

Scotland The Bread!

Rediscovering wheat diversity for the public good

A lecture given by Andrew Whitley as part of the series 'What's for Dinner? The future of Food & Farming in Jersey and elsewhere.' at the Royal Jersey Agricultural and Horticultural Showgrounds on Friday September 30th 2016.

The lecture series is organised by Alasdair Crosby, editor of Rural Jersey Country Life.

1 From the Corn Laws to Brexit: Britain's love affair with the world market

In 1846 – as we were taught at school – the British parliament repealed the Corn Laws. Henceforth, it was decreed, the colonies and the rest of the world would supply Britain's bread corn, not its own farmers. 170 years later, the vote for Brexit seems to suggest a partial rekindling of our love affair with free trade and world markets. I say 'our' love affair, but back then, as now, not everyone was equally besotted. For the majority, the promise of cheap food may have seemed irresistible – as a guarantee of bodily subsistence or an excuse to pay low wages, depending on your 'station', as they used to say. But there were losers. Not, funnily enough, the large landowners and farmers whose political representatives had argued long and hard against Repeal. The privileged class has deep pockets, is adaptable and survival is its business.

The main casualty, I would argue, was bread itself – its quality, understood as its capacity to nourish – and hence, of course, the people who most depended on it, which was the great majority of the working population in the 19th century. If that sounds a bit sweeping, its worth remembering, for example, that in Manchester in 1800 a typical family spent 24 out of the 28 shillings a week earned by its members on bread. In 1833, a Factory Commission report alluded to the reasons why people were so dependent on the first 'convenience food', i.e. bread: "too often the dwelling of the factory family is no home; it is sometimes a cellar, which includes no cookery, no washing, no making, no mending, no decencies of life, no invitations to the fireside". No kitchen, no conviviality.

A Board of Trade enquiry in 1904 and a Royal Commission on the food supply in 1905 found that the average British diet still contained a large amount of bread – 6.7 pounds per person or 46% of their total weekly intake. That's almost five times as much bread as we eat today.

However, given that it was feeding a rapidly expanding urban population at the centre of a rich and powerful British Empire, in what sense can we possibly say that bread was a casualty of globalisation Mark I?

In addressing the theme of 'the future of food and farming' which is the motif of the 'What's for Dinner?' series, I hope to show how past decisions affecting where our bread comes from and what it's made of have had momentous consequences for the health of the nation and the biosphere and to suggest how we are now at a historical juncture –

perhaps as significant as 1846 – when we can, if we choose, genuinely ‘take back control’ of our bread supply, for good and all. I will humbly suggest that the Scotland The Bread project may be a model for communities to secure their food supplies with better bread, happier farmers, more skilful bakers, healthier citizens and a more diverse environment.

2 The Jersey connection

My bread-time story begins, as it happens, in Jersey. Not because Colonel John Le Couteur of Belle Vue was the first, or the only, wheat ‘improver’ on this island or in the modern world. But because he lived and worked at a pivotal moment in the evolution of the British wheat and bread supply; because the fate of his wheats was determined by those very forces that I argue damaged our bread so insidiously; *and* because there is a Scottish connection.

Four times President of the Royal Jersey Agricultural and Horticultural Society, Sir John was an important farmer, much involved with the cattle breed for which the island is perhaps best known. It is intriguing just how far back the exchange of breeds and seeds goes. In the 1830s, Sir John wrote to a Hungarian enquirer that his grandfather had sent cows to Scotland “qui ont formé le type de la belle race dite ‘Ayrshire’”. Quite a claim. His own most famous wheat variety, Talavera, came from the area of the same name in Spain, scene of a notable battle in the Peninsular War (1807-14). Colonel Le Couteur fought in that war but it seems that his interest in wheat was kindled only when he met Professor La Gasca, Curator of the Royal Gardens of Madrid who had been exiled for his anti-Hapsburg political views and was growing scores of different wheats in the gardens of Mr Saunders, a Jersey nurseryman. Le Couteur learned a great deal from La Gasca and before long (according to the Farmers Magazine of 1835) was proposing that Jersey could supply ‘the most approved seed-corn for Great Britain’. Le Couteur hastened to reassure mainland farmers that they need not worry about competition because Jersey had only 25,000 acres of arable ground in total. An export-oriented agricultural economy, international trading, concerns over competitive advantage – plus ça change...

Le Couteur’s Talavera found its way to the Eastern edge of Southern Scotland, to Mungoswells in East Lothian, where one of the 19th century’s most famous wheat breeders, Patrick Shirreff, produced in the 1860s a variety called King Richard by ‘fecundating Shirreff’s Bearded White with pollen from Talavera which has large grain of the finest quality’. Quality, in this case, meant bread making quality, as is confirmed by a report thirty years later from a meeting of the National Association of British and Irish Millers in which the writer bemoaned British farmers’ adoption of higher-yielding wheats that were no good for bread and the disappearance of Talavera (‘a finer wheat could scarcely be desired for a miller’).

So what was going on? Why were farmers choosing not to grow the best bread wheats?

3 The change from self-sufficiency to commodity markets via high farming

John Walton, in a fascinating article in the *Agricultural History Review* in 1999, challenges the convention that it was all because of the Corn Laws, or the Repeal of same. He argues that, far from being displaced by a torrent of imports of hard wheat from Russia, Argentina and later Canada and the USA, British bread making wheats suffered at the hands of their *own growers*.

Livestock fattening, to supply an increasingly affluent nation of British beef-eaters, seemed to be where money was to be made. So-called 'farmers' wheats' were those chosen for grain yield and for straw quality to supply winter bedding. They also needed to respond well to the increasing quantities of manure now available in the cycle of intensification known as 'high farming'. Le Couteur, Shirreff and other farmers produced or selected or imported many kinds of wheat and as late as 1860 a variety discovered fifty years before by a Mr Hunter of East Lothian could be described, in a review of the principal wheats being grown in Britain, as bearing comparison with any of the newer wheats 'either in the sheaf, stack, sack, flour-mill or bakers' shelf'. This was wheat designed to feed people in the locality well.

But the divide between traditional varieties which had supplied thousands of small mills with locally-grown wheat and thus local bakeries with breadmaking flour and higher-yielding soft wheats that were suitable for fattening livestock (and for cakes and biscuits) grew ever wider. This was, of course, partly a response to a growing demand for meat. But, as I noted earlier, a rapidly-growing urban working class still depended massively on bread. So why didn't British farmers cash in and grow the excellent all-purpose wheats developed by the likes of Le Couteur and Shirreff?

One explanation was the availability – tariff-free after 1846 – of hard wheats from abroad that made stretchy dough and big loaves. At the beginning millers would mix small amounts of these wheats with British ones to even out quality variations. But the supply of good baking-quality British wheats gradually dwindled as farmers decided they were better off growing larger quantities of grains to feed animals rather than people. In this, they were encouraged by the agricultural societies, the precursors of the NFU. Patrick Shirreff, in his 1873 memoir 'Shirreff on Cereals', devotes about a third of the book to a series of complaints against the local agricultural societies who appear to have gone out of their way to resist his attempts to 'improve the cereals' by novel breeding and selection techniques. Shirreff was against the Corn Laws, which he thought a bar to agricultural progress, and he attributed much of the bile that came his way to this. But he also railed against the tendency of judges at shows and competitions to favour the fat, soft, starchy grains that are the sign of a low gluten wheat. A paradoxical new orthodoxy seemed to have gripped the powers-that-be in farming: they spurned innovators such as Shirreff with their new bread making varieties while rewarding new varieties that were suitable only for animal feed.

Not for the first time, the farming establishment seemed to be serving the interests of the few. The vacuum in British bread making wheats was filled by imports brought in on increasingly efficient ships. Joseph Rank and others built large industrial mills on the

seaboard, equipped, after 1870, with roller milling technology that handled hard imported wheat better (in the sense of stripping more of the nutrients out to make white flour) than traditional stone milling could. Demand for British bread making wheats dwindled, farmers couldn't sell their lower-yielding baking wheats for a fair price and were condemned to be price-takers in a thoroughly commoditised and globalised market. The price of wheat dropped by half between 1846 and 1900. Small country mills that had for centuries turned local wheat into fresh flour to make tasty bread were wiped out and local economies saw value sucked away to industrial centres and into the coffers of grain barons such as Cargill, Bunge and Louis Dreyfus.

4 The Green Revolution and the CBP

At the turn of the 20th Century Britain was the leading world power but it produced remarkably little of its own staple food, wheat. This 'openness to free trade' or 'critical lack of food security' – however you choose to think of it – lasted until the definitive supply disruptions of the Second World War left the country on the verge of disaster. The post-war settlement made national self-sufficiency in food a priority. Easier said than done if you've spent the previous century or more developing and growing wheat varieties largely meant for animal feed. The race was on to build some baking quality back into British wheat.

Enter the big beasts of the mid-20th-century grain chain: the so-called much-hyped Green Revolution and the more prosaic Chorleywood Bread Process. Both were motivated by the age-old concern to increase the supply of cheap food. But those good intentions turn out to have paved a road to nutritional, environmental and socio-economic hell.

I haven't time to justify in detail what may seem a bit of an exaggeration. But if I outline some of the key points, I think it may become clear why the degradation of our bread that began two centuries ago or more has continued – and perhaps accelerated – since the 1950s, despite enormous advances in disposable income and material living standards.

Who would have thought, when the industrial baking boffins at Chorleywood in leafy Hertfordshire found a way to make white sliced bread with British grown wheat (despite its legacy of poor quality), that 55 years on, sales of this staple would be falling off a cliff and between a quarter and a third of the population would be avoiding or limiting bread consumption due to an intolerance or allergy to gluten? There's no denying the enormity of this achievement. Human beings have gratefully and respectfully eaten the mix of flour, water, yeast and salt that we call 'bread' in various forms for perhaps fifteen thousand years – yet the boys from Chorleywood took a mere fifty years to turn it into an international laughing-stock that no-one respects and one in four of us no longer eats at all.

How did they do it, and why?

Let's start with the Green Revolution.

This is the name given to the coordinated post-war plan to breed high-yielding varieties of rice, maize and wheat to increase the total amount of food available to famine-prone areas of the world, particularly Asia and Africa. The breeding programmes shared common approaches: the new plants should ideally have greater natural resistance to certain pests and diseases and, crucially, they should respond to 'packages' of agrochemical inputs (synthetic fertilisers, fungicides, pesticides, herbicides and hormone straw stiffeners and so on). In the case of wheat, a dwarfing gene was introduced to shorten straw length in order to carry a heavier seed head and minimise the consequent risk of lodging in wind or rain.

The programme successfully achieved greatly increased yields, though it didn't address unequal access to food, with the result that half a century on, 800 million or so of our fellow citizens still go to bed hungry. But look closely at the new hybrid wheats and there are other ways in which they fail both the 'end user' (ordinary people) and the environment.

Green Revolution wheat varieties – the kind that are used in almost all the bread we eat – have fewer important minerals (iron, zinc, magnesium) than older varieties. They often have more 'epitopes' of gliadin protein that trigger coeliac and similar auto-immune and intolerance conditions. And in a classic example of the law of unintended consequences, it's recently been discovered that breeding pest-resistance into modern wheat may have increased the prevalence of proteins called amylase trips inhibitors (ATIs). These are primary resistance molecules that ward off pests. But they are also strong activators of human immune responses and inflammation and may contribute to the onset or worsening of coeliac disease and non-coeliac gluten sensitivity.

ATIs demonstrate the link between modern agronomy and baking – or, to put it simply, what happens when wheat breeding responds to the needs of industrial scale farmers and bakers, not citizens. If you look closely (you'll need good eyesight or powerful specs) at the ingredient list on the wrapper of your typical sliced loaf, you'll almost always see an ingredient called 'wheat protein'. When it is bought by bakers, this material is called 'vital wheat gluten', but in their loaves it magically becomes 'wheat protein'. Gluten is protein, of course, so the label isn't inaccurate, but it could be misleading, especially to people wanting to control their gluten intake. But why does our bread, made from modern wheats that have been assiduously bred to contain more and better gluten (to make a bolder loaf), need extra gluten? To make the biggest, softest loaf possible, of course, and as a way of using lower quality, cheaper wheats. The problem is that this added commercial gluten contains higher percentages of ATIs than the natural protein in the wheat itself. Could there be a link between the systematic use of added gluten in industrial loaves, rolls, pizzas and panini over the last thirty or forty years and the rise in coeliac disease and non-coeliac gluten sensitivity?

Here's another example of 'unintended consequences'. Intensive farmers routinely spray soluble nitrogen onto wheat plants after flowering when the grain is filling, in an attempt to boost protein levels. Nitrogen 'translates' into grain protein and this late spray onto the wheat plant's leaves bypasses the tedious business of soil, roots, sunlight, photosynthesis and all that 'natural husbandry'. It's the botanical equivalent of an intravenous drip, rather than a square meal. But wheat treated this way (that is, most of the wheat that goes into our daily bread) has been shown to contain double the amount of a peptide called omega-5 gliadin which is a significant trigger of auto-immune conditions such as the much-researched Wheat-dependent Exercise-induced Anaphylaxis.

A picture is emerging, is it not?

When wheat is bred for markets, people and the environment suffer. Markets have never been the perfect mediators of supply and demand that their devotees claim. Now, they are the playground of big finance. In 2012, 98% of the trades on the Chicago wheat exchange were financial; only 2% involved physical shipments of grain. In the words of Brewster Kneen in his book about the privately-owned grain conglomerate Cargill, *Invisible Giant*:

The major motivation for 'globalisation' has not been to ensure that the primary producer gets a fair price, stays on the farm and feeds the family and the community, but to provide reliable and cheap access to raw materials, anywhere in the world, for the so-called 'value-adding' activities of the food system giants. The 'value' that is being added is not nutritional, however. It is shareholder value... It is not farm incomes, community economic stability, the health of the citizens, or equity and justice.

Farmers are often both victims and unwitting agents in this process. Consider this. When a farmer is planning which variety of wheat to grow, he can consult the very useful National List which ranks recommended varieties according to trial results – listing yield, protein, straw length, resistance to lodging, resistance to disease and so on, all compared to a control. The list is divided into two main categories, so called 'milling' (that is breadmaking) wheats on the one hand and varieties destined for animal feed on the other. Only in the section devoted to animal feed varieties is there any mention of nutritional density or digestibility. We don't know, because we don't bother to find out, what is in all the wheats that go into the human food chain.

When a researcher does take the trouble to measure modern bread wheats, she reveals a long-term decline in the density of certain minerals, notably iron and zinc. And in case you're tempted to imagine that this doesn't matter because we can get these minerals (which significant numbers of people don't get enough of) elsewhere in our modern diet, remember first, that people on low incomes eat more bread than average and may have limited access to an adequately varied diet, and that, as a society, we have actually signed up to the importance of having a minimum standard of nutrients in our bread:

since 1953, all flour except wholemeal has been fortified, by law, with calcium, iron and two B vitamins. As a method of dietary improvement, this is more symbolic than effective: for one thing, the government's own scientists have reported on more than one occasion that the form in which the iron is included in mandatorily fortified flour makes it almost completely inaccessible to the human digestion.

The issues of digestibility and bioavailability remind us how the story of wheat quality doesn't end on the baker's bench. When the Chorleywood Bread Process was invented in 1961, it was hailed as technological triumph that would see British wheat used in British bread once again. It was, as it turned out, a Faustian pact: in return for the immediate pleasures and advantages of national self-sufficiency in wheat (and thus cheaper, tariff-free ingredients for our daily bread), we got the inevitable end-game of diet-related disease in which the industrial loaf plays a major rôle.

How come?

The Chorleywood process uses high-speed mixing, a cocktail of chemical emulsifiers, genetically engineered enzymes and zero fermentation time (not forgetting the added gluten) to whip up a dough using (theoretically) lower-protein, softer wheats. Depending on the quality of the harvest, the percentage of British wheat in industrial bread is around 80% - and there have been periods when one or other of the big bakers has promoted its loaves with a 100% British claim. So – good marks for self-sufficiency. But not so good when you consider the decline in nutrients and the increased toxins in the wheats being used. And positively 'nul points' when you consider the disastrous effect of removing the fermentation step which, since the dawn of breadmaking as we know it, has been essential to raising a loaf.

We now know, that only when you allow time for the yeasts and beneficial bacteria in dough to ferment, do they transform an indigestible lump of stodge into the true staff of life. The bacteria are the real heroes in this, and it's fascinating to see how diversity in the human gut microflora, now being recognised as a key marker of health, is supported by a similar diversity of bacteria in good bread dough.

We call the best exemplar of this process 'sourdough'. It depends on slow-acting naturally occurring yeasts to do the raising work, which allows enough time for the lactic acid bacteria to work their wonders as they gradually acidify the dough. Here are a few of the things that sourdough fermentation does:

- it 'pre-processes' proteins and starches to make them easier to digest
- it makes minerals that, in a quickly made bread pass straight through our body, more bioavailable
- it reduces the glycemic index of bread, slowing the absorption of sugars into the blood stream and increasing satiety – fewer slices needed to feel satisfied and less likelihood of type-2 diabetes, not to mention more affordable bread

- it even 'manufactures' beneficial compounds such as the cancer-preventative lunasin in dough.

I could go on. But I challenge the industrial loaf industry to prove that removing all these and other time-related benefits – which came as standard with most bread eaten by humans until half a century ago – has played no part in the current epidemic of gluten allergy and intolerance.

5 The new approach - diversity and health

I hope that this inevitably cursory overview has indicated how we have, for too long, been growing the wrong kind of wheat and making it into loaves that are less nutritious and digestible than they ought to be.

A new approach is desperately needed, one which has human health as its goal, harmony with the biosphere as its operating principle and equity as its moral compass.

In contrast to the intensive monocultures of industrial agriculture, diversity will be (in the words of Martin Wolfe) our defence against adversity. In wheat breeding, this means finding and developing varieties, mixtures, landraces and composite populations that thrive in agroecological systems, characterised by soils that are teeming with micro-organisms and holding on to the carbon that we must stop releasing if we aren't going to fry the planet.

And as we find and propagate ever more nutritious wheats, we need to apply the same principles of patient engagement and diversity to our bread baking and sharing. A quick sale based on low price and convenience simply postpones the real costs to individuals and society.

6 Scotland The Bread

This is what Scotland The Bread is all about. It has two aims - the improvement of wheat and community baking. It's a project defined by a country but it's not nationalistic. It's just that the situation in Scotland is so extreme. Its farmers grow upwards of a million tonnes of wheat of year, yet virtually none of it is used to make bread. Diet-related ill health is almost out of control. Scottish men's waistlines have increased by 2" in the past ten years and obesity is likely to cost the health services £3 billion by 2030.

Guided by Andy Forbes of Brockwell Bake Association in London, we began by searching gene banks for wheats that may once have fed Scotland. We found Rouge d'Ecosse, Goldendrop and Hunters and now have a good three tons of each in the barn, awaiting testing to confirm a previous analysis that indicated above average mineral density in these varieties. One of the most exciting moments was when I brought a few grams of grain called simply "Shirreff's" from the gene bank in the Vavilov Institute in St Petersburg. We've also forged links with Swedish plant breeders who have screened

hundreds of landraces and old varieties for mineral density. Some of these were trialled in the Royal Botanic Garden Edinburgh this year and did well. A diversity of wheat seeds is going out to organic farms around Scotland and in a few years we expect to see the development of a host of local modern landraces – each adapted to produce consistent yields of high-nutrient, digestible and tasty grain, flour and bread. Some of the genes may be old, but the methods we are using to evaluate them are cutting edge. This isn't a museum project - it's about growing better grains and knowing what we've got.

Earlier this year, we launched a non-profit Community Benefit Society and have raised over £35,000 in public shares (and we are eager to sell more). This money will support our initial research and testing and our wide community engagement. But it's vital that we develop demand at the same speed as supply, because we have no intention of leaving our farmers to the uncertain mercies of the market. Last year, over 60% of cereal farmers lost money, even when they achieved top yields by piling on expensive inputs. So we're going to do things differently, by rewarding farmers, not for the tonnes of wheat they produce but for the **number of people they nourish** per hectare. We're developing a fair-trade model which will bring producers and citizens closer by sharing risk and benefit in a transparent way.

Close connections – knowing where your daily bread comes from – are at the centre of our second 'field of activity', community baking. It takes real skill to fashion a shapely and delicious loaf from the nutritious wheats that we'll be growing in Scotland. Which is why we need to turn conventional notions of 'efficiency' on their head and plan for **more jobs per loaf** – real, skilful, meaningful, fulfilling jobs, feeding our fellow citizens with real bread.

Community-supported baking deliberately blurs the distinction between producer and consumer by adding convivial exchanges to plain cash as a legitimate currency in thousands of small bakeries that will constitute a new infrastructure to replace the unsustainable status quo that has done such damage to our health and wellbeing.

My hope is that the future of food and farming in Scotland, and perhaps in Jersey, fulfils the noble intentions, and learns from the perseverance and humanity, of those early 'improvers of the cereals', Patrick Shirreff and John Le Couteur. When it comes to making the world a better place for everyone, which I fancy we all wish to do, I suggest that we do it one loaf at a time. But do it we must.