SECURITY FEATURES OF NETHERLANDS BANKNOTES

A systematic approach

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Introduction

The security features are distinct and noticeable parts of the front and back of a Netherlands banknote. They are designed in a systematic way to make forgeries very difficult. When a forged note shows deficiencies, it is not a question of chance or luck. The security features chosen are there precisely because they are difficult to imitate.

Four manufacturing techniques

What systematic method do we use when designing security features for a banknote? In Netherlands banknotes, and in the banknotes of many other countries, four manufacturing techniques are used, viz:

— paper making,

— intaglio printing,

— dry offset printing, and

— letterpress.

Difficult to forge

Each technique serves to realise a number of security features. If we succeed in the design of efficacious features, we make the forger's work very difficult because:

— he must master four different techniques,

— he must invest in expensive machinery for each technique,

— he must be an experienced craftsman himself and work with such persons, and

— he must acquire specialised basic materials.

Security features deficient and distorted

In practice, the four techniques are so difficult to master and the equipment and materials are so difficult to come by that a forger is forced to try to imitate a genuine banknote using the equipment and the materials which are commercially available. However, we are conversant with the characteristics and the shortcomings of the equipment likely to be used by forgers, and we deploy our knowledge to the full in the design of security features. Consequently, forged notes invariably are deficient and show distortions, and they also lack important details. It must be stressed that we are able to predict where in the design a forger will come to grief. Not all forged notes founder on the same features, but, most certainly, all will fall down on one or other of the features designed specifically for that purpose.

First step

The first step when designing a new banknote is to establish the nature and the number of security features we wish to incorporate in the technique. In Netherlands banknotes there is a total of some twenty features. To name but a few: watermark and fluorescent threads in the paper, tactile relief and micro-lettering in intaglio printing, a transparent register gauge and rainbow printing in dry offset, machine-readable numbers in letterpress.

Second step

At the second step the design or the pattern of each security feature is established. When we design a pattern we must consider at least three technical attributes:

— the colours to be used in the pattern,

— the gradation or density of the colours chosen, and

— the spatial frequency of the line patterns.

Let me elaborate on these technical terms.

Colours

The colour of a pattern is obvious and does not need any explanation. Colour can be used to great advantage. Most forgeries are screened three- or four-colour offset reproductions. The printing materials mostly used for such reproductions are available from reputable companies. The properties of the materials are developed in accordance with internationally accepted colour standards; the Euro-scale is a well-known example. Of course, standardisation came about because it permits easy, fast, qualitatively good, and

moderately priced colour reproductions. However, standardisation necessarily implies that some colours, which fall outside the standardised range, cannot be reproduced faithfully. If some colours of the security features in a banknote are deliberately chosen because they fall outside the standardised range, we are almost certain that the note will be very difficult to reproduce.

Metamerism

A second application of colour in banknotes is metamerism. Metamerism, despite its unusual name, is a colour effect which is all around us. Let me give an example: if a part of a car is damaged or scratched and it must be repaired, the result may look perfect in broad daylight: there need not be a discernible colour difference between the new and the old paint. However, when, at night, the same car is seen in the yellow sodium light of a street lamp, the difference between the newly painted part and the rest of the car may be very marked.

In very general terms the metameric effect may be described as follows. If there are two coloured surfaces close to each other, we can choose or mix the two colours in such a way that they appear the same in broad daylight, yet distinctly different in artificial light or through a coloured filter. In practice, metamerism is always a nuisance and as a result, manufacturers refrain from making metameric paints and inks. Again, this provides us with opportunities for security features. If a security feature is printed in two metameric colours, when it is reproduced, the reproduction will not show metamerism. Superficially, both colours will be reproduced, but the metameric effect will be lost. The colours will either look the same or they will differ from each other, as the case may be, but they will not change with the lighting. And, often, the result will be even worse in that the colour shades are altered completely. It is almost certain that metameric colours cannot be reproduced faithfully.

Gradation or density

The second attribute of a pattern which must be considered is that of gradation. After choosing a pigment we can make a range of colour shades from it, from almost white to fully saturated, depending on the concentration of the pigment. With the aid of certain accessories we can measure gradation as density. The density of a coloured surface is then the amount of light absorbed by the surface relative to pure white paper. Generally, a reproduction technique can only cope with a limited range of densities. A good example of this is provided by xerographic colour copiers, which are unable to reproduce intermediate densities. On the other hand, although offset presses have less difficulty with the intermediate densities, they cannot reproduce low and high densities at the two extremes of the range. Therefore,

it is effective to include a wide range of densities in the security features of a banknote in addition to a wide range of colours.

Spatial frequency

The third attribute of a pattern which must be conscientiously chosen is spatial frequency. The frequency of a pattern depends on the thickness of the lines present in the pattern and their spacing. If lines are closely printed, the frequency is high and if lines are sparsely printed the frequency is low. The spatial frequency can be counted and is expressed as a number of lines or points per unit of length. For instance, the fineness of a printers' screen or of a scanner is usually given as the number of dots per centimetre or inch.

Here, too, every printing technique has its limitations. The spatial frequency is particularly suited to thwart modern scanners. A high-quality scanner uses a very well-defined spatial frequency. In the first place this means that frequencies higher than half the scanner's frequency are not well reproduced. In the second place it means that a scanner is vulnerable to moiré patterns and other interference effects. Although manufacturers of scanners invariably claim that their equipment avoids moiré, it is always possible to find an unusual pattern with which a scanner is unable to cope. This is the pattern which we want to incorporate in a banknote. Such moiré-forming patterns we have called screen traps.

Summary of the technique

I come now to a summary of the first and technical part of my lecture. I have explained that four manufacturing techniques are used in the production of Netherlands banknotes: paper making, intaglio printing, offset printing, and letterpress. We measure and catalogue the properties of our equipment and materials, and we do the same with the equipment and the materials available commercially. We compare both lists of properties and the design security features outside the scope of the forger's equipment and materials but within our own. In particular, we pay attention to colour, gradation, and spatial frequency. There is absolutely no doubt that we are able, in this systematic way, to design a banknote which cannot be copied. The quality of the paper machine at our paper mill, and the printing presses at our printing works surpasses that of all other equipment available in the market.

Applied psychology

However, the problem is not only technical but also requires an understanding of applied psychology. The design of security features should enable the public to distinguish forged from genuine notes without requiring the use of measuring instruments or pictures for immediate comparison. This aim can

only be reached if the public are given the means to remember where they must look and for what on a banknote.

No more than six security features published

It is well documented that a person can memorise, at the very most, twelve items from a list of unrelated facts. We did our own research and we found that this also applies to banknotes. With the use of public opinion polls, which are repeated every two years, we established that no one could name more than five security features. It is, therefore, useless to publish more than six security features. The rest is simply forgotten. It is much more useful to select a limited number of features and to choose the designs commensurate with the theme and predominant colour of the banknote. A limited number of related features should be easier to memorise by the public by arousing their interest and appreciation than a much larger number of unrelated — and thus confusing — features.

Relationship of colour, subject, security features, names

In the Netherlands, as in many countries, the predominant colour of each denomination is historically determined. Previously the main subject of Netherlands banknotes was chosen by the Nederlandsche Bank, without any attempt to make it appeal to the public. However, about ten years ago a beginning was made to choose the main subject of a Netherlands banknote relative to the colour: thus a brown Snipe for the brown 100-guilder note, a yellow Sunflower for the yellow/orange 50-guilder note, and a red-violet Lighthouse for the purple 250-guilder note. The depiction of the subjects is not entirely naturalistic but the colours and the subjects do support each other.

Furthermore, the patterns for the security features are chosen to fit the main subjects. These must be realistic, as opposed to abstract, so that they are easily remembered. It is vital that there is an obvious relationship between the colour, the subject, and the security features of each banknote.

The security features should also be denoted by an easily understood yet technical name. These four factors combined will have to attract the attention of the public and facilitate easy memorisation.

Conclusion

Ladies and gentlemen. In a few words I have sketched how modern banknotes can be designed, at least how we have been doing it in the Netherlands for about ten years. I hope my lecture has convinced you that modern banknotes cannot be deceptively forged, by which I mean that anyone can establish beyond doubt whether a banknote is genuine or not. I also hope that I have convinced you that we can predict on what security features a forger

will come to grief. This is why I want to suggest that the publication *Contrefaçons et falsifications*, which your organisation has been publishing with so many success for so many years, could open with a general introduction detailing the main security features found in banknotes of most countries and identifying the few security features in each individual banknote.

The latest Netherlands banknote: 250-guilder / 1986 (Lighthouse)

To finish this lecture, I would like to show you a few slides of the latest Netherlands banknote to illustrate our systematic approach.

Front Slide 1 shows the front of the note. You see a sturdy lighthouse from whose top a multi-coloured spectrum emanates. The denomination is 250 guilders which is roughly equivalent to US$ 120.–. It was designed as systematically as possible. All security features for the public have a realistic (i.e. not an abstract) design which is related to the theme of a lighthouse along the coast line. You will notice the strong violet colour which is difficult to reproduce within the confines of the Euro-scale. The note is very colourful which, we hope, will pose problems for the forger.

Back Slide 2 shows the back of the same note. Again it is very colourful. The back is much more detailed than is the front. Please note the watermark. It is a rabbit playing — I imagine — in the dunes around the foot of the lighthouse. A distinct shadow watermark with maximum contrast between light and dark areas is very good as a security feature. In the Netherlands no forger has ever attempted to make a real watermark.

Relief of the engraving Slide 3 is a close-up of the top of the lighthouse. It is engraved. The relief of the engraving is at a maximum here and can be easily felt. In the Netherlands no forger has ever applied intaglio printing or even imitated the relief with any degree of success.

Register between front and back Slide 4 shows one of the patterns on the front which does not seem to mean anything. A similar pattern on the back is also shown. When we hold the note to the light (in slide 5) suddenly a standing bird emerges. It is an oyster catcher common along our coast. This illustrates very well how security features can be designed to become meaningful only in the context of the note and only when viewed properly.

Microlettering Slide 6 shows the microlettering on the back. It is more or less a legend as commonly found on a map. The names of the places with major lighthouses are given. In front of the names the blinking patterns

observable at night are depicted as triangles and rectangles. The numbers correspond to the numbers along the coast line, which is also shown on the back. Please note that the legend starts with larger letters at the top which gradually go over into extremely small letters of 0.3 mm. The reader is enticed to go on reading once he has started with the larger letters.

Fluorescent threads Slide 7 shows a picture of the fluorescent threads in the paper, familiar to all of you.

A pair of metameric colours Slide 8 shows a green rabbit in a green bush also on the back of the note. Both greens are metameric colours which look almost the same in broad daylight. In artificial light or through a red filter the greens differ. This slide demonstrates clearly that the effect cannot be copied. Fortunately, as expected, the photographic process used in this slide changes both colours so that the metameric effect is lost. The only place to see the real effect is in the real banknote. I have one with me. Slide 9 shows the same through a red filter.

Microlettering Finally, slide 10 shows another text in microlettering. It is a few lines from a poem about a lighthouse, written by a poet who died fifty years ago. The letters are 0.2 mm high and this time they are printed in intaglio on an offset background in the same colour.

Leaflet to assist the public The main security features of this banknote were published in a leaflet available to the general public. I have distributed one copy of the leaflet to each delegation. It has an English text.

That is all. Thank you, Mr Chairman.

Note

This lecture was presented to the '7ème Conference Internationale sur le faux Monnayage' / '7th International Conference on Forgeries', Lyon (France), 22-26 June 1987. This digital version, composed in October 2006, follows the original text with minor emendations. Dr Peter Koeze, Adviser to the Governing Board, retired from De Nederlandsche Bank, the National Central Bank of the Netherlands, in 2004.

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