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George G. Brownlee
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A Quaker upbringing

Biography is perhaps one of the most difficult of all historical and literary ventures, because it involves not only the compilation of material and its understanding, but also an attempt, which can never be wholly satisfactory, to enter into the soul of the subject and to create an honest account of life as well as to present a portrait.[1]

Cicely Crewdson, an elegant lady in her late thirties, was on holiday with her father at their family holiday home in the small village of Syde in the Cotswolds. Her holiday was nearly spoiled because she needed urgent treatment for a septic finger. Sepsis was potentially life-threatening in those days before effective antibiotics, such as penicillin, were available. The local doctor was summoned and agreed to come over from the nearby village of Rendcomb to treat Cicely. The doctor's name was Frederick Sanger and he was still a bachelor. Her treatment would have needed a number of visits by this doctor to see how the patient's finger was improving. Cicely Crewdson and Frederick Sanger got to know one another and doctor and patient were married in 1916.

We can only guess what attracted Frederick and Cicely to one another but Frederick would have been a quite suitable match for Cicely. Educated at St John's College, Cambridge, he qualified as a doctor and completed his MD in 1902. Soon after he travelled to China as a missionary where he worked as a hospital doctor and found time, energy

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and enthusiasm to set up a new school for poorer children who were generally denied the education available for the children of the mandarin or upper-class families. Returning to Devon, his parent's family home – probably for health reasons in 1912, Frederick then moved with his widowed mother, Ann, to Gloucestershire where he practised as the local doctor. His mother died shortly after the move in 1913.

Cicely Crewdson was the youngest daughter of a rich and successful family, who owned a cotton mill in Styal, Cheshire near Manchester. The Crewdsons had strong Quaker traditions, although Cicely's father, Theodore, had actually renounced Quakerism in favour of the Church of England. Cicely, the youngest of six children, had been brought up as a Victorian lady of the Church of England persuasion. There was no question of her going out to work. Frederick Sanger was nearly 40 years old and Cicely Crewdson 36 years old when they married in 1916, so they were ready to settle down and have a family.

Cicely and Frederick set up home in The Old House, Rendcomb in Gloucestershire with its large garden backing onto the River Churn. Rendcomb is a small, picturesque Cotswold village that today is probably largely unchanged since 1916. The village has a parish church with a twelfth-century font, a village store and a manor house – converted to a school, along with a small number of typical Cotswold stone-built houses with attractive stone-tiled roofs, in the pleasantly undulating countryside of the Churn valley. Sheep would be grazing on the hillside then as they are today in this predominantly farming community. It would have been an isolated country living then, quite remote from the larger cities. Few local people then would have been able to afford cars. Today communications are better but the local roads are still narrow and winding, discouraging any through traffic in the village. The nearest market town is Cirencester, built in Roman times, 6 miles away.

Frederick had his one-room, quite claustrophobic surgery 'outhouse' at the side of the house, where patients would be seen. In those days doctors did their 'rounds' and often visited their patients in their own homes so there was no need for a large surgery. The small surgery contrasted with the large old house with its imposing frontage, Cotswold stone tiles and large reception area inside. Cicely had to run the house, but she would have been no stranger to this as she was brought up in a substantial house in Styal, Cheshire. No doubt, her older, unmarried sister May, who often visited Rendcomb, sometimes with her father Theodore

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Crewdson, would have given advice on securing the services of servants. Cicely, like her parents, would have had the help of a housekeeper, a cook, a gardener and later a nanny when the children were born.

Cicely and Frederick Sanger had three children. Theodore (Theo) was born in 1917, Frederick (Fred) – the subject of this biography – was born soon after in 1918 and Mary (May) five years later in 1923. The three children, Theo, Fred and May, were brought up as Quakers as father Frederick had converted from the Church of England after his marriage, influenced by the books and traditions in the Crewdson family. Mother Cicely remained Church of England and attended the local Anglican church every Sunday. Father Frederick went to a Quaker Meeting House with the children. The children were taught the importance of telling the truth, and prayers were said every morning and night. Fred, the second child, was strongly influenced by his elder brother, Theo, and they played together a lot. Theo was more extrovert than Fred, who described himself later as a 'quieter and more retiring fellow' than his elder brother Theo.

Cicely and Frederick were well matched and happily married. They enjoyed taking walks together in the local countryside and going riding. Frederick was a romantic and wrote love poems to his wife, Cicely, in a neat script, long after they were married. Cicely was kindly and more serious than Frederick, who had more of a sense of humour. There were never any arguments in this family even if there were differences of opinion.[2] It was a happy, carefree time. There were no money worries and it was a wonderful, privileged upbringing for Fred and his elder brother and younger sister.

Cicely kept a diary from 1918 to 1937 detailing the major events in the family life over these years.[3] Shortly after Fred was born on 13 August 1918, Cicely notes in her diary a difference in temperament between Fred and his elder brother, Theo:

> He is a dear little fellow, but very small 5¾ lbs at birth, and lost ½ lb the first week, but is gaining now. He is very quiet and peaceful, sleeps all day and will hardly wake up for meals, he opens his eyes at night. He is not a bit like Theodore . . .

Cicely's diary gives us many insights into Fred's temperament and upbringing as we shall see later. It is hard to ignore this insight – one wonders if she would have guessed that her second child would become

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a famous scientist. Sadly Cicely was never to know this as she died from cancer in 1938 when Fred was still an undergraduate at Cambridge. At Theodore's first birthday party in 1918 a cake was provided 'and it was iced – an unheard of thing in war time', Cicely records. Apart from this reference to icing on Theo's birthday cake, there is no mention of the First World War in Cicely's diary. With an estimated 2 million lives of servicemen and women lost in the UK in the First World War it would have been surprising if the wider Sanger family had not lost a relative. In fact Fred Sanger lost a distant second cousin, Henry. Perhaps their Quaker beliefs, that one should not kill others, kept the Sanger family partly insulated from the terrible war with its huge loss of life going on around them in Europe.

The Sanger family moved house in 1923 to 'Far Leys' in Tanworth-in-Arden, another village closer to Birmingham, when Fred was 5 years old. The reason was partly so that Frederick, his father, could be nearer Birmingham, an important Quaker centre. Fred's early schooling was taken care of by a Quaker governess, Miss Shewell, who taught Fred, Theo and two other village children until Fred was 9 years old.

The governess, Helen Mary Shewell, or HMS (Her Majesty's Ship!) as she was called by the children, replaced the first governess, Miss Potter, on 18 May 1924. Miss Potter, according to Cicely's diary, 'certainly got the boys on well in lessons, but I did not like her way with them. They got frightened of her and disliked lessons so I felt we must make a change.' With Miss Shewell they are now 'much enjoying lessons. She stays three afternoons a week and takes them out and they have lovely times in the sand heap with her. She thinks them quite forward for their age. Der (Cicely's nickname for Fred) is very good at sums – both addition and subtraction.'

Miss Shewell taught both Theo and Fred at the same time and noted that Fred was brighter than his elder brother: 'Der (Fred) is the cleverest, he goes quietly on without any effort. Ogo (Theo) rushes at things and then often gets tired.'

Miss Shewell travelled each day from Hall Green, Birmingham to teach all three Sanger children and various village children, who came to the school room at 'Far Leys', for 10 years. She only left the Sanger home in 1934 when May was sent to Overstone – a boarding school for girls. HMS had become a family friend and Cicely wrote in her diary in September 1934:

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> It is terribly quiet at home with no child. It seems so strange with no school room and Miss Shewell after ten years. I am glad she has got a post and hope we shall still see a lot of her. She certainly has done very well for my children.

The Sangers' visitors' book confirms that Miss Shewell, still living at Hall Green, Birmingham, remained a family friend since she stayed at the family's Caudle Green house in August 1939 for two nights, after both Frederick and Cicely had died.

Theo got Fred interested in science at that stage, as Theo was very keen on natural history – animals, looking at bugs, catching newts, etc. 'Far Leys' had a spacious garden and pond, which was full of fish, and in the spring masses of toads came in and spawned there. They also collected grass snakes, which although frightening to young children were harmless.

The next stage in the education of the young Fred, only 9 years old, was quite traumatic. He was sent away to the Downs School, Malvern (a Quaker school), as a boarder in 1927. Not liking this much at first, he slowly learned to adapt to the move away from his mother's apron strings and survive the inevitable bullying. Fred found schoolwork easy there. Cicely writes in her diary: 'Der (Fred) finds work in the 1st form easy, he is top of the form and I am afraid he will slack, but hope not.' His main interests at that time seemed to be centred around his school holiday activities. At about that time he took up carpentry and painting both encouraged by his parents. Cicely notes in her diary in February 1928 when Fred was 10 years old, 'The boys were both much occupied in the holidays in making secrets for my birthday. Der has had a most original idea and carved me a church on a small piece of wood and then coloured it. It is most effective and quite his own idea.' Later on the young Fred took up welding. He had a forge at home and made a garden gate for his parents. Fred was still very quiet at home – he was nicknamed 'Mouse'. His mother worried that he was not outgoing enough. In 1930 she wrote: 'Fred has come on lately. He looks much stronger, has grown and is fatter and has been very fit and well all this year. He is also not quite so shy. He is a most delightful quiet companion and is always ready to help and do things.'

In 1932 – now 14, Fred then moved as a boarder to Bryanston in Dorset, a public (private) school that was quite new then. Fred tried for

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a scholarship but failed to get one, records Cicely. 'Freddy finished up well at the Downs. He got his cricket colours but did not manage a scholarship to Bryanston; he and a friend tried for it but neither got it.' Bryanston suited Fred. He was happy there – perhaps by now he had adapted to being a boarder away from home, even though 'the food was pretty dreadful, certainly not as good as at the prep school I had been to, but there was enough of it'.[4] Fred thrived on the liberal, project-based teaching that had been introduced there. He also started learning some science from Geoffrey Ordish, the chemistry master, and Frazer Hoyland, the biology teacher. These masters were stimulating teachers who involved Fred, and presumably other pupils, in other after-school activities (e.g. biology club, chemistry club). Fred was a diligent pupil, progressing well, near but never at the top of the class. Fred participated in sport at Bryanston (as did all pupils) in rugby, cricket, swimming, fives and squash, but did not excel in these activities although he enjoyed them. He was more academic than sporty. Fred did very well in his School Certificate exam, and was labelled 'seven-credit Fred'. It is quite clear that Fred was hardworking and interested in his class work and did particularly well at chemistry and biology. This qualification guaranteed his entrance to St John's College, Cambridge where both his father and uncle Tom (Hubert) had been undergraduates.

Cicely and Frederick, father, had been hoping Fred would study medical subjects in the Natural Sciences Tripos when he went up to Cambridge, but Fred had decided otherwise, records Cicely in 1935:

> We are all delighted that Fred has got seven credits in the School Certificate, including Latin, so he is right for Cambridge now. He has decided he does not want to be a medic which is rather disappointing to us but we feel it is no use to press him if he doesn't like the idea.

Fred's last year at Bryanston was very pleasant and academically undemanding, since Fred had already secured his place at St John's. Fred did not try for a scholarship for Cambridge since he was advised by the physics master at Bryanston that 'he was not quite up to it'. In that final year in school in 1936 Fred went on a school exchange visit to Salem in southern Germany as the two schools had arranged exchange visits. Fred spent a couple of months there with fellow pupil David Forbes, enjoying the outdoor activities and learning some German. He was also exposed to the Hitler Youth Movement and refused to salute

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'Heil Hitler' in class, but appears not to have been aware, like many others, of the impending threat of war.

On arriving in Cambridge in 1936 Fred had to decide which subjects to take for Part I of the Natural Sciences Tripos. It was clear he should take chemistry but he chose physics as another full subject, and maths and biochemistry as half subjects. His choice of biochemistry was prescient and arose from his meeting with Ernest Baldwin, who was a tutor at St John's College. He persuaded him to take biochemistry – a subject new to Fred that tried to explain 'biology in terms of chemistry'. Baldwin was an enthusiastic teacher and a member of the Biochemistry Department at the University of Cambridge. Gowland Hopkins had made this department pre-eminent in this subject because of his discovery of vitamins.

Fred did not care for his first St John's 'digs' (lodgings) in Bridge Street, Cambridge and he moved nearby to Park Parade off Jesus Green later, and was happier there. 'Fred is having rooms in Park Parade as he feels Bridge Street is so shut in. I hope he will keep fitter there as he always gets a cold as soon as he gets to Cambridge,' writes Cicely. She continues: 'Both boys [Theo was a new undergraduate at Trinity Hall at the same time as Fred was at St John's] find they have to work very hard to keep up. The Friends (Quakers) have been very good in looking after them and they both go to meetings.' The Quaker family tradition was seemingly a help to both Fred and Theo in settling down in Cambridge.

Fred's decision to forgo medical subjects in favour of basic science subjects caused him difficulty in Part I of the Tripos – a situation he had not expected. It turned out he needed three years to gain a second in his Part I Tripos, instead of the normal two years. The reason was that he found physics and maths very difficult, not having studied them beyond the General Certificate stage at school. He could not catch up with the other undergraduates, who had studied physics and maths for Higher Certificate at school. There was nothing for it. Fred admitted defeat with physics and gave it up after the first year. Instead he changed to physiology as a full subject in his second year, finding it much easier and more interesting than physics, probably because of his strong biological background at school. He struggled on with maths as a half subject but did not enjoy this subject. He liked biochemistry most and this was the subject he chose for Part II of the Tripos in his final fourth year as an undergraduate.

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There is more for a young man to do in Cambridge than simply work. Fred was still a committed Quaker. He had joined the Cambridge scientists' anti-war movement and had signed the 'Peace Pledge Union', pledging that he would not fight. As a Quaker he was a confirmed pacifist. The Second World War started in September 1939 with the invasion of Poland by Germany, while Fred was still an undergraduate, about to start his fourth year at Cambridge specialising in biochemistry. His pacificism had two important consequences. He met his future wife, Joan Howe, a pretty brunette at Newnham College, hailing from near Leicester, through the anti-war group. They were married a year later in 1940 in Syde in the Cotswolds where his uncle Dilworth had a farm near to Rendcomb where Fred had lived as a child.[5] Sadly, both Fred's father and mother had died from cancer by this time. Fred also registered as a conscientious objector, which meant he was not called up to fight in the Second World War.

Fred had made no plans to continue an academic career until he heard he had been awarded a first for his biochemistry Part II. He decided, only then, that he was good enough to do research. Fortunately he did not need a sponsor for his PhD studies since he had become financially independent through an inheritance from his parents. So he was able to finance his own PhD studies at Cambridge. Even then there were difficulties to be overcome, because Bill Pirie, with whom Fred had initially chosen to work, decided to leave the department only one month after Fred had started his PhD, leaving Fred in the lurch. Fortunately Albert Neuberger then agreed to supervise Fred's research on the metabolism of lysine, an important constituent amino acid of proteins.[6]

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How about studying insulin?

Fred Sanger started his research in arguably the best-known biochemistry department in Britain in 1940 under the leadership of Frederick Gowland Hopkins. Hopkins, affectionately known as 'Hoppy', held the first Chair of Biochemistry in Cambridge from 1914 and had modernised biochemistry in the UK. Biochemistry had lagged behind advances in this subject in Europe, and particularly in Germany, in the previous century. The subject had evolved from physiological chemistry and was originally a branch of physiology with a chemical bias. But Hopkins, as the first Professor of Biochemistry in Cambridge – although not the first in the UK which was in Liverpool University in 1902[1] – established a vibrant British school of biochemistry even though he had an unconventional training as an analytical chemist and medic and had never formally studied biochemistry himself. 'In Hopkins two things were significantly combined: the training and tastes of an organic chemist, and the imagination of a biologist and physician.'[2] A careful and committed experimentalist, he had brought Cambridge fame through his discovery of vitamins as accessory food substances needed in minute quantities, for which he was awarded the Nobel Prize in 1929. But his engaging, friendly and benign personality meant that 'Hoppy' headed an open and enquiring department, where no subject, including politics, was off-limits. He was popular and approachable with the advanced Part II students. He had appointed talented and sometimes controversial scientists, such as J. B. S. Haldane, Joseph Needham,

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Malcolm Dixon, Bill Pirie, Ernest Baldwin and Robin Hill. Among his appointments were the women scientists Dorothy Moyle (later Needham) and Marjorie Stephenson who became eminent in their fields. Hans Krebs and Ernst Chain – fleeing persecution from Nazi Germany and both to become future Nobel prize winners – were made welcome by Hopkins in the 1930s. In fact the department was affectionately known by some as the 'Hopkins Matrimonial Agency' because of the number of marriages between research workers[3] and 'Little Moscow' because of the left-wing tendency of the Needhams, Pirie and others.[4] But science flourished in that environment, although by 1940, when Fred Sanger started his PhD, Hopkins was 'very old, rather frail and deaf, but he used to totter around the lab'. Nevertheless he talked to the young Fred Sanger and congratulated him on his first class degree.

Fred's research for his PhD was very much on the theme of essential factors in the diet – a major theme of Hopkins' own research. Fred, under the watchful eye of Albert Neuberger, who was relatively young then and still very active experimentally in the lab, was asked to investigate the breakdown products of lysine, when this amino acid was fed to young rats. Lysine was important because it was an 'essential amino acid' in the diet that was absent in some proteins. Like tryptophan, valine and some other amino acids, it could not be synthesised in the body from simpler chemicals *de novo*. Fred never achieved his objective of understanding the breakdown of lysine and said of his own thesis: 'I wouldn't say it was a great thesis.' Lysine metabolism was only understood many years later in the 1970s,[5] but Fred did manage to publish five papers from this period of research with Neuberger,[6] including some war work on the protein composition of various varieties of potatoes, although this was not of any real practical benefit to the war effort.

Fred describes Neuberger as his main teacher, the person who really taught him how to do research. 'He was a very kind person too and very helpful to me. I feel I owe a lot to him.' This may be 'unduly generous' according to Neuberger[7] although many scientists later in their careers recognise the importance of their first research mentor. Perhaps the real benefit of Sanger's PhD training under Neuberger was to introduce him not simply to the practical aspects of science – after all Fred was very practical and ingenious in making things himself. Rather Neuberger

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