4. From healthy cows to healthy humans: Integrated approaches to world hunger, c1930-65

Michael Bresalier

From 1945, Zebu cattle living on the Indian sub-content were exhaustively identified, enumerated and evaluated by officials working for the newly created Food and Agriculture Organisation (FAO) of the United Nations (UN). These indigenous, humped-backed cattle (*Bos Indicus*) provided crucial sources of draught power, food, and income to the area's human inhabitants. Surveying them was a lengthy and painstaking process that took seven years to complete. It was disrupted by political events such as the partition of India, the creation of Pakistan, and the end of British rule in 1947, which impacted on the provision of agricultural services and the presence of technical experts able to attend to the Zebu. It was made more difficult by the Zebu themselves. Numbering over 100 million in India alone (which held nearly half of the world's population), their living conditions, locations, and roles within agrarian systems varied greatly, as did their physical state. Investigators identified at least twenty-eight distinct breeds, whose diverse sizes, shapes and productive capacities reflected their adaptation to particular climates and environments. Many were burdened by chronic infections, parasites, and malnutrition, which undermined their health and limited their abilities to fulfil their human-designated roles.[1]

The Zebu attracted attention at this time due to the findings of the FAO's first *World Food Survey*. Reporting in 1946, it anticipated a growing food crisis across much of the world: production was below pre-war levels, famine had just devastated Bengal, and millions of people were unable to meet their basic calorie requirements. With the world's population predicted to increase exponentially, the situation would only deteriorate.[2] The Zebu survey formed one facet of the FAO's response. It sought to identify those cattle with the greatest potential to develop more productive bodies, and to enrol them in a campaign to combat human hunger. This campaign extended beyond India to Latin America, Africa, and much of Asia, and enlisted not only cattle but also buffalo, chickens, pigs and others. However, the recognized importance of milk for child growth and development, and the vitamin, mineral and protein deficiencies that it helped to address, meant that cattle played a central role.

This role was not entirely new. The twin challenges of improving human nutrition through increased milk consumption, and developing agriculture through improvements in livestock health and production, had preoccupied nations, colonies and the League of Nations during the inter-war years, culminating in calls to 'marry food and agriculture.'[3] However, it was only after the war, under the aegis of the FAO and the World Health Organisation (WHO), that these two agendas became truly integrated. In framing healthy, productive cattle as essential to the production of healthy, well-nourished humans, these organisations encouraged experts in human and veterinary medicine to transcend the institutional and disciplinary boundaries that had grown to separate them,[4] and to forge new relationships with each other, and with the human and bovine subjects whose bodies they sought to transform.

[1] Joshi and Phillips, 1953.
[2] FAO, 1946.
[3] Amrith and Clavin, 2013; Way, 2013.
[4] On the emergence of these boundaries, see chapter 3.

Taking the inter-war period as its jumping off point, this chapter will explore and account for these previously undocumented post-war developments. In revealing the centrality of cattle to the international campaign to feed the world, it will add a crucial zoological strand to the existing historiography on world hunger, and demonstrate the importance of a cross-cutting approach to domains of science and policy that historians typically study in isolation from one another. Existing accounts of post-world hunger adopt two distinct approaches. Some historians have framed it as a problem of over-population, and explore neo-Malthusian efforts by American philanthropists such as the Ford Foundation, and UN experts such as Julian Huxley, to manage the crisis by controlling human fertility.[5] Others approach hunger as a problem of agricultural development, and interrogate the alliances between the Rockefeller Foundation, the American government and the FAO that resulted in efforts to modernize food production through seed-and-soil science and hybrid crops, culminating in the so-called 'Green Revolution.'[6] In these accounts and in the burgeoning literature on international health organisations,[7] livestock hardly feature.[8] Relegated to histories of development, they are viewed largely in terms of their ability to promote economic growth and destroy the environment.[9] When their influence over human health is considered, it is primarily as hosts and transmitters of infectious diseases to humans.[10]

However, as this chapter will demonstrate, livestock attracted attention for other reasons. Post-war experts from across the UN and its allied agencies viewed them not only as threats to human health but also as potential contributors to it, suppliers of highly nutritious foodstuffs that would benefit human health and strength.[11] This role was not disconnected from that of disease transmitter because many of the zoonotic infections that animals conveyed to humans undermined their own health and productivity. However, as we will see, international efforts to promote cattle as sources of meat and milk focussed not only on the prevention of their diseases, but also – in line with the WHO's human-centred definition of health as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity' – on improving their feeding, breeding, husbandry and general health.[12] The unproductive bodies of developing world cows therefore shaped and were produced by the post-war international campaign against world hunger, which brought experts and activities that historians have tended to regard as 'veterinary' in character into the realms of human health and medicine.[13]

In recounting the history of that campaign, and its bovine subjects and shapers, this chapter draws on the traces that cows left on the historical record.[14] As subjects of investigation by experts in animal pathology, nutrition and physiology, cattle frequently feature within their scientific

[5] For example: Connelly, 2003; Connelly, 2006; Connelly, 2008; Bashford, 2014.
[6] For example: Marglin, 1996; Perkins, 1997; Cullather, 2004; Cullather, 2010.
[7] For example: Borowy, 2009; Borowy, Mills, and Zhang, 2016, and other papers in this special issue.
[8] Veterinary contributions to the post-WWII campaign to feed the world are, however, mentioned briefly by Jones, pp.96-100.
[9] Steinfeld et al., 2006; Hodge, 2007; Weis, 2013.
[10] Hardy, 2003. For other references see Appendix: Annotated Bibliography.
[11] Wiley 2011.
[12] WHO, 1946, p.100. For a general discussion see Staples, 2006, pp.132-6.
[13] Orland, 2004.
[14] Benson, 2011.

literatures. They also appear within the statistical surveys and policy documents of the FAO, WHO and allied agencies. As producers of vitamins, fats and proteins for human consumption, they left indirect traces upon the bodies of their human consumers, and in scientific publications and policy documents dedicated to human health and nutrition.[15] Through analysing these traces, the people and circumstances that gave rise to them, and the methods used to create them, this chapter will shed new light on the people, organizations and agendas that drove the interlinked creation of healthy cattle and healthy humans in the post-war international arena.

The first section will explore the parallel development during the inter-war period of scientific and policy agendas that granted two distinctive roles to cows. Within human health and nutrition, new knowledge of vitamins and trace elements led experts to regard cows as important sources of human food, and to promote the consumption of their milk.[16] Within agriculture and veterinary medicine, scientific advances and the deepening agricultural depression led experts to view cows as key sources of farming income, and to attempt improvements to their health and productivity. Within colonial and international settings, links formed between these two agendas, resulting in calls to 'marry food and agriculture.' The second section will relate how, in war-time and the immediate post-war era, these links were concretised by food shortages and the identification of 'protein malnutrition' as a key problem within the developing world, such that world hunger came to be viewed as a problem of unproductive cattle, whose health and nutrition had a direct bearing on the health and nutrition of their human consumers. The third section outlines how the FAO and WHO responded to this problem by creating new structures within which different types of experts came together to plan the creation of new bovine bodies and new experts capable of bringing them into being. It also touches on the consequences of these plans for the cows who helped to shape them.

5.1 Cows in inter-war medicine and agriculture

The inter-war period witnessed a new consciousness about the centrality of foods produced by animals to the nourishment of humans. By the 1930s, patterns of food consumption in most of the industrial world had shifted from grain-based to animal-based diets – the so-called 'nutrition transition.'[17] Meat, milk and other livestock products gained pride of place on the tables of all classes, becoming integral to national cultures, tastes and identities.[18] Their significance to human health and nutrition was increasingly recognized. In the later nineteenth century, early nutrition scientists had regarded animals as crucial sources of calories and protein, whose meat and milk could help to repair muscles and ensure the efficient functioning of the human motor.[19] During the early twentieth century, as nutrition science expanded, gained institutional expression, and won new sources of public funding, the evaluation of animal foods shifted to focus on newly identified components – amino-acids, minerals and vitamins – which scientists deemed essential for normal physiological growth, development and function. In 1918, the American biochemist and nutrition

[15] Wiley, 2014.
[16] Valenze, 2011.
[17] Otter, 2012; Grigg, 1995; Popkin, 1993.
[18] Knapp, 1997; Cantor and Bonah, 2010.
[19] Rabinbach, 1990, pp.120-45.

scientist, E.V. McCollum, heralded this as the 'newer knowledge of nutrition.'[20] Despite early controversies, it was eventually accepted as nutritional fact, generating a Nobel Prize for the discoverers of vitamins, Christiaan Eijkman and Sir Frederick Gowland Hopkins.[21]

A number of nutritional scientists sought to translate the findings of experimental research into practical knowledge that could guide medical and public health professionals, policy-makers and the public.[22] Ranking foods according to their nutritional value, they concluded that those derived from animals were the best for humans.[23] Their laboratory and field studies showed that milk, meat, eggs and fish not only provided high quality proteins – with the best combination of essential amino acids – but also other micronutrients, notably vitamins A and D, which were identified as especially important for infants, children and pregnant and lactating women. In this evaluation, milk was awarded pride of place and defined as a 'protective food.'[24] The dairy cow therefore became an essential contributor to the health and efficiency of human bodies.[25] For McCollum, 'the consumption of milk and its products forms the greatest factor for the protection of mankind',[26] while an enquiry by experts associated with the League of Nations characterized it as the best and most readily available 'protective food', 'the nearest approach we possess to a perfect and complete food.'[27]

In shifting attention from the quantity to quality of food intake, the newer knowledge of nutrition reframed understandings of an adequate diet, its cost, and relationship to health. It also led to the identification of 'malnutrition' as a new medical problem caused by inadequate dietary intake of vitamins, amino-acids or minerals, and characterised by sub-optimal growth, health and productivity.[28] Scientific investigations revealed that malnutrition could be rectified by adding bovine bodily products to human diets. These stimulated significant improvements in growth and efficiency, rectified deficiency diseases such as rickets, and helped to reduce maternal mortality. Dietary surveys conducted in 1930s Britain, where economic depression had devastated industrial heartlands, suggested that a fifth of all children were chronically malnourished. Read alongside scientists' calculations of the cost of a nutritious diet, this finding stimulated criticisms of a government that repeatedly asserted the adequacy of its responses to poverty. It also encouraged efforts to increase the consumption of 'protective foods' like milk.[29] In Britain and the USA, policies were introduced to provide daily milk for school children.[30] There was also a movement to encourage pasteurization as a means of improving the quality and public appeal of milk, which was often produced in unhygienic conditions and contaminated with germs that caused scarlet fever and tuberculosis in humans.[31]

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[20] MCollum, 1918.
[21] Smith and Nicolson, 1989; Smith, 1997; Gratzer, 2005; Carpenter 2003; Vernon, 2007.
[22] Barona, 2010.
[23] McCollum, 1918, pp.69-83.
[24] Ibid., p.82.
[25] On McCollum's work, see Valenze, 2011, pp.238-250.
[26] MCollum, 1918, p.67.
[27] League of Nations, 1937, p.87.
[28] For accounts of this development, see Vernon, 2007 and Barona, 2012.
[29] Smith, 1997; Mayhew, 1988; Barona, 2008; Barona, 2012.
[30] Welshman, 1997; DuPuis, 2002; Atkins, 2005.
[31] Atkins, 1992; Atkins, 1997; Waddington, 2004.

John Boyd Orr, a medically trained nutrition scientist who headed the Rowett Intitute of Animal Nutrition in Aberdeen was at the forefront of British nutritional research, dietary surveys, and the political campaign to promote government action.[32] He also helped to establish malnutrition as a colonial problem. With the head of the Kenyan Medical Department, John Gilks, he surveyed the diet and health of different tribes, finding differences in the health and physique of populations that consumed animal-based diets compared to grain and vegetable-based diets. Similar observations had been made by Robert McCarrison in India, and were subsequently confirmed and elaborated there by W. Akyroyd, and by other colonial investigators working in West Africa, the Middle East, and Kenya – where field studies were impeded by the Maasai migrating to fulfil their cows' need for water.[33]

In the Gold Coast (present-day Ghana), the Jamaican-born British paediatrician, Cicely Williams, working for the Colonial Medical Service, identified a new form of malnutrition that she attributed to 'some amino or protein deficiency.'[34] Found in infants who had been breast-fed by malnourished mothers and weaned on maize porridge, it led to severe bloating, loss of hair, blotched skin, wasting, diarrhoea and oedema. She awarded it the native *Ga* term, 'Kwashiorkor'.[35] The condition was also identified by investigators working in other parts of colonial Africa, though they used different terms for it.[36] In drawing medical attention away from the tropical diseases that had lent medical definition to these regions since the later 19th century,[37] these discoveries suggested that the prime animal shapers of human health were not the parasitic animals that transmitted tropical diseases, but the bovine animals that supplied nutrition to humans. They also fuelled concerns that low-level production and consumption of bovine bodies was holding back economic development in Africa, and could threaten global security by prompting a Malthusian crisis in India and mass migration to the west.[38]

These investigations awarded cattle the role of food producers for under-nourished humans. However, other experts awarded them a different role – as resources for agricultural and economic development that suffered health and nutritional problems of their own. This bovine role became increasingly important during the inter-war depression. British dairy farming won many new converts in this period because the perishability of milk afforded protection from the flood of cheap food imports that depressed the prices of other products. By 1930-1, dairy cows supplied 27% of the gross agricultural produce of England and Wales and were farmed by three-quarters of the members of the National Farmers Union. However the high volume of domestic milk production resulted in low prices, particularly in summer when cows tended to calve. British efforts to address this issue focussed on expanding the market for milk, through its provision to schoolchildren, and with the aid of a national Milk Marketing Board.[39] There were also research and policy initiatives that aimed to

[32] Orr, 1936; Pemberton and White, 2000; Vernon, 2007.
[33] Worboys, 1988; Arnold, 1994; Weindling, 1995; Vernon, 2007. The colonial agendas which drove this work, and which contributed to the health problems identified, have been investigated and critiqued. Brantley, 1997.
[34] Williams, 1933; Williams, 1935.
[35] Stanton, 2001.
[36] Trowell, 1940; Trowell, 1949.
[37] Worboys, 1988, pp.208-25.
[38] Hutchinson, 2002; Tilley, 2011; Amrith and Clavin, 2013.
[39] Atkins, 2005.

make production more efficient by improving the health, nutrition and breeding of dairy cows, whose bodies were reportedly deteriorating as farmers adopted cost-saving measures to ride out the depression.[40]

As subjects of scientific investigation, British cattle were distributed between the 'watertight compartments' whose formation was described in the last chapter. The policy of channelling public funds for agricultural research into selected fields and institutions, and the hostility expressed by veterinarians towards disease investigations performed by non-veterinarians, meant that the breeding of cows was investigated at Cambridge University, their nutrition at Cambridge and the Rowett Institute in Aberdeen, aspects of dairying at University College Reading, and cow health at the Royal Veterinary College and State Veterinary Laboratory. In these various locations, researchers worked to promote the development and application of rational breeding practices, to apply the new knowledge of nutrition to bovine diets, and to counteract diseases such as brucellosis and tuberculosis which undermined cattle (re)production.[41] Their research programmes – which impacted on the bodies, behaviours and lived experiences of cows owned by Britain's more progressive farmers – were quite separate from those concerned with human health and nutrition, which took place within medical schools and in research institutions supported by the publicly funded Medical Research Council.[42] This separation was reflected in policy: health matters were dealt with by the Ministry of Health and farming matters by the Ministry of Agriculture. Where connections were inescapable, as with the management of zoonotic diseases like bovine tuberculosis, which spread via milk to humans and was a major focus of concern in this period, they were characterised by conflict owing to very different framings of the problem by experts and officials concerned with human and animal health.[43]

As director of the Rowett Institute and a member of the MRC's Nutrition Committee, who conducted research on the mineral content of livestock pastures and the nutritional content of human diets, Orr was one of the few individuals to transcend these institutional, disciplinary and species boundaries and approach cows as simultaneously medical and agricultural problems.[44] As a qualified doctor, his research on bovine nutrition perpetuated long-standing zoological traditions in medicine, as outlined in the previous two chapters. It proceeded in tandem with his concern for human nutrition, and may even have enabled it, by allowing him to draw analogies between the causes of malnutrition in animals and humans.[45]

Orr also benefited from, and contributed to, the more fluid situation in colonial contexts where research and policy compartments were less water-tight, enabling the cow's dual roles to be considered in tandem. As a member of the Research Committee of the Empire Marketing Board, he

[40] DeJager, 1993; Vernon, 1997; Woods, 2007; Woods, 2010.
[41] Woods, 2007.
[42] DeJager 1993. From 1933 the MRC was headed by Edward Mellenby, who built on the zoo-based investigations of John Bland Sutton, as described in chapter 1, to cement the link between rickets and vitamin D. See Petty, 1989.
[43] Waddington, 2004; Hardy, 2003.
[44] Valenze shows that McCollum also sought transcend these boundaries in the USA. Valenze, 2011, pp. 238 *passim.*
[45] Orr, 1966; Kay, 1972; Smith, 1999.

travelled and conducted dietary surveys throughout the empire. His survey on the health and nutrition of Kenyan humans followed on directly from a survey he conducted on the health and nutrition of Kenyan settlers' cattle, and was stimulated by co-investigator, John Gilks' observation that the Kikuyu sometimes sought out the same substances as those contained within the special saltlicks that they encouraged their cattle to consume.[46] While the report of the cattle survey did not directly connect the health and feeding of cattle with that of humans, it did argue that 'a general improvement of agriculture and animal husbandry' would advance 'the health and working capacity of the native.'[47] In promoting the production and consumption of milk, it lent support to the Kenyan government's efforts to improve agriculture through the development of mixed farming, a method extrapolated from the British context, which received wider support in this period from colonial agricultural scientists alarmed by the ecological and economic consequences of arable monoculture and nomadic pastoralism.[48] Studies like Orr's and Gilks' strengthened their belief that relationships between humans, cows and the land needed to change, and that by developing agriculture, they would advance human health, working capacity, and by extension the colonial economy.[49]

The League of Nations took up these issues as part of its wider agenda of achieving global security through economic stability. Its 1931 publication, *The Agricultural Crisis*, studied the effects of the Great Depression on world agriculture, and identified lack of purchasing power as a key problem. In 1932 it initiated enquiries (to which Orr contributed) into the impacts of depression on public health and nutrition. These integrated the dietary standards and recommendations drawn up by different governments and researchers, and placed the issue upon the Assembly's agenda.[50] In 1935, Frank McDougall, an Australian economist and expert on imperial trade, presented his analysis of these dual problems in a 15 page memo to the League. He outlined how, in the west, scientific advances had led to increases in agricultural production, but due to plummeting prices, some farmers were disposing of surpluses by burning wheat or pouring milk down gutters. To support their farmers, some governments had introduced protectionist trading policies and agricultural subsidies, but this was preventing the distribution of nutritious food to the people who most needed it. The problem was not that the world had too much food, but that due to flaws in pricing and marketing, it was not being consumed.[51]

The belief that fulfilling human nutritional needs would lift agriculture – and the world economy – out of depression generated calls to 'marry food and agriculture.'[52] MacDougall argued that this could be achieved through agricultural policies that promoted farm-based production, rationalized distribution and greater consumption of nutritious foods. The principle won support from a League of Nations 'mixed committee', which was highly unusual in bringing together experts in public health, agriculture and economics. Its interim report, released in 1936, emphasized the need to increase the production and consumption of protective foods like milk.[53] It argued that on account

[46] Brantley, 1997, p.55
[47] Gilks and Orr, 1927; Orr and Gilks, 1931.
[48] Hodge, 2002; Hodge 2007.
[49] Hall, 1936; Little, 1991; Worboys 1988.
[50] Terroine, 1936.
[51] Burnet and Aykroyd, 1935; Staples, 2006, pp.71-4; Borowy, 2009, 379-93; Amrith and Clavin, 2013; Way, 2013, pp.153-73.
[52] Jachertz and Nützenadel, 2011.
[53] League of Nations, 1936; Way, 2013, pp.153-73.

of the 'application of science to agriculture' there was already 'ample scope' for shifting world agricultural production in this direction, so that with appropriate government support, 'the real needs of each community for the health-giving foods may be correlated with the undoubted power of agriculture to produce all that is necessary for abundant health.'[54]

Amongst the obstacles to this shift which the committee identified in its final, 1937 report, were: natural conditions – soil and climate – which limited what foods could be produced, the structure of agricultural holdings, lack of capital, the conservative outlooks of peasant farmers, the need for more scientific research and education, and the cleanliness, quality and safety of products like milk. The report also highlighted recent changes that were helping to address these problems. However, as in other discussions of inter-war nutrition, the health, feeding and keeping of cows was hardly mentioned.[55] While commentators acknowledged cows as key participants in plans to feed the world, they did not draw direct associations between the bodily condition of cows and that of their human consumers. With the outbreak of war, however, this would begin to change.[56]

5.2 War and its aftermath

Although looming hostilities prevented the translation of the Mixed Committee's findings into action, Orr took its lessons back to Britain, where heavy reliance upon imported food was undermined by war. In his 1940 volume, *Feeding the People in Wartime*, and in advice that he and other nutrition scientists provided to the Minister of Food on the development of a nutrition-based national food plan, he promoted the consumption of home-produced milk, vegetables and arable foods.[57] This advice had little influence on rationing policy, but it did inform the creation of schemes that channelled protective foods like milk to children, pregnant and nursing women. Dairy cows not only served these groups but consumers in general, because a reduction in other, imported animal proteins enhanced human reliance upon home-produced milk.[58] As vital suppliers of food, and key contributors to national defence, they were rewarded with privileged access to scarce supplies of imported feedstuffs. However, these supplies soon ran short, forcing farmers to utilize and grow other different types of feed to which bovine bodies proved less responsive. Their reduced milk output could not be addressed by increasing cow numbers because there was nothing to feed them on. The only solution was to increase the efficiency of production. To this end, scientists intensified their scrutiny of cows and efforts to rectify deficiencies in their feeding, breeding and health.[59]

British veterinarians played an important part in this process. Their leaders – who included Thomas Dalling, head of the Government Veterinary Laboratory – won the attention of farmers and the state by estimating the enhanced quantity of milk that they could generate through a state-subsidised

[54] League of Nations, 1936, p.87.

[55] League of Nations, 1937, pp.151-84.
[56] Collingham, 2012, pp. 467-500.
[57] Orr and Lubbock, 1940.
[58] Smith, 2000.
[59] Woods, 2007.

veterinary scheme for controlling certain diseases of dairy cows.[60] Significantly, the diseases targeted by this scheme were not the zoonotic conditions like tuberculosis, which had acted as points of connection between inter-war human and veterinary medicine, but those that impacted primarily on milk output and therefore human nutrition: mastitis, infertility, brucellosis and Johne's disease.[61] In winning support for their scheme, vets forged important connections between the health and productivity of bovine bodies and those of humans, and made their expertise relevant to both. Their interventions reshaped the bodies and lived experiences of cows. They subjected them to rectal examinations to assess and promote their reproductive performance, to udder manipulations aimed at evaluating their milk producing capacity, and to vaccinations and drug treatments. They also branded unproductive cows as 'passengers' and recommended their culling.[62]

At the end of the war, similar connections between the health and productivity of bovine and human bodies were forged on the international stage as the newly formed FAO surveyed the state of global food and agriculture.[63] It found that some areas devastated by the fighting lacked the human and animal resources they needed to produce sufficient food.[64] In other areas these resources existed but were not up to the task. The Zebu survey mentioned above was just one of several that revealed very large livestock populations but startlingly low levels of animal protein consumption by humans.[65] Throughout the developing world, cows were failing to perform their human-designated roles as food producers. India held 250,000 million or one-quarter of all cattle and water buffaloes in the world, but the average annual yield per milch animal was only 200kg compared to 4000kg in the Netherlands.[66] Whereas the average annual yield of an American beef cow was 75.6kg, in Asia, the figure was less than 12kg. These unproductive bovine bodies caused particular alarm due to unprecedented (and unexpected) population growth in the Far East, Africa, and Latin America. Population experts predicted an impending collapse as human numbers outstripped food supplies. The FAO's first *World Food Survey* estimated in 1946 that two thirds of the world's human population were hungry. Their findings added the threat of starvation to the persistent problem of malnutrition.[67] As the cold war set in and decolonization began, fears grew that hungry people would join disaffected rebel groups or turn to communism.[68] In this context, cows were not only crucial sources of food, but also political actors capable of influencing global security.

As the FAO's first director, Orr responded by attempting to implement earlier ideas of a marriage of food and agriculture.[69] He sought to create a World Food Board which would centrally organize

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[60] "Sir Thomas Dalling", 2012.
[61] Woods, 2010.
[62] Ibid. Although brucellosis was a zoonosis, its transmission to humans was infrequent and not widely recognised.
[63] FAO, 1946; FAO, 1952. For the history of FAO, see Phillips, 1981; Biswas, 2008; Staples 2006; Jachertz, 2014; Jachertz and Nützenadel, 2011.
[64] Dodd, 1949; Phillips, 1951; Hambidge, 1955.
[65] Joshi and Phillips, 1957.
[66] Cattle estimates are from Phillips, 1951, pp.241-56; yield estimates are from Sukhatme, 1963, p.12 and Phillips, 1963, pp.254-5.
[67] FAO, 1946, pp.6-7.
[68] Perkins, 1997, pp.118-39; Cullather, 2007, pp.11-43; Robertson, 2012, pp.85-103.
[69] Orr, 1943; Orr, 1948.

world food production according to actual needs rather than the market, with the ultimate aim of ensuring food as a basic human right. This radical vision never materialized, largely because of resistance from major agricultural powers. Instead it developed into a system for donating, disposing or trading agricultural surpluses from the developed to the underdeveloped world through mechanisms such as FAO's World Food Program, the USA Food for Peace Program and UNICEF's child health/milk initiatives.[70] On taking control in 1949, Orr's successor, the American, Norris E. Dodd, maintained this system of food redistribution. However, he also turned more directly to the problem of food production in the face of new evidence about the scope and severity of global under-nutrition.[71] This evidence was gathered by a joint FAO/WHO Expert Committee on Nutrition. Formed in 1949, it was charged with determining and developing strategies to tackle the most pressing human nutritional problems.[72] It integrated the WHO's interest in improving human health and nutrition with the FAO's interest in improving the efficiency and equitability of food production, distribution and consumption.[73] At its first session in Geneva, it identified 'kwashiorkor' as a key nutritional problem and target for international action.

Interest in this disease had grown considerably in the decade since Williams had identified it in the Gold Coast. Studies by medical researchers, including Hugh Trowell in east Africa, John Fleming Brock in South Africa, and the British physiologist and nutrition expert, J.C. Waterlow in Central America, suggested that it potentially affected many parts of the world.[74] Unlike other forms of malnutrition which were associated with vitamin deficiencies, it was linked to deficiencies of certain amino-acids which were obtained from proteins found particularly in milk and meat. Its problematisation therefore re-emphasized the cow's significance as a supplier of these products. The joint committee recommended that kwashiorkor be adopted as the official term for malnutrition directly arising from with milk protein deficiency, and that the FAO and WHO support surveys to determine its prevalence in different parts of the world.[75]

The first survey was conducted in sub-Saharan Africa in 1950 by Brock (a committee member and WHO consultant) and Marcel Autret (a biochemist and member of FAO's Nutrition Division). Their 1952 report, *Kwashiorkor in Africa*, claimed that it was evident in every community they visited, except the Maasai in Kenya and Batussi (Tutsi) in Rwanda, who produced and consumed a large amount of cow's milk.[76] A second survey, conducted in 1953 by Autret and the Guatemalan paediatrician, Moisés Béhar, showed that kwashiorkor was prevalent throughout Central America.[77] These studies confirmed the international scale of the problem. They also raised new questions about its specific nature and identity, for while protein deficiency was the key variable, it was not unique to the condition, and was implicated in several other deficiency diseases including marasmus, and nutritional anemia. Distinguishing kwashiorkor from these conditions was necessary to determine its prevalence and develop programmes to tackle it. Following meetings in The Gambia

[70] Staples, 2006, pp.84-96.
[71] Staples, 2000.
[72] FAO/WHO, 1949.
[73] For a history of the Committee see Barona, 2012, pp.263-294.
[74] FAO/WHO, 1949, p.15. For a full accpunt, see Ruxin, 1996.
[75] Ibid., pp. 15-16.
[76] Brock and Autret, 1952.
[77] Autret and Béhar, 1954.

and Jamaica, in late 1952, the joint committee decided to redefine it as one of a number of conditions they brought together under the new category of 'protein malnutrition'.[78] While not entirely straightforward, this category expanded the focus of international concern, as illustrated by the claim made by one of its creators, J.C. Waterlow, that 'we are concerned not only with the very sick and the dying, but perhaps much more with mild or chronic, so-called 'marginal', states of malnutrition in infants and children...this is a far more important problem than acute kwashiorkor'.[79]

The Third Report of the FAO/WHO Expert Committee, published in 1953, consolidated this change in focus. Protein malnutrition had become the single most important world health problem, the cause of an epidemic of deficiency diseases in underdeveloped countries, which severely burdened their populations, economies and healthcare systems.[80] The Committee was quite clear about the general causes and solution of protein malnutrition. First, *food supply* was a key determining factor: many underdeveloped countries were unable to meet the nutritional needs of their populations and particularly suffered from 'low production' of milk, meat, fish and eggs. Therefore the 'first and essential step' in tackling protein malnutrition was to ensure that 'the rights kinds of food' were available 'all the time.' Second, *population growth* had exacerbated the problem. Partly resulting from improvements in public health, it had spurred increasing production of starchy foods, which satisfied the immediate needs of the growing numbers of hungry people but not their protein requirements.[81] Therefore agriculture in underdeveloped countries needed to be transformed to meet these requirements, with a focus on generating more animal proteins, particularly from the bodies of cows. The unique importance of milk proteins (and by extension, cows) was emphasized at a second conference on protein malnutrition in Princeton in 1955, which proposed milk as a reference protein for determining the amino acid requirements for infants and young children.[82] These developments opened up new avenues for linking human nutrition to livestock bodies. World hunger was being bound up with world cattle populations. As the key means of rectifying protein malnutrition, cows were becoming more important to human health and nutrition than ever before.

Curiously, these connections have been largely overlooked in historical accounts of the growing hegemony of protein malnutrition in world hunger campaigns spearheaded by FAO, WHO and UNICEF in the 1950s and 1960s.[83] Considerable focus has been placed on the work of the Protein Advisory Group (PAG), created in 1955, which brought together nutrition experts from the three main UN agencies and various academic and research institutions.[84] PAG played a leading role in identifying a growing 'protein crisis' across the world and in characterising it in terms of a widening 'protein gap' between regions with adequate per capita supplies and those without – most of Africa, Asia and large parts of Latin America. Along with fixing world attention on protein malnutrition, PAG also promoted particular solutions to the problem.[85] The best known were its efforts to develop and

[78] Waterlow, 1955, p.3. See Carpenter, 1987, 1994.
[79] Waterlow, 1955, p.3.
[80] FAO/WHO, 1953.
[81] FAO/WHO, 1953, pp 8-9, 25-27.
[82] Waterlow and Stephen, 1957.
[83] Carpenter, 1986; Carpenter, 1994; Newman, 1995; Ruxin, 1996.
[84] Ruxin, 2000.
[85] Ruxin, 1996, pp. 156-8.

market ‘new protein foods’ synthetically derived from plants, algae, and petroleum products.[86] Criticisms both before and after pointed out that these efforts directed large financial investments to first world scientists, institutions, and industries, but did little to foster agricultural and economic development in hungry countries, and ultimately failed to redress the chronic problem of inadequate protein supplies.[87] While such criticisms were well-founded, it is important to note that these schemes represented only a small fraction of international efforts. Far greater importance was placed on improving ‘traditional’ sources of animal protein, particularly cows.[88]

5.3 Healthy cows, healthy humans

By the mid-1950s, international experts had reached consensus that the developing world required more animal food, particularly the vitamin and protein rich foods derived from bovine bodies.[89] Ralph Wesley Phillips, an American specialist in animal husbandry and breeding, who oversaw the Zebu study, and became the first director of the FAO’s Department of Agriculture, recognised that ‘there are many areas in the world where human needs for animal protein are not adequately met.’ Highlighting the ‘striking variation’ in food availability within underdeveloped and developed regions, he aimed to address the significant shortfalls in production in countries outside of North America, Australia, New Zealand and post-war Europe.[90] One way of achieving this goal was to increase livestock numbers. This had been a short-term strategy in post-war Europe but seemed less applicable on a global scale. The world livestock population was already large – roughly equivalent to the human population (soon to reach 3 billion), or double if domesticated fowl were included.[91] Although on average, the protein that animals supplied seemed adequate, the highest levels of production and consumption were concentrated in the developed world, which contained less than 40 percent of the world’s livestock but produced nearly 80 per cent of its meat and eggs.[92] The problem elsewhere was not livestock numbers but productivity. In a review of world cattle for *Scientific American*, Phillips, noted that: ‘the best zebu performances have been far below those of European breeds. In India a few well-handled Sahiwal cows have produced somewhat more than 10,000 pounds of milk in a year. In the United States, Holsteins have produced as much as 40,000 pounds.’[93] If third world animals could match outputs of first world animals then threats of starvation and malnutrition could be averted.

Achieving this goal was far harder than adding numbers to existing stocks because it involved tackling the reasons why third world animals were so unproductive. W. Ross Cockrill, a Scottish veterinarian who joined the FAO’s Animal Health and Production Division (AHPD) in 1953 and later became its assistant director, summed up the problem: ‘multitudes of livestock which could be the

[86] For example, Altschul, 1976.
[87] McClaren, 1974; Tappan, 2013.
[88] For examples, see FAO, 1957, pp.19-20.
[89] M. Autret, who had carried out study of kwashiorkor in Africa, declared that "protein malnutrition is without doubt the main nutritional problem in the underdeveloped countries today." FAO, 1960, p.1.
[90] Phillips, 1951, p.244.
[91] Phillips, 1963, p.15. Phillips' figures were taken from FAO, 1962.
[92] Pritchard, 1966, p.361.
[93] Phillips, 1958, p.57.

genesis of alleviation of human hunger are themselves suffering from disease and malnutrition.'[94] For Cockrill, the state of bovine bodies was both analogous to, and a cause of, the condition of the human bodies they were supposed to be nourishing. Cows were frequently stunted and unproductive because they relied on deficient forage, grazing and pasture lands. They suffered from endemic infectious, parasitic, nutritional, metabolic, and organic diseases that sometimes killed them but more usually reduced their growth and productivity.[95] The majority were produced by opportunistic matings rather than those planned to effect improvements in their bodies. Husbandry practices such as overstocking, or traditions which derived from the symbolic or economic value that humans placed upon cows, further undermined their health and productivity. Consequently, as Cockrill later reflected, 'The world's livestock population which, if properly managed, could be the genesis of alleviation of human hunger and malnutrition, is itself in large part starved, diseased and parasitic upon the human race.' [96]

Efforts to address these problems were mounted not only by the FAO but also the WHO. Each formed a section that enrolled cows in the campaign against world hunger. Each positioned veterinarians and experts in animal science (which brought together genetics, nutrition and husbandry, and had developed into a taught discipline in American universities in the 1930s) as crucial to the improvement of bovine – and by extension, human bodies.[97] This turn to veterinary expertise was stimulated not only by shifting perceptions of the relationships between bovine and human health, but also by vets' war-time activities, which had demonstrated their capacity to serve human health as well as agriculture. As outlined above, vets claiming to be 'physician of the farm and the guarantor of the nation's food supply' had worked to improve British milk output for the benefit of consumers, while in the USA, they had helped to ratchet up livestock production.[98] War had also granted vets opportunities to operate on the world stage, assisting in the relief and redevelopment of war-torn nations. Such activities elevated their status and encouraged a shift in professional identity, putting them in a strong position to join other experts in addressing the challenges of feeding the world. Their involvement fashioned the world's cows into veterinary subjects, and reinvigorated and expanded older veterinary public health agendas stretching back to the nineteenth century.[99]

One of the key institutional contexts was the FAO's Animal Production and Health Division (APHD).[100] This was headed from 1950 by the Australian, Keith Kesteven, who had left livestock farming and breeding in the late 1930s to study veterinary science at the University of Sydney. During the war, he had acted as veterinary advisor to the Australian armed forces.[101] Afterwards, as a member of UN Relief and Rehabilitation Administration (UNRRA), he led efforts in China to redevelop its livestock industry and eradicate rinderpest. He built the AHPD into an important body employing 32 specialists at headquarters in Rome and employing over 300 in the field, where they helped some 60

[94] Cockrill, 1964, p.260.
[95] For example, see Meyer, 1953.
[96] Cockrill "Feeding Tomorrow's Word", 1968., p. 12.
[97] Jones, 2003, p. 99.
[98] Woods, 2007.
[99] Koolmees, 2000; Hardy 2003.
[100] Phillips, 1981, pp. 102-107.
[101] "The Gilruth Prize Citation 1975: Dr. Keith Valentine Leighton Kesteven", 1975.

different countries to plan livestock health and production programs.[102] Most staff came from universities, institutes, and agricultural departments of leading livestock producing nations, with the USA, Britain, Denmark, Australia, New Zealand and Canada heavily represented. A few came from developing nations, particularly India and parts of Latin America, where veterinary and animal production services were fairly well established. A selection of staff were sent to member countries for specialist training in an aspect of animal or veterinary science.[103] By 1959 the Division consisted of three branches focusing on production, health and dairy production. Each was dedicated to developing and applying forms of expertise that would bring the bodies of third world livestock in line with those of the first world.

The Dairy Branch grew out of AHPD's work in providing technical assistance in milk production and plant management for the Milk Conservation Programme.[104] This had been established by the United Nations Children's Fund in 1948 to distribute dried skimmed milk powder from major dairy producing countries to war-ravaged and under-fed countries across Europe, Asia and Africa.[105] The FAO supported the programme as a short-term solution to shortages of dairy foods, while also promoting the expansion and improvement of local milk production, with the long-term aim of enabling countries to become self-sufficient.[106] One means of achieving this goal was through technical and material assistance for dairy cooperatives.[107] From 1946, it supported a dairy cooperative in the Anand district of Gujarat province outside of Bombay, which broke an old monopoly, rooted in British colonial rule, that under-paid farmers and supplied sub-standard milk.[108] With FAO and bilateral support from Denmark and New Zealand, new dairy plants were built and new dairy technicians and veterinarians trained to run them. The cooperative enabled small producers to pool and receive a reasonable price for relatively small quantities of milk. Their cows became subjects of shared veterinary animal husbandry services that aimed to enhance their productivity. The FAO viewed the cooperative as a key model for its approach to improving dairy production in the developing world.[109]

Technical support for dairy cooperatives relied on the expertise of the APHD's other branches. The Animal Production branch focused on developing programs that combined breeding, nutrition and husbandry. From its inception, it concentrated on collecting information on 'animal genetic resources' through surveys of cattle breeds in different regions. The Zebu in India and Pakistan, and other breeds in Africa and Europe, were scrutinised and evaluated as a basis for advising governments and local breeders on 'how best to utilize their valuable animal genetic resources.'[110] Nutrition was also a key focus. One of the Division's first reports, *Nutritional Deficiencies in Livestock*, detailed the state of animal nutrition in much of the world, the variety of nutritional diseases that

[102] Keseteven, 1966; Cockrill, 1968.
[103] Dalling, 1957. For a study of Swedish input into this programme, see Bruno, 2016.
[104] Phillips, 1981, pp.105-6.
[105] For UNICEF's milk programmes, see Gillespie, 2003.
[106] Pederson, 1967.
[107] For FAO work on cooperatives, see Simons, 1976.
[108] The best historical account of the cooperative is Valenze, 2011, pp.238-50.
[109] Kesteven, 1966, p. 236-37; Cockrill, 1968.
[110] Phillips, 1981, p.105.

burdened livestock, and ways of improving their nutrition.[111] Building on almost a half century of animal nutrition research in the USA,[112] the authors argued that just as with humans, poor animal diets led to poor growth and dietary deficiencies, and were a 'chief factor limiting production of meat, milk and eggs…Tremendous quantities of the world's feeds are wasted in this type of feeding, resulting in large losses of human foods.' Not only was 'the vitamin A value of milk... entirely dependent upon the amount present in the feed', but 'underfeeding dairy cows results in the reduction of milk supply as much as 75 percent.'[113] Therefore '*correcting dietary deficiencies in livestock rations will do much to increase the world's supply of meat, milk and eggs*.'[114] To address the problem, the American nutritionists who authored the report placed particular emphasis on improving the quality of pastures through mixed farming and the application of fertilisers.

The AHPD also had a Health Branch. Its activities were co-ordinated by vet, Thomas Dalling, who had helped to lead the British veterinary profession's wartime efforts to connect bovine and human health. He had also advised UNRRA and the FAO on the post-war reconstruction of European veterinary services and livestock economies.[115] He was convinced that 'to improve the food supplies of protein origin for people in different parts of the world…we must increase animal production; and if we can increase and can better the health of animals, then we will have gone quite a long way towards increasing that animal production.'[116] Certainly, the health of animals needed bettering. Third world cattle were burdened by all manner of disease: major epizootics such as rinderpest and foot-and-mouth disease were a constant threat to herds; scores of parasitical infections presented chronic problems across the world, rarely killing animals but seriously reducing their productive and reproductive abilities; and finally, there were the zoonoses, which undermined the health and strength of their animal and animal victims.[117] Dalling's branch supported an exhaustive array of activities aimed at each of these types of disease. The most high-profile was its campaign to eradicate rinderpest, but its work on parasitical and zoonotic diseases was no less important.[118] The branch provided veterinary expertise and tools such as vaccines, antibiotics and diagnostics. By 1957, it had a field staff of over 40 veterinarians, most of whom were highly experienced had taken leave from established positions to be assigned to a particular country or region for a year or two.[119]

While each country presented its own needs, field veterinarians adopted a shared approach to planning veterinary programs.[120] First, they worked with government officials to evaluate the nature and extent of existing veterinary services, including available laboratories, equipment, and materials. Second, they helped formulate general programs of disease control, which included prioritising diseases according to their burden and available means of control. Third, they instructed local people in how to diagnose livestock diseases, prepare biological products (diagnostic tests, therapies and vaccines), and develop and deliver veterinary education. As Kesteven explained in 1961:

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[111] Allman and Hamilton, 1949.
[112] Olmstead and Rhode, 2008, pp. 270-4.
[113] Allman and Hamilton, 1949, p.20.
[114] Allman and Hamilton, 1949, p.1, italics in the original.
[115] "Sir Thomas Dalling", 2012.
[116] Dalling, 1957, p. 238.
[117] Kesteven, 1961a, 1961b.
[118] Kesteven, 1963.
[119] Dalling, 1957, p.239.
[120] Shaw, 1962; Kesteven, 1963.

'[Control over animal diseases] can only be done by setting up veterinary services in the countries which now lack them, strengthening services in the other countries, and establishing effective international co-operation and co-ordination… Only by such international effort will man be able to control and perhaps ultimately eradicate animal diseases.'[121]

In its efforts to create new experts capable of transforming unproductive bovine bodies into plentiful sources of human food, the FAO worked closely with the Veterinary Public Health (VPH) unit of the WHO, which was created in 1948 within its Division of Communicable Diseases.[122] It had been proposed by James Steele, who as Chief of the United States Public Health Service's newly created Veterinary Division, had overseen the 1945 creation of a specialised VPH programme at the US Communicable Diseases Centre.[123] A key proponent of bringing veterinary expertise into public health, who had a particular interest in zoonotic diseases, Steele envisioned that the WHO's unit would collect information on zoonoses, distribute data, provide seminars and consultancy services to physicians and veterinarians, conduct investigations, and promote research on the control or elimination of zoonoses. It would also cooperate with the national and international agencies responsible for animal and human health. The unit's first head was an American, Martin Kaplan, who had degrees in veterinary medicine and public health.[124] Having worked for the FAO and as a veterinary consultant for the UNRRA in Europe at the end of the war, he was convinced of the value of veterinary medicine for human health. This was spelt out explicitly in the working definition of VPH that his unit generated: 'all the community efforts influencing and influenced by the veterinary medical arts and sciences applied to the prevention of diseases, protection of life and promotion of the well-being and efficiency of man.'[125]

The VPH unit forged close relations with other organisations that were similarly drawn to study and improve unproductive bovine bodies – the FAO, other UN agencies and the World Organisation for Animal Health (OIE) – leading to collaborative programmes on zoonoses, meat hygiene and veterinary education, which drove the integration of veterinary services with public health and agricultural services.[126] For example, it worked in partnership with Dalling's Animal Health branch under a Joint WHO/WHO Expert Committee on Zoonoses, which was established in 1950 in response to the World Health Assembly's identification of zoonotic diseases as key threats to human health within newly independent and developing agrarian nations.[127] The committee was tasked with identifying zoonoses that were evident 'world problems' and for which effective control measures had already been developed.[128] Over the next decade, it agreed a standard definition of these diseases, which brought over 100 different infections under one general category, creating fertile terrain for veterinarians to expand their international role in human health.[129]

[121] Kesteven, 1961a, p.109.
[122] Kaplan, 1953.
[123] Steele, 1979, p.6.
[124] Martin Kaplan, 1976; Soulsby, 2006.
[125] This definition came out of WHO/FAO, 1951, p.3.
[126] "Veterinary public health", 1974, p.108.
[127] FAO/WHO, 1951.
[128] "Veterinary public health", 1974, p.108.
[129] WHO/FAO, 1959.

Perceptions of zoonotic disease threats had shifted significantly in the context of the world hunger campaign. Previously, the animals affected had been regarded as costly impediments to agricultural production, and as transmitters of infections to humans. However, their promotion as food sources for hungry humans led to the realisation that in addition, these animals produced less food for humans, thereby posing dual threats to human health. This was highlighted by one of the Committee's leading experts, the Swiss-American veterinary scientist, Karl Meyer, in a technical paper on 'The zoonoses in their relation to rural health' that he presented, on Kaplan's invitation, to the Seventh World Health Assembly:

> 'One need only to consider all of the adverse effects of the zoonoses to realize the urgency of control: loss of life, acute and chronic illness of inhabitants of rural areas, loss of life and impairment of productivity of farm animals with all of the social and economic implications, and loss of life and acute and chronic illness of city dwellers to whom the zoonoses may spread…These infections unquestionably have far-reaching economic aspects; they may mean mere loss of profit or they may mean critical want. In some areas they preclude the raising of livestock altogether…in others they make an already poverty-stricken group poorer still and deny food supply to undernourished populations. In their destruction of food supply alone they are major economic problems. Some of the diseases…are detrimental to rural populations because of their direct effects on health of farm people, making habitation in rural areas impossible or hazardous; some are more important in their effect on the world's food supply.'[130]

Pointing to the complex challenges zoonoses posed, Meyer laid out an agenda for positioning veterinary public health as integral to their control. Tackling zoonoses in developing countries would require extensive technical assistance, close 'co-operation between physicians, health workers and veterinarians', and between veterinary and agricultural agencies. Kaplan's VPH Unit sought to implement this agenda. It coordinated epidemiological studies and basic laboratory research on zoonoses, including the development and standardization of diagnostics, treatments, and vaccines.[131] It invested in technical assistance to resource-poor countries that helped them to build or expand veterinary laboratory services, and to train local veterinarians and technicians in how to make and administer biological products for zoonotic disease control. As with Dalling's division, veterinary education formed an important part of its strategy.[132]

In all of these efforts, international experts remained acutely aware of local contingencies. Kaplan was especially adamant about avoiding one-size-fits-all approaches (which many of his WHO colleagues were to take in campaigns against malaria and other human infections).[133] This approach probably stemmed partly from these experts' experiences of working in different countries, which alerted them to how specific environmental, cultural, agricultural and economic contexts shaped livestock health and production.[134] The results of their own surveys also revealed that cows came in many different shapes and sizes, with varying physiologies, genetic traits, nutritional needs and biological capacities. There was also great diversity in how they were bred and fed, the natural and

[130] Meyer, 1954, p.4.
[131] Kaplan, 1954.
[132] See, for example, FAO/WHO, 1962 and 1963.
[133] See, especially, Kaplan, 1966.
[134] FAO/WHO, 1951, p.16.

built environments in which they were housed, milked, and slaughtered, the ways in which they were managed, and the customs and cultures through which they were valued. Therefore while the principles and aims of livestock improvement might have been universal in kind, in practice, there was no single technological fix or magic bullet could transform them into more efficient suppliers of protein. Programmes had to be modified according to the particular livestock bodies and cultures affected.

Turning the aspirations of expert committees in Rome or Geneva into bovine bodily realities was made more difficult by the shortage of veterinarians and veterinary assistants: 'We estimate that there are about 1,000 million cattle and buffalo in the world… [But] there are not more than 200,000 qualified veterinarians to cope with this vast general practice and many fewer specialists in husbandry and nutrition.'[135] Moreover, most of these experts were based in developed countries. To overcome this problem, FAO and WHO committees envisaged the creation of a new kind of veterinarian, which Cockrill referred to as the 'international veterinarian'. This was a trained professional who would be concerned not with the treatment of individual sick or injured animals, but with 'prophylactic, curative or management methods designed to apply collectively to national herds and flocks.'[136] The goal was to foster 'the healthy animal and the means by which it can live its life in a state of health and productivity.'[137] These aspirations reveal, once more, the perception of bovine bodies as analogous to humans, whose health was defined by the WHO in 1948 as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.'[138] The general strategies for creating these healthy bodies were also analogous: population and disease control were seen as first measures, which would lay the ground for others.

What this meant for many cows was, in the first instance, culling.[139] In countries such as India, overstocking and overpopulation were viewed by veterinary and livestock planners as the foremost obstacle to improvement.[140] Cattle competed for land with humans, and as Indian agricultural policy promoted increases in crop production, the production of cattle fodder declined, resulting in rising numbers of malnourished cattle.[141] The Indian statistician and influential director of the FAO's Statistics Department, P.V. Sukhatme, pushed for population control in both humans and cattle as key to India's modernization, but the cow's sacred status protected it.[142] In other parts of Asia and in Africa, it was not so fortunate. Old, 'useless' and surplus young cows were slaughtered to improve stock quality, alleviating pressure on pastures, grazing lands and water supplies, and reducing competition with hungry humans for grains and other crops. Surviving cows – which were deemed potentially productive – had their bodies scrutinised by veterinary services, the exact nature of their examination and manipulation shaped by everything from available funding and technical assistance to whether they were owned by large dairies, cooperatives or subsistence farmers.

[135] Cockrill, 1967, p.56.
[136] Cockrill, 1966, p.9.
[137] Cockrill, 1964, p.252.
[138] WHO, 1946, p.100.
[139] Hambidge, 1955, p.157.
[140] Hambidge, 1955, p. 166.
[141] Ibid., p.166.
[142] Sukhatme, 1963, p.3; Sukhatme, 1966, p.7.

At the Anand dairy cooperative, a flagship initiative for the FAO and WHO, the bodies and lives of cows were significantly transformed over a twenty year period.[143] These were mostly Gir cows, the most famous and widely used breed of dairy cattle in India.[144] When the project began in 1946, they were housed in 'villagers dwellings or in filthy annexes', but by 1966 had "hard standing and comfortable quarters.[145] Thirty veterinarians monitored all aspects of their health. Their health and productive capacities were preserved by vaccination against rinderpest and brucellosis, regular monitoring for symptoms of foot-and-and-mouth disease and bovine tuberculosis, antibiotic treatments for bacterial infections such as mastitis and metritis (inflammation of the uterus), and anti-helminthic treatments for chronic parasitical infections. Every village centre was supplied with a veterinary kit containing simple remedies and antiseptics, which was used by trained animal health assistants to treat minor infections and ailments.[146] Feeding had also become more regulated and routinized. No longer reliant on limited grazing and pastures, cows received fodder grown with added nitrogen to improve its nutritional quality, and a daily portion of a vitamin-enriched feed mix to improve the quality and quantity of their milk. A feed mixing plant, supplied by OXFAM, processed 100 tons of this mix each day for the cooperative's dairy cows and buffalo. Cow genetics were also being modified. With FAO support, the cooperative built an artificial insemination centre run by Vergehse Kurien, who had studied nuclear physics in the USA but returned to India in 1946 to manage the cooperative's dairy operations.[147] Trained by the FAO in veterinary and animal science, he worked with FAO experts to develop a breeding program that would 'increase the genetic potential' of dairy cows and buffalo. Gir bulls were used to improve other native dairy cows, and cows were cross-bred with high-yielding Friesian and Jersey cattle. These transformations in the material conditions and biological capacities of the cooperative's cows radically transformed their productivity. In 1946, they were producing between one and two thousand gallons of milk a day. By 1966 this had risen to 25,000 gallons a day.[148]

Kesteven and his colleagues regularly referred to the Anand cooperative as a successful example of how improving the general health of dairy cows could improve the production and supply of milk, leading, in turn, to improvements in human health and productivity.[149] Throughout the 1960s, the APHD vigorously pursued the development of dairy cooperatives as a crucial strategy for getting more protein out of animal bodies and into human bodies.[150] However, translating the local successes of Anand into other parts of India and beyond proved a formidable challenge. The sheer variability of cow bodies and the contexts in which they lived generated equally variable sets of interventions, with varying implications for the lived experiences of cows, and the health and nutrition of their human consumers.

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[143] Bellur, 1990.
[144] Gaur, Kaushik and Garg, 2001.
[145] Kesteven, 1966, p.336.
[146] Cockrill, 1968, pp. 10-12.
[147] For an excellent account of Kurien's work, see Valenze 2011, pp. 238 *passim.*
[148] Kesteven 1966, p.336.
[149] It gave rise to what, by the 1980s, was being called India's "white revolution". Bellur et al., 1990.
[150] Simons, 1976.

Conclusion

International concern with protein malnutrition reached its apex in the mid-1960s. Reports issued by FAO, WHO and the other UN agencies warned of an 'impending protein crisis' in the developing world.[151] Increasing supplies of animal protein – particularly from milk and milk products – lay at the heart of their recommendations and solutions.[152] The FAO's *Third World Food Survey*, issued as part of its 'Freedom From Hunger Campaign' in 1962, concluded that because in developing countries 'the level of animal protein intake is only one fifth of that in the more developed areas, world food supplies would have to rise by 50 per cent by 1975.'[153] Two years later, the FAO characterised protein shortages as being 'at the heart of the world food problem.' While acknowledging that proteins could be derived from certain vegetable foods, its official view was that it was 'far easier to build satisfactory diets, particularly for these vulnerable groups, when good supplies of animal protein are available.' Meeting the challenge meant that 'much greater resources [had to] be expanded to increase production of such protein-rich foods as fish, meat, eggs and milk'.[154] Such increases could only be achieved by increasing the efficiency of livestock production: heathier, better nourished cows were key to the creation of healthier, better nourished humans.[155]

As we have seen, while nutrition experts trained in human medicine played vital roles in characterising the nature and extent of the crisis, they did not work alone. The belief which emerged through and after the Second World War, that the state of human bodies was deeply dependent on, and also analogous to that of bovine bodies, resulted in a campaign against world hunger which integrated medical expertise with that of vets and animal scientists, under new institutional structures created by the FAO and WHO. Veterinary and animal experts brought crucial knowledge and skills that derived from their own relationships with food animals. At one and the same time they highlighted the essential roles of animals *and* of animal experts in meeting the urgent and growing needs of a protein hungry world. If, 'In a world where so many people go hungry, any menace to the health of man's food-yielding animals is a menace to the health of man himself,'[156] then according to Kesteven and his colleagues 'In the forces which are fighting protein lack, the veterinarian and the animal production specialist are [the] vanguard.'[157]

While experimental and field work on livestock animals had been essential to the development of 'new nutritional knowledge' since the turn of the century, veterinary and animal production experts generated new understandings of the complex and intimate connections between animal health and nutrition, and human health and nutrition, and applied them to the production of more animal proteins, especially cow's milk. Since the inter-war period, nutritionists had pointed to the miraculous properties of milk in improving the health and efficiency of children, mothers and workers, in their own nations and in colonies stricken by kwashiorkor and other deficiency diseases.

[151] "*Feeding the Expanding World Population,*" 1968;
[152] Phillips, 1963.
[153] FAO, 1963, p.9; FAO, 1964a.
[154] FAO, 1964b, p.i.
[155] FAO, 1962; FAO, 1967.
[156] "Healthy animals," p.257.
[157] FAO, 1967, p.8.

After 1945, they recognized and promoted its significance for both human health and for the economic health of farmers and agrarian societies in the so-called developing world. Thus, milk, and the bovine bodies that created it, represented a *material site* in which veterinary and nutritional expertise could be integrated for a common purpose. With the formation of new international organisations, most notably the FAO and WHO, and the making of protein malnutrition into a new field of international action, their formerly loose associations under the inter-war 'marriage of agriculture and health' were transformed into institutionally embedded connections and incorporated into the international campaign to feed the world.

All of the human activities described in this chapter were inspired and shaped by cows, in their various roles as producers of food for humans, transmitters of infection to humans, victims of poor health and husbandry, and producers of agricultural profit. While, as we have seen, these roles could inspire quite different responses mounted by different groups of experts, under the campaign to feed the world they began to be considered in tandem. The millions of cows identified in Asia, Africa and Latin America as diseased, malnourished, overpopulated and poorly bred were seen as a key reason why so many humans suffered ill health and poor nutrition: they did not produce enough food for humans and they could also transmit infections to them. It was in order to address these issues, and thereby enable cows to perform better as sources of human food – as well as agricultural profit – that WHO and FAO experts came together in the 1950s and 1960s, to survey, evaluate and work out how to improve bovine bodies.

Yet, while part of the solution was to create new healthy cows by scientifically controlling their diseases, nutrition, breeding, and management, doing so involved creating new animal experts – veterinarians, animal scientists, technicians and many more – along with an array of services, facilities, laboratories, and clinics that would provide the infrastructure for their work. Therefore in responding to, and reshaping perceived connections between bovine and human bodies, the incorporation of veterinary medicine and agricultural science into international health agendas had profound and far-reaching impacts. It changed the bodies, surroundings and lived experiences of cows, and brought them into new relationships with a new breed of local expert and the facilities and technologies they employed. It also created new opportunities for vets and animal scientists to participate in, and shape, human health agendas.

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