# Reminiscences and Reflections of a Codebreaker

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## 1 Introduction

Many books have now been published about the work of the Bletchley Park codebreakers during World War II. Outstanding among these are Alan Turing: The Enigma, by Andrew Hodges [Ho], a sensitive and enormously informative biography of a genius who made a unique contribution to winning the war while he was simultaneously inventing the computer; and Codebreakers, edited by F. H. Hinsley and Alan Stripp [Hin], a series of articles providing detailed information on the methods employed by the codebreakers of Bletchley Park. Particularly to be commended among the latter is the article by Professor I. J. (Jack) Good, entitled "Enigma and Fish", in which Jack, one of the key members of the teams working first on Naval Enigma and then on the even more sophisticated Geheimschreiber code (which we called Fish!), describes the machines employed by the Germans and the machines we developed to help to read messages encrypted by these machines. It is a great advantage, of course, for those able, like Jack Good, to provide precise descriptions of these machines and of our methods, that much of the necessary information has now, at long last, been declassified.

With so many good sources of information available, it would be pointless to write yet another technical article. On the other hand, there has not been the same wealth of information available about the more human side of our activities at Bletchley Park, so perhaps there is a gap to be filled. Of course, I will only speak for myself. I, too, like Jack Good, worked first on Naval Enigma (in 1942) and then on Fish until the end of the European War (May, 1945); but I had a period, at the end of 1942 and early in 1943, when I was withdrawn from the Enigma team and joined the research group actually trying to understand the modus operandi of the Geheimschreiber machine. I then was attached to the Testery, but liaised with the Newmanry. The Testery people largely used hand methods, that is, they did not themselves use the Colossus machine; but, of course, they routinely used the output of Colossus to complete the effective decryption of a message. The Newmanry ran the Colossi.

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Even though this reminiscence is very informal and personal, it is relevant to point out that the teams to which I belonged were working on the highest grade Germany military and diplomatic ciphers. I do not believe that those working on lower grade (e.g., field) ciphers felt much of the excitement we felt; and I am sure that those who only came into the picture once the messages had been deciphered had an entirely different experience from our own.

What then are my most vivid recollections from those days? Let me start with the recruiting process.

## 2 The Road to Bletchley Park

It is now common knowledge (see e.g., Hinsley et al., Vol. II [Hin]) that in October, 1941, four top Bletchley Park cryptanalysts, including Alan Turing, wrote a letter to Churchill arguing that it was essential to give the highest priority to the recruitment of codebreakers and the provision of necessary equipment. Churchill might have reacted like a bureaucrat and said that the letter should have been properly routed through the corridors of Whitehall — but he didn't. He saw the good sense of what was proposed and its urgency; and he minuted his chief of staff "Action this day". Thus it came about — though I did not know this at the time — that an interviewing board came to Oxford in November, 1941, to look for "a mathematician with a knowledge of modern European languages". (Unfortunately, however, the dictates of security required that the candidates should not be told the nature of the work they would ge doing — it was my distinct impression that the members of the interviewing board did not know this themselves.)

Now the British educational system, at the time, being based on the principle of premature specialization, virtually guaranteed that there would be no such person, except by chance. [1]

My tutor recommended me to attend the interview although I was not a mathematician — merely an undergraduate student of mathematics — and my knowledge of German was rudimentary, since I had merely been teaching myself for a year. [2]

In the event, I believe I was the only candidate to present himself, and I was immediately offered a position — in the Foreign Office. However, the condition was imposed that I must start in January, 1942. This was a blow as my age group (I was born in 1923) was not due to be drafted till August, 1942. But my experience of training for the Royal Artillery as a student at Oxford — all university students had to undergo military training — had convinced me that, if I was conscripted into the Royal Artillery, I would

[1] There were, of course, many outstanding mathematicians among the Jewish refugees from Germany and Austria, but they could not be trusted as enemy aliens!

[2] It could not be doubted that German was the "modern European language" in question.

almost certainly die young — of sheer boredom! Thus it did not take me long to decide that, whatever the secret work I was to undertake at Bletchley Park, it was certain to be far more interesting than being an artilleryman, and, much as I regretted losing two terms at Oxford, the sacrifice was surely worthwhile. How right I was!

So it came about that, on 12 January 1942, I presented myself at the gates of Bletchley Park and was escorted to Hut 8. I met many people that day, but I didn't find out the nature of the work. For one person I met — none other than Alan Turing himself — asked me if I played chess and added, when I replied affirmatively, that he had a chess problem he had not been able to solve and invited me to help him to solve it. Fortunately, I was able to help him to solve it; and I like to think that the cordial relationship I enjoyed with Alan Turing for the remainder of his tragically short life (he committed suicide in 1954, just short of his $42^{nd}$ birthday) owed much to the fortunate circumstances of our first meeting. On my second day I discovered that I was to be involved in the decoding of Naval Enigma, especially of the highly secret Offizier messages, and I got my first instructions in the subtle methods developed by the Hut 8 team of cryptanalysts to achieve an amazingly high success rate and a remarkable speed of decryption. A uniquely exciting period of my life had begun!

## 3 A Tribute to My Colleagues

It goes without saying that my colleagues were all extraordinarily good at their wartime jobs at Bletchley Park — they were intelligent, quick, inventive, immensely hard-working and always encouraging each other. Almost all resumed or went on to academic jobs after the war, though some chose different careers. [3]

It is really invidious to pick out any for special praise or mention; yet I feel I should if only to point to the wide variety of attributes they displayed, either in common or individually, in addition to their mathematical flair. I will, rather arbitrarily, confine myself to seven names, which, to avoid gross favoritism, I will refer to in alphabetical order. Of course, it is understood that these people made a profound impression on me; most of them have continued to exert an influence on my life in the postwar years.

Hugh Alexander (C. H. O'D. Alexander, to give him full panoply of initials) was the British chess champion. He was a most colorful person, with an attractive personality and striking intelligence. He and Shaun Wylie taught me much of what I learned about Naval Enigma and the decoding problem in my early days in Hut 8 — he was at that time in charge of our Section. What struck me about him then, in addition to the qualities I have mentioned,

[3] One, Roy Jenkins, now Lord Jenkins of Hillhead, was Home Secretary in a Labour Government and is now Chancellor of Oxford University. Another, Peter Benenson, founded Amnesty International.

and his sense of humor, was his complete informality. This, combined with a total lack of self-regard, I was to come to recognize as the distinguishing mark of greatness in my colleagues. Unfortunately, I saw very little of Hugh after leaving Hut 8.

Jack Good (now I. J. Good, Distinguished Professor of Statistics Emeritus at Virginia Polytechnic Institute) was the nearest any of us came to being an applied mathematician — I will revert to this point later. He was, in fact, a probabilist, but he was — and is — a polymath. Both in Hut 8 and in the Newmanry he was enormously effective and productive, both of decrypts and ideas. He is possessed of a prodigious and totally accurate memory which makes him, today, the most reliable, and comprehensive, authority on the history of those times. His very individual sense of humor, together with the modesty which was characteristic of all those heroes of long ago, enrich our friendship, which persists to this day.

Donald Michie (now Professor of Artificial Intelligence at the University of Edinburgh) was an example of inspired recruitment. He came to the Testery (though he also liaised very effectively with the Newmanry) as a classical scholar, but showed remarkable adaptability to our work, acquiring an ability to think mathematically even though he knew very little mathematics. He was, and remains, truly brilliant. He became a very close friend of Alan Turing, Jack Good, myself and many others; and his sunny disposition and willingness to learn — together with a remarkable ability to do so very quickly — made him an invaluable colleague. It is perhaps not coincidental that, as he mutated from classical scholar to become a master of theoretical computer science, his politics moved simultaneously from right to left (though always reasonable!)

Max Newman (Professor M. H. A. Newman, F.R.S.) was already a distinguished topologist when he came to Bletchley Park to head the Section responsible for the machine aspects of the decryption of Fish, by 1943 certainly the most important high grade cipher being used by the Germany military. He was wonderfully effective in this role, and struck up a working relationship with Alan Turing which was resumed at Manchester University after the war when, in conjunction with the university electrical engineers and others at Ferranti, they designed (and built) a computer [4]. Both Alan Turing and I joined his department in 1948 — but at very different levels of seniority!

Max had excellent ideas, mathematical and administrative; but it is first and foremost as a facilitator that I remember him. Both in the Newmanry and in the Mathematics Department at Manchester University, he created conditions under which we, his colleagues, could work best. He never imposed on us a chore which could only be justified on bureaucratic grounds. From

[4] Max was appointed Fielden Professor of Pure Mathematics at Manchester University in 1945 on leaving Bletchley Park

his understanding and leadership I benefited enormously — at both places where he exercised them. See [H] for further remarks about Max Newman.

Alan Turing, it is generally agreed, was a genius. He had already shown this at Cambridge before the war, when he produced his strikingly original definition of a computable function in which he introduced the concept of a universal machine, now always referred to as a Turing machine. What very few knew then, and somewhat more know now, is that, even in those early days, his machine was not merely, in his mind, a metaphor but also a blueprint for a machine which could actually be built, that is, a computer. The history of the development of these ideas is very well treated in the book by Andrew Hodges, already referred to.

I will be saying more about Alan Turing later. Let me only add now that it was an extraordinary, and wonderful, experience to know him; and that he was the friendliest of men [5].

Henry Whitehead (Professor J. H. C. Whitehead, F.R.S.) has a special place in my affections, and not only because he was such a lovable man, so creative a mathematician, and so interesting and diverse a personality. Henry already had a reputation as a great — but difficult — mathematician when he came to Bletchley Park. He had done outstanding work in algebraic and combinatorial topology at Oxford, but his work was not well understood (he rewrote much of it after the war in the hope of achieving greater clarity). Nevertheless, he was recognized as an outstanding talent and, after the war, he was appointed Waynflete Professor at Oxford. He and I had become very friendly at Bletchley Park — we shared a common attitude to politics, cricket and beer, among other interests — and, after his return to Oxford, he invited me also to return to Oxford to become his doctoral student. I accepted his invitation entirely on the basis of my affection for him and my trust in his intellectual judgment. [6]

Thus Henry exerted a profound influence on my choice of career and hence on my life. I have never regretted that influence. Very unfortunately, Henry collapsed and died, suddenly and unexpectedly, on a street in Princeton in 1960 at the age of 55, at the height of his powers — a grievous loss to mathematics and all his many friends.

Shaun Wylie, like Hugh Alexander, inducted me into the work of Hut 8; but he and I remained close friends as he also moved to the Newmanry — and, subsequently, we became colleagues on the faculty of Cambridge University and wrote a book together, Homology Theory, which became a standard text among graduate students and algebraic topologists for many years. Shaun is a man of unmistakable brilliance, matched only by kindness. He is a great teacher and a very cultured scholar. I have benefited more than I can say from

[5] This needs to be said, as he has sometimes been presented as awkward and nervous and uncomfortable in the presence of others.

[6] I recall asking him "What is algebraic topology, Henry?" He replied, "Don't worry, Peter. You'll love it!" On the strength of that assurance, I decided to become his student.

his friendship — and that of his remarkable wife Odette, whom he married when she was a Wren [7] — a very senior Wren — working in the Newmanry. Long may they both flourish!

## 4 The Teaching of Mathematics

I learnt many lessons from my exciting three and a half years at Bletchley Park. I have already hinted at some; thus, for example, I learned of the friendliness and lack of conceit of good mathematicians, a fact I can now conclusively confirm after 50 years among academic mathematicians. However, there is one lesson I learnt, about the teaching of mathematics, which I regard as crucially important. It does, however, embody a very controversial principle.

We were, first in Hut 8 and then while working on Fish, a group of some 30 people (at our peak). We were, almost all, mathematicians or would-be mathematicians. But none of us — with the possible exception of Jack Good — could be described as applied mathematicians. We were pure mathematicians, in the sense that our main interest and love of research, actual or intended, lay inside mathematics itself. Yet we were all, at Bletchley Park, applying mathematics. True, we were not doing conventional applied mathematics — ordinary and partial differential equations, theoretical physics, and such. We were, of course, using (and developing) some statistical methods but their theoretical basis was neither new nor terribly profound. If there was one branch of mathematics which we could be said to be using systematically, it was mathematical logic. But a better description of our work would be to say that we were using a mathematical way of thinking in our approach to the problem at hand — the mathematics itself was not very sophisticated, but we would have been useless if we had not acquired this ability to think clearly in mathematical terms. It is also worth adding that we would have been useless if we had not been strongly motivated, that is, consumed by a fierce desire to solve the problems the enemy was confronting us with.

What has all this to do with the teaching of mathematics, let us say, at the university level? To me the obvious implication is that the essential features of a good mathematics education, designed to enable the student subsequently to use mathematics effectively in his or her chosen occupation are that it inculcate the ability to think mathematically, that is, that the student acquire, in Speiser's phrase, mathematische Denkweise; and that it build in the student a strong appetite for using mathematics to solve problems which originate outside mathematics. (Of course, this must then be supplemented by a real interest in the problem area with which the student is confronted in his or her chosen profession.) What do not seem to be essential components of a good mathematics education for the future user of mathematics are (i) any special attention to the areas of mathematics usually associated with

[7] Women's Royal Naval Service.

the occupation chosen by the student, or (ii) the acquisition of expertise in the area (of science, engineering, statistics, . . .) to which the mathematics is to be applied, or, indeed, in any other area. As to (i), it would seem to me that any part of mathematics could serve to prepare the student to apply mathematics, provided it is properly taught, that is, taught for genuine understanding and effective problem-solving and not merely for the acquisition of knowledge and mechanical skill. As to (ii), I remain convinced that the experience of applying mathematical reasoning to the study of some discipline would be very valuable to the student. But time is limited, and we must make choices; and there can be no case for impoverishing the student's mathematical education to provide time to acquire a working knowledge of some other discipline. As any enlightened employer will tell you, "We can teach you what we want you to know about our work. What we cannot teach you is the necessary mathematical know-how."

## 5 The Life and Death of Alan Turing

I have already, in this article, testified to my enormous respect for Alan Turing, whom I have described as an authentic genius; and to my incredible good fortune in being able to claim him as a friend, despite the vast difference in our intellectual capacities. His contribution to the work of the Bletchley Park codebreakers was unique and irreplaceable. This has been attested by many; and forms a theme of the excellent play "Breaking the Code" by Hugh Whitemore, and the remarkable novel Enigma by Robert Harris [8]. However, there is a particular feature of his life and his nature which must be set on record if one wishes to complete the picture of the man — Alan Turing was a homosexual. This fact is central to the drama of Hugh Whitemore's play, and is there treated very sympathetically; but the details of Turing's life given in the play are too far removed from reality for one to rely on this fine work of fictional drama to provide a basis for an assessment of the man.

In the first place, we, his colleagues at Bletchley Park had no idea that Alan was a homosexual, since he gave no evidence of this fact throughout his time at Bletchley Park; indeed, Jack Good has trenchantly and pertinently remarked "Fortunately, the authorities at Bletchley Park had no idea Turing was a homosexual; otherwise, we might have lost the war."

Unfortunately, in the early 1950's a vigorous campaign was mounted in Britain against male homosexuals — homosexual acts carried out in private by adult males were a criminal offense — and in 1952, in circumstances well described by Andrew Hodges in his biography, Alan Turing was arrested and brought before a magistrate on a charge of committing this "crime". The magistrate recognized that Alan was a very special person — a Fellow of the

[8] While Turing's contribution was unique, our work was no "one-man show" — contrary to the impression given in these two dramatic reconstructions of Bletchley Park days.

Royal Society, Reader in Mathematics at Manchester University, holder of the Order of the British Empire for (unspecified) services to his country during the war — and tried to be as lenient as possible. Alan was "bound over" — effectively, a verdict of guilty but with no penalty imposed, on condition that he underwent hormone treatment whose effect, he later bitterly remarked, was merely to enlarge his breasts. He lost his security clearance; and the U. S. authorities treated him as a felon and refused to grant him a visa (he had been engaged on joint work with Johnny von Neumann). Lonely and depressed, he committed suicide on June 7, 1954, during the Whitsuntide weekend, by eating some apple slices he had himself laced with cyanide. Clearly, he know that, sooner or later, he would find life intolerable and, in his typical way, he prepared himself and his circumstances for the arrival of that event.

It is shameful that civilized nations should enact vicious legislation capable of ruining the lives of some of its finest citizens, and then set the forces of "law and order" to hound those unfortunate people whom they might catch in their trap. It is alarming to find the same prejudices [9] which destroyed the life of a very great man, to whom all who love freedom and democracy owe so much, once again manifesting themselves today, doubtless strengthened by fears of the AIDS virus and its effects. (Even as I write, the radio is reporting a case in Wyoming where four young people tortured a student of the university, Matthew Shepard, till he was close to death, for no other apparent reason than that he was known to be gay [10]. Will we never learn?

## References

[H] Peter Hilton, *Obituary*, M. H. A. Newman, Bulletin of the London Mathematical Society, 18 (1986), 67 - 72.

[Hin] F. H. Hinsley, et al., **British Intelligence in the Second World War**, 3 volumes, Her Majesty's Stationery Office.

[Ho] Andrew Hodges, **Alan Turing: The Enigma**, Simon and Schuster, N.Y, 1988

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[9] Let no one suppose these prejudices were then confined to Britain, and that official America was innocent of such barbarism. The Immigration and Nationality Act (1952) states "Aliens afflicted with psychopathic personality . . . shall be excludable from admission to the U. S." In 1967, the Supreme Court pronounced that "the legislative history of the Act indicates beyond a shadow of doubt that the Congress intended the phrase "psychopathic personality" to include homosexuals."

[10] The student died two days later.