

UNITED STATES GOVERNMENT

# Memorandum

DEPARTMENT OF THE TREASURY  
BUREAU OF ENGRAVING AND PRINTING

TO : See Distribution

DATE: August 25, 1983

FROM : Maurice M. Schneider  
Executive Assistant

*M M Schneider*

SUBJECT: Study of Mechanisms for the Denomination of Currency by the  
Blind or Visually Impaired

I am attaching a final draft copy of the "Study of Mechanisms for the Denomination of Currency by the Blind or Visually Impaired." Please review it and respond with any comments you may have by September 7th. If you respond by telephone, please follow with your comments in writing.

Distribution:

Dr. Graminski  
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**A STUDY OF MECHANISMS FOR  
THE DENOMINATION OF U.S.CURRENCY  
BY THE BLIND OR VISUALLY IMPAIRED**

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## I. INTRODUCTION

### A. Purpose and Scope

The purpose of this study is to identify and evaluate possible changes to U. S. currency which will assist the blind or sight handicapped in distinguishing currency denominations. In developing the recommendation, the study group reviewed applicable design features utilized by other countries as well as features which are or will be practicable as a result of technological developments, and assessed the effect of these features on the production of U. S. currency.

### B. Background

This study was requested by Congressman Edward R. Roybal, Chairman of the House Select Committee on Aging, on February 8, 1983. Significant interest in the development of U.S. currency to assist the sight impaired, however, has existed since the early 1970's. In January 1971, the Netherlands introduced bank notes with distinctive raised (tactile) symbols for each denomination. In June of that year, Congressman Rarick of Louisiana introduced H.R. 9102 which would have required the incorporation of braille denomination information in currency. Several similar resolutions were introduced between 1971 and 1981, none of which were passed into law.

The Bureau of Engraving and Printing (BEP) has conducted research into methods of denominating currency over the past twelve years, including studies in 1976 and 1980. The 1976 study evaluated the incorporation of braille markings in currency. Experimental currency notes were printed and both the physical characteristics of these notes and the usefulness for sight handicapped individuals assessed. During 1980, research was done to evaluate the potential impact of "notching" notes in unique locations for each denomination as well as cutting the corners of the notes.

Both the Federal Reserve System and the U.S. Secret Service expressed fundamental concerns over problems which might arise during the transition period when notched or

corner cut and regular currency would co-circulate. The current study was commissioned to provide a definitive statement on the issue of currency for the blind through a more exhaustive examination of options than had previously been undertaken.

### C. Methodology

The study was conducted under the overall direction of a Steering Committee with representatives from the American Council of the Blind, the Federal Reserve System, and the U.S. Secret Service. A Working Group, which consisted of BEP technical, engraving, and printing specialists, performed background research and prepared the study. Two electronics consultants, one from the American Foundation for the Blind and one from the National Science Foundation, provided information on electronic currency reading machines. .

The study itself consisted of three portions:

1. The currencies of 54 foreign nations and the U. S. were reviewed for certain characteristics which would contribute to denomination discrimination by the sight impaired. Those countries which had purposely introduced intaglio, braille-like denomination symbols were then contacted. They were requested to provide information on the utility of the measures they had taken as well as to describe adverse effects encountered during production and circulation. Five countries responded to this inquiry.

2. The BEP working group then evaluated selected features on the basis of cost-effectiveness, probable usefulness to the sight impaired, and impact on the production of currency.

3. Finally, the concept of an automated portable currency reader was evaluated as an alternative, with or without any changes in the design of currency. Criteria used were production feasibility and cost to the consumer.

## II. EXECUTIVE SUMMARY, FINDINGS AND RECOMMENDATION

### A. Executive Summary

There are two approaches which can be taken to provide assistance to the blind and visually handicapped for distinguishing different denominations of U.S. currency. These are the incorporation of certain features in the designs of Federal Reserve Notes and the development of portable electronic devices which will "read" and provide denomination information. The usefulness of these measures varies for different segments of the sight impaired population depending upon the degree of visual impairment. That population includes persons who have been blind since birth, those who were blinded later in life, and the partially sighted.

This study is the result of the efforts of a group of technical specialists from the Bureau of Engraving and Printing (BEP), under the direction of a Steering Committee composed of representatives from the American Council of the Blind, the Federal Reserve System, and the U. S. Secret Service. The BEP working group assessed various mechanisms for denominating currency on the basis of cost-effectiveness, utility to the visually handicapped, and effect on production and circulation. The study findings are based upon a review of the currencies of 54 foreign nations, the experiences of countries currently producing currency for the blind, previous research performed by BEP, and findings by the American Foundation for the Blind. Several high potential mechanisms for denominating currency were identified:

1. Visual mechanisms, including intaglio colors, offset tints, and large, distinct numerals. The use of these visual devices would aid the partially sighted but would be of no benefit for the blind. Increased annual cost for currency for these modifications range from \$640,000 to \$3,500,000.

2. Tactile mechanisms, such as braille-like symbols, clipped corners, and different sizes. Devices in this category could be of value to the blind as well as the partially sighted depending upon the device and the tactile skills of the target population. A design modification with high apparent utility for the blind and low counterfeitability is sized currency. This option would require BEP to expend about \$26 million in implementation costs and would increase manufacturing costs by about \$7 million per year.

3. Aural mechanisms, specifically an electronic "reader" to produce audible signals for different denominations. The working group determined that the development of a portable electronic currency reader should be encouraged whether or not actual changes to the design of currency are proposed.



## B. Findings and Recommendation

### CHAPTER III. IDENTIFICATION OF FEATURES TO AID THE VISUALLY HANDICAPPED

#### Findings:

III-1 There are three major categories of the sight handicapped, each with slightly different needs: Those born blind, those blinded later in life, and the partially sighted.

III-2 Each of these groups has different skills to use in identifying the denomination of U. S. currency.

III-3 A survey of 54 foreign nations indicated that the currencies of all these countries contain some features which may be of some benefit to the visually impaired population. However, few countries have intentionally designed currency for this purpose.

III-4 None of the countries contacted indicated that the systems they were using for denomination of currency by the blind were completely satisfactory.

III-5 Potentially useful design features are either visual (colors, large clear numerals) or tactile (braille or braille-like symbols, cut corners or notches, different sizes).

III-6 Electronic technology is presently available which can produce audible signals identifying bank note denominations.

### CHAPTER IV. ANALYSIS OF OPTIONS AVAILABLE TO THE UNITED STATES

#### Findings:

IV-1 A potentially effective method of providing currency denomination information to the sight-impaired is to develop hand-held, electronic currency readers.

IV-2 Based on limited information, it would appear that the most widely useful currency design change would be to produce Federal Reserve notes in a different size for each denomination. However, the effects of such a change on broad and diverse segments of the population would be monumental.

IV-3 Costs for making currency design changes range from \$640,000 to \$6,670,000 per year in addition to initial costs. Depending upon the design, as many as 150 additional Full-Time (personnel) Equivalents would be required by BEP to produce modified currency.

IV-4 Changes to currency design and the issuance of new currency will probably have a significant impact on the public and private sectors especially on currency handling and processing equipment such as change machines.

**Recommendation:**

Pursue the development of and seek funding for a handheld electronic reader to denominate currency.

### III. IDENTIFICATION OF FEATURES TO AID THE VISUALLY HANDICAPPED

#### A. General

In order to identify a range of features which should aid in the denomination of currency, the working group utilized a three stage process. First, the "target population", or groups the denomination features would be designed to help, was identified. Next, the range of practicable options was examined through a review of 54 world currencies. Finally, the list of options for BEP analysis was determined, based upon the world currencies, BEP experience, and research into technological developments.

#### B. Target Population

There are actually three different categories of sight handicapped, each with different abilities which affect their needs for handling and denominating currency. These categories include:

1. Persons who are born blind or who become blind in early childhood. They usually develop an excellent sense of touch and may have the ability to read braille. Currency with braille-like intaglio (line engraved, raised) printed symbols would assist this group.

2. Those who become blind later in life as a result of accident, disease, etc. and whose touch is typically no better than that of a sighted person of normal sensitivity. Raised or embossed symbols or braille markings (especially "jumbo" braille) might assist this group, although many do not read braille.

3. Individuals who are not totally blind but who have limited vision. These persons are usually able to distinguish bright, clear colors or large, simple numerals (also called Sanserif numerals).

- The sight handicapped "target population" is therefore not a single entity, but a composite of individuals with disparate skill levels, many of whom are not able to read common braille or braille-type symbols. To assure the broadest utility to the visually impaired, features would have to be selected which accomodate the abilities and needs of those who are blinded later in life and who may not have an especially acute sense of touch.

### C. Survey of Foreign Currencies

A list of the currencies of 54 foreign nations was developed and the designs categorized by denomination (see Appendix 1). Factors considered as relevant were (differences in) note size, the location of key design features, color and depth of color, use of intaglio (or raised) printing, and inclusion of braille or braille-like elements. The braille elements could be produced in the currency paper, embossed on the notes, or intaglio printed.

1. There is a good deal of diversity among world currencies in terms of printing methods as well as design features. Some of the foreign currencies, such as those of Belgium, the Netherlands, and Israel intentionally, incorporate features to assist the sight handicapped. Other currencies contain mechanisms such as colors, which may, unintentionally assist the sight impaired. Of the 54 currencies reviewed, only that of the United States employs the same colors for all denominations. Other relevant currency characteristics which were identified include:

a. Large, simple (sanserif) numerals for denomination - currencies of Ireland, Israel, and the Netherlands bear this type of numeral isolated from the surrounding design so as to be distinct and clearly legible.

b. Different sizes for different denominations - Twenty-nine of the countries employ a different size for each denomination. Nine other countries utilize sized notes for some, but not all, denominations.

c. Braille symbols - None of the surveyed countries use braille or braille-like symbols which are embossed on the notes or are manufactured in the paper. However, Belgium, France, Ireland, Luxembourg, the Netherlands, Sri Lanka (Ceylon), and Switzerland issue currency with distinctive symbols imprinted by the intaglio process.

2. - Foreign experience with denomination features -The seven countries which utilize intaglio printed denomination symbols on their notes were contacted and asked for an assessment of their experiences. Five countries, Luxembourg, the Netherlands, Switzerland, Belgium, and Israel, responded. With the exception of Belgium, the respondents indicated that the symbols were of some utility to the blind. However, all of the Central Banks noted that the imprinted symbols were of limited durability. The Swiss found, through testing, that raised printing was generally ineffective after a few months - as soon as the bills lost their "crispness". Switzerland also felt that different sizes of currency was potentially the most effective method of denomination.

The Director of the Central Bank of Belgium indicated that while the utility of printed symbols to the blind was questionable, there seemed to be no obvious reason to eliminate the features, (as there seemed to be substantial drawbacks to other methods of tactile denomination). Durability of the printed symbols was also found to be a problem by the Belgians.

3. Selection of features for BEP Evaluation. Based upon previous research at the Bureau of Engraving and Printing and the review of denomination features in foreign currencies, a list of potential devices for inclusion in U. S. currency was developed (figure 1). These were categorized by the means the visually handicapped would use to discriminate between different notes. The major categories include visual, tactile, and aural techniques. The category for audible signals, which would be produced by currency "readers", was included in recognition of recent advances in electronics technology which provide the capability to miniaturize commercially available devices. Chapter IV discusses the various options in more detail.

#### D. FINDINGS.

III-1 There are three major categories of the sight handicapped, each with slightly different needs: Those born blind, those blinded later in life, and the partially sighted.

III-2 Each of these groups has different skills to use in identifying the denomination of U.S. currency.

III-3 A survey of 54 foreign nations indicated that all the currency of these countries contain some features which may be of some benefit to the visually impaired population. However, few countries have intentionally designed currency for this purpose.

III-4 None of the countries contacted indicated that the systems they were using for denomination of currency by the blind were completely satisfactory.

III-5 Potentially useful design features are either visual (colors, large clear numerals) or tactile (braille or braille-like symbols, cut corners or notches or different sizes).

III-6 Electronic technology is presently available which can produce audible signs identifying bank note denominations.

#### IV. ANALYSIS OF OPTIONS AVAILABLE TO THE UNITED STATES

##### A. General

This chapter presents the results of the BEP evaluation of selected features to assist the sight handicapped in denominating currency. Visual, tactile, and aural techniques are discussed in terms of cost, utility to the target population, and impact on production and circulation.

##### B. Visual Mechanisms

Persons of limited vision can often distinguish bright, clear colors of different hues as well as large, simple numbers. Color may be incorporated in currency in the intaglio printed image, in offset background tints (surface printing from photographically reproduced plates), or through tinting of the substrate (paper) during manufacture. To be of the most utility to persons of limited vision, the colors should be very distinctive, i.e. primary colors. Colors may, in addition, provide increased counterfeit deterrence value for currency. However, the optimum counterfeit deterrent currency requires more subtle coloration in order to make reproduction difficult. Such a configuration which might combine a dark, intaglio image with pastel offset background designs, would be of limited use to the sight handicapped.

1. The use of colored intaglio inks would require an initial cost of at least \$470,000 and an annual increase in BEP costs of \$640,000 (\$.13 per 1000 Federal Reserve Notes). An additional 16 Full Time Employee Equivalents (FTE's) would also be needed.

2. The introduction of offset (background) tints would cost at least \$2,200,000 initially and \$3,460,000 per year. As many as seventy-two more FTE's would be required.

3. The manufacturing of currency with large, legible numerals would require a major design change and the preparation of new currency dies and printing plates. Any costs would have to be weighed against the utility for only a small portion of the visually handicapped population.

### C. Tactile Mechanisms

Tactile mechanisms for the denomination of currency by the blind may be produced by modifications to either the substrate (paper) or the image (inks, etc.). Substrate modifications include different sizes (dimensions) for different denominations; notched edges, clipped corners, or perforations; and embossed braille or braille-like symbols. Image modifications include intaglio printed braille-like symbols and braille-like symbols applied by a hot-melt or similar embossing procedure.

1. Research by the Central Bank of Switzerland indicates that different sizes of currency by denomination are most useful to the blind. No exceptional tactual acuity is required: a small template or coded ruler can be carried for use in comparing the dimensions of each banknote.

There are several disadvantages to this approach, however. Inserting new denominations in a sized sequence would be extremely difficult. For example, introduction of a \$2 bill between a sized \$1 and \$5 bill would have required substantial changes in the way BEP produced the notes as well as the handling by banks and private citizens. The current estimates of implementation costs at BEP for sized currency is \$25,630,000, principally to acquire new processing equipment and to modify existing printing and processing equipment. Annual manufacturing requirements would increase costs by about \$6,670,000 and would result in the need for 150 more Full-Time Equivalents. There would also be costs to the private sector for sized cash register drawers, modifications of automatic teller and change machines, etc.

2. Notched edges or clipped corners have frequently been suggested as a means for the tactile denomination of currency. However, of the foreign currencies reviewed, none exhibit this design feature, primarily because wear characteristics might invalidate the distinctiveness of notches or cut corners in a relatively short time. A similar mechanism would be the perforation of the substrate (paper) in a different pattern for each denomination. Greater tactual acuity would likely be required to recognize this device than to differentiate notched edges or clipped corners. Both of these design changes would necessitate additional capital equipment and staffing. The initial cost would be about \$2,600,000. Annual costs would be \$1,400,000 and require 29 Full-Time Equivalents.



3. There are several methods of producing currency with braille or braille-like symbols. Traditional braille documents are produced by embossing a special, stiff paper to produce a series of raised dots in groups or "cells" which designate letters or numerals. "Jumbo" braille is a larger, more widely spaced version of braille dots designed for those possessing a poorer sense of touch. For such embossing to be retained in a circulating banknote, the substrate would probably have to be thicker and stiffer than is typical of currency paper at present.

A related option would be the manufacture of currency paper (substrate) with inherent (not embossed) patterns of raised dots. Such a substrate could be produced by selective deposition of extra fibers as a pattern of small lumps during the papermaking process. In this way, the overall substrate would not have to be unusually thick or stiff; in fact, the small lumps would be more easily discernable if the paper were rather thin and flexible. Alternatively, the process recently developed by the Minolta Corporation (Osaka, Japan) for the photocopying in relief of braille documents could be adapted to currency production: photosensitive microcapsules, included within the substrate, expand on selective exposure to long-wavelength illumination, creating a three-dimensional reproduction of the desired dot pattern in acceptable relief for braille. By this latter method of inherent substrate dot production, braille patterns could be generated after the banknotes are printed.

Of the various features considered in this study, braille-like symbols which are printed by the intaglio method are the only design elements produced by any country solely to assist the blind. These elements are an integral part of the intaglio design, and are simply plate-printed as a component of the overall intaglio image. As reported by the Netherlands Bank, intaglio-printed identification marks are of optimal design when they are of the maximum height obtainable in plate printing (0.004 in) and the minimum width necessary to technically realize that height (0.020 in). However, because the relief achieved by intaglio printing is only one-fifth that of traditional braille, and because only a small proportion of the blind can read genuine braille characters, printed tactile identification marks usually consist of simple figures recognizable even at low relief. Symbols formed by narrow lines with an opening about a finger's width (0.400 in) between them, such as a square, circle, or triangle, have been found by

Dutch researchers to be the most easily recognized. The tactility of intaglio-printed identification marks can be enhanced by the design of such symbols using closely spaced (0.020 in) double lines, in order to reinforce the tactile effect.

As an option, braille-like symbols or dot patterns could be applied to printed banknotes as a final stage in currency production using a hot-melt resin to create the desired design. In this way, the relief obtainable would likely be much greater than that achieved by intaglio printing. The adhesion of such an applied resin to the currency paper substrate would, however, need to be carefully evaluated.

The utility of braille-like symbols for the blind is especially limited for these individuals who, because of age or infirmity, may lack necessary sensitivity or manipulative powers. Although intaglio printed braille-like symbols would be more easily discerned if the currency paper were rather thin, the height of the symbols will greatly increase the effective note thickness. This is also true for embossed or inherent symbols and means that process changes will have to be made in the handling and storage of notes. Costs to adapt current BEP equipment will be about \$8,100,000. Annual costs will be about \$3,050,000 with a requirement for 100 Full-Time Equivalents. There may be additional costs associated with redundant raw material inventories for dots imbedded in the paper substrate. Although Israel has encountered no problems with processing bank notes containing intaglio printed symbols through their bank's currency handling equipment, no tests have been run with U.S. currency to determine the effect on change machines, etc. There is also some question as to the life of bills with braille markings. At the present time, \$1 bills last about 18-22 months in circulation. The Federal Reserve System is attempting to upgrade the quality of currency which may significantly lower the circulation period. Adding braille dots may further lower the circulation time, requiring greater production and possible higher equipment expenditures at BEP.

#### D. Aural mechanisms

The development of a pocket-sized electronic reader, into which a banknote could be inserted and from which an audible signal would be emitted communicating the note's

denomination, is within the realm of currently available technology. Electronic denomination can be based on a number of different detection mechanisms, including recognition of images now present in currency. Features which could be incorporated in currency for instrumental detection are colors (intaglio or offset); bar codes, grids, or coded perforations; and threads of specific composition, shape, and/or location which would be embedded in the substrate.

A desk-top size electronic denomination unit has already been successfully developed under the auspices of the American Foundation for the Blind. This machine, which is available through the Foundation's Consumer Products Department, cost around \$600.00. A successful reader which is portable has not yet become commercially available. A preliminary study sponsored by the Foundation (June 1, 1983) indicated that development of a miniaturized electric reader was feasible. Cost to consumers would range from about \$75.00 to \$250.00 depending upon sales volume. These estimates are tentative, but could be refined by the Foundation within 3 months through a more exhaustive analysis, funded at about \$15,000.

Research has been initiated by the Bank of Canada to evaluate electronic denomination of currency on the basis of recognition of the different colors employed in the present Canadian banknote issues. As an alternative, the Canadians have also proposed the electronic recognition of special grids (cross-hatching) of varying line densities which could be incorporated as localized design elements in an intaglio image. The Design Section of the Bureau of Engraving and Printing has developed a series of experimental Federal Reserve Notes with the oval border of the portrait area (obverse) redesigned to incorporate an unobtrusive bar code as part of the intaglio design. Such configurations might be refined to enable electronic denomination of U. S. currency on the basis of bar code recognition. The incorporation of threads of special composition in currency paper would also provide a means of denomination. However, threads or bar codes would present only marginal advantages in electronic reading over recognition of intaglio characters now existing in notes.

## E. Summary

Each of the proposed design modifications presents some difficulties in regard to necessary changes to BEP production methods. Each requires equipment changes and additions of personnel. There are also a number of not yet ascertained costs to the private sector for adaptation of currency handling, change making equipment, etc. The information which is available from foreign banks, however, would seem to indicate that more of the sight impaired population would benefit from different sizes of currency than any other method of denomination. The different notes could be easily distinguished through use of a small "template". The implementation of this option, however, would have profound consequences for the public and private sectors in modifying currency handling equipment (cash registers, change machines) and issuance of new currency and redemption of replaced notes.

Preliminary indications are that almost as broad a segment of the sight impaired population would benefit from use of an electronic device to audibly denominate bank notes as from sized currency. This option is considered as the second most useful option only because portable, affordable devices have not yet been commercially developed.

Braille-like symbols would not be as useful for denomination as the sized currency and electronic scanner for three reasons: many sight handicapped cannot read braille, the aged or those who are blinded later in life often do not have an extremely sensitive sense of touch, and braille symbols will likely wear down extremely rapidly in circulation.

Notched edges or clipped corners on currency are anticipated to be of some utility. However, none of the foreign governments surveyed have employed this device in their currency. Because of this lack of experience with clipped corners and notches there is some concern about the effect of these techniques on currency wear characteristics, public perception of the modified notes, and usability of the notes in automated currency handling equipment. Additional problems may arise if notched currency is circulated without recalling presently circulating notes. Alteration of uncut notes could result in fraud and consequent nonutilization of the system by the target population.

Even though different colored notes are widely used by foreign governments, this technique would be useful only to those who have some vision. There would be no advantage to the blind.

#### F. Findings.

IV-1 A potentially effective method of providing currency denomination information to the sight-impaired is to develop hand-held, elec-tronic currency readers.

IV-2 Based upon limited information, it would appear that the most broadly useful currency design change would be to produce Federal Reserve notes in a different size for each denomination. However, the effects of such a change on broad and diverse segments of the population would be monumental.

IV-3 Costs for making currency design changes range from \$640,000 to \$6,670,000 per year in addition to initial costs. Depending upon the design, as many as 150 additional Full-Time (personnel) Equivalents would be required by BEP to produce modified currency.

IV-4 Changes to currency design and issuance of new currency will have a significant impact on the public and private sectors, especially on currency handling and processing equipment such as change machines.

#### G. Recommendation.

Pursue the development of and seek funding for a hand-held electronic reader to denominate currency.

## V. SUMMARY

Features which are selected for incorporation in currency to assist the sight handicapped should be of utility to the widest segment of the population possible, have minimal impact on Bureau of Engraving and Printing production and public circulation, and be cost-effective. The BEP analysis indicates that there are a number of potentially useful design features which will assist various groups of the sight impaired. These include incorporation of visual cues for the partly sighted and tactile mechanisms for the blind. The potential also exists for developing low cost electronic units which will "read" the denomination of currency through the recognition of already existing intaglio designs. These devices will produce audible signals and would therefore be useful to almost all of the visually impaired. The only currency design feature which is generally as useful to the entire target population as an electronic reader is currency which is sized by denomination.

There are several considerations which indicate that caution should be used in recommending any changes to the design of currency. The cost of the modifications which the Bureau reviewed range from \$640,000 to \$6,670,000 per year, in addition to one-time implementation costs of up to \$25,630,000. These expenditures, however, represent only a portion of the true cost. The currency handling system comprises many segments, including retailers, banks, and private citizens. The industrial sector is also involved in currency changes as a result of capital expenditure and technological research to develop and manufacture cash registers, coin changers, automated teller machines, etc. These are also policy implications related to a "new" currency. Currency is a tangible representation of the strength of Governmental institutions and the U. S. economy. Major changes or logistical problems associated with the distribution of bank notes may, at the worst, lead to some loss of public confidence or even temporary hoarding.

Applicability of currency design modifications to the sight impaired population is also a complex question. Experience of the European nations which produce bank notes with features specifically included to assist the blind is rather limited. Tactile mechanisms such as braille-like

symbols meet the requirements of only a portion of the target group and are limited in terms of note durability. Colors would assist the partially sighted but not the blind. Electronic currency readers are now available but a commercial, low cost, easily portable version has not yet been developed.

## Figure 1.

### An Outline of Mechanisms for the Denomination of Currency by the Blind or Visually Impaired.

#### 1. Visual

##### A. Bright clear colors of different hues

- (1) Intaglio inks
- (2) Offset background tints
- (3) Substrate

##### B. Large, distinct, simple (sanserif) numerals for counters

#### II. Tactile

##### A. Substrate (paper) modifications

- (1) Different sizes (dimensions)
- (2) Notched edges, clipped corners, or perforations
- (3) Embossed braille or braille-like symbols

##### B. Image modifications

- (1) Intaglio-printed braille-like symbols
- (2) Hot-melt (or similar) applied braille-like symbols

#### III. Aural (Electronic)

##### A. Image recognition of existing designs

##### B. Instrumental recognition of different colors

##### C. Recognition of printed bar codes or grids, or coded perforations

##### D. Recognition of thread(s) of specific composition, shape and/or location embedded in substrate



Figure 2

## Analysis of Proposed Changes to U. S. Currency on Bureau Operations

<u>Option</u>	<u>Aid Visually Impaired</u>	<u>Aid Blind</u>	<u>Increase In Initial Cost</u>	<u>Increase in Annual Costs</u>	<u>Increases in Manufacturing Cost per-thousand Notes</u>	<u>Increase in FTE <sup>1)</sup></u>	<u>Increase in Space (square Feet)</u>
1. Use of intaglio inks in different colors	Yes	No	\$ 470,000	\$ 640,000 <sup>2)</sup> 1,280,000	\$ .13 -.30 <sup>2)</sup>	16	-
2. Intaglio inks remain unchanged, offset tints would be utilized	Yes	No	2,200,000 <sup>2)</sup> 12,000,000	3,460,000 <sup>2)</sup> 9,327,000	.69 -1.86 <sup>2)</sup>	16 - 72 <sup>2)</sup>	12,000
3. Change in size of note by denomination	Yes	Yes	25,630,000	6,670,000	1.33	150	36,000
4. Notches or clipped <sup>3)</sup> corners	Yes	Yes	2,600,000	1,400,000	.28	29	100
5. Use of braille or braille-like symbols	Somewhat	Somewhat	8,100,000	3,050,000	.61	100	48,000

<sup>1)</sup> FTE = Equivalent to Full-time Employee

<sup>2)</sup> The range of estimates represents the costs associated with incorporation of various levels of counterfeit deterrence features through note coloration in conjunction with denomination information. The lower estimate is for currency for the sight impaired only.

<sup>3)</sup> An estimate of \$.15/1,000 notes the first year of the program and \$.02/1,000 notes each year there after was developed by BEP in 1980, based upon extrapolations of technology available at the time. The cost of \$.28/1000 is based upon current, validated information.

## APPENDIX 1


# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Algeria: dinar (DA)						
10 (1964)	182 x 93	1.96	169	pale rose, violet	no intaglio	
50 (1964)	206 x 106	1.94	218	pale orange, yellow	no intaglio	
100 (1964)	220 x 112	1.96	246	pale blue, orange	obverse only	
Argentina: peso (\$)						
1	155 x 75	2.07	116	bright brownish-orange	obverse and reverse, all denominations; overall design similar, all denominations; counter design and placement similar: \$1, 5, 10, 50, 100, 500, and 1,000; counter design and placement similar: \$5,000, 10,000, and 50,000; distinctive counters: \$100,000, 500,000, and 1,000,000	
5	155 x 75	2.07	116	medium greenish-blue		
10	155 x 75	2.07	116	medium purple		
50	155 x 75	2.07	116	grayish brown		
100	155 x 75	2.07	116	medium burgundy		
500	155 x 75	2.07	116	medium yellow-green		
1,000	155 x 75	2.07	116	golden brown		
5,000	155 x 75	2.07	116	bright clear blue		
10,000	155 x 75	2.07	116	bright orange		
50,000	155 x 75	2.07	116	dull brownish-violet		
100,000	155 x 75	2.07	116	black		
500,000	155 x 75	2.07	116	brown, green		
1,000,000	155 x 75	2.07	116	dark blue, rose		
Australia: dollar (\$)						
1 (1973)	140 x 70	2.00	98	medium brown, orange	obverse and reverse, all denominations; intaglio counters of upper left obverse (ULO) and lower right reverse (LRR) are quite distinct	
2 (1973)	146 x 73	2.00	107	clear green		
5 (1973)	150 x 75	2.00	112	purple, rose		
10 (1973)	154 x 77	2.00	119	clear turquoise		
20 (1973)	160 x 80	2.00	128	bright orange		
50 (1973)	165 x 83	1.99	137	medium yellow, green		
Austria: schilling (S)						
20 (1967)	132 x 65	2.03	86	Colors fairly dull, muted: medium brown	obverse only	
50 (1970)	140 x 70	2.00	98	violet	obverse only	
100 (1969)	150 x 75	2.00	112	medium olive	obverse and reverse	
500 (1965)	154 x 80	1.92	123	rose-brown	obverse and reverse	
1,000 (1966)	159 x 84	1.89	134	medium blue-green	obverse and reverse	

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Bahamas: dollar (\$)						
½ (1968)	156 x 67	2.33	105	medium brownish-violet	obverse and reverse, all denominations; designs almost identical, all denominations	
1 (1968)	156 x 67	2.33	105	bright green		
3 (1968)	156 x 67	2.33	105	bright red		
5 (1968)	156 x 67	2.33	105	bright orange		
10 (1968)	156 x 67	2.33	105	bluish-gray		
20 (1968)	156 x 67	2.33	105	medium brown		
50 (1968)	156 x 67	2.33	105	orange-brown		
100 (1968)	156 x 67	2.33	105	bright clear blue		
Barbados: dollar (\$)						
1	150 x 65	2.31	98	red	obverse and reverse, all denominations; designs almost identical, all denominations	
2	150 x 65	2.31	98	bright blue		
5	150 x 65	2.31	98	medium green		
10	150 x 65	2.31	98	medium brown		
20	150 x 65	2.31	98	violet		
100	150 x 65	2.31	98	blue-gray		
Belgium: franc/frank (F)						
100 (1978)	140 x 76	1.84	106	medium burgundy	obverse and reverse, all denominations; distinct counters	LRO: • • • •
500 (1979)	(specimen not available)					
1,000 (1980)	(specimen not available)					
5,000 (1982)	160 x 76	2.11	122	medium bluish-green		○
Brazil: cruziero (Cr\$)						
100	154 x 74	2.08	114	violet, burgundy	obverse and reverse, all denominations; designs similar, all denominations: rotational symmetry of all design elements	
200	154 x 74	2.08	114	blue-green, dull violet		
500	154 x 74	2.08	114	dark blue, violet-brown		
1,000 (1978)	154 x 74	2.08	114	olive, rich brown		
5,000	154 x 74	2.08	114	dk. brownish-violet, brown		
Burma: kyat (K)						
1 (1973)	125 x 60	2.08	75	Colors fairly muted: blue-green, olive	obverse and reverse, all denominations; distinct counters	
5 (1973)	135 x 70	1.93	94	blue-violet		
10 (1973)	145 x 80	1.81	116	red-violet		
25 (1972)	155 x 90	1.72	140	orange-brown		
50 (1979)	165 x 100	1.65	165	brown, violet, green		
100 (1976)	175 x 110	1.59	192	blue-green		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Canada: dollar (\$)						
1 (1973)	154 x 70	2.20	108	blue-green, black	obverse and reverse, all denominations; designs very similar, especially \$1, 2, and 20	
2 (1974)	154 x 70	2.20	108	brownish-red		
5 (1979)	154 x 70	2.20	108	clear blue		
10 (1971)	154 x 70	2.20	108	clear violet		
20 (1979)	154 x 70	2.20	108	olive		
50 (1975)	154 x 70	2.20	108	bright orange-red		
100 (1975)	154 x 70	2.20	108	medium brown		
Cayman Islands: dollar (\$)						
1 (1971)	156 x 66	2.36	103	Colors quite distinct: medium blue	obverse and reverse, all denominations; designs almost identical, all denominations	
5 (1971)	156 x 66	2.36	103	medium green		
10 (1971)	156 x 66	2.36	103	medium red		
25 (1971)	156 x 66	2.36	103	medium brown		
Ceylon (Sri Lanka): rupee (R)						
5 (1982)	117 x 63	1.86	74	medium orange-pink	no intaglio obverse only obverse only obverse and reverse obverse and reverse obverse and reverse obverse and reverse	R0 (vertical) 
10 (1982)	127 x 66	1.92	84	olive		
20 (1982)	136 x 70	1.94	95	purple		
50 (1982)	146 x 73	2.00	107	medium blue		
100 (1982)	156 x 76	2.05	117	bright orange		
500 (1981)	165 x 60	2.06	132	violet-brown		
1,000 (1981)	175 x 83	2.11	145	medium green		
Chile: peso						
5 (1975)	145 x 70	2.07	102	Colors clear, soft: green	no intaglio no intaglio obverse only obverse and reverse obverse and reverse obverse and reverse obverse and reverse	
10 (1975)	145 x 70	2.07	102	orange-red		
50 (1975)	145 x 70	2.07	102	clear blue		
100 (1976)	145 x 70	2.07	102	clear violet		
500 (1977)	145 x 70	2.07	102	soft rose-brown		
1,000 (1978)	145 x 70	2.07	102	clear blue-green		
5,000 (1981)	145 x 70	2.07	102	orange-red		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Costa Rica: colon (C)						
5	156 x 67	2.33	105	medium green	obverse and reverse, all denominations; designs fairly similar, all denominations	
10	156 x 67	2.33	105	medium blue		
20	156 x 67	2.33	105	medium brown		
50	156 x 67	2.33	105	olive		
100	156 x 67	2.33	105	gray-black		
500	156 x 67	2.33	105	violet		
1,000	156 x 67	2.33	105	brick-red		
Cyprus: pound (£)/mils						
250 mils (1966)	126 x 73	1.73	92	Colors distinct: dark blue	obverse and reverse, all denominations	
500 mils (1966)	141 x 83	1.70	117	medium green		
£1 (1966)	150 x 89	1.69	134	medium brown		
£5 (1966)	166 x 96	1.73	159	bright clear blue		
Denmark: krone (Kr)						
20 (1972)	125 x 72	1.74	90	Colors very muted: soft brown, gray	Central counters (0); obverse only obverse and reverse obverse and reverse obverse and reverse obverse and reverse	
50 (1972)	140 x 72	1.94	101	soft greenish-blue		
100 (1972)	150 x 78	1.92	117	soft rose, gray		
500 (1972)	164 x 85	1.93	139	soft green		
1,000 (1972)	176 x 93	1.89	164	soft brown, gray		
England (UK): pound (£)						
5	141 x 78	1.81	110	dark blackish-blue	obverse and reverse, all denominations; designs very similar, all denominations	
10	152 x 85	1.79	129	medium brown		
20	161 x 90	1.79	145	violet		
50	169 x 95	1.78	161	olive-brown		
Fiji: dollar (\$)						
1	156 x 67	2.33	105	medium brown	Designs almost identical; no intaglio obverse only obverse and reverse obverse and reverse obverse and reverse	
2	156 x 67	2.33	105	clear green		
5	156 x 67	2.33	105	brownish-orange		
10	156 x 67	2.33	105	violet		
20	156 x 67	2.33	105	clear blue		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Finland: markka (M)						
1 (1963)	142 x 69	2.06	98	yellowish-brown	no intaglio	
5 (1963 Litt. B)	142 x 69	2.06	98	bright clear blue	obverse only	
10 (1980)	142 x 69	2.06	98	green, orange	obverse only	
50 (1977)	142 x 69	2.06	98	brown, violet	obverse only	
100 (1976)	142 x 69	2.06	98	violet, light blue	obverse only	
500 (1975)	142 x 69	2.06	98	brownish blue	obverse and reverse	
France: franc (F)						
10 (1972)	141 x 76	1.86	107	strong orange-brown	no intaglio	
20 (1980)	140 x 75	1.87	105	medium violet, yellow	no intaglio	
50 (1976)	150 x 80	1.88	120	medium blue-black	obverse only	
100 (1978)	160 x 85	1.88	136	medium brown	obverse only	
200 (1981)	173 x 92	1.88	159	yellow-brown, blue-green	obverse only	••• (LLO)
500 (1968)	181 x 97	1.87	176	orange-tan, black	obverse only	••• (LLO)
W. Germany: deutsche mark (DM)						
5 (1960)	120 x 60	2.00	72	olive	obverse and reverse, all denominations	
10 (1960)	130 x 65	2.00	84	blue-violet		
20 (1960)	140 x 70	2.00	98	gray-green		
50 (1970)	150 x 75	2.00	112	medium brown		
100 (1960)	160 x 80	2.00	128	blue-black		
500 (1960)	170 x 85	2.00	144	reddish-brown		
1,000 (1960)	180 x 90	2.00	162	olive-brown		
Greece: drachma (Dr)				Colors soft but distinct:		
50 (1978)	143 x 64	2.23	92	clear medium blue	obverse only	
100 (1978)	158 x 67	2.36	106	brick red, orange	obverse and reverse	
500 (1968)	158 x 74	2.14	117	olive	obverse and reverse	
1,000 (1970)	158 x 81	1.95	128	medium brown	obverse and reverse	
Guyana: dollar (\$)						
1	155 x 65	2.38	101	medium red	obverse and reverse, all denominations; designs almost identical, all denominations	
5	155 x 65	2.38	101	medium green		
10	155 x 65	2.38	101	medium brown		
20	155 x 65	2.38	101	violet-black		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions				Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )				
Hungary: forint (F)							
20 (1975)	166 x 73	2.27	121	Colors dull, muted:		obverse only	
50 (1975)	166 x 73	2.27	121	dark blue		obverse and reverse	
100 (1975)	166 x 73	2.27	121	medium brown		obverse and reverse	
500 (1975)	176 x 81	2.17	143	brownish-purple		obverse and reverse	
				violet			
Ireland: pound (£)						Distinct counters (0);	
1 (1977)	148 x 78	1.90	115	olive		obverse only	
5 (1976)	156 x 82	1.90	128	medium brown, peach		obverse and reverse	
10 (1978)	164 x 86	1.91	141	violet, pink		obverse and reverse	
20 (1980)	172 x 90	1.91	155	clear medium blue		obverse and reverse	
50 (1982)	180 x 94	1.91	169	reddish-brown		obverse and reverse	
Israel: pound (I£)				Distinct color combinations:			LL0:
5 (1973)	128 x 76	1.68	97	dark brown on peach	obverse and reverse, all		⠠⠠⠠
10 (1973)	135 x 76	1.78	103	dark violet on lilac	denominations		⠠⠠⠠
50 (1973)	141 x 76	1.86	107	dark green on light green			⠠
100 (1973)	147 x 76	1.93	112	dark blue on light blue			
500 (1973)	153 x 76	2.01	116	black on light yellow			⠠⠠⠠⠠⠠
Israel: sheqel (IS)						Distinctive counters;	
5 (1978)	141 x 76	1.86	107	dark green on light green	obverse and reverse, all		⠠ (LLO)
100 (1979)	159 x 76	2.09	121	medium orange-brown	denominations		⠠ (LLO)
500 (1982)	138 x 76	1.82	105	dark red			⠠ (MRO)
Italy: lira (L)				Colors brown, dull, indistinct:			
1,000 (1982)	112 x 61	1.84	68	pale rose-brown, green	no intaglio		
2,000 (1973)	132 x 65	2.03	86	medium brown, peach	obverse only		
10,000 (1976)	133 x 70	1.90	93	blue-green, black	obverse and reverse		
20,000 (1974)	161 x 79	2.04	127	medium brown	obverse and reverse		
50,000 (1977)	148 x 70	2.11	104	brownish-red, blue, green	obverse and reverse		
100,000 (1978)	156 x 70	2.23	109	brownish-red, blue	obverse and reverse		

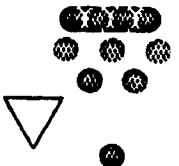


# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Jamaica: dollar (\$)						
1 (1960)	144 x 64	2.25	92	violet, tan	obverse and reverse, all denominations	
2 (1960)	147 x 68	2.16	100	dark green, tan		
5 (1960)	150 x 70	2.14	105	medium brown, tan		
10 (1978)	152 x 72	2.11	109	clear violet-blue		
20 (1978)	156 x 76	2.05	119	orange-red, brown, purple		
Japan: yen (Y)				Colors very muted, similar:		
500	159 x 72	2.21	114	dark blue, tan	obverse and reverse, all denominations	
1,000	164 x 76	2.16	125	olive, brown, tan		
5,000	169 x 80	2.11	135	blue-green, black, tan		
10,000	174 x 84	2.07	146	green, brown, tan		
Jordan: dinar (JD)						
½ (1975)	136 x 68	2.00	92	medium brown, peach	obverse and reverse, all denominations	
1 (1975)	144 x 72	2.00	104	medium green, tan		
5 (1975)	152 x 76	2.00	116	dark red, peach		
10 (1975)	160 x 80	2.00	128	blue-violet, tan		
Korea (Seoul): won (W)						
500 (1973)	159 x 69	2.30	110	soft green, blue	obverse and reverse, all denominations	
1,000 (1975)	163 x 73	2.23	119	soft purple, violet		
5,000 (1977)	167 x 77	2.17	129	soft brown, orange		
10,000 (1979)	171 x 81	2.11	139	soft olive		
Libya: dinar (D)				Green intaglio, all denominations:		
¼	142 x 71	2.00	101	medium green, pink	obverse and reverse, all denominations	
½	152 x 76	2.00	116	medium green, peach		
1	162 x 81	2.00	131	medium green		
5	172 x 86	2.00	148	medium green, sky blue		
10	180 x 91	1.98	164	medium green, pink		
Luxembourg: franc/frang (F)						
20 (1966)	130 x 70	1.86	91	dark blue	obverse and reverse, all denominations	
50 (1972)	136 x 73	1.86	99	dark brownish-black		
100 (1970)	142 x 76	1.87	108	medium red		
New series:						
100 (1980)	142 x 76	1.87	108	medium red	obverse and reverse	

LRO:  
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# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Malta: pound (£M)						
1 (1967)	137 x 69	1.99	95	Overall effect similar: med. brown, gray, peach violet, gray, pink gray, purple-red, peach	obverse and reverse, all denominations	
5 (1967)	145 x 75	1.93	109			
10 (1967)	152 x 80	1.90	122			
Mexico: peso (\$)						
20 (1972)	155 x 66	2.35	102	medium red	obverse and reverse, all denominations	
50 (1973)	155 x 66	2.35	102	bright medium blue		
100 (1974)	155 x 66	2.35	102	bright violet		
500 (1979)	155 x 66	2.35	102	olive, brown		
1,000 (1978)	155 x 66	2.35	102	brown on peach		
5,000 (1980)	155 x 66	2.35	102	blue and red on sky blue		
10,000 (1981)	155 x 66	2.35	102	dark blue on chartreuse		
Netherlands: gulden (G)						
5 (1973)	136 x 76	1.79	103	Colors distinct: bright, clear green	Distinct counters (0); obverse only obverse only obverse only obverse and reverse obverse and reverse obverse and reverse	LLO: 
10 (1968)	142 x 76	1.87	108	bright, clear blue		
25 (1971)	148 x 76	1.95	112	clear red		
50 (1982)	148 x 76	1.95	112	bright orange and yellow		
100 (1977)	154 x 76	2.03	117	medium brown		
1,000 (1972)	160 x 76	2.11	122	medium bluish-green		
New Zealand: dollar (\$)						
1	140 x 70	2.00	98	Colors bright, clear, distinct: brown	obverse and reverse, all denominations; designs almost identical, all denominations	
2	145 x 72.5	2.00	105	clear violet		
5	150 x 75	2.00	112	bright orange		
10	155 x 77.5	2.00	120	clear blue		
20	160 x 80	2.00	128	medium green		
100	160 x 80	2.00	128	bright crimson		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Nicaragua: cordoba (C\$)						
1 (1968)	156 x 67	2.33	105	medium blue	obverse and reverse	
2 (1972)	156 x 67	2.33	105	olive	obverse and reverse	
5 (1972)	156 x 67	2.33	105	medium green	obverse and reverse	
10 (1979)	156 x 67	2.33	105	red	no intaglio	
20 (1979)	156 x 67	2.33	105	ochre	no intaglio	
50 (1979)	156 x 67	2.33	105	violet	no intaglio	
100 (1979)	156 x 67	2.33	105	blackish-brown	no intaglio	
500 (1979)	156 x 67	2.33	105	olive	obverse and reverse	
1,000 (1979)	156 x 67	2.33	105	medium blue	obverse and reverse	
Nigeria: pound (£)/shilling (s)						
5 s (1965)	127 x 73	1.74	93	reddish-violet	obverse and reverse, all denominations; designs very similar, all denominations	
10 s (1965)	138 x 77	1.79	106	medium green		
£1 (1965)	152 x 84	1.81	128	medium red		
£5 (1965)	157 x 90	1.74	141	dark blue		
Norway: krone (Kr)						
10 (1974)	125 x 65	1.92	81	medium blue	obverse only	
50 (1974)	145 x 73	1.99	106	medium green	obverse only	
100 (1963)	145 x 78	1.86	113	burgundy	obverse and reverse	
500 (1978)	170 x 90	1.89	153	yellowish-green	obverse and reverse	
1,000 (1975)	170 x 90	1.89	153	reddish-brown, violet	obverse and reverse	
New series:						
100 (1977)	144 x 78	1.85	112	burgundy on peach	obverse only; dominant counter	
Oman: rial (R)/baisa						
100 baisa	120 x 62	1.94	74	ochre	obverse only	
R ¼	128 x 67	1.91	86	blue	obverse and reverse	
R ½	136 x 72	1.89	98	green	obverse and reverse	
R 1	145 x 78	1.86	113	red	obverse and reverse	
R 5	154 x 78	1.97	120	purple	obverse and reverse	
R10	164 x 78	2.10	128	purplish-brown	obverse and reverse	
R20	175 x 78	2.24	137	blackish-blue	obverse and reverse	

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Papua New Guinea: kina						
2	140 x 70	2.00	98	medium green		Similar designs; distinct counters; obverse only
5	145 x 72.5	2.00	105	purple		obverse and reverse
10	150 x 75	2.00	112	blue		obverse and reverse
20	150 x 75	2.00	112	orange-brown		obverse and reverse
Portugal: escudo (\$)						
20 (1978)	134 x 66	2.03	88	medium green		obverse and reverse, all denominations
50 (1968)	142 x 70	2.03	99	medium brown		
100 (1980)	150 x 74	2.03	111	clear blue		
500 (1979)	156 x 78	2.00	122	reddish-brown		
1,000 (1968)	164 x 82	2.00	134	blue-green		
5,000 (1980)	170 x 75	2.27	128	olive, brown		
Qatar: riyal						
1 (1982)	134 x 66	2.03	88	Colors soft, muted: golden brown, med. brown		Designs very similar; obverse only
5 (1982)	140 x 67	2.09	94	burgundy, violet		obverse only
10 (1982)	146 x 69	2.12	101	yellow, green		obverse only
50 (1982)	152 x 71	2.14	108	blue, blue-black		obverse and reverse
100 (1982)	158 x 72	2.19	114	olive, brown		obverse and reverse
500 (1982)	163 x 74	2.20	121	blue-green, violet		obverse and reverse
Russia (USSR): rouble (R)						
1 (1961)	105 x 53	1.98	56	medium brown		obverse only
3 (1961)	114 x 57	2.00	65	medium green		obverse only
5 (1961)	114 x 57	2.00	65	blue		obverse only
10 (1961)	122 x 61	2.00	74	brick red		obverse only
25 (1961)	122 x 61	2.00	74	violet		obverse and reverse
50 (1961)	140 x 70	2.00	98	medium green		obverse and reverse
100 (1961)	140 x 70	2.00	98	medium brown		obverse and reverse
Solomon Islands: dollar (\$)						
2 (1977)	140 x 70	2.00	98	Colors distinct: medium green		obverse and reverse, all denominations; designs nearly identical, all denominations
5 (1977)	145 x 75	1.93	109	medium blue		
10 (1977)	150 x 80	1.88	120	violet-red		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Sweden: krona (Kr)					Distinct counters (0);	
5 (1965)	110 x 68	1.62	75	violet on yellow	obverse only	
10 (1963)	120 x 68	1.76	82	green on pale blue	obverse only	
50 (1965)	130 x 82	1.59	107	medium blue on yellow	obverse only	
100 (1965)	140 x 82	1.71	115	brownish-red on pale blue	obverse only	
1,000 (1976)	180 x 82	2.20	148	med. brown on violet-white	obverse and reverse	
Switzerland: frank/franc (F)				Colors distinct:		ULO:
10 (1979)	137 x 66	2.08	90	medium brownish-red	obverse and reverse, all	•
20 (1979)	148 x 70	2.11	104	medium greenish-blue	denominations	••
50 (1978)	159 x 74	2.15	118	medium green		•••
100 (1976)	170 x 78	2.18	133	dark violet-blue		
500 (1977)	181 x 82	2.21	148	medium brown		
1,000 (1978)	192 x 86	2.23	165	violet		
Thailand: baht (B)						
5 (1969)	130 x 67.5	1.93	88	violet	obverse and reverse	
10 (1980)	132 x 69	1.91	91	soft blackish-brown	obverse only	
20 (1981)	138 x 72	1.92	99	medium green	obverse only	
100 (1978)	154 x 80	1.92	123	burgundy on peach	obverse and reverse	
500 (1975)	160 x 82.5	1.94	132	violet on lavender	obverse and reverse	
Trinidad and Tobago: dollar (\$)				Colors distinct:		
1 (1964)	156 x 66	2.36	103	clear red	obverse and reverse, all	
5 (1964)	156 x 66	2.36	103	clear green	denominations; designs	
10 (1964)	156 x 66	2.36	103	black	almost identical, all	
20 (1964)	156 x 66	2.36	103	violet	denominations	
100 (1964)	156 x 66	2.36	103	bright clear blue		

# Denomination of Currency by the Blind or Visually Impaired

Country: currency' (abbr.) Denomination (date)	Dimensions			Overall Color(s): Saturation, Hue(s)	Intaglio Printing: Obverse, Reverse	Braille-like Symbols
	Lgth. x Ht. (mm)	Aspect Ratio	Area (cm <sup>2</sup> )			
Turkey: turk lira (TL)						
5 (1970)	135 x 60	2.25	81	Colors muted: violet, tan	obverse only	
10 (1970)	121 x 55	2.20	67	olive	no intaglio	
20 (1970)	142 x 65	2.18	92	reddish-brown	obverse only	
50 (1970)	160 x 72.5	2.21	116	gray	obverse and reverse	
100 (1970)	168 x 77	2.18	129	grayish green	obverse and reverse	
500 (1970)	170 x 80	2.12	136	blue-green	obverse and reverse	
1,000 (1970)	170 x 82.5	2.01	140	violet-blue, burgundy	obverse and reverse	
5,000 (1970)	140 x 72	1.94	101	violet-brown	obverse and reverse	
United States: dollar (\$)						
1	156 x 66	2.36	103	black obverse, green reverse, all denominations	obverse and reverse, all denominations; designs very similar, all denominations	
2	156 x 66	2.36	103			
5	156 x 66	2.36	103			
10	156 x 66	2.36	103			
20	156 x 66	2.36	103			
50	156 x 66	2.36	103			
100	156 x 66	2.36	103			
Viet Nam (Saigon): dong (D)						
50 (1972)	142 x 71	2.00	101	blue-green, light blue	Designs very similar; obverse only	
100 (1972)	146 x 73	2.00	107	medium green, light green	obverse and reverse	
200 (1972)	146 x 73	2.00	107	purplish-red, greenish-tan	obverse and reverse	
500 (1972)	152 x 76	2.00	116	orange, tan	obverse and reverse	
1,000 (1972)	152 x 76	2.00	116	medium blue, tan	obverse and reverse	
Yemen: rial (R)						
1 (1973)	120 x 65	1.85	78	green	obverse only, all denominations	
5 (1973)	130 x 68	1.91	88	red		
10 (1973)	135 x 71	1.90	96	blue		
20 (1973)	145 x 73	1.99	106	violet		
50 (1973)	150 x 75	2.00	112	olive-brown		

## APPENDIX 2

DE NEDERLANDSCHE BANK N.V.  
POSTBUS 98 - 1000 AB AMSTERDAM

ONDERDIRECTEUR  
MR. J. R. STEINHAUSER

Amsterdam, March 31, 1983.

12/2/83

Mr. Robert J. Leuver  
Director  
Bureau of Engraving and Printing  
U.S. Department of the Treasury  
14th & C Streets, S.W.  
Washington, D.C. 20228

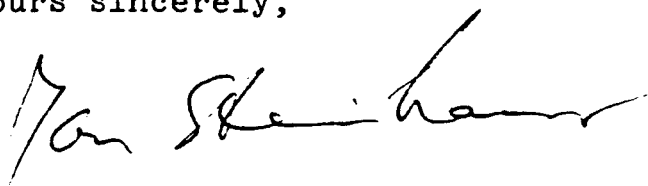
Dear Mr. Leuver,

Back at my desk from my visit to the United States, I want to thank you very much indeed for your hospitality on March 24, 1983, at the Bureau of Engraving and Printing. I found the tour through the printing works very interesting and I was very much impressed by the laboratorium.

I enclose herewith a note we sent to the Bank of Canada on the intaglio marks for the blind as I promised. I also enclose a note of Dr. Koeze on the life-length of banknotes. An other trial is still on its way concerning the life-length of banknotes with regard to the machine direction in the papermill. I spoke about these trials with Mr. Seidel and Mr. Graminski. As soon as the report on the trial is there, I will send it to them.

Would you please be so kind as to pass my gratitude to Mr. Seidel, Mr. Graminski and Mr. Heygster for the time they spent on me during my visit.

Yours sincerely,



Enclosures



Amsterdam, May 25, 1981.


Mr. I.G. Freeth  
Bank of Canada  
Ottawa K1A 0G9  
Canada

Dear Mr. Freeth,

Thank you very much for your letter of April 24, 1981, on identification of banknotes for the blind. As you know, we have used tactile symbols since the issue of our present f 10,- banknote in January 1971. The experience we have gained since then is mixed. On the one hand, it is recognised in broad circles that tactile symbols may play a useful role for visually handicapped people. On the other hand, we feel that the present, rather gross form of our symbols is suboptimal. Smaller symbols might be recognized easier.

Generally, one has to reckon with two categories of visually handicapped people. The first category includes persons born blind or become blind in the first years of their life. These people have an excellent feeling and have the ability even to feel and read the text and numerals in intaglio on the front of our banknotes. For them special tactile symbols are not necessary. In our latest f 100,- banknote issued since March 16, 1981 we have improved upon the tactility of the text using letters without serifs and leaving out cadre lines etc. which hinder feeling. The letters are placed simply against a background in offset.

The second category includes persons become blind later in their life, e.g. after a traffic incident. These people may be compared with others blindfolded. Their feeling is not exceptionally good, generally. For them special tactile symbols would be of a great help because they are not able to feel and read the text. It is this category at whom we aim our efforts.



Amsterdam, May 25, 1981.

Mr. I.G. Freeth

Canada

- 2 -

Pure braille numbers are not effective, because only a small proportion of the visually handicapped are able to read braille. In our country only about 4000 people out of 90.000 visually handicapped are familiar with braille. This is why we have chosen for a simplified system using the principle of braille. As you remark, pure braille dots have a height greater than the embossing which it is possible to achieve in intaglio. In the present form of our symbols we have compensated the lesser height by the greater width of the dots. On afterthought, this appears a fallacy. A simple experiment is sufficient to show this as follows.


If a sheet of normal writing paper (thickness about 0,1 mm comparable to the embossing on our banknotes) is laid flat on the smooth surface of a table, it is very well possible for people like you and me to feel the edges of the sheet. However, the even surface of the sheet is not recognizable. As shown above, people without visual handicap but blindfolded are representative of the category of handicapped people we aim at. So the conclusion is that it is not the actual height or the top of the intaglio point that is felt, but the discontinuity due to the height difference. Tactile symbols are optimal if they have the maximal height which can be achieved and the minimal width necessary for that height. The symbols should be spaced such that they can be felt one by one. Typical dimensions of special tactile symbols are:

height : 100  $\mu$ m

width : 1 mm

interspace: 5 mm

Using this principle the tactile symbols of Switzerland, Belgium and other countries are better than ours.



Amsterdam, May 25, 1981.  
Mr. I.G. Freeth  
Canada

- 3 -

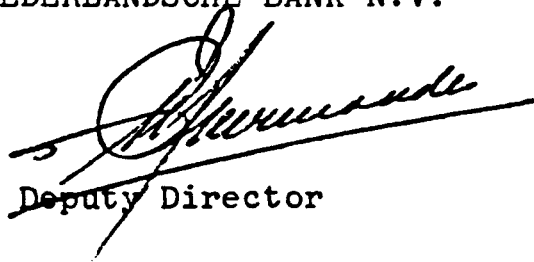
All countries have devised their symbols according to some sequential system, e.g. an increasing number of dots or lines. Obviously, it is difficult to insert a new denomination into the sequence. Recently, we have encountered this problem when we decided to design a f 50,- banknote which does not exist at present. It is more practical to devise symbols using (simplified) numerals or (simplified) text. We are working along this line but our investigations have not yet come to a conclusion.

Finally, we have no information on how long the tactile feel remains useful in the circulation.

We hope that the information above is of any help to you. Taking this opportunity I should mention that Janus Ritter has retired in January and that Mr. J.R. Steinhauser has taken over his responsibilities. Peter Koeze and Jaap Brugman asked me to send you their personal regards.

Yours sincerely,

R. DE NEDERLANDSCHE BANK N.V.



Deputy Director

CAISSE D'ÉPARGNE DE L'ÉTAT

DU GRAND-DUCHÉ DE LUXEMBOURG

BANQUE DE L'ÉTAT

252  
6/10/83

DIRECTION

CB/JJ

*Luxembourg*, June 7th, 1983  
*1, Place de Metz*

Mr. Robert J. LEUVER  
Director  
Department of the Treasury  
Bureau of Engraving and Printing  
Washington, D.C. 20228  
(U.S.A.)

Concern: Incorporated design elements for blind.

Dear Mr. Leuver,

Referring to your letter of April 21st, 1983, I want to inform you that, as Luxembourg is linked to Belgium by an agreement on monetary association, belgian notes are legal tender and form therefore the greater part of luxemburgish circulation.

Within the framework of this agreement, Luxembourg keeps its sovereign right to issue own notes, but has accepted limits as far as the amount and the denomination are concerned.

As Luxembourg has no own engraving and printing center, our experience in the field of incorporated design elements for blind or visually impaired is very limited.

Nevertheless, I think that intaglio printed design elements have a legibility and an utility to aid the blind in determining the denomination.

Unfortunately, the durability is very limited because these marks are only perceptible as long as the notes are in new or rather good conditions.

Sincerely yours,

*W. J. Leuver*



DIRECTION

Brussels, 13th july, 1983.

RS2  
7/18/83

Dear Mr Leuver,

Your letter dated April 21st, 1983 concerning the incorporation in banknotes of means by which the visually impaired might recognize them, only reached me recently. I heard that in the meantime you met Mr J. Van Droogenbroeck in Brussels and talked about this subject.

So, I can only confirm our general impression about the use of intaglio printed signs : although the utility to the blind population of the elements as implemented in our notes is questionable, and their durability is not what one should hope and the printing of the deep intaglio engraving causes more frequent replacements of the packing material on our intaglio presses, we still see no obvious reason not to print those signs.

Furthermore, the other existing ways of enabling people to distinguish between different denominations of banknotes other than by sight (significantly different sizes, braille numbers or raised dot codes, clipped corners a.s.o) also have their specific drawbacks.

We hope that in the future better printed intaglio signs will fulfill this particular task more satisfactorily.

If you need more technical details on this matter, please do not hesitate to get in touch with Mr J. Van Droogenbroeck.

With kind regards,

J.-P. Pauwels  
Director

Mr Robert J. Leuven, Director  
Department of the Treasury  
Bureau of Engraving & Printing  
WASHINGTON, D.C. 20228 (U.S.A.)

בנק ישראל  
BANK OF ISRAEL  
CURRENCY DEPARTMENT

*M. Reilly*  
JUL 11 RECD

Jerusalem, July 4, 1983

Dr. Edmond L. Graminsky, Chief  
Office of Research and Technical Services  
Department of the Treasury  
Bureau of Engraving and Printing  
Washington, D.C. 20228  
U. S. A.

Dear Dr. Graminsky,

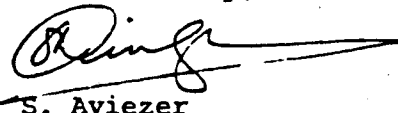
Re: Mr. R.J. Leuver's letter dated April 21, 1983  
regarding design elements for the blind

In reference to Mr. R.J. Leuver's letter dated April 21, 1983, (which was received by us only on 14th inst.) we wish to inform you that we have not undertaken a special probe relating to the legibility and utility to the blind of the design elements incorporated in our banknotes for their benefit.

As you may well know, we do not print our banknotes in Israel, but mostly in Holland. That is why we have originally adopted the system of the signs for the blind from the Dutch banknotes in coordination with the Dutch Central Bank. Filled signs were thought at the beginning to be the best element for sensitive touch but later, thanks to more investigations carried out by the Dutch and Belgian Central Banks, hollow geometric shapes were chosen for more recent banknotes as being a better element for the blind to feel. That is the reason a circle has been put on our latest banknote (the I.S.500).

From the foregoing, it is obvious that we cannot point out if there were any detrimental effects in the production of the notes. Moreover, lacking automatic sorting systems, we are not in a position to report of any effects in the transport of the notes. Anyway, no problems were encountered in the passing of the notes through counting machines.

Yours faithfully,



S. Aviezer  
Assistant Director - Currency Department



EMBASSY OF SWITZERLAND  
SCHWEIZERISCHE BOTSCHAFT  
AMBASSADE DE SUISSE

WASHINGTON D.C. 20006,  
2900 Cathedral Avenue N.W.  
Telephone 462-7611  
713-7900

Ref.: 521.2 - PB/mo

January 21, 1983

Mr. Raphael Perl  
Subcommittee on Housing and  
Consumer Interests  
717 House Office Building  
Annex I  
Washington, D.C. 20515

Dear Mr. Perl,

The Swiss National Bank has informed us as follows regarding the issue of the Swiss experience with a code for the blind on Swiss banknotes:

"The problem is currently being studied by most of the European central banks. However, the Swiss National Bank (SNB) believes that to date no efficient banknote markings have been found to benefit all types of blind people. A good differentiation method for the blind is still the different size of the individual banknote denominations. Therefore the SNB has encouraged the manufacture of templets to measure the different denominations.

Following are some remarks concerning the experiences the SNB has had with the Swiss banknotes:

- The selection of the markings was made by the associations for the blind at the time new banknotes (competition 1970) were created.
- The selection of the markings presented few difficulties; the printing of the markings, however, was more problematic. Banknotes are subject to much greater wear and tear than, for example, books or newspapers in braille.
- After the first few tests, the raised printing that was introduced at the time by the Netherlands and Israel was adopted. After a few months of circulation, a poll of the associations for the blind unfortunately revealed the inefficiency of the markings as soon as the banknotes lose their printing crispness.

./.

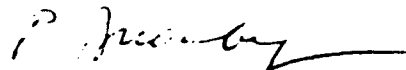
- Further tests were not possible during that period due to lack of time and problems with design, printing and security. The creating of banknotes takes many years and must be prepared on a long-term basis. But we shall endeavor to find new ways to devise a code for the blind when we prepare the next series of banknotes.
- The associations for the blind request that the markings be retained and suggest
  - o that the code be imprinted diagonally on the front and back side
  - o that more space be left between the dots and lines to facilitate reading
  - o that thinner paper be used to achieve a greater sensitivity of the code.

However, the printing method which would assure the thickness and permanence of the markings is yet to be found. Perforated printing seems to be out of the question for technical and security reasons.

- The addition of the code for the blind did not result in any additional costs to us because it formed an integral part of the copper printing plate when the new banknotes were made.
- There are about 5,000 blind persons in Switzerland, and about 20,000 persons with impaired vision. This is approximately 1‰, respectively 3‰ of the total population. In spite of this minority, there is a consensus of opinion that the problem should not be neglected."

We trust this information will be useful to you. Should you have any further questions do not hesitate to write or to call us.

Sincerely yours,



Peter Buomberger  
Secretary of Embassy





## APPENDIX 3

AMERICAN FOUNDATION FOR THE BLIND, INC.

June 1, 1983

Mr. Maurice M. Schneider  
Executive Assistant  
Bureau of Engraving and Printing  
Department of the Treasury  
14th & C Street, S.W.  
Washington, DC 20228

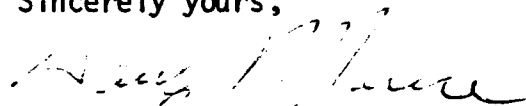
Dear Mr. Schneider:

Enclosed is the feasibility study on techniques for generating a personal size paper money identifier to be used by blind and severely visually impaired persons.

In a period of a few weeks, it is only possible for us to give you a rough estimate of cost, but we feel that they are probably accurate. If you require an extensive study and evaluation of the two techniques, to further refine the proposal and to get better information on the comparative advantages of the two techniques, I believe that it would require approximately three months of effort and \$15,000 to get a more definitive evaluation. Specifications would have to be written and sent to a number of organizations.

I hope this information is what you require and would be happy to give a presentation to Congress if you request it.

Sincerely yours,



Douglas R. Maure, Director  
Technological Development Dept.

DRM/bb

enclosed

15 WEST 16TH STREET, NEW YORK, N.Y. 10011 / TEL: (212) 620-2000  
CABLE ADDRESS: FOUNDATION, NEW YORK/AN EQUAL OPPORTUNITY EMPLOYER

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Region II	15 West 16th Street, New York, New York 10011 (212) 620-2037
Region III	203 North Wabash Avenue, Chicago, Illinois 60601 (312) 269-0095
Region IV	100 Peachtree Street, Atlanta, Georgia 30303 (404) 525-2303
Region V	1111 West Mockingbird Lane, Dallas, Texas 75247 (214) 630-8035
Region VI	760 Market Street, San Francisco, California 94102 (415) 392-4845
Legislative Office	1660 L Street, N.W., Washington, D.C. 20036 (202) 467-5996

A POCKET CURRENCY READER FOR THE BLIND  
A feasibility Study\*

It is the purpose of this document to outline an approach for a pocket sized device for reading the denominations of paper currency. The primary purpose for the consideration of such a device, is an aid for the blind. It will be understood that the technology may also be applicable to a wide range of automatic processes where a definition of product or orientation may be desirable. However, we here limit the discussion to a currency reader for the blind in the United States.

The basic technology is not new. Readers have been on the market for sorting currency for about fifteen years. These devices, however, have been enormously complex and expensive, compared to anything that could serve the individual blind person. More recently, however, a joint program between the American Foundation for the Blind and ARDAC, a company serving the note acceptor field, has reduced the complexity of the earlier designs to the point that a new product keyed to the needs of the blind vendor has now been accepted by the Foundation, and is available through the Foundation's Consumer Products Department.

In order to establish a reference for further discussion of the device here proposed, it is appropriate to discuss this device known as the paper money identifier for the blind.

\*T. Lynch, Ohio License E013319

The unit is pictured in Fig. 1. It operates from the normal power line. It accepts the notes in any geometric approach, and announces the denomination in clearly articulated English. It even tells the operator if the bill is of a preferred geometry (i.e., upside down). It "knows" bills from all denominations from one to twenty dollars. Although the reading of the notes is a fairly sophisticated process, involving a pattern of forty to sixty indices, the unit is not particularly effective against sophisticated counterfeit notes. It will be understood that there is a great deal of technology involved in such discrimination, and a device claiming effectiveness in this discrimination very quickly becomes expensive. Early studies by AFB concluded the marketability for the vendor aid will be severely limited if the retail unit cost of the device is much more than \$600.00, and, consequently units were set that precluded engineering and development costs permitting for the rejection of counterfeit notes.

Having described in the above paragraph what might be termed the state of the art, we now turn our attention to the description of this proposal.

First, if \$600.00 is a market problem for the blind vendor, even when assisted by the Randolph Sheppard Act, it is clear that a personal note reader must aim at a substantially lower figure if the market is to be large enough to support the device. It is probable, therefore, that a financially unassisted development effort of such a device will never happen, and therefore the purpose of this discussion is to provide a background for funding requests.

A way to make substantial progress in this problem area of unit cost is to make the decision favoring sophisticated design and extensive tooling. This means the development of the device will be comparatively expensive, but the selling cost to the individual user will be moderate. It is impossible to estimate this figure with any degree of accuracy since production cost is sensitive to volume. In large volume (100,000 units) the cost of \$75.00 seems reasonable and could increase to \$250.00 with relatively low volume.

We now turn our attention to the problems involved in going from the device of Fig. 1 to the pocket version.

The major difference is that Fig. 1 handles the bill, moving it at a controlled rate of speed through the scanning mechanism. This is an expensive part of the machine, but it solves some tough problems. It cannot be a feature of a pocket device because of the cost but also because such a mechanism puts impossible demands upon the power available in a pocket device. Accordingly, the proposed device hypothecates a design where the scanning process is manually performed. The preferred embodiment is pictured in Fig. 2. The note is threaded sideways into the machine, and captured by a roller with an inertia brake. The operator, after loading the bill into the machine, pulls one end (either end), withdrawing the note and providing a mechanism for the scanning process. The inertia brake will control to an acceptable degree the regularity of the extraction process. The "reading" of the note now becomes a simple extrapolation of the process in the vendor note reader.

It will be understood that a description of this reading process in detail will serve no one better than the potential counterfeiter, so we shall not reveal such details in this description. In fact, the vendor device does work; it has been approved by the American Foundation for the Blind, and since the scanning process and the logic are expected to be closely alike in the two machines, it is not in doubt that the pocket version of the device will have comparable performance.

The vendor device for the blind announces the denomination of the note in plain English. This is an expensive feature. It is not yet clear that the price objective for the pocket version will permit this type of read-out. It seems quite possible that a suitable investment in a speech synthesis chip specifically for the blind reader might reduce the per unit cost to an affordable figure.

Should further study of the cost/performance ratio push the decision to a non-speech readout, pin-type readouts are available, and an acoustic read-out comprising a keyed note or notes can be easily achieved. However, due to tactual discrimination problems for the elderly blind and blind diabetic may preclude this as an option.

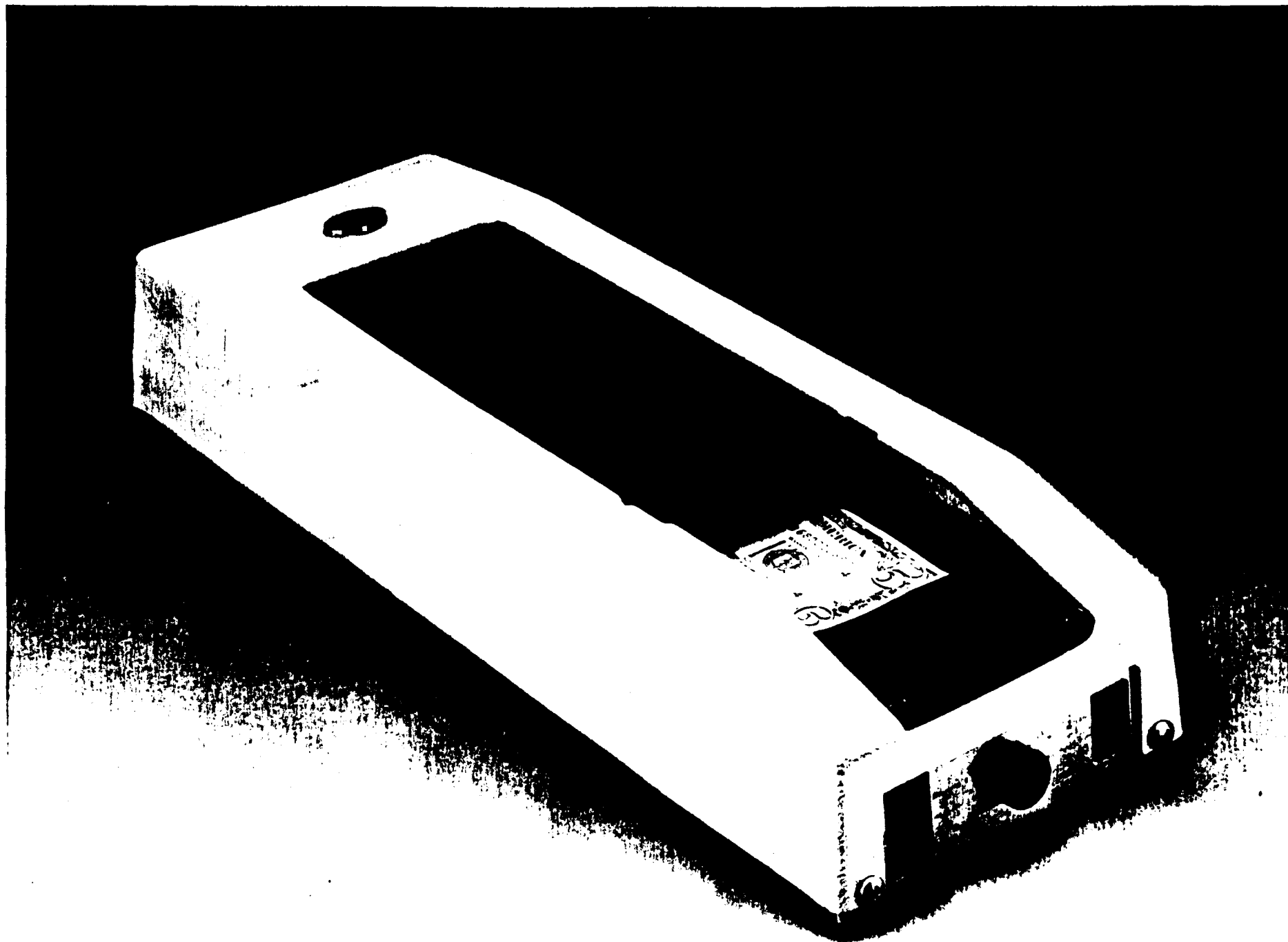
What we conceive, therefore, is the development of a pocket currency reader for the blind, similar in concept to the artist's sketch in Fig. 2, derived in its essential operating features from a currently available vendor note reader for the blind.

A prototype, functional unit could be available in nine months. A marketable device from hard tooling, in eighteen months. The estimated cost for such a program is \$250,000. Depending upon volume, price per unit from \$75.00 to \$250.00 seems feasible.

The Bureau of Engraving and Printing has proposed a bar chart to be placed around the face on the bill. As I understand it, they propose a 12 mil spacing with 8 mil for a one and 4 mil for a zero. Each bit code would be utilized permitting error correction. This technique would probably cost the consumer approximately the same as the techniques described above. The reason that this seems likely is that the reduction in size of the computer algorithms in the microprocessor does not materially decrease the cost of the instrument. The microprocessor costs would possibly be reduced from \$10.00 to \$9.00. Because of the fine spacing on the bar chart, it does not seem likely that the optics would be substantially less complex than the existing optical system, and in fact, because of the close spacing might even be more expensive. Therefore, it seems that the bar chart approach would cost approximately the same as the approach suggested by ARDAC.

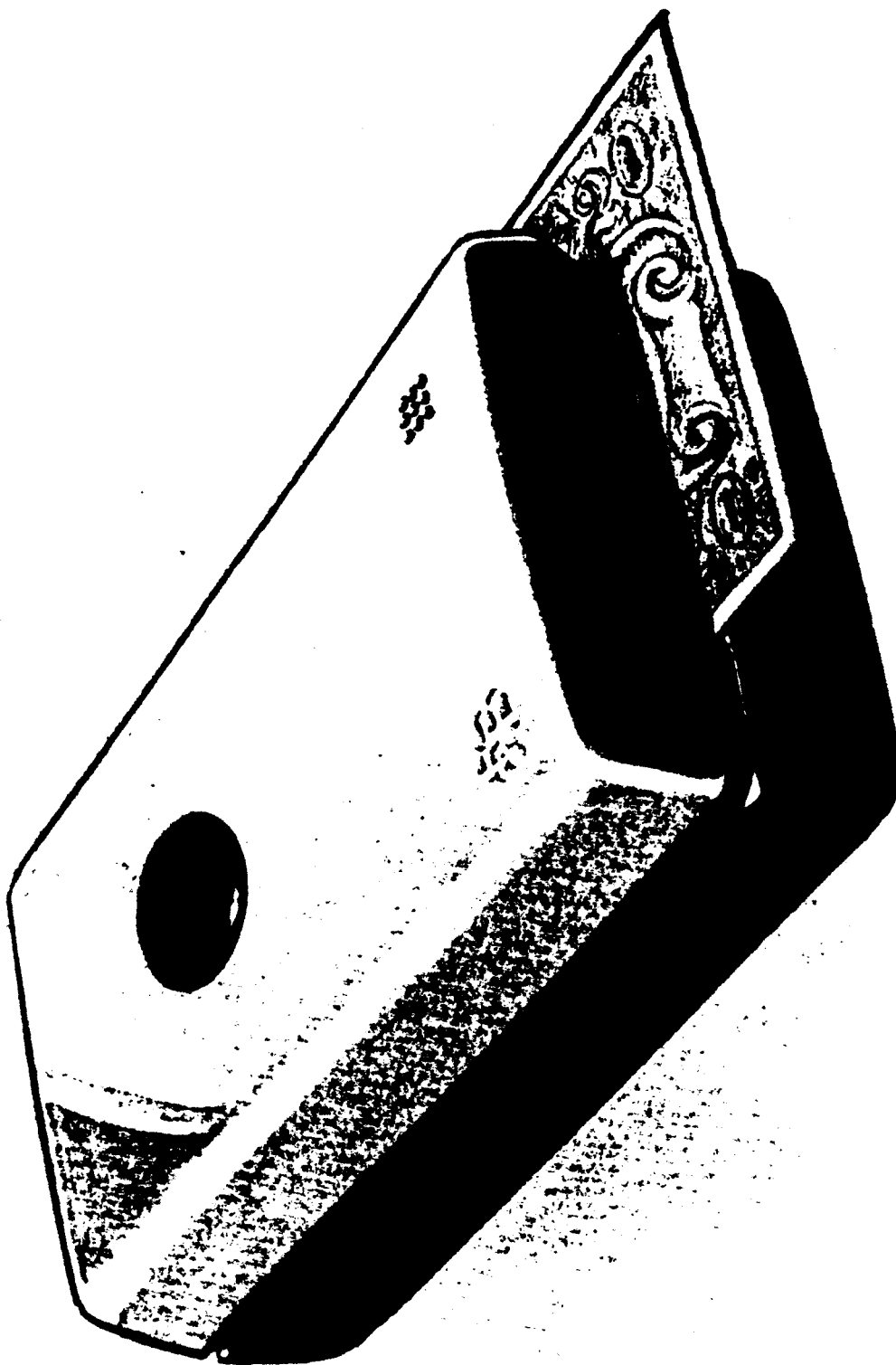
June 1, 1983





VENDOR PAPER MONEY IDENTIFIER  
FOR THE BLIND

FIGURE 1



POCKET CURRENCY READER FOR THE BLIND  
FIGURE 2

## APPENDIX 4

# DIMENSIONS - STANDARD AND JUMBO BRAILLE

	<u>Standard Braille</u>	<u>'Jumbo' Braille</u>
Dot height (in)	0.018 - 0.020	0.018 - 0.020
Dot diameter (in)	0.050 - 0.065	0.66
Dot spacing, same cell (in)	0.092 $\pm$ 0.002	0.121
Dot spacing, adjacent cells (in)	0.235 - 0.250	0.378
Dot spacing, adjacent lines (in)	Not less than 0.400	0.500

## BRAILLE MARKINGS

Over the years we have printed some experimental currency notes with various types of raised markings which were examined by blind people, and we have been in contact with the Netherlands where Braille-marked currency has actually circulated over a period of time. The results of both efforts confirm that special markings on currency would not be of any particular or lasting value to most blind people, due to the rapid wear of the raised symbols and the fact that the great preponderance of blind people lack the sensitivity of touch required to distinguish the markings. The latter situation arises because more than half of the legally blind persons in the United States are over the age of 60 and lost their sight at an older age. Even among younger sight-handicapped people, however, the tactile sensitivity required for reading Braille varies greatly from person to person and is not a universally acquired skill among the blind.

In a survey, made by us in August 1977, of 22 organizations known to be concerned with various aspects of blindness, none responded in favor of special markings on currency to assist the blind. Moreover, the largest representative organization of blind people -- The National Federation of the Blind -- has actively opposed any legislation for Braille-type markings on U.S. currency. Therefore, because of the technical issues involved and because blind people themselves do not generally express the view that money handling is a major problem, we are no longer engaged in efforts to place raised markings on currency notes.

Internationally, at the Third Pacific Rim Conference of Banknote Printers, held in Ottawa in September 1977, most member nations agreed that Braille-type currency has little real value to the blind and only serves as a "goodwill" gesture. This had been the finding of those nations who have experimented with this approach, and it seems highly unlikely at this time that many more nations will attempt to adapt their currencies in this manner.

**NATIONAL FEDERATION OF THE BLIND  
RESOLUTION 71-07**

WHEREAS, Congressman Rarick of Louisiana has introduced in the House of Representatives of the 92nd Congress H.R. 9102, a bill to provide for paper money of the United States to carry a designation in Braille indicating the denomination; and

WHEREAS, the requirements of this legislative proposal would only serve to strengthen and more firmly entrench the too generally accepted stereotype of the blind person as dependent for participatory functioning upon special gimmicks and inconveniencing adjustments to the sighted; and

WHEREAS, it is the fear and concern of the National Federation of the Blind that ways soon would be found and devised to corrupt and alter Braille designations of paper money values by which blind persons would be defrauded and cheated; and

WHEREAS, the overwhelming and always present problem of blind persons is not the ability to differentiate the various dollar values of paper money but the great and constant problem of blind persons is to obtain employments commensurate with their talents, training, and abilities which will enable them to earn dollars as competing and functioning members of the labor force; now, therefore, be it

RESOLVED by the National Federation of the Blind in Convention assembled this 6th day of July, 1971, in the city of Houston, Texas, that this organization directs its officers to take all actions necessary, including the presentation of testimony in congressional hearings and otherwise, to defeat H.R. 9102.

Adopted unanimously.