both Houses, the FDA initially supported Congress's attempt to restrict antibiotics via PAMTA. However, industry and USDA pressure once again made the FDA abandon statutory in favour of voluntary AGP restrictions.

Meanwhile, problems abound. The CDC has recently reported that each year about one in six Americans (ca. 48 million people) become sick from contaminated food. An estimated 128,000 cases require hospitalization, and 3,000 are fatal. Amongst the main culprits are mostly resistant *Samonella*

enterica, *Listeria monocytogenes* and *Campylobacter spp.* Together, these three bacteria species cost US citizens ca. $8.4 billion per year. While this figure is only valid for resistant foodborne infections, the cumulative cost of antibiotic mass-use in US agriculture is probably far higher.[2] Facilitated by a 'medicated environment', resistant bacteria and plasmids circulate freely between US farms, hospitals and the environment and muddy the boundaries between humans and animals.

In Europe, awareness is currently growing that AGP bans might not be enough. With new resistant strains of livestock-associated pathogens found in British food in 2015,[3] the NGO alliance Sustain estimates that on-farm antibiotic use still constitutes ca. 45% of total UK antibiotic use.[4] Clearly, reforms of therapeutic antibiotic use in agriculture are necessary. However, they promise to be difficult. Despite the 2013 publication of a five-year antimicrobial resistance strategy, British officials continue to have no overview of on-farm antibiotic use or resistance selection. Moreover, Britain's five-year strategy specifies neither concrete antibiotic reduction targets nor measures to achieve them. Throughout the EU, veterinary overprescription of antibiotics remains a problem. In 2014, a survey of 3004 veterinary practitioners from 35 EU countries cast light on veterinary prescription habits. Although older antibiotics like penicillin and tetracyclines were still preferred for most disease indications, so-called Critically

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[2] Renée Johnson, 'Food Safety Issues for the 114th Congress', *CRS Report* (Washington DC: Congressional Research Service, 2015 February 13), p. 1.
[3] Fiona Harvey and Andrew Wasley, 'What is the superbug LA-MRSA CC398 and why is it spreading on farms?', *Guardian*, 18.06.2015, URL: http://www.theguardian.com/society/2015/jun/18/what-is-the-superbug-la-mrsa-cc398-and-why-is-it-spreading-on-farms (accessed: 23.06.2015); Fiona Harvey, Mary Carson, Maggie O'Kane and Andrew Wasley, 'MRSA superbug found in supermarket pork raises alarm over farming risks', *Guardian*, 18.06.2015, URL: http://www.theguardian.com/society/2015/jun/18/mrsa-superbug-in-supermarket-pork-raises-alarm-farming-risks (accessed: 18.06.2015).
[4] 'Overuse of Antibiotics in Farming', *Sustain - Save Our Antibiotics* (http://www.sustainweb.org/antibiotics/overuse_of_antibiotics_in_farming/ [29.06.2015]).

Important Antibiotics (CIAs) like macroloides, fluoroquinolones and third generation cephalosporins were used for 26% of cattle and 20% of pig treatments.[5]

Reacting to such figures, NGOs like the European Consumer Organisation (BEUC) demand mandatory reports for metaphylactic antibiotic use and a phasing out of prophylactic antibiotic use. The therapeutic treatment of individual animals should be the norm rather than the exception. The BEUC also call for a decoupling of veterinarians' right to prescribe and sell antibiotics, restricting non-human uses of CIAs and ending veterinary 'off label use' and the so-called 'cascade', whereby veterinarians can prescribe drugs listed in the Table of Allowed Substances in Commission Regulation (EU No37/2010) for unauthorised uses. Lauding Norwegian and Dutch precedents, the BEUC demands EU-wide reduction targets.[6]

Similar demands have been voiced by the UK's Alliance to Save Our Antibiotics. The Alliance has also assessed agricultural antibiotics' relative impact on overall bacterial resistance. Although non-human antibiotic use "may not be the main driver of resistance in humans", the Alliance states that it is "a very important contributor"[7]. Regarding *Salmonella* and *Campylobacter* infections, farm animals are the "most important source of antimicrobial resistance."[8] For *E. coli* and *Enterococci*, there is "strong evidence that farm

[5] N. D. Briyne et al., 'Antibiotics Used Most Commonly to Treat Animals in Europe', *Veterinary Record,* (June 4 2014), p. 1 & 5.
[6] 'Antibiotic Use in Livestock: Time to Act', *BEUC Position Paper* (Brussels: BEUC, August 2014), pp. 2-3.
[7] 'Antimicrobial Resistance - Why the Irresponsible Use of Antibiotics in Agriculture Must Stop. A Briefing from the Alliance to Save Our Antibiotics', (Alliance to Save Our Antibiotics, 2015), p. 10.
[8] Ibid.

animals are an important source of antibiotic resistance."[9] Regarding MRSA, antibiotic use in the UK might make a "small contribution to treatment problems in human medicine" [10], but international data shows that this might increase substantially. Meanwhile, there is a "solid theoretical case" [11] that agricultural antibiotic use could cause resistance in other pathogens such as *Neisseria gonorrhoeae* via horizontal resistance transfer.

Ahead of the planned Transatlantic Trade and Investment Partnership (TTIP), the challenges of antibiotic regulation seem daunting, and regulatory differences on both sides of the Atlantic remain substantial. However, they are not immovable.

As this dissertation has shown, there has never been a timeless and ideal way to regulate agricultural antibiotics. Instead, regulators' positions have been strongly influenced by the contradictory risk cultures surrounding them. Over time, different risk cultures have emphasized either the residue, the resistance or the welfare aspect of the 'antibiotic problem'. The different emphases resulted from antibiotics' integration into pre-existing civic risk epistemologies. Within these epistemologies, antibiotics' linguistic and cultural connotations often had a stronger influence on resulting risk priorities than an 'objective' evaluation of their impact on public health did.

In the US, powerful fears of invisible contamination led to an early focus on antibiotic residues and an equation of antibiotic regulation with the strategies developed for unrelated toxic and carcinogenic chemicals. While this focus neglected the 'objectively' greater risk of bacterial resistance and antibiotics' role

[9] Ibid., p. 12.
[10] Ibid.
[11] Ibid., p. 15.

in enabling problematic animal welfare standards, it was instrumental in the pioneering of national monitoring programs for antibiotics in foodstuffs.

Although residue concerns were also present on the other side of the Atlantic, the risk emphasis given to them was never as prominent as in the US and was soon matched by growing concerns about bacterial resistance – as visualised by the PHLS – and animal welfare problems. As a result of Ruth Harrison's *Animal Machines*, E.S. Anderson's warnings about 'infectious resistance' and the Teesside deaths; antibiotics surfaced as a common denominator of consumer, medical, animal and environmental concerns. This shared sense of risk created new alliances between different communities, challenged institutional and epistemic boundaries between animal and human health and enabled Britain to pioneer resistance-oriented reforms in 1971. Following the enactment of the Swann bans, it took the 1996 BSE crisis for antibiotics to re-emerge as a common denominator for various groups concerned about risks resulting from intensive agriculture. Historically, effective antibiotic regulation thus emerged only in situations when differences in attitudes towards antibiotics were broken down either by activists or external crises.

Hoping for future crises is, however, not a viable regulatory strategy. Neither is the regular invocation of doomsday narratives of a looming post-antibiotic apocalypse. Starting in the late 1950s, scenarios of resistant pandemics or a sudden return to Medieval medicine have failed to foster sustained change.[12]

[12] Antibiotic 'futures' and the trope of the antibiotic 'revolution' are discussed in Scott H. Podolsky and Anne Kveim Lie, 'Futures and Their Uses: Antibiotics and Therapeutic Revolutions', in Jeremy A. Greene, Flurin Condrau, and Elizabeth Siegel Watkins (eds.), *Therapeutic Revolutions: Pharmaceuticals and Social Change in the Twentieth Century* (Chicago: University of Chicago Press, Forthcoming).

By creating the impression that antibiotics will go out with a bang and not with the far more likely long and quiet whimper, doomsday narratives have diverted attention from the systemic importance that antibiotics have acquired in both modern medicine and food production. As evidenced by the repeated failure of dramatic medical warnings to engender action, it will need far more than an individual spurt of panic and attention to motivate long-term policies of sustained antibiotic reduction.

In order for future resistance-focussed reform to work, regulators will have to establish a viable middle ground between stakeholders' distinct risk epistemologies. On both the international and domestic levels, it has never been 'natural' to be more concerned about antibiotic resistance than about residues in food or animal welfare abuse. As highlighted by the historical ups and downs of 'One Health' perspectives, [13] integrated notions of animal and human microbiological risk were not self-evident either. In order to convince domestic and international stakeholders to reform farming, lifestyles and regulations, merely stating the 'facts' about antibiotic resistance and hoping for the best is not enough. As a regulatory and activist strategy, it has failed since the 1960s. A more successful strategy would consist in 'learning' the language of individual risk cultures in order to effectively translate the risk posed by resistance and build an international consensus on antibiotic reduction.

Most importantly, this dissertation has shown that even notionally successful antibiotic reforms have failed to convince many farmers of the logic of antibiotic reduction. Although the agricultural community has often reacted

[13] Michael Bresalier, Angela Cassidy, and Abigail Woods, 'One Health in History', in Zinsstag Et Al. (ed.), *One Health: The Theory and Practice of Integrated Health Approaches* (CABI, 2015).

antagonistically to non-agricultural interventions, this does not mean that farmers cannot reform. In the case of the organic market, shared concerns about 'pure' food in the absence of state guarantees created a lucrative risk alliance between producers and consumers. Both sides agreed that the absence of risk in the form of antibiotics and other chemicals mattered more than slightly higher food prices or differences between the numerous philosophies guiding alternative agriculture. Whereas shared notions of purity have created a new, yet conspicuous market for 'pure' foods, such a strategy will not work in the case of resistant bacteria, which do not distinguish between consumers wealthy or concerned enough to buy 'pure' food and those who are not. Relying on antibiotics as a risk-minimizing tool since the 1950s, intensive livestock producers still have to be convinced that the risk of using antibiotics is greater than the one they are supposed to combat. At the same time, they have to be provided the financial and institutional security to do without their antibiotic insurance.

While the evaluation of more concrete policy is a task for the future,[14] one can only hope that a transatlantic consensus on antibiotic reduction arises soon. Cautionary tales about the short-sighted squandering of assets abound in human history and mythology. Living in a pangenomic reality, consumers, farmers and regulators have to realise that every antimicrobial intervention in the environment will produce a microbial reaction. Regardless of how much money is spent to reopen the antibiotic pipeline, there will be no final human 'victory' over bacteria because resistance is natural. Instead, it is time to abandon themes

[14] See a recent contribution by Scott H. Podolsky et al., 'History Teaches Us That Confronting Antibiotic Resistance Requires Stronger Global Collective Action', *Journal of Law, Medicine & Ethics,* 43/2 (Special Supplement) (2015).

of antimicrobial wars in hospitals and on farms and re-gear our systems of pharmaceutical use to a sustainable strategy of microbial management and co-existence. By diverging from the standard account of antibiotic use in human medicine and focussing on the 'other 50%',[15] this dissertation has highlighted some of the reasons why the agricultural mass use of antibiotics in food production has so far failed to meet this goal. If societies do not find a more adaptive approach to adaptive resistance, the human history of antibiotic use may well turn out to be brief and pyrrhic.

[15] In the US, some estimates hold that ca. 70% of antibiotics important to human medicine are given to livestock; 'Pew Antibiotic Resistance Project', (http://www.pewtrusts.org/en/projects/antibiotic-resistance-project/about/antibiotic-use-in-food-animals [accessed: 17.04.2015]).

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