

# QUIET QUADRANGLES AND IVORY TOWERS

By PAULINE CURTIS

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## 1 Introduction

I believe everyone has an interesting story to tell. My story only became ‘interesting’ when I started my career in the Civil Service, having being recruited straight from Oxford University as a research scientist at the National Physical Laboratory, part of the Department of Industry. My five years there is the endpoint of this volume. The rest of my career, which I describe as ‘Working with Conservative Ministers’ chronicles my journey as an administrator as I pushed my way up the Civil Service promotion ladder. I quickly found it was more interesting to spend money on doing the right things from within the Government system, than to beg for money from outside it.

Scientists do not spring from nowhere and women scientists are even rarer. I am unusual in having a full-time career for 20 years as a civil servant while simultaneously working as a part-time lecturer in the Open University. My success was due to the influence of many people. This book describes the important influencers: my parents, my teachers at school, my friends and the tutors who inspired me at Oxford, and then my colleagues at the Open University and the National Physical Laboratory at Teddington. Most importantly, my husband Pete is truly my other half; my most important friend, my soul mate and partner. I am so lucky to have met him at Oxford and am proud to dedicate this book to him. I believe I was successful in my career because I was able to work very hard, with his encouragement. Having no children, I was able to commit my weekday time to studying, then to research and finally become dedicated to public service.

My scientific career began when I gave my first public lecture at the Wulfrun Institute, now the University of Wolverhampton. I was in my third year in the Sixth form at Cannock Grammar School, waiting to start as an undergraduate at Oxford University, and had done some independent research into flame proofing of material. I found I enjoyed doing research. Later I realised it is only worthwhile if the results are communicated, and that required writing, presentation and acting skills. I am still learning the acting skills.

As a young scientist I wrote a number of research papers which were published, then turned that skill towards writing letters and speeches for Ministers. I was good at taking complicated technical issues and describing them so that even a Minister could understand. Success at policy work involves giving good advice too, and I was soon trusted by senior officials and Ministers. Even in the 1990s there were only a few dozen women in the Senior Civil Service when I became Assistant Secretary in 1994.

This volume is the first part of my story, from when I was born in a coal-mining area in the Midlands and educated there, followed by six glorious years at Oxford before starting my career in the Civil Service.

These memoirs are published with the permission of the Permanent Secretary of the Department of Trade and Industry and the Cabinet Office.

Pauline Curtis  
Pangbourne  
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## 2 My Parents

Looking back now, I wondered where the beginning was. Where should I start? I decided to begin with the marriage of the most important people in my life, my parents. Looking for my influencers, they were the first and most important people in my life. Their meeting seemed the best place to start.

My parents lived just a few miles apart. My father lived in the coal mining village of Chasetown, and my mother lived in Brownhills. Both places are just off the main A5 Watling Street Road, between Cannock and Lichfield, and some 15 miles north of the city of Birmingham. It is all part of the Black Country, named because of the pit heads and the coal mining. My mother was born in 1914 and my father in 1913, just before the First World War so they experienced the problems of that era. My father was the sixth child in a family of six boys and two girls. At the age of eight, his father was killed in an accident with a cutting machine in the local coal mine, so things were hard. My mother was the third of four children - two girls and two boys.

My parents first met when my father was thirteen and my mother was just twelve years old. Before he died he wrote about his life and this is how my father described the meeting, in his own words.

‘During my 14th year I went to another venue, the venue of love. This I must explain. It was to go out on a Sunday afternoon, all in our Sunday best clothes, and we all had a nice Sunday suit with tie or bow, and the young ladies dressed to kill. We were all of the same mind - a Sunday afternoon promenade along what we called the Pool Dam. Many couples got together and eventually after many years of courtship they got wed.

For myself I met a grand young lady a year younger than myself whom I had noticed when I was 13 years old. She was only allowed to promenade if she took the dog for a walk. We became very good friends and had a rendez-vous by a canal bridge not very far from her home. Eventually I started to play soccer for a very good team at Brownhills called Brownhills Wesleyans - a chapel soccer team. This certain young lady was very interested in soccer because I was a player and she used to stand behind the goals which encouraged me to score. So that she would clap, clap, clap.’

The Pool Dam was the edge of the artificial lake at Chasewater, between Chasetown and Brownhills. Throughout his school years my father played football. Football was his passion and he had a lot of success playing for local teams in the area. In 1932 he left home, just before his eighteenth birthday and enlisted in the Army, joining the Royal Artillery. After initial training he joined his older brother, Bernard, at Portsmouth, with the 2nd Anti-Aircraft Regiment. They both were good football players. He remembers his debut, playing for the 6th Anti-Aircraft Battery.

‘I made my debut, it was on a Wednesday, the afternoon that all sports were a part of the army routine. It was a great day for me and I had the spectators clapping and shouting for joy. I cannot remember the team we played, but they remember me. Although the opposition scored a goal I managed a hat-trick of goals so what a delight it turned out to be. We had won by 3 goals to 1’.

He enjoyed Army life and excelled at many sports, although football was always his first addiction. He played Centre Forward wearing the No 9 shirt. In 1933 he moved to the School of Anti-Aircraft Defence at Biggin Hill, learning to use radar, and after eight months was asked to stay on as an Assistant Instructor. He continued playing football, and winning a number of trophies. One special match was when he was called back to play with his old team at Portsmouth.

‘During the 1933/34 soccer season I was recalled by the 6th Anti-Aircraft Battery to take part in the annual football trophy for the Anti-Aircraft Group. We battled our way to the Final which was played at Aldershot. We had a very tough Final and we defeated the opposition by one goal, a very unusual goal. It happened at the start of the second half. It was our kick-off to start the second half. I decided to kick the ball as hard as possible towards the opposition goal, and to my amazement the ball landed in front of their goal. The goalkeeper came out a few yards to collect it before it bounced but alas the ball bounced first and it was going over the keeper's head. His reaction was quick to jump and push the ball over the crossbar but alas he pushed the ball too low and it entered the net. That effort and goal was the only one of the final which enabled the 6th Anti-Aircraft Battery to return to Portsmouth with the winner's trophy.’

Overseas postings followed and he spent a year on active service in Malta. It was the time when Italy threatened to capture Malta, and use the island as a base to defeat Abyssinia. Again he played lots of football in his spare time, before returning to England in 1936. There followed more success at football, including one match playing for Port Vale in 1937.

Meanwhile my mother had left school at 14 and become apprenticed to a dressmaking firm in Birmingham. She had to travel by bicycle all the way from Brownhills each day, to Six Ways Aston, which was a long trip. She was living at home and gave her small weekly pay packet to her mother to pay for being home, receiving just ‘pocket money’ in exchange. This upset her father because he expected to be given the money, and said so. My mother was always very close to her own mother, took her part in arguments, and was therefore seen as a trouble maker by her father.

Time passed and she made her career in dressmaking and tailoring. She was paid piece-work rates, so the more items she sewed the more money she earned. Many of the clothes made were good quality, and the height of fashion. The girls, in those days all the machinists were girls, were allowed to buy pieces of left-over material, to make their own clothes. My mother used to be proud that she came home from work with a piece of material on the Friday night and was wearing it to go out on the Saturday evening. She had her own Singer sewing machine, which she worked by turning a handle. Her clothes were always just ahead of the fashion and she said she used to sell the completed garment to friends, buy some more material and make something new for the next week.

She led a sheltered life at home. Her friends at work were from the Birmingham area and were more ‘street-wise’. She tells stories of the time she went with some of them on her first holiday, just before her twenty first birthday, to the Isle of Man. It was 1935. First her parents asked to meet the girl she was going to be sharing a room with, Rose, to make sure she was a nice girl. Having passed the test, the holiday was agreed. The journey involved taking the steamer service to Douglas from Liverpool,

and it was the first time she had ever seen the sea. The Isle of Man Steam Packet Company is the oldest continually operating passenger shipping company in the world, having begun operations in 1830. By the First World War there was a fleet of fifteen Steam Packet Company vessels, many of which were requisitioned. My mother and her friends caught the Ben-My-Chree(4), launched on 29 June 1927, which must have been a magnificent new vessel. The previous vessel of that name, Ben-My-Chree(3), had been lost during the war.

For my mother, the novelty of being on the ocean overcame any tendency to sickness. The other girls all fell ill, leaving her to look after a mound of suitcases. Having arrived at Douglas and settled in to their Hotel she went out with the group into a bar for the first time and was not sure what drink to ask for. Her friends all had a Gin and It and she tried the same, but just the one drink was enough. Her mother had told her to make sure she did nothing which she wouldn't want to talk about when she got home. Some of the antics of the other girls must have shocked her. They stayed out late at night and had what would be called in Birmingham 'A Good Time'.

They all returned on the Viking which was much older having been launched on 7 March 1905. The Viking had been used as an aircraft carrier in the First World War and there was a stamp printed to commemorate her when she was HMS Vindex with Bristol Scout aircraft in 1915. The Viking had a long career, including being used to evacuate civilians from Guernsey in June 1940, just before the island was invaded by Germany during the Second World War.

Back home, life seemed to continue with each week the same until she was re-introduced to my father in 1937. He had completed his six years in the Army and came back to be reunited with his childhood sweetheart, my mother. He must have changed a lot, and would have been a tall suntanned soldier, wearing a sharp fashionable suit. She did not recognise him when she was introduced to him as he sat drinking tea in the front room with her mother. They renewed their friendship and it developed into courting.

Having left the Army my father first worked as a bus driver, and then as a driver of a coal lorry. Work was not easy to find, and the driving skills gained in the Army were useful in civilian life. He proposed to my mother on Xmas Eve 1938, and they planned to be married on Easter Saturday 8 April 1939.

The week before the actual wedding day he was a passenger in a vehicle which collided with a motor cyclist, killing him. My father was then summoned to appear at court as an accident witness, on the actual wedding day. Fortunately he was able to give evidence early, having explained that it was his wedding day, and just got to the church on time.

All young couples look special on their wedding day. My mother made her own wedding gown and the dresses for the bridesmaids. The local church was just a short walk from the house in Brownhills, and the reception was held at my mother's family home, but her father would not pay anything towards it. My parents had to pay for everything themselves, and they had no money left for a honeymoon holiday.

Young married couples did not buy a house in those days, they rented one. My parents rented a brand new house in Burntwood which they moved into immediately. There were three pairs of houses built by a Mr Bradbury, and they were in the countryside,

just off the main road between Lichfield and Cannock. Our house was the first house, number one, and the road was called Boney Hay Road because if you continued down the road you eventually got to the village of Boney Hay. In a similar style the main road was called Cannock Road, because it led to the large mining town of Cannock. Immediately opposite Boney Hay Road was a road of similar pairs of houses built at the same time, but that was a new road, so was called New Road. On a clear day you could see across from the upstairs bedroom window, past the fields of the farm opposite, and all the way to the three spires of Lichfield Cathedral.

The house was a typical design for the time and there are thousands of the same types scattered around the country. The front door opened to a very small lobby with the stairs climbing directly up to three bedrooms, two double and one single. Then downstairs there was a front room with a pantry, and a kitchen/dining room from where there were separate doors to another small pantry and opposite to a bathroom with bath and wash basin. Outside there was the entry door to the WC, which was part of the house but only accessed from outside. Our garden was triangular. Although it was the first house in the road it had to be fitted alongside the back gardens of other houses which were already established on the main road. So there was a very wide front garden which tapered to a point in the back garden. The other house of the pair, obviously called number three, was a mirror image design and had the benefit of a narrower plot with a back garden which was much longer.

After living in Army accommodation and then in lodgings, being married was a spectacular improvement in the quality of life for my father. He describes what it was like.

‘The first Sunday it seemed like paradise to be listening to our radio and preparing together our daily food, and sitting at our new highly polished dining room table with matching highly polished chairs, to a meal prepared and cooked to the highest standards of cleanliness and taste. A Buckingham Palace meal. Just for us two. Never in living memory had there been a first day of marriage in any way more perfect. But alas Monday came around. My wife had this first week off. But I went off to do my usual and now more enjoyable work, full knowing that the day would end with firstly a home coming greeting, my house slippers by the fire, romantic music on the radio, then sitting down to a meal fit for a king and queen, and in our own house. We surely felt like them, King and Queen of the castle.’

Six weeks later he was called back for three months to work as an Army reservist, then immediately afterwards, on 3 September, the Second World War started and he was sent away fighting, leaving my mother alone in the house with her Labrador dog, Sandy.

While he was away my mother worked in the tailoring trade. Married women without children had to work for the war effort and her choice was between munitions or tailoring. She didn't want to work on manufacturing weapons, although some of her neighbours were forced to do so. Having had been trained in tailoring before her marriage that was the obvious choice. Sewing was a skill which was useful to her for the rest of her life. She did not go out very much, except for Church on Sunday, so had limited expenses. Eventually she received my father's pay as a soldier and any savings were put away regularly into Savings Certificates.

She was also very careful with managing within the constraints of wartime. Living in the countryside with a garden there were opportunities to grow ones own food. Indeed it was compulsory to do so as it helped The War Effort. Towards the end of the war she went into shares with a friend to buy a pig. The agreement was that my mother bought the baby piglet and the other lady would feed it until it was the right size to butcher. My mother was determined that it would not become a pet else it would be too difficult to eat. Eventually the pig became of size, and was then killed and divided. My father was surprised and delighted when he came home on leave and was proudly shown the side of bacon hanging behind a curtain in the front room.

When my father came back from the Second World War in 1945 he had been impressed by the way my mother had saved, and said that she was doing such a good job that he was happy for her to continue managing their income when he started work again. I think it helped that her family had been shop keepers in the past, and she knew how to handle money. So from that date she always had control of the money in the house, and my father only asked for a weekly allowance for his personal spending money. It was an unusual arrangement. During the war the soldiers had been sent parcels of gifts, including lots of cheap cigarettes. So it was no surprise that he was addicted to cigarettes when he got back home, whereas my mother had never smoked. I think she had tried a cigarette once and hated it, so never tried it again.

At the end of the war she had put together enough savings that they could buy a little car, and she talks about their first holiday back together when they took the car and a tent down to Devon. Camping in a farmer's field in Bude and Lyme Regis may not be everyone's idea of a perfect holiday, especially with the problems of petrol rationing at the time, and the restrictions of food coupons. They were young, I had not arrived, and there was much less traffic on the road in those days. It must have been a wonderful holiday.

Eventually Mr Bradbury who had built the six houses decided that he wanted to retire as landlord and sell the houses, so everyone was invited to put down a deposit to buy their house. None of the other tenants had enough money saved to put down a deposit. My mother had this passion for saving, and everything that was bought in the house had to be paid for by cash. Even expensive items like a car and furniture. She had seen the misery which could be caused by shopping on the 'never never' as it was called. When weekly payments could not be made then the stuff was re-possessed. It was also an expensive way to get a loan.

Because my mother had been saving, she had enough money to put down the deposit on their house; indeed she had so much saved they were offered the option to buy all six houses, or they could choose to buy two houses and the field at the other end of the row. In those days it was unusual enough to buy your own house, and the local saying was 'Yer carn't live on bricks 'n mortar'. Indeed it was not very profitable to be a landlord, and rent out houses. The tenants could cause a lot of trouble and repairs had to be paid for. The field at the bottom was in a Green Belt area, and everyone said that the Council would never allow building there. They decided on the low risk option, and decided to buy two houses - their own house, and the one next door, which was then rented back to the people who were already living there as 'sitting tenants'. Mr Bradbury advised them on how to get a mortgage to buy the houses and this was the only time they ever borrowed money.

For just two people their house was large, and they did not need three bedrooms. So the largest bedroom, on the front of the house, was converted into an upstairs sitting room. Friends and neighbours used to come for evening whist drives, and card tables and chairs were set up. Recall that in the 1940s everyone made their own entertainment.



### 3 I Finally Arrived

While they were both working they were able to have a good standard of living until I came along in 1952. They had both wanted a family and were very pleased when I eventually arrived. I know there were problems and my mother had to have lots of special treatment in hospital before I could be conceived. She was almost 40 when I was born, and I was to be her only child. Afterwards she said that I should have been a twin, like her own mother had been a twin. I think she was probably mistaken; she was not very aware of basic human biology and a second dead child would have caused different complications. Some of the surgery did not heal properly and has been a trouble to her all her life. She was too shy to go back to her doctor and get the problem looked at, with the risk of further surgery.

Being the only child, and with my mother continuing to do sewing by working from home, we were by local standards well off. She had a good reputation in the area for making ladies dresses. An only child becomes the focus of family life, and soon the child realises how to get what they want. I am sure I was no different to any other only child. In my case, my father was out at work, and it was my mother who was with me all day. She continued sewing and I have some wonderful clothes which she made at that time. There were lots of hand-smocked blouses and dresses, made of fine Liberty cotton and Viyella wool and cotton blends. Having been trained in the tailoring trade meant that my mother had a good eye for material and always used good quality stuff.

My mother liked to take me out with her. In the beginning I used to be pushed in a posh Pedigree pram. Friends in the village used to criticise that I was being treated like a princess - to which the reply was that it had taken long enough for me to arrive and the royal family could produce children whenever they wanted, so I was worth more than a princess. My mother's sister May never had any children and she was two years older than my mother, so when I was born she must have realised that she was not going to have children. Before getting married she had been a children's nanny, and would have been very good with children of her own. She poured all that affection onto me, and came visiting most weeks when she had finished work in her hairdressing salon. It was still a shock to my parents when the first words I spoke were 'AyAy' - meaning Auntie May, instead of the usual 'Ma' or 'Da' which they might have expected.

I spoke early but did not walk until much later. When I finally learned to walk I was firmly attached to a set of reins when we went out. My only model for behaviour was my mother and so at an early age I knew how to behave properly in restaurants and how to eat properly. My mother liked to go out shopping to Walsall each week and I had my own special cutlery when we went out to lunch.

The farm opposite our house had a small shop, which was on the corner at the end of the road. The old farmer's sister, Miss Froggatt, used to sell bread and milk and a few other things. I recall she was a plump old lady, and we stood one side of the counter and she stood on the other. When I was small I was too frightened of her to go into the shop on my own.

One year I attended my cousin's wedding and although I was not invited to be a proper bridesmaid my mother made me a glorious little white crinoline lace dress. I

think I looked better than the real bridesmaids. My hair was done in ringlets, by wrapping it all tightly in bandages overnight. I remember how much it hurt trying to sleep, but the end result the following day was worth it. The photographs make me look like a little angel, but I know that I also had a temper when I didn't get my own way. My little 'Mick' as my parents described it later.

My mother also made me a beautiful white rabbit-skin coat, with matching hat and muff. This was real fur, and the only problem was that it was very, very white. I used to wear black patent shoes with it. It was my outfit for going out for special occasions, and I must have looked a million dollars in it.

## 4 Starting at School

My birthday is in September and so I had only just reached my fifth birthday when I started school. As well as being young, I was also small, and to make matters worse, I was bright. There was no serious bullying, although I had long hair and had my pigtails pulled occasionally. Even at infant school it was said that I would get to Oxford University, and my parents responded by saying that they would support me if I was bright enough. I think they expected that I might become a school teacher and come back to live at home, after my degree. That was the limit of their imagination, in those times. No-one from either family had ever gone to University, although one cousin had done a Diploma in Horticulture at Oxford after returning from the Second World War. I started with the advantage that because of my mother's efforts I could read before I went to school. My father was good at mathematics and I had inherited his sharpness with numbers. The foundation was thus set for early progress with my studies. It is so much easier to do well when you are already ahead of the rest of the class.

I don't remember much about my time at either the infant or the junior school in Burntwood. The main building was Victorian with outside toilets. It is now divided into houses and there are more houses built on the old sports field. We used to go outside during the morning break to collect a little glass bottle of milk given free to drink each day. I remember being given the polio vaccine, a pink stain on a sugar lump. It was a ten minute walk from home down the hill to school in the village of Burntwood, and a slightly longer walk uphill back. I used to go home every day for lunch and my mother was always waiting at the school gate to meet me.

I remember I was never much good at sports but when I was seven years old I did start to learn to play the piano. Being an only child I had always been comfortable doing things on my own, or with my parents, and did not enjoy team games or competitions with other children. Music was an excellent hobby, and it fitted in well with my structured way of thinking. Many people who are good at mathematics are also good at music. My parents bought a second-hand piano for me from my father's elder sister who had moved into a smaller house and had no space for it. Like all beginners, I was supposed to practise every day but I did not. However I still made reasonable progress, and my teacher, who came every Wednesday after school, was very patient. At junior school I was able to learn to play the recorder and my parents bought a descant recorder, followed later by a larger treble recorder. Both these instruments were easy for a small child to play in the sense that noise came out without great difficulty. To balance all this I was no good at all at singing, and I had no flair for improvisation. I needed to have the music notes all written out in front of me, and then it was easy. In contrast, my Uncle Charlie, my mother's younger brother, never learned to read music but could play any tune once he had heard it.

The junior school had an arrangement with the swimming baths in Lichfield and children were taken there for swimming lessons. I slipped and fell on the wet floors on my first trip and this caused a permanent fear of swimming and dislike of communal public swimming baths. I can still remember the smell of the chlorine. Many years later, when I was at grammar school waiting to go up to Oxford I went

back for one day each week to help with the teaching. As well as helping with classes I was put on duty at the swimming pool while the children learned to swim. This time it was at a new pool at nearby Chasetown, not the old baths in Lichfield which had been demolished to make way for more new houses. I didn't like to admit that I could only barely swim myself, but it was safe enough. There were others on lifeguard duty.

I had some minor health problems when I was young. When I was seven I had an unsuccessful operation to correct an overlapping toe. The extended stay in a children's hospital meant I did a lot of extra reading and arithmetic, and also received a present of a cowgirls outfit for being such a well behaved patient. Towards the end of my stay I made friends with another girl of about my age who had long beautiful blonde hair. I borrowed her hair brush and for the first time in my life I caught head lice, the nasty little insects which children at school normally pass on to each other. It was seen as a disease of poor children, and my mother was mortified. She had to buy a fine nit comb from the chemist to clear them out of my scalp. The operation failed and the toe is still overlapping, making my right foot look a mess with a bunion on the other side. My mother has bunions too so I guess it is an inherited weakness.

Another memory was of catching chicken pox. The first time was very mild, I am told, and I don't remember it, but the second time was more serious. We did not expect that I could catch it twice. The treatment involved being immersed in smelly purple bathwater to subdue the ferocious itching, and then I was covered in pale pink calamine lotion. I was not very amused, and I still scratched the spots. Fortunately I got better after just a couple of weeks. Other common childhood illnesses were not so memorable.

The house was comfortable but downstairs there were just the two rooms, the kitchen/diner and living room, as well as a WC outside and separate indoor bathroom. My mother wanted to have a decent kitchen and so they decided to build a veranda on the back. This was the full width of the house, with bricks up to window level and then a glass roof on top. It meant that the gas cooker moved into the veranda and a new sink and a lot of modern kitchen cupboards were installed. It would have been expensive to get someone to build the veranda and my father did a lot of the labouring work at the weekends, to save money. In the Midlands a lot of people worked for cash at weekends.

My father moved to work for the BRD Company Ltd at Aldridge, now part of GKN plc. It was an engineering firm and manufactured a variety of products including bearings, turbine blades, pit props for the mining industry and crankshafts. My father said that the letters BRD stood for Blades Research and Development and until the mid 1950's the company had been entirely devoted to the manufacture of gas turbine blades for aircraft engines. The badge which he wore on his blazer had a propeller on it, and my mother still has a little plastic thermometer, shaped like a pit prop. In the early 1960s the BRD Company began to specialise in the production of prop shafts and continues in that business, as GKN Driveline Walsall, now. One morning, on his way to work on his motorbike, he had an accident and broke his leg. This took some time to repair and when he was well enough to go back to work he was knocked down a second time, by someone he knew. He was just walking in the company grounds on his way to report back for work, and the driver said he did not see him. The same leg was broken again and when it healed it was shorter. Fortunately he was able to get sick pay, else it would have been a disaster for us all. The BRD Company Ltd looked after its employees well. It was still hard for my mother; not only did she have the

worry of the operations but also she had my father sitting around the house. And sick pay was not the same as full pay.

We watched a lot of television. My father got home from work every day just before 1800 and his first action was to change into slippers and sit in the corner with a cigarette and his newspaper, and watch the news on the television. Television had been invented in 1936 but then was abandoned during the Second World War until 1949 when the transmitters at Alexander Palace and Sutton Coldfield and elsewhere were built. It was called high definition, at 405 lines. Sutton Coldfield was not far away from our house and it was possible to get a reasonable signal. My parents were one of the first in their area to buy a television set, and there was just the one channel, BBC, and it was only in black and white. Their TV set had a small screen by modern standards and was disguised as a piece of furniture, with a pair of doors which closed to hide the screen. Neighbours came to the house specially to see the amazing new technology. As David Frost is quoted as saying 'Television is an invention that permits you to be entertained in your living room by people you wouldn't have in your home.' We listened to a lot of music and watched a lot of quiz shows, and I remember one show where I sent in a cartoon drawing. I must have been only eight years old and I was so excited when they held it up and showed it on the screen, and said that it was done by Miss Pauline Ward of Burntwood. I won a prize, a few Premium Bonds, but it was being on television which was the exciting part. It was the talk of my school the next day.

Workers at the BRD Company had a busy social life. Every Christmas the Sports and Social Club paid for the children to go to a pantomime and to have a party. I remember helping pack the bags of goodies for the children, and labelling them with either Girl or Boy and an age so that the contents were suitable. The Horticultural Society held its summer flower show at the BRD Sports and Social Club. For many years my father was the Secretary of the Sports and Social Club and was a keen gardener. Interested in local politics, he had some contact with the local Labour MP, Julian Snow. He was MP for Lichfield and Tamworth from 1950 to 1970, and then retired to become Lord Burntwood. They were about the same age, although my father said he never voted Labour; he was always a Liberal. On one of his visits overseas Mr Snow had been to visit Japan. He returned with some pretty little miniature almond blossom trees which he gave to me as a present. For Christmas 1960 I started to purchase other little plastic trees and bushes, to make an artificial garden. Then in July 1961 I put together a miniature garden made of real grass and plants, with flowers and vegetables. This won me the Junior Gardener Diploma at the BRD Flower Show. I followed that with a more extensive miniature garden in 1962, and again won the prize. By 1963 I entered again, and won again. I was then awarded a pretty silver plated rose bowl, and told that I was not allowed to enter again. It was time for other children to win the prize. I remember that I was getting bored with the competition after winning it for three years, so I was happy to stop, and in 1964 I would be too old to count as a Junior Gardener.

I am sure that teachers know which children thirst for knowledge and enjoy reading. Since I was supposed to be heading for grammar school, as part of the intellectual preparation, my parents had been persuaded by a salesman to purchase the Children's Encyclopaedia as well as a full set of the Colliers Encyclopaedia, so that I had a source of useful information. It was all installed with pride in a new bookcase in the front room.

The weather in Burntwood could be bitter in the winter, with snow commonplace. There is a local saying that if you can live in Burntwood then you can live anywhere. I recall that the time of my 11 plus exam was the worst winter in history. It was November 1962 and I was just ten years old, and expected to go to the posh Friary Grammar School in Lichfield just before my eleventh birthday. Teachers at the junior school expected me to pass, and that it would then be automatic that I would be offered a place at The Friary. They were right that I was going to pass the exam, but wrong about the consequences. I was only offered a place at the new modern Grammar School at Cannock. There was no choice, and off I went to Cannock. Burntwood is mid-way between the two places, although Cannock as an old mining town is very different from the genteel cathedral city of Lichfield. One other important difference was that The Friary was girls only, whereas the new Cannock Grammar School with its badge of an oak leaf and acorns and its motto of 'Live Worthily' was mixed.

## 5 Going to Cannock Grammar School

Starting at Grammar School was an exciting new challenge.

Of more mundane matters, Cannock Grammar School had a formal school uniform and we received a list of what had to be bought. Everything had to be bought from the school outfitters and there was a special event in Cannock where the parents of new children went to purchase the items. I was dressed several sizes too large at the beginning. My mother said she was going to buy clothes so that I could grow into them. The clothes were new, of good quality, and were therefore expensive. There was no market in second-hand school uniform because the school was too new. The winter uniform of grey woollen skirt, green blouse, dark green blazer and posh grey gabardine Mac, together with the regulation grey pants and socks, and the other standard items like swimming costume and sports uniform must have made a big hole in my father's monthly pay. Then later there was the summer uniform to buy too. Having a uniform meant that everyone at the school was dressed equally, which I believe is a good idea. I looked longingly at the girls in the sixth form who had a distinctive and different uniform - their blouses were a different cut and colour although still green, and they wore pleated grey skirts. The uniform also meant that it was easy for teachers to know whether an individual student was senior enough and allowed to be walking around Cannock town centre at lunchtime.

Travelling to school was a daily adventure. There were no special school buses, and I had to do my best and catch the normal buses. My parents had bought me a bus pass, so that meant I did not need to carry cash to buy my daily tickets. The direct bus to Cannock left from the bottom of the hill in Burntwood, and was usually full of schoolchildren, as well as lots of other people too. It was a double-decker bus, and I liked to sit upstairs with a view. The journey was quite long, because the bus went through many of the villages, so I used the time to read. Other children spent their time doing the homework which had not been done at home. There were other suitable buses to Cannock, for example from Chase Terrace, but that meant a much longer walk to the bus stop. I sometimes got off my bus on the way home at Chase Terrace, to visit the library, and then continued home on foot. It was slightly downhill although it was tedious with a heavy bag and lots of books. Sometimes for a change I would catch a bus to Hednesford where I would connect with another bus. Having the bus pass meant that I had lots of options.

Living so many miles away I never spent time in Cannock after school was finished, and we were not allowed to leave the school to go into Cannock during lunch breaks. Classes finished promptly at 15.35 and I went home on the 15.55 bus every evening. There was nothing to do in Burntwood so instead of going out to discos like my teenage friends in Cannock, I collected books each week from the library and spent my spare time reading. My taste was varied. I used to read fiction - for example I worked my way through many of the Biggles series, and then started reading true stories of aircraft and aircraft accidents. I later enjoyed the Chinese detective stories by Robert van Gulik; the first book I remember was the Chinese Maze Murders and the main character was Judge Dee. There were many stories in the series written from 1967 onwards and I devoured them all as they appeared on the library shelves. I also used the library as a serious addition to the books used to teach classes at school.

There were several classic chemistry books and physics books which I took home and digested, especially as O-level time approached. I found I had a good memory and could repeat whole Chapters from memory, as well as draw copies of the scientific diagrams.

My favourite of all the books was a large heavy reference book. I was only able to read it under supervision in the library, it was so special and valuable. The title was 'L'Architecture Religieuse en France a l'Epoque Gothique'. It was a beautiful heavy book, printed in two volumes and written in French, but with hundreds of beautiful pictures of the fine gothic cathedrals of France. My ability to read French was limited, but I poured over the beautiful pages until the book had to be sent back to the British Lending Library. It was my first interaction with a truly fine and classic book. I memorised the title in the hope that I might one day find the book to buy. The author was R de Lasteyrie and it was published by Auguste Picard of Paris in 1926. I recently found a copy of Volume 2 for sale in Paris, via the Internet, and purchased it. It was an unusual book for a teenager to come across, especially since it had to be ordered from the British Lending Library. I think I was reading other books about gothic architecture, having fallen in love with the gothic style when admiring Lichfield Cathedral, and the title was included in the list of references.

A strong Christian faith had always been a comfort to my parents, and especially to my mother. As a family we attended Christ Church at Burntwood and so it was natural that as I got older I should follow the classes which lead to confirmation in the Church of England. My mother had never been confirmed as a child, so she followed the classes too. We were confirmed together by the Bishop at the cathedral in Lichfield, in 1965. My mother made me a high waisted white lace dress for the occasion, and we all had to wear a white veil.

Lichfield cathedral is a medieval cathedral and as such is unique because of its three spires. Locally it has been named 'The Ladies of the Vale'. Built in the Gothic style, the main parts, the Choir Transepts and Nave, date from 1200 to 1260. The cathedral is beautiful and incorporates a spectacular Lady Chapel, built in 1330, and containing the wonderful Flemish stained glass windows dating from 1530 and brought from Herckenrode Abbey in 1803. Restoration work has continued throughout recent years, especially to the statues on the West Front and the three spires. Different corners of the building have been disfigured by towers of scaffolding, but it is all to the long term benefit of the structure. Whenever I visit I feel the presence and power of the history and am uplifted by the soaring gothic design. There have been many famous Bishops at Lichfield. Bishop Selwyn, who was the first Bishop of New Zealand from 1841 to 1868 and died in 1878, has his monument in Lichfield Cathedral. Although it is a very large monument it is not easy to find and is hidden at the far end of the cathedral, in the Lady Chapel.

In the 1960s all schoolgirls loved The Beatles, and I was no exception. I collected a series of picture cards given out with sweets. I also became addicted to a new TV programme called Top of the Pops which began on the BBC in 1964. It ran for 42 years with the last performance being on 30 July 2006. Jimmy Saville was my favourite DJ in those days; there was also Alan Freeman, Pete Murray and David Jacobs. For Christmas I was given a small portable record player so my weekly pocket money started to disappear on records. I was always waiting in the queue at the record shop on Saturday morning whenever there was a new Beatles record.



The Cannock Grammar School was quite progressive in its subjects. There was no distinction between classes for girls and boys, so during the first two years everyone had lessons in domestic science, art, woodwork and metalwork. In the woodwork classes I managed to carve a wooden cat, to which I added a pair of bright green glass eyes. In metalwork classes I cut and polished a brass shoe horn. I preferred the challenges of chemistry to doing cooking. The preparation of a fruit salad one week, and cheese and potato pie another, were not very technically interesting, and the food tasted boring compared with food at home. I discovered that being good at chemistry meant that following recipes was easy.

Music was an important part of non-academic studies. Much of this was learning for my own enjoyment, but I managed to take part in the school orchestra playing the recorder for Noyes Fludde, written by Benjamin Britten. It was performed in St Luke's Church in Cannock. It is a chunky building, made of brown stone, and inside for the concerts it seemed dark and dismal. Somehow I struggled to keep in touch with the waving of the conductor's baton. It is really difficult when you can read music but have not learned how to be part of an orchestra. During these years I continued to play the piano, and worked my way up to the standard of grade 5. I never took any exams because although I could play reasonably well, I saw no benefit in formal exams. I had enough to do at school without any extra studies, and anyway I was frightened of making a fool of myself by failing the aural test, an essential part of the syllabus.

Having many years experience as a Works Study Engineer at the BRD Company, my father was asked to help set up the pricing for a new factory in Newtown in mid-Wales. That meant that he had to commute there each week, taking other people with him in his car. As the factory began production he was asked to move there permanently. It was made clear that his future career progress would depend on the move, but he refused saying that my schooling was more important. I was working towards the O-level exams and the move to Wales would certainly have damaged my studies and it was not clear that the schools there were as good. In addition, we did not want to have to learn the Welsh language.

After two years I was selected to join the fast stream for GCE O-levels. This meant serious accelerated academic study, with three years work compressed into two and I found I would be taking nine O-levels in the summer just before my fifteenth birthday. Sadly I had not been able to study music because it clashed on the timetable with Latin. And in those days bright students had to pass Latin to go to Oxford; now it is not compulsory. Other timetable clashes meant that I could not study history or geography either. I did not do very well, because only four years of study was really too early, but I managed to pass them all, including scraping through the Latin. I memorised much of Virgil's Aeneid because I could not make much sense of the Latin grammar, and I can still repeat some of the passages now. The other near-disaster was English Language and Literature, which I just passed. It was not until much later when I started studying French and German seriously that I was properly introduced to the theory of traditional grammar.

When I started at Cannock Grammar School I had found arithmetic easy, and this developed into a natural flair for Mathematics. By the time I sat O-levels I was very good at Mathematics, and reasonable at Physics, Chemistry and Biology, so I was definitely steered towards becoming a scientist. In my year there were four of us who were good at Mathematics, so I had to work hard to maintain my position ahead of the

three boys at the top of the class. Delaying another year would have meant I made much better grades, but it was assumed by the school that starting A-level studies early was more important.

## 6 Holidays in England

One of the problems with living in Burntwood is that it is so far away from the sea. We always had a nice car, and because I was travelsick when small we always had a nice large car. The first two cars which I remember were Humber - the first a pretty two-tone light blue and grey Humber Hawk, followed by a plain blue Humber Super Snipe. My father always bought them second hand, usually for cash from someone who was a friend of a friend. My mother would never let him have a brand new car, or buy a car on hire purchase.

We managed to get away most summers on holiday. I especially remember Weston-super-Mare where we stayed in a hotel on the seafront. I think it was called the Madeira Hotel. If so then it is still there. I was very young and my memory is only of the beautiful sandy beach, and my bucket and spade. The food was good at the Hotel, and I remember the dinner menus were printed on a card. It was a formal hotel and not the sort of place which encouraged families with small children, but I must have been well-behaved. My mother always says that I was trained to eat neatly with a knife and fork from an early age, and I was expected to behave properly when sitting in a restaurant.

Next we tried Skegness. The Hotel was less interesting; I can't remember anything about it. But I do remember that Skegness lived up to its name of being bracing, or just plain windy. There was a Butlin's Holiday Camp just outside the town and one day we bought a One Day Pass to visit. For a child it was wonderful. All the rides in the fairground were free. The other magic about Skegness was the ice cream. Back at home the choice was vanilla or vanilla, or homemade orange squash lollies, so it was amazing to see a long stall selling what seemed to me to be hundreds of different flavours of ice cream. This was definitely Ice Cream Heaven. Now there are many places which sell 31 flavours of ice cream, and every corner shop has tubs of different flavours.

After the one visit we never went back to Weston-super-Mare or to Skegness.

We then had several years in succession at New Brighton. Living in Burntwood we were equally far from the coast in all directions, and New Brighton was just the closest beach. But it was more than that. In those days New Brighton was the top holiday resort in the North West of England. The Wallasey resort attracted people from all walks of life and all income brackets. The New Brighton Bathing Pool, situated in central New Brighton, was one of the largest open air water stadiums in the world. The Pool offered safe bathing to the smallest of children. Accommodation was said to be available for 3,000 bathers and 20,000 spectators. After our first visit, we always booked our holiday when the Annual Miss New Brighton beauty competition was being held. I suppose we must have been limited by my father's job and the Midlands Works Fortnight, which was always in August. Famous personalities, like the comedian Norman Wisdom, used to come and judge the beauty competition. Sadly, after extensive storm damage in 1990, the baths were closed for the last time.

The nearby Tower Buildings contained the famous Tower Ballroom. In the 1950s and 1960s the Ballroom had top named acts pulling in the holiday makers, one small group who performed there were called The Beatles, although we never saw them

play live. The Tower Ballroom was destroyed by fire in 1969. The Tivoli Theatre became an Amusement Arcade; it was also destroyed by fire in 1976. My father discovered the one armed bandits and other games and I was allowed to put the occasional coin in for him. My mother hated gambling of all types, but there was no problem as long as it was only a small amount which he lost. There was a daily limit and once that was gone, it was gone. Like my mother, I could not see the entertainment value in feeding hard-earned cash into a machine, where it disappeared. The only other gambling was that my father was a member of a group at the BRD Company which used to fill in the Pools each week, and then we all sat down in front of the television on Saturday afternoon checking the football results to see if they had won anything.

In those days the golden beaches at New Brighton were pleasant and you could rent a deck chair and watch the sea. I was learning to play the piano and one summer I was pushed forward to take part in the children's talent competition. We had noticed that there were these talent competitions the previous year and I had been made to bring my piano music. I won the preliminary heat, playing Beethoven's Fur Elise, but was then knocked out in the second round, trying to play the Minuet in G.

In the 1960s the famous Royal Iris was the Wallasey Ferry, bringing day trippers across the River Mersey. There were often large ships going past the end of the pier, and I used to practice reading the names of the ships from the window of our hotel room, without binoculars. Some of the names were not easy to read letter by letter, but with some common sense it was possible to successfully guess the missing letters so that the name was a proper word.

I went back in the 1970s and was shocked at the pollution and debris on the beach there. I did not recognise the place as being where I had enjoyed so many wonderful holidays. Maybe it is best not to go back to the location of childhood memories. It is only recently that I have discovered what happened to all those old landmark buildings. The mixture of gales and fires had reshaped the town, and not for the better.

When I was about nine years old my parents bought a caravan jointly with Mom's sister Auntie May and her husband Uncle Tom. We had our solid Humber car and so it was easy for us to tow the caravan. Auntie May and Uncle Tom had a Wolseley which was smaller and lighter. We found it was not easy to find a site to keep the caravan. Uncle Tom had been born in Freetown, Sierra Leone, where his family owned a department store. I never knew his precise age, but he was much older than my mother and I guess he was born around 1900. His original name was Fitzgerald Arabathini, (my spelling is from the phonetics and is not necessarily the correct spelling) but he changed it to Thomas Brown when he came to live in England as a young man. His elder brother had been sent by his parents to Sheffield University to study for his degree, but Tom was the second son and did not benefit from the same education. He came to London anyway, and did a variety of work before becoming a hairdresser in Brownhills. There are pictures of him as a young man in London dressed in a top hat and tails, and wearing spats. Although I had known him since I was born I had never really noticed that he was a different colour. He was just my uncle. Unfortunately we found that racial prejudice was alive and well in the Midlands. We were refused a caravan space when other white families who arrived in the queue after us were found one. This disgusted my mother, who had honestly not expected to find a problem.

We really wanted to keep the caravan somewhere within easy driving distance for a weekend, and we had decided that ideally we wanted to be near Leamington Spa. After being rejected by the caravan park we drove past a nice farm and my mother suggested we just stop and ask them. So it was that we met the Cardall family near Kenilworth who were prepared to let us leave our caravan in their field by the River Avon for the summers. Of course it had to be towed up to the safety of the farmhouse for the winter because the River Avon can quickly rise in level, and the lower fields were always flooded. Over the years we all became firm friends; I played with their children during the day and the adults sat with a few beers in the evening and talked. When it was time to cut the hay we all joined in and helped. Although far too young to drive I was allowed to sit in the driving seat of the Humber, and steer it around the field. It was an automatic so there was no need to worry about changing gear. We children had great fun together chasing the hens and collecting their eggs. I did not have any friends of my own age to play with at home, so I enjoyed playing with them. It was not far to drive to Kenilworth, and it made a good place for a long weekend away. The caravan was still there when I went away to University, and we still exchange Christmas cards with the Cardall family.

Sometimes en route we had lunch at one of the restaurants nearby. I remember that at one meal in Kenilworth Uncle Tom had giant prawns as a starter, the sort that you have to pull apart and eat with your fingers. He asked the waiter for finger bowls, much to everyone's surprise, and he got them. Their hairdressing business did well and Uncle Tom had money and could indulge himself in the latest fashions - he had good taste in clothes. He had to make trips to London as part of keeping up to date with new hair styles. He mentioned going to demonstrations by 'Teazy Weazy' Raymond, who was then a very famous London hairdresser. Uncle Tom used to gamble, on the 'gee gees' as he called them. Perhaps this was due to his meeting 'Teazy Weazy'. I remember watching the Grand National on the television in 1961 when Nicolaus Silver, a grey horse, won. Pierre Raymond had winners in 1963 with Ayala, and later in 1976 with Rag Trade. My father liked to watch racing too, but didn't gamble very much, except for having a small flutter on the Derby and the Grand National. I tried to put some mathematics into understanding which horses succeed, and keep a book of winners, but soon got bored. There was no easy way to predict who would win.

While visiting London, Uncle Tom bought his clothes from a well-known Department store, Simpson's of Piccadilly. Once they had his measurements he did not need to go back, just tell them what he wanted and it was made and delivered. We thought that it was something special to go shopping in Lewis's or Rackham's in Birmingham, and visiting London just to buy clothes was beyond our means. We did have one holiday in London, and then did all the usual tourist things - Buckingham Palace, the Houses of Parliament, Westminster Abbey, and St Paul's cathedral. We stayed in a nice little hotel in Leinster Gardens, near to Paddington station, where there are lots of family hotels. Our train from Lichfield brought us into Euston and we had a trip around the Circle Line on the Tube. It was all very exciting for a young girl only just in her teens.

While my father was in the Army, based near London, he had made friends with a couple, mainly because they all had a common interest in playing tennis. After the war they kept in touch and when they retired they moved to Seaford, near Worthing. Their daughter had a small guest house and we used to stay with the family, in Worthing. It was not a very interesting place for a holiday for young people. Every day the old folks with their wheelchairs were arrayed on the promenade, and the whole

atmosphere was of a genteel seaside resort where time had slowed down. Paris was much more fun.

## 7 Going Abroad for the First Time - Paris

At school there was an arrangement with another school in Paris for pen-friends. It was by this means that I was introduced to Josette, whose father had a Renault garage at La Courneuve on the northern edge of Paris. She came to stay with us in the summer of 1967, and then it was agreed that I would travel back to Paris with her at the end of her stay with us. When the time came my parents took us to Birmingham airport and then Josette's parents met us at Paris Le Bourget airport. I had to have my own British Visitors Passport. Flying abroad at fifteen years of age was fun for me, but I guess it was a difficult time for my parents who had to leave me at the airport and hope that I had a good holiday. They had not met Josette's parents. The British European Airways staff looked after us very well on the short flight. I suppose we must have flown in one of their fleet of Viscount aircraft; it certainly had propellers.

During my visit to Paris I was able to visit the wooden replica of Concorde which was on static display. There was a long queue of people waiting in line to go through and look at it. I remember thinking that it was narrow and there was not much space for passengers. The first Concorde didn't fly until 1969, so it had to be a replica which I visited. My memory is that it was at Le Bourget, but the experts say that it was at the other airport, Orly, and was later destroyed in a fire. Anyway, the Air and Space Museum at Le Bourget now has two French Concorde on display, the prototype 001 (F-WTSS) and the production aircraft 213 (F-BTSD).

In 1967 I would be finishing my O-levels and it was a good chance to practice the French language. I settled in to their apartment which was directly above their Renault garage. Meals in France are, of course, different to back home. Breakfast was just coffee and croissants, which I found I liked. Exotic prepared hors d'oeuvres were purchased from a local charcuterie, and salad was eaten separately to the meat. The cooked meats and cheeses were different too. I learned a lot of new vocabulary, and I think I ate most things which were put in front of me. I was impressed with snails in garlic butter served in shells, and bought a kit so that I could repeat the dish for my parents at home. I loved the wonderful fresh bread and pastries, so different to English plastic cheap sliced white loaves.

There was one exception to my enjoyment of French food. The family had a cottage in the countryside, as well as running the garage. Most French families have summer cottages and go there in August, and the Roy family were no exception. So one day we all suddenly piled into the car and set off for the weekend. I have no idea where we went, it must have been an hour or two drive away and I remember a nice small detached house with a garden. But the most memorable event was when we arrived there was a special meal which had artichokes. The smell made me feel sick - I might have even been ill and disgraced myself. The idea was to peel off the leaves one by one and eat the soft base. It was obviously intended as an expensive delicacy. I hated them.

Back in Paris, there were a number of places which we visited. The most important tourist destination in Paris has to be the Eiffel Tower, and I posted a card back home from the summit. I was entranced by the churches. Sacre Coeur sat like a white cloud on top of its hill. The colours of the stained glass of the cathedral of Notre Dame were spectacular. And last, but not least, there was the Sainte Chappelle. To me it was a

beautiful Gothic jewel. It was built by Louis IX, King of France, between 1246 and 1248 to house the true cross of thorns, together with nails and pieces of wood from the cross of Calvary. In its stone lacework are set the most ancient stained glass windows of Paris. Located on the Ile de la Cite, the building is now enclosed within the walls of the Palais de Justice. The ground floor is a colourful area, with ornate painted red and blue columns and a blue painted ceiling decorated with fleur de lys. The ground floor is low, and contrasts with the upstairs which is very tall, very gothic in style and lightened by the most amazing stained glass windows.

One of the best ways to see Paris is not to dive underground on the Metro, but to take a trip on a Bateau Mouche. These large boats with enormous glass windows spend their time going up and down the River Seine. We had the standard one hour sightseeing cruise, which departed from just opposite the Eiffel Tower, near the Pont d'Alma. Although always full of tour groups it was a good way to see Notre Dame and other famous landmarks from the water.

Then the family took me to the Palace of Versailles. We drove and I remember it was not the easiest place to find parking. The gardens were beautiful and we spent the whole day there. We had all got dressed up because we had tickets for the Son et Lumiere spectacle in the evening. Unfortunately, although it was summer, it rained and that spoiled the occasion. I got thoroughly soaked, and my nice new blue dress and jacket, dry clean only according to the label, was never the same again. At least the colour didn't run.

In spite of the weather I enjoyed Paris. I can still recall the enormous ice-cream sundaes smothered in Chantilly which Josette and I were treated to at the Renault coffee-shop in the car showroom on the Champs Elysees. I had never had whipped cream before. My mother didn't drink milk and she never bought cream, only ice cream. One of the advantages of being with the owner of a Renault garage was that there was special service for us and we sat at a reserved table in one of the booths.

I was required at school to write a diary about my visit, which included postcards of the various places I visited. This was no hardship because I enjoyed collecting all the information and putting it together into a scrap book format. It was finally handed in to my teacher, and marked, but the main benefit was that it enabled me to tell my parents where I had been and what I had seen.

In looking through my old papers, I found a postcard of Paris sent by Anna Zumbach in March 1967. She was a second pen friend and she lived in the German-speaking part of Switzerland. I had not learnt German, so we could only write in French as our common language. We never met, just exchanged photos. She told me that her father was a diplomat and travelled widely. I still have the delicate silver coin bracelet which he brought back from Peru for me. The pattern in the coins had been cut away, leaving a fragile lacey design. Sadly the matching earrings have gone. I didn't appreciate them when I was young and gave them to a charity shop. By an enormous coincidence I bought the exact matching necklace in an antiques arcade in Wallingford just a few years ago.

Having travelled during the Second World War, my father never wanted to leave England on holiday. However, I was learning French at school and wanted to do more travelling. Package holidays had just started in the 1960s and my mother and I went away together, first to Paris, flying from a little airport on the south coast to Beauvais



and then onwards to Paris by coach. It was only the second time my mother had left England; the first time had been to the Isle of Man by ferry on holiday before she was married. It was very exciting. I think the holiday company was Clarksons, and the UK airport was either Lydd or Lymington. I remember that the aircraft had propellers.

We were escorted everywhere by our tour representative and stayed at a nice 3\* hotel, with one of those old fashioned little lifts, so typical of Paris, that had metal concertina doors and were just the right size for four people. Continental breakfast with bread and croissants was served at the Hotel, as well as dinner. An organised coach tour was included and we did everything that first-time tourists do – saw the Eiffel Tower, the Arc de Triomphe, walked down the Champs Elysees, climbed the steps up to Sacre Coeur, and knelt in Notre Dame. We had some free time too. The Hotel was central and the Metro was outside, so it was easy and cheap to travel. I knew what to do, and was familiar with the currency, so my mother let me lead, and she followed. We visited a very similar selection of places to those I had visited when I went to stay with Josette and her family. Unfortunately in the intervening years I had lost contact with them. On the way back we had time to visit the cathedral of Saint Pierre in Beauvais which is famous for its astronomic clock, some twelve metres high and built between 1865 and 1868 by A. L. Verite.

It was the start of the travelling bug for me.

## 8 The Sixth Form

Before I joined the Sixth Form I won a competition to collect letters of the alphabet hidden in boxes of Quality Street chocolates, and make them into a sentence - the longer the sentence, the better the prize. I had to buy a lot of big boxes of chocolates. It was not a real competition. Once I had a long enough sentence I automatically got the top prize - a big brown leather briefcase. It was my pride and joy in the Sixth Form. When it was full of all my books it must have weighed well over ten kilos.

With my success in O-levels it was obvious that I was going to study Mathematics at University, and then the only academic option was to accompany that by studying Physics and Chemistry at A-level. Other subject combinations were allowed within the school timetabling, but exotic combinations were not accepted by the best Universities. I enquired whether Mathematics, Physics and French were acceptable as a combination but was firmly advised that it was not. I decided that I could always study modern languages later, if I wished. I was still hoping to get to either Oxford or Cambridge University. My school was not very strong on Mathematics, and there was no teaching of Further Mathematics, which would have been a good alternative to Chemistry. Further Mathematics was only done by private study in the Third Year Sixth Form.

I continued top of the class in Mathematics and won prizes of book tokens which gave me even more advanced Mathematics books. I was less confident in the Physics and Chemistry practical classes, but was careful in my measurements and good with numbers. It seemed that most practical results converted to a straight line graph at some point. I continued to digest textbooks in the hope that I could memorise enough information to cover up for my lack of flair. The main aim was to do equally well in all three A-levels.

I began to be interested in the stock market. There was a special offer whereby the Financial Times newspaper was offered cheaply to students and I started following share prices. It was not long before I had begun to compare different shares and put together a theoretical portfolio, containing major 'blue chips' like Shell, Unilever and Trafalgar House. After several months watching them daily, and the share price hardly changing, I decided that it was all too boring to do this for real and stopped reading the FT. My actual savings from my weekly pocket money went into Premium Bonds instead. We had a system whereby I and my parents each contributed every week towards buying a Premium Bond. I think I put in twenty pence and they each contributed forty pence, to make up the £1.

Auntie Ivy, who lived just around the corner, was not a relative but was a very good friend of my mother. One day she presented me with a mandolin, made in 1898 by Giovanni Paladino and decorated with mother of pearl. I was enchanted by it as an item, but I found it hard to play. On the one hand, you have to train your fingers on the left hand to get hard for pressing on the pairs of strings, and on the other you have to develop a floppy right wrist in order to achieve the tremolo with the plectrum and make the sustained sound which is essential to make a melody. I did teach myself to play simple tunes but without a teacher and proper lessons it was difficult to progress. At school I had the chance to learn another instrument and was offered a clarinet. This grumpy instrument only made a musical note if it was in a good mood. I had lots of trouble with the reed and it took me several sessions before I could get a reliable

musical sound. I got impatient and stopped the lessons. My piano was so much easier to play.

Developing my interest in music was an important part of my time in the Sixth Form, although I still never sang. Every year the school performed a musical, often Gilbert and Sullivan. I remember staying at school late to watch the dress rehearsal for the Pirates of Penzance, and take photographs. It was much more my style of music. The key roles were sung by teachers and sixth formers. My mathematics teacher, Mr Blakeley, was one of the policemen. It was all great fun and I still have the little black and white photos. I went on to join the D'Oyly Carte Opera Trust and paid to see their professional productions whenever I could. The nearest theatre was in Birmingham, and they also came to The Playhouse Theatre in Oxford. It was at the time when their copyrights were going out of date and the income from publishing the score for use by schools and other music groups was reducing.

In the Sixth Form there were lots of extra things to do. On sports, we were able to learn to play golf. This resulted in my father buying a second-hand set of golf clubs from an auction, but they were more suitable for a chap of his height than me. The putters were useful but the old fashioned woods were not. We cleaned and painted them anyway but they were not used, and many years later I inherited them and gave them away to a charity shop. Our back garden lawn developed a series of small round holes and was converted into a putting green. This was good fun and we bought a pair of smaller putters, ladies size, so we could play foursomes when we had friends visit. The ground was not level and it was difficult, but not impossible, to get a hole-in-one. Usually it was my father who managed this; he spent a lot of time practising at weekends and said that he knew each blade of grass. He also mowed the lawn and could take advantage of the lines of stripes.

After having the veranda built when I was a toddler, the next project had been to build a large garage on the side of the house, separated by a corridor which was used for hanging out the washing. Behind the garage there was a small workshop room and a coal bunker. The garage was built of double bricks so that an extra bedroom could be built above it. My parents were still expecting that I would settle in Burntwood, and planned to build a separate large studio bedroom for me.

My father was a good all-round sportsman, and he had trophies for tennis and table tennis, won at the BRD Company. From the beginning I had been encouraged to play tennis at school, and spent hours in the front garden at home hitting a ball against the door of the garage. By the Sixth form I had managed to just get into the school team although I was not particularly good. Even if I did not play very well, I knew that it was important to look competent. My first tennis racquet was replaced by the top model – a Dunlop MaxPly with real gut strings, and I wore a nice Fred Perry tennis dress. On Saturdays the school played in a local league and I was often asked to take part, as a reserve. Even if I didn't play very well, I was dressed to look good.

I never much liked any of the other team sports which were played outside. I started to play table tennis with the advantage for me that it was an indoor game, although I did not have a table for practice at home. We did have a small snooker table and my father and I used to play often.

It was assumed that we would need to be able to dance when we got to University and ballroom dancing classes were timetabled one afternoon each week. We all had a good

laugh trying to copy the dancing steps by the teacher. We only managed to do the waltz and the quickstep. I remember going to my first grown up Ball at school; I think it was at Christmas. My mother made my first long dress and a beautiful black velvet long cape. Auntie May, who still worked in her hairdressing salon, put my hair on top. I looked quite grown up. I still have the dress and cape in my wardrobe.

Another skill needed at University was to be able to take lecture notes and we all had the chance of learning shorthand and typing at the local Technical College. It was not true shorthand but was Speedwriting. The idea was that words were written, but without the unnecessary letters. I tried to learn proper Pitman shorthand later on my own, but was not dedicated enough. I found typing easy to learn, probably because I already had the dexterity skills through playing the piano, and my father had a typewriter at home which I could use.

By now I played the piano well and although I still did not have any flair for singing or other instruments I was able to go on from the piano and learn to play the organ. Lessons were provided at school and they had a nice large new organ with a full radiating pedal board and two manuals. Although I had never done any exams, I was told that my practical piano ability was at about Grade 5 which equalled O-level standard. Often I practised in the school Main Hall during the lunch break and no-one seemed to mind the odd mistake or gentle cursing when I got something wrong.

Once I began to learn to play the organ I was expected to play for services at Christ Church Burntwood when the regular organist was away. This was just a matter of getting to the church early on Sunday and playing the music. The vicar told me which psalms and hymns were going to be sung and I just practiced them in advance. I don't sing, and thankfully I was not expected to run the weekly choir practices. Once I started playing the organ my father sometimes came and sang in the choir. The church is located in a quiet part of the village, not far from the old St Matthew's Mental Hospital, and I know my parents were worried in case any patients came to listen to my practising while I was on my own. Occasionally I was asked to play for weddings or funerals, which supplemented my pocket money. This was not often because the permanent organist, Mr Roster, was retired and tried to do them all himself to augment his pension.

## 9 Foreign Students stay with us

At home I helped my mother so she could continue with her sewing work. By now the tenants had left our house next door, moving to an old folks' bungalow. There was now the question of what to do with the house. One option was to sell the house, but the two houses together made a nice detached property. This was what was done and the two halves were joined together, by opening up doorways in the walls upstairs and downstairs. My mother suddenly became very busy with a range of lodgers, often cooking breakfasts and evening meals. All this was a lot of work at all hours of day and night just to make enough to pay the mortgage.

Thinking of ways to earn more money to upkeep the enlarged house, my mother saw an advertisement for families with school-age children to take paying foreign children during the summer. The foreign children live as part of the family and are expected to learn English. In addition they have organised trips and language classes. The first of these was a nice girl Sabine, and we enjoyed her company very much. When she first arrived she did not speak very much English, and my mother spoke no French. So we took her into the pantry and pointed at different food, saying 'You like?' The first lesson for her was to remember the English names of everything. With the help of a dictionary we were soon able to communicate, and once she had become accustomed to listening to us we found that she had a good vocabulary. She was part of the family and we were sorry when the time came for her to go home. Then we were allocated another girl, Beatrice. I especially remember difficulties with Beatrice because although she was younger than me she was a much older looking girl, emphasising her rounded figure by wearing very short skirts and low-cut frocks. She quickly had a fleet of local admirers, who had to be controlled. My mother gave strict instructions to my father to stop looking at her, and equally strict instructions to Beatrice that she wanted a certain standard of behaviour from her.

The next year there followed a delightful polite young man, Didier. He carried my shopping when I went out, and caused a real stir in the neighbourhood. He was a very striking young man, and the neighbours are reported as saying 'Mrs Ward will kill her daughter if she catches him with her.' They did not realise that he was actually a guest of the family, and from France. Didier enjoyed his visit, which was organised through the same organisation as the earlier girls. On his return his mother wrote and asked if we would be prepared to take his younger brother the following year, but for direct payment instead of through the organisation. We agreed, and the following year his more lively younger brother Stephane arrived.

The final student was an Italian girl, Grazielle, who kept in contact with us all for many years until she married. One year she sent us an Italian Panetone cake as a Christmas present. Unfortunately it got squashed in the postal system, but the crumbs were very tasty. She was much younger than I, and was still at school when I was already at University. Many years later Pete and I visited her in Chiavari when we were driving through Italy on a touring holiday after we were married. At that time she and her twin sister were both working in a Hotel there. Her sister was going out with the son of the owner of the Hotel. A room was found for us at the Hotel for a few days, and we were invited into the mountains to have dinner with their parents. Fortunately Graziella drove; it was not an easy road. Graziella's mother, who was dressed in the sombre black clothes of a traditional married Italian woman, said that she did not go down into Chiavari town, and rarely went as far as the nearest village.

They had a nice house with enough garden to grow all their own vegetables, and they collected wood from the other side of the valley for fuel, crossing by flying fox. They made their own wine, and distilled some of it to make grappa. Although they were isolated, there was a fridge and a television, run from a generator. We spoke very little Italian, and they spoke no English, so Graziella had to act as translator. We all had an excellent meal, everything was homemade, and then Pete was invited to have some of their homemade cheese. We asked what sort, and the closest translation was 'jumping cheese'. It looked like an old gouda when it came out of the fridge. Then we saw something move, and a little wiggling object leapt out of the cheese. It was a special delicacy and Graziella's father picked it up and devoured it and the cheese with gusto. Pete decided to give it a miss, and everyone had a good laugh. They did not expect him to have any. The following year Graziella wrote to say that she had found a boyfriend and hoped to marry shortly, and then she sent us a little wooden toy train. She had left the Hotel and was working in a toy shop and they were making wooden toys.

## 10 Will it be Oxford or Cambridge ?

My A-level studies kept me very busy for the two years, doing Mathematics, Physics, Chemistry and General Studies, as well as the special Physics paper. I was also a Prefect and then became the Head Girl, and this kept me extra busy outside lesson time. When the exam results came out I was almost afraid to open the envelope, and I was so excited when I did get the four A-levels, each at top grade A. My parents were so proud of me and they rewarded me with a heavy gold cross and chain, which I have worn ever since. I only gained a 2 in the special Physics paper but that was reasonable since I was successful at Physics by reading widely and digesting and memorising everything I read. I had some intrinsic ability but the special papers were designed to challenge the brightest students. In Mathematics it was different and I had a real flair for using tools and solving problems. So it was that with my four A-levels already obtained in the summer, I continued in the third year in the Sixth Form so that I could sit the Oxford and Cambridge entrance exams in Mathematics in the autumn. I must have fancied my chances with languages because I also did an optional French paper for Oxford. I had to make choices for alternative Universities in case I failed the Entrance Examinations. I recall a number of offers. I think one was from Leicester University and another was from University College, London.

Then it was off with my mother on a 'Thomas Cook's tour' of the two towns so that I could see the pros and cons of the three ladies Colleges at Cambridge and the five ladies Colleges at Oxford. In the 1970s there were no mixed Colleges. This is in contrast to 2007 where there is just the one ladies College, St Hilda's College at Oxford, soon to become mixed, and all the other Oxford Colleges are mixed. In Cambridge there are still two ladies Colleges. My impressions were that Oxford was a more pleasant town than Cambridge, and of the Colleges at Oxford my first choice was St Hilda's College. This was mainly because of the situation and atmosphere of the various Colleges, not the academic ability of the tutors about which I had only limited knowledge. For my parents living in the Midlands it was also much easier to get to Oxford than it was to Cambridge.

Interviews soon followed. I took the train to Cambridge first. I was interviewed at Newnham and then told to go to New Hall for another series of interviews. I didn't like either place, neither the accommodation nor the tutors, and it must have showed. Having been educated at a modern Grammar School I had never met the sort of old ladies in tweeds and woollen stockings who inhabited Newnham. Obviously Newnham had rejected me at our first meeting, but then thought it was worth sending me to New Hall in case they had a spare place. I preferred New Hall where the tutors were younger and the atmosphere seemed friendlier. Applicants often went to visit several Colleges if their first choice could not take them, but they were thought to merit a place elsewhere. It was all good practice for me; I had never had interviews before. I was disappointed, but not surprised, when my application was rejected.

Then I went to Oxford for interview. St Hilda's College was my first choice College and Oxford was my first choice University, so I was very worried that I might not be accepted. I very much wanted to make a good impression. St Hilda's College had two mathematics tutors, Margaret Rayner and Irene Moore. They were called Miss Rayner and Miss Moore, although they both had doctorates. Miss Rayner was tutor in Applied Mathematics and was the more senior. I remember that Miss Moore was a surprise, she was a new tutor for Pure Mathematics and had just completed her PhD, so she

was only in her 20s. It was nice to meet academics who were not of the tweed jacket spinster mould which I had seen at Cambridge. I was asked polite questions about my school, my father's occupation, and why I wanted to come to St Hilda's College. There was also some digging into my competence in Mathematics. I was not sent to any other College for interview, compared with other young women who were sent off to St Anne's College for a second interview, so I was hopeful.

I went back home and waited with my fingers crossed. I can still see the short telegram which arrived with the news that I had been awarded a place. The post man had to make a special journey on his bicycle. We did not get many telegrams in Burntwood, and the news was soon all over the village. The neighbours all came to congratulate my parents, and it merited a short paragraph in the local newspaper. I knew that my success had been because of the inspiration from my teachers, and we invited the Mathematics teacher, Mr Blakeley, and the Physics teachers, Mr Stanley and Miss Dale, who had been so influential to have a celebratory meal with us at the George Hotel in Lichfield. It was our favourite local Hotel and is a charming converted 18th century Regency coaching inn, just a short walk from the famous cathedral. The Hotel had organised a private room for us, and I had my first sip of real Champagne.



## 11 More Studying in the Third Year Sixth Form

Successfully winning a place to read Mathematics at Oxford was unusual at my school. The school had an excellent Physics department, and usually sent one or two boys (not girls) each year to read Physics at Cambridge. Several of the science teachers had themselves graduated from Cambridge, which also helped. I was good at Mathematics but without the encouragement of good teachers that ability would have risked lying dormant. Indeed my Mathematics teacher, Mr Blakeley, freely admitted that his degree, which was from Wales, was not that good. Nevertheless he was able to encourage many of us to go beyond his own abilities. Unfortunately he moved on promotion to a school in Rugeley at the time I was grappling with Further Mathematics.

Modern young women would then have taken a gap trip around the world but I decided to stay at school and study for the Further Mathematics A-level. I had been told at interview that it was essential to get Further Mathematics before starting at Oxford, and anyway it enabled me to make some sort of a sense of the long reading list which arrived shortly after the telegram offering me a place. Since I was only just 17 years old, an extra year at school was no hardship. Classes were not very demanding and enabled me to spend one day each week at my old junior school, helping as a teacher's assistant. I helped with Science and Mathematics teaching and recorder classes. In the summer I got my A-grade in Further Mathematics by the skin of my teeth, with very little help from the poor lady who was allocated as my teacher. Although I didn't appreciate it much at the time, learning to work on my own would be an essential skill later.

In addition during the year I developed an interest in flame proofing materials. This was provoked by reading an article about different finishes and their response to washing. I arranged access to the Chemistry laboratories at school during lunch breaks and was able to design and build a testing rig and then try out what happened to different flame-resistant materials and the effect of washing. There were some recipes available for flame proofing at home, which I used and then compared with commercial flame proof material. I wrote to companies asking for samples and was pleased when they were sent. Some flame proofing processes are only valid from one wash to the next, whereas commercial ones can survive washing. I had a lot of fun experimenting and had a set up which enabled me to measure the effect of a standard flame, not only the colour and intensity of the burning but also the time it took for the material to be consumed.

At the time I did not realise that my careful approach to the experimentation was the basis of good research practice. It just seemed the common sense approach to trying to quantify what was happening. Teachers at school saw what I was doing and my Physics teacher had links with the Wulfrun Institute in Wolverhampton. I was invited to write up the work and present an evening lecture there. In those days we were not taught classes on interview techniques, or on preparation of lecture material. For me, it was simply a case of preparing very carefully and then trying hard to communicate my work to the audience. I used large sheets of paper, flip charts, to write out the key points. Of course, presenting lectures is a core skill for scientists and has been an important part of much of my career since.

When I did my O-levels I had only barely passed in English Language and English Literature, so I had absolutely no pretensions about being a writer or a poet. And I had

not then, being only seventeen years old, discovered that people can be empowered to do anything, if they only try. Before I went up to Oxford I was given the following poem as a leaving gift by one of the teachers. Perhaps he realised that writing was not one of my strengths and was hoping to encourage me to write. I don't know whether the poem was written for me, or copied by hand out from a book of poems. I never bothered to check and now he is not around to ask. Certainly there is no record of him, or his wife and three kids, when I searched the Internet. He would be 80 years old now, if he was still alive. It does manage to capture the essential something of the swinging 60s.

We have listened, we have listened all our adolescent years  
To the wisdom and the counsel you keep pouring down our ears  
You can talk a lot of guidance and about some kind of fight  
But you really want our mimicry, to prove that you are right

You have every right to criticise the garments that we wear  
And how much of our legs we show, and how we do our hair  
But every single one of you, with sense to see the truth  
Has gazed at us in envy at our golden glow of youth

As swift and soft as sunlight and as tireless as the tide  
You began on our lovely bodies but it's us that are inside  
And we rattle and we crackle with our laughter showing through  
So that everything around us must be new and new and new

So there you stand surrounded by the rubble of your dreams  
And everything that you have made is giving at the seams  
But the emptiness of failure cannot swallow the success  
Of the dolly at the disco in her swinging mini-dress

During my last year at school I also applied to join Mensa, the high IQ society. I did well on the 3 hour test at home, scoring 165, and was then invited to go to the University of Aston in Birmingham to sit the proper test under invigilation. My mother went with me. I was still too young to venture out into the rougher outskirts of Birmingham on my own. This time I scored 163 which was still very good and above the magic 155, and I was invited to join. I was very proud that they had recognised that I was extra bright. In the 1960s Mensa was still very small and I thought it would give me access to new friends when I got to Oxford. I suppose I expected all the other students to be Mensa members.

I had a lot of spare time and started to teach myself to draw in pencil and paint in oils, trying to copy pictures. I wish now that I had taken formal art classes at school in that final year. One pencil sketch of which I am proud was of the Mathematical Bridge at the Queen's College, Cambridge. My Chemistry teacher did his degree there, and showed me a postcard and the shape of the bridge fascinated me. I searched but I never found it when I went there on interview. I only saw the bridge much later when I organised a conference in Cambridge. It is said that the bridge was a design of Isaac Newton and had been originally assembled without any nails, and that after it was taken apart to find out how it was able to stand then it was impossible to put it back together. But none of that is true, the bridge having been built in 1749 long after the death of Newton. According to Queen's College, who should know because it joins two of their buildings, the Bridge was completely rebuilt in 1905, in teak instead of

the original oak. In this version of the Bridge, the joints were fastened by nuts and bolts passing right through the joint, the bolt heads being on the internal elevations of the side arches, and therefore visible to people passing over the Bridge. Previous versions of the Bridge had the joints fastened by coach screws driven in from the outer elevation, which were therefore not visible to the casual passer-by on the Bridge, as the screws did not penetrate as far as the inner elevation. Perhaps the sight of bolt heads where none had been seen before might have given rise to the myth of the failed re-assembly.

Once I reached the magic age of seventeen I was encouraged to learn to drive. My mother could not drive and so I started by taking the wheel of our car, under my father's instruction. This did not work very well and so it was agreed that I could have proper driving lessons. The Humber had a gear change on the steering column, which was different to the floor change of the driving instructor's car, which added to my problems when I went out with my father. I was also short and could only just see over the steering wheel and reach the pedals on the Humber. Learning the Highway Code was easy, but I found it difficult to steer in reverse. I usually ended up far too far away from the kerb, as I still do even now. I did not pass my test on the first attempt, but on the second. Although I had been encouraged to pass my test, I was not allowed to have my own car. We could only afford to have the one car, and by the time I went to Oxford my father was ill and was looking forward to early retirement on health grounds. This also meant that he could not afford to replace the old Humber, until it became unreliable and had to be replaced by a little Vauxhall Viva. Anyway there was nowhere to park a car in Oxford and undergraduates were not supposed to keep one.

In advance of starting at St Hilda's College I had been sent a long and frightening book list, for reading during the summer before arriving at Oxford. I started my search at the only bookshop in Lichfield, which sold all sorts of wonderful books, mostly second-hand. They had nothing. Then my mother and I made a special trip by train to search for the books at the University Bookshop in Birmingham, but they were not on the reading list for their students and I was only able to find a few. Those which I did find and purchase were very difficult, and I was worried how I would manage when I started lectures. I never thought of going to Oxford and looking in the bookshops there. It was a special trip for me to go as far as Birmingham, and Oxford was a million miles further away.

Having been accustomed to wearing school uniform, I was now going to have to buy lots of new clothes. My mother had a cousin, Annie, who had married into a family in Wolverhampton which owned clothes shops and had market stalls. So we set off by bus to visit them and start to collect informal clothes suitable for a student. I gained my very first pair of blue jeans, as well as lots of lingerie. We got them all at 'cost price', and it was nice to meet their young family and see their house. Annie was an artist and had painted the whole bathroom wall with a colourful mural of mermaids and fishes. Lichfield had several nice dress shops and we waited until the summer sales and then completed my wardrobe. Trouser suits were fashionable and I had a very nice dark blue woollen combination, and eventually found a matching blue skirt in Oxford. My mother believed that it was best to pay extra for good quality clothes, which would last longer. She was able to shorten skirts and trousers for me, and soon I had a decent pile of new clothes. We bought a large metal trunk, second-hand, to pack everything in. The traditional way to send everything to Oxford was to fill a trunk, and send it as Luggage in Advance, by train.

For my summer holidays that year I went with my mother to Lido di Jesolo in Italy, staying at the Hotel Monaco on the seafront. My father stayed at home, explaining to us that he didn't want to go back to Italy having been there in the Second World War. Again this trip was with Clarksons. Their Court Line aircraft were painted in pastel shades, and the coaches to get to the airport from Birmingham were the same matching pastel colours. Pale blue, yellow, pink and apricot were the colours. I can't remember which airport was used, probably it was Luton by then. The hotel room was OK, but we were on the side so we didn't get the direct sea view. We looked with envy at the Hotel Cesare Augusta just further down the road. It was much more expensive, graded as 4\* instead of 3\*, and with its large outdoor swimming pool it looked very nice. If we sat on the beach then we had to sit only in the area reserved for our hotel. Meals were simple but satisfactory. There was a not much choice and every meal had ice cream for dessert, but we had never had Italian ice cream before, and adored all the different flavours. My mother developed an addiction to Tutti Frutti and we used to go out in the afternoon to buy scoops of it at the local ice cream stand. The sun was much hotter than back home. Yes, I know we should have known that, and I am sure that my father warned us before we went. With my darker colouring I managed well, but my mother caught her shoulders and went a pretty red colour and then peeled. It was all quite painful for her. A bottle of suntan lotion helped limit the damage.

Lido di Jesolo is close to Venice so we paid extra for an organised tour there. We wandered along the canals, got serenaded on a gondola, and sat in St Marks Square. We took a trip to the islands of Burano, Murano and Torcello. In Murano we watched the famous glass-blowing and got persuaded to buy some of the cheap 'seconds' for sale on the pavements. We also had an expensive day trip to Florence, a horrendous long hot drive in August. The temperature reached 33 degrees as recorded on the bus during the journey. We arrived so exhausted that we just sat in the cathedral, one of the few cool places in the town, then sat outside eating slices of watermelon. I wandered around the town with another lady while my mother rested.

## 12 Starting Three Years at Oxford

In October I was packed and ready to be taken to Oxford by my parents. St Hilda's College was the last of the women's Colleges to be founded in Oxford. It was set up in 1893, associated with Cheltenham Ladies' College. Situated on the eastern side of the town, beyond Magdalen Bridge, it looked more like a distinguished country house Hotel than a traditional college. When I arrived there were five distinct buildings housing students. The original house, Cowley House, was named Old Hall. It was there that many tutors had their rooms and it was in this building that I had been interviewed. There were a number of large rooms, overlooking the gardens and the River Cherwell just beyond. It also housed the large library. A much smaller building, Milham Ford, was close to the river and included the small chapel. The building was previously Milham Ford School, and the name had not been changed. At the end of Cowley Place stood South building, which had been built in 1877 as Cowley Grange. It was a fine building, with a large formal staircase. On the Ground Floor there were the kitchens and Dining Room, a small TV lounge, and various sitting rooms for the Principal and the Senior Common Room. As an undergraduate I belonged to the Junior Common Room. The first floor contained a mixture of nice large bed sitting rooms. Beyond South building had been built two modern undergraduate buildings. The first was the Wolfson Building, opened in 1964. It was simple brick rectangular building, with its identical undergraduate rooms opening off a long corridor. The University was expanding and that meant a lot of new building work was taking place.

I was lucky as a 'fresher' to have a room allocated in the brand new Garden Building. I suppose that older students did not expect the building to be completed on time and decided on the safer option of choosing existing rooms in other buildings which were finished. So the Garden Building was full of first year undergraduates. It was almost square, made of concrete and glass, and looked like a goldfish bowl. People walking past could look straight in to the rooms, in spite of the long net curtains. Designed by Peter and Alison Smithson, and only formally opened on 26 June 1971, the building would eventually win a prize for its architecture. It deserved it. I arrived and fortunately the building was finished, at least as far as I could tell. All the student rooms were on the outside of the building with full length windows and each had their own washbasin, with shower rooms and bathrooms in the centre. On each floor there was also a kitchen, but it was called a moab - from the Bible Psalm 108 'Moab is my washpot' rather than the autobiography of the same name by Stephen Fry. I understand that some girls living on the ground floor found that other students benefited from being able to climb through the large windows when getting back into the building late at night. It was thoughtful of the architects to think of that possibility.

Before arriving in Oxford an older student was allocated to me, to give advice and help and answer any questions. Her name was Stella and she was also a mathematician, and one year ahead. In addition, by coincidence I had made contact with another new St Hilda's College Mathematics undergraduate, Janet, who was a family friend of my godparents. In turn, she had made contact with Steve who was one year older and studying Physics at Jesus College. So once we had unpacked, Janet and I set off together down the High Street for afternoon tea with him. We found a room full of his friends, each keen to meet us. For me it was an important meeting because one of the men at the tea party on that first day was Pete, who four years later became my husband. He had just completed his undergraduate degree in Physics and was just starting research towards a Doctor of Philosophy (DPhil) in Atmospheric

Physics. I met Miles, also studying Physics at Jesus College, whose brother had been an undergraduate with Pete. Having met several men from Jesus, they had other friends at other colleges, and Janet and I soon found friends of our own. So it soon extended into quite a large mixed group.

The first ceremony for a new undergraduate is Matriculation. I had been told to arrive with sub-fusc clothing, namely a white blouse, black skirt, black tie or ribbon, and black stockings and shoes. My mother had made the white blouse in a Viyella wool and cotton blend material, because she worried that it would be cold in October. In Oxford I had to purchase a gown for my tutorials - in my first year it was a short commoner's gown. It was made of black material but with the style of a turned-over collar. It had no sleeves, but had a streamer on each side with square pleating and hanging to the full length of the gown, which covered a normal jacket. And there was a compulsory soft felt cap to wear too. All the new undergraduates had to be dressed in this uniform and then we were all shepherded down the High in a long crocodile to be received into the University at the Sheldonian Theatre. It is still the same ceremony today although ladies now have the option of wearing a square cap like the men instead of the soft cap. Lectures at the Mathematical Institute in St Giles' did not require me to wear my gown, but individual tutorials, with either Miss Rayner or Miss Moore at St Hilda's College did. Each week there was a formal dinner in College, I think it was on the Wednesday evening, and then it was a requirement that gowns were worn. Many students chose to eat at the earlier informal dinner instead. The food was the same and self-service meals were much quicker.

The next interesting task was to decide which of the hundreds of University Societies and Clubs looked fun to join. The Freshers' Fair in the Examination Schools is the traditional place where these options are laid out and new members are captured. As a mathematician it was inevitable that I should join their society, the Invariant Society, which met each Monday evening in the basement of the Mathematical Institute. Thirty five years later I still see the same maths jokes but now they are on the Internet - some things never change. The current laugh on the Internet is the quote from Paul Erdos, a very famous mathematician 'A mathematician is a device for turning coffee into theorems.' I certainly learned to drink coffee at Oxford.

Outside the University I hoped to have time to attend Mensa meetings. I had never attended any meetings at home in the Midlands. I did not have transport and there were no meetings in my local area. I think my parent would have worried at the idea of me going off on my own to pubs or, even worse, strangers' houses, to play games and talk. There were regular weekly Mensa meetings, I think in a room in Keble College, which I attended for a time.

I looked around for a pleasant church and found St Mary Magdalen, an Anglo-Catholic church in the centre of town where I was allowed to play their excellent and expensive new organ between services. It was, and still is, a peaceful refuge in the centre of Oxford, with the persistent gentle whiff of incense. High Mass on Sundays was at 10.30 and was very traditional; it was sung and in Latin. The service finished just in time to walk back along the High to St Hilda's for Sunday Lunch. This meal was one of the College's better culinary efforts. Except for formal hall once each week, meals were cafeteria style, and Sunday lunch was always a traditional roast followed by apple pie and custard. We usually had friends from other Colleges invite themselves for lunch, and we were pleased to have a meal in their College in exchange. Our meal tickets could be used for visitors so that missing one meal during

the week gave a spare ticket to entertain a visitor on Sunday. At the end of term spare tickets had no value, so there was an incentive to use them all, or trade them with friends.

I needed to buy mugs and a supply of instant coffee for the various visitors who turned up on my doorstep. The other important item for entertaining visitors was to buy a large tin box of fancy biscuits, and then keep it topped up. I recall one special visitor liked lemon puffs, another liked custard creams and I would eat anything with chocolate. I soon developed a dislike of milk or powdered milk but needed the caffeine hit to keep awake while burning the midnight oil to get work done on time. I also liked to work while listening to music and my new little transistor radio gobbled its way through batteries.

The academic term is only eight weeks long and it is very intensive. The first term, which begins in October, is called Michaelmas, for fairly obvious reasons. The next, from January to March, is Hilary and this is followed in the summer by Trinity. Each morning my lady scout would Hoover and clean my room, while I made the long journey on foot from St Hilda's College in Cowley Place to the Mathematical Institute at the top of St Giles. I did not have a bicycle. Of all the five women's Colleges, St Hilda's College is the furthest from the science area. There were lectures every morning, including Saturdays. St Hilda's mathematicians were expected to attend lectures, and each week there were a number of questions, often based on old exam questions, set for us to work through. Our solutions had to be handed in to be marked. In my year there were six mathematicians, one of whom, Mirrlees, arrived as a scholar. Oxford undergraduates come in three varieties. Scholars are those who have been awarded a scholarship, and are usually very bright or special in some way. Then there are those who have been awarded exhibitions. Finally all the rest, the majority, are commoners. With six mathematicians, to have five commoners and one scholar is typical.

Tutorials with Miss Rayner or Miss Moore were a fearsome intellectual experience, taken in pairs, where the work of the preceding week was taken apart and new challenges were attacked. Later when I became a lecturer myself I appreciated the value of using previous exam questions as tutorial material. They had the advantage that the exam solutions were usually available to tutors too.

I had to work very hard to cope with the first term of undergraduate work. It was all like a foreign language compared with mathematics at school, even though I had studied and passed the necessary Further Mathematics A-level. Instead of being the brightest at my school I was now struggling to grasp even the most ordinary theorems. So was everyone else I talked to, except for a few scholars who had been better prepared for Oxford by their school. I spent the entire Christmas vacation with my head stuck in piles of mathematics books with obscure and abstract formulae, and was hit with a Collection as soon as I got back to St Hilda's College after Christmas. This is a nasty little exam to check that you have done and understood the reading set for the vacation.

Later in Hilary Term was the celebration of the first day of May. The day began early. Or I suppose for some people it might be the end of a long night before. In either case, just after sunrise the celebrations began with the choirboys of nearby Magdalen College singing from the top of Magdalen Tower. The whole of Magdalen Bridge was filled with people, and from then the celebrations begin in earnest. In spite of the

temperature, many students end up soaked in the River Cherwell, having jumped off the bridge. The day continued with Morris dancing in the town centre and the pubs were all open. St Hilda's College thoughtfully provided the option of a packed breakfast, booked the previous day, with sandwiches and a boiled egg and a piece of fruit. Having got up so early it was going to be a long time to wait for lunch. It was not a special day for academic study and I think lectures continued as normal, although there were less students. Neither of the May Bank Holidays were holidays from lectures.

The summer term, or Trinity term, was going to be a mixture. On the one hand there were all the joys of my first summer in Oxford, with punting, tennis, and croquet. St Hilda's College owned a number of punts which were kept at the punting station at Magdalen Bridge. Jesus College also had punts, but they were kept elsewhere. There were three punting stations: at Magdalen Bridge, Folly Bridge and the Cherwell Boathouse. Punts were available for booking throughout the day, and until dusk in the evenings. St Hilda's College had a formal booking system and we had to sign up in a book for a slot. In the beginning we took out two punts together, packed a picnic, and found older friends who would teach us to punt. In spite of not being a good swimmer I never thought of wearing a life jacket and I never saw anyone else wearing one. If I had fallen in then my friends would have jumped in to help me. The River Cherwell, which went through Magdalen Bridge, was gentle. It did not look at all dangerous.

The mistake which beginners make when punting is if they deviate from the narrow gravel path on the river bed they can get the punt pole stuck in the mud. Then it is important to let go of the pole, and paddle back to collect it. If you hold on to the pole and the punt continues to move away then there is eventually a splash. Unfortunately many people forget in the excitement of the moment. Initially I learned to use the pole for steering; it can be left in the water and used as a rudder. With practice the pole is dropped vertically alongside the punt and then pushing the pole defines the direction of motion. The next stage of learning is to use alternating ends of the pole in a cartwheel motion, but then there is no chance to make corrections by using the pole as a rudder. It is a popular means of propulsion when racing, but not suitable for genteel outings. I made myself a long cotton gingham skirt for the summer which looked nice reclining elegantly in a punt. Not far from Magdalen Bridge there were rollers where we used to pull the punts up to the next level, and then it was a pleasant trip upstream until we found a suitable picnic spot. We had one friend who even after many years could never steer in a straight line and just hit one bank and then the other one; we named his style Kirkian motion. Unfortunately he could not swim and many years later he drowned in the River Cherwell while punting. We were more careful if we went from Magdalen Bridge in the other direction, past the gardens of St Hilda's College and down to the River Thames. Everyone treated the River Thames with respect; there were a lot of large boats as well as the Salter Bros Steamers, and the River Thames was much deeper than the River Cherwell.

St Hilda's College had one hard tennis court. When the Garden Building had been built there was space left in front for a croquet lawn and a grass tennis court in the summer. I had never played tennis on grass, although it was the normal surface for competitions like Wimbledon. I played a lot of tennis at school but I lacked the determination and dedication which makes a good competition player. So although I could give my friends a reasonable game, I was never sharp enough to get into the Oxford Ladies team and gain the coveted Blue in the matches against Cambridge. I lost concentration too easily, especially if I was not winning. In the evenings we



played table tennis and I did try to concentrate harder, but again I missed the 'half Blue' whereas one of my friends, Pam, was a much better player and did get into the team.

Every Oxford College has a beautiful garden, and some Colleges have large manicured lawns. In the summer every week brings new opportunities to attend Open Air Theatre performances and concerts. St Hilda's College had a meadow by the river and was one of many Colleges with enough space to host dramatic productions. One of the best gardens is at Trinity College, and listening to Shakespeare in the evening here is magical, sipping a glass of white wine or a Pimms cocktail in the interval. I had come a long way since leaving Burntwood in October and was entranced by Oxford in the summer.

Unfortunately throughout Trinity term there was the distant shadow of exams. In Mathematics these were the First Public Examination, Honour Moderations, which were popularly called Mods and were held at the end of the term. They were fierce and important exams. The results were classified just like a degree, and were published. I continued to work very hard, and thought I had done reasonably well. I had no doubts that I would get a pass. I only needed to get graded as Second Class, which was the typical grade for women reading Mathematics. Honour Moderations in Mathematics were five consecutive exams, each three hours long. Mine started on the Tuesday morning, 22 June and ended at lunchtime on Thursday 24 June.

After the exams I went back to my room at College and drank some Champagne to celebrate. The next day I packed and went home and waited for the results. Pete was based full-time in Oxford doing his research and found time to go to see the list of results when they were published. I was very excited when he rang to say that I had been awarded First Class in Moderations. I have a latent competitive streak and this was a pleasant surprise to me. I had a nice letter from Miss Rayner congratulating me. She said that I had done well, except for one paper, and was at the lower end of the Firsts. Of the six of us there were two Firsts and four Seconds. It was a good year.

Afterwards I discovered that my results meant that I would automatically receive a scholarship from St Hilda's College. This meant a small extra amount of money to spend on books and biscuits, and I went shopping for the distinctive scholar's gown. It is made from black cotton material in full style with a gathered stiffened yoke behind and short open sleeves. The scholar's gown reaches to the wearer's knees, and is much longer than the commoner's gown. The scholarship gave me the confidence that I was in the top 20 mathematicians of my year, and I realised that I might be able to go on and get a First Class Honours degree, something which I and my parents had not dreamed possible twelve months earlier. They had said they would be happy if I got a nice solid Second Class pass. Most teachers at my school only had Second or Third Class degrees. Being a scholar also meant I was higher in the list for choosing my room in College, although that was only a real benefit in my third year. Rooms for the second year had already been allocated.

Even in the summer vacation we were not allowed to sit about doing nothing. I did not go out to work and get a 'proper' job but spent the time at home, helping my mother with her business, packing her sewing and helping with the Bed and Breakfast business. She often had 5 people staying in the other side of the house. I was lucky to be at home, instead of working in a shop or stacking shelves in a supermarket. On the academic side, Miss Moore had told us to carry out a project of our choice, and I

completed a paper on the Mathematics of Campanology – Bell Ringing. I found the underlying mathematics very interesting and it made a nice change to study something which was not directly linked to the endless pushing towards success at Finals. The original paper on Campanological Groups was written by T J Fletcher in the American Mathematics Monthly Vol 63 (1956) pages 619 - 626. It is still topical now, being referenced by recent lectures on the Internet. I suppose that is one of the benefits of studying classical mathematics rather than modern subjects like computing and business studies. Mathematics does not go out of date or out of fashion.

## 13 Enjoying the Second Year

In the second year I had the benefit of knowing what I was doing, and what was on offer. I settled in happily to my room in the Garden Building again. Living in an Oxford College is an extraordinary experience that no-one can comprehend without having lived through it. It was good to be back and to catch up on all the news with my friends. There were societies to join, meetings to attend, eating and drinking in Oxford in the evenings and a rich and varied selection of concerts of all shapes and sizes.

My mathematics studies became more specialised and I chose Logic, Partial Differential Equations, Applied Analysis, Optimisation Theory, Lebesgue Integration, and Mechanics, as well as Combinatorial Theory and Numerical Analysis. This was a standard number of new subjects for someone working towards First Class Honours. Weaker students would follow a narrower selection. It also showed a clear move away from Pure Mathematics and towards Applied Mathematics. Yes there was a lot of academic work, but at the end of this year there were no exams. Repeat. No exams. It is different now.

I found I had a special aptitude for the Optimisation Theory, Combinatorial Theory and Numerical Analysis. By coincidence, none of these were taught at St Hilda's College because neither Irene Moore nor Margaret Rayner had relevant research experience. In the first year we had always had lectures from a range of different mathematicians, each an expert in their particular subject, but now we also had tutorials from other people for the first time. I worked hard, with varying levels of success. My choice of specialist subjects meant that I diverged from my friends at St Hilda's College although we still had tutorials together on other subjects. We spoke about the difficulty of the various options and compared the different tutors. I wondered whether I would be as successful in Finals as I had been in Mods.

At school I was never very good at English Literature, and it was only at Oxford that I began to be interested in modern poetry. It started with the publication in 1970 of a book of Selected Poems by Mary Wilson, the wife of the Prime Minister Harold Wilson. Their son, Dr Robin Wilson, was a research fellow in Mathematics at Jesus College, who specialised in Graph Theory. From 1970 to 1974 the country was between the two Wilson governments, and at the same time I was studying Combinatorial Analysis. It is understood that every College cannot tutor everything, especially when it got to second year and third year specialisations. So it was that I was one of many who were sent out to Dr Robin Wilson for tutorials. When Mary Wilson's slim volume of poetry was published I recognised in her poem about Oxford, some of my own feelings: the three short years as an undergraduate were passing all too quickly.

The other influence on both Pete and I was Rod McKuen. For many years we purchased each and every book of poetry which he wrote and read the poems together. And in addition we have much of his music on vinyl or tape. After many years in retirement he is now back giving concerts and transferring the most popular of the old records and cassettes onto CD. We are collecting his music again.

I still attended the church of St Mary Magdalen for Mass on Sunday and my bookshelf of religious books steadily increased. When my parents visited Oxford they

came to Mass with me, although I am not sure that they really enjoyed the incense and Latin. Sometimes we went to worship at the cathedral, in Christ Church College instead. In 1972 I wanted to go to Rome for Easter and fortunately my mother was interested in going there too. We booked a package tour together and stayed in a dark nasty little Hotel, where the reception desk was up on the first floor. It was only 2\* and cheap, but it was central. We stood in St Marks Square with thousands of other visitors, listening to Pope Paul VI. He was just visible, a small speck in the distance, but we had seen him in the life. Then we did the other tourist sights: the Statue of Victor Emmanuelle and the Coliseum, as well as spending a day in the Vatican. I came away with a rosary and a small model of the famous Pieta statue, and the start of a conversion to Roman Catholicism. Of my friends at Oxford, Janet and Miles were both Roman Catholics.

The summer finally came and with it I could really enjoy the strawberries, cream and Champagne. We tried to book the St Hilda's College punts in the evening whenever we could. It was allowed to use them until dusk and in May that could be quite late in the evening. One popular place to take the punts was to the 'Vicky Arms', a waterside pub on the River Cherwell which did food as well as drinks. By now I was proficient at punting, and even managed to perfect the cartwheel style where instead of dropping the pointed end of the pole into the water each time it was more efficient to pivot it and pole with alternate ends. This meant that both ends of the punt pole got equally wet and muddy, and the punter and the people reclining in the punt often got damp too. But we didn't mind, and it meant we were faster and could overtake other punts that used the traditional punting style. One weekend my parents came to visit and Pete and I managed to persuade them, and my Auntie May and Auntie Doris who came too, to take a short trip in two of the St Hilda's College punts. I still could not really swim, and thankfully I learned the skills of poling the punt without too many incidents. I never fell in, and I think that was because I tried to be reasonably sober.

The end of my second year also coincided with the end of the third year for many of my friends. We all had a good summer together, sprinkled with the need for them to do revision for their Finals. I left at the end of Trinity term whereas they stayed to do their exams and then celebrate the end of Finals. There was no proper GoodBye because we had agreed that we would all be keeping in touch.

The long summer vacation was shorter for me because I returned to Oxford early. I had decided that I would be specialising in computing and numerical analysis, so I needed to learn how to programme computers. The Programming Research Group at Oxford offered courses to students in the computer language Algol60 and I was able to join their three week Summer Vacation course. The idea was to give experience of the paraphernalia which surround actually running a programme on a computer. So the typical tasks were to produce a table of a number, its square and its cube, or print the first 30 members of the Fibonacci series, which introduced the concept of a for-loop. Another example involved using recursion to calculate a factorial. This is a series whereby one factorial, written  $1!$  has the value 1, two factorial written as  $2!$  has the value 2 multiplied by  $1!$ . The series continues, with each factorial calculated from the previous one, so that for example five factorial written as  $5!$  is 5 multiplied by  $4!$ . A good programmer will use a neat formula to compute this. Another challenge was the Tower of Hanoi puzzle, which was invented by the French mathematician Edouard Lucas in 1883. We were given a tower of four disks, initially stacked in increasing size on one of three pegs. The objective is to transfer the entire tower to one of the other pegs, moving only one disk at a time and never a larger one onto a smaller. It is

a classic computer science challenge for students and its solution touches on important topics: recursive functions and stacks, and recurrence relations. It was all good stuff. I admit that I found it very difficult initially, but then I was never going to become a really sharp programmer. I wanted to learn about programming computers only as a tool for solving problems.

Unfortunately I was unable to stay in my nice room at St Hilda's College in the Garden Building during the summer vacation because the rooms were used for conferences. I was pushed out into one of the College houses down the Iffley Road for three weeks. The room was older, and I discovered the delights of cooking for myself. I was limited by only owning a small frying pan and one saucepan. I still did well and my favourite meal was a fried pork chop followed by a boiled tinned syrup sponge. There was always the choice of pubs in Oxford for evenings when I didn't want to cook. I was now a brisk ten minutes walk further from Magdalen Bridge, and it took too long to walk to the Programming Research Laboratory. With some trepidation I finally bought a second-hand bicycle.

## 14 Finals Looming, and Plans for the Future

When Mary Wilson had written her poem about life as an Oxford undergraduate she saw images of a poor student cramming - Finals loom over all. It must have been the same for her son, Robin, when he was an undergraduate. The third year is very important, but it is lived in the present, and the inevitable exams are not part of daily concerns, at least not at the start of the year. In Mathematics, cramming does not help because the exams need the application of mathematics, not the re-digestion of facts from books.

For my third year I moved into a nice large corner room in the Garden Building. Each floor of the building has four corners, and each corner room is larger than the standard rooms, which should be no surprise. Some of the corners were occupied by tutors but there were a few available for students. It was the rule that everyone in their third year at St Hilda's was able to live in College, if they wished. On the basis of priorities, as a scholar I was able to get room 110, a corner room on the first floor. My grant from Staffordshire County Council for the academic year 1972/73 was just £416, and my parents had to contribute £64, making a total of £480. This was the total amount I had to live on for the year, and was paid in termly instalments. In 2007 it is less than my monthly bill from the supermarkets. The cost of accommodation, called College Battles, were deducted and paid automatically, leaving me with a small amount for extras and consumables.

Pete had a car and on fine Sunday afternoons we liked to drive out to Blenheim Palace, walk around the grounds and then have a cream tea at the shop by the Main Gate. We always persuaded them to give us filter coffee instead of the traditional pot of tea. We discovered from relatives who lived in Woodstock that there were public footpaths through the grounds, and that saved on paying the entrance fee to the Park. Sometimes we drove over to the back entrance at the Bladon Gate, although usually we entered from the public footpath on the northern edge of Woodstock. A spectacular feature of the grounds is the Grand Bridge, built by the mason Bartholomew Peisley, under Vanbrugh's direction. The main arch was keyed in 1710, and is 101 feet (almost 31 metres) wide. The public footpath goes to the bridge, but not across it. It is a beautiful bridge, especially in the autumn when the trees around turn a golden bronze. With the right light conditions it is spectacular. I did a colour pencil sketch of the bridge which I gave to Pete as part of his Christmas present.

Pete came from the city of Bath, which is only a short drive from Oxford. One weekend I was taken to visit the city and have lunch with his parents. They lived in a Georgian house, on four floors, with a view across the valley of the River Avon near Kelston. Their house was half of a large house, with high ceilings and large rooms. The dining room had the superb views and the sitting room was large with a snooker table in the centre. There were only three bedrooms, but the visitor bedroom was on top of the sitting room and was so large that there was space for three single beds, and still spare space to walk around. I also met Pete's sister Pat and her husband John who were living in Bristol with their four children. Bath is a beautiful city, and I preferred it to Lichfield because the streets are wider, the shopping area is much better, and the scenery, especially the River Avon and Poulteney weir is so beautiful. However, Lichfield cathedral is much more spectacular than Bath Abbey.

Some of our friends had been awarded their degrees and left Oxford and were working. A few were doing an extra year of teacher training, starting research, or had an extra year at Oxford because their studies were for four years instead of the normal three years. Miles had moved back to Yorkshire and was sharing a flat with his friend Mike, in Mirfield. We all still kept in touch, and there were annual parties at their flat in Yorkshire at New Years Eve and walking holidays over Easter. We sent a postcard to Miles and Mike, addressed to 'The Flat above the Bacon Factory. The one with all the empty bottles outside. Mirfield'. It arrived three days later, which made us all smile. The postman had obviously noticed their rubbish bins.

In those early years I never joined the traditional Easter walking holidays, which involved a lot of walking in beautiful parts of the country, staying in Youth Hostels. The idea of walking was not a problem, although I had difficulties with my old weakness in my back carrying a heavy rucksack, but I did not fancy the dormitory accommodation. I liked a bedroom to myself. Over thirty five years later there are still Easter walking holidays, although they are now based on expensive self-catering cottages with en-suite double rooms and there is less walking and more eating and drinking. We enjoy them and go whenever we can. For me the friends made at Oxford are so important, and we are always ready to help each other. If I do not see someone for several years when we get together it is as if we had last met just a few days previously. That is the strength of the bond from being friends at Oxford. Last year we went to visit a friend who we had not seen for over thirty years, now a teacher in New Zealand. He had not changed, although it took longer to catch up with all the news and we needed help from him to tow us up a muddy hill from his farm at the end of our visit.

As my final year at Oxford progressed it became clear that I should be able to win a place for continuing to do research, and my specialist areas were Combinatorial Theory and Numerical Analysis. I was good at both. On the one hand I very much enjoyed combinatorial theory, and graph theory in particular. My favourite tutor was still Dr Robin Wilson, the son of Harold Wilson, who was a bright and colourful chap exuding enthusiasm for his branch of mathematics. He often appeared in a multi-coloured striped hand knitted jumper, which matched his research work on the famous Four Colour Theorem.

It was said that the best University for research in Graph Theory was not Oxford but was the University of Waterloo in Ontario, Canada. Professor Tutte, in the Department of Combinatorics and Optimization Theory there, was the acknowledged expert and his Graph Theory group was the best in the world. Getting accepted at such a remote place depended on being recommended from Oxford, and that was not difficult. But where would I find the money and how would I deal with moving to a strange country? Money was the first problem. One option was to compete for a Teaching Fellowship, but this meant that I would have to work at the same time as trying to complete my research. So I applied for a Commonwealth Scholarship from the Association for Commonwealth Universities, and was called to London for the interview panel just before Christmas. The interviews were held in a prestigious building in Russell Square. It was a difficult interview, not because of the challenging questions, but I had never before been confronted by such a large Panel of people, most of whom just watched the interview and asked no questions. I suppose I knew more than they did about my subject, and I had excellent references from Oxford, so in March I was offered a scholarship. This was for one year, and for the degree of Master of Mathematics (MMath). Assuming I finished in one year then I would be

able to ask to extend the duration of the scholarship and continue with the degree of Doctor of Philosophy (PhD). There were strict conditions on my travel and I would be required to go back to the UK at the end of the scholarship. It was not a side door through which students might obtain residence in Canada.

It seemed at the time that there were two difficulties for me. The first was whether I would thrive being overseas for the time. Canada is such a long way from Oxford and family and friends, especially Pete of whom I had become very fond. Would I go alone or would he come with me? And the second was a concern about the benefit of having a qualification in Graph Theory, although it was an exciting and fun subject. There seemed to be few opportunities to continue research back in the UK in that subject and at the same level. Eventually I decided against going forward for the PhD at Waterloo, and thought of just doing the MMath and then coming back to Oxford to continue with the DPhil. I knew that I was not a prize winning academic and could not rely on getting a post-doctoral research fellowship back at Oxford, although I might be able to do so elsewhere. I managed to delay the decision until April, when Professor Tutte from Waterloo was visiting Oxford. I wanted to meet him; after all if I went to Canada I needed to be able to work with him. If I expected a spark when we met then I was disappointed. If anything our short meeting made me wonder whether it was such a good idea to go to Canada.

I already knew that I would be able to stay at Oxford and do a DPhil in Numerical Analysis at the Oxford University Computing Laboratory, provided I gained at least a good Second Class degree. I would be guaranteed a grant too, whereas I was not guaranteed a grant to do Combinatorial Theory at Oxford. The choice was therefore between Numerical Analysis at Oxford or Graph Theory in Canada. So I had two choices. In the end, taking the easy option and staying at Oxford won, and I rejected the scholarship to Canada in the May. Staying at Oxford would also mean that I could see more of Pete, who was in the final stages of completing his DPhil.

Final Examinations in Mathematics are always at the very end of the exam cycle, meaning the end of eighth week and the start of ninth week, and are taken in the Examination Schools. It is only a short stroll along The High from St Hilda's College. Many different examinations take place at the same time, so the first problem is to find the right room and be seated in front of the right exam paper. There were nine exam papers, each of three hours. The first three papers are general and every mathematician has to do them. Then the next three papers are more specialised, divided into the subjects which were chosen in the second year as an undergraduate. The final group of three papers are seriously challenging, and in my case were about Combinatorial Theory and Numerical Analysis – the specialist subjects in my third year. The main trick is to know where to find your specialist subjects in the mass of questions. Thankfully the different options are marked in bold text. Also the exam papers are open ended and you are allowed to answer as many questions as you can, given the time limit of three hours. There is no advantage from leaving the exam early as even attempting a few lines on another question may get a few extra and valuable marks. There is a lot of scope for students to dip into a large number of different topics, or to focus more deeply on completing a few difficult questions well. Those aiming for First Class Honours knew that they had to take the latter option. I wanted to do my very best in the exams, although my DPhil grant did not require a First Class degree.



The first exam was in the morning of Thursday 21 June and there were two papers each day for three consecutive days. Then Sunday was allowed as a day off, and to recover, before doing the final and more challenging set of three papers. I was lucky with my specialist papers and I still remember that one of the Combinatorial Theory questions set asked for a proof, but of something which was untrue. By instinct the question felt wrong, and I found a counterexample. So that would have given me a bonus towards getting my First, and also saved a lot of time because trying to complete the proof would have been frustrating.

By the end of the last exam, at lunchtime on the Tuesday, there was nothing left to do except drink Champagne with my friends to celebrate the end of the last exam. I was too excited to be tired. The following day I would be going with Pete to an Oxford Summer Commemoration Ball, in our case at Magdalen College, just next door to St Hilda's College. My mother had made a beautiful long ball gown for me especially for the occasion. Although tickets are expensive, the Summer Commemoration Balls, abbreviated to Commems, are a 'must do' after Finals. Magdalen College was the best and most expensive of those in my year. It is also a very beautiful College, with extensive grounds including a deer park and a picturesque walk along the banks of the River Cherwell. Only the largest Colleges could afford to have Commem Balls, and then it was not every year. There were also Summer Balls on the Friday at the end of eighth week, when undergraduate lectures have finished and early exams are over, and others wait until after the last exams have finished, during the ninth week. I never thought about the reason for the special naming of Commemoration Balls, but it is said to be because the Wednesday of ninth week sees the University's annual Encaenia or commemoration of benefactors. Balls were definitely formal, so men have to wear a dinner jacket and black bow tie else are not admitted at the entrance. The dress code for women is equally formal, and is typically a long evening gown. More recently formality has changed and the Magdalen Commem Ball in 2006 was white tie, but ladies could wear shorter gowns, although still very formal. Tickets are only sold as double tickets, were priced in guineas, and included supper and unlimited drinks. Most people drank Champagne, and this is real Champagne not fizzy white wine. Entertainment was varied and top class, ranging from the best bands from Top of the Tops, to classical string quartets. For example, the Rolling Stones played at the Magdalen Commem in 1964 and Pink Floyd played in 1967. I was having so much fun I can't remember who was playing in 1973, but there was something for everyone. Each couple was allocated a 'sitting out room' where coats could be left and where it was possible to just sit and relax between the frantic dancing. The Commem entertainment continued all night, and ended with breakfast for those who were still able to stand up at 6.00 the following morning. Pete and I had an excellent evening and at dawn the following morning, walking along the banks of the River Cherwell, he proposed marriage and I accepted. Instead of being Pauline Ward I was now looking forward to becoming Pauline Curtis.

The problem then was how we would deal with my parents. I was just under 21 and Pete had to ask their permission. Even if I had been older he would still have sought their permission. It was the normal thing to do. I finished packing and we drove up together to Burntwood. My father was initially against the engagement. No-one was good enough to marry his only daughter, and he viewed all men from Oxford as arrogant, toffy-nosed and from a different class. It was his prejudice and he hadn't noticed that I had changed too while at Oxford. I was destined to spend a further three years away doing research, and there was no chance that I was coming back to live at Burntwood. Perhaps they were worried that all my education would be wasted and

they had visions of my giving up and sitting at home surrounded by small screaming children. But that was not what either Pete or I had in mind, and after some discussions with my parents which sorted this out, we set off by train to Birmingham to go shopping for the engagement rings. We came back with a diamond solitaire for me and a signet ring for Pete. My parents were not at all happy, but they decided it was only an engagement and we had not set a date for the wedding, except that it would not be for at least twelve months. The assumption was that Pete would first finish his DPhil and I would complete my MSc.

## 15 Working at CERN, the Best Research Lab in the World

Having rejected the opportunity to go to Canada, I still was interested in travel overseas. During my final year as an undergraduate in 1973 I had seen an advert for Summer Vacation Students to work at the 'Conseil européen pour la Recherche nucléaire' (CERN), an international research establishment in Geneva. 'Scientific research lives and flourishes in an atmosphere of freedom - freedom to doubt, freedom to enquire and freedom to discover. These are the conditions under which this new laboratory has been established'; these were the words written in 1954 by Sir Ben Lockspeiser, first President of the CERN Council. Working at CERN was going to be a good introduction to the world of top class research.

My research interest was in computing, I was expected to get a First at Oxford, and so I had no difficulty in winning one of the posts in the Data Handling Division, DD for short. This was the same part of CERN which welcomed Tim Berners-Lee, the famous inventor of the World Wide Web, some five years later. So, after finishing my degree and before starting my DPhil research I spent three delightful summer months near Geneva; CERN is located nearby on the Swiss/French border, at Meyrin.

CERN Summer Vacation Students did not earn very much. My letter of appointment shows that I would receive a subsistence allowance of just 1039 Swiss francs per month, and out of this was deducted a compulsory 1.79% for accident and health insurance. Ladies stayed in single study bedrooms in a Hostel on site. Men had the choice between the same Hostel and the cheaper dormitory accommodation. My room was 12 Swiss francs per night. The better standard of accommodation meant that I had less money to spend on food and travel. Although I did receive an advance on the first months pay, it was not very much. I recall that the staple at the end of the first month for dinner was a slice of ham with chips, and sometimes the luxury of sticky apple pastries. I have retained my liking for pastries ever since. The start of the second month meant that my standard of eating improved. Also there was a daily ritual with my boss of going out to the central restaurant area mid-morning for a minute cup of very strong black coffee. It was partly a social occasion and gave the chance for people to talk about their research and swap ideas. I remember that most evenings during the week I ate at the canteen and carried on working, or attended lectures. The site was active twenty four hours each day and seven days each week because of the equipment which was running. And it was a long bus trip from Meyrin to the centre of Geneva.

Although my office was only in a temporary building, it was a room to myself and I could concentrate on learning the programming language Fortran IV and making my contribution to the developing Graphics package GD3. I have always found it easier to work when I was on my own. As a student numerical analyst I was going to be responsible for providing a suitable routine for carrying out interpolation. I was not expected to do this from first principles. The method used was one written in 1970 in the Computer Journal, and described in a research report in 1972 by M.J.D. Powell and his colleagues at Harwell, the UK Atomic Energy Research Establishment near Oxford. My work was based on Fortran coding which had been also published in the Computer Journal and was in use by the Harwell Subroutine Library. In those days libraries of useful programmes were freely available and shared between programmers. The publication of numerical algorithms and code was an important part of spreading best practice and moving research in numerical methods forwards.

At Oxford the Numerical Algorithms Group, Nag Ltd, formerly based in Nottingham, was just beginning to make a commercial business providing tested numerical software.

I was also involved in modifying and improving existing routines and writing test programmes to test the system thoroughly before it was added to the program library. This was in 1973 and the computer facilities at CERN were the best in the world, with Control Data Corporation CDC 6400 and CDC 6600 to which were added the new CDC 7600. I still have the printout of the coding which I did. Two very important lessons were learnt. The first was that there had to be a standard way of writing code, so that other people could check it and change it later, if necessary. With this in mind, my programming style was deliberately forced to be the same as that of my boss. The second was that there must always be a lot of thorough testing. And having someone test the software who had not written it, was a good idea. At the top of each subroutine was a banner which stated the name of the author, the name of anyone who had modified the code, and the dates.

Technically it was an exciting time at CERN, and this is reflected in the highlights reported at the time of their 40th anniversary in 1994. In 1971 there had been approval of a proposal to build a second laboratory adjoining the existing site in France and Switzerland for the construction of a new Super Proton Synchrotron which was initially planned to reach 300 GeV. And in 1973 the first important discoveries from the experiments at the Intersecting Storage Rings emerged: protons grow in size as their energy is increased; and colliding protons can produce diffraction patterns rather like those of light bending around a disc, thus showing the wave nature of the proton. It was with the French-built Gargamelle bubble chamber in a neutrino beam at the Proton Synchrotron that one of CERN's greatest physics discoveries was made: it was found that neutrinos can interact with another particle without changing into a muon. This behaviour is known as the 'neutral current interaction' and was the discovery which opened the door to what became known as 'new physics'. It had great implications for the theoretical ideas about the fundamental forces of physics. In particular, it gave strong support to the theory which attempts to unite our understanding of the weak force - governing such phenomena as radioactivity - with the familiar electromagnetic force. All these wonders were shared with any of the CERN staff who wanted to attend the special lectures, and I made sure that I could attend as many of the lectures as possible. I have kept the notes of a lecture describing Recent Work on Black Holes by a young man from Cambridge University named Stephen Hawking. I had no idea that he would become so famous later.

Geneva is a very pretty city and there is a lot to see and do in the local area. The waterfront, with the famous Jeu d'Eau fountain, and the waterfront gardens is delightful. And the town is seriously historic. The Cathedral in the Old Town was John Calvin's old church, Tenebras Lux (After darkness light). I found a Catholic church by the Cornavin Railway station which didn't seem to mind that I stumbled over the French words of the Mass, and struggled with the sermons.

Shopping in Geneva is good and I was overwhelmed by the variety of Swiss watches for sale, and the astronomical prices of the best and prettiest. There was a Department Store, Placette, and I saved my wages and bought a long cotton summer skirt and bolero jacket there in the summer sale. My friend Ann, another Summer Vacation Student, bought one at the same time. She was still studying for her degree at Kingston Polytechnic and was working at CERN during the vacation. There were a

number of excellent restaurants, all too expensive on my student salary. Mostly I ate back in the canteen at CERN where the prices were cheap, but the occasional block of Swiss chocolate, again from Placette, went down well.

I was lucky compared with the students who worked with the experiments and my weekends were free of work. I was determined to see as much as possible of the rest of Switzerland. This began with the local area. In the summer there is a regular vintage paddle steamer service. Geneva is on the western end of Lac Lemman, and the Swiss-French border goes through the middle of the lake. I took short cruises to the beautiful French floral village of Yvoire, and then came back through Nyon and Coppet. I had longer trips by boat to Lausanne, Montreux and Vevey but it was slow. It was better to catch the train between Geneva and Lausanne, and then explore by ship, including the little medieval Chateau at Chillon. Most weekends I used my Swiss RailPass to buy reduced rate day return tickets and explore. Switzerland had an excellent train system. Further afield the trains to Lausanne connected with others and during the week I poured over the train timetables and visited Interlaken, Gruyere, Zermatt and Lucerne.

I soon met other Summer Vacation Students in the canteen, as well as Ray who was working at CERN as part of his DPhil research from Oxford University and had brought his car with him. I much preferred to travel by train, although some of us did go out a few times by car, to visit places which were not easy by train. It was surprising that one of the little border roads between Switzerland and France near CERN, which we crossed regularly, never seemed to have anyone on duty.

I was there in August and the first of August is Swiss National Day. It is a holiday, but it is much more than a holiday. It is a time when everyone sits outside with a rough earthenware mug of soup, or a few dozen litres of beer, and has a good time with their neighbours. I joined the celebrations in the afternoon in Meyrin. Then in the evening, in Geneva, there was the most fantastic firework display down by the lake. I was told that each year a different country provided the fireworks and in 1973 the country responsible was China. They were spectacular.

I was definitely going back to Oxford at the end of the three months, and I met some students who were in the same position. Other students were hoping to use their Summer Vacation Student posting as a start for applying for a more permanent job at CERN. There were very few truly permanent jobs because these had been filled by young people when CERN was established, and they were not yet near retirement age. There were some good contracts for three years, and that appealed to many younger people as the salaries were high, with the tax-free advantages which went with working at an international facility. Even my boss at CERN was only on a series of three year contracts, which must have been more difficult for him once his wife had their first child. As UK nationals they were not allowed to buy somewhere to live, and were limited to renting an apartment. Eventually, like many other workers at CERN, they had to come back home to England.

I came back to the Oxford with a new Swiss watch, as a treat from Pete for my 21st birthday which was in September while I was away. He came over to Geneva to visit for a few days and stayed in the Hostel. I had spent a series of pleasant afternoons browsing in the shop windows before getting down to a short list of two. The choice was between Patek-Philippe (beautiful but very expensive and I could only just afford it if I kept eating ham and chips) and Enicar (actually a more useful watch and much

less expensive). I chose the Enicar and it gave almost 20 years of useful service. Pete had been given a Tissot watch by his parents for his 21st birthday, but I did not like the style of their feminine versions.

While I was working my parents took the opportunity to visit me and flew over in September for a week. It was the first time my father had travelled abroad with my mother on holiday. I had found accommodation for them in central Geneva, but even a cheap B&B was very expensive then because of the rate of exchange. This conversely meant that my Swiss francs were worth a lot of pounds when I took them home. I must have been careful with my money because I had enough money saved to buy a Swiss fondue set and a nice pair of hiking boots when I got back to Oxford. The boots lasted a long time and were only consigned to the rubbish heap in 2005. I still use the fondue set.

Being away in Switzerland I never had a proper 21st birthday celebration, although my parents had a few friends to visit when I got home. My Uncle Tom had died two years earlier but he had always kept a few nice bottles of wine in his garage. Auntie May was still working in her hairdressing business and had decided that my birthday was special. She did not drink wine herself but had gone and looked to see whether there was any of his stock of wine left. She arrived with two bottles, both fizzy. One was a very old Pomagne, a sparkling cider, and the other was a 1953 vintage Moet Imperial Champagne. The Pomagne was a nasty flat brown liquid, but the Champagne was still sparkling and drinkable. I kept the empty bottle. I wished Uncle Tom had lived to meet Pete and to share my 21st birthday.

## 16 The First Year of Research Life at Oxford

With a First Class Honours degree I was confident that I would be high on the list to receive a grant for my DPhil research at the Computing Laboratory in Oxford. In July I received the important piece of paper which informed me that I had been awarded a Science Research Council Research Studentship for training in methods of research. The basic rate was £695 per year, tax free. At Oxford I was not allowed to start directly on the DPhil and my first year was for the degree of Master of Science (MSc).

Before going to CERN my mother and I had found a little bed-sit in the north of Oxford, in Farndon Road, for when I returned in the October to start research. It was in an old Victorian house, divided into separate rooms and with a shared WC and bathroom. I never got to know the other occupants. I think we must have all been research students. I was at the top of the house, with a room with a little window which looked out onto the front garden. Fortunately Farndon Road was quiet. After living in the modern light Garden Building at St Hilda's College for three years it was comparatively dark and dismal. I was provided with a little old Belling cooker which was too small to do anything useful. Fortunately Pete had a share of a large kitchen in his flat in Bardwell Road, with a normal cooker. He had an enormous room, it must have been 30 foot square, but it was a single storey extension in the garden of an old house. It had a flat roof with three outside walls and was very cold and damp in the winter. Without an electric fire and an electric blanket it would have been impossible, and he was often glad to stay at work in the evening, where it was warm. In the summer it was nicer.

Having enjoyed a room to myself at CERN I found that rooms at the Computing Laboratory were in short supply for students and I was expected to share an office. But that was not a serious problem. Much of the time we were out at lectures and libraries or worshipping the terminals which were used to communicate with the computers. I shared a ground floor room with a mature student who was a lecturer from WAIT in Western Australia. He had taken a one year sabbatical and was using that time to get his MSc. The only disadvantage of the room was that it looked out at the front of the building, which could be a distraction. The office had plenty of bookshelves, so I did not need to have another large room of my own. I only used my little bed-sit for sleeping and making breakfast. Pete and I never considered living together before we got married, although we knew people who had.

I now had a bicycle, and living at Farndon Road was convenient to get to the Mathematical Institute at the top of St Giles, and the Computing Laboratory at 19 Parks Road. The Numerical Analysis Group shared the building with a group of engineers. We had the south end of the building whereas they had the north end. Unfortunately it was as far as I could get from St Hilda's College, which was a pity because I did not get involved at all with Middle Common Room life. I was too busy dealing with the challenges of new technologies to add the social side of College life. In addition, both Pete and I were working hard in our different research areas, so any spare time we spent together. Although he had completed his three years of research he was still working hard in the fourth year, writing up his DPhil.

At Oxford I faced the programming transition from the nice CDC mainframes of CERN to the slower, but still modern, ICL 1906A with the George 3 operating system. Computer programmes were written and typed onto Hollerith cards which were then

fed into the computer. With luck the programmes would work as designed and the results would arrive some hours later, assuming that no-one managed to drop the heavy boxes and shuffle the cards. I spent many evenings working late at my programming; the computer building was open until midnight. The computers worked quicker at night when the day staff had gone home, and the length of queues were shorter. Having spent three months programming in Fortran at CERN, I now found I was expected to do programming work in Algol60 again. I justified the change by deciding it was a good idea to be fluent in several programming languages. Oxford was linked to other University computers, including the larger machines at the University of Manchester (UMRCC) and the University of London (ULCC). Computing was a two stage process. First the code had to be compiled and then it was run. Many a typing error was found at compilation time. Logical errors were only found later. My numerical analysis work for the MSc was organised and I was expected to carry out a structured set of programming tasks and to report back each week on the results. In many ways it was rather like a tutorial, but more challenging. I must have learned a lot, but I didn't enjoy the experience. Somehow no matter how hard I tried I always had some fault which needed to be corrected, or had missed some feature of the problem.

My main subject for the MSc was Numerical Analysis with two subsidiary subjects of Combinatorial Theory and Differential Equations. It was not very useful for me to go through the normal lectures in Numerical Analysis and Combinatorial Theory for the MSc because I had already done them as an undergraduate. In contrast, my knowledge of Differential Equations was not strong, and for that I was assigned to work with Dr Jim Murray at Corpus Christi College. His research interest at the time was temporal oscillations, particularly the Belousov-Zhabotinsky reaction. When the oxidation of malonic acid by bromate in aqueous sulphuric acid is catalysed by the cerium ion it was observed that the ratio Ce(IV)/Ce(III) oscillates with time. These oscillations are pretty when observed as a colour change in the stirred solution. There had been an analysis of the problem so I did not have to think about how to model the chemistry. Applied mathematics was not one of my strengths and I would have been stressed to try and work out what to do. ( On a model for the temporal oscillations in the Belousov-Zhabotinskii reaction (J.D. Murray). *J. Chem. Phys.* **61**: 3610-3613, 1974. ) I was fortunate to work with Dr Murray. Since then he became a Professor at Oxford, and Fellow of the Royal Society, and subsequently became an Emeritus Professor at the University of Washington in Seattle. My role was to use the computer to analyse the nonlinear equations. First the nonlinear equations had to be represented by suitable difference formulae. So it was by this route that I began to work with so-called 'stiff' systems of equation, and the methods of Gear to solve them. The programme used, called DIFSUB, was already published, but it had to be applied to this novel and new situation. Much of the state-of-the-art of numerical analysis was of this type. There were many new problems, to be solved by appropriate, modified or new numerical methods, and a lot of good Fortran code was published freely in the computer journals, for re-use.

Ray, whom I had met at CERN, came back to continue his DPhil research at Oxford. He was based in the Metallurgy Department, just next door to the Computing Laboratory. When we both got back to Oxford we arranged to meet for coffee and he introduced me to his colleagues. Each afternoon there was a ritual to take afternoon tea in the canteen of the Engineering Building next door and for several months I went over there once each week for tea with them. The coffee was good and I adored the



sticky lardy cakes. Normally there was only instant coffee and biscuits at the Computing Laboratory.

Each Easter research students and staff from the Computing Laboratory and the Mathematical Institute were invited to take part in the Oxford Study Group with Industry. This unique form of technology transfer was pioneered in Oxford when Dr Alan Tayler of the Mathematical Institute and Professor Leslie Fox of the Computing Laboratory held the first meeting in 1968. It was an annual meeting, is still a regular feature of research life, and has led to many interesting subjects for research papers and theses. The format is that a number of scientists working in industry bring interesting and difficult problems to be discussed. The mixture of mathematics and computing skills from Oxford is a powerful combination, and groups of staff and research students sit down for a week and look at the problems together.

The main task for the summer was to write my MSc dissertation, which was going to become the foundation for the DPhil thesis which followed. Dr David Mayers from New College was my allocated supervisor. Originally I was going to work with him and Dr Murray on the Belousov-Zhabotinskii temporal oscillations but then there was a topical conference on Moving Boundary Problems in Heat Flow and Diffusion, held in Oxford in March 1974. The idea for the conference, held by the Institute of Mathematics and its Applications, had arisen from the work of the Oxford Study Group with Industry. It was here that Professor Fox introduced me to problems of change of phase – mainly either melting or solidification. These, called Stefan problems after the German mathematician of that name who researched the theory in 1890, were now ready to be solved by computer. And so it was that my MSc dissertation was instead written on the subject of the Numerical Solution of Stefan problems. MSc dissertations are not expected to contain much original research but they give the opportunity for a thorough exploration of the current state of research, and the chance to experiment by using numerical methods which have been published. At Oxford, the MSc dissertation was usually used as the basis for the introductory chapter of the subsequent DPhil thesis. This meant that my DPhil was going to be about Stefan problems too.

As a graduate I had been encouraged to join the Institute of Mathematics and its Applications, and in 1974 I applied to attend my first conference outside Oxford. There was an annual IMA Conference on Numerical Analysis and in 1974 it was held at the Royal Irish Academy in Dublin. Formal approval had to be given in order to have the costs of attending the conference paid. I was lucky. Several of us were able to fly across to Dublin and we all stayed in student accommodation at Trinity College, Dublin (TCD). TCD was founded in 1592 and is the oldest university in Ireland. Unlike Oxford which is made up of many different Colleges, Trinity College is the sole constituent of the University. Standing on a self-contained site in the heart of Dublin, the College covers some 40 acres of cobbled squares and green spaces, around buildings which represent the accumulated architectural riches of nearly three centuries. It was an oasis of peace in the times of the troubles.

One of the great treasures of TCD is the Book of Kells, exhibited in the Old Library building. Written around the year 800 AD, the Book of Kells contains a richly decorated copy of the four gospels in a latin text based on the Vulgate edition (completed by St Jerome in 384 AD). The gospels are preceded by prefaces, summaries of the gospel narratives and concordances of gospel passages compiled in the fourth century by Eusebius of Caesarea. In all, there are 340 folios (680 pages). It

is a spectacularly beautiful work of religious art, and I made sure I found time between conference sessions to go and admire it.

Conference delegates had a tour of Dublin by coach and parts of the town were a mess with signs of bomb damage and gunshots. Seeing the situation on the ground is somehow different to seeing it on the news broadcasts on TV. The coach trip continued into the countryside, which was a contrast of peaceful green fields, and included the inevitable stop at a tourist shopping centre which enabled me to buy a nice white linen tablecloth with a clover leaf pattern as a present. Many of my colleagues went out in the evenings to explore the delights of the town, and to sample the local brew: Guinness of course. I don't remember very much about the conference, not because of all the other activities but simply because I was only there to listen and meet people. I felt far too junior to ask questions. The speakers were all senior academics whereas I was only a young research student. It would be several years before I would be considered for presenting a paper about my own research.

## 17 A Last Family Holiday Together in Switzerland

Just before I was married in 1974, my parents and I had a week together in Switzerland, staying at the resort of Vevey which is on the Lake of Geneva, called Lac Lemman in French. When I was working at CERN just outside Geneva in 1973, my parents had visited me there on holiday and liked Switzerland. This time we booked a package holiday which included Swissair flights to Geneva, and transfers between the airport and our hotel. Holidays to Switzerland were still expensive because of the exchange rate, and we chose a very modest hotel. It was called the Hotel de Famille and it was close to the railway station. In fact, we looked down onto the railway line from our room, so there was some noise from the trains. In addition, the package tour had decided that I was a child, not a young woman of 21 years old. I had to share a small room with my parents. I don't know who was more embarrassed, me or my father. Otherwise it was a nice Hotel, with those lovely soft down duvets that were the norm in Switzerland. We had booked half board so breakfast and evening meal were included.

Staying in Vevey was a good choice. It was a cheaper town for accommodation than either neighbouring Geneva or Montreux. It was small but still had plenty of facilities and things to do. Walking along the lake front was a delight, and there were fewer tourists than I remembered in Geneva. The paddle steamers made frequent stops at the wharf in Vevey. There was a good train service along the banks of Lac Lemman, so we could go to Lausanne and Geneva in one direction, and Montreux in the other.

On the Saturday morning we were surprised to find Vevey's Market square transformed into a summer market. We had not realised that there had been a 'Marche Folklorique' in Vevey for many years. In 2005 it was the 37th annual event, which would have made our visit in 1974 one of the early years. There were groups of musicians and dancers wearing local costume, which all contributed to a cheerful welcome. Of course, the traditional market reflected the region's winegrowing and agricultural traditions, and there were stands selling local produce. It was a chance for everyone from the area to meet in a convivial atmosphere, and enjoy themselves. It was fun for the tourists too.

Vevey is in the French speaking part of Switzerland and my parents spoke no French. So it was my job to go and find out what was happening, and how to get involved. I had some problems understanding the Swiss-French accent but eventually had some success. We purchased a small tasting glass, etched with the image of the famous vintage paddle steamer, the Savoie, which was built in 1914 and is still cruising on Lac Lemman, and then tasted the local wine. Swiss wine is not spectacular. Most people are amazed to hear that Switzerland produces any wine at all, since hardly any is exported, although it used to be possible to buy a limited range from the Swiss Trade Centre in London. The problem is the low volumes produced, and consequently the very expensive price compared with similar quality wines from its French neighbour. A quarter of all Swiss wines are produced along the shores of Lac Lemman, and these are generally good. Most wine is white, and the Fendant grape produces crisp and fruity wine which is perfect for making the speciality Swiss cheese fondue. The red wine made from the Gamay grape is also pleasant, and is a light summer picnic wine. Neither the red nor the white wine seems to travel well, and is for drinking on holiday, or shortly after. It certainly did not benefit from cellaring. I found this out by bringing some back, purchased from the duty free shop at the airport. It lost its brightness, and

a normal bottle would have been considered slightly 'corked' but it was not the case here. The cheapest Swiss wines only had screw tops.

## 18 Marriage and Settling down in Witney

Some years earlier I had replied to an advertisement in a Sunday newspaper, which provided free books about the Roman Catholic Church. Two of my best friends at Oxford, Janet and Miles, were both Roman Catholics and with them I was able to attend Mass, although in those days I could not accept the sacraments until I was converted. From St Mary Magdalen and its extreme AngloCatholic Anglicanism it was only a small step to Roman Catholicism, and I decided to move across. The conversion process involved a series of discussion sessions at the Catholic Chaplaincy. I had already been christened and confirmed into the Church of England, so this was a good starting point.

I met the two chaplains who lived in the Old Palace, in Rose Place, on the corner of St Aldate's. The Old Palace is a striking old building. It is said to date from the 16th century when it was the home of the first Bishop of Oxford, when he moved to Oxford to make the chapel of Christ Church College his cathedral in 1546. The house is conveniently sited just opposite Christ Church College. On the ground floor there was a bookshop with an extensive collection of religious books. The large room on the first floor was ideal for meetings of all sizes. Every step on the ancient floor boards upstairs gave a groan as if it was carrying all the worries of the world. I presume there was accommodation on the floors above. My instructor was Father Gerry Burke, the Assistant Chaplain, who later moved from Oxford up to Sheffield when he finished his posting in Oxford. At that time the Chaplain was Father Crispian Hollis, who became Bishop of Birmingham, and then Bishop of Portsmouth. Born in 1936 he must be retired now. I remember the first Easter when I went to the Passover Meal and began to feel as if I was really part of the Church family. Eventually I was accepted into the Roman Catholic faith and was able to be married there. Pete came with me to a series of instruction discussions with Father Gerry, to talk about the responsibilities of marriage and promise that any children would be brought up in the Catholic faith. At that time we had no intention of having children, and this did not seem to be any impediment to the conversion to Catholicism.

We looked for nice matching wedding rings, and spent some time with Payne's in the High Street, where they had a selection of multi-colour rings. We liked the idea, which was very modern in those days, of a three coloured gold ring. Payne's is an excellent silversmith and jewellers and we have bought several items from them over the years. However we were not persuaded by their wedding rings. We wanted something which would still look nice after it had been worn for a long time and eventually found a faceted design elsewhere in Oxford. Over thirty years later, the pattern on the rings has worn down, but is still pretty.

I wanted to get married in Oxford, not in Burntwood, and my parents had agreed and said they would pay for the wedding. This meant that I took responsibility for all the wedding arrangements, and had to keep the budget within the amount that my parents prescribed. I was lucky that two Oxford friends, Jim and Rosemary, had got married a few months previously, and they recommended their caterers. A mid-range buffet menu was chosen, and whole salmons were added to make the food special. A nice 3 tier cake was ordered from an excellent cake shop in North Oxford. We had to provide our own drinks and so we wandered around Peter Dominic in Oxford, and then we spent a few happy days with friends choosing the red, rose and white wine, and

sampling different bottles of real Champagne. Even if the wedding only had a buffet it had to have nice wine and proper Champagne.

Meanwhile my mother was busy making my white dress and the red velvet dresses for the three bridesmaids. She had always promised that she would make all the dresses herself. We had looked together at a lot of wedding dresses in the shops in Birmingham and then sketched out a design before finding a pattern which was suitable. The basic pattern for all the dresses was similar. There was a high neck, a high waist and a panelled skirt with enormous circular sleeves falling from the elbow. My dress was decorated with wide guipure lace; the bridesmaids had simpler lace trimmings. I had two special friends from St Hilda's College, Janet and Pam, and normally I would have chosen both of them to be bridesmaids. But Pam had already got married and I had the traditional view that bridesmaids had to be single. I wish I had asked both of them now. There were also two young bridesmaids, both family and about the same age. Jennie was the youngest daughter of Pete's sister, and Julie was the daughter of my godparents. The flower shop in the Oxford covered market prepared all the flowers. I had a large matching red and white bouquet, and little balls of red and white flowers for the bridesmaids completed the scene. The men, Pete and his best man Miles and the usher Trevor, had red ties and buttonholes. My father bought a new suit for the occasion. My mother and Pete's mother both wore suits and fancy hats. Pete's father had died soon after my first visit to meet the family in Bath. We had decided that lounge suits were formal enough although one relation turned up to the wedding in white tie and tails. I suppose he thought that being held in Oxford it would be very formal.

I wanted to get married according to the rights and rituals of the Roman Catholic Church. The Catholic Chaplaincy and Newman Rooms in Oxford had a new modern building, completed in 1972, including a chapel, an enormous narthex foyer and a large room for meetings which was perfect for wedding receptions. So this was our choice. Father Gerry was very helpful in discussing the options, including having an informal service on the banks of the River Cherwell, with poetry readings if we wanted. We decided to be fairly traditional, with standard bible readings and hymns. The chapel had a small electronic organ, which was sufficient for us. Having the wedding service and the reception in the same building had obvious benefits, especially if the weather was bad.

During my MSc year I had survived in my dark little attic room in the house in Farndon Road, and Pete continued with his large cold and wet room in Bardwell Road. Neither place was good for a couple and we were now both earning enough to get a small mortgage. At the end of his DPhil grant Pete was employed as a Research Associate and in 1974 he had passed his viva voce and was awarded the DPhil. In addition, my DPhil grant would pay for my travel expenses by car to Oxford. During the summer we had explored the small villages around Oxford where the houses were cheaper and visited a lot of places, including one derelict thatched cottage, before finding a pretty mill workers cottage we could afford in the market town of Witney. Like many such cottages there was no front garden, just the narrow pavement in front of the house. The back garden had a concrete patch and our neighbours said that everyone used to keep a pig. It entered through the front door as a piglet and finally ended up in the oven. The concrete made a good base for our garden shed. There was no garage and our car was parked in front of the house until we found a garage to rent further down the road.

It was only five minutes walk to the shops and the Butter Cross in the centre of town, and our cottage was at the end of a row of cottages in Lowell Place. It was only small. Downstairs there was the main living room, a new single storey kitchen extension and shower and toilet, and there was a double and a single bedroom upstairs. The main feature was that the cottage was built of Cotswold stone, and the living room had thick stone walls and a walk in feature fireplace for burning wood. The current owners had spent a lot of time modernising the cottage, and were now moving on to a bigger place to start a family. There was still a small amount of work to do inside, but it was a perfect start for us. And still having the two rented flats at the same time meant that we could move in to the new place slowly over the summer of 1974.

There were minor things to do, like making curtains and buying basics. We did not have a lot of furniture to start with. We bought a new and expensive Slumberland bed, on the basis that it is important to have the best we could afford. And we also bought a new settee for the front room which could convert into a small double bed for visitors in an emergency. My parents gave us an oak dresser made by Old Charm as a wedding present. This was the start of a serious relationship with Wood Brothers of Ware who make the Old Charm furniture. Over the years we have collected a lot of their furniture and it has always been well made. Other items were second hand, or came from family, including a lovely solid round table, from Pete's home in Bath.

We had decided to wait until I finished the MSc at the end of September before getting married. We got married on Saturday 12 October 1974, which was a glorious blue, bright and sunny day, the sort of perfect light that you only get in October. Some of the wedding pictures show our gliding friends looking up at the sky; it would have been a good day to be out flying.

While close family stayed at the Old Parsonage Hotel in Oxford, many others drove across to Oxford for the day. My parents arranged for a small bus to bring family and friends down from the Midlands, although they came down to Oxford earlier. My mother was still doing the final sewing, getting the hems right on the dresses, on the evening before the wedding. Traditionally we had arranged for two nice posh black wedding cars for the short drive across town, although it was really only walking distance. The Catholic Chaplaincy is just opposite the entrance to Christ Church Meadows, and our photographer proposed that all the photographs be taken in their gardens. It worked very well, although herding everyone across the busy road was a challenge. On the day of our 21st wedding anniversary we went back to Oxford, had our lunch at the Restaurant Elizabeth, and got our photograph taken at the same spot in Christ Church Meadows. Now there are signs everywhere requesting tourists keep off the grass.

During the day we heard from Miles that he had proposed to Felicity Jane, and when we came to collect together the wine which was left at the end of the celebrations we gave them a bottle of Champagne. My father caught Miles with the bottle and thought he was taking it away without permission. It was a simple misunderstanding which was soon sorted out.

For my going-away outfit I had made a long skirt, a short pleated skirt and a waistcoat in a cheerful yellow and orange check wool. With a matching yellow blouse and an orange floppy felt hat I felt very posh. Everyone thought we were going straight off on honeymoon but we were driven back to our house in Witney, where we stayed overnight before going away.

We had originally planned to have two weeks on honeymoon on the island of Menorca. It sounded a beautiful place and during October the hotels were still open but most of the tourists have gone and it would be nice and quiet. Pete had never had a package holiday, but I persuaded him that my holidays with Clarksons had been good, and it was good value. Unfortunately we booked with Clarksons, who then proceeded to go bankrupt in August. So we went back to Thomas Cook in Oxford, who had booked the trip, and they managed to re-book us to go to Menorca with another company, called Apal, who also unfortunately then proceeded to go bankrupt. By now we were just a few weeks away from the wedding, and all our savings were tied up on the holiday. Fortunately Thomas Cook was very good and refunded all our money to us, well in advance of the refund being issued to them. We decided to abandon the idea of package holidays and booked ferry crossings to take our car across to Europe for three weeks. It was an excellent decision and we drove through France as far south as the Mediterranean coast before crossing into Italy and then heading north through Germany. We have memories of sun-bathing on the beach at Menton in contrast with making a snowman in Unterwossen, the little village on the German / Austrian border where Pete used to go gliding.

In Bardwell Road Pete had often been able to bribe the cat from the flat above to visit. He used to send it back home after eating garlic pate, and other delicacies designed to surprise its real owners. One day we found the cat had a note attached to say that it should not be fed garlic pate. I had always had a cat at home too. Now we had our own house it was not long before we decided to share our home with a cat. We saw adverts for the Buckland Cat Sanctuary, and found an amazing house full of cats of all shapes and sizes. We succumbed and were soon the new owner of a lovely little tabbie kitten. We called her/it 'Topsy'. It was great fun going out into the garden at night shouting Topsy, Topsy, calling her to come in. She enjoyed Witney, especially playing with the delicacies from the fish pond belonging to the cottage further down the road. One day their daughters brought her back to us wet. She had fallen into the pond, or so they said. She also enjoyed exploring the scrap yard which was at the end of the back garden. We presume it was home to mice, and so provided extra treats.

Witney was a very friendly place. We wondered why our pint of milk was wrapped in a newspaper on our doorstep when we got home from work. Then an old lady who lived opposite admitted that she had been putting our milk in her fridge to keep it cool and then putting it out on the doorstep when she thought we would be on our way home. We got to know our neighbours quite well, and I often went and sat for an hour with the lady opposite for a chat.

In spite of our extra income we were still not very well off, so we used to scour the shelves in Sainsbury's supermarket in Oxford at the weekend, looking for bargains and cheap food at its sell-by date. It was on one of these occasions, just after a sugar shortage, that Pete noticed that there were very few packets of salt on the shelves. With a twinkle in his eye, and a loud voice, he said that we must stock up on salt because of the strike in the Siberian Salt Mines. We did need some salt, so he picked up two packets and we moved on. Later in the week it was announced on Radio Oxford that there was a sudden local salt crisis in the Oxford area, which was unexplainable. We knew what had happened.

Witney is a large market town and had a lot of shops, including a Waitrose supermarket, which we also regularly checked for cheap bargains. This does not mean



that we only ate mince and sausages. We liked to eat interesting food; for example after Christmas we found a frozen goose at a very good price. It was good, but had very little meat considering its size and price. Witney also had a fine specialist delicatessen and we sometimes found interesting bottles of wine there as well as freshly ground coffee beans.

Real ale was becoming more easily available and we started going to the Butcher's Arms, in Corn Street, then a new pub and just around the corner from our house. The beer was slightly more expensive than other pubs, but it was a friendly homely atmosphere and it was close to home. For other meals there was a Chinese restaurant, also in Corn Street and not far away, which had taken over the premises from a French restaurant. They had inherited a collection of interesting old wines including bottles of Chateauneuf du Pape which we steadily drank our way through. When they eventually ran out of bottles we had to buy two halves instead. We were such good customers that it was the same price as for a full bottle.

One luxury was that our friends from the Oxford Gliding Club had given us some Waterford Lismore sherry glasses as a wedding present, and we continued to build our collection whenever we found them for sale at a discount. They were just £2.20 each when we got married, which was a lot of money in those days. Over the years the price has multiplied by a factor of fifteen, and some 30 years later Lismore is still a popular current pattern. We hunt in so-called 'antique' shops for the old glasses which somehow seem to have much more fire than the new. Modern fashion seems to be for doing more polishing of cut glass - a pity in my opinion. Just recently we found four champagne glasses and four liquor glasses in New Zealand, and brought them home.

## 19 Working towards my Doctorate

Having successfully completed my MSc dissertation, and given its title, the obvious title for my DPhil thesis was ‘The Numerical Analysis of Stefan Problems’. Doing ‘analysis’ sounded more challenging than simply ‘solving’, and implied the required level of new and creative ideas to move the research world forward, as was then expected in a DPhil thesis. There was a lot of work to do to complete a DPhil in the remaining two years, after a fairly slow year spent doing the MSc and getting married and settling down. Monday to Friday we drove together from Witney in the morning, and Pete parked the car outside the Atmospheric Physics Department. My office was just across the road and I typically spent the rest of the day partly in the library continuing to follow up ideas and read new publications, and partly glued to the seat of a computer terminal, coding. I was still sharing an office, but this time it was on the first floor, it was larger with desks for three students and there were just the two of us. It looked out onto the back of the building, so there were no distractions.

I was able to do a small amount of undergraduate teaching in Combinatorial Theory and Numerical Analysis, which all augmented my research grant. Some of this was one-to-one tutorials but the rest was helping with classes. I also taught basic mathematics to engineers and scientists. The strength of the Oxford system is that lecturers produce good sets of lecture notes, and often have written classic books in their subject area. In addition, the usual material for tutorials is to go through past exam questions. So my only challenge was to be better than my students, and to encourage them to learn. I found that you can only really understand a subject when you have to teach it.

By the summer of 1975 I was starting to make some impact on the subject of analysis of Stefan problems. That year one of the visiting academics to Oxford was Professor Joseph W Jerome, from Northwestern University in Illinois, USA. His speciality was the analysis of non-linear equations and at Oxford he also became interested in Stefan problems. With his support, I became an enthusiast for finite element methods, instead of the more traditional finite difference methods which had been favoured by Professor Fox. There were lively discussions between Professors Fox and Jerome about the merits of the two techniques. I saw it as discussions between the old and the new, which was somewhat of a simplification.

The first two Chapters of my thesis were straightforward, although time-consuming to research. The first Chapter was an Introduction which defined a Stefan problem as a moving boundary problem between different phases, for example between a solid and liquid, and then continued to discuss the existence and uniqueness of the solution to such a problem. Few Stefan problems have an exact analytic solution, something which can be written down as a mathematical formula. Then the second Chapter described existing techniques to non-mushy problems which have simple geometry. Mushy problems, a self-evident terminology, are more difficult to deal with because there are two boundaries, one between the liquid and the mush and the second between the mush and the frozen solid. Some of the existing methods found in the literature were purely numerical; others were a mixture of analytic and numerical techniques. Here the survey article by Professor Fox, given at the conference on Moving Boundary Problems in Heat Flow and Diffusion in 1974, mentioned earlier, was the obvious reference. I was surprised to discover an early paper by Ernie

Albasiny from the National Physical Laboratory, who had done some computation of a solution using the Pilot ACE computer in 1956.

The bulk of a DPhil thesis has to be original research work, and I considered a number of ideas for new and improved methods. Some were my own inspiration; others came from discussion with colleagues. Some of my own ideas did not find favour with Professor Fox, and some of his ideas I did not appreciate. I wanted to look at different mathematical formulations, and solve them using better computing methods than those in current use by mathematicians. Eventually I concentrated on two methods, a traditional Crank-Nicolson finite difference approach and the more modern finite element approach of Galerkin, dating from 1970 onwards. The former was an obvious candidate for applying to Stefan problem, whereas the latter had never been used before. I wanted to compare them. I soon got lots of experience with using the library programmes which solved large systems of simultaneous equations, systems of non-linear equations, and stiff differential equations. These moving boundary problems certainly led me into many different corners of hard numerical analysis. Professor Fox wanted me to use the Regula-Falsi method, which translates as False Position. The idea here is to make a series of guesses about what is happening to the boundary, and hopefully find that the real moving boundary is between two of these guesses, and so can be found. Tracking the boundary in this way can be done in a series of small steps. Everything involved a lot of programming, and as the error in computing was inevitably dependent on how fine an approximation was used, reducing the error by a factor of two could increase the computing time dramatically. It was important not to squander computer time by carrying out unnecessarily fine approximations, yet traditionally doing a series of increasing fineness gave a good indication of the error compared with the 'real' solution.

Having exhausted the simple non-mushy problem, I moved on to mushy problems, and carried out a very similar experimentation. I also became fascinated with the inverse Stefan problem. The idea here is to know a formula for the desired shape of the boundary between a solid and a liquid as time passes, and to want to work out what external temperature should be imposed in order to achieve this specified boundary. In 1976 there were no numerical methods available to deal with this problem. I compared two different approaches and obtained numerical results.

Every two years there is an important conference on Numerical Analysis in Dundee, and I was able to attend the event in July 1975. Professor Jerome was one of the invited speakers. The conference had a number of interesting papers and gave me the chance to meet other leading researchers, including Walter Murray and Phil Gill from the National Physical Laboratory. Walter was an international expert on nonlinear least squares and nonlinear optimisation, and was an invited speaker. My first meeting with him was as he and Phil Gill were playing tennis. It looked as if the conference was going to have a social side. I wished I had brought my tennis racket, but then thought again as I was bound to get soundly beaten. They were both very good at tennis, as well as being strongly competitive. Maurice Cox and Geoff Hayes, also from the National Physical Laboratory, were there and each submitted a paper on splines and data fitting. I was not really interested; my main interest was still on the analysis of differential equations.

Oxford researchers were invited to contribute to many conference and research groups, and a lot of these were organised by the Institute of Mathematics and its Applications. So I was encouraged to attend appropriate meetings in order to meet

people and exchange ideas. It was on this basis that I was able to attend the IMA Conference on the State of the Art of Numerical Analysis in York, in April 1976. I always tried to purchase a souvenir of conference trips and this time I came back with two lovely small silver coffee spoons, with a white rose in enamel on the handle.

And finally, each Easter the meetings of the Oxford Study Group with Industry meetings continued, attended by a variety of industrialists with a range of simple to impossible problems. I always attended the Easter meetings, although I was not looking for extra research topics or possible contacts for the future. There was a '3-line whip' and we were all expected to dedicate a few days to help with the problems. In Easter 1976 a number of these problems had come from the Central Electricity Generating Board (CEGB) and a special meeting was arranged in Oxford to look at them in more detail. I was a member of the team invited to attend this meeting in June 1976. CEGB researchers dealt with a range of interesting subjects, and for a short time I wondered about a career there. For example, one of the interesting problems concerned the use of wave power, using a floating duck, and there had been another problem concerned with acid rain and its transport in the atmosphere. I found the discussions interesting and was amazed at how easily the Oxford mathematicians were able to simplify a complex problem into something which they could begin to analyse. It was only after this that the numerical analysts could get to take the formulated problem and try and find out its numerical solution. In 1976 I found the time spent away from my own research was an irritation. I was desperate to complete as much of my computing as possible before leaving Oxford in the October.

## 20 Summer Holidays

In spite of the pressures of work we still managed to find time for holidays. Pete's sister and family had now moved from Bristol to Guernsey. The arrival of VAT had meant a lot of extra paperwork in their pharmacy business and they decided that it was better to have a change. They had spent their summer holidays in Guernsey for several years, the four children enjoyed the island life, and there was a vacancy to work in the Princess Elizabeth Hospital as the pharmacist. John applied and was accepted. At the time we were married, in 1974, Pat was still in Bristol dealing with the sale of their business, while John was already working in Guernsey and unable to come back to the UK because of the strict rules of travel. They hoped he would be able to work there for the 20 years necessary to obtain permanent residence, and indeed did so.

With four children they needed to buy a large house, and were able to find a traditional detached house near to the hospital, in the centre of the island. The house had previously been a small Guest House, and as well as sufficient bedrooms for the family in the main part there was a small single storey wing with two bedrooms and its own bathroom. It was perfect for us and Pete's mother when we went to visit them.

Guernsey is a beautiful island and we enjoyed walking along the cliff paths on the south coast, as well as browsing through the little shops in the main town of St Peter Port. When the weather was good it was only a short hop on the ferry to Herm, with its shell beach, cliff path walk, and we always planned to have our lunch at the White House Hotel. In the spring it is possible to take a boat trip and see the puffins which nest along the coast. We usually visited in the spring or in September.

The arrival of summer meant that the weekends were often spent gliding. When we first met, Pete was an instructor at the Oxford Gliding Club at Weston-on-the-Green. As well as teaching new students in the Club two seater K13 trainers, Redfin and Elfin, he had a share in a Phoebus single seater glider. Originally owned by a friend, also called Peter, Pete had been invited to join the syndicate as well as Dave who was working towards his DPhil and also lived in the flat at Bardwell Road. Buying a glider is expensive and they are usually owned in a syndicate. Everyone helps with annual repair and maintenance, as well as collecting the glider if it lands away from the home airfield. Although I was confident enough driving the car, I was not allowed to tow a glider trailer. If Pete or Dave or Peter, managed to land the Phoebus in a field everyone helped trail the glider back home. I found I often spent sunny days sitting by the car on the grass waiting for him to come back from his flights.

Eventually the Phoebus was replaced by a new Astir, which was manufactured by the Grob company in Mindelheim in Germany. It was a first glider from a new company, and they had no agents in the UK. Although they had a history of building gliders under licence, the Astir was their own special design. It performed well and was soon seen to be a very good aircraft for general club use. Peter and his syndicate friends set up Soaring Oxford Ltd, and became agents for the Astir, and continued as agents for the Grob range of gliders for many years. I sometimes went out on demonstrator trips to show our Astir to other gliding clubs, and let them fly it. Typically all the demonstrator flights were at weekends, and this fitted in well as a hobby. Everyone was still doing their normal work during the week. Soaring Oxford Ltd did not purchase any gliders but arranged for the sales paperwork between the Grob company in Germany and the UK gliding people, and helped organise the delivery of the

gliders. I remember when an enormous container full of them was delivered and we had to unpack it. The first challenge was which part to take out first and everyone walked around, looking at the way in which all the fuselages and wings had been packed together. Eventually the key piece was removed, and gradually it was all unpacked.

Gliding is the sort of business where a sale could be done on a handshake, and people could be trusted. Once there were many Astir gliders in the UK it was possible to justify a base for repairs and to hold spare parts, and this was arranged at Booker Airfield. Previously spare parts had to be obtained as required from Germany, and this meant a delay, which meant the damaged glider was out of action for this time. For major accidents this was acceptable, but not for small problems. As time passed, more Astirs were designed and purchased, so there was a twin Astir for training, a single seater Astir for club and private use, and eventually motor gliders and then light aircraft.

I never got interested in learning to glide alone, although I did have several training flights and kept a log book. I enjoyed the flying as a means of seeing the countryside but once the glider did tight turns I panicked. I still don't like to be at an angle, and that is something I have had to work hard to overcome in order to go sailing. The glider has to make tight turns in order to climb and gain height in thermals, and to be allowed to go solo a pilot has to have done some limited stalls and recovered from them. Many pilots enjoy doing aerobatics but I do not, so I was resigned to being only a passenger. Even then I was too light and had to struggle and carry a lump of lead ballast as well as the parachute.

When Grob produced their G109 motorglider I got more interested in flying, but only as a means of travelling. I thought it would be useful to have a Private Pilots Licence and that it would be a good alternative to travelling on business by train. I quickly realised that the British weather is not reliable enough, and I could risk spending hours sitting on airfields waiting to fly. It was also much more expensive per mile than driving. And I would still have to pass the nasty aerobatics tests.

## 21 Starting my Career

Coming to the end of my three year DPhil grant it was time to think about finding a job. There was never any idea of staying at home, perhaps going on the dole, and completing the DPhil there. I had been brought up that everyone worked. It was a duty. Being married made no difference.

At Oxford there is an excellent careers advisory service and many of the leading organisations make a special effort to recruit bright Oxford graduates. I was deluged with ideas for what to do, and information from a wide range of different organisations. It seemed to me that traditionally Oxford women mathematicians went into teaching, accountancy or the Civil Service, depending on their ambitions and ability. Before I was married my parents had wanted me to go back home and become a teacher in the local school, but I always knew that I could not limit my career to that, either geographically or academically. Accountancy did have some attractions, and several colleagues from St Hilda's College had taken that route and recommended it as a career. It meant moving to London and going through another serious set of exams. However if successful and after several years studying, then the rewards were great and the possibility of management consultancy and working with a range of different companies was an attraction. But I had enough of learning and exams, for the moment anyway. There were opportunities for graduate recruits in the banking sector, with the additional bonus of a cheap mortgage as an attraction. It was tempting as a short term job, while I looked for something better, but I did not see myself limited as a career bank manager. Some of the major IT companies came to Oxford looking for recruits, including ICL and the research group at IBM. I was sure that I wanted to continue working in computing, preferably on the innovation and research side, and the challenge was to match that aspiration with a suitable job vacancy. Unfortunately you can only apply for a job which is vacant. Going to work in industry had less appeal for me because I wanted to do something to contribute towards improving the quality of life of the country, not the share value of an international company. I was also arrogant enough to expect that a First Class degree from Oxford, followed by a DPhil, was a key to opening the doors to the most exciting jobs available.

In the spring of 1976 I filled in application forms for the Civil Service Science Group and for a number of Research Fellowships and waited impatiently to see what happened. Eventually I had invitations to attend for interview, including at the Government Communications HQ (GCHQ) at Cheltenham, and at the National Physical Laboratory (NPL) at Teddington. I had to look at a map to find out where Teddington was. But first there was an initial interview for NPL, held in Oxford, at the Randolph Hotel. I had never been inside the Randolph Hotel, although we had sometimes had a drink in the outside Bar. It was the best and most expensive Hotel in Oxford, and my parents always preferred to stay in a simple B&B down the Iffley Road. Built in 1864 its large gothic designed brickwork dominates the corner of Beaumont Street. It contrasts with the famous Ashmolean Museum opposite, built 200 years earlier. I marched up the steps to the Reception desk and after an exploration of the rabbit warren of corridors was soon demurely seated outside the interview room. This was the traditional first stage, and there I was interviewed by Mr Jackson, the Head of Personnel, accompanied by a young graduate scientist who already worked at the NPL. The meeting went well, and I left with a positive impression.

The interview for GCHQ was at Cheltenham, but I did not see anything of the bright lights of the town; it was all work. It involved several days with a group of other hopeful candidates doing a series of exams, trying to identify aptitude for coding work, interspersed with interviews. I knew very little about the theory of coding and tried to solve the unusual problems from first principles, which was not a very successful strategy. I ran out of time in the tests and was frustrated by my lack of success. My Mensa score of 163 did not help me here. In their turn my interviewers were not impressed with my incomplete approaches. I did not enjoy the intellectual challenges of the work and was not going to be very successful or happy if I worked there. I was not surprised when I was rejected. I was the wrong shape peg for their particular hole.

I also applied for research posts. As a brand new post-doc the first step towards becoming a permanent academic at a University was traditionally to establish academic credentials. This meant taking a series of short term research fellowships, each usually for three years or less, and presenting papers at conferences and publishing in learned journals. There were few research fellowships around in my subject area and so I applied for everything, including the McIlrath Junior Research Fellowship at St Hilda's College. It was only a short term research contract but St Hilda's College was special. I wanted desperately to stay and continue my research at Oxford, and would have liked to have continued at my old College, where I had been so happy. However competition for research fellowships at Oxford is intensely competitive, even when the fellowship was limited to women. It is not enough to get a First, it has to be a really good First, and follow that with exceptional sparkling research work. Going back for interview to the tutors who knew you only as a quiet hard-working undergraduate was more difficult than I expected. I was duly interviewed, but I was not successful. I learned then that I was not good at spontaneous interviews and that even with preparation I could easily be wrong footed and tongue-tied.

Some time later I learned that Professor Fox was asking the Wolfson Foundation at the same time for a research grant to support an extra member of staff in the area of my research work. I still have a copy of the proposal 'Computer packages for the Stefan problem' requesting £66,000 over 3 years, with the programming part of the work being costed at £12,000 for one person over the 3 years. It is a well written proposal, but he did not succeed either. Looking back, I don't remember being seriously interested in his three year grant for a programmer; if I couldn't go back to do research at St Hilda's College then I wanted a proper long term job.

When looking for a job I had made the mistake of applying to organisations which I wanted to work for, rather than thinking about where I had the contacts and how I should use these contacts for advice and networking. Everyone I knew had made their career in the organisation where they first worked, and so I wanted to be careful that I made the right first choice. Of course, at that age I believed I would be successful at anything and everything, so the GCHQ experience had dented my confidence, which was probably no bad thing. In contrast, the interview at the NPL was very relaxed and civilised. I had plenty of time to drive down to Teddington for the interview in the morning. The interview panel included Mr Jackson as Head of Personnel, who I had already met, Dr Martin who was in charge of the numerical analysts, and a principal scientist Dr Cox. Although too young to have worked directly with Professor Fox, they did know of my abilities and had already received a recommendation of my qualities from him. Professor Fox had been a senior scientist at the NPL from 1945 to



1957 before moving to set up the Oxford University Computing Laboratory. After my interview I was invited to stay for lunch in the staff canteen in Glazebrook Hall where Maurice Cox continued the interview informally. We found that we had attended some of the same conferences, and had academic friends in common. I did not know then that I would be working closely with him when I joined the NPL. Although some 10 years older than me, he had recently been awarded his PhD, having submitted a thesis on Numerical Methods for the Interpolation and Approximation of Data by Spline Functions to City University in 1975. So he was sympathetic about what was involved in juggling a full time job and writing a thesis. He had been working at the NPL at the same time as carrying out his research whereas at least I had spent my 3 years concentrating only on my research project. I remember thinking that the NPL was an extension of being at Oxford; with the simple comfort food on the lunch menu, including a hot sponge pudding and custard. The work sounded interesting, the location was pleasant and rural, and the people were friendly.

The interviews must have been satisfactory. On 21 April 1976 I received a letter from the Civil Service Commission recommending me for appointment as a Higher Scientific Officer at NPL, to join the Division of Numerical Analysis and Computing. This is the normal grade for a raw post-doc and the starting salary was to be £3254 plus £275 Outer London Weighting, and with an additional supplement of £313.20. This made a total of £3842.20, not forgetting the 20 pence ! It was a similar salary to having £12,000 over three years at Oxford. Two days later I received a friendly letter from the Head of Personnel at the NPL hoping that I would decide to join and I sent back a holding reply on 5 May.

I did not accept the job at first because I was going to be interviewed for an Atlas Research Fellowship jointly between the Rutherford Laboratory at Harwell and Pembroke College on 20 May. These joint Research Fellowships in numerical analysis and computing were described as Atlas Fellowships, after the original Atlas computer, and are based with different Oxford Colleges, from memory three different Colleges. They have an advantage that the College Fellowship is held jointly with a Government Research Establishment, and at the end of the grant it is often possible to join the permanent staff at the Rutherford Laboratory. The Fellowships are valid for some 3 years and so only become vacant on that timescale. St Hilda's College also had an Atlas Research Fellowship but the timing was wrong for me. Only the one at Pembroke College was vacant and in 1976 Oxford Colleges were not yet mixed. I knew that Pembroke College was only able to accept women as lecturers and not as fellows, so I told myself that I did not really expect to be successful. But if you don't apply then you can't win. The NPL agreed that I could delay my response to their offer, which was very kind. I therefore delayed my decision until 27 May when, having been unsuccessful in getting the Atlas Research Fellowship and with no other interviews on the table, I accepted.

## 22 Moving House from Witney to Didcot

It was then that the consequences of working at Teddington hit me. We had a pretty Cotswold stone cottage in Witney which was an impossible location for commuting to the new job. It would have been possible for Harwell, Swindon and Oxford, but not to Teddington and the edge of London. Pete and I had already agreed that we would probably have to move, and that it was going to depend on where we were both working. Now I was organised, but Pete was still working in Oxford, and would be there for at least another year, so we started looking for somewhere within commuting distance of both places. We had one car, and did not want to buy a second car, so one of us had to commute by train. Pete said he needed the car because he was working half the week in Oxford, and half at the Rutherford Laboratory in Harwell.

Half way between Teddington and Oxford would have meant moving to somewhere like Ascot or Bracknell, and we were limited by our budget. These areas are expensive. Reading had good train routes, but we did not like the town and the long rows of cheap terraced houses were disappointing. There was nowhere suitable within our price range and within walking distance of the station, so we looked further along the main railway line towards Oxford. The next place along the main railway line is Didcot, which was then a small commuter town on the edge of the Downs. Houses were cheaper and we eventually found a modern semi-detached house on the south edge, looking directly out onto the Downs. The house did not look much from the front but the previous owners had built an enormous single-storey extension on the back, so there was a beautiful large new kitchen. We had a few unexpected problems sorting out the details of the planning permission for the extension, but it did not delay the purchase.

We had been lucky that our cottage in Witney had actually appreciated in value during the two years whereas more standard boxes on the housing estates had not. It was also a very nice little cottage, with a lot of character, with the only disadvantage being it had a small downstairs shower room, and no bath. We advertised it for sale in the usual way, and then a private buyer turned up on our doorstep who knew the house. The family had lived there in the past and they had heard on the grapevine that it was for sale. We discussed the price and shook hands on the deal.

The site of the new house in Didcot was ideal in many ways. We could walk out of our back garden gate directly onto the public footpath along the edge of a field and this was perfect for our cat, Topsy, and her hunting. Although Witney was a large market town with lots of traffic, we lived in a side street which was very quiet with no through traffic. In Witney the cat did most of her hunting in the rough ground beyond our garden, which was full of rubbish and scrap. Before he retired it had been a yard which was used by a scrap dealer who lived further down the road, and the vehicle access was along the side wall of our house. In our new area, on the edge of Didcot, the streets were also quiet and there was little risk to her from the traffic. However there were other cats in nearby houses and our poor little cat suffered from the unwanted attentions of a large bully who came into our house through the cat flap and ate her food. She used to hide on the top of the kitchen wall cupboards. After chasing the bully out of our kitchen several times we decided that it was time to go into battle on her behalf. One day the other cat was in the house and Pete put a large pile of bricks on the other side of the cat flap, and then came into the house, shouting. The cat quickly ran at the cat flap, bumped into the pile of bricks, and was travelling so

fast that they all scattered in the garden. He must have had quite a surprise followed by a headache, and never came back into the house again.

Moving up from a terraced cottage to a semi-detached house was a good move, but commuting from Didcot to Teddington by train was not. The quarterly season ticket was very expensive, and for the first month I struggled with the journey, changing at Reading and then getting off at Feltham and catching a number 285 bus to the NPL. This was not very reliable and I decided to do the whole journey by train. In those days the trains ran to a sensible timetable and I got to know the finer details of the connections at Ascot, Staines, Feltham, Richmond and Twickenham. I used to leave home just after 6 in the morning, and was back late at night. It was good to be able to work on the train since I was very busy writing up my DPhil, but getting off one train and catching another was tedious. I also learned how to ride a moped so that on day trips I did not have to walk between the house and Didcot station, but I was forever worrying whether it would start in the evenings coming home. When I was really tired I stayed at a B&B near the NPL overnight, an expensive option. Eventually I was introduced to a colleague, Bridget, who worked at the NPL and who rented out her spare room. I stayed with her during the week and commuted home at weekends. From Bridget I re-discovered my needlework skills. She had made a number of beautiful cushions, and one was made of wool embroidered in a cobweb stitch. I admired it and she told me about a local shop which sold the kits. That solved my Christmas present, and I eventually made two - a yellow one and a pink one.

## 23 Starting Research at the NPL

But this is all getting ahead of my story about working at the NPL.

I moved my bank account from Oxford to Teddington and joined the NPL in November 1976, which gave me a month gap after finishing my grant at Oxford to get organised in the new house in Didcot. I was very much aware that it is only permitted to have a few extra months to complete my DPhil, and that it had to be all agreed, typed and bound within four years of starting. So this meant a deadline of October 1977. I hoped I could work well to deadlines.

I had naively expected that the day to day life as a scientist in a Government Laboratory would be similar to my experiences at Oxford and CERN. In 1976 the NPL was part of the Department of Industry, although it had previously been part of the Department of Trade and Industry (DTI), and would be part of the DTI again later. On my first day I arrived as instructed at the Main Gate, at the Queens Road entrance. On arrival I was presented with a copy of the Official Secrets Act, for signature. At the time, the rules on dealing with official documents and their publication were not an issue. As far as I was aware I would not be doing any work classified as Secret, and I did not expect to provide two copies of any publication, certainly not a book, to the Department of Industry. I am reading the small print now with more care ! Completion of my DPhil while working at the NPL had already been agreed, and there was no interest from the NPL library in having a copy of my eventual thesis. And anyway I was supposed to be completing the thesis in my own time.

Much of my official research work would be limited by commercial considerations with a strong emphasis on doing 're-payment' work, which meant solving problems for industry and other research organisations at real commercial prices and under real commercial pressures. Care was needed to make sure that publications in learned journals and elsewhere did not divulge sensitive details. There was extensive reading of articles for publication before they were allowed to leave the NPL; approval had to be made by the Superintendent who was the Head of Division, in my case Ernie Albasiny. Research scientists were still actively encouraged to publish, with the increasing political pressures on showing that their work was indeed of value.

In 1976 the NPL site was an interesting one. It is on the edge of the Royal Park at Hampton Court, Bushy Park, and contains Bushy House which was built in 1663 and said to be designed by William Samwell. When the NPL was founded in 1899 the House was given by the Crown to be the home of the new laboratory. It was adapted for physics and metallurgy laboratories on the ground floor and in the basement, whilst the Director's apartment occupied the upper floors. When I arrived the building was a Museum, although the Director's apartment upstairs was still functional. There was a fine painting of Ada Lovelace on display; she was famous for having written a description of Charles Babbage's early mechanical general purpose computer, the analytical engine. She was therefore in many ways the very first programmer. The site was large and spacious with an active Sports Club. It was an oasis of green on the edge of London, with deer grazing in the distance. I was told they became a hazard wandering on the roads at night.

The laboratory buildings came from a variety of different architectural styles, depending on their vintage. Formerly Mathematics Division and established in 1945,

Numerical Analysis Branch of the Division of Numerical Analysis and Computing (DNAC) was located in Building 21. Building 21 and its neighbour Building 23 were originally built for aerodynamics research in 1916 and 1918 respectively. Building 23 then contained the Duplex Wind Tunnel and Aero Workshop, and was converted in 1961 into a restaurant and conference centre and renamed Glazebrook Hall after the first NPL Director Sir Richard Tetley Glazebrook. The NPL had a Main Library and DNAC had its own specialist library in the centre of part of Building 21, with offices arranged on a gallery around the edge. Only the senior established staff were in this part of the building, and these offices were re-allocated only when staff left or died. Most staff at the NPL were committed to work there for life, and many staff continued to come to work even after they had retired. For example the famous Professor James H Wilkinson, a rare Special Merit Chief Scientific Officer, kept his office well after retirement. He was rumoured to come to work by bicycle, but I never saw him. I was given a small office to myself in a quiet corner. At least it was my own office, and I did not have to share it with anyone. The Head of the Numerical Analysis Branch, Dr David Martin, was my line manager when I first arrived.

The NPL had traditionally been at the forefront of computer science research and these specialists were based in Building 93, which was a brisk five minutes walk to the other end of the site. Famous staff from those days included Donald Davies with his influential work on packet-switched data which became the basis of the Internet, Donald Bell who went on to become the Director of the National Engineering Laboratory at East Kilbride, Brian Wichmann who developed new computer languages, and Chris Evans who worked on microprocessors and wrote *The Mighty Micro*, which discussed how people's lives would be affected by the new microprocessors.

Many years later, and after his death, I obtained a copy of *The Mighty Micro*. It must have been very popular because my copy is the Fifth Impression, dated December 1979. It was the basis for a series of six TV programmes, so that must have widened his potential audience. After some useful historic background to the computer revolution, which he defined as beginning in 1975, the interesting parts are about his predictions for the short term, middle term and long term future. In this context, long term meant 1991-2000, some 25 years ahead of the date of the book. The book was provoked by microprocessor technology being in common use, and foreseeing a continuation to the exponential reduction in size and increase in speed. Applications were still predominantly numerical and here it was not obvious that calculations really needed to be carried out much faster. There are obvious areas where speed does matter, for example in numerical weather forecasting, where traditionally the fastest and largest computers had always been purchased. He expected that the main impact of microprocessors was not going to be in traditional number crunching, but in products which reached into mass markets. In the short term, gadgets and gimmicks were predicted, and these have certainly developed although not always obedient to his timescales. Of course, fast graphics which would support home computer games opened up new markets and established a breed of sedentary children who spent their time with keyboards and joysticks. The reduction to the working week and an earlier retirement age, were seen as obvious consequences of the reduction in workforce as the new technology replaced jobs. These redundancies would not only be in the junior and manual grades; professionals in medicine, law and teaching would all suffer as their specialist knowledge was encapsulated into computer programs. It is a good book to revisit now and look at the predictions from a position of knowing what

actually happened. Extrapolating the potential of a new technology is notoriously difficult.

Artificial Intelligence was emerging then as an important strategic technology, with obvious moral and ethical considerations. The Turing Test for Thinking Machines, proposed in 1950, was the litmus paper to decide whether a machine is self-aware and conscious, and did so by a conversational discussion which actively compared the responses of the machine and a real human being. Researchers at the NPL were very aware of the work of Alan Turing because he had joined the NPL immediately after the Second World War to work on the design of a large automatic computing engine, the ACE. He made the first plan of ACE and carried out a great deal of pioneering work. This was the first practical realisation of his logic theories and it laid the foundation for all modern computing. However his vision was of a computer and programming which could simulate mental processes, whereas the NPL only wanted to perform calculations. The consequences of these different views were inevitable. Turing left in 1948 to continue his work at Manchester University, and ultimately died by suicide in 1954.

Building 93 was built in 1965 as Autonomics Building to house the site computer and was typical 1960s architecture. Joint seminars were held there but the physical distance between Building 21 and Building 93 meant that I had little contact with the staff there. Soon after my arrival the two parts joined to make the Division of Numerical Analysis and Computer Science (DNACS). The overall Head of the Division, called a Superintendent, was based in Building 93, safely out of day-to-day contact from us, and Management by Walking About had not been invented. Some of the scientists around me said that the post of Head of Division was best suited to a failed scientist, rather than a successful administrator. I was told that it had been difficult to persuade any NPL people to apply when the post became vacant, but that was only gossip and may not be true. I thought it would be a good job, and might suit me later.

Having been used to state-of-the-art mainframe computing facilities at CERN and Oxford it was with some shock and disbelief that I found out that I would have to use an English Electric KDF9. Oxford had owned a KDF9 from 1965 until 1971, when it was replaced by the ICL 1906A. The KDF9 had been a modern computer in the 1960s, but was well past its sell-by date by 1976. Or so I thought. However I settled down to use it and found that the excellent staff of the NPL Computing Services Unit had managed to produce a reasonable service.

Writing up a DPhil is a struggle. Having done most of the practical numerical work the final stage should be the writing. But it is during that writing when it is inevitable that gaps will be found in the numerical work, and these have to be addressed. During 1977 I was very busy completing my DPhil and although I spent 80% of my official time on specific NPL work, I also spent 50% of my time on the DPhil. This sounds like an error in arithmetic but it was possible because remember I was spending 2.5 hours each way each day sitting on a train – we were still living at Didcot. It all added up to a lot of potential working time, and the same number of extra hours work was done on the days when I stayed overnight at Teddington. It was all very hard. Fortunately I still had access to the ICL 1906A computer at Oxford and the larger CDC computers at ULCC London to programme new ideas and explore extra areas. The elderly NPL KDF9 was too small and slow for the extensive finite element calculations I needed to do for the DPhil.

After several iterations of text between Teddington and Oxford, lots of time spent on the telephone agreeing changes, and several depressing visits to Oxford to discuss progress, I eventually took the top copy along for photocopying and binding. I finally submitted my DPhil thesis in August 1977. It would have been impossible without the support and encouragement of my husband, and he waited anxiously to see what happened to my thesis. Soon afterwards I was invited to attend for the viva voce, all dressed up in my Bachelor of Arts gown and cap and the formal sub-fusc clothing: white blouse, black tie, black skirt, black stockings and shoes. The formal interview interrogation was carried out by Dr David Mayers, who also had to dress in the formal way including a white bow tie, and Professor John Crank from Brunel University. There is always an external examiner, and I was pleased that it was going to be Professor Crank. He gave his name to the famous Crank-Nicolson method used for solving partial differential equations, particularly the heat equation. I was reasonably confident, and managed to defend my work successfully. While it was not a DPhil which was exceptionally brilliant work, it was solid enough to be approved. It was indeed new ideas and new methods, but novelty should not be the only criteria for a successful research candidate. My impression was that Professor Fox had become careful that his students did not submit a thesis until their level of work was satisfactory. In my time one student had been forced to go back and do extra work and rewrite his thesis. No one wanted that to ever happen again.

Once I had been successful, I assumed that the next step was to take the DPhil work and use it as the basis for publication. I wrote a short paper titled An Iterative Technique for the Numerical Solution of Moving Boundary Problems. It never did get published as part of the NPL report series, but it helped me prepare talks about my work. Other academics were curious about what I had researched and the results I had obtained. A thick DPhil thesis is not an easily digested document, even by other numerical analysts, and much of my thesis was not good material for a seminar. The important discoveries had to be extracted and highlighted.

Shortly afterwards I received my first invitation to give an external seminar. It was at University College London, in January 1978, and my title was Recent Developments in the Numerical Solution of Direct and Inverse Classical Stefan Problems. It was a coincidence because UCL had been my third choice for University, if I had not been accepted at Oxford or Cambridge. I knew that I needed to produce a professional presentation, since I was an ambassador for the NPL now, and not just a set of rough hand scribbled OHP slides. Deciding what to write on the slides was easy but getting them to look nice was more difficult. Eventually I bought a set of stencils and an old-fashioned nib pen and black ink, and laboriously drew each letter on white paper. It took days and days of careful crafting, and I had to finish it at home in the evenings. Then the result was photocopied onto clear acetate. This meant that it would be preserved for future use - I was young enough to be hopeful to get a lot of invitations to give talks.

At Oxford I had suffered good and bad examples of best practice in presenting lectures. I realised that the best researchers are not always the best speakers. The same applied to seminars. As well as the excellent academic staff at OUCL there were others at Harwell and elsewhere who regularly reported on their research work. Of these I was especially impressed by Professor Mike Powell, who had the reputation of never giving exactly the same paper twice. He went on to become Professor of the Department of Applied Mathematics and Theoretical Physics (DAMTP) at

Cambridge. I was determined to try and base my approach on the best of those around me. Even in those early days I saw the presentation of a seminar as an occasion which demanded very careful preparation, and in many ways resembled a theatrical performance. The slides had to be clear, legible and well written, with just the right amount of information. I found I needed to do several practice runs, to check content and timing. The only difficulty with all this rehearsal work was how to deal with the inevitable Question and Answer session at the end. I had seen many academics who deliberately made their presentations so long that there was no time left for questions. That approach appealed but did not seem honest. I hoped to learn how to defend my work if I had more practice with Questions and Answers. Unfortunately there was no training offered on how to do presentations, and it was only several years later that I went through a formal course. By then it was too late and I had learnt to cope.

Inevitably I was invited, or rather required, to give one of the colloquia at the NPL on the work of my DPhil. NPL did not do seminars, only colloquia, although I would find it difficult to explain the precise difference. I have found the slides of that presentation and believe that the talk was also presented at OUCL in 1978. The title of the talk was Numerical Methods for Heat Conduction Problems involving a Change of Phase. There were three examples considered: freezing of spherical hailstones, spot-welding of metal sheets and thawing of fish fingers.



## 24 Getting to know NPL colleagues

Because we lived a long way from Teddington I never got involved with the social side of working at the NPL. Staff who lived nearby were able to use the sports facilities at weekends, and many played for the NPL in competitions. The Civil Service has a strong traditional of competitive sports.

When I first arrived at the NPL I had more in common with the applied mathematicians who were working with partial differential equations than the data fitting group. One of the important daily rituals was to meet for coffee, and everyone in Building 21 met in the coffee room on the gallery floor. At CERN and at Oxford I had seen that the morning coffee break was an important social time when people could meet to discuss new ideas and approaches to their research, or simply talk about the sports results from the weekend. I made sure I remembered to go and meet everyone for coffee.

Many people at the NPL lived within walking or cycling distance of the Laboratory, and went home for lunch. Those who were having problems with the costs of living near Teddington brought their own sandwiches. I was one of those who paid for lunch in the canteen, and quickly joined a small group of colleagues who ate early. Having left home early I was ready for a very early lunch. On Fridays the lunch group often went out to a local pub. Without a car I had to hitch a lift but that was never a problem. Our favourite pub was on the edge of the grounds of Hampton Court Palace where I remember being introduced to the local speciality: prawn and asparagus sandwiches with a pint of either Ruddles County or Fullers ESB. Sometimes a few of us walked across to the Queen Dowager instead, which was just outside the NPL Main Gate.

When I arrived the working hours were not regulated. It was expected that everyone did at least 36 hours each week, and normal working hours were 9.00 to 17.30 on Mondays to Wednesdays, 9.00 to 17.00 on Thursday and 9.00 to 16.30 on Friday, with an hour for lunch. With the traditional research culture I am sure that most people worked much longer than the standard 36 hour week, just like everyone did at Oxford. The NPL Administration suddenly proposed a system of flexible working time, whereby arrival at work was monitored by use of a yellow plastic key which was pushed into boxes scattered around the site. We had one in Building 21 and there was another at the canteen so people could record the start and end of their lunch breaks. It was not compulsory but several of us quickly saw the advantages and joined. Core compulsory working hours were defined as between 10.00 to 12.00 in the morning and then 14.00 to 16.00 in the afternoon. A minimum lunch break of 30 minutes was a legal requirement and with flexible working it could be up to 2 hours. This enabled me to go off by train to Kingston-on-Thames to get my hair done at Bentalls department store without feeling guilty that I had taken too long a break for lunch.

In spite of the occasional long lunch break I quickly found that I was indeed working well over the 36 hours each week, and in this situation it was possible to store hours and then ask for time off in lieu. So I could work very hard for several weeks and then take a day at home on leave, providing my line manager did not object. As a new recruit I only had four weeks annual holiday in the beginning so the potential for extra days was useful.

## 25 Moving House from Didcot to Farnborough

We only stayed in Didcot for a year. We expected a change then because Pete had a research grant at Oxford for just the twelve months, and then needed to find a job, and when I started at the NPL he had no idea where he would be going. In fact, he moved to work at the Royal Aircraft Establishment (RAE) at Farnborough in September 1977, and we were offered one of their 'tied' houses to rent. We moved all our possessions with us to Farnborough and kept our fingers crossed for the sale of the house in Didcot. Unfortunately the house took several months to sell; it was not very interesting from the front and many potential purchasers just drove past. Once we had got them to ring the doorbell and look around then we found people were much more interested. It was the large kitchen which had sold the house to us, and which sold the house to the next owners.

We soon settled in to Farnborough. In those days the RAE had a very active Staff Mess and Pete became a member; now it has all disappeared. Pete and I played tennis at the RAE Sports Club, but only between ourselves and not competitively. We also played table tennis and billiards in the Staff Mess. I usually lost, but it was often a close match. In the beginning there was a canteen which served very cheap evening meals, and some days we ate there. It was really intended for the staff who lived in rooms at the Staff Mess and was an idea left over from the days when accommodation was automatically provided for staff until they found somewhere of their own. Some people lived in accommodation in the Staff Mess for their whole career. It was very cheap.

We went along to the Bar once or twice each week, and there was an excellent cellar from where bottles of wine and spirits could be purchased to take away. We tasted some excellent old Spanish Gran Reserva Rioja, as well as decent French clarets. We still have just one bottle of the Berberana Gran Reserva 1970 in the cellar; all the 1966 and earlier has been consumed. Another local source of good wine was the Army and Navy Department store in nearby Camberley. One Christmas we had the chance to purchase some of their 1973 clarets: Chateau Liversan and Chateau la Lagune. It was one of the few occasions where we disagreed. I liked the Chateau Liversan whereas Pete said that although the Chateau la Lagune was disjointed at present it was going to develop into a beautiful wine. He was right. Pete's mother had a nice house in Bath, with a proper wine cellar, and we were able to hide away several cases of wine until they were ready to be drunk. Fortunately she did not drink.

During the year there were social events organised, including several Wine and Cheese Tastings. We were interested in wine and had a subscription to the magazine *Decanter*, and we always visited the famous annual Bristol Wine Fair. The first time we attended a tasting at the RAE we treated it just like attending other wine tastings - take just a small sip of wine number 1, write some notes then go on to try wine number 2, etc. We soon noticed that people were drinking the wine, rather than tasting it. French bread and different cheeses were just left on the tables, each matched with a particular wine, and it was a matter of helping yourself. After several hours the music started and people began to sit around the room, instead of standing around the tables. Then the wine started circulating in baskets, until everything which was available was consumed. It was a very jolly evening and we got to meet a lot of fellow wine lovers. Thankfully it was always at a weekend, so we did not have to go to work the following morning. When there was the General Election on 3 May 1979 there was a

similar wine and cheese party, except that the white wine was all coloured with a blue dye, so the choice was between red wine and blue wine. This was a pity because there was one white wine, Lamberhurst Priory 1976, which was beautiful. The summer of 1976 had been exceptional in England and had resulted in high sugar levels in English grapes. Everyone said how good it was and wanted to buy some from the cellars to take home afterwards. Unfortunately there was just one bottle left, so it was auctioned. We also found another interesting wine in the cellar, Chateau Musar from the Lebanon. With imagination it was possible to taste the gunpowder in it.

Eventually the house in Didcot was sold, and then we looked around urgently for a nice place of our own in Farnborough. We were keen to get out of the 'tied' house, which was a mid-terrace on an estate of similar houses in Keith Lucas Road. Firstly, it was too small and some of our furniture was still kept in store with family. Secondly, buying a house was a much better investment than having cash from our sale earning interest in the bank. Originally limiting our search to semi-detached houses we realised that we might be able to afford to make the step up to a detached one. We looked at a new link-detached Georgian-style house, one of many in a little cul-de-sac, but it was very small inside and its kitchen was just a narrow corridor with kitchen units along the one side. Then we saw an older detached house in Reading Road, with a separate garage and a large back garden. It was perfect, just within our price range, and we managed to get our offer accepted as the house prices took their lurch upwards in 1978. I remember sitting on the doorstep of the estate agent in Farnborough early on the Saturday morning so that we could make sure that we had our offer accepted and were not gazumped by someone else contacting them by telephone. We were fortunate that we were a cash buyer, so that was in our favour, and once the price was agreed the vendor kept his side of the bargain, although he could have got a higher price just a few weeks later.

It was only one mile between the two houses and we decided that we could do our house move ourselves. We arranged to have one month overlap, when we had both houses, and a friend let us borrow his trailer. It took much longer than we expected to get everything moved in, and there were large items which we could only move with help. We bought an old chest freezer from a friend who was emigrating and installed it into the garage, once a proper electric cable had been installed. Our old front loading washing machine soon joined it. There were the occasional floods and so it was better for the washing machine to live outside in the garage, instead of in the house. As we explored the area we found a nice delicatessen only a few yards away, run by a friendly Italian, Luigi, and his English wife. They kept an excellent range of cheese, salami, Italian coffee beans and cooked meals. We had a saying that we wanted a 'Luigi half pound' of cheese - which was about 12 ounces. Everything which Luigi sold was larger than usual.

We were not very rich, with a large mortgage and two salaries on the lower levels of the Civil Service pay structure. My husband Pete would have just completed six months at the RAE in March 1978 when it was his birthday, and he was informed that his annual holiday allowance would, by tradition, start in March. This gave a problem because he had half a year of holiday to take before the end of March. Some days could be carried forward into the next year but it still left us with the problem of where to take 1 week holiday in February at short notice. We chose to go to Tenerife, to the Hotel Florida in Puerto de la Cruz, and this was the start of a regular annual holiday in the sun each February.

Commuting to the NPL from Farnborough was much, much easier than from Didcot. It was not far from the house to cycle to the main Farnborough station, and then it was only a short direct journey to Surbiton, from where I cycled to the NPL. I bought a nice fast lightweight racing bike which kept me fit, and I travelled with it in the guards van. It had a label with my name, and this said Dr P Curtis, so I sometimes found I was asked the most interesting medical questions on my way to work.

We often had Pete's colleagues from the RAE to our house in Farnborough and, in spite of the distance, I suggested we should begin to extend the same hospitality to colleagues from the NPL. My boss was Dr David Martin and so I invited him, and his wife, to come to dinner. I always enjoyed cooking something special for visitors, and wanted to impress. I was still only a Higher Scientific Officer whereas David was a Senior Principal Scientific Officer, three steps above me. He was therefore very important. No-one had told me that he and his wife were allergic to cats, but our cat knew. We were sitting happily in the front room, with the standard glass of dry sherry, when Topsy walked into the room. She took one look at David and put her paws around his leg, then proceeded to bite him. There was a howl, and not from the cat. She was put outside in disgrace, but the atmosphere of the meal was destroyed. Thankfully it didn't seem to make any difference to our working relationship back at the NPL.

Later I transferred across to the Data Fitting Group, led by Geoff Hayes and working with Dr Maurice Cox. Geoff invited everyone to his house one evening, I think it was just before Christmas, and that was the only time when Pete and I visited one of my DNACS colleagues. Sven Hammarling, a senior lecturer at Middlesex Polytechnic, spent some time working as a visiting research fellow at the NPL, and we were invited over to his house one evening. He was an enthusiast for the music of Stephane Grapelli. I had never heard violin music like this before, and we became enthusiasts too.

## 26 Research Contracts

As at Oxford, attendance at conferences was encouraged although it depended on getting approval for the expenditure from the Superintendent. For example, I was able to attend the Institute of Mathematics and its Applications (IMA) conference on Numerical Methods in Applied Fluid Dynamics at the University of Reading in January 1978. This was handy because it was easy to get from Farnborough to Reading by train, and the ticket to attend the conference was very cheap. I did not need to stay at a hotel in Reading, and I was an Associate Fellow of the IMA and so got a reduced conference rate. It was essential to keep up to date with research methods and keep a watch on potential new interesting mathematical problems, which could lead to contract work. I went with Dave Ferriss from DNACS who had a lot of experience in solving industrial problems and I was keen to listen to a range of problems from other academics and industrialists.

I also went back to Oxford each Easter to take part in the Oxford Study Group with Industry meetings, and was invited to take part in a conference at Durham in July 1978 on Free and Moving Boundary Problems in Heat Flow and Diffusion. Professor Fox still kept an interest in what was happening at the NPL and I suspect it was because of my contact with him that I was able to persuade the NPL to pay for me to attend both meetings.

Having been employed for well over twelve months, I discovered that the NPL carried out the standard system of annual staff reporting which was pervasive throughout the Department of Trade and Industry, and I was required to apportion my time during the year to different activities. I wish I had known when I first joined because I would then have kept records. The following lists give some idea of what I had been doing since I arrived in 1976, and shows roughly 25% of my time had been spent relating to my DPhil work, and the rest was directly charged to specific consultancy projects, so-called repayment work. It also shows that I included time spent attending the Oxford Study Group with Industry meetings, held over the Easter vacation. The industrial problems brought to these meetings had the potential to develop into consultancy work. In addition it was tactful to keep in good contact with Professor Fox and the Oxford University Computing Laboratory while I was still writing up the DPhil.

### Achievements during my first year at NPL - 1977

Familiarisation with NPL computing systems	10%
Analysis of aircraft engine performance (for MOD)	40%
Calculation of alcoholometric tables (for Customs and Excise and LGC)	10%
Preliminary investigation of an axisymmetric flow problem arising from the separation of a foam into gas and liquid	5%
Consideration of the motion of a rotating fluid (for Met Office)	5%
Numerical solution of a system of ordinary differential equations (for Unilever Research)	5%
Research on the numerical solution of nonlinear differential equations for phase-change analysis	20%
Preparation of a seminar for the numerical solution of phase change problems	5%

Of these tasks, the analysis of aircraft engine performance for the Ministry Of Defence and the calculation of alcoholometric tables for Customs and Excise and the Laboratory of the Government Chemist were both serious consultancy projects, which I worked on alone, whereas the other smaller tasks did not result in much repayment income. The NPL implemented a policy that one or two days consultancy work was never charged for. My impression of the means by which repayment work was found was that senior staff had direct contact with people who sought our help, and negotiated the payments and allocated the work to the best scientist. Sometimes work followed from a letter or telephone call 'out of the blue' with a request for help, sometimes it followed discussions at seminars or conferences. The NPL was well known and the Numerical Analysis Group where I was working had a good reputation. It was an obvious source of expert help for other parts of Government.

At the risk of boring readers who are not excited by mathematics, a short outline of the two problems follows. The aircraft engine performance problem as received at DNAC was that there was an existing computer programme, written in the programming language Fortran by someone who had since left the Ministry of Defence Procurement Executive, MOD(PE), and which used to work and now did not. The mathematical problem was to take aircraft drag and engine thrust data and solve the minimum time-to-climb and minimum fuel-to-climb problems. The MOD(PE) wanted to apply this computer programme to the sort of aircraft which had engine data for dry, reheat and idle. Through attendance at the Farnborough Air Show with the gliding business, I had maintained an interest in new aircraft. I guessed that the programme was to be used to analyse the theoretical performance of the new fighter bomber Tornado IDS (InterDicator/Strike) and the interceptor ADV (Air Defence Variant). For the purpose of the investigation, artificial sample data was constructed which had the characteristics of the real data but was different. Investigation of the theoretical basis which underpinned the old computer programme led me to find that there were two types of trajectory - related to the changes which occur at the speed Mach 1. The mathematics reduced to finding the unique minimum of a function, and this function was computed by interpolating between the given data points. NPL had written software for such numerical optimisation problems and this was suitable, combined with spline fitting of the data. The end results of the research were graphs of the minimum time-to-climb envelope, which showed the best combination of height and speed as the aircraft strove to climb in the minimum time. A similar graph showed the matching curve for using the minimum fuel. MOD(PE) were able to use the formulae provided to produce various tables, and said they were satisfied with the results when they used real data. It was important that their new tables looked exactly the same as the previous tables, although the underlying mathematics and programming was very different.

I did not see a Tornado aircraft flying until I went to the Farnborough Air Show in 1980. The first Tornado prototype had flown in August 1974, but delivery of the first Tornado IDS, to the RAF, was only in June 1979. The first Tornado ADV prototype followed in August 1979. The Farnborough Air Show only took place every two years, and so 1980 was the first chance to see my wonderful fighter aircraft for real. Both the Tornado Multi Role Combat Aircraft (XX947, prototype 03, built in 1975) and the first F2 variant (ADV) prototype (ZA254) flew. We knew from the Air Show in 1978 that the aircraft would be flying over our house, often at low level and sometimes we could look directly up their tail pipe. It was very noisy during the formal flying displays. The Tornado was distinctive with its pair of engines, and their glow on reheat. Our cat hid indoors when it flew over.

For obvious reasons, approval had to be obtained from MOD(PE) to publish the theoretical details of the work and it was finally published in December as NPL DNACS Report 11/78 The Calculation of Optimal Aircraft Trajectories. I was very excited because this was my first publication, which was jointly authored with Dr David Martin. As my boss, he had dealt with the customers at MOD(PE), discussed my approach as the work developed, and had given some good advice on the various written versions of the report.

As an interesting contrast, the production of alcoholometric tables was traditional data fitting work in support of standards. The task was to produce a Spirits Table which gave a rapid means for determining the dutiable alcohol content of a bulk of spirits, of known alcoholic strength by volume, when its volume has been measured at some temperature other than the standard one of 20 degrees Centigrade. The user for the Tables was HM Customs and Excise and the computation was done by the Laboratory of the Government Chemist (LGC). Historically the gunpowder test was used to determine the alcohol content - if a mixture of gunpowder and the liquid burned, then it was 'proof'. After the introduction of the hydrometer in 1725 it was possible to use a more scientific approach.

Over the years, different countries had used different approaches. In 1975 the International Organization for Legal Metrology (OIML) published a formula which represented density in terms of temperature and percentage alcohol, and this was to be used to produce Spirits Tables which were to be used by everyone. In practice the temperature and density was known and the problem was to work out the percentage of alcohol, by turning around or inverting the OIML formula. In order to do this on a modern computer the various formulae in use had to be converted from the given unstable and unsuitable 'power series' representation published by the OIML, to a better behaved and equivalent representation using Chebyshev polynomials.

I was able to visit the LGC, then at Cornwall House in Central London, and see at first hand the analysis work carried out, and admire some of the more unusual substances which were found pickled in alcohol. It was not a difficult numerical task once the Chebyshev coefficients had been computed. My new Tables were printed by HM Customs and Excise in 1979, and the NPL DNACS Report 35/80 The Use of Chebyshev Polynomials for the Production of Spirits Tables was published in October 1980. The topic of alcohol and duty on spirits was deemed to be a very topical one at Christmastime and I was asked to write a non-technical article for the Christmas issue of the NPL News magazine. I found that I liked writing simple technical articles; little did I realise then that this skill was going to be essential for me in my career later. The results was also submitted to the OIML, and published in the OIML Bulletin in June 1981. So the delay from learning of the problem until the results were formally published was some 4 years. I still have no idea how much was paid for me to do the work.

As 1978 progressed I found I was doing less work related to the subject area of my DPhil, and more consultancy work, especially contributing to the Data Fitting Group. Looking at the balance of work for 1978, it was a mixture of completing existing work, and starting new problems. I got out more, attending conferences and giving presentations, and it became acceptable to allocate 10% of my time to reading journals and maintaining my technical skills. Previously all this had to be hidden in the work done for particular contracts. Initial discussions were also free, up to 5 days

investigation, and so several problems fell in to this category. Five percent of my year is only 2 weeks of actual work.

Achievements during 1978

Problem from MOD(PE) (Aircraft Performance Analysis) and writing of DNACS Report based on this work	35%
Problem from LGC (Production of Alcoholometric Tables)	20%
Algorithms for data fitting	15%
Algorithms for phase-change problems; attendance at Symposium On Free and Moving Boundary Problems (Durham)	10%
Investigation of hot-rolling problem (BSC) at Oxford Study Group with Industry meeting	5%
Work and advice on other problems including	
Conversion tables for LGC	
Freezing fish (MAFF)	
Transmission line modelling (Nottingham University)	
Algorithms for Partial differential equations	5%
Reading journals and attending seminars (including giving seminars at UCL London and OUCL Oxford)	10%

Colleagues at the NPL had always been concerned about my commuting by train and bicycle and one day Dr David Martin said that he had talked with other senior colleagues who operated a car pool from Farnborough and they had a vacancy. He suggested I ring Bernarr Hopkins, and gave me the number. I soon found out that Bernarr was very senior, one level higher in grade than David, and was Superintendent of the Metallurgy Division. To my delight he was very amenable to the idea of an extra member and suggested that I join the group and see if it worked.

Our new house in Farnborough was within walking distance of the RAE Staff Mess and the Main Gate, so Pete did not need the car. It just sat outside the house. I did not want to drive daily, the route went along the M3 which was busy at rush hour, but a car pool where I drove roughly once each week was perfect. I soon met the others. We had a new Austin Maxi, and I recall that Geoff Toothill had a wonderful new pale green Saab 95 which took off from traffic lights like a Saab fighter aircraft, Bernarr Hopkins had a Morris 1800 and Alex Williams had a Rover 2000. If I was driving I was able to leave the house at about 8.15, then there was a standard route to collect the others. If it was not my turn then I just waited to be collected. We lived close to Bernarr and so did not disturb the existing pick-up route. The arrangement worked very well, although when the weather was freezing I was easily persuaded to swap my turn with someone else. Just once I made a gentle slide sideways into the kerb and that cost me a new wheel. Geoff retired first, and the three of us continued together until Alex and I left the NPL. Bernarr and Alex both became very good friends to me, as well as colleagues.



## 27 Teaching with the Open University

Professor Leslie Fox celebrated his 60th birthday in 1978, and I was one of many of his students and friends who were privileged to be invited to join him for an excellent formal dinner at Christ Church College, Oxford. It was a good chance to meet up with colleagues and catch up with news. By chance, or was it deliberately, I was seated next to Dr Mick Bromilow, who had also been a DPhil student of Professor Fox and was just a few years older than me. All of his DPhil students had been informally labelled 'Fox cubs'.

This meeting with Mick had a profound effect on my career. When he left Oxford, Mick had joined the fledgling Open University, as a lecturer in the Mathematics Faculty at Milton Keynes. Recall that the Open University was created in 1969, as a brainchild of the then Prime Minister, Harold Wilson, and his Minister for Education Jennie Lee. As an organisation it was still in its growth phase, and one of the challenges was finding suitable part-time teaching staff. Most good academics were already settled in full-time teaching at their own Institution, and had little time for extra work. Although the course material and TV programmes were produced centrally at Milton Keynes, the actual face-to-face teaching of students took place at local centres spread throughout the country. Tutors had to be found in the local areas to teach these students. Mainly they were contacted by word of mouth, and often worked inside Polytechnics or Colleges of Further Education, rather than traditional Universities. Many of the early Open University students were school teachers who wanted to earn a degree. In the early years the Open University did not have enough of its own students who after graduation could then continue as tutors, so it had to recruit.

For practical reasons the country was divided into regions. I lived in the South Region, which was administered from a posh country house, Foxcombe Hall at Boars Hill just outside Oxford. Each Region was managed by a Director who had a number of Staff Tutors responsible for the teaching side, and a larger number of administrators who organised the students. I was interested in establishing my credentials as an academic, because I still had a lingering interest in going back to a full-time University career. Mick knew that I was good at numerical analysis, and I had done some undergraduate teaching at Oxford. As we ate our way through dinner he spoke about the work of the Open University and I expressed interest in becoming an Open University tutor.

Subsequently Derek Goldrei, one of the two permanent mathematics Staff Tutors based at Oxford, came to our house in Farnborough and interviewed me. It was a very friendly discussion and I was offered a contract to tutor M351 in October 1978. For explanation, M is a mathematics course, 3 is a 3rd year level undergraduate course and 51 was part of a sequence. M351 was followed by M352 etc. There was no formal competition. Now (in 2007) each Open University job has to be advertised and everyone, including an existing tutor, is required to go to a formal interview board, and compete. This seems to me to be an enormous waste of time for the permanent staff, when they have a good pool of able tutors and are going through the procedures in order to be seen to be 'fair'. It is true that new tutors need to be interviewed, else mistakes can be made. But dealing with existing tutors, particularly those who would become redundant if they did not find a new course to teach, is not done satisfactorily. Other Universities have a system of staff management and training and development,

so that teaching staff can have their expertise developed and change their specialisms over time. The main difference now seems to be that there are many potential Open University tutors chasing too few Open University jobs, and there has to be an interview process to select between them.

In 1978 those were different and heady days for the new Open University. Each Region had some autonomy, and was the basic management unit for tutorial staff. Staff Tutors, like Derek, had the power to recruit their new staff. All the new recruits were invited to an induction meeting where the Director spoke about the role of the Open University and about our future year as new tutors. We had the most splendid lunch, with lots of good wine, sitting sociably at large round tables, and served by ladies in neat uniforms. I was impressed. It was the standard of a conference dinner or a meal on High Table at Oxford, which was fitting because the Open University was a real University and its tutors should be broadly equivalent to those in Oxford Colleges. Now that has all changed. Meals at the annual meetings of Open University tutors are self-service, and certainly a lot cheaper. It is justified on the basis of enabling tutors to mingle and reducing the time spent eating; in practice it is also a cost saving which must please the accountants.

My course material landed with a heavy thud at my local Post Office, while I was at work. It was too large to go through my letter box and I had to go and collect it. I decided to install a larger letter box. I was relieved to discover that I recognised most of the teaching material from Oxford, as expected since Dr Mick Bromilow had been involved with writing it all. I started teaching in February 1979, and continued until the course was re-written in 1987. Even mathematics courses can get out of date, and the balance of the course changed so that there was more about numerical optimisation and less about solving systems of equations. By 1987 computer subroutine libraries had become well established and it was not necessary, nor encouraged, for the students to work from first principles any longer.

This teaching all fitted in very well with my work at the NPL, and provided a little extra money to supplement the Civil Service salary. It was not well paid, being an hourly rate linked to a junior University lecturer's salary, and based on a system of piece work. My course required the student to attempt four pieces of work, called Tutor Marked Assignments or TMAs, and I was paid for each one which I marked. So there was an incentive to keep students because then I got paid more. Each year there were one or two students who needed special help, either because of family situations where they had problems getting the work finished to the deadlines, or because they were not good enough to complete the course. I was required to offer a telephone help service in the evenings and at weekends, and students often rang just to talk to someone. The job was partly about listening and encouraging the students, as well as teaching the material. I had the view that not everyone who paid to do the course was going to be good enough to pass it. M351 was a course taken by students who were working towards an Honours degree; those doing a Pass degree didn't get to study at third level. I worked hard with those who had the potential, but sometimes I had students who were just not good enough. Then it was a task to try and steer them to give up early enough that they got a refund, and then helping them choose a more suitable course for the following year. Students only had to score 40 percent to pass, and then get at least the same score in the exam. Being a mathematics course I often had students scoring 90 or 95, and I sent a prize, a cheque for the value of a bottle of Champagne, to any student who scored 100.

My face-to-face lecturing generally took place at Bulmershe College in Reading, and on a Saturday. It was possible to arrange short teaching sessions in the evening but Saturday is the day which students usually prefer; it is assumed that students are working during the week. There were two types of teaching. Each year began with a tutorial, where the tutor and their personal group of students, usually 25 to 28 students, meet to discuss the course. During the academic year, from February to October, there were also a set of regular Mathematics Day Schools, which could be attended by any student in the country, not necessarily from the same Region. Derek or his colleague Bob Coates always attended the Day Schools so that he could see what the tutors were doing and talk to them about any problems. A Day School meant that I was supposed to be on my feet in front of a blackboard for the whole day. We always started at 10.00, stopped for a lunch break, and finished at about 16.00. I certainly remember that it was a very long day for me, with 5 hours standing up teaching. For each Day School, a set of Questions were posted to me in advance, together with the Tutor notes which I was to use with them. There were also lots of printed handouts to give to the students. So all I needed to do was to work through the questions the evening before, and then go and do the teaching. The idea of providing such material centrally was a good one. It meant that all the tutors of M351 had the same set of Questions and Answers for their Day Schools, and that helped quality control. Now tutors have to do all their own preparation for their tutorials and the quality must be much patchier, although with the use of email and tutor electronic conferencing everyone is able to share the Questions and Answers which they use for their own students with others. Lecturing was hard work. I was used to sitting when I was working, not standing up or prowling past students desks looking at what they were doing. For each Day School I was paid a fixed price, plus my travelling expenses. I remember one Day School in Winchester when no students had arrived by 10.00. After I had been sitting reading for an hour, one chap knocked on the door. We agreed that he could have a short version and we sat and worked through the Questions and Answers together. Attendance at tutorials or Day Schools is not compulsory and in the summer there may only be 4 or 5 students who turn up, less if there is a cricket match on TV. Because the Day Schools and the TMA marking were done in chunks, payments came in irregular dollops, often several months after the work was done because of the delay in processing the claim forms. I used to joke that all my Open University teaching was just enough to pay for our annual two week holiday in the sun in Tenerife.

## 28 Impatient for Promotion

In 1979 I started to look around for a move from the NPL, and in February I had spotted an advertisement for an Atlas Fellowship, this time based at St Hilda's College. I applied and after some delay I was invited for interview in June. At least my previous lack of success at interview at St Hilda's College had not wrecked my chances of a different post. On the day of the interview I was not well, probably hay fever of which I did suffer in the summer, and I did not get the job, although I was asked if I would consider a level transfer at my current grade and salary from the NPL to the Rutherford Laboratory. Knowing that I was then living in Farnborough, I was also offered the chance of a 'tied' house for rent on the Harwell site. Because of the research links to Oxford I would have taken the Atlas Fellowship, but I was much less interested in a level transfer to the Rutherford Laboratory because I knew I was close to being eligible for promotion at the NPL, and a move to a new area would bring an inevitable delay while I proved my abilities again. The problem was that I was finding it difficult to make progress at the NPL in the promotion stakes and this frustration was shown by looking for jobs elsewhere on promotion. I did not mind where I went, but I wanted the promotion. I now suspect that my eligibility for promotion was being 'managed' to ensure that I was successful at the promotion board first time, when I eventually got there. But it would have been helpful if I had been able to be involved with that strategy and understand what was happening. It was my first time trying to get a promotion and there was no-one I could talk to about how it was all organised and how best to play the game. Instead I was spending time on applying for jobs which reduced the time actually getting my research work done, and that could even risk lowering my performance rating.

While all this was going forward, in April 1979 I asked for permission to attend a conference on The Production and Assessment of Numerical Software in Liverpool. It was developing into an important subject area, and my work was heading firmly in that direction. Initially I was told that the NPL would not pay for me to attend, and I can't remember whether I had to pay for myself. In either case, attendance at a conference at Liverpool was not expensive. Approval for staff to attend conferences was becoming more difficult, as budgets reduced, and had to be approved by the Superintendent. Dr Maurice Cox was going to present a paper about the Design of Software Libraries, and so he was automatically able to attend the conference. I was already giving a paper at another conference soon after, in June in Dundee, so the cost of attending that conference was significant. I can now understand that expecting to be paid to go to two conferences so close together could be considered selfish and took money out of the travel budget which others deserved to spend. However there were a number of interesting sessions at Liverpool, including John Reid from Harwell and Brian Ford from NAG, and when I got there I was glad I had made the effort to attend. My notes say that I drove there, and visited my parents en route.

Having spent so many school holidays in the New Brighton area it was interesting to finally take a trip on the old ferry across the River Mersey, the Royal Iris. She was built in 1951 and was the first of the diesel powered ferries across the River Mersey. The conference dinner was held on board and I remember standing on deck in the evening and staring out at the waterfront lights as the old boat chugged slowly up and down the River Mersey. She was sold in 1993 and in 2006 lay de-commissioned out of the water at Woolwich, close to the Thames Barrier.

My first experience of submitting a paper of my own for discussion with a group of eminent numerical analysts was at the 8th Biennial Conference on Numerical Analysis at Dundee, in June 1979. Having completed the work for MOD(PE) and had it published, my talk was obviously about The Calculation of Optimal Aircraft Trajectories. At Dundee I met many people, a mixture of old colleagues and new friends. I was able to make contact again with Professor Joe Jerome, who was attending as an invited speaker and had flown across especially from the USA. It had been several years since we met when he had made his first visit to Oxford on sabbatical, and we swapped updates of our research. My talk was in one of the smaller lecture rooms, but was well attended, and as a consequence I was invited to give a seminar at the Mathematics Department of Brighton Polytechnic. The date chosen was in October 1979, and it was timely to talk about the work on Spirits Tables as well as the Aircraft Engine Performance. These were both neatly covered under the title Practical Applications of Approximation theory to Problems from Industry. I had now moved away from solving differential equations, supervised by Dr David Martin, and was firmly under the control of Dr Maurice Cox and his boss Geoff Hayes.

In contrast, being perceived as having a range of programming experience, I was one of a small group invited to do some programming with a new language, Ada. The history of Ada was that the Department of Defense in the USA was concerned in the 1970s by the number of different programming languages being used for its embedded computer system projects, many of which were obsolete or hardware-dependent. Requests for proposals for a new programming language were issued and four contractors were hired to develop their proposals. In May 1979 the Green proposal, designed by Jean Ichbiah at CII Honeywell Bull, was chosen and given the name Ada - after Augusta Ada, Countess of Lovelace. The NPL connection was because Brian Wichmann from the NPL was part of that Green team. We experimented with the language by translating parts of the NPL Data Fitting Library into Ada, but it was only a novelty for me. I never expected any repayment work to require it should be used. I spent less than two weeks working with Ada, including the time being trained to use it.

Before being considered suitable for promotion I was required to attend the Department of Industry's Middle Management course. This was seen at the NPL as of no use to a professional scientist, but was something which had to be done in order to get through the promotion boards. The two-week course was in two parts. I was duly nominated and was invited to attend the first part which was in the Autumn of 1979. My choice of venue was Warwick, mainly because it was easy to get to, but I soon discovered this was not a good choice because the environment at the cheap Hotel there was bad and my room at the Hotel was on the front and there was a noisy main road. When it came to choose where to go for the second part of the course I already knew from the grapevine that the best location was at the Master Builders House Hotel, at Bucklers Hard near Brockenhurst in the New Forest.

The second part of the course was in February 1980 and I remember being collected by taxi from the railway station at Brockenhurst and driven through the snow to Bucklers Hard. The course material was interesting, the accommodation was excellent and the food was as good as at home. In the evening we were allowed to eat anything off the standard three course menu, and this included venison, one of my favourites, and game pie. The beer was good and there was a fine choice of wine although we were limited to house wine with dinner. After dinner we migrated into the public bar and joined the locals next to the big log fire. I sipped my glass of ginger wine, which

lasted all evening, while others drank more serious liquids. There were real concerns that we might all get stuck there, as the weather deteriorated. It was such a nice place that I dared to hope we might. I was very impressed and on my return home I persuaded Pete that we should go there for a weekend away. He was also hooked. We soon found out that there was a nice large four poster room in the old part of the Hotel with views over the Beaulieu River, costing only slightly more than the standard newer twin rooms used for conferences.

The Hotel was owned by Lord Montague of Beaulieu, and when we first stayed there it was managed as part of the Lyons Empire, and then became a Forte Heritage Hotel. One year we went there for their New Year celebration, and as usual we took our cat. The hotel had always welcomed dogs, and at an early stage we had arranged that our cat would be treated as an honorary dog. This time there were new owners and on the file the Hotel had written cot rather than cat, and so we were surprised when they offered us a cot, and they were surprised when we walked into reception with a cat in his box. But it was all fine at the end of the day. He was very comfortable - the best four poster room which we always booked still had its enormous bathroom with kitchen cupboards so that there was plenty of space for his food dishes and litter tray.

Our previous multi-coloured moggie, Topsy, had been run over outside our house in Farnborough and replaced by a gentle Birman kitten, named Tush, who was used to living indoors, preferably with access to a warm cushion by a central heating radiator. We obtained Tush as the result of an advertisement in a cat magazine, and he came from near Teddington. His owners were not really Birman breeders, they just liked Birman cats and had the one female cat and her litter. When we visited the house they had their plates set for dinner on a breakfast bar, and the cat plates were there too. They all ate together. Apparently the cat and kittens slept on the owners' bed at night and then were taken to the airing cupboard to spend the day, except at weekends when they could stay asleep on the bed. There were two kittens to choose between. Tush, a seal point, was good at climbing up curtains, and I think his owners were pleased when we chose him; his brother was a quiet lilac point. Tush had been born into a life of comfort and he seemed to like the four poster bed. Following a series of new owners and refurbishment of the old rooms, the Hotel no longer accepts pets and they have reconstructed the old part of the Hotel. Our room has lost part of its bathroom, and the other four poster rooms have become en-suite. Previously they had their personal bathroom but down the corridor, which was not really acceptable in a modern hotel. From the advertising brochure it seems the four poster beds have all gone. Prices have gone far too high for us, but we still have lunch there when we visit the New Forest.

In spite of the prejudice of my NPL colleagues, I found the Middle Management course was interesting. I had the chance to meet other people at the same grade but doing very different types of work. I was forced to look at what I was doing at the NPL and explain it to bright but non-scientific colleagues. I started describing myself as a problem solver, which is what we were all doing at the NPL. I found some inspiration from a quotation by George Polya, a famous Hungarian mathematician, in his book *How to Solve It*.

‘Solving problems is a practical art, like swimming or skiing or playing the piano: you can learn it only by imitation and practice.... if you wish to learn swimming you have to go into the water, and if you wish to become a problem solver you have to solve problems’ - George Polya

I didn't keep the lecture notes but recall that some of the topics covered were an in-tray exercise, interview techniques, presentation skills, role playing, negotiating, and working in teams. Some of the tasks were recorded and then played back for discussion. There were limited opportunities to use any of my new Middle Management skills at the NPL, but I was given a bright vacation student to supervise during the summer.

I was surprised to be invited to take part in the CRAC /SRC Graduate School at the University of Stirling from 20-25 June 1980. I had received my DPhil grant from the Science Research Council, so felt it was a duty to accept their invitation. The NPL did not object, but were not very enthusiastic. CRAC, the Careers Research and Advisory Centre, was based in Cambridge and was responsible for organising courses for PhD science students so that they could experience some of the situations which face a person working in an organisation in either the public or private sector. I was one of fourteen invited 'Executives' – young graduates working in the private or public sector. The course was a mixture of basic management training, interview techniques and participation in a Business Game. I enjoyed going to Stirling, and chose that venue because it was as far away from Teddington as I could go. My travel expenses were being paid by CRAC/SRC. It was also at the best time of year for my work, so the choice wasn't only driven by the travelling bug. Indeed I was so busy I didn't get chance to see much of the area. Even on the Sunday there were lectures and tasks all day, which I objected to. It would have been nice to have an hour free to go to church. Overall the course was fun, covered some of the ground of the Middle Management course, but was of very little direct benefit to the NPL, although perhaps of benefit more widely to the Civil Service. Some of the 50 PhD students who attended would be candidates for the Science Group, and many spoke to me about the pros and cons of my job.

When I first arrived at the NPL it was not usual for the Numerical Analysis Branch to get invited to do work for other teams within the NPL. As time passed, better contacts were established and one such project was to help the Division of Mechanical and Optical Metrology (DMOM) measure lens attributes. We were given a fringe pattern of a lens, a pretty picture of regular alternating black and white stripes rather like a zebra, and the problem was to calculate from that the aberration properties of the lens. It is basically a data fitting problem and we could offer a lot of expertise in choosing the right representation for the aberration function. For the numerical analysts, this involved using the Chebyshev representation of a polynomial, not a 'power series'. Unusually for me, the work was implemented in BASIC on the ICL 2972 computer, before being moved across to the HP 9825 desk-top machine being used by DMOM. Eventually the work was published in December 1982 as NPL Report DITC 7/82 Reliable Computation of the Aberration Function Representing an Interference Pattern of a Lens. Looking back, I was surprised to see that this work began in 1980, and the task was fairly simple, but the Report was not completed until the end of 1982.

## 29 At Last – Promotion to Senior Scientific Officer

The next step in my civil service career was to be promoted from Higher Scientific Officer to Senior Scientific Officer (SSO). Those readers familiar with the Civil Service Fast Stream will know that a fast-stream entrant joining straight from Oxford would start as an Administrative Trainee or Assistant Principal and expect to then reach the grade of Principal in about four years. For a scientist of the same age, progress involves waiting for typically three years for promotion from Scientific Officer (SO) to Higher Scientific Officer (HSO), which is the same grade awarded to a new entrant with three years research experience, then another wait for promotion to SSO and then a further wait to be judged eligible for promotion to Principal Scientific Officer (PSO). Principal and PSO are roughly equivalent grades although involving different types of work. It doesn't need a degree in mathematics to work out that the fast-stream graduate has five or more years head start, and this means that they are also well placed to reach a higher final grade, while retiring at the same age. PSO is likely to be the ceiling for many science graduates, unless they are exceptionally good scientists or have an aptitude for a career in management. It was certainly suggested to me at the NPL that I should not expect to get beyond PSO, but this was also a reflection that in those days few women strove for further promotion.

I was 28 years old when I was finally put forward for interview for SSO in the list dated September 1980. It was four years after I had arrived at NPL and I was frustrated with being still only graded HSO, so I had been applying for jobs on promotion elsewhere. After the list of interview candidates came out, and before the actual interview, I was asked to report to the Deputy Director, Dr Ronald Coleman. Colleagues around me had no idea why I had been invited and were nervous. Dr Coleman asked how I saw my future career and whether I would consider spending some time working at Department of Industry Headquarters in London. There was the possibility of a vacancy in a Private Office, and I was asked whether I would be interested in the opportunity. I expressed interest, without having the faintest idea what happened in a Private Office. I wanted a move, something which looked like a career move, and away from the NPL. I found out later that I was supposed to go and work in Sir Peter Carey's Office. He was the Permanent Secretary.

My colleagues worked at my interview technique and gave me a practice promotion board, and I was successful at the interview panel and was promoted on 1 February 1981. My new salary was then £7,898 plus outer London weighting of £424, making £8,322. It was quite a jump from my starting salary of £3,842.20 as HSO.



## 30 Moving from Farnborough

Meanwhile Pete had enough of his work and was moving from the RAE at Farnborough and back to the Rutherford Laboratory at Harwell, near Oxford. He had not intended to get into weapons work, but that was where he had been placed when he joined the RAE. This time he was moving within the Civil Service and so we had the benefit of their generous moving expenses. In January we began to look at houses which were on the main train line to London, for my new posting in Headquarters, and also were on the bus route to the Harwell site for him. The UK Atomic Energy Authority laboratory at Harwell employed a lot of people and so that the local roads were not jammed by their cars when they all arrived at work at 8.00 or 8.30 there was an extensive network of cheap buses. In the London direction, the end of the Harwell bus route was at Reading, and the bus went through Pangbourne and Streatley on its way to Harwell. We needed to live within the range of the bus routes in order to get our moving expenses. Being next door to UKAEA Harwell, staff at the Rutherford Laboratory were able to buy tickets for the Harwell bus too. We thought about places between Reading and Didcot, yet again, and looked at Caversham and Goring, and then we looked more seriously at Pangbourne.

We were selling a detached house in Farnborough, so wanted to move to another detached house. There were very few nice detached houses for sale in Pangbourne, and we had been sent information about both of them. Yes, there were just the two. One was a converted chapel, directly underneath the railway line, and the other was a fancy Victorian house by the river with turrets, which was one of the Seven Deadly Sins. D H Evans, a successful 'common draper' from London, had purchased a large house and a piece of land by the river and built seven Victorian summer bungalows in 1896. The first house has his initials, DHE, cut into the decorative woodwork. The coming of the railway in 1840 had meant that Pangbourne was within easy reach of London for weekend commuting. The local people did not like the houses because they were built on an area where they used to have picnics. The house for sale was the sixth house, and we are not sure which of the sins belongs to it: anger, greed, gluttony, pride, lust, sloth, or envy. The seven houses were typical of large Victorian weekend houses along the River Thames, and there are similar houses in Reading, Henley and Maidenhead, and elsewhere.

Pete had friends from his time at Oxford who lived in Pangbourne, and we visited them to seek their advice. We quickly rejected the converted chapel, but the other house was pretty although it had been empty for a few years and needed quite a lot of serious work to be done. We walked around the outside of the house, peering in through the windows, before going and talking to the estate agent. We loved the house, and its location, and we could afford the price, but worried about exactly how much repair work needed to be done. On investigation we found that there was already an offer in place, below the asking price, but the purchasers were having problems selling their own house. We offered a lower price but were effectively a cash sale. There was an extra reduction in our purchase price because just before we completed the purchase the children of the vendors held a party in the house, stealing some of the lead off the roof and kicking in the doors. We even found a one-armed bandit in the middle of the dining room. The damage meant there was more repair work to do, and the estate agent made sure that a fair recompense was agreed. The survey told us nothing we did not expect, and we bought the house four weeks later, on 18 March.

The following day I pursued the timing of my move to Private Office, and was told that there was no sign of a vacancy until the end of the year. So we continued to live in Farnborough while in Pangbourne the rotten wood was taken out and sprayed, one back window was replaced, and the upstairs balcony floor was rebuilt. We had extra central heating radiators added and replaced the old oil heating boiler with gas. There was a lot to do but it was not too bad a problem. The kitchen and bathrooms were useable, and we laughed as to how we were going to need three WCs with just the two of us. In 1981 the house was not yet a Grade II Listed Building, so we were able to do the repair work quickly. Pete moved job in April and suffered camping in the new house, while I lived in Farnborough trying to find a purchaser for the house there. It was fortunate we had a three month bridging loan paid for by the Civil Service because it took over three months to sell our house in Farnborough. To this day we cannot understand why it was so difficult to sell.

The car pool from Farnborough to Teddington reduced further when Alex Williams left his post as Superintendent of the Division of Mechanical and Optical Metrology, and went to London on promotion as Head of Research and Technology Perspectives Division. The only route on promotion from Superintendent at the NPL was to become Deputy Director and then Director. So there was much more opportunity and a variety of interesting jobs at the same grades in Headquarters in London. It was an excellent career move, and living in Farnborough meant that it was an easy train journey for him. This left just Bernarr and I sharing the driving.

## 31 Staff Reductions mean I can Finally Leave

On 1 May 1981 the Director of the NPL, Dr Paul Dean, spoke to all staff in the Numerical Analysis Branch, stating that the numerical analysis team would decrease to between one third and one half of its present size in the next two to three years, with most of this reduction taking place by 1 April 1982. This was said to be a consequence of the need for a continuing reduction in the NPL staff numbers. As might be expected, staff morale plummeted, and I became even keener to move on, especially as I was now commuting to Teddington from Pangbourne. There was already gossip that I was leaving to go to London. From Pangbourne I had a choice of driving or taking the train and changing at Reading, Ascot, Staines and Twickenham. It was a very similar situation to when we had previously lived at Didcot, in 1977.

I wrote to Professor Leslie Fox at Oxford with the news of our house move and the news about the staff reductions at the NPL. He was interested in what was happening at the NPL and gave me useful advice on my options, and confirmed that there were sometimes job vacancies in the Oxford area. I said that I was aiming to get to Superintendent or equivalent, and he (rightly) said that my aim was highly ambitious, and I shouldn't blame myself if I failed, but there was no harm in ambition. Whether he would have been proud of me in my final career I don't know. I would like to think so. I did eventually achieve my ambition, and to a limited extent kept my academic dreams alive as well. I made a list of places I would like to move to, and started to watch for suitable possibilities. It was much later I heard that he had a heart attack in 1981, and this was the reason he retired earlier than expected in 1983.

Unfortunately I seemed to have made for myself a key role in organising the NPL Data Fitting Conference at Robinson College, Cambridge in the Easter vacation of 1982 and I was told that I could not move from the NPL until after Christmas 1981. So I gritted my teeth and continued working hard. Again I supervised two vacation students during the summer. Both helped with Fortran programming of the new Data Approximation Subroutine Library (DASL - pronounced dazzle) which was going to be launched at the conference in Cambridge.

It was not until early October that I started meeting people with a view to speeding up the transfer to London. I was already doing some work for Dr Andrew Wallard, who was on secondment from the NPL to the Research and Technology Perspectives policy part of the Department of Industry. This was supposed to be finished by 20 November, which was a Friday, so I had already pencilled in the 23 November as a good date for my move. I met Alex Williams, Barry Copestake and Grant Lewison, the three most important people in my new line management chain. If I got to London then I would be working directly for Dr Lewison. Fearing that it was all going to fall through, I applied again to work at Harwell, this time in the UKAEA Energy Technology Group, not the Atlas Laboratory. I was asked to attend for interview on 26 November and I publicised the date widely. On 25 November I was told to report to the Department of Industry Building, Abell House, for my new job which would start the following Monday. I therefore arrived at the Policy and Perspectives Unit on 30 November. So I was away from Teddington at last, although I left with the feeling that it was a pity I had to force the move too hard. And I felt sorry for colleagues at Harwell who had set up an interview for me, and I then cancelled at only 24 hours notice.

I left the NPL with no special celebration, no party, and no-one even circulated a Good Luck card. I suppose it was a symptom of the times.

## 32 Last Link with NPL – Completing the DASL Library

Part of the agreement for my move was that I could still spend up to two days each week completing work on the Data Approximation Subroutine Library and the associated Tutorial Conference. During 1981 I had visited a lot of possible venues for the conference. On the one hand I wanted to find somewhere where there were good facilities, with lecture rooms and en-suite accommodation under the same roof preferably. The date of the meeting was decided to be during the Easter holidays, so University accommodation was a distinct possibility, and it kept the price low compared with going to a hotel with conference facilities. Many of the attendees were expected to be junior scientists who would not be able to pay for expensive accommodation. It would have been nice to take the conference to Oxford but there were not enough undergraduate rooms which were en-suite. Robinson College at Cambridge was brand new and had the right facilities and at the right price. I think Geoff Hayes must have been educated at Cambridge; he easily accepted my suggestion for the venue. His main concern was whether we could provide free sherry at the conference dinner.

I felt very strongly that the conference material should be well presented and in a common house style, particularly the advertising material, the lecture notes and any other handouts. I persuaded everyone that a bright vivid yellow was a good colour and that we should be consistent through all the material. DASL was definitely going to dazzle! By coincidence it was exactly the same colour as the kitchen units in my house in Farnborough. I was nominated as the contact point for enquiries and all the application forms, and we waited in anticipation to see whether we would get enough attendees to make a profit.

Although labelled as a Conference it was really three days of intense teaching. The lectures started at 9.15 on the first morning, and finished at 15.45 on the third day. Between it was non-stop, except for breaks for coffee, lunch and tea. The lectures were performed in pairs, with one person teaching the theory and the other working through case studies. There were four of us to share the work and I took part in three of the twelve lectures. The lectures had been produced at the NPL and I was just given my set and expected to get on with the teaching. Fortunately I had now three years experience of lecturing with the Open University, so I was confident in doing the lectures. If I have a fault it is that I always spend far too much time on preparation of the material compared with other colleagues, but I believe preparation is important especially when it is for a meeting where the delegates are paying.

It was a very successful conference. There were enough attendees that the NPL made a profit, and the feedback from attendees was that the overall experience was good and the content was useful. On the Friday evening I packed up my papers and finally walked away from it all, leaving David Martin, Geoff Hayes, Maurice Cox and Gerald Anthony to finish packing up all the material and take everything back to the NPL. The NPL photographer took a final group photograph of us all.

### **33 The End – but it was really only the beginning**

I did not expect to have any involvement with anyone from the Data Fitting Group, or the NPL, again. How wrong I was! NPL crossed my path several times as I later gained policy responsibility for software engineering and then budget responsibility for the entire National Measurement System.

The story of this part of my journey follows as ‘Working with Conservative Ministers’, as I made my transition from a scientist seeking money to continue my research, to a programme and project manager who aimed to spend public money effectively in support of Government policy. It was busy and exciting times in the Department of Trade and Industry in the 1980s and 1990s and I am proud to have been a part of it all.

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