BANK OF ENGLAND

Speech

Balancing security and aesthetics: the evolution of modern banknote design

Speech given by

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I would like to thank Andrew Bailey, George Baldwin, Victoria Cleland, John Keyworth, Hannah Reynolds and Kevin Wills for comments and contributions.

It is a pleasure to be here tonight: I can think of no better venue than the British Numismatic Society to discuss the evolution of Bank of England banknotes. For over a hundred years the society has enabled experts and enthusiasts in the study of coins and paper money to come together and exchange ideas and research. But I trust you will also understand why, with just six months' experience as Chief Cashier, I consider this venue a somewhat daunting one. Indeed, I admit, after reading on your website that you have four members with over 60 years' experience in numismatics and thirteen more with over 50 years' experience, I toyed with suggesting that we reverse the normal tradition after my speech, with me doing the questioning and you the answering.

The Bank has one overriding objective in banknote matters: to maintain public confidence in the currency. This means that on the one hand the public must be able to access our banknotes on demand; no trivial task given that today there are some 2.8 billion of our notes in circulation with a total value of over £50 billion. And on the other hand, the public must have confidence in the integrity of their banknotes; that they are genuine. This means our banknotes must be both instantly recognisable and hard to copy. The integrity of our banknotes depends in turn significantly on their design, the main focus of my talk tonight.

Contemporary banknotes follow a well developed design blueprint. This blueprint means first of all that our banknotes share common features, notably: the same paper, with a particular feel; a common approach to the use of raised lettering; each note bears a picture of Her Majesty the Queen on the front alongside a promise to pay signed by the Chief Cashier; and on the back of each note there is an image of a historical figure. Second, each denomination has its own unique features: its own standard size and predominant colour and with each new version of a particular denomination, say a £50 note, a new historical figure, or figures, to help distinguish the new-style note from its predecessors. Finally, underpinning this outward appearance is a detailed research and development process to integrate new security features, such as micro-lettering and successive generations of holograms, into the overall design to make the note hard to counterfeit.

One consequence of this approach is that the Bank's notes today share a distinctive aesthetic quality. Indeed one could view our notes as having become everyday pieces of art, which perhaps are seen first-hand by more people than any other in the country, and which have become a quiet part of our shared identity.

The blueprint I have sketched out is relatively modern and would fail to varying degrees to describe accurately the characteristics of the notes that we issued in the nearly 300 years before the 1970s. In fact, the design, aesthetics and security features of our banknotes have changed markedly over that period. In large part these changes have been the natural result of technological progress. But they also reflect how the use of our notes has evolved, from their beginnings as a novel financial instrument to an everyday tool which we collectively use to fund around 20 billion purchases per year. And in part they simply reflect changes in the Bank's attitudes towards design. Collectively, then, our banknotes provide a historical record

of how the Bank has responded to the economic requirements and technological possibilities in the era of their issuance.

The architect of our contemporary approach to banknote design was Harry Eccleston, who sadly passed away in April last year. As lead designer Harry was responsible for the development of the D series, introducing the blueprint that we still follow and ushering in a more unified approach to banknote design. My main aim tonight is to recognise Harry's contribution. I think that is best done by first setting out at a high level how the design of our banknotes has developed over time – this historical record I was just referring to – in order to put the contribution of his D series into context before then setting out how the Bank will be taking this heritage forward with the new-style £50 note which will be launched next week. Finally, I will also outline some important elements of the Bank's broader strategy to protect the integrity of our notes.

Banknote evolution

The Bank has been issuing banknotes, or 'running cash notes', as they were first known, since it was founded in 1694. [S3] These first notes were effectively receipts for coin deposited with us and were generally the preserve of wealthier individuals: in 1696, the value of notes in circulation was just over £2 million. There were no fixed denominations and a note could be 'written down', or part-paid out, if a portion of the note's full value was withdrawn. A note was valued and dated by hand by one of three cashiers who also signed the note.

As such, the Bank has faced since its inception the challenge of designing and producing banknotes which are secure against counterfeiting. In 1694 the question was whether the notes should be mainly hand-written or at least partly standardised through printing. [S4] In considering this question, the Bank went as far as commissioning printing plates, which with the benefit of hindsight we can see anticipated the future design of our printed notes, notably by including a vignette of Britannia which the newly formed Bank had incorporated into its corporate seal. But the Bank almost certainly never used these plates, preferring predominantly hand-written notes. Why? As far as I can tell, although part-printing offered clear production benefits, the Bank seems to have taken the view that predominantly hand-written notes would be more secure. [S5] Although that may seem a strange judgement from today's perspective, we should remember that while the printing technology of the time was far behind today's, the artistic quality of the calligraphy of the early cashiers was high. So the judgement may well have been correct. Indeed, when the Bank did issue some 12,000 printed notes a year later, the forgeries of Daniel Perrismore forced us to return to predominantly hand-written notes within months.

One week after the return to hand-written notes the Bank decided that a '...mould be made for making Ten reames of paper...' and a special committee was set up to '...consider of the forme of the Mould.'[1] This was

[1] Mackenzie (1953) p.8.

the genesis of the watermark in Bank of England notes, a security feature which survives today. Prior to this watermarks had only been used by printers to indicate the size of paper and the inclusion of, by the standards of the day, a unique and sophisticated watermark greatly strengthened the security of our notes. Because of it, in July 1697 the Bank was sufficiently confident to return to part-printing its notes, using a new design, enabling it better to reconcile production and security considerations than it had previously been able to.

In these founding years the Bank also confronted the need to complement secure design with effective deterrence. In 1697, after lobbying by the Bank, Parliament made forgery of our notes a felonious act, punishable by death. Deterrence, albeit with more modern sentencing standards, remains an important part of today's anti-counterfeiting strategy.

In 1725, standardised denominations were introduced, with today's £20 and £50 denominations appearing for the first time. [S6] To try to stop forgers changing a banknote's value, the 'sum block'– an elaborate value-based design feature – was introduced in 1743. Coupled with an improved vignette of Britannia, this helped to raise the technological barrier against counterfeiters and in addition helped to make both the issuer and the denomination more recognisable.

Around the turn of the 19th Century, things became more complicated. To counter the rapid depletion of the Bank's gold reserves caused by fear of an invasion, the Bank was instructed by Parliament to cease paying out gold on presentation of its notes. This was the so-called Restriction Period, and it lasted from 1797 to 1821.

To compensate for the absence of sufficient coin, lower denomination notes were issued, increasing our note circulation from just over £9 million in 1797 to over £16 million in 1800. This led to hastily-prepared notes reaching the hands of people who were often illiterate and unfamiliar with genuine banknotes – an opportunity that counterfeiters seized upon.

This prompted a concerted legal response. In a period of around 20 years, some 300 people were capitally convicted on forgery-related charges, compared to just three over the preceding decade or so. But it was also clear that the Bank had to strengthen the security of its notes and to that end the Bank invited the public to submit forgery-resilient note designs. Almost four hundred suggestions were received over roughly 20 years. Some were workable, some infeasible (such as the suggestion of banknotes 'wrought in silk') and some were ahead of their time, like the suggestion that 'a Portrait of the King, engraved in the line way, by the best Engraver, should be printed on all Bank Notes'.

[S7] And there were design submissions, such as that of Perkins, Fairman & Heath, in which complex artistic scenes and geometric patterns were combined to yield a strikingly modern design. But the Bank in that period preferred simplicity: a waved line watermark was added in 1801 as a result of the suggestions

received, and printed serial numbers and dates followed in 1809. These more simple innovations did prove effective and were hard to forge, which coupled with the decision to cease issuing £1 and £2 notes, led to a decline in counterfeiting at the start of the 19th Century.

In 1838 the Bank went as far as commissioning a pictorial note specimen. Yet judging again that that it was harder to counterfeit a well-designed, simple banknote than a complex one, we rejected the note design for looking like 'a picture with a note in the middle.' [S8] Instead, the Bank stuck with the basic design of its white notes, incrementally adding new security features during the century including a shaded watermark and a new Britannia vignette in 1855. [S9] As a result, to the casual observer, a note from the 1690s would not look entirely dissimilar to those whose legal tender status was ultimately withdrawn in 1961.

In making these judgements the Bank seems to have factored in the ability of the public to recognise a genuine note, and to have been concerned that counterfeiters would find it easier to pass off forgeries of complex designs than simple ones. Although we might reach a different judgement today, we continue to consider the ease with which our notes can be authenticated when developing new designs.

[S10] From 1928, with the advent of Series A, the Bank's notes took the first significant step towards contemporary note design with the inclusion of colour printing and printing on both sides of a note, albeit only in denominations of up to £1.

With the onset of World War II the pace of change was again forced by external factors: the production of high-quality counterfeits of the higher value white notes by Germany. Although the German plot was not successful and relatively few of the counterfeits entered circulation, the Bank responded by retiring the remaining white notes: those above £5 were withdrawn in 1943. The £5 note was updated with a thread in 1945 and those without were withdrawn in 1946. One official at the Bank described the episode as 'the most dangerous ever seen' and it had a clear impact on our approach to note design. [S11] Finally, the B series £5 note, designed by Stephen Gooden, enabled the last of the white notes to be withdrawn in 1961.

[S12] Series C, designed by Robert Austin (10/-, £1) and Reynolds Stone (£5, £10), brought the reigning monarch's portrait to the front of our banknotes, as had been suggested over a century earlier, and where it has remained ever since. When looking back at series A to C it is clear that an increasing number of the features we see in modern banknotes had begun appearing. [S13] But it was the D series of notes, designed by Harry Eccleston and first issued between 1970 and 1981 that truly heralded the arrival of our modern banknotes.

Harry Eccleston's contribution

Harry Eccleston started working with the Bank in 1958, having previously been a lecturer in illustration and printmaking and having served in the Royal Navy during the Second World War. He started as an assistant to Austin and became the Bank's first full-time banknote designer and the first to design an entire series.

This was a significant change. Before Harry joined the Bank, each note was designed on contract by an artist following a competition. This meant that no one individual had overall responsibility for the production of the note: the artist submitted a design which, if accepted by the Bank, would be turned over to the printing works to industrialise. Moreover, different artists could be responsible for particular denominations, as with the C series, Harry, by contrast, was a full-time employee of the Bank, responsible for a whole series who reportedly described his work as industrial design to defeat forgery.

Harry brought great technical expertise to the task. He once said that the designs for the D series were 'a blending together of several different designs into a single piece of artwork so that you can hardly tell, for example, where the geometric lathe work ends and the hand-engraving begins'. The back of the £50D is the result of such an approach, where a geometrically-lathed sky, augmented with astronomical symbols, was blended harmoniously with a hand-engraved image of a cityscape, dominated by St Paul's Cathedral. He also demonstrated exceptional attention to detail. Harry typically undertook some three months of research and three months of drawing for portraits and scenes that were used on each of the notes. [S14] These preliminary drawings for the back of the £5D, go some way towards demonstrating this.

The overall result was that, at a time when commercially available printing equipment was becoming more sophisticated, Harry's highly-detailed designs and use of colour ensured that all but the most refined counterfeits could be recognised as imitations, even before checking for the watermark or other features. Looking back, I think it is clear that his detailed and aesthetically balanced design succeeded in supporting the security of the note to a greater extent than had previously been achieved.

Harry's responsibility for the whole series also resulted in our first aesthetically-consistent family of banknotes, establishing the common elements of the blueprint that I described earlier. The D series was the first of the modern series to contain the now-commonplace £20 denomination and the £50. His approach meant one could know what to expect from the composition of a D series £5 note having seen a £50 of the same series – something that was not the case previously.

If the Bank deserves credit for giving Harry Eccleston the remit to produce an entire series of banknotes, it was his artistic style and technological understanding that enabled him to introduce such a step change in the design of our notes.

Recent developments in banknote design

Naturally, there has been further evolution since Harry's time. [S15] In one particularly notable change, the portrait of the Queen was standardised in the E series and enlarged across the denominations, based on photographs taken by Harry's successor as artist designer, Roger Withington, who had worked with Harry on the D series and ably took forward his legacy.

But more profoundly, advances in technology have revolutionised the mechanics of the design processes. The era of pen and ink design is increasingly being replaced by computer-based processes. And, nowadays, such is the rate of technological innovation that the Bank's specialist research team constantly has to investigate the merits of new banknote security features and examine the opportunities that new technologies afford to counterfeiters. To give one relatively recent example of the latter, in preparation for the launch of the E series £5 in 1990, the team developed a palette of 23 colours to negate the risks associated with the greatest threat then imaginable – a computerised colour laser photocopier from Japan: a copying tool requiring no expertise.

I hope Harry Eccleston would be heartened to know that despite these developments, the approach that he established still exerts a strong influence over our approach to banknote design today. In particular, the basic blueprint for the layout of our notes remained unchanged, and we strive to match the commitment he showed to including an accurate depiction of the historical figures on our notes. [S16] Indeed, the most recent F series notes, the 'Adam Smith' £20 launched in 2007 and the new-style £50 to be issued on 2 November next week, share some detailed design similarities with Harry's £1 'Newton' note – the bold use of colour and of white space and the placement of the Britannia vignette. I like to think that these details pay tribute to his contribution.

The New £50 and its features

[S17] The new £50 will be the first of our notes to have twin portraits on the back, Matthew Boulton and James Watt. Ever since Eccleston's D series, the Bank has given close consideration to those individuals it has portrayed on its notes. This is an excellent opportunity to commemorate those who have made great achievements. Our approach has been to choose individuals who have made a lasting contribution, which is widely recognised and has had enduring benefits. This points to choosing historical rather than contemporary figures. The Bank has recognised contributions from a wide range of fields including science and technology, the arts, economics, architecture and social reform. Given the need for universal acceptability we shy away from choosing characters who could be viewed as unduly controversial. Name recognition is obviously a factor too. And finally, we prefer that there should be good artwork for the Bank to base its pictorial representation upon, to underscore the authenticity of our notes.

Set against those criteria Boulton and Watt individually deserve consideration. I gather that your society held its summer meeting in 2009 in Birmingham to mark the bicentenary of Boulton's death, so I imagine you will need little introduction to Boulton's work in revolutionising the production of coin. His methods brought security in the form of uniformity to Britain's coinage, something which the Bank had yet to achieve for its notes in the 18th Century. And the contribution of Watt was immortalised by the decision to name the unit of power after him. However, our banknote focuses on their collaboration, starting in 1775 and lasting for a quarter of a century, to develop and market steam engines, initially for the mining and textile trades but eventually for a multitude of industries in the UK and abroad. When considering the contribution of their steam engine technology to the Industrial Revolution, I am in no doubt as to their worthiness for portrayal. Moreover, I hope that you will agree with me that the design we have chosen, depicting both the steam engine and the Soho manufactory where it was assembled matches up to Harry's exacting standards for aesthetics and historical accuracy.

As well as a first for our banknote art and being the first to bear my signature, the new £50 will deliver a significant update in security features, carrying eight features for cash users compared to the five of its predecessor. Today I would like to reveal the most notable among these: a technology which is new for the Bank, called motion thread. Woven directly into the paper, the motion thread is a semi-translucent feature with five windows along its length which contains images of the £ symbol and the number 50. As you will be able to see for yourselves from next week, when a note is tilted from side to side, the images move up and down. And when the note is tilted up and down, the images move from side to side and the number 50 and £ symbol switch. The thread, in combination with the other security features, reflects our intention to design a secure note. I would encourage everyone to take the time to examine this new security feature, whether seeing it for the first time next week or when receiving a note in five years' time.

Our broader strategy towards protecting the integrity of the currency

Although my focus this evening has been on design, good design is not sufficient on its own to ensure the integrity of our notes and I would like to finish by remarking on three aspects of our broader strategy: ensuring genuine notes can be recognised as authentic; ensuring the quality of our banknotes; and deterring counterfeiting activity.

Authenticating banknotes

As my comments about the Bank's choices during the 19th Century make clear, we have always placed weight on ensuring the ability of cash handlers to authenticate genuine notes. But our approach to this has evolved considerably, particularly over the past fifty years.

In significant part, this has been in response to changes in the technology used by banks and other large-scale cash handlers. Back in 1960 when Austin's £1 note was introduced, there was something of a

clamour around the moving of the serial number, as tellers were accustomed to look for it on the top right when counting up. But not long after, machine verification started to transform the industry, reducing the reliance on tellers. The high speed note sorters used by wholesale cash handlers today can process over 100,000 banknotes per hour and are able to look for complex features. This change has been echoed in the ways in which we, as members of the public, receive and pay-away notes. For a number of years ATMs have been the predominant source of banknotes for the general public (there are now over sixty thousand ATMs in the UK) and we are making more and more purchases by feeding notes into machines rather than handing them over to cashiers.

During this period we have developed a close working relationship with the machine manufacturers, which brings mutual benefits both through information exchange and opportunities for machine testing. When developing new security features we consult the industry at an early stage on the technology required to verify the feature and when nearing the issue date for a new design we aim to ensure that they have the opportunity to update and test their equipment prior to the launch. On an ongoing basis, the Bank also works with the cash industry to ensure that their machines can recognise and remove counterfeits reliably, with machines that pass our tests listed on the Bank's website.[2]

Our approach to verification by the public has also developed over this period, in two significant ways. First, we now take a more systematic approach to assessing how cash users respond to different note designs, for instance by making use of perception studies to understand attitudes towards our designs. One of the earliest studies, in the 1970s, was carried out by University College London. The report contained some conclusions which tended to validate the design choices underpinning the D series: the "distinct characters of 'frontness' and 'backness' should be maintained on the two sides of the notes", "because the fact that people inspect notes according to their side can be used, like denomination identification, as a 'psychological' security device. In this respect, it would be of value if the front and back portraits were differentiated by a 'conceptual' cue such as the historical age to which they belong or their membership or not of the British Royal House." Since then perception studies have become an increasingly common part of our banknote design method. For example, the Bank conducted an 18-month project and a perception study with over 100 participants before finalising its choice of motion thread for the new-style £50 note.

Second, we now invest more time and effort in educating the public about our notes. In 2004 a dedicated banknote education team was established, with a remit of educating the public about how to authenticate our notes. The team creates a range of education materials (which these days include leaflets, online reference guides, DVDs and even YouTube clips) and provides education programmes aimed at raising awareness among key target groups, such as retailers and police forces. The team also focuses its work on groups or areas which are very busy or might attract particular attention: for example, we will next year work with

[2] http://www.bankofengland.co.uk/banknotes/retailers/framework.htm

businesses in proximity to the Olympic sites to help staff understand how to identify genuine Bank of England notes.

Banknote Quality

Because an older, dirtier note can be more difficult to verify as genuine than a newer, cleaner note, the Bank is concerned not only with the quantity of notes in circulation but also with the quality, or condition, in which they reach the public. In general, this is not a problem but one unintended consequence of the growth in the number of ATMs I mentioned earlier was to disrupt the circulation of £5 notes. As banks increasingly chose to dispense £10s and £20s from their ATMs, fewer £5s entered circulation and it seems that this scarcity encouraged retailers to hang on to the ones they had, rather than return the unfit ones to a bank. The quantity and appearance of the £5 notes in circulation began to suffer. This could be frustrating, both from the public's point of view and for the Bank in aiming to ensure note integrity. The Governor highlighted this issue in 2007 in his speech at the Mansion House, and launched an initiative to investigate how the dispense of £5s to the public could be increased. The idea behind this initiative was to reverse these trends: not only would more and higher quality £5s enter circulation, but retailers would be more confident in their supply of £5s and so be more inclined to bank them, allowing old notes to be replaced with new.

From 2010, we have been working directly with the largest ATM providers to encourage them to dispense greater volumes of £5s and earlier this month we implemented a new incentive structure to increase sorting and dispensing of £5s by the wholesale cash industry (the Note Circulation Scheme members), who sit between the Bank and the broader cash handling community. The ATM initiative has already borne some fruit: as you may have seen recently in the press, there are now nearly five times as many £5-dispensing ATM's in the UK as there were in 2009 and you can now search for your nearest £5 ATM on the website of LINK, the UK's cash machine network. Clearly, there is more to do, and it is too early to declare success, but there are grounds for being optimistic about our ability to meet our goal that in 2012, £4bn of £5s will be acquired by the public, compared to just over £2bn in 2010.

Deterrence

Unfortunately no matter how well we design our notes, whatever their quality, and however well educated the public are about authentication, there will be some level of counterfeiting. For this reason deterrence remains a key part of our strategy and we work with the Serious Organised Crime Agency and regional police forces to bring counterfeiters to justice. Over 2010, three major sources were disrupted, several smaller operations shut down and a number of successful convictions made, including two sentences of 12 years. 2011 has seen disruption of two further substantial operations. We remain grateful for the continuing efforts of the police among the many other calls on their time. In this context, I would like to mention both that we look forward to the newly created ' National Crime Agency' supporting this approach

and that we welcome the appointment of an Association of Chief Police Officers' (ACPO) lead on counterfeit currency.

Conclusions

The Bank has been issuing banknotes since its founding year and has been confronted with the challenge of securing their integrity ever since. Unsurprisingly, over such a long period the design of our banknotes has evolved considerably, from the original black and white designs introduced in the 1690s, to the contemporary notes which owe many of their characteristics to the designs and concepts introduced by Harry Eccleston. Banknote design is complemented by a broader strategy to support integrity which has also evolved considerably, particularly in recent years as technological change has revolutionised the way in which cash is handled.

There are many lessons from our history, including the need for the Bank to be continually alive to emerging threats to the security of its notes. So, while I am looking forward to the launch of our new-style £50 note next week and hope that the public will appreciate both the aesthetic design and new security features in the note, you can rest assured that my team and I will not view our job as ending there. We will look toward new challenges and developments in our mission to maintain confidence in the currency.

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