

A SCOTTISH  
POTATO BREEDER'S  
HARVEST

PART TWO

BY

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# A SCOTTISH POTATO BREEDER'S HARVEST

## PART TWO.

I could easily sit back and let my varieties speak for me but I decided not to do that because every good brand, be it Scotch seed potatoes or Jack Dunnett's varieties, needs to have a history or tell a story.

Eight years ago I published "A Scottish Potato Breeder's Harvest" in hard covers and this is my supplement. The page numbers follow on and the format is the same, a series of papers that I have been stimulated to write for various reasons over the years, or texts of talks I have been asked to give. Now, however, what I shall call Part One retrospectively and its supplement Part Two can be brought together on line and downloaded from *Caithness.org* which is about life and activities in my native county of Caithness.

The following supplementary papers are not peer reviewed scientific papers intended for scientists. They continue my running commentary on potato breeding for a wider readership of people interested in fresh potatoes, which will be most of us to some extent, either as producers or consumers, or both. There will be some repetition of important points.

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Published in 2006 in the Journal of the Royal Caledonian Horticultural Society, who had kindly awarded me a gold medal for potato breeding. Maintains that blight resistance genes advantageous in the wild have never given lasting protection under conditions of clonal monoculture and probably never will, so the best course is to keep potatoes properly sprayed – a disillusioned and slightly quirky article.

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## WHAT TO EXPECT FROM POTATO BREEDING

What not to expect from plant breeding is also worth considering, so please bear with me while I go back over some old ground for those who have not read Part One.

There are two directions of potato research and development, from the top down and from the ground up. My experience of these directions is personal and not necessarily unprejudiced. As I have already recounted at greater length (pages 23-25) we were in the middle of producing the famous series of Pentland varieties when a new Director, the late Dr Norman Simmonds took over. He maintained there had been a worldwide failure of potato breeding because potato breeders had failed to increase the yield of potatoes and that that explained their failure to replace some very old potato varieties, whereas cereals breeders had brought about a green revolution by greatly increasing the yield of cereals. He deduced that potato breeding material was exhausted because it rested on the narrow genetic base of the few primitive South American cultivars that had found their way to Europe in the sixteenth century, and a trickle more thereafter. He proposed to re-create the cultivated potato, which he called Tuberosum, on a basis of the hundreds of primitive cultivars in the Commonwealth Potato Collection which had mostly been collected as tubers picked off South American market stalls, and he forecast that the resulting Neo-Tuberosum would outyield existing European varieties by up to forty percent. This was a visionary proposal, rooted in history, therefore doctrinaire, and top down because, as Director, he was in a position to implement it. Had he succeeded the whole world would have thanked him.

I was half persuaded myself and finally resigned because my position as an established potato breeder had been undermined. After ten years in obscurity as a commercial seed grower, which was my lead-in time as a private potato breeder, I found myself becoming angry, not with Dr Simmonds or anybody else, but with myself, and I could have kicked myself for failing to see that the alleged worldwide failure of potato breeding rested on a fallacy - which still persists to some extent.

Many of us will have seen pictures of sheaves of cereals being forked onto carts while the Battle of Britain raged overhead. Look again and you will see that the sheaves are nearly as tall as the people. Then came the combine harvester which required grain to ripen on the stalk before it was cut, so new varieties were produced with shorter and stiffer straw. What was achieved was a repartitioning of assimilates, more to the grain and less to the straw. Also, the shorter strawed varieties could withstand heavier manuring without lodging. That was the green revolution. It brought cereals varieties into the modern world of the combine harvester. To those who call for a second green revolution in the simple belief that if it happened once it can happen again, I say IT CANNOT BE DONE AGAIN, not until someone thinks of a new rationale, which may be never. Cereals breeders were not really racing ahead of potato breeders. They were catching up, and I believe it is potatoes that will do most to alleviate the world's impending shortage of food.

The Neo-Tuberosum revolution never materialized because existing varieties proved to be more competitive than expected and the Scottish Plant Breeding Station ceased to exist as a separate entity largely because expectations had been raised sky high and not fulfilled : and the stream of Pentland varieties had dried up.

That makes it a cautionary tale to rank with Allan Parker's cautionary tale of the demise of seed production in Prince Edward Island, Canada. Those who attended the British Potato Council's conference at Crieff in Scotland in 2008 will have received a copy of his presentation. Ware production for processing in PEI increased to the stage at which the rotation became potatoes/snow/ potatoes in some parts, the health of seed potato crops was compromised, and former seed markets in the U.S.A. and South America, and to a lesser extent in Italy and North Africa, were irretrievably lost.

Now, in complete contrast to the Neo-Tuberosum saga, which was such a quintessential example of potato research and development from the top down, I shall consider development from the ground up, specifically how my variety Nadine came to be seen as the highest yielding variety in Britain and possibly in the world, which I did not expect.

Nadine started life looking not very strong, fairly early maturing, and a prolific producer of tubers that could run small under dry conditions. NIAB gave it 7 out of 9 for yield, which was unremarkable. That was in 1987, when the old Potato Marketing Board was still monitoring the yield of leading varieties by "crop check weighing" carried out by fieldsmen in order to arrive at a prediction of a given year's national production. Nadine regularly came out top because growers had discovered for themselves that Nadine responded to high fertility in much the same way as short strawed cereals varieties. Excessive manuring can wreck other varieties. I have seen Maris Piper growing up through wire netting in a so-called maximum yield plot at SCRI, towering over me in full flower when it should have been ripening off. To the inexperienced eye, I imagine it must have seemed capable of yielding a truly enormous crop. In fact, there were hardly any decent sized tubers underneath and winter was coming on.

In a context of feeding the world there is one very important question that only growers can answer in a definitive way that will be understood by everybody. What is the maximum yield of potatoes per unit area that has actually been achieved in Britain and elsewhere? We accept there has to be a limit at a given time, just as there has to be a limit to how fast a human can run or swim over a certain distance, and the nearer we come to the limit the harder it is to beat. At present the British record stands at approximately 100 t/ha and is held by Nadine as far as I know. Certainly, I was asked by a packer to present a bottle of best malt whisky to a grower who had carted off over 100 full one-tonne boxes of Nadine per hectare.

Before I go any further I wish to put it on record that it was the late Alaster McDonald of Christchurch, New Zealand and Laurie Eldridge of Albany, West Australia who both picked out Nadine when travelling independently in the UK on the look-out for new varieties. The fact that Nadine has been the leading fresh market variety in New Zealand for the past 10-12 years is not too surprising since the climate there is not unlike the climate of the British Isles, the main difference being the almost complete absence of potato infesting nematodes of the genus *Heterodera*. Most of the suitable ground in NZ is already under cultivation. The position in Australia is very different. In complete contrast to the rotation in PEI which became potatoes/snow/ potatoes, the Australian rotation is more likely to be 40 years bush/1 year potatoes/40 years bush, which implies a total absence of soil-borne potato pests and diseases. There is anecdotal evidence that the Australian record yield is of the order of 120 t/ha and it has been suggested (by George McKay, former head of potato breeding and research at SCRI) that the Australian limit could be as high as 140 t/ha. To put that in context, the average yield of the British potato crop in recent years has hovered around 47 t/ha for maincrops and Dr Pamela Anderson, the Director of CIP, the world potato centre in Peru, speaking at a conference held at SCRI in 2008, put the average yield of potatoes in developed countries at 14-15 t/ha and 6-8 t/ha in developing countries. Growing conditions in Britain vary with soil and weather and the differing incidence of pests and diseases. In the Australian outback the days are nearly always blazing hot and the nights cold. The sand is deep enough to cover a massive yield of potatoes. It is almost devoid of some nutrients, which have to be bled into the irrigation water and delivered with clockwork regularity by a centrally pivoted spray boom. Conditions are not conducive to late blight because *Phytophthora infestans* requires high humidity for sporulation and its spores are inactivated by exposure to intense sunlight. The major potato viruses require insect vectors which cannot survive where there is virtually no vegetation to survive on. Harvesting is easy. That is a fairly broad brush picture of intensive cultivation under semi-desert conditions in Australia, which should hold for all deserts or desert fringes, so lack of space around the world for increased potato cultivation is not an issue. Marketing factors related to consumer preferences can never be ignored, of course, which is presumably why my variety Valor and not Nadine is grown in the depths of the Egyptian desert in a region where an underground river supplies the water.

I am not especially well informed about the scope for increasingly intensive potato cultivation in China and India but I can guess that free trade leading to increased manufacturing and associated services, leading to subsistence farmers leaving the land, leading to farming on a scale large enough to justify investment in the facilities required for intensive potato production, would be no different from what has happened during the transition from an agrarian economy to a post-agrarian economy in countries such as Britain, where only 2% of the workforce is now engaged in agriculture. As frequently expressed, the difference between subsistence farming and a developed economy is the difference between six half starved children helping around the farm and two well fed children being well educated, which has obvious implications for stabilizing the world's population.

Never in my wildest dreams did I visualize fresh Australian grown Nadine potatoes being exported to South East Asia or Egyptian Valor going to Russia, but I still wish they could do more, because they are not reaching distressed people suffering from devastation caused by natural disasters and wars in the poorest parts of the world. All too often we see television pictures of food aid being delivered in the shape of sacks of wheat flour, soya or maize. Fresh potatoes are obviously unsuitable for this purpose, being about 80% water, not concentrated nourishment, too bulky and too perishable. These disadvantages could be overcome completely by resorting to one of the oldest food technologies known to man, the production of *chuño* from fresh potatoes. It is well known that South American hunter/gatherers foraged for the almost invariably bitter tasting tubers of wild potatoes, spread them out overnight under freezing conditions to make them soft and sweet, stamped on them, and dried the resulting mush in the heat of the day. It made bitter potatoes sweet and palatable and capable of being stored indefinitely under dry conditions. The key fact is that the balance between starch and sugar is controlled by an enzyme which responds to changes in temperature. At low temperatures the balance shifts in the direction of sugar. Sweetening in cold stored potatoes is a constant problem for manufacturers of French fries and chips or crisps because sugar caramelises and turns dark brown at frying temperatures, but that is by the way. *Chuño* is still made and marketed in South America. It must be, because I possess cakes of *chuño* that look like potatoes made from polystyrene foam. I have kept them for several years in a loosely covered jar beside the stove in my living room. They were a gift from a friend who had travelled in South America, where I have never been myself. More importantly, they contain all the nutrients of fresh potatoes because nothing has been lost in cooking or processing, and nothing has been added. And we know from history that a diet of fresh potatoes and nothing else can sustain life for prolonged periods. They were the crop of last resort for Irish cottars who subsisted on potatoes and virtually nothing else until famine caused by the advent of late blight, destroyed their way of life. Could there be a more nourishing and more palatable food for alleviating famine than *chuño*? It could be shaped like biscuits, flavoured as desired, packed in cardboard boxes, and would probably appeal to children.

Some times potato breeders struggle to keep up with the market and sometimes they try to lead the market, as in this case. There seems little doubt that potatoes under central pivot fertigation in semi-desert areas or even deep in the desert can produce far more digestible staple food per hectare than any other crop and it can all be converted into readily transportable and storable *chuño* without loss of nutrients. Its manufacture would only require a little extra cooling overnight and a little extra ventilation during the day in semi-desert areas. Since there is no lack of vacant, arid ground in politically stable areas, the only potential limiting factor is lack of water which, I dare say, we all knew already. No doubt the market will provide the water by means of pipelines, or tankers trundling over dirt roads, or desalination, given that the financial return from the production of *chuño* proves to be more than sufficient to meet the cost.



What I very much like about the whole idea is the fact that it is basically a freeze/drying process that was probably stumbled upon accidentally by the South American hunter/gatherers who went on to domesticate the potato; or perhaps they had observed that birds and animals (in my case wild ducks and roe deer) seem to prefer half frosted potatoes. Modernising the process using Nadine, at least for a start, could make it the culmination of my single handed breeding programme that began in Caithness and kept on growing from the ground up as more and more people became involved.

I do not expect the maximum yield of potatoes to increase significantly in the future, partly because there has to be a limit and we have probably reached it with existing varieties; and partly because their basic metabolism and photosynthetic pathway were probably perfected long ago by millions of years of evolution followed by thousands of years of domestication and breeding. As things stand, I suggest that modern varieties are capable of greatly increasing the world's supply of readily transportable and storable food, albeit in the form of *chuño*, long before the target date of 2050 - the date by which the world's food production needs to be doubled according to prominent politicians - and it could be done in politically stable, arid countries such as Egypt and Australia, in response to market forces. I have instanced two of my own varieties because they are being grown commercially under arid conditions at the present time.

I do expect pests and diseases to be controlled more effectively by breeding in future. There are hundreds of hobby breeders in Holland. About fifty of them are associated with Caithness Potatoes Ltd. There are also one or two in Scotland, including Zella Doig, the wife of one of the founders of Caithness Potatoes. She has four varieties on the UK National List. There are also many biologists in University departments around the world looking into host/parasite relationships at the molecular level with a view to exploiting gene silencing techniques. In effect, that means creating new resistance genes. In my ideal world, and it may only be science fiction, hobby breeders will leaf through a catalogue of resistance genes and decide which resistance genes, perhaps one of several alternative eelworm resistance genes, they wish to have incorporated into their new varieties, on a rental basis, whilst giving due consideration to value for money. Best of all is to avoid disease, by growing potatoes under fertigation in empty, arid areas where the main potato pathogens are either absent or too ill-adapted to be troublesome.

## THE MOMENT WHEN THE PENNY DROPS

That is my way of describing the birth of a new idea. Very occasionally, it comes out of the blue, as in blue sky research. Sometimes a curious train of thought leads up to it, as follows.

My wife Nancy and I had been discussing thinning neeps (singling turnips) in our young days in Caithness. It was an important job because there were no selective weed killers in these days and no precision seeders, so the weeds grew strong and the weeds stronger. Everybody had to help. She said she would fall behind, but every now and then she would come on a stretch of drill her aunt had cleaned for her, which allowed Nancy to catch up. Afterwards, I thought I could have told her life would not always be like that. Disillusionment is a normal part of growing up and long experience. That is when the penny dropped, and I realized I had become a somewhat disillusioned potato breeder. What's more important, it seems high time somebody took a jaundiced look at some ongoing potato projects. Take blight resistance, for example.

Newly graduated, I started work under the late Dr William Black at the Scottish Plant Breeding Station, Pentlandfield, just outside Edinburgh. He was one of the world's leading potato breeders and specialised in breeding for resistance to late blight caused by *Phytophthora infestans*, the fungus directly responsible for famine in Ireland in 1845/6. He had acquired wild potato material that had been collected in Central America, identified resistance genes, and had incorporated the first one (R1) into a new variety called Craigs Snow-White. It was never commercialised because the resistance rapidly broke down due to the emergence of a new race of blight, and the same thing happened to Craigs Bounty, which incorporated R2. When I joined him he had just released Pentland Ace, which had R3. It was a very good looking variety, and I saw it standing green and untouched by the blight which had reduced the surrounding susceptible varieties to a sea of blackened stems. Since my previous experience of potato production had been helping to gather potatoes in baskets behind a horse drawn potato spinner, I was very impressed by this demonstration of what could be achieved by scientific plant breeding. Later in the year, a disturbing report came in. Pentland Ace had been blighted in a grower's field and, worse than that, most of the tubers were infected. That was not the end of breeding for blight resistance at Pentlandfield. Pentland Dell had three resistance genes in combination (R1,R2,R3) and became the leading variety of its day. Then came a report that the resistance had broken down in Cornwall and the following year the new race of blight infected Pentland Dell all over the country, with dire results for those farmers who had come to rely on the resistance and saved on spraying. Pentland Dell is still an important variety, but not for its resistance to blight. Surely that should have been enough of a lesson. Not so, Because NIAB has reported that SCRI's variety Stirling showed much less resistance last year (2005) than formerly. The same old story, I thought, or the same old treadmill if you have become as disillusioned and sceptical as I have become.

It would probably be wrong to dismiss R genes as useless, when they are only useless under conditions of clonal monoculture ie when whole crops consist of genetically identical plants of one variety. In the wild, given widely dispersed plants of varied genetic constitution, the turnover of resistance genes and corresponding races will probably be slow and epidemics unknown.

We have come to understand that extreme resistance begets extreme selection pressure and are quite accustomed to the idea of bacteria becoming resistant to antibiotics in hospital, stains of blight becoming resistant to certain fungicides, greenflies resistant to aphicides, and even weeds resistant to herbicides and so on.

So I dismissed all hope of controlling blight by means of major resistance genes, either singly or in combination, although some other breeders carried on. You never know, one could imagine them saying, perhaps the next resistance gene to be discovered in a wild potato will be proof against mutation in the fungus and give permanent resistance. At the last count, eleven different resistance genes had been tried and failed. "It wont quit", said one American breeder, referring to *P. infestans* with a mixture of admiration and exasperation.

Can genetic engineers hope to do better? They are not restricted to potatoes as sources of resistance genes but can scour the whole plant kingdom for them. The first snag is that the idea of genetically engineering food plants does not appeal to most European consumers. Even if that were to change, there is a more fundamental problem with this approach, because it is the selection pressure generated by a resistance gene that counts, not the origin of the gene, nor how it was incorporated into potatoes. I can see no real hope in this direction, either.

Is there anything more that can be done to control blight except resort to chemical control by spraying crops with increasingly effective fungicides? Well, we have a highly organised and sophisticated potato industry. There is a campaign to minimise sources of early infection by preventing unsprayed potatoes from flourishing in dumps or tips. There is a dependable blight forecasting service that allows growers to vary the intervals between anti-blight sprays according to the weather, and there is a last line of defence in the gift of potato breeders, and that is tuber resistance. Poor old Sharpe's Express, which is still esteemed on a local scale in Caithness, has its tubers clustered closely around the stem bases where blight spores in rainwater trickling down the stems are liable to infect them, whereas my own Osprey sets its tubers so wide and deep they are sometimes missed by the harvester. Also the drier varieties, those with tubers of higher dry matter content, are the least risky because their tubers tend to shrivel up and mummify when blighted, rather than liquefy and set up a spreading, smelly wet rot that is every growers' nightmare.

In the final analysis, it still remains possible to grow very susceptible varieties that are over a hundred years old, such as Jersey Royal and King Edward, and produce pristine samples of them for the supermarkets. You might think that seeing them there would add a touch of gloom and despondency to my disillusionment. Actually no, because the fact that people still appreciate the old varieties suggests that people are still interested in fresh potatoes in general, up to a point anyway. It is enough for me that I can often see my own varieties on sale in British supermarkets, seed of them being loaded onto ships bound for the Middle East, flourishing in the Australian outback, taking pride of place in New Zealand, and being grown to a lesser extent in France and The Netherlands. I can think of thousands of people busy growing them and preparing them for sale, and millions of people eating them.

“Better not overdo the disillusionment then” said Nancy. Agreed. It is just that her story reminded me of my own bright morning over fifty years ago when I stood beside Dr Black and admired his new variety Pentland Ace standing green and immune from blight amidst susceptible varieties that had been completely blighted down.

Update. The resistance of Lady Balfour from SCRI, and Orla from Southern Ireland, broke down in 2008.

## A POTATO BREEDER'S RESPONSE TO UNJUSTIFIED CRITICISM

I have just finished reading Joanna Blythman's award – winning book entitled , “SHOPPED. The Shocking Power of British Supermarkets” published in 2004. While I admire her breadth of knowledge of the food industry, I cannot say the same for her knowledge of potatoes, and she does not give to British supermarkets the credit they deserve for resisting GM (genetic modification or engineering), albeit more out of self interest than conviction. Consider the following quotation from Joanna's book.

*“Whatever the fruit or vegetable the main driver for research and breeding nowadays is the will to reshape the natural order to fit supermarket criteria. That has created a bonanza for bland-tasting high-yielding ...varieties because they fit the supermarket stereotype and perform well when used in conjunction with synthetic fertilisers and pesticides. Often such varieties are genetically very similar – the Pentland group of potatoes---for example”.*

As a matter of fact, the supermarkets were not much of a force in the potato market before 1970 when Pentland Squire, the last of the Pentland varieties, was released. They were bred primarily to suit the grower/dealers who dominated the Potato Merit Trials Committee up to that time, who favoured high-yielding disease-resistant varieties that were relatively easy to grow. Sainsbury's disapproved, and published a full page advert depicting a large tuber of Pentland Crown, stating,

*“This is a Pentland Crown potato, the most widely grown variety in the country. Sainsbury's refuses to sell them”.*

This was a case of an increasingly powerful supermarket standing up to producers on behalf of consumers, whilst advertising itself very cleverly at the same time. It was a turning point in state-financed potato breeding. I know, because I was still helping to breed Pentland varieties when the advert appeared. In fairness, Pentland Dell is still the fifth most widely grown potato variety in Britain.

The next quotation, from an anonymous grower speaking to Joanna comes even closer to home:-

*“Some of the varieties they (supermarkets) want have shelf life but I'd never bring them home for my dinner. They have no flavour – Nadine is one example. The flavour is dreadful but they look tremendous.”*

Well, I bred Nadine privately and far from apologising for it I have defended it in my book as a mass market variety, cheap, nutritious, good looking and anybody can add any flavour they like. In general, I could have said, strong flavours bring out strong likes and strong dislikes, so mild or bland flavours will be broadly more acceptable. Cheeses are a good example. Potatoes are never eaten raw like fruits, and certainly used to be seen as the staple, somewhat bulky basis of a meal, like pasta, rice, bread or chapattis, mopping up the gravy or any sauce that might be added. If that is less true nowadays, it is because it benefits supermarkets to add value to potatoes in different ways, and ready prepared meals have become more varied. Even so, Nadine is easily the most widely grown variety in New Zealand - so how can its flavour be dreadful?

It is the “shocking power of British supermarkets” that has actually protected British consumers from the encroachment of GM technology that agrochemical companies like Monsanto and Bayer are trying hard to foist on them, aided and abetted by some of the largest food producers and some academics. If this is shocking power, it is the shocking power of consumers, because supermarkets have no vested interest in GM. Justin King, the chief executive of Sainsbury's, made that plain in *The Farmers Weekly* of 5 Jan 2007,

*“One has to start with the consumer. Today the consumer has yet to be convinced that there is a benefit to GM crops. The early development of GM was in areas where the consumer could not see the benefit to them but could see the dark hand of business doing something that benefited only themselves.”*

He also said that Sainsbury's paid a premium for milk that could be differentiated as,

*“GM-feed free milk, in-conversion organic milk, and organic milk.”*

This implies, firstly, that supermarkets, despite all their power, have not been able to stop GM technology entering by the back door. Secondly, it implies that organic food is good for you and GM food is bad for you, a generalisation or belief incapable of conclusive proof that is certain to be the subject of endless debate. Much more important meantime is the public's *perception*, which is what determines buying power. We do not live by bread alone, not in affluent countries anyway. Lifestyle choices are becoming more and more important, one hopes. Organic production is equated with flourishing wildlife and increasing biodiversity, and is seen as life enhancing. GM food technology can be seen as life distorting, which is a frightening idea. Consider the Bt gene from the bacterium known as *Bacillus thuringiensis* which confers resistance to potato tuber moth, cotton bollworm (another moth) and maize corn borer ( a butterfly ). Why did such a potent and advantageous resistance gene not exist in green plants before the advent of GM? Because, if it had, a host of present day species of moths and butterflies that are harmless to crops would not exist, and nor would all the species of plants they help to perpetuate by pollination. That gives some idea

of the devastation that could conceivably result in the very long term if a gene like the Bt gene were ever to spread throughout the plant kingdom, possibly as a result of horizontal gene transfer mediated by viruses. No matter how unlikely that scenario might be, a better one is taking shape. At the molecular level, host/parasite relationships pose the same problems and present the same opportunities whether the host is plant, animal or human. Certainly, it will be possible to identify and sequence specific genes that are vital to the metabolism of any particular pathogen. Certainly, it will be possible to construct pieces of RNA that will bind to a vital gene or parts of it and stop it functioning, or silence it. Beyond that I cannot go with any certainty, but I can envisage hundreds of hobby breeders interacting with thousands of molecular geneticists and choosing which patented man-made resistance genes to have inserted into their varieties, to be paid for on a royalty-sharing or rent-a-gene basis. We would know exactly what we were doing, without the fear of unintended consequences that causes so many people to reject GM. And potato breeding would not become the preserve of a very few, very large agribusinesses.

Clearly, a good selection of organic fruits and vegetables on display will help a supermarket's image, and that is not all. Putting the names and sometimes the pictures of growers on potato prepacks helps connect the shopper with farming. So-called heritage varieties like Kerr's Pink and even Orkney Black, which are difficult to produce to modern standards, sometimes make their appearance for old time's sake. In these and many other ways the supermarkets will continue to try to interest and even entertain their customers because of the danger of becoming victims of their own success. If they find out too much about us and arrange to meet all our needs from cradle to grave, we will know exactly what to expect from them when we go shopping and it could become a monotonous chore. Bored customers could tend to drift away in search of more interesting and congenial places to shop, or resort to the internet.

On reflection, therefore, I find that I do not need to fear the alleged shocking power of British supermarkets, either as a consumer or as a potato breeder, for the following reasons:-

- Without going into details, I can shop around.
- The UK is only one country and there is a global market for potato varieties out there. They can be airmailed as microplants or microtubers from one quarantine station to another on the other side of the world.
- I have not given up breeding for British supermarkets. I see small salad or gourmet potatoes selling in supermarkets for £3,000 or more per tonne when the ex-farm price of ordinary potatoes is £100 per tonne or less. So there is a clear need for more prolific varieties of superior eating quality. Sooner or later, the British supermarkets will obtain them, and the price will come down.

If I were a producer in danger of losing a supply contract or a local retailer being forced to close down by supermarket competition, it would be different, so it all depends on who you are, and what you are trying to do.



## POTATO BREEDING AND THE GLOBAL MARKET

I'm going to waste very little time on a general introduction to the global market. You will find some of its more visible products in the car park, motorcars from a large range of countries, and no doubt you were disappointed to hear that Jaguar and Rover are in trouble. That's the global market, only the fittest survive, and you know that as well as I do.

So I'm going to talk about something I'm bound to know more about than you, the evolution of the Caithness Group and the position of Caithness varieties in the global market. According to one investigative economist, namely Mr Iain McGregor of the Scottish Agricultural College, we have an annual turnover of twelve to fifteen million pounds. It seems not too bad for a single handed potato breeder working in close collaboration with three major Scottish grower/dealers.

We have twenty varieties on the UK National List and I am going to draw them up in the shape of a football team, putting eleven in the first team and leaving nine on the bench, and I am going to use them to bring out some of my ideas or discoveries about the global market for fresh potatoes. I learned as I went along, of course, much of it from my colleagues who did all the marketing. But you will not get them to tell you their story. They are far too discreet for that.

The defence consists of five export varieties. In the goal I have put Argos, which, as its name suggests, was bred for Eastern Mediterranean countries in order to compete directly with the Dutch variety Spunta, one of the most widely grown varieties in the world. Spunta is low in dry matter, large tubered, and high yielding. It represents the potato in its most basic role, filling bellies with a cheap, nutritious food. It is often cubed or diced to thicken stews or soups. Argos is the only variety I ever bred that often out yielded Spunta in official trials in Cyprus. It has no fallback market in the UK, so we have to be careful not to overproduce it. The two varieties in front of Argos, in the middle of the back four, outflank Spunta, which is a better strategy than head-on competition. Winston is earlier maturing, so it requires less irrigation, and water is a very expensive and politically sensitive input in arid countries. Valor is later maturing than Spunta and will still be bulking after Spunta has died down. By some stretch of the imagination, Winston can be likened to drought evading species which die down early and survive the dry season as bulbs or corms, which is typical of the Mediterranean flora. Valor can be likened to a deep rooted drought resistant species like lucerne. You can hurt your back trying to pull Valor out of the ground before it is ripe. That gives us a spread of three varieties taking over from Spunta to some extent and we sell a total of about 4,000 tonnes of seed of them in early winter. They are being loaded aboard ship in Dundee right now, which helps even out the seed growers' work and improves their cash flow, now that spring delivery of seed to England just in time for planting is usually required.

The remaining varieties in my back four are the red tubered varieties Stemster and Maxine, intended to compete mainly with Desiree but also with Red Pontiac, an old American variety, which still has a following in Spain and Portugal.

Stemster was one of a batch of five Desiree x Maris Piper hybrids we trialled in association with Algerian agronomists. They all out yielded Desiree by virtue of their later maturity. You could say they were better adapted to subtropical latitudes, like their distant Andean ancestors. That was going to give us some seed production problems in Scotland, which we expected we could overcome. They looked like Desiree, cooked like Desiree, and had eelworm resistance, which Desiree lacked. They were all placed on the UK National List, which was quite an expensive investment, and we never sold a single tuber of any of them to the Algerians - for two reasons we only understood with hindsight. Firstly, the Algerian growers were mostly subsistence farmers who could not fully exploit the increased yield potential and, secondly, Desiree itself was effectively an uncontrolled variety, a commodity, so the Algerian buyers preferred to shop around for the cheapest possible Desiree, which was overproduced more often than not. It was always going to be very difficult to displace Desiree, but at least we tried.

Meanwhile, Stemster, the only hybrid to survive the Algerian debacle, is widely grown in France for export to Spain, Portugal and Morocco, and makes a useful contribution to Caithness royalties. You could say it is seconded to France and we need to substitute it in the Caithness team.

Maxine competes with Red Pontiac in Spain, not very successfully because its bright red pigmentation fades in warmer soils, which does not seem to happen to Red Pontiac. We know that the red stems of the garden dogwood brighten up after frost and the growers of Poinsettias for the Christmas market subject their plants to a cold spell to brighten their red bracts, so perhaps something similar happens to Maxine in reverse. I only brought in Maxine because I needed to fill a gap in the team with an export variety.

My midfield consists of Harmony, Kestrel, Nadine and Osprey, all of which can be seen in British supermarkets and also in New Zealand and Australia. The inclusion of Harmony and Osprey is easily explained. There was a shift in the British market towards the production of larger tubers suitable for baking. Inevitably, the first response was to take advantage of existing varieties' plasticity in order to increase their baker content by agronomic means. That was bound to lead eventually to the introduction of varieties having a genetic predisposition towards the production of fewer but larger tubers. Despite that genetic tendency, Harmony and Osprey have proved to be manageable enough for seed production purposes. You will not find them in the same supermarket. That would be too confusing for everybody.

Kestrel is a highly distinctive variety with purple eyes and purple splashed rose end. That was supposed to be its badge of quality. People like myself who are not too good at remembering names could always ask for the purple splashed variety. It worked up to a point and may still be working. It was taken up by gardeners, helped by its well attested resistance to slugs. Enthusiasts and knowledgeable gardeners are very well served by, and active in, the Henry Doubleday Research Association, which has an enduring relationship with one well known British supermarket, which brackets Kestrel with old heritage varieties. It is an unlikely story. Who would have thought it possible to compete directly with Maris Piper on grounds of quality? Price yes, but quality no, which brings me to Nadine.

I checked prices in a superstore a few days ago. Maris Piper was 138 pence for 2.5 kilos compared with Nadine at 88 pence. An unbiased observer would deduce from that that Maris Piper attracts a premium for quality and Nadine must be cheaper to produce. That would be right, and I need only add in fairness to Nadine that there cannot be too much wrong with its quality or it wouldn't be the most widely grown variety in New Zealand for the fresh market. If it were up to me I would say, yes, by all means let people decide to pay the extra for Maris Piper, or not, as the case may be, and change their minds whenever they wish. As to yield, NIAB'S rating of 7 out of 9 for Nadine was probably appropriate under conditions of average fertility but irrelevant because Nadine growers are mostly specialists who exploit Nadine's response to high fertility in order to obtain record yields. At the instigation of a potato packing firm I have presented a bottle of premium whisky to a grower who carted off over 100 tonnes per hectare, which is more or less the theoretical limit postulated by potato physiologists for Northern European latitudes.

We do not export Nadine ourselves but the Australians do so increasingly to South East Asia. Fresh Nadine travels well. Much of the Nadine is grown under central pivot fertigation in South Australia beside the Murray River, not far from Adelaide. The rotation is about forty years of bush, one year of potatoes, and about forty years of bush. And I have seen Nadine just loving it, giving virtually unblemished tubers, and again the yield looked to be close to the theoretical maximum for any potatoes anywhere. Try to imagine Nadine being harvested, flowing over optical graders, being loaded into refrigerated containers, travelling north to Darwin over the new transcontinental railway and straight aboard ship to South East Asia. Compare that with a mental picture of a line of Asian women wading in a paddy field and transplanting rice seedlings by hand, and remember that the burgeoning population of Britain during the industrial revolution was fed by greatly increased food production at home, including more potatoes, and by imports of cheap wheat from the North American prairies. Perhaps you will see something similar happening again, with Nadine helping to supply cheap imported food for increasing numbers of South East Asian factory workers and their families.

I have two diminutive strikers up front, Shelley and Mimi, which made their debut this year in the “Baby New” market. (see The Youth Team, page 104)

Now I am going to start summing up and broadening out. The growth of Caithness Potatoes has been an evolutionary process. If we were to start again it might turn out better or it might turn out worse but it would certainly not turn out the same. I do not know how many potentially successful varieties I have discarded at an early stage and I try not to look back at the ones I have left lying in the field. Ownership of the Rights over our portfolio of varieties is the key to our business. It makes for a stable relationship with our customers, who cannot buy seed of our varieties from anybody else. There can buy plenty of other varieties, of course, from other seed growers, but we find that some of our regular customers come to us not only for our own controlled varieties but also for stocks of uncontrolled and generally available varieties because they know us and we have been able to invest in the best handling and harvesting equipment, cold stores, and now in box drying stores. That is the best cure for blackleg and the storage diseases that plagued Scottish seed potato growers when production was more fragmented and less highly capitalized. It is not the only way to run a thriving seed potato business. You can belong to a group of farmers who have cattle and sheep and grain to fall back on or you can spread the risks of seed production by clubbing together and investing in central storage and grading, or you can grow seed potatoes on contract. We are simply not into all of that because we are specialists rather than farmers.

Speaking as a breeder, I cannot complain that some very well established varieties are difficult to shift from their place in the market. It is this stability that makes for a steady income from royalties - it means there is a good chance that a reasonably successful new variety will hold its place for thirty years, which is the duration of Rights over potatoes. We could not live with a complete flux of new varieties, and there is no shortage of them, as any breeder attending NIAB's Open Day will know only too well.

You will have gathered that I do not think it is a good idea to compete directly with established varieties and better to get round them or outflank them or undercut them on price. Kestrel only got into a supermarket in competition with Maris Piper because it already had the support of a section of the general public who had grown it in their gardens. How often will that happen? Obviously, a shift in the market will create openings for new varieties and we have tried to exploit that with Harmony and Osprey for baking and Mimi and Shelley for salad, which usually means microwaving.

When all else fails one can try something completely different and, marvels of marvels open up a new market or a new use, which must be every potato breeder's dream. That brings me to my two

favourite varieties and I freely admit to having favourites as much for personal reasons as business reasons. I am referring to Mimi and Nadine.

Mimi is my pathetic little variety, which is also one of the best tasting varieties I have ever bred, with firmest flesh. I wish to see peeled baby Mimi being spooned onto children's plates at lunch break in competition with chips, not because I deplore chips, but just as a fresh tasting alternative, probably a more expensive alternative, but perhaps not too expensive, since Mimi produces nothing but baby potatoes. If children were then to start asking for Mimi in the home, that would undermine some long established varieties.

I remember Nadine when all there was of it in the whole world was six small heaps of potatoes in a small field in Caithness. I certainly never dreamed then that I would be able to walk through flourishing crops of Nadine in the Australian outback, and get a glimpse of how the world could be fed. *NOT* by genetic engineering, because we can already obtain the theoretical maximum yield of potatoes, but by liberalization of trade.

Consider China with its booming economy and its ability to export goods at unbelievably low prices. That, combined with very effective birth control, no more than one child per mother, must mean that more and more farm workers will drift away to find better paid jobs in towns and cities, clearing the land for more highly capitalized agriculture – just as happened in East Anglia and the Scottish Highlands, and not without painful disruption. We can hope that this shift from an agrarian economy to a post agrarian economy is what will feed the world's increasing population until it stabilizes; and it is not beyond the bounds of possibility that imports of cheap potatoes from the wide-open spaces of Australia will ease the transition in China. It needs to happen. It needs to be stimulated by increased liberalization of trade; and not only for the sake of increased food production, but because the interdependence that results from global marketing will make for a safer world.

Update. In season 2008/9, up to 19 Jan 2009, a total of 13,531 tonnes of seed of protected Caithness varieties had been exported, along with a total of 3,100 tonnes of generally available, unprotected varieties.

NIAB was formerly the National Institute of Agricultural Botany.

## THE YOUTH TEAM

What was supposed to be amusing when presenting “Potato Breeding and the Global Market” turned out to be helpful, so I have drawn up my first eleven varieties as if in position on the field of play, and will continue to use sporting metaphors.

Mimi          Shelley

**HARMONY   KESTREL   NADINE   OSPREY**

Maxine   **WINSTON   VALOR   STEMSTER**

### **ARGOS**

I will say no more about the well established varieties that appear in bold print with the exception of Harmony partly because I have already discussed them and partly because the bare facts about them are available in databases compiled by the following organisations:-

British Potato Council   [www.potato.org.uk/varieties](http://www.potato.org.uk/varieties)

Scottish Agricultural Science Agency   [www.sasa.gov.uk](http://www.sasa.gov.uk)

My younger varieties, the ones I think of as my youth team, have still to prove themselves, or fail, as the case may be. They have their own stories, which I shall relate and then review in future updates.

**HARMONY** scored the maximum 9/9 for resistance to black dot in Independent Variety Trials funded by BPC. Black dot is a tuber blemishing disease superficially indistinguishable from silver scurf. An important difference is that the former can be controlled by fungicides whereas the latter has proved much more difficult to control by chemical means. I confess that I was not aware that black dot and silver scurf were similar diseases caused by different species of fungi when I bred Harmony; and nor was anyone else at that time as far as I know. I must assume that by selecting for bright, clean skin finish down through the generations I finally arrived at complete resistance to black dot without knowing anything about the underlying genetics. The following sentence in New Scientist of 22/11/2008 page 47 jumped out. “*Evolution isn't fussy – it'll take new genes wherever it can get them*”. So will potato breeding. It will be up to growers to find out for themselves if Harmony's resistance is equally effective everywhere against all populations of black dot. That should add up to an excellent example of research and development from the ground up.

**MIMI** was given a trial run in the first team and graced the shelves of ASDA and Marks and Spencer for a spell, without making a permanent place for itself. Perhaps red skinned salad potatoes were too much of a novelty. I returned it to the bench with a view to selling it peeled. Small, peeled Maris Piper treated with a preservative (sodium metabisulphite) can be seen looking fresh and bright on the British market; so can similar looking potatoes on the Australian market “with a long shelf life and no added preservatives”; and there are “potato pearls” on the American market which seemed to be cubed potatoes with the corners rubbed off; and packs of small steam peeled Bintje have been on sale in various European countries for many years; but this market has never really taken off. I find that surprising because small whole peeled potatoes for microwaving are just as convenient as microwavable chips and, dare I say it, healthier eating. Peeled Mimi resembles Pink Fir Apple (which is no relation) in its creamy/lemon flesh, firm texture and distinctly good flavour. Consumers will need to be their own best judge of that. It is not prone to enzymic discolouration and steam peeling would blanch it anyway. Such a product is perfect for portion control and weight conscious, health conscious people. Perhaps the market has been waiting for the right variety. Perhaps that could be Mimi.

**SHELLEY** was nearly a financial disaster. Shortly after it was launched, complaints of bitter taste were received by the retailer and passed on to me. Sure enough, when I tasted my carefully stored Shelley I detected the bitter taste of glycoalkaloids, slow to develop and lingering. I had it removed from the British National List of varieties immediately and all stocks in hand were disposed of. This was a variety that had passed its official trials, including Value for Commercial Use, and all of those involved - the breeder, seed growers, packer and supermarket buyers were more than satisfied with its eating quality. Either we were all wrong about Shelley, or levels of glycoalkaloids can vary from year to year for unknown reasons, and more so in certain newer varieties than in older varieties that have stood the test of time.

There are no varieties that do not contain trace amounts of at least two glycoalkaloids at levels too low to taste unpleasant, but which can be detected by laboratory tests. When one delves into it, the subject of flavour in potatoes begins to look like another minefield. Potatoes are not fruits, they do not contain seeds, so there can be no evolutionary reason why they should be palatable to birds and animals in their role as agents for undigested seed dispersal. On the contrary, there is good reason why they should be pervaded by distasteful molecules acting as deterrents to grazing and making the roots and tubers unattractive and rather poisonous to foraging animals and pests such as eelworms. The first people who experienced this chemical defence system were the South American hunter/gatherers who discovered how to make bitter tasting wild potatoes sweet and palatable by means of a freeze/drying process which, if modernized, could greatly increase the world's food supply. They went on to domesticate the potato, which probably meant selecting

against glycoalkaloids. Much later, when breeders started using wild potatoes as sources of disease resistance about eighty years ago, Dr William Black at the Scottish Plant Breeding Station had to select against what he called the “demissum taint ” when transferring *Solanum demissum*’s major genes for resistance to late blight into new cultivars. Similarly, in breeding for eelworm resistance ex *Solanum vernei* I also had to select against glycoalkaloids and probably lost some of the resistance in the process. The best that I could do was to ensure, as far as possible, that I never used a bitter tasting parent, and Shelley was the only variety that ever let me down.

Where will we find genes for positively good flavour when it is something that would have been useless or even disadvantageous in ancestral potatoes? There are some clues worth considering. I have learned that the most flavoursome, very immature, early potatoes will leave me with a slight tingling sensation on the tip of my tongue, which warns me that glycoalkaloids could be approaching a detectable level. And potato connoisseurs in Caithness maintain that Sharpe’s Express has unbeatable flavour when first harvested; then it disappears when the tubers are dormant, and returns when they start sprouting. That is tantamount to saying that flavour is a byproduct of active growth, and I suspect the same could be said of glycoalkaloids. Perhaps glycoalkaloids too high gives a bitter taste, too low is tasteless, and good flavour lies somewhere in between. That is in line with the quotation I have already highlighted in italics, to the effect that evolution will take new genes wherever it can get them. Perhaps it found genes for flavour in potatoes’ chemical defence mechanism.

The Caithness connoisseurs already mentioned are my potato growing friends and relatives – the sternest critics of my potatoes. Over the years I have supplied them with samples of many potential new varieties. When asked to comment on their eating quality they invariably said they were all right and kept on growing Sharpe’s Express as their early variety and Kerr’s Pink as their maincrop. That did not unduly discourage me because I have defended mass market potatoes on the grounds that anybody who can sit down to a savoury meal of meat and vegetables plus potatoes that look all right and taste all right is well enough off, especially if the potatoes are relatively cheap. That brings me at last to the crux of my dissertation on potato quality, which is to acknowledge that during my long career as a potato breeder there has been a gradual shift from a market dominated by producers to a market dominated by consumers, thanks to the rise of supermarkets. The varieties I choose to think of as my youth team were bred in response to this trend.

Without putting all my eggs in one basket, I had recourse to Pink Fir Apple as a parent. It was recorded in Britain as early as 1850. Nobody knows how it came to have such a distinctively waxy texture and distinctive flavour. In Alan Romans’ Potato Book the tubers are said to be “firm and delightful hot or cold”, and Alan Wilson in his book on The Story Of The Potato Through



Illustrated Varieties says “its great feature is the waxy texture and new potato taste which is retained after harvest”. He also warns that it is very prone to blight. Personally, I have tended to reserve it for special occasions for fear of tiring of its special flavour and have usually been satisfied enough with potatoes that taste all right. If Pink Fir Apple had a contribution to make to the eating quality of my breeding material I accepted that it would be at the expense of tuber conformation and disease resistance, at least initially.

**UPMARKET** and **LULU** were ready to come forward as substitutes for Mimi and Shelley. They have a common parent in a seedling descended from Pink Fir Apple, as crossed with Valor in the case of Upmarket and Harmony in the case of Lulu. Upmarket is a maincrop baking potato with vivid red eyes and red rose end like King Edward, and short oval to round and rather dimpled tubers like Marfona. Lulu's pigmentation is more localized but otherwise it looks not unlike Upmarket. I have never found a hollow tuber of either of them, no matter how large, which is crucially important in baking varieties. I see them as complementary rather than alternative varieties, but managing them will not be my business. They have been taken up by a High Street retailer and their further development will depend on consumer response and their general reliability.

Reaching this stage of testing consumer response under commercial conditions means that the whole supply chain had been subjected to the test of commercial practice for several years. I made sure that all concerned were well warned that Upmarket had proved very susceptible to tuber blight under experimental conditions during its official trials. It had scored one on the customary nine point scale. That is not the end of the story, and more like the beginning, because the list of extenuating circumstances is long.

- The best known variety rated 1/9 for tuber blight is Russet Burbank, which dates from 1875, and is grown around the world wherever people appreciate burgers and chips as served in McDonalds Restaurants. Exquisa, a Dutch variety which makes regular appearances in British supermarkets is also rated 1/9. So is Rocket, a well known first early variety bred at the former Cambridge Plant Breeding Institute.
- I allow my breeding material to be blighted down every year in Caithness. I will put on three or four anti-blight sprays during the early part of the season. Then I stop spraying, let blight take over, and watch what happens. I would not have entered Upmarket for official trials if it had shown too much blight. The seed growers who have multiplied Upmarket for several years never noticed too much tuber blight either, or they would have informed me. The same goes for the English ware grower in Lincolnshire and the packer.

- Tuber blight cannot develop unless spores from the foliage are washed into the ground by rain and come into contact with tubers. It therefore depends on foliage resistance, the weather, and how well buried the tubers are. Upmarket is rated 6/9 for foliage blight, well above average, compared with 2/9 for Russet Burbank, 3/9 for King Edward and 4/9 for Marfona and Maris Piper. A score of 6 means that a variety is resistant, but not so resistant that breakdown of resistance becomes inevitable in the long run. Both Upmarket and Lulu set a good many of their tubers so deep that digging shares have to be lowered more than usual to avoid cutting them, so I have suggested it might be best to grow them on light land.
- Since extreme foliage resistance has always proved unreliable due to mutation in the fungus, and we are still waiting for molecular geneticists to refine their gene silencing techniques, commercial growers are forced to spray against blight, which they do as effectively and infrequently as possible. Some varieties are easier to protect than others. Since Lulu is a first early with sparse foliage, it is easily covered and the tubers are not intended to be stored, anyway. Upmarket's stems are only about half as long as Maris Piper's and stand erect while MP's tends to lie down and thatch the ground. I suspect that this makes modern varieties such as Upmarket, Harmony and Osprey easier to manage than older varieties such as Russet Burbank, King Edward and Maris Piper.
- Blight associated with soft rotting bacteria can cause the tubers of some varieties to break down in store, which is smelly and messy when it happens. In other varieties, blighted tubers gradually become wizened or mummified and are easily removed. It depends on dry matter content and how prone the variety is to soft rot. Since Upmarket has medium dry matter and scores 8 for resistance to blackleg, which is a form of soft rot, it seems reasonable to expect that any tuber blight in it would not lead to serious trouble in store.

As far as I know no British crop of Upmarket has suffered from tuber blight so far, despite the undoubted fact that the tubers are very susceptible under experimental conditions. Let it be said that there is nothing unusual in the idea that sometimes it may be worth taking a risk in order to succeed. Very few people going into a High Street store are likely to come out carrying a 2.5 kg pack of potatoes. They are much more likely to pick up a few loose baking potatoes or a punnet of salad potatoes for their next meal. It is entirely understandable, therefore, that a High Street retailer should choose to stock the highest quality variety of potato that is available in sufficient quantity, even in the knowledge that it might be riskier than most.

**EMBLEM** was nearly passed over, which is the fate of most potential new varieties, not because there is much wrong with them but because they are not special enough. Emblem resulted from

my efforts to increase the eelworm resistance of my breeding material ex *Solanum vernei*. I guessed that different breeders would have lost different genes, so I attempted to reassemble them by outcrossing my own breeding line to the Dutch bred variety Sante and the English bred variety Midas. Emblem's parents are Valor x Midas.

I was in a good position to assess progress because some years earlier I had deliberately infested a test plot with a mixture of six different field populations of *Globodera pallida*, the pale cysted eelworm, where I could observe how well my test plants stood up to eelworm, which was their tolerance. And the varied occurrence of cysts on their roots, ranging from crowded to sparse, enabled me to score for resistance. It was not a very successful project because it transpired that different breeders had probably all lost the *same* resistance genes, probably the ones responsible for high glycoalkaloid content. I despaired of ever being able to restore enough of *vernei's* resistance to obviate the need for routine applications of nematicidal chemicals to infested fields.

Emblem is an early maturing variety, but not as early as my established variety Swift, which has a loyal following requiring about 100 tonnes of Scotch seed per annum. I arranged for Emblem to be grown in Jersey but it was frosted down at one site and did not recover, whereas Jersey Royal recovered well enough to yield a crop. Jersey Royal, invariably the first early variety to appear in British shops at the start of the new season, is not really a first early variety. It is actually a very old maincrop dating from 1879 and has the rare ability to set tubers early without stopping growing. Emblem could not match that.

The breakthrough came when my very hard to please Caithness critics agreed that Emblem was as good to eat as Sharpe's Express and some said better. That had never happened before, so I immediately set about entering Emblem for official trials. I guessed it might appeal to the same market as the Irish variety Rooster, which has an appreciative following in Caithness, and well beyond Caithness. There was also a possibility that Emblem might fry well enough to take a slice of the early crisping market which was catered for by the Dutch variety Premiere; and if it fried well enough in the Middle East it might outflank the Dutch variety Hermes by maturing earlier and needing less irrigation. Emblem's superior eating quality was a solid foundation we could try to build upon.

Potato breeding is not an exact science. Varieties like Emblem gradually evolve and, without wishing to be too fanciful, seem to take on a life of their own. That is why I do not hesitate to promote Emblem as a substitute for Maxine in my back four. Maxine was failing for the simple reason that its skin was the wrong colour. In the cool, black and moist soil of my Caithness croft it was bright red with a hint of purple, but faded to a dull bluish pink in Spain. The old American

variety Red Pontiac, that Maxine was competing against, kept its red colour, which consumers were accustomed to and liked.

**CLEVNA** and **TRESDALE** are mainstream varieties aimed at the British salad potato market currently dominated by Maris Peer. Clevna's parents are Osprey x Pentland Ivory, the so-called "quality Pentland" I was using to raise dry matter contents. Tresdale is Harmony x 6RE98, one of my standard parents (but not one descended from Pink Fir Apple ).

Maris Peer is not a highly specialised salad variety. Released nearly fifty years ago, before microwave ovens had revolutionised the preparation of convenience food, and before potato tubers below 40 mm diameter began to be retailed as salad potatoes or baby potatoes, it requires close planting of suitably treated seed in order to maximise the yield of salad sized potatoes, whilst producing a limited tonnage of very saleable oversized potatoes, too. Different dual purpose varieties like Maris Peer, Clevna and Tresdale are likely to benefit from somewhat different, specific, production regimes that can be thought of as fine tuning the varieties for best results.

I grow my potential new varieties and established varieties side by side, preferably where I can look at them every day, observing emergence, ground cover, growth habit, development of foliage blight, and the onset of senescence; and will dig a few plants at weekly intervals to observe tuber initiation and development, and to note the development of black dot and powdery scab; and will set trays of tubers side by side in order to compare size distribution, skin finish and sprouting in store; and will regularly prepare samples for dinner and monitor eating quality throughout the storage period. I will close my notebooks when I come to know a variety well enough, aided by official test results and growers' reports.

While Clevna and Tresdale will not begin their official trials until 2009, I already know how they will be marketed, all going well, because I do not wish them to compete against each other. Clevna, which is the more distinctive variety, with longish oval tubers and red terminal eyes, will be restricted for an indefinite period to the same High Street stores where Upmarket and Lulu could also be appearing exclusively. Tresdale is plain white with oblong tubers and has inherited Harmony's long dormancy. It is earlier maturing and higher in dry matter content than Harmony, which is a baking variety. Seed of Tresdale will be supplied to all comers, as in the case of Harmony.

**SEATER** is a highly specialised salad variety, bred for the purpose. Its parents are Shelley x 3RE96, both of which were promising but flawed. Shelley's fatal flaw was the bitter taste of glycoalkaloids, while 3RE96 was too prone to incipient hollow heart in the form of a brown spot in the middle of tubers that were none too large. Some of 3RE96's supporters persisted in growing it

on as a potential new variety because of its excellent flavour and texture (it is descended from Pink Fir Apple) but I looked on that as a disaster waiting to happen and dropped the variety. Breeding is a different matter. Serious faults are not necessarily strongly inherited, and so it proved. I found myself with thirteen very promising advanced selections which I watched over carefully as described above, and selected only one to go forward because it seemed outstanding, and called it Seater.

Seater is the same type of variety as Mimi, a very prolific first early that produces almost nothing but salad sized tubers, which are longish oval and white. In theory, Seater is certainly capable of being double cropped, meaning two successive crops in the same field in the same year, and certainly capable of greatly reducing the cost of producing salad potatoes, but all that and much else remains to be seen. It has been farmed out for commercial trials and is being multiplied rapidly, because it sets so many tubers, with a view to beginning official trials in 2010.

My reconstructed team reads as follows

**LULU    UPMARKET**

**HARMONY    KESTREL    NADINE    OSPREY**

**EMBLEM    WINSTON    VALOR    STEMSTER**

**ARGOS**

**Reserves:- Swift, Celine, Mimi, Tresdale, Clevna and Seater.**

Enquiries about the availability of seed should be addressed to  
andrewlorimer@caithnesspotatoes.com

## CONCLUSION

I have ceased generating new breeding material and Seater is likely to be the last variety I will enter for official trials. I thought I had no successor in place but now I am not so sure. Ewan, my 13-year old stand-in who cuts my grass, and waters my plants, and feeds the birds when I am away, has taken an interest in potato breeding and has already raised his first generation of potato seedlings with a little help from me. Although he may not know it, he represents hobby breeders the world over and especially in Holland, who breed potatoes for reasons best known to themselves.

I have heard it said that potato breeding is a numbers game and a matter of luck. So it is, but there is more to potato breeding than luck. The most heartening way of putting it is to say that luck favours the prepared mind. It just happened that Nadine, which was initially selected in the cool and windy climate of Caithness, proved suitable for intensive potato production under conditions of high fertility in England, and even more suitable for growing under central pivot fertigation in the Australian outback, the most intensive system of open air potato production there is. The rate of application of water to the crop can be varied according to the time of day or night and the input of nutrients can be varied to suit the crop's stage of development. Weather is not an issue. The sun shines brilliantly almost every day for the whole day, and soil-borne pathogens ought to be absent. Yields well in excess of 100t/ha, the British record set by Nadine, should certainly not be exceptional under these conditions. Compare that with the average of around 45 t/ha for maincrop production in Britain, which will be quite high by European standards, and the 6 - 8 t/ha achieved by subsistence farmers in developing countries according to the Director of the World Potato Centre (CIP) in a lecture at SCRI, as reported in the SAC Potato Newsletter for Autumn 2008.

I have also heard it said that the difference between the ideal post-agrarian society and an agrarian society is the difference between two well educated and well nourished children enjoying all the amenities of modern city life, and six half starved children helping around the farm. Clearly, the desirable way of stabilizing the world's population is for increasing numbers of subsistence farmers to migrate to the cities of their own accord in order to improve their way of life, and make way for intensive agriculture. Birth rates are falling in most developed countries. The population of Scotland would fall below five million were it not for immigration. That is what I had in mind when I suggested that potatoes grown under central pivot fertigation in the wide open spaces of Australia might help to ease the transition from an agrarian economy to a post-agrarian economy in countries such as China, because I knew that fresh Australian grown Nadine potatoes were being exported to South East Asia, and as far north as Korea to a limited extent.

It was not a very realistic suggestion, firstly because such migration would be slow and the world

is already running short of food: and secondly because fresh potatoes are heavy and perishable and cannot be stockpiled for famine relief. It was only in the course of writing "What to Expect from Potato Breeding" that I came to appreciate the full significance of what the hunter/gatherers who began to domesticate the potato about seven thousand years ago had achieved when they discovered a way of making bitter tasting potatoes sweet and palatable, light and readily transportable, and capable of being stockpiled for as long as necessary. The product is called *chuño* and I have kept my sample of it for several years. It is made by a freeze/drying process employing nothing but natural resources, basically by leaving potatoes to freeze on the mountain side and dry out in the heat of the sun. The Australian outback, where the days are blazing hot and the nights are cold, could be nearly as suitable for the process as the Andean plateau. The modernisation of the process calls for engineering, not potato breeding, because Nadine is available now. I presume that the enormous yields obtainable and the cheap production process discovered in ancient times would more than defray the high cost of water for irrigation. I do not know what price mass produced *chuño* would command on the open market in a world that is running short of food, but I do know from internet sources that *chuño* is an esteemed ingredient of traditional Peruvian and Bolivian dishes, the food of the Andean Altiplano.

Since one desert or semi-desert is very like another, *chuño* could be produced around the world under almost unvarying conditions, and it could be done now with Australia in the lead. It is not a new and untried technology. On the contrary, it is a very ancient technology that needs to be modernised in order to help banish the spectre of mass starvation from the world.

Meanwhile, with the help of my wife Nancy (or Anne ),I will be closing down my breeding programme with a good conscience. I dig the potatoes and she gathers them. Actually, she is more than a potato picker, having edited a heavy volume of local history entitled "Lest We Forget The Parish Of Canisbay", where both of us were born and brought up. She persuaded the local people to write their own history of crofting, which was close to subsistence farming, cash poor but socially rich. She says she couldn't get them to stop and it turned into a history that is widely acknowledged to be a classic of its kind. Copies are still available through Caithness.org. I mention it because we know about subsistence farming and regret its passing, but there is no alternative if the world is to be fed. I reiterate that *chuño* could ease the pain of economic migration and, in the last resort, provide for famine relief.

Just suppose for one moment that we have the political will to avert starvation by fully exploiting potato production over vast arid areas of the world that are presently almost barren, what then? Then we could set aside large tracts of naturally productive land in the interests of wildlife in general and endangered species in particular, and be the better for it.

I think it was seeing me and Nancy harvesting potatoes with a five pronged graipe that gave Ewan the idea that potato breeding was not too difficult. If so, he was half right. Like a great many other activities, potato breeding is easy, but it is hard to make a success of it.

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Update. I have already said that the financial return from *chuño* production would need to be more than enough to pay for the provision of fresh water for irrigation. Conventional desalination is expensive because the process of reverse osmosis requires large amounts of energy to force water through a membrane that is impermeable to ions. The New Scientist issue of 17 Jan 2009 includes an article about the possibility of greatly reducing the cost of desalination by using membranes constructed from parallel nanotubes. This kind of futuristic chemical engineering, which simulates the movement of water through the membranes that line the walls of living cells, might have an important role to play in providing water for intensive potato cultivation in arid areas.