Evaluation of Forensic Methods for Overprint Analysis

by Lyman R. Caswell

Introduction

In the aftermath of World War I, many stamps of the occupied countries of Europe were overprinted for various purposes. Of these, the red and green Szeged overprints on stamps of Hungary are unique. Although most catalogues include them in the listings of stamps of "occupation" (*megszállás* in Hungarian, *besetzung* in German), they were produced by a Hungarian authority,[1,2] and are the only stamps among these issues to have later been recognized as official issues of the Hungarian government.[3] Some Hungarian authorities prefer to call them "local issues" (*helyi kiadások*).[4] This article reviews the history of these stamps and reports the results of examination of the green overprints using qualitative analytical methods.

Historical Background

At the end of World War I, Hungary was a country undergoing disintegration. In the fall of 1918, Slovakia, Croatia-Slavonia, and Transylvania seceded from Hungary, and were promptly occupied by, respectively, Czech, Serbian, and Romanian armies. By the spring of 1919, the Czech Legion had occupied Carpatho-Ukraine, Serbia had taken Bácska in the south, and Bánát in the southeast had been divided between Serbia and Romania. The Romanian army was advancing into what was left of Hungary. A French army, which had been sent to the Balkan front during the war to support Serbia, occupied an area in the southeast, which included the cities of Arad (now in Romania) and Szeged. Figure 1 shows the borders of Hungary before and after World War I and the location of Szeged.

On March 21, 1919, Communists seized power in Budapest to form the Hungarian Soviet Republic (*Magyar Tanácsköztársaság*) under dictator Béla Kun. With approval of the occupying French forces at Szeged, Admiral Miklós Horthy, who had been Commander-in-Chief of the Austro-Hungarian Navy, organized the Hungarian National Government (*Magyar Nemzeti Kormányi*) as a counterrevolutionary nationalist government in opposition to the bolshevist government in Budapest.

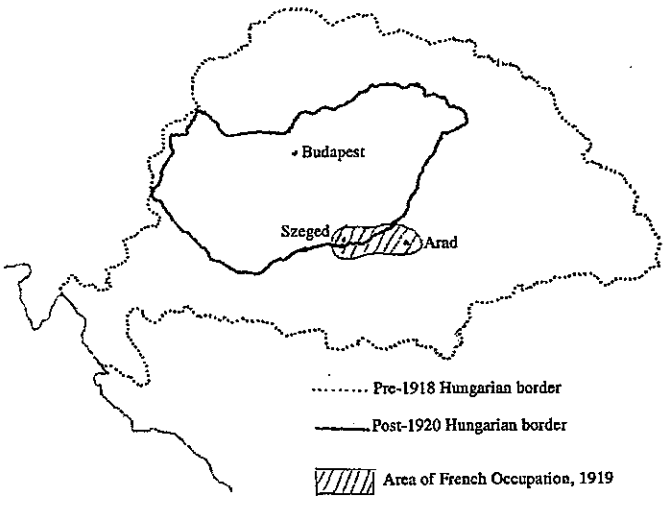


Figure 1. Hungary before and after World War I and location of Szeged.

Szeged Overprints

Origin

Dr. Lajos Varjassy, the Minister of Commerce of the National Government, obtained permission from the occupying French military to overprint available Hungarian stamps, "MAGYAR NEMZETI KORMÁNYI / Szeged, 1919," and issue them at the Szeged post office as publicity for the nationalist government.[4] The overprints were actually created as a product whose sale would raise money to pay the back wages of local postal employees.

Figure 2. Szeged overprint, "Hungarian National Government"

Overprints were applied to the current definitive and war relief semipostal stamps in the Szeged post office, including some with the *Köztársaság* ("Republic") overprint applied earlier. Express delivery, postage due, and newspaper stamps were also overprinted. The overprinting was done in only two days. The work began at the King's Press in Szeged, hereafter referred to as Print Shop 1. Shortly after the work started, the local typographers union, which may not have been in sympathy with the goals of the National Government, went out on strike. Postal workers, and others with no experience as printers, were hastily recruited to continue the typesetting and overprinting. At the end of the first day, the proprietor of Print Shop 1 closed the shop and refused to permit its further use for the work. He did, however, allow the printing plates to be transferred to the second printer in Szeged, known only as Print Shop 2, where the overprinting was completed the following day by the same inexperienced workers. The overprinted stamps were issued on June 28, 1919.

As might be expected from the conditions under which the overprints were applied and the inexperience of the workers, a large number of varieties and errors were produced. These have been listed and described by Ettre[1] and by Brainard.[5, 6]

Since both print shops used the same printing plates, their products cannot be distinguished by differences in the types. Print Shop 1 overprints can be distinguished[5] by the force with which they were applied, resulting in "inksplash" or "squeeze" of the letters, that is, the ink in the body of each letter is thinned, while the letter has a dark outline. The strong impression also produced reverse embossing on the back of the stamp. These characteristics are not observed with either the Print Shop 2 products or the counterfeits.

Colors

Most of the stamps received red overprints. Stamps on which a red overprint would not show clearly were overprinted in green. Red, white, and green were (and are) the colors of the Hungarian national flag. Green overprints were applied only in Print Shop 1 to Scott Catalogue[7] numbers 108, 109, 122, 127, 153, 168, B53, B55, and B60. Two of these stamps were also surcharged with new values in addition to the green overprint. Scott 109, the 3-fillér harvesters, was revalued to 45 fillér with a red overprint, and Scott 122, the 1-Korona Parliament, was revalued to 10-Korona with a blue overprint. Scott 153, the 2-fillér harvesters with the "Köztársaság" overprint, was revalued to 20 fillér with a red overprint. It was not issued without the revaluation. Only two stamps, Scott numbers 154 and 158, received green overprints in both print shops. The green overprint on the newspaper stamp, Scott P8, was applied only in Print Shop 2. The numbers of stamps receiving green overprints varied from 700 for the 3 f. harvesters-Köztársaság (Scott 154) to 50,700 of the 20 f. on 2 f. harvesters-Köztársaság (Scott 153).[6]

Although the colors of the red overprints from the two print shops are distinguishable,[5,8] no color distinctions have been reported for the green overprints of the two print shops, both of which are described as "dark green."[8,9]

Counterfeits

Like all of the Occupations overprints, those of Szeged have been extensively counterfeited for sale to stamp collectors. The green ink of the counterfeits is similar in color to that of the genuine overprints, but many of the counterfeits can be identified by characteristics other than color. Brainard's study of Szeged overprint proof sheets has resulted in a comprehensive list of printing errors on genuine stamps.[5,10] Printing varieties not on this list can be assumed to be indications of forgery.

A major forger of Szeged and other Occupations overprints was Géza Tarján, a Budapest stamp dealer who set up his operation in 1919.[11,12] His reproductions of the Szeged overprints were so good that it is believed that he had the original printing plates.[13] Some of the forged Szeged overprints are, however, easily distinguishable by the placement of the date "1919." In the genuine overprints, the second "1" of "1919" is below the left edge of the "g" of "Szeged." In the counterfeits, the date is shifted to the right, so that the second "1" of "1919" is below the center of the "g."[5]

Examination of the backs of the Occupations stamps sometimes reveals the marking of an expertizer as a guarantee of genuineness. In 1998, Budapest stamp dealer and expertizer Deszö Flasch published an annotated list of these marks, which has been expanded by Kock[14] to include worldwide expertizers and forgers. "ABONYI" is the mark of Jenő Abonyi, a Budapest stamp dealer who was active in the late 1940s. "BODOR" is the mark of Dr Mihály Bodor, a stamp dealer of Pécs who is no longer active. "FLASCH" is the mark of Flasch himself, who died in 2006.

The mark "PAPE" of Géza Tarján's temporary associate German stamp dealer Heinz Pape represents a special case. The "Good Pape" mark, indicating a genuine stamp, is clean-cut and neat with all letters very clear, made with a fine, metal stamp which cut into the paper, and was usually applied at the lower left corner of the stamp. Its dimensions are 1.25 × 2.5 mm. The "Bad Pape" marks may appear on both counterfeit and genuine stamps. They have either broken letters or smearing, or both. They are believed to have been made with rubber stamps and are of variable size. According to Kock, some of the "Bad Pape" marks are forgeries made by Tarján after the two dealers ended their business arrangement in 1921.

Investigation

Analytical techniques

The analytical procedures used in examination of the overprints were reflectance spectroscopy and X-ray fluorescence spectra. Early uses of these techniques have been reviewed by White.[15] New computer technology has permitted correlation of reflectance spectra with visible colors, enhancing their use as a tool for color identification. These abilities are incorporated into the Foster & Freeman Video Spectral Comparator VSC 6000.[16] The seminal study of the 1919–1920 postage due stamps of Slovenia by Herendeen et al.[17] has clearly demonstrated the utility of this instrument not only for the measurement of color, but also for a new quantitative approach to the identification of the colors of stamps. DeBlois and Harris[18] have used similar analytical methods to quantify the color varieties of the 8-cent stamp of the United States Presidential Series. Peterson et al[19] have extended the use of the technique to overprints in their study of the 1881–1888 Philippine overprints.

Recent work by Liston[20] has demonstrated the use of X-ray fluorescence spectral

analysis for the identification of the compositions of the inks used in printing the pink, pigeon blood, and rose varieties of United States Scott numbers 64 and 65.

Research questions

These analytical methods will be applied to the green Szeged overprints in order to answer two important questions. First, can clear-cut distinctions be made between the inks used by the two different print shops? Second, can these methods distinguish between the genuine and the counterfeit overprints? A future article will report the results of a similar study of the red overprints.

Initial examination of stamps

Prior to making the spectral measurements, the stamps were examined on the basis of the qualitative characteristics described earlier to determine, to the extent possible, which ones had Print Shop 1 overprints and which had counterfeit overprints. This examination resulted in the discovery of previously unreported characteristics displayed by some counterfeit stamps.

The distances between portions of the overprints were measured with an accessory provided as a special feature of the VSC 6000 reflectance spectrophotometer. On harvesters and other upright format stamps, the distance between the "E" of "NEMZETI" and the "S" of "Szeged" averaged 9.2 mm, with a standard deviation (S.D.) of ± 0.1 mm. On normal parliament stamps, the distance between "E" and "S" averaged 4.8 mm. (S.D. ± 0.1 mm). A few parliaments had overprints that averaged essentially the same as those on the harvesters, 9.3 mm (S.D. ± 0.1 mm), showing that the wrong setting of the overprint had been used (Figure 3). Although this wrong setting was reported by Ettre[3] as a genuine variety, all of the examples in this study could be identified as forgeries by other criteria. Brainard[10] has confirmed that the distance between "E" and "S" on genuine parliament overprints is 4.8 mm, and that those with the 9.3 mm distance are forgeries.

Figure 3. Left, genuine overprint. Right, counterfeit overprint with wrong spacing.

Inspection of the stamps shows variation in the numerals of the date. In the genuine overprints, the loops of the "9s" in "1919" are either open circles or nearly circular ellipses, and the serifs on the "1s" are clearly printed (Figure 4). Most of the overprints with shifted dates, and the overprints on the parliament stamps with the wrong dimensions, have the same characteristics, supporting the suspicion that Tarján used the genuine plates for printing these counterfeits.


Figure 4. Two varieties of 9s.

Two previously unreported counterfeit varieties were observed. In one, the loops of the "9s" are tiny, nearly closed ellipses, and the serifs of the "1s" are indistinct or missing. In a second variety, which also has shifted dates, the second "19" of "1919" is in a smaller font than the first "19." Figure 5 shows examples of these two varieties.

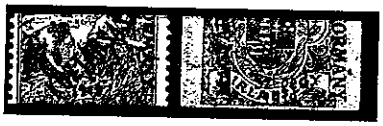


Figure 5. Left, closed 9s. Right, shifted date and small second 19.

The genuine overprints and the Tarján counterfeits are neatly printed with even distribution of ink. On some of the other stamps, the overprints appear to have been underinked, resulting in a speckled or mottled appearance under magnification.

These overprints were assumed to be counterfeits, even when they met other qualifications for genuineness.

Examples of Scott numbers 154, 158, and P8 that lacked characteristics of counterfeits and of products of Print Shop 1 were assumed to be products of Print Shop 2.

Measurement of reflectance spectra

The basic function of a reflectance spectrophotometer is the measurement of the spectrum of light reflected from a surface. The Foster & Freeman Video Spectra Comparator VSC 6000 measures the intensity of the reflected light as the percentage of the intensity of the light reflected from a white magnesium carbonate tile. It has a dedicated computer that records the data both in analog form, which is also displayed as the spectral curve on the video screen, and in digital form, giving the intensity of the reflected light at one-nanometer intervals. The spectral range of the VSC 6000 is 400 to 1000 nanometers. Only the visible portion of this range, 400 to 780 nm, is useful for color determination. Human vision does not respond to the near-infrared portion of the data, 780 to 1000 nanometers.

Each stamp to be examined was placed in a typical stamp mount in reverse of the usual mounting arrangement, with the back of the stamp facing the closed side of the mount. The mount was attached to a light gray card measuring 2.5" × 2.5", using a dot of archival glue. The flaps of the mount were trimmed with manicure scissors so that the stamp was held in place by narrow strips of the mount at the top and the bottom, and the rest of the stamp was exposed for study. Figure 6 shows an example of a stamp mounted in this way.

Figure 6. Example of mounting for overprint analysis.

The stamp was illuminated by a 100-watt filtered incandescent spot light. The reflectance was taken with 18 power magnification from an area of 0.03 square millimeter. Reflectance measurements were made from at least two points on the overprint, as far apart from each other as possible. The measurements on most of the stamps were repeated by a second operator, and the results for each stamp were averaged.

It was found that the reflectance from a part of an overprint overlying the printed (colored) design of the stamp resulted in a flat spectral curve, apparently the result of subtractive mixing of the reflectances of the two colors. Satisfactory measurements were obtained only from portions of an overprint that overlay an unprinted (uncolored) area of a stamp. This limited the measurements to overprints on harvesters, parliaments, and newspaper stamps. The useful region of the harvesters was the area between the horizon and the clouds; for the parliaments it was the areas below the clouds to the left and right of the spires; and it was the area between the crown and the inner frame of the newspaper stamps. The portion of a misaligned overprint that overlay a margin was especially useful. This occurred frequently with newspaper stamps, whose design is narrower than that of the harvesters.

Measurement of X-ray fluorescence spectra

If electromagnetic radiation of sufficient energy, such as gamma- or X-radiation, causes the expulsion of an electron by an atom, X-ray fluorescence (XRF) is emitted when the atom recaptures an electron. The frequency or energy of the emitted X-ray is specific for each chemical element. Measurement of the energy of the emitted X-rays can thus be used to identify the elemental composition of a substance. The XRF spectrum of an ink is thus a "fingerprint" of the ink, with emission maxima due to the atoms of the various elements in the surface. Like reflectance spectroscopy, X-ray fluorescence is a tool for nondestructive analysis of inks used on stamps.

While in theory XRF can be used for detection of any element, the available instrumentation is limited to the measurement of the heavier, metallic elements. The results are useful for identifying metal-containing pigments and mordants but will not be informative concerning organic dyestuffs. At the time the Szeged overprints were created, the compositions of inks were in a period of transition, with some metallic pigments being replaced with synthetic organic colorants as new inks were manufactured.

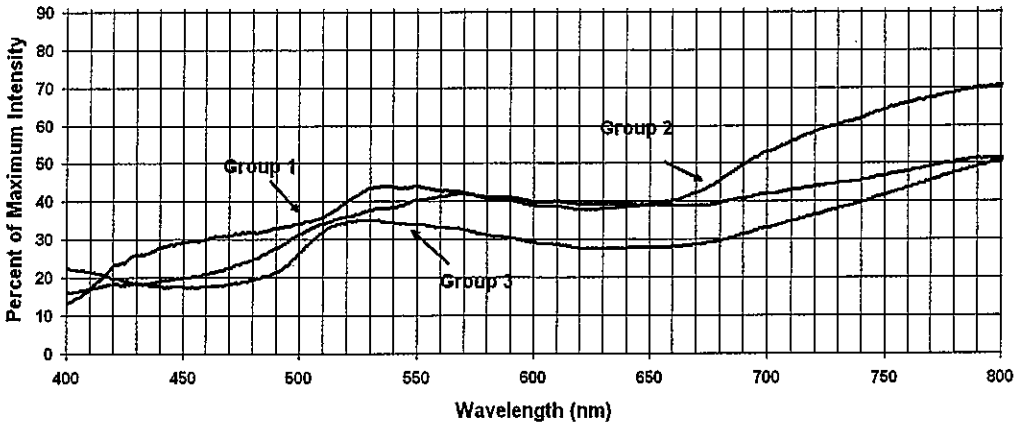
The X-ray fluorescence spectra were taken for six overprints: two genuine Print Shop 1 overprints, two overprints believed to be made by Print Shop 2, one shifted-date counterfeit believed to be a Tarján production, and one bluish-green counterfeit.[24] Each measurement was made on a portion of an overprint that overlaid an unprinted area of the stamp, like the measurement was made for reflectance spectra. Spectra of the blank area of four of the stamps were also measured to determine if there was "bleedthrough" of the paper spectrum into the overprint spectrum.

Results and Discussion

Reflectance Spectra

The reflectance spectra of the green overprints all showed reflectance peaks in the green region of the spectrum, ranging from 30 percent to 60 percent of the intensity of the incident light, depending on the stamp. The stamps showing these peaks fell into three distinct groups. Most of the stamps with genuine overprints showed a wavelength reflectance maximum λ_{max} in the range 530–545 nanometers (nm), with an average of 535 nm. All of the stamps with λ_{max} 550–570 nm were counterfeits; but to the eye, the colors of their overprints were indistinguishable from those in the first group. The average λ_{max} was 564 nm. A third group, comprising mostly of counterfeit stamps, had λ_{max} in the range 510–525 nm. The overprints on these stamps fell into two groups as seen by the eye. Overprints with an average λ_{max} equal to 515 nm were a darker green than those in the other two groups, some slightly bluish. Three overprints with an average λ_{max} of 520 nm were lighter greens which ranged in visual appearance from the green of genuine stamps to slightly yellowish. All of the spectra, with one exception, had minima in the vicinity of 660 nm in the orange range of the spectrum. Figure 7 shows three reflectance spectral curves, one typical for each of these three λ_{max} groups of spectra.

Figure 7. Typical Reflectance Spectra Curves



It is obvious from these data that the reflectance spectra of these stamps do not correlate with their visible colors. Examination of Figure 7 shows stronger reflection in the red area of each of the spectra than in the green, even though the overprints appear green to the eye. It must be remembered that a reflectance spectrum is a *physical analysis* of reflected light, subdividing it into small wavelength increments. The color observed by the eye, on the other hand, is the result of a *neural synthesis* of the responses of the three visual pigments of the retina to the reflected light, dependent upon the sensitivity of each of the pigments to a limited range of the spectrum. The observed color is thus not a predictable physical spectrum of the reflected light.

A set of parameters for objective correlation of the reflectance spectrum of a surface with the visible color of the surface has been developed by the *Commission Internationale de l'Éclairage* (CIE, International Commission for Illumination). The dedicated computer of the VSC 6000 calculates some of these parameters from the reflectance spectrum. The parameters of importance for this study are the *tristimulus values*, ***X***, ***Y***, and ***Z***. These values are numerical estimates of the response that each of the three visual pigments in the human eye should make to the observed reflection in the order red, green, blue. The value of *Y* is a combination of the green response and the total brightness of the reflection.[21] From the tristimulus, values are calculated by the 1976 CIE *chromaticity coordinates* ***u'*** and ***v'***:[22]

$$u' = \frac{4X}{X + 15Y + 3Z}; \quad v' = \frac{9Y}{X + 15Y + 3Z}$$

The ***u'***, ***v'*** coordinates are a measure of visible color. If the ***u'***, ***v'*** values for two different surfaces are close together, their visible colors are also close.

Table I summarizes the average values of ***u'*** and ***v'*** for each reflectance group, along with their standard deviations. Inspection of these data shows that there is overlap between the range of values for overprints with λ_{max} averaging 535 nm (Group 1) and those with λ_{max} averaging 564 nm (Group 2), especially in the ***v'*** values. The 520 nm (Group 3a) is close to Groups 1 and 2, but the 515 nm (Group 3b) shows no overlap with the other groups.

TABLE I

Summary of the Reflectance Data for the Three Spectral Groups

Group	Average λ_{max} nm	*u'*		*v'*	
		Average	S.D.	Average	S.D.
1	535	0.206	0.004	0.515	0.005
2	564	0.212	0.003	0.513	0.006
3a	520	0.195	0.008	0.524	0.004
3b	515	0.187	0.007	0.492	0.004

The overlap of the ranges of ***u'***, ***v'*** values for Groups 1 and 2 is in agreement with the observed similarity of the colors of these overprints. Group 1 contains six genuine overprints from Print Shop 1 and one that may also be from Print Shop 1, but lacks the characteristic forceful impression. Of the remainder, three may be from Print Shop 2, and one is a shifted-date counterfeit. Group 2 overprints are all counterfeit. Four of them have shifted dates, two parliament stamps have the wrong distance

between "E" and "S," and two of them have speckled ink. To the eye, all of the stamps in Groups 1 and 2 are the same shade of green.

The overprints on the three stamps in Group 3a are a very slightly lighter green than those in Groups 1 and 2. One of these has a shifted date, and two have the narrow, compressed "9s" in the date.

The overprints on the five stamps in Group 3b are all darker green than those in the other groups. The lightest green of them has Print Shop 1 characteristics, but the color is darker than those of the recognized Print Shop 1 overprints, and it is doubtful that it is genuine. Another in this group has a shifted date. The remaining three are bluish green, one of which is a mottled overprint and another has compressed "9s" in the date.

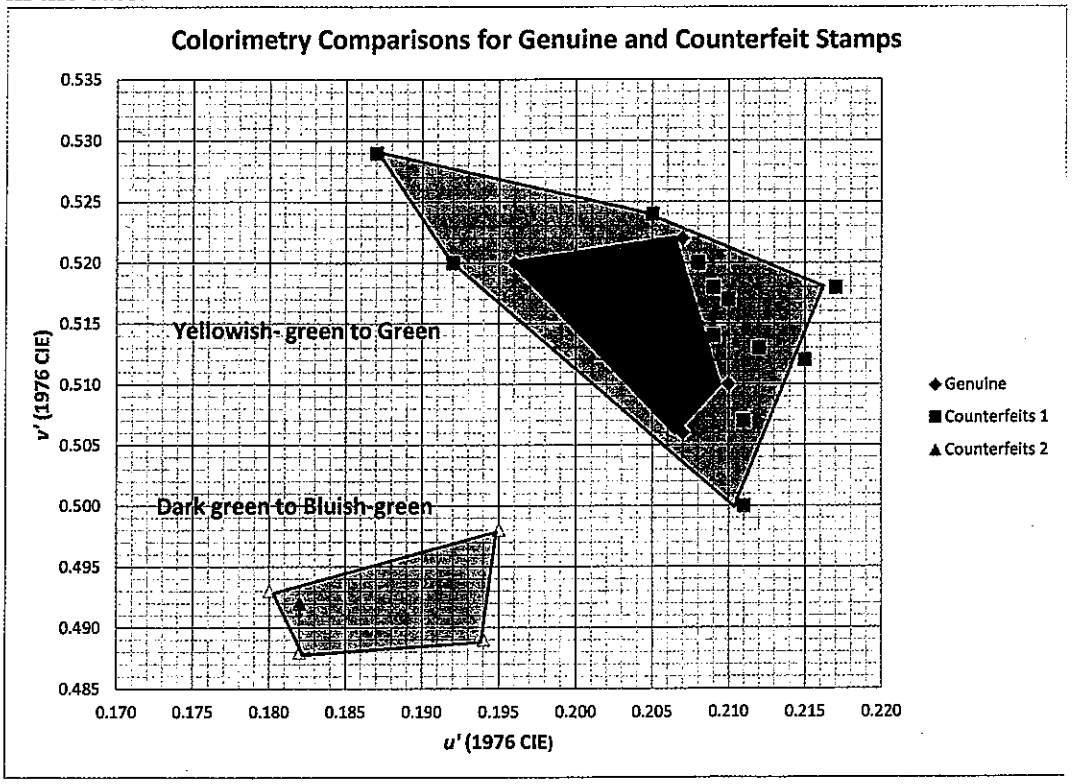


Figure 8. Convex hulls containing genuine and counterfeit overprints.

A plot of v' against u' will group together reflectances that yield similar visible colors.[22] Herendeen et al.[17] have shown that each group of u', v' points on such a plot can be enclosed within a *convex hull* computed from the data,[23] displaying the color range of the group. Figure 8 graphically shows the distribution of the data within the respective convex hulls. The convex hull of the colors of the genuine overprints is completely enclosed by the larger convex hull of the majority of the counterfeit overprints. These two hulls contain all the u', v' values of Groups 1, 2, and 3a. The colors within these two

Figure 9. Left, genuine green overprint. Right, counterfeit bluish green overprint.

hulls show a continuum from lighter to darker from left to right, with no clear-cut divisions of shade. The overprints in Group 3b form a separate convex hull in agreement with their observed darker color. The three at the left of the hull are slightly bluish. Figure 9 compares the color of a genuine stamp with the bluish green of a stamp in Group 3b.

X-ray fluorescence spectra

The convex hulls (Figure 8) did not provide distinctions between the colors of the overprints from the two print shops, or between the colors of the genuine overprints and most of the counterfeit ones. Diagnostic distinctions were therefore sought in the identification of the components of the inks by X-ray fluorescence spectra.

This was the first time that XRF spectra had been taken from targets as small as the letters of the overprints. The instrumental ports had to be made smaller than usual in order to minimize response from parts of the stamp other than the overprint. Even so, the smallest usable size, 1.5 mm, was wider than an overprint letter. The small port required 600 seconds, a longer than usual recording time, and increased the noise level of the recorded spectra. Figures 10 and 11 show examples of the results

Figure 10. Print Shop 1 and Shifted Date Counterfeit Comparison

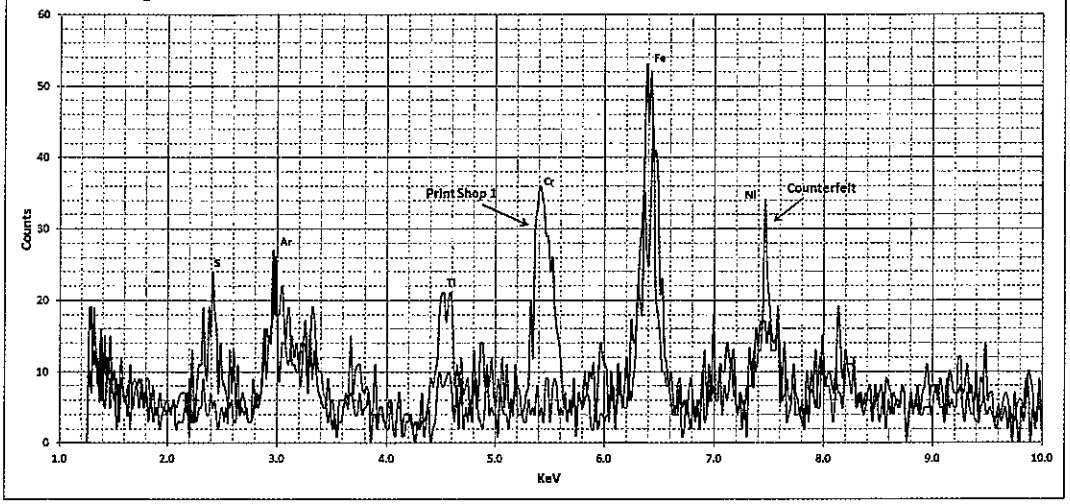
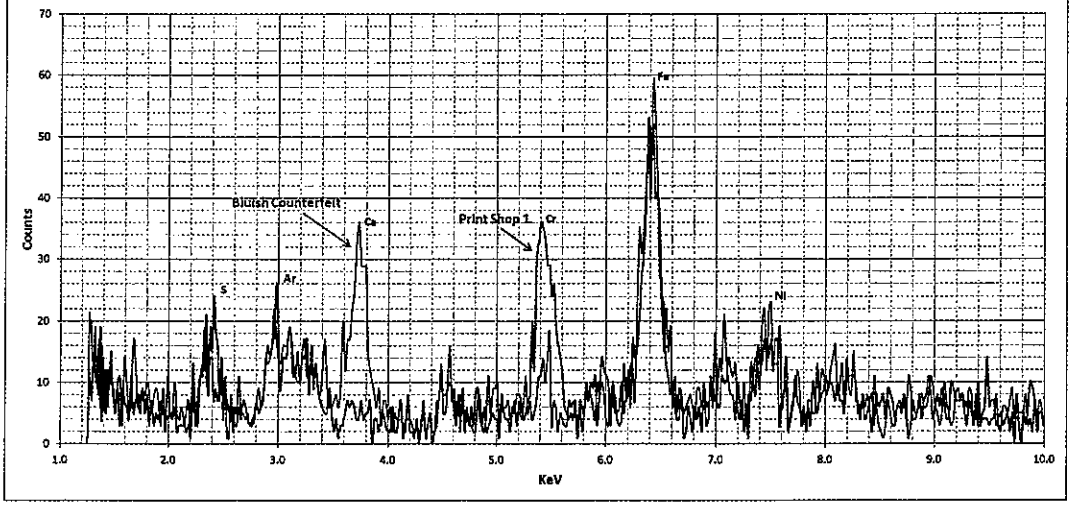


Figure 11. Print Shop 1 and Bluish Counterfeit Overprint Comparison



after some smoothing. Principal peaks are labeled with the symbols of the emitting elements.

The XRF spectrum of the genuine Print Shop 1 overprint displayed a strong chromium signal, which was either absent or very weak in all of the other spectra. Its presence is indicative of chromic oxide, or "chrome green," a widely used inorganic pigment. Other green colorants must have been used in the inks of Print Shop 2 and the counterfeits.

The strongest peak in all of the XRF spectra was due to iron, indicating the presence of an iron-containing pigment. The commonest red pigment is ferric oxide, and its presence provides an explanation for the strong reflectances by all of the overprints in the red region of all of the reflectance spectra, 700–780 nm (Figure 7).

The shifted-date counterfeit showed an unexpected titanium signal. The use of titanium dioxide as a color brightener in inks and paints is of recent origin. There may have been earlier usage of other titanium-containing substances, but this is uncertain. Liston has suggested[25] that the ink may have contained ilmenite (ferrous titanate), a black mineral, which would also contribute to the iron content of the ink.

The XRF spectra of the two suspected Print Shop 2 overprints were dissimilar. One of them showed a significant calcium signal, which can be due to use of calcium carbonate as a solid adsorbent to render soluble dyes insoluble.[20] The other, the overprint on a newspaper stamp (u', v' equal to 0.200, 0.519 in Figure 8) closely resembled the spectrum of the counterfeit, except that it contained no titanium. The bluish-green overprint also yielded a strong calcium signal, but had a weak nickel signal, unlike the other counterfeit.

The sulfur peak probably originated from the paper. The argon peak resulted from argon gas in the ambient air.

Conclusions

The reflectance spectral techniques utilized in this study confirmed analytically the lack of visual difference between the products of the two print shops.

The strong chromium signal in the X-ray fluorescence spectra of Print Shop 1 overprints is definitive for the work of this print shop. It is absent or very weak in the XRF spectra of the Print Shop 2 and counterfeit overprints. Although the colors of the latter overprints match those of Print Shop 1, they derive from entirely different, unidentified colorants.

The distribution of points for counterfeit stamps in Figure 8 demonstrate the works of at least three different counterfeiting operations. The overprints represented by the cluster just to the right of the convex hull of genuine overprints are almost certainly the work of master forger Géza Tarján. The two points at the extreme left denote a slightly lighter shade of green, and are by a different forger. The stamp initially thought to be a product of Print Shop 2 was shown to be a counterfeit.

The third group of counterfeit overprints is a new discovery. The points for these overprints lie in the convex hull at the lower left of Figure 8, and their dark green to bluish green shade is visually distinct from the colors of the other overprints.

Visual examination of the overprints showed a new characteristic of counterfeits. Overprints whose "9s" have tiny, almost closed, elliptical loops and poorly formed or absent serifs on the "1s" are counterfeit. In a newly discovered counterfeit, the second "19" of "1919" is printed from a smaller font than the first.

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