Pioneers on the air:
BBC radio broadcasts on computers and A.I., 1946-56

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This paper was presented at the sixth International Colloquium of ACONIT (Association pour un Conservatoire de l'Informatique et de la Télematique), 'History of Computing and Networks', held on 25, 26 and 27 November 2002, Grenoble, France.

Resumé

Between 1946 and 1956, a number of BBC radio broadcasts were made by pioneers in the fields of computing, artificial intelligence and cybernetics. Although no sound recordings of the broadcasts survive, transcripts are held at the BBC's Written Archives Centre at Caversham in the UK. This paper is based on a study of these transcripts, which have received little attention from historians.

The paper surveys the range of computer-related broadcasts during 1946–1956 and discusses some recurring themes from the broadcasts, especially the relationship of 'artificial intelligence' to human intelligence. Additionally, it discusses the context of the broadcasts, both in relation to the BBC and to contemporary awareness of computers.

Introduction

The early post-war years in Britain saw the launch of a handful of projects to build the first British digital computers, and also early developments in cybernetics and artificial intelligence. This period also saw pioneering developments in cybernetics and artificial intelligence, notably through the work of W. Grey Walter and W. R. Ashby. The decade following the Second World War is therefore of particular importance to historians of computing and computer-related topics in the UK.

During the decade 1946–56, several of the leading participants in these pioneering developments spoke about their work in BBC radio broadcasts. Although no sound recordings of these broadcasts have survived, transcripts and, in some cases, scripts, have survived at the BBC's Written Archives Centre at Caversham, Reading. As these broadcasts were made by the practitioners themselves, rather than by journalists, and date from the time of their pioneering work, this material constitutes valuable primary source material.

The background

The first surviving document in the BBC's archives relating to the new electronic computers dates from November 1946, when Sir Charles Darwin (grandson of the evolutionary biologist) gave a short news talk about the launch of the UK's first computer project, the ACE machine at the National Physical Laboratory in Teddington. Between this broadcast and December 1956 there were twenty-four broadcasts on computers and related subjects, such as cybernetics, information theory and artificial intelligence, not counting repeat broadcasts. Of these twenty-four broadcasts, three have not survived in any form, leaving twenty-one for which there is a surviving text. The Appendix to this paper lists these twenty-one broadcasts, together with titles, speakers' names, dates of broadcast and repeat, and name of the BBC service which broadcast the programme.

As can be seen from the Appendix, the bulk of the broadcasts date from the period 1949–56. That is to say, most of the broadcasts came after computers had been constructed and used in the UK. Speakers included such notable figures such as Douglas Hartree, Max Newman (also an occasional broadcaster on mathematics), Maurice Wilkes, Nobert Wiener, Christopher Strachey, D. M. Mackay, W. Grey Walter, Sam Lilley and Alan Turing.

Apart from Charles Darwin, one of the earliest speakers to broadcast on computers was the Cambridge mathematician Sam Lilley, who had worked in ballistics during the Second World War. He gave two radio talks in 1945, but no material from them survives. Alan Turing's two radio appearances, in 1951 and 1952, are already known from copies of the texts held at the Kings College Library at Cambridge. These two broadcasts have already been discussed in Hodges (1983).

Before looking at the broadcasts themselves, it is useful to set out a short chronology of early UK computing developments, together with relevant broadcasts or broadcasting developments. Table 1 covers the period from 1937 to 1950, a period when there were few broadcasts.

Table 1   Chronology of UK Computing Developments

Date	UK computing developments	BBC
1936–7	Alan Turing's 'On Computable Numbers' paper (Turing, 1936–7)	
1939–45	Second World War	
	Alan Turing and Max Newman at Bletchley Park	
1946	Maurice Wilkes visits EDVAC in USA	Launch of Third Programme (September)
	Douglas Hartree visits ENIAC in USA	
	Launch of ACE project, designed by Turing.	
		Charles Darwin announces ACE project on BBC Home Service (9 Nov. 1946)
1947	Construction of EDSAC begins in Cambridge under Maurice Wilkes.	
1948	Conference (March), 'A discussion on Computing Machines', held at the Royal Society. Participants include Douglas Hartree, Max Newman, Maurice Wilkes, Freddie Williams and Andrew Booth. (Booth *et al*. 1948)	
1949	EDSAC (Cambridge) operational May.	Sam Lilley, 'Electronic Calculating machines,' (Overseas Service, 26 Sept. 1949)
	Mark 1 Prototype (Manchester) operational in stages, April–October	
1950	Alan Turing's 'Computing Machinery and Intelligence' published in *Mind* (Turing, 1950)	W. Grey Walter, 'Brains: Electronic and Human' (Home Service, 4 May 1950)
	ACE pilot machine operational	D. M. MacKay 'Mind-like Behaviour in Machines' Parts 1 and 2 (Third Programme, 10 June and 16 June 1950)

Data compiled from Campbell-Kelly (1982); Wilkes (1985, pp. 138 and 142); Campbell-Kelly (1980, p. 134); Booth *et al*. (1948).

The three most significant UK computer projects of the immediate post-war period are shown in Table 1. Specifically they were:

1   ACE, at the National Physical Laboratory, designed by Turing, launched in 1946 and operational in a pilot version in 1950.

2   EDSAC, at Cambridge, designed by Maurice Wilkes, begun in 1947 and operational in May 1949.

3   Mark 1 Prototype at Manchester University, associated with Max Newman and (from 1948) Turing, using novel cathode-ray-tube memory devised by Freddie Williams. Operational during April to October 1949, having evolved from an earlier 'Baby' test machine (operational June 1948). Replaced in February 1951 by the Ferranti Mark I.

All three of these machines became operational, in varying degrees of completeness, in the period 1949/50.

The completion of these three machines engendered a considerable amount of press publicity, sometimes rather sensationalist. For example, even *The Times* frequently ran the headline 'The Mechanical Brain' over relevant articles and correspondence during 1949. Three years before, during an earlier spate of interest in the as-yet unbuilt machines, the headline 'The Electronic Brain' had frequently been used (*The Times*, 1946, 1949). This general rise in the popular awareness of the new computing machines coincides with the increase in the number of BBC broadcasts. Of the twenty-one surviving texts referred to earlier, eighteen are from the period 1949–56.

More than three-quarters of the talks listed in the Appendix were broadcast on the BBC's Third Programme, inaugurated in 1946 and specialising in cultural and intellectual matters. Such programmes would not have reached a mass audience. The audience for a Third Programme broadcast in 1949 was estimated to be around 90 000, although the total pool of listeners to the Third Programme was estimated to be about 250 000 (Carpenter, 1996, pp. 96 and 109). At this period, broadcasts on the BBC's more popular Home and Light services routinely had listenerships of a few million. Nearly all the Third-Programme broadcasts were produced by T. S. Gregory, who specialised in broadcasts on philosophical and theological matters (Carpenter, 1996, p. 193).

For the most part, what survives of the broadcasts in the BBC's Written Archives Centre is a transcript prepared after the broadcast from a disc recording. Timing information on the transcripts shows that talks typically lasted for around 20 minutes. The transcribers were usually clerical staff, and they occasionally misinterpreted what they had heard. For example, in the transcription of Wiener's 1951 talk 'The New Industrial Revolution', the term 'Newcomen Engine' (a type of steam engine dating from the eighteenth century) appears as 'new common engine'. Such garblings are, however, not frequent and for the most part not difficult to resolve.

In a few cases, what survives in the archive is not a transcript but the speaker's annotated broadcasting script, showing handwritten corrections, re-wordings, pauses and emphases. Examples of surviving scripts are Hartree's 1946 broadcast 'The New Giant Calculating Machine', W. Grey Walter's 1950 broadcast 'Brains: Electronic and Human', and Christopher Strachey's 1952 broadcast 'Calculating Machines and the Brain'. All the transcripts and scripts are on microfilm, the hard-copy originals having been disposed of in the 1960s or 70s.

Five of the broadcasts in May and June 1951, by Hartree, Newman, Turing, Wilkes and Williams, form a self-contained series produced by Gregory under the general heading 'Automatic Calculating Machines'. These broadcasts are the subject of a paper in preparation by the present author.

The broadcasts as a whole are too numerous to cover in detail in this paper, which will therefore concentrate in summary form on a few recurring themes from the broadcasts.

The broadcasts

The distinctive value of these broadcasts as historical sources lies in the fact that they are the words of the pioneers themselves at the time when they were breaking new ground. The broadcasts show what these people considered to be significant in the work they were doing, and what would be of interest to a lay audience. Thus, although the broadcasts do not offer the historian new revelations, they do give a personal and fairly informal slant on what the speakers' work was about, and what made it potentially or actually useful.

Speakers generally made reference to the usefulness of computers in mathematics, science and engineering. However, the potential of computers outside these fields was already clear at an early date. In December 1946, two-and-a-half years before there were working machines in the UK, Douglas Hartree said in a broadcast interview:

> '[Computers] can also be used in many problems of modern statistics, problems which are of importance in economics, public health and sociology...'

Another potential use of computers, often cited now but perhaps not so much appreciated in the early days, was suggested by Sam Lilley in September 1949:

> '... as bigger and bigger machines are built, their performances will come much nearer to that of our brains. ... machines may very well help us to understand how our own brains work.'

A number of the broadcasts were concerned with relatively straightforward technical descriptions – what computers consisted of, what they did and how they did it, and what they could be used for. The two broadcasts by Hartree (1946 and 1951), and those by Newman, Wilkes and Williams (all 1951) belong to this group. The talk by Freddie Williams, for instance, is concerned almost exclusively with the technology of memory, both the mercury delay-lines used in the EDSAC and ACE machines (Cambridge and Teddington respectively) and the cathode-ray-tube memory used at Manchester, for which he and Tom Kilburn were largely responsible. Williams's approach in his talk is to use homely analogies. For example, to illustrate the recirculation and regeneration of data in mercury delay-line memories he says:

> 'Suppose one attempted to store numbers by telling them to a man and asking him for them later. Then each man could only remember very few. Suppose as personal experience suggests, he could only safely remember one, and that for a rather short time. Then we should need a lot of men. But suppose we took one man and stood him some distance away from a cliff. If he shouted a number and then listened, after a certain time he would hear an echo. He could then shout the number again, and the only tax on his memory would be between hearing an echo and shouting again; after a further delay he would again hear an echo and shout, and so keep the number circulating between himself and the cliff.'

Taking all the broadcasts together, however, what is particularly striking is the number which are either entirely concerned with the philosophical issues surrounding artificial intelligence (as we now term it) or which allude in passing to these issues. In fact, nearly all the speakers touch on the use of the term 'electronic brain' at some point, and several discuss the appropriateness or inappropriateness of the term at some length. An instance is Douglas Hartree's 1946 broadcast, in which he was interviewed about his recent trip to the USA to use the ENIAC. He discusses the distinction between analogue and digital machines, and mentions the work of Charles Babbage. Almost inevitably, the discussion turns to human-like behaviour in computers:

> Hartree: 'In a long and elaborate calculation it often happens that a situation arises in which there are several possible alternative procedures, of which it is necessary to select one. However the calculation is carried out, this selection has to be made on the basis of certain conditions or tests, and the machines can be so designed and provided with operating instructions that if and when a situation calling for such a selection occurs, the machine selects and applies the appropriate tests.[...] This faculty endows the machine with what I think is not unfair to call a limited amount of judgement.'

Hartree, however, was not happy for too close a parallel to be drawn between the computer and the human brain:

> Interviewer: 'This need for thought, and probably hard thought, on the operator's part, in drawing up the instructions [i.e. the program] is, I take it, the reason why you object to the term "electronic brain" which has been applied to machines of this kind.'

> Hartree: 'Yes, that's just the point.'

Other speakers shared Hartree's unease at the equating of computers and brains. For example Max Newman, five years after the Hartree broadcast quoted above, says:

> 'Now there is some danger here that the jargon of "obeying instructions" and "choosing alternatives" which has become the customary way of describing the behaviour of these machines, may evoke a picture of the machine "conning" the branched instruction, looking to see if line 27 is empty, and then faithfully choosing the appointed alternative. In fact the machine "obeys" its instructions in exactly the same sense that a railway train "obeys" the points, going to Crewe if they are set one way and to Macclesfield if the other.'

The general thrust of this argument is that the behaviour described here only *appears* to be intelligent. Once one understands what the computer is actually doing, the issue of whether its behaviour can really be described as intelligent collapses. Turing, as is well known from his *Mind* article (Turing, 1950), took a different view. He sets it out at the start of his 1951 broadcast:

> 'I shall give most attention to the view which I hold myself, that it is not altogether unreasonable to describe digital computers as brains.'

Much of the rest of his talk is a kind of *resumé* of the ideas he discussed in his 1950 *Mind* paper, that is to say: the concept of the universal machine, its ability to imitate any other sort of digital computer, and the arguments that had been advanced against the possibility of computers ever being truly intelligent. Turing's own views, according to his broadcast script, were also shared by one mathematician:

> 'One ~~well known~~ mathematician has expressed the [...] point of view to me rather forcefully in the words "It is commonly said that these machines are not brains, but you and I know that they are".'

The phrase 'well known' is struck out in the script, though whether from a re-assessment of the mathematician's celebrity or a wish to better maintain his or her anonymity is unclear.

Sam Lilley was guardedly willing to allow the use of the term 'brain' in connection with the new computers. In his 1949 broadcast he says:

> 'Now in all this you will see that there is a good deal of justification for the name "electronic brain". The machine is enough like a brain to be able to take a few simple instructions and on that basis carry out a very long and complex routine. Now that is really

very like a lot of work that in ordinary life we should call brainwork. Think of an office routine, for example. That consists in carrying out a complex process from a few instructions, and yet we should call it brainwork. Nevertheless, we should say that in a sense it is second-class brainwork – the first-class brainwork consists in thinking out the instructions.'

Another speaker who addressed this subject was Christopher Strachey in 1952 (in one of the few Home Service broadcasts). He seemed to think the distinction between human intelligence and machine intelligence was one of degree rather than kind:

'The really important point, I think, is that there's a difference of several orders of magnitude between the comparatively simple programme we can prepare for a machine, and the vastly complicated operations performed by the brain when it's thinking.'

Also there's the question of experience:

'The way we think now when we try to solve a problem is the result of all this experience, and we certainly don't start any problem completely from scratch. A machine, on the other hand, is completely cleared of all its memories at the end of each problem, so that it has to start afresh each time.'

Strachey was evidently planning to say a lot more on this subject, but struck it out from his annotated script – though what he first planned to say is quite legible. The next two extracts are part of the deleted material.

'Most people, I think, would agree that mechanically obeying a fixed set of rules shouldn't be called thinking. In this sense the machine is certainly not thinking when it plays draughts, for the rules it obeys are fixed once and for all by the programme. But suppose the rules are not fixed, and that its game improves with practice. It would then appear to learn from experience. Ought we to call this thinking? I think we'd certainly be more inclined to do so.'

Self-modifying programs of the kind Strachey refers to above are mentioned several times by broadcasters as offering the potential for more convincingly intelligent behaviour (for example Hartree and Newman in May 1951). Strachey is inclined to think that nevertheless any such 'intelligence' would not be viewed as the real thing:

'As a matter of fact there's already at least one programme which makes the machine learn in this way. But I feel sure that after looking in detail at any such learning programme, you would once more say that it was only another more complicated sort of trick, and that the machine wasn't thinking at all.'

Whether we would similarly downgrade the status of human intelligence if we knew how it worked is not discussed.

One speaker who was freely anthropomorphic in his discussion of computers was W. Grey Walter, one of the UK's early cyberneticists. In his 1950 broadcast he said:

'The best modern machines correct their mistakes and learn from experience, and they also have personalities with good and bad qualities. Their designers nearly always refer to them by name – Bessie, Eniac, Edsec, Sesame – and sometimes they have breakdowns too. Sometimes an unruly memory of some number may spread right through a big machine and make it behave very oddly. The cure is rest – switching it off – or shock – putting a large

current in – or operation – cutting a bit out. [...] Usually when a machine is working badly its operator regards it as a responsible person, reproaches it bitterly and chastises it – when it works well, he takes the credit for its clever design.

[...]

It's quite possible to make machines that will learn tricks, work together, help one another out of trouble, sacrifice themselves for the common good and so on.'

However, the most provocative speaker is Norbert Wiener, who broadcast in April 1951. Whereas the other speakers see computers as powerful tools with a barely guessable future, Wiener sees them as precipitating social unrest. He predicts that this will come about through the use of computers in factory automation:

'... the machine will come in cumulatively and drive man out. There isn't much doubt that that will be the case over very large sectors of employment. [...] As to the cost of these machines, it will probably go down from what it is now, whether it is tens or hundreds of thousands of pounds, to what it is in the near future, which is thousands of pounds, to the level perhaps of hundreds of pounds. When you consider that this is the order of price, not of the whole factory collection of labourers, but of the single labourer, you will see that the machine has a great economic argument for it. But if the machine displaces man, it must change our valuation of man.'

In Wiener's scenario the automation of factories in the USA would proceed rapidly if the USA had to participate in further military action abroad, presumably in Europe. His talk implies that he thought such action was very likely in the near future. The legions of factory hands called up to serve abroad would be replaced by automated equipment at home. At the end of their military action,

'... the boys who come back are very likely to come back to see the factories used by a few people to make a quick fortune while they themselves have no jobs. That is not a socially safe situation.'

No other speaker shared Wiener's apocalyptic vision. Indeed Wiener is the only speaker who explicitly referred to a military context for possible future computer use, although other speakers spoke of the impetus that the Second World War gave to computer development.

After 1956

Although this survey has a cut-off date of 1956, this date is arbitrary and computer-related broadcasts certainly continued after this date. Notable among these are two broadcasts by A. D. Booth, who during the late 1940s was involved with one of the lesser-known computer projects, the Automatic Relay Computer at the laboratories of the British Rubber Producers Association in Welwyn Garden City. The first of Booth's two broadcasts, transmitted on 28 November 1958, was entitled 'The Future of Computers'; the second, on 6 April 1960, was entitled 'Visit to Russia to Discuss Computing Machines'.

Two other notable broadcasts were by the cyberneticist F. H. George, at the time Lecturer in Psychology in the University of Bristol and later Director at the Institute of Cybernetics at Brunel University. His book *Philosophical Foundations of Cybernetics* (George, 1979) takes Turing's 1950 paper as its starting point. In February 1958 he broadcast 'Logical hardware. Neural Nets for Biologists' and 'Models of Learning'.

Conclusions and further work

The broadcasts discussed in this paper were not intended as a coherent series – apart from the five broadcast in May and June 1951 under the general title of 'Automatic Computing Machines. Consequently no single theme or view of computing prevails. However, certain recurring themes do emerge from the broadcasts. The principal one is the contentious relationship of 'artificial intelligence' to human intelligence. Other recurring themes (to a lesser extent) are:

the potential of computers to transform radically practices in a wide range of technical and non-technical areas;

the potential for self-modifying programs to display 'learning'.

The fact that these themes do recur suggests either that the broadcasters regarded them as being of particular significance, or that they regarded them as being of especial interest to their audience, or possibly both. Regrettably the author of this paper has so far found no internal BBC documents that shed light on how the subject matter of the broadcasts were decided. The search continues, however. Similarly the question of the response of critics and listeners to these broadcasts are matters of continuing investigation.

It would be a mistake to view these broadcasts in isolation from other popularisations of computing and cybernetic developments during the same period. For the educated lay-readership there were, for instance, short items in *Penguin Science News* during the early 1950s relating to the new computers. However, unlike the radio broadcasts, these were not written by the practitioners themselves. At a more populist level there was the extremely popular Nim-playing machine built by Ferranti and featured at the Festival of Britain in London during the summer of 1951. The radio programmes are therefore seen to be topical, and to touch not only on matters of contemporary interest but also on matters of contemporary anxiety. A modern parallel might be genetic engineering and the human genome project. Computers themselves, of course, continue to be a matter of both interest and anxiety fifty years after these broadcasts were made.

Two of the speakers in the programmes discussed in this paper have been privileged with scholarly collected editions of their works, namely Alan Turing and Norbert Wiener. That their collected works do not include their BBC broadcasts seems regrettable. One desirable outcome from this paper would be to see some of these broadcasts published.

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Acknowledgement

Biography of the author

Allan Jones has worked for many years at the UK's major distance-teaching institution The Open University. For over twenty years he worked in the University's publishing division, editing course material in various subjects including electronics, control engineering, materials science, music and philosophy.

In January 2001 he became a lecturer in the University's Department of Telematics in the Faculty of Technology and is currently working on a new course in music technology. Besides pursuing research interests in the early history of computing in the UK he also researches unpublished twentieth century music for the classical guitar.

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Appendix

Broadcasts, 1946–56, for which texts survive

Broadcast date	Repeat date	Speaker	Title	BBC Service
9 Nov. 1946		Sir Charles Darwin	The Automatic Calculating Engine (news talk)	Home
11 Dec. 1946		D. R. Hartree	The New Giant Calculating Machine	Home
26 Sept. 1949		S. Lilley	Electronic Calculating Machines	Overseas
4 May 1950		W. Grey Walter	Brains: Electronic and Human	Home
10 June 1950	17 September 1950	D. M. Mackay	Mind-like Behaviour in Machines: 1 Mechanising Thought	Third
16 June 1950	22 Sept 1950	D. M. Mackay	Mind-like behaviour in Machines: 2 Machines and the 'Mind-body Problem'	Third
3 March 1951	17 June 1951	C. Cherry	Communicating Information – Languages and Codes	Third
2 April 1951		D. M. Mackay	Measuring Information	Third
30 April 1951	2 May 1951	N. Wiener	The New Industrial Revolution	Third
5 May 1951	24 June 1951	D. R. Hartree	Automatic Calculating Machines	Third
8 May 1951	26 June 1951	M Newman	Automatic Calculating Machines	Third
15 May 1951	3 July 1951	A. M. Turing	Can Digital Computers Think? (No. 3 of 'Automatic Calculating Machines')	Third
2 June 1951	4 July 1951	F C Williams	Automatic Calculating Machines	Third
5 June 1951	10 July 1951	M. V. Wilkes	The Use of Automatic Calculating Machines (No. 5 of 'Automatic Calculating Machines')	Third
14 Jan. 1952	23 Jan. 1952	Turing, Newman, Jefferson and Braithwaite	Can Automatic Calculating Machines be Said to Think?	Third
8 May 1952		C. Strachey	Control Without Men. Part2 Calculating Machines and the brain. (Part 1 missing)	Home
7 Oct. 1954		D. M. Mackay	On Comparing the Brain with Machines: Part 1 Motives and Methods	Third
14 Oct. 1954		D. M. Mackay	On Comparing the Brain with Machines: Part 2 Progress and Perspective	Third
5 Dec. 1956		W. Mays	Machine-like Processes and Thought Processes: The Likenesses and Differences Between Machines and Men	Third
10 Dec. 1956		C. Cherry	On the Present State of Brain Models	Third
12 Dec. 1956		F.H. George	Machines and Human Behaviour: Reproducing Human Behaviour in Machines	Third