WORK IN PROGRESS

Initially, this was just a small work examining just a single component of the Bush Memos. Because of recent interest in the work, however, I have been asked to push the project thorough to completion – seeing if this information might be useful for tracking down the origin of the Bush memos. That said, this report will continuously develop until the project is completed. The next step will be a statistical evaluation of commonly and uncommonly used characters.

David Hailey

REPORT
Toward Identifying the Font Families in the Bush Memos

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ABSTRACT

The following evidence from a forensic examination of the Bush memos indicates that they were typed on a typewriter:

1. The specific font used is from a typewriter family in common use since (circa) 1905.
2. The characters “e,” “t,” “s,” and “a” show indications of physical damage and/or wear.
3. The characters that are seldom used (e.g., numbers) show few indicators of damage or wear.
4. The consistent quality of individual character types throughout the memos seem to be inconsistent with a theory their defects are caused by random artifacts from copying, but may be consistent with worn platen and variations in paper quality.
5. Overlapping characters occasionally indicate paper deformation consistent with hammered impressions.
6. Critical indicators of digital production are missing.

Implications are that there is nothing in this evidence that would indicate the memos are inauthentic. Furthermore, from the point of view of the physical evidence in the documents (excluding any rhetorical evidence or external evidence, which is not examined in this study) I believe that no amount of additional research on the part of CBS would have lead them to exclude the documents from their *60 Minutes* report.

Finally, it was never the intent of this study to identify the font used to produce the memos. Rather, the effort is to *draw* the font and identify characteristics in it that might someday lead to an exact source.

Table of Contents

1. Abstract
3. Executive Summary
4. Definition of Terms
5. Overview of Findings
6. Identifying the Font Family
11. Problems with Current Assumptions
14. Physical Evidence
16. Are the Memos Typed?
17. Test 1: Searching for Human Error
17. Test 2: Searching for Defective Type
21. Test 3. Indicators of Inconsistent Printing
22. Conclusions

EXECUTIVE SUMMARY

There are a number of reasons for identifying the physical source for the recently released memos indicating that President George Bush failed to meet his obligation to the Air National Guard and disobeyed orders to take a flight physical.

A careful examination of even the worst copies may provide some evidence of the documents' authenticity or help disprove their authenticity. For example, if the evidence demonstrates that the documents were originally digitally produced, it would disprove their authenticity. Or if the font were discovered to be a daisy wheel font, the documents' provenance would be ruined.

On the other hand, if evidence indicates they were typewritten, it lends support to the credibility of CBS in general and to Dan Rather and his producers in particular. If evidence demonstrates that the memos were typewritten using a font usually available in the military, but less common among civilians, at least on this evidence they were right to air the memos.

Given the current extent of political animosity, the voice of defendable evidence can be useful. In short, there is justification for an independent lab to examine the documents and make the results publicly available.

Qualifications of the Lab

Interactive Media Research Laboratory is a small university lab that does scholarly studies and writes about issues involving the impact of technology on communications. Among other things, it investigates archival and authentication problems. As the principal investigator and lab director I have researched and written on these topics since 1991, with more than 50 publications. Largely, my research has been involved in problems we face in the future, but my understanding of the subject is good and my experience supports the contention I am qualified to offer an informed (if not expert) opinion.

I served in the U.S. military (Army) from November1963 to Christmas 1970. For five of those seven years I was an Army illustrator responsible for short run publications including memos such as those in question. Ultimately, I have a total of almost 35 years experience in document design and production, including designing, analyzing and spec'ing type. I have an archive that includes military documents produced between 1963 and 1984 and have access to a repository of military documents here at the university. Finally, I am experienced using computers to manage and manipulate images, including type, and my equipment is more than up to the task.

Nature of the Studies

This is a visual study, a search for visual clues. I would be uncomfortable attempting to run some mathematical analysis of spacing or kerning or leading. The heart of this study is to find undamaged characters that permit me to recreate an alphabet that is a close match. Having said that, I must confess that I believe this is a study any competent visual designer could have performed in the 1980s. Graybeards among visual designers will remember those people who came in with the badly photocopied brochure having no idea

where it came from, saying, “I want one that looks exactly like this.” Looking at an unknown font and identifying it was a part of the visual designer’s stock and trade. Graphic designers of the time would have a stack of font books such as my own four-inch-thick copies of “*Alphagraphic Typemaster’s Book of Faces--Serif*,” and “*Alphagraphic Typemaster’s Book of Faces—Sans Serif,*” and they would have used them often. It is in that tradition that I approached this project. In this study I have tried to do the following:

1. Identify the defining characteristics in the font used in the memos, especially focusing on the nature of the serifs but also examining the characteristics of the strokes that would be used to produce the characters. Are the serifs square or spur-like? Do the strokes vary in width or are they of consistent thickness? If some strokes vary, which ones?

2. Identify typefaces that replicated the above characteristics.

3. Identify a manufacturer who may have produced a typeface that fit the memos.

4. Identify any characteristics that would indicate a typewriter and not digital printing (e.g., worn or damaged characters).

5. Search for any typing artifacts (e.g., strikeovers).

6. Based on the above, establish a hypothesis describing how the documents may have been created and recreate scenarios that successfully reproduced the effects found in the typed memos.

7. Propose an approach for testing the theories I establish.

DEFINITIONS FOR TERMS USED

I use certain terms with unique meanings that I may not make clear in this report. The following is a brief definition of these terms.

Cross stroke	The line across a vertical character (e.g., t).
Crossbar	The line connecting two vertical lines (e.g., H).
Ear	The upper right tab common on the lc, “g.”
Font	A typeface in a specific size and style (e.g., Stymie 10pt. Bf).
Font Family	A collection of fonts that share identifiable characteristics.
Serif	The short stroke at the top and bottom of characters.
Shoulder	The upper left or right quadrant of a rounded character.
Slab	A broad, flat serif typical of Typewriter typefaces.
Spur	A specialized serif that evolves from the character to a point.
Stem	Stroke in vertical characters (e.g., F, B, and l).
Stroke	Used to describe nature of lines in characters. (e.g., thin stroke).
Typeface	The generic name of a family of fonts. (e.g., Stymie).
Typestyle	I use “typestyle” and “typeface” interchangeably.

Typewriter A specific typeface developed circa 1905 by Remington.
typewriter A generalized term for fonts designed for typewriters.

OVERVIEW OF FINDINGS -- NATURE OF THE DOCUMENT

The information available in such poor reproductions is surprisingly significant. First, I believe the claim that the Bush memos were done in Times New Roman or related typeface is not defensible. I also believe the claim that the memos were done with current word processing software is not supported by my data. I believe the documents are printed using an impact printer (typewriter or daisy wheel) and are not digitally produced for the following four reasons:

1. The font is a common typewriter typeface invented at the beginning of the 20th century and in continuous use until the computer replaced the typewriter. The font's name is "Typewriter." Although the typeface was somewhat modified for civilian communities in the 1960s, it remained commonplace in the military well into the 1970s. In short, the Bush memos were produced in a version of Typewriter commonly used in the military at the time.

2. It may be possible to find worn and damaged characters. The top left of the "t" appears to be worn to the extent that it seldom makes an impression. The "e" shows indicators consistent with physical damage. The "a" and the "s" show similar indicators of wear and/or damage.

3. Seldom used characters such as numbers, capitals, and the lower case "o," "q" and "p" (and the other less used lower case characters) show no signs of damage.

4. Flaws in the characters are not random as one would expect from artifacts from copying but are sufficiently inconsistent to imply inconsistent (mechanical) printing.

5. There are indications of white "blisters" perhaps cause by a character typed on paper that was deformed by the impact of the previously struck character.

I will leave it to others to verify or refute my findings with additional physical evidence, but I contend that the memos were probably done in a proprietary IBM typewriter font redesigned specifically for proportional typing. In 1984, I wrote articles on an IBM Selectric that uses an uncondensed IBM equivalent. I believe the font used in the memos to be a variant of the font used in Figure 1, below.

gravel of volcanic origin, washed out of the primal Davis Mountains further west. The aggregate is very hard, but porous, and has high internal moisture. In fact, the moisture level of the rhyolite was the controlling factor of production. District specifications required that the mix discharge temperature be at a minimum of 300° F. According to the local Texas Highway officials, anything less than 300° will allow too much moisture retention and stripping problems.

Figure 1. Example a selection typed with an IBM Selectric typewriter.

Differences between the above font and that used in the Bush memos are consistent with making the above font compatible with a proportional typewriter. The "g" on the Bush memo was narrowed with a tiny ear, the stroke at the bottom of the "t" is shortened, the numbers "6," "7" and "9" are simplified and the “”W” and “R” are slightly modified. With a few exceptions the lower case characters are condensed while the caps are left uncondensed. Oddly, the “s” is doubly condensed while the “m” is extended. These characteristics should make the specific machine or type ball easy to identify. It is possible that the “m” and “s” add to the credibility of my thesis. I suspect that their unique designs result from the need to make them fit into a limited number of possible space sizes. Spacing issues, however, are outside the parameters of my experience.

An overview of my research follows in three sections: (1) IDENTIFYING THE FONT FAMILY, (2) PROBLEMS WITH CURRENT ASSUMPTIONS, (3) PHYSICAL EVIDENCE.

IDENTIFYING THE FONT FAMILY

The process I followed was to extract representative samples of each character from the memos and sort them from best to worst.

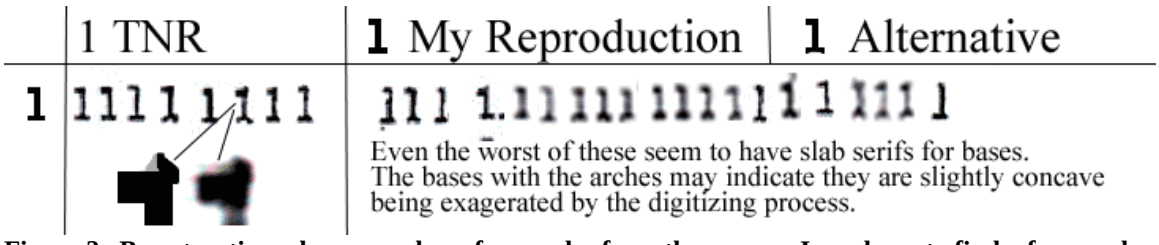


Figure 2. By extracting a large number of examples from the memos, I can hope to find a few good enough to act as templates. Although some seem to have some slope on the top serif from top right down slightly to bottom left, I believe that slope to be an artifact of the process. Still, if it is not an artifact, the font family this belongs to remains unchanged.

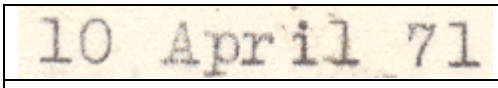
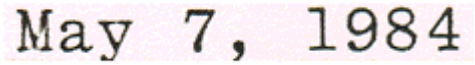
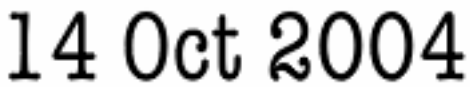
Although this is a single character, it becomes an important part of identifying the font family as "Typewriter." Other characters treated in the same manner verify my conclusion.

The "1" depicted above is found in a font family called "Slab Serif." The Slab Serif family can be further subdivided into "Clarendon," "Typewriter," and "Slab Serif."

> **Definition:** A Slab Serif is a type of serif font that evolved from the Modern style. **The serifs are square and larger, bolder than serifs of previous typestyles**. Considered a sub-classification of Modern, Slab Serif is further divided into Clarendon, **Typewriter**, and Slab Serif (a separate sub-category of Slab Serif) styles. (emph. mine)
>
> (http://desktoppub.about.com/library/glossary/bldef-slabserif.htm)

A quick examination of a variety of fonts produced in Typewriter between 1923 and the current date confirms that the above "1" fits into this family.

Table A. Examples of the character "1" being used between 1923 and the present day.

	Underwood, manual typewriter -1923s (civilian).
	Bush pay statement form (military).
	From Bush memo (military).
	From Bush memo (military).
	From article written with a civilian typewriter (civilian).
	From contemporary ITC American Typewriter condensed.

On the other hand, the above "1" is unusual in common, modern word processing typefaces, if it exists there at all. In addition to the obvious top serif on the number "1" is a characteristic of the bottom slab. It is always broad and flat, although the bottom of the serif often has an almost imperceptive concave shape. On occasion, the concave shape peaks in a dimple at the bottom of the stem. In the Typewriter typeface, this slab universally ends the down stroke of all vertical characters and usually ends the down strokes of the capital "A.

Table B. Depicting the most common typefaces available in Word, including times new roman.

111	Times New Roman
111	Book Antiqua
111	Bookman Oldstyle
111	Palatino
111	Modern # 20
111	Century
111	Century Schoolbook
III	Centaur
111	Garamond
111	Georgia

I replicated the "1" in figure 2 by drawing it. Once we have established the font family, however, it becomes possible to search for a font that is a close match. One font that I was able to locate is found in a series of articles I wrote in the 1980s. I wrote the articles on an IBM Selectric. The typewriter was of the mono-spacing variety, and the characters were designed for that use. But if I compress the original characters as someone would to make them compatible with a proportional machine, I find a match that is very good with only two exceptions, which I will discuss later. Using this font, I am now able to replicate most of the characters of the memo.

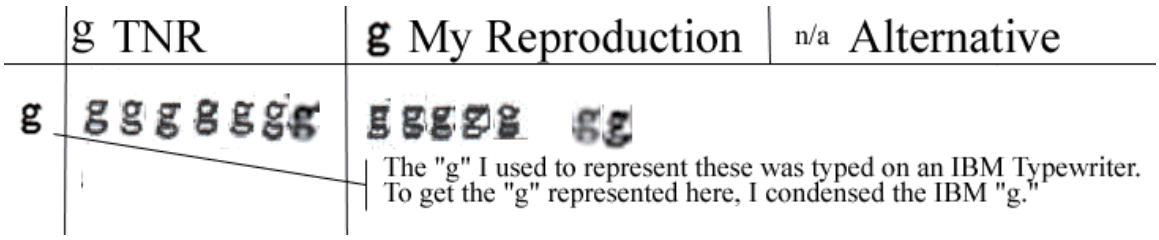


Figure 3. Note that the Times New Roman "g" has a tiny spur for an ear. I contend that although the ear is small in this font, it is still much thicker than the Times New Roman. Moreover, the inconsistency of stroke found in TNR is not found in these characters. The "g" I used is a Typewriter font that was actually taken from an IBM typewriter.

By doing the same thing to all of the characters, I am able to create an alphabet that compares reasonably (though not perfectly) with characters taken from the bush memos. Not all of the characters match. For example, the "W" in my IBM sample is the new version missing the central serifs. During this process, I am also able to isolate a number of defining characteristics that work somewhat like a fingerprint for identifying the specific font once we see it.

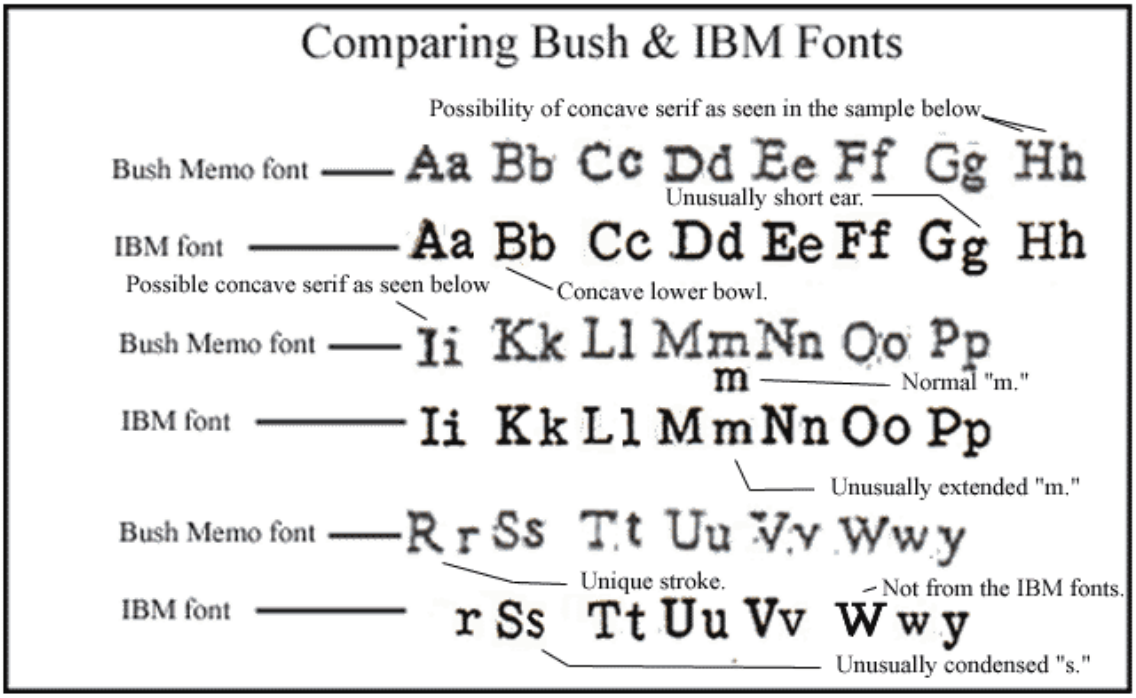


Figure 4. This is a comparison of direct matches that existed in both the Bush memo and comparable documents in our archive. Capitals are not compressed. Lower case characters are compressed, except the "m," which is extended. The lower case "s" is doubly compressed.

If I can replicate the original memos, I can replicate specific words containing the above characteristics. If I am correct, someone examining documents from the 111th need only construct a few words containing specific characters to speed exploration of a large collection of documents from the 111th. "Flight," for example, should be a word that

consistently appears in 111th documents and contains the unique characteristics of both the “g” and the “t.” A searcher looking at 111th documents could quickly compare the sample words and know instantly if he or she is looking at the same font. A person doing this could very quickly support or undermine the contention that the documents are authentic.

Variations in “Typewriter” Typeface

Different typewriter manufacturers created their own variations of Typewriter. A variety of them are currently available. Digital versions include "ITC American Typewriter," and two typefaces named "Secret Service Typewriter," and “Passport.” All of these and most other digital typefaces were taken directly from impressions of old typewriters. The image below is from a 1923 example of Typewriter (Figure 5).

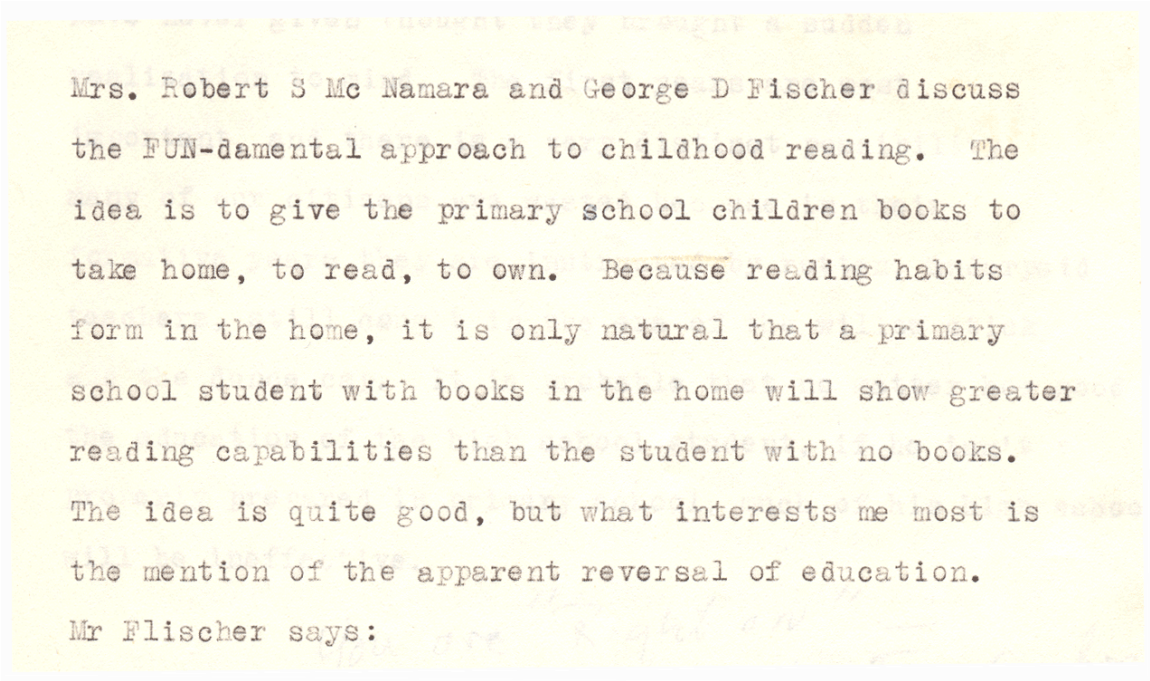

Mrs. Robert S Mc Namara and George D Fischer discuss
the FUN-damental approach to childhood reading. The
idea is to give the primary school children books to
take home, to read, to own. Because reading habits
form in the home, it is only natural that a primary
school student with books in the home will show greater
reading capabilities than the student with no books.
The idea is quite good, but what interests me most is
the mention of the apparent reversal of education.
Mr Flischer says:

Figure 5. Paragraph typed on 1923 Underwood, demonstrating existence of Typewriter typeface dating back at least that far. Typeface was invented circa 1905 by Remington and adopted and adapted by all other American manufacturers.

Identification of the Font Family in the Bush Memos

The font used in the Bush memos seems to be characterized by slightly convex base slabs. Ironically, the font used in the Bush memos was originally and decidedly not designed for proportional spacing. Proportional spacing permits a “one” to exist in space designed for a number (permitting accounting columns) and an “M” to exist in a much larger space. Without broad serifs, a “one,” which has to fit in a space big enough for an “M” in a monospaced environment becomes more isolated in a large white space. The broad serifs on the vertical characters keep a row of “ones” from looking like a row of

trees in an otherwise empty field. That said, possibly the most identifying characteristic of the Typewriter family is the broad base with occasional slightly curved bottom serifs and the flag flying at full mast on top of the "1" (as seen above).

Interesting Transitional Typeface

Perhaps the thing most interesting about these memos is that the typeface seems to mark a transition in type design between monospacing and proportional spacing. The characters have all of the characteristics of a monospaced type, but they are proportionally spaced. The result is characters with serifs that overlap as often as not.

Conclusions About CBS Role

There is no good way for proving the documents in question are authentic. If I were in the Texas Air National Guard, and I said, "I saw the documents in Col. Killian's cabinet," who would believe me? The answer to that question depends entirely on the political point of view of my audience. It is possible however to infer from physical evidence that CBS (and Mr. Rather and his producers) justifiably believed the documents to be authentic. Given enough time and concentration, I believe any competent "expert" would have concluded that they are typed in a font commonly used in the military at the time. There is currently outside evidence indicating that the documents are inauthentic, but none of it exists in the mechanics of documents themselves. They are completely in keeping with typewritten documents of the period in question – early 1970s. Whatever the outcome of this kafuffle, I am convinced that in the end, it will be generally recognized that the documents CBS released to the public were typed.

If one considers that the thing that makes the news "news" is its immediacy, it is hard to impugn CBS for using the memos in a news story. It took IMRL three weeks of careful examination to conclude that the documents are typed and complete this report – implying that after all of this careful study, the result would have been to say ". . .all of our evidence suggests they are authentic." Of course all of the evidence is not in yet. New evidence has come to light that suggests they are inauthentic. That does not change the fact that at the time of the broadcast, all evidence CBS possessed appears to have indicated the documents were authentic.

PROBLEMS WITH CURRENT ASSUMPTIONS

Critics speculate that the documents are inauthentic for a number of reasons. They suggest that proportional typing as inconsistent with typewriters of the time. They suggest that certain characters such as the number "4" (missing a bottom serif) are not used on typewriters. They argue that there is a problem with the superscript "th." They largely claim that the font used in the memos is Times New Roman, and they have done projects using proportion and space to argue that the font used in the memo has to have come from a word processor.

At one level, there is some reason to understand the confusion of an uninformed examiner. Although this will appear as Times New Roman in a PDF, on my monitor, I am typing in 12pt Times New Roman, and I am looking at a font named "Typewriter." A friend from PC Magazine has said, ". . . that's TrueType hinting at work, and Microsoft (through Monotype) put a tremendous amount of effort into making Times New Roman perform that kind of trick." In short, if a casual observer were to hold a Bush memo up to their monitor, there is a good chance they would see a relatively close match, but they are matching Typewriter to Typewriter, not TNR to TNR.

A typewritten four with no serif on its bottom is unusual but not unheard of. In the sample below, the font is from the Typewriter family and was done on a typewriter (note the whiteout on "Mr.").

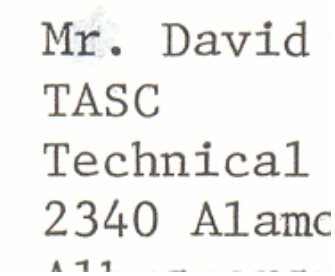
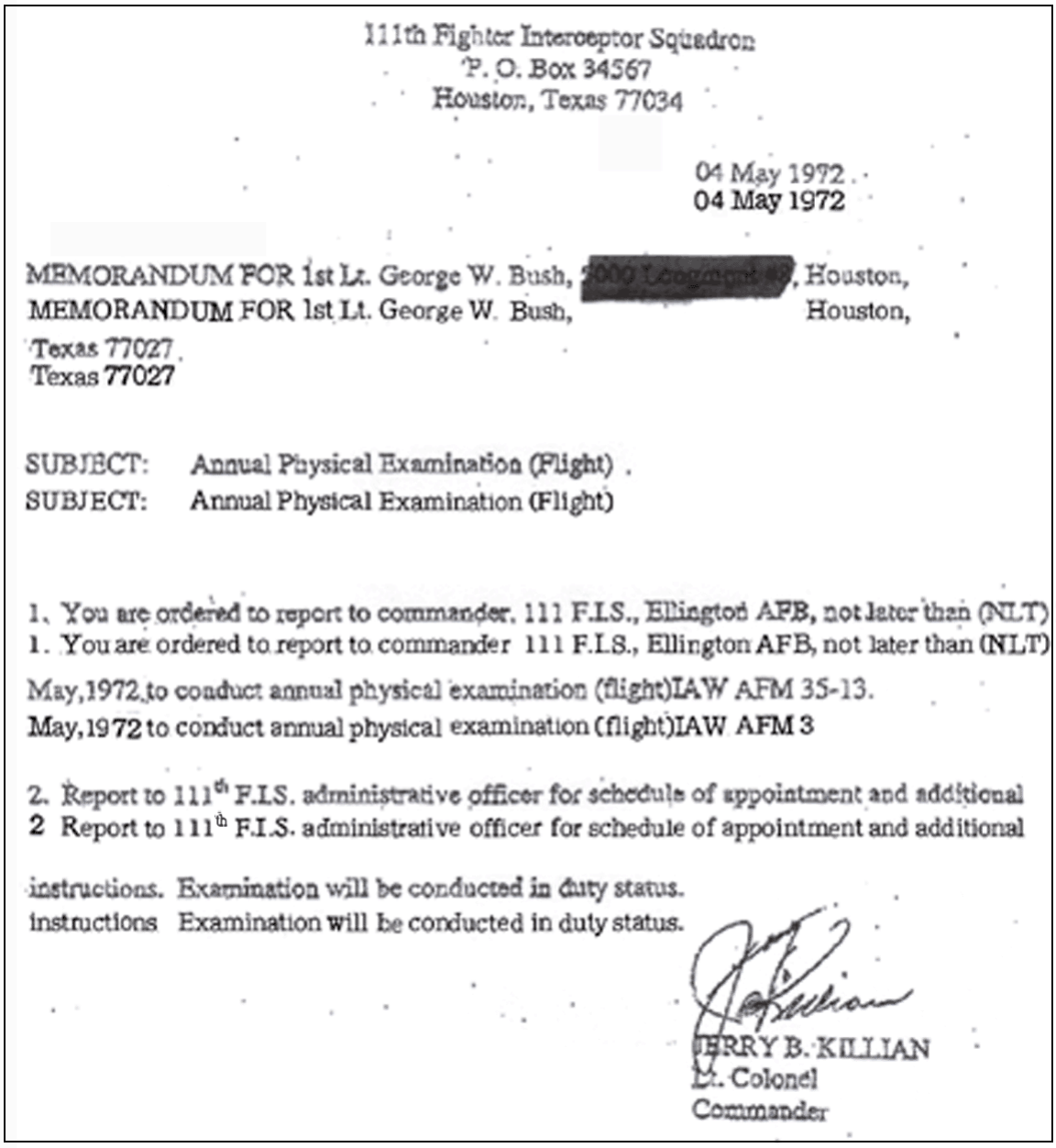


Figure 6. The four in the above example is both open and lacks bottom serif. Except for the one, numbers tend not to be good indicators of font families. On the other hand, because they will frequently be unique within any given font, they are useful for fingerprinting a specific font.

The ability of the military to produce the proportional text with a superscript "th" with a typewriter is beyond question. If I remember correctly, IBM is on record as saying they have made machines capable of that since 1944.

Finally, it is critical to demonstrate you have identified the font family before doing anything else. I have examined the work of a few others who have discussed this problem. I suggest that it is inappropriate to begin by assuming that the documents are done in Times New Roman, making no effort to check original assumptions. In one case, the author assumes that the document was done in Times New Roman and continues by assuming that he can recreate the proportions of the memos. I contend that these memos are copied at least once. Copiers work by dragging a light across a glass plate under the document. The image of the document is reflected off a mirror that progresses with the light. The image is transmitted through a lens onto a rotating drum below. These are all mechanical processes that change the proportions of the copy. It might be shorter, or longer or narrower, or wider. Even the relationships between characters change. Because the light passes through a relatively cheap lens, the characters can drift out of proportion across the page. Moreover, if readers examine my collection of "g's" earlier in this report, they will discover that some of them are 30% larger than others. If the characters can be different sizes, it follows that the spaces between them are also different sizes. If we do not know anything else, we know that if you placed these photocopied memos on top of the originals the texts will not line up.

For a person to begin by assuming that he is dealing with Times New Roman and then continue with the assumption that he can successfully divine the proportions is not unlike presenting the argument that the earth is the center of the universe, beginning the with the untested argument that the earth is flat and that the author can divine its dimensions from the Bible. If, in fact, the author's initial premise is not valid, all conclusions are suspect.



111th Fighter Interceptor Squadron
P. O. Box 34567
Houston, Texas 77034

04 May 1972 .
04 May 1972

MEMORANDUM FOR 1st Lt. George W. Bush, [redacted], Houston,
MEMORANDUM FOR 1st Lt. George W. Bush, Houston,

Texas 77027
Texas 77027

SUBJECT: Annual Physical Examination (Flight) .
SUBJECT: Annual Physical Examination (Flight)

1. You are ordered to report to commander, 111 F.I.S., Ellington AFB, not later than (NLT)
1. You are ordered to report to commander 111 F.I.S., Ellington AFB, not later than (NLT)

May, 1972 to conduct annual physical examination (flight) IAW AFM 35-13.
May, 1972 to conduct annual physical examination (flight) IAW AFM 3

2. Report to 111th F.I.S. administrative officer for schedule of appointment and additional
2 Report to 111th F.I.S. administrative officer for schedule of appointment and additional

instructions. Examination will be conducted in duty status.
instructions Examination will be conducted in duty status.

JERRY B. KILLIAN
Lt. Colonel
Commander

Figure 7. The above is an example of a bush memo and my replica based on using Typewriter condensed as my font of choice. Note that the match is very close. The quality of the superscript "th's" and some of the numbers preclude me from making realistic replicas of them.

I believe that the critical arguments of the above document experts are based in misinformation. The only answerable questions are "is this Times New Roman or

similarly contemporary, digital font," and (perhaps), "is the typing mechanical or digital?" Working on the hypothesis that this is Typewriter, and was typed on a machine, I am able to make an excellent production a Bush memo (Figure 4) using the IBM characters in figure 4.

THE PHYSICAL EVIDENCE

Apart from the "1," the alphanumeric characters within a typeface will all have distinguishing characteristics to varying degrees. There will be characteristics that reflect the font's family, and there will be other characteristics that reflect the personality of the design team. After examining the Bush memos and searching through my archives of old typed documents, I found a close match on documents I typed on an IBM Selectric in 1984 using a font, naturally, designed by IBM. My recollection is shaky, but I believe the font was called "American Typewriter."

The Typewriter variants share many characteristic with IBM' font. I have listed a collection of "Typewriter" faces for comparison. While there are commonalities there are also differences that can be used to identify specific fonts.

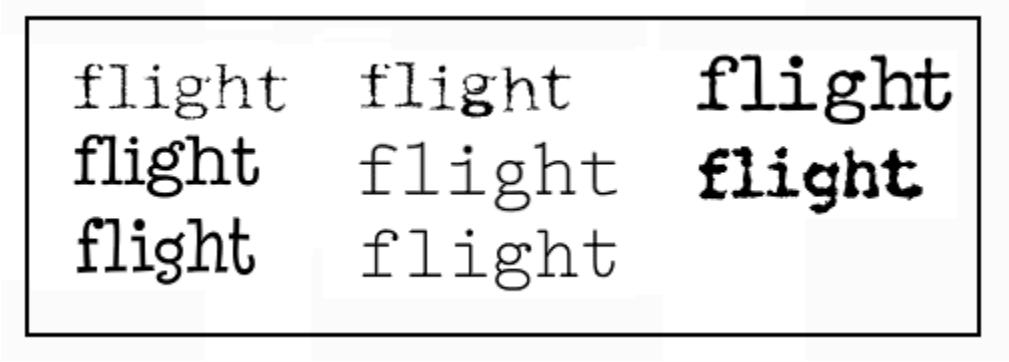


Figure 8. The above provides examples of variations in Typewriter, digitized. In some cases, the examples are taken directly from antique typewriters and digitized for use on computers. The Bush memos are done in a species from this genus.

There are a few things worth noting. The ears on the "g's" frequently vary from face to face. On the other hand, the cross strokes on the "t's" change little. Typically, the right line of the cross stroke will be somewhat longer than the other side. The serifs on the bottoms of the "f," "l," and "i" make large and stable foundations, and the top serifs on the "l's" are universal. In short, given the small modifications various manufactures will generate, the characteristics of the Typewriter font family are universal and easily identified.

The unique characteristics of the Typewriter family of fonts are found in the text in the Bush memos. I am confident that the font used to produce the Bush memos is not Times New Roman; nor is it a comparable, contemporary typeface.

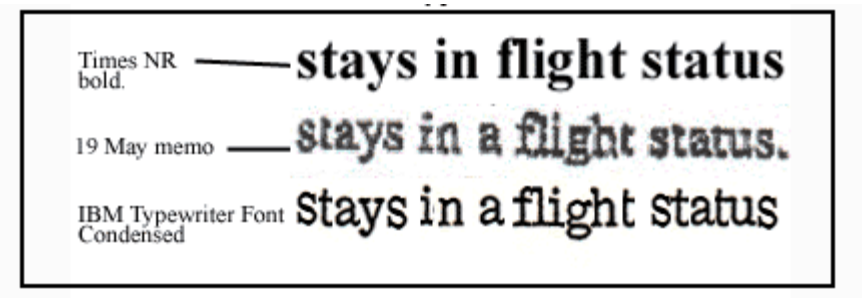


Figure 9: Comparing Times New Roman, the Bush memo and the IBM font condensed. Note the slightly curved serifs in the "f," "l," and "i." These curves are often found in the IBM Typewriter font. One can see the same convex bases in both the Bush memos and the IBM font. Their occasional exaggeration is a predictable artifact of digitizing at relatively low resolution.

In the above example, all of the characters seem to be consistent with a condensed version of the IBM font.

1) The strokes in the text have a consistent width in both the Bush memo and IBM font. (Times characters have inconsistent width.)
2) The serifs are heavy and have consistent weight. (The Times serifs are short spurs.)
4) Cross strokes on the "t"s are heavy in both the memo and IBM font. (Times New Roman cross strokes are fine.)
5) The bowls of the Bush and IBM "a"s are of consistent width.
6) The "e"s are similarly closed in American Typewriter and the memo, and their crossbars are more dense.
7) The bottom serif in the "i" in the Bush memo is completely compatible with the IBM font. It is slab-like, and contains a comparable curve.

The vertical characters I mentioned earlier provide additional evidence.

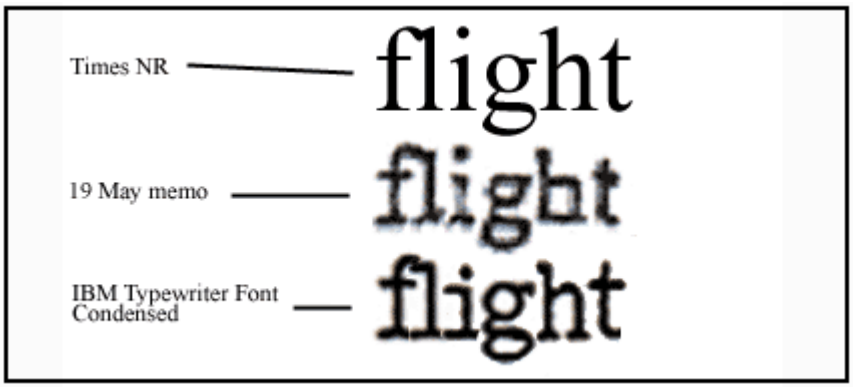


Figure 10. Comparison of the characters used in the word “flight” in the Bush memos. Times New Roman is characterized by strokes of varying widths, with vertical strokes being thick and horizontal strokes being thin. It is also characterized by pointed spurs for serifs. The difference is particularly clear in the shape of the “h” and “g.” Typewriter is characterized by strokes of consistent thickness and slab-shaped serifs.

In no sense are the defining characteristics of the characters in "flight" in the Bush memo like the defining characteristics of the characters in the Times New Roman sample. On the other hand, every defining feature of the Bush memo is comparable to the critical features of a Typewriter bold condensed font.

1) The "f" from the memo stands on the slab typical of the IBM font.
2) The "g" lacks the variation of line found in Times NR, but contains the same consistency of stroke found in the American Typewriter sample. The bowl of the "g" is very similar and lacks the variation of width found in the Times New Roman example.

The majority of characters used in the Bush memo match with no manipulation beyond compression. The upper case R, however, needs a slight change to match.

ARE THE MEMOS TYPED?

That the memos are created in an old typewriter font in no way demonstrates that they were typed. Many of the examples of Typewriter I presented in Figure 5 are from digital typefaces downloadable from the Internet. Theoretically, a fraud could be perpetrated by downloading an old-looking font or developing one from scratch and using it.

I have received criticism for this section from some who say “it looks like he is looking at clouds and seeing faces.” In a sense, this is the perfect analogy for what I am doing. That I am looking at clouds, however, does not mean that I am delusional. Tremendous information may be inferred from clouds. There is a mountain across the valley from my house. During the summer, the mountain generates thunder storms. I can infer that the mountain is interacting with the weather because the storms always begin exactly the same place on top of the mountain. The pattern is clear. I can also predict with absolute certainty how close the storm will pass as it goes by – about three miles. Patterns, even subtle patterns, may be used to create an image in the mind’s eye, permitting a researcher to visualize forces that caused the pattern. Our sun wobbles slightly and an astronomer surmises that there must be one more planet. Green mold in a petre dish is surrounded by interesting circles and a researcher surmises that the mold must be killing bacteria. It is the ability to create the metaphor of originality that makes it possible to look at a thing and learn from it. At this point, I am speculating based on past experience and perhaps a little creativity. It is the ability to see origins as metaphors that permits the creative mind to make meaning from patterns.

Looking for Human Caused Artifacts

In figure 6 there is an excellent example of a human caused artifact – whiteout. In figure 1, the word “is” is struck through by pencil. Typists make mistakes and occasionally correct them with simple strikeovers. In addition to strikeovers and erasures, typists often ratcheted the platen up to read what they had so far written. They did not always ratchet it back down into exactly the right place. Also, typists would occasionally remove their manuscripts from the machine and later replace them -- angle and horizontal alignment can be compromised.

Because type is used and abused, it becomes damaged and worn. A well used typewriter should have indications of one, the other, or both. If I am able to find and replicate the effect of damaged type, it should provide evidence that this document was typed.

Because platens and paper are inconsistent, the results of damage or wear could be to be inconsistent beyond the expectations we would impute to photocopying and digitizing. In other words, if the "t" or "e" is worn or damaged, we should see the damage remain constantly visible while constantly changing. If someone downloaded a digital typeface with built in flaws, the effects of the flaws should be consistent because digital printing is of such high quality and contrast. A manufactured flaw in a digital font should show up with little variation.

Because electric typewriters pound the paper and the platen, there is the possibility of seeing distortion caused by the pounding. For example, in a digitally printed document, all characters that overlap will simply merge. Those of us who remember typing, also remember that we frequently typed using two or three sheets to protect the platen. When we did this, our pages would have textured backs, sometimes with punctures, created from the impact of the character, which frequently drove its shape through one page and into the other. If an "f" overlaps an "l," and there are arcs of white between them, there is a possibility that the arcs are caused by one character striking a segment of page and distorting it, and the other character not hitting the page quite hard enough to overcome the distortion.

TEST 1. SEARCHING FOR HUMAN ERROR

To test for human error, I resized the documents to maximum sizes (see figures 11 and 12) and searched for symptoms of strikeovers or erasures. I found no indicators of human error in the document.

TEST 2. SEARCHING FOR DEFECTIVE TYPE

Given normal wear and tear, one might expect that the most often used characters might have defects that do not show up in the less used characters.

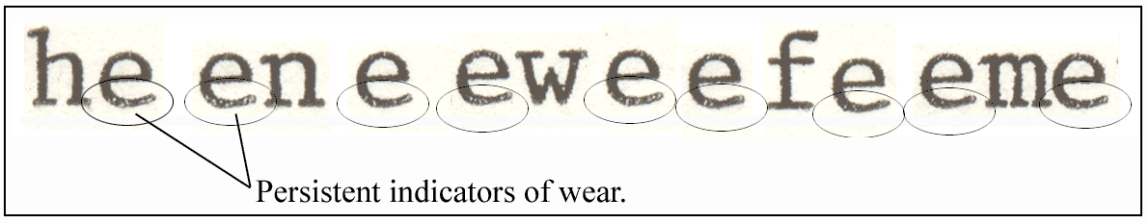


Figure 11. These characters are extracted from a high-resolution scan of a government letter typed with an IBM Selectric typewriter using a carbon ribbon. Note that all of the "e's" show indications of wear on the bottom stroke indicated by a weakness in the stroke and failure to achieve full density blackness. All "e's" in the memo show this same characteristic. Note that the other characters show no similar indicators of wear.

Figure 12. Damage can often become more apparent at high contrast. While the bottom of the characters show consistent damage, the left side of the bowl on the fourth "e" from the left shows damage caused by a defect in the ribbon or paper.

Even documents that have been altered by photocopying and digitizing can leave indicators of worn or damaged type. I examined type in the Bush memos for signs of damage and/or wear. I found a number of signs of well used and somewhat abused type. Most notably, the left segment of the cross stroke and top of the ascender on the "t" show signs of wear. As far as I can determine, in all cases one or both are missing, indicating wear or damage. Since other characters do not share this trait it difficult to come to a conclusion the effect is random.

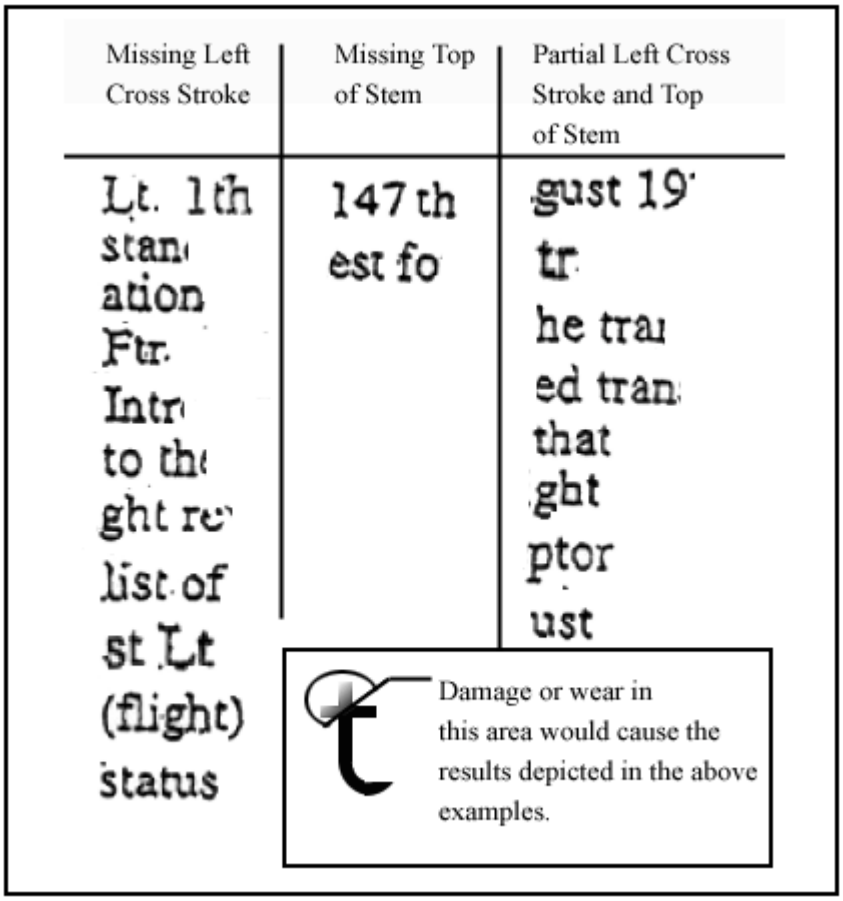


Figure 13. The above examples are consistent throughout all four memos. In all cases in these memos, the left half of the cross stroke and/or the ascender of the "t" is incomplete.

By comparing each apparently damaged character to its neighbors, I was able to determine that the “t’s” demonstrate the same pattern of damage or wear throughout all of the documents. Note that I capture the “t” with the characters next to it so it becomes possible to compare their quality. If the adjacent characters are relatively good shape, it follows that the “t” may have a problem. If the pattern continues as this does, it becomes difficult to come to any other conclusion than damaged or worn type.

By copying a “t” typed with an IBM typewriter and adding “wear” to the cross stroke and ascender consistent with my hypothesis in figures 13 and 14, I am able to replicate the problems seen in the “t’s” in the Bush memos (figure 15). The character appears to be worn in a pattern of fading toward the left and top of the cross stroke and ascender (Figure 14).

Figure 14. Letter “t” scanned in and artificially “worn” out; printed in high contrast; then rescanned in 72 pixel/inch resolution. Results are identical to comparable characters in the Bush memo.

If I remove the bottom of a random selection of t’s from the characters and compare the tops to a character I manufacture, I find a close match.

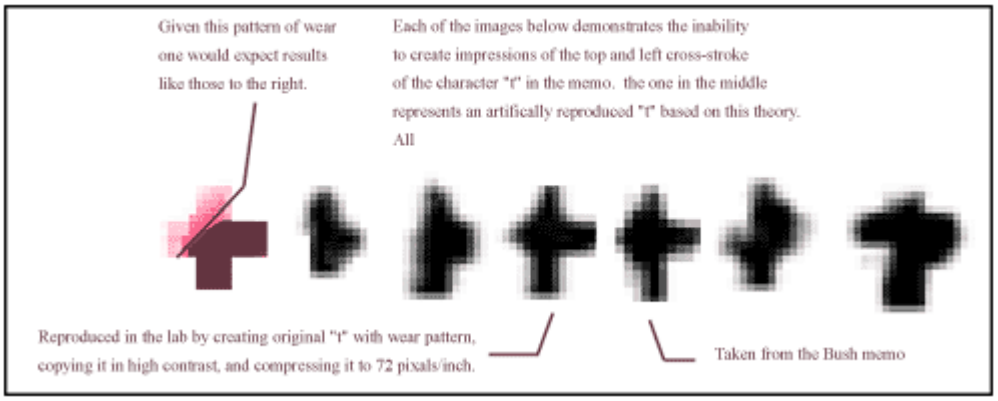


Figure 15. Five of the above characters are from the memos, representing the various configurations of "t." The one identified in the middle was produced by creating a defective "t," copying it at very high contrast, then scanning it at 72 pixels/inch.

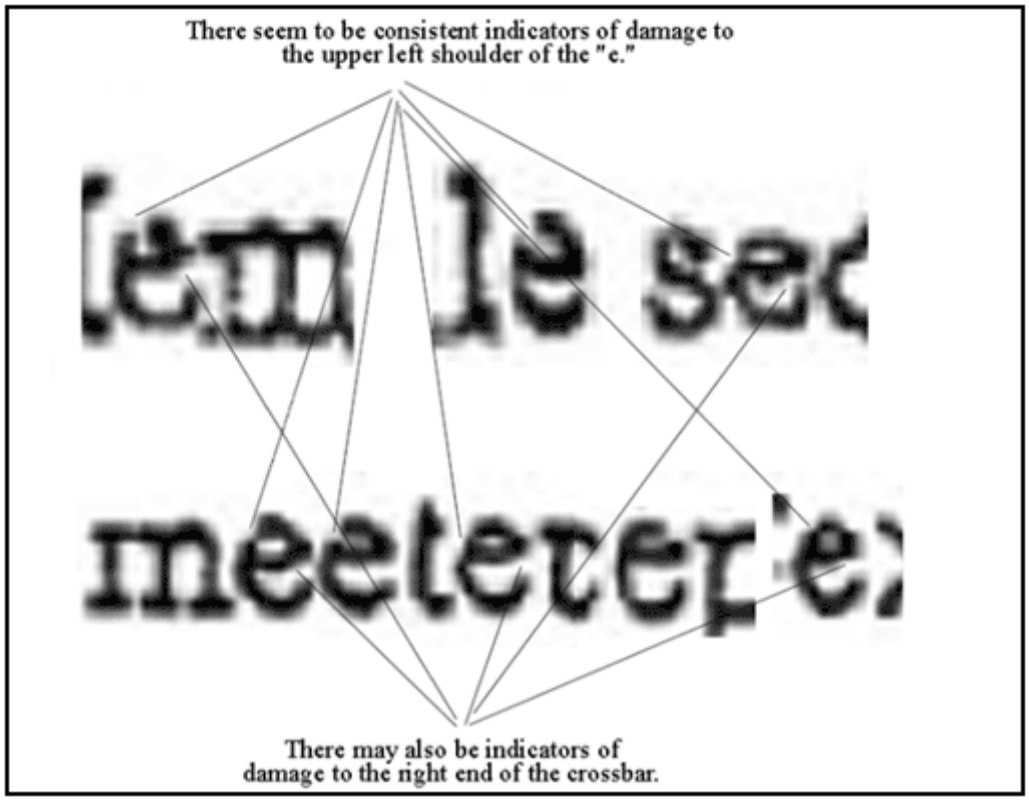


Figure 14. The upper left shoulder of the "e" shows signs of damage throughout the memos. (Image scanned at 4200 lines/inch)

Examining the e in the Bush Memos

Another character that shows extensive wear and/or damage is the "e." By blowing the text up to 500X, it becomes possible to see consistent indicators of damage. The damage appears to be deep scratches or wear that pass from the upper left shoulder through the bowl and out the other side in two places. A third scratch appears to pass below the bowl.

The “c” and the “o” (figure 14) are deformed, but their strokes remain relatively consistent. The left middle of the “o” does show some indications of weakness that reoccur as a pattern in the documents, but no indications of weakness comparable to the “e.” In my opinion, the pattern in the “e” is probably scratches or gouges.

Figure 15. Although there is some movement in the shoulders of round characters, there seems to be no cropping. The “c” and the “o” do not share the weakness in the upper left shoulder that the “e” displays.

An examination of all the characters seems indicate that the most used characters are also most likely to show indications of wear or damage.

TEST 3. INDICATORS OF INCONSISTENT PRINTING

If a document is typed, there may be variations in impact based on placement of the platen, quality of the platen, variations in paper quality across the page, etc. Worn type will be especially prone to being affected by patterns in the paper or platen. If the paper is harder or if the key strikes a raised section of the platen, the worn character will be less complete. If the key strikes in a depression or on softer paper, the character will be more complete. Digital printing may create variations in thickness of a character’s stroke based on absorbency, but unless the ink head has a problem, the complete character will always be printed. A digitally printed document, photocopied and scanned will look like the samples in figure 16.

Figure 16. If the word variation is produced so that the characters overlap by as little as a single pixel, there is no sense of one character creating anything resembling a crescent in the adjacent character. Instead, there is some tendency for space between them to fill in as between the "t" and the "i."

Digitally printed characters overprint each other without difficulty. Typed characters may show a different tendency which seems to become visible when characters barely overlap. There may be a few of these examples in the Bush memos. I suggest that these examples are caused when a key strikes paper and causes a deep impression – perhaps because the typist is using multiple sheets. The next key strikes and is unable to fill in all of the impression, causing a white crescent between the characters.

Figure 17. Demonstration of crescent effect possibly caused by first character modifying second character. Digital prints tend to do the opposite. If the characters are very close, the space between them tends to fill in. This is a consistent pattern with the t and the r.

One thing that may be important to notice is the "rm" combination in the above image. The "r" completely eliminates the upper-left serif on the "m." These are but six of many similar examples in this memo.

In short, characters seem to be interfering with each other in a manner in keeping with a mechanical, and not a digital, process.

CONCLUSIONS

Since current odds hold that the Bush memos are faked, the question of their authenticity turns to whether CBS should have known they were inauthentic. In fact, there seems to be nothing in the memos that indicates they are faked. All evidence points toward a mechanical production process and away from a digital process.

Furthermore, the mechanical process seems to be consistent with typewriters used in the military at the time in question.

If I had been one of the experts advising CBS, I would have advised them that there is nothing physical in the memos implying they are not authentic. All physical indicators imply they are authentic. I would have told them that from my point of view, the memos are worthy of presenting to the public.

FURTHER RESEARCH

I suggest several things for future research. The way to demonstrate or refute the viability of my theories is to test them using careful and fair metrics. It is possible to argue that the "e" might not be damaged, that the problems with the "t" are random artifacts from photocopying, but at this point such arguments are not productive. I believe that an examination of the first part of this report is simple. Do the characters in the font memos look more like my characters than Times New Roman?

The second part is more subtle. Permit me one last analogy. We are currently seeing signs that indicate planets are orbiting distant suns. The signs are subtle. They involve the fact that the distant suns wobble slightly and rhythmically, and they darken from time to time – also rhythmically. The astronomers are speculating that there must be planets orbiting those suns. There is currently no way to know. That does not make their speculation incorrect or improper. It simply means proof for their theories must wait for future tools.

That said, I believe there are some opportunities to test my theories. I believe that a group of graduate students doing a good Student's *t* test would quickly refute or support my argument. Such a test permits an examination of averages between two homogeneous groups consisting of as few as 10 or as many as 30 members. If such a test were done right and showed no statistical difference between the averages of two groups where I predict a difference (commonly used as opposed to seldom used characters), my theory about being able to see damage would be suspect. When I come back to this problem, if nobody else has, I will design and run such a test. Another productive approach is to examine more documents that came from the 111th during that period. If I am right, there will be documents that look exactly like the Bush memos with flaws I believe I have predicted; that would go some distance toward proving provenance. A third test would be to attempt to produce similar results using hardware and/or software. This is not a test I feel qualified to run. On the other hand, an examination of characteristics in typed documents I currently possess may be shown to exactly replicate characteristics in the Bush memo. Finding these characteristics would support my thesis.

Finally, I do not believe I need to find a typewriter or type ball as some have speculated. In this effort, my intention was to establish the font family used in the Bush Memos, perhaps identify the manufacturer of the font used in the Bush Memos, and answer the question "From the point of view of the physical evidence, was CBS remiss in airing the memos." I believe I have answered the first question. I have answered the second question with, "maybe." No doubt, everybody will have an opinion on this third question. In the end, my opinion is only an opinion. I leave the third question open. I have stated how I would have answered it, but in the end I leave it open because it is the American public answer that matters.