

**FINAL REPORT**  
**Toward Identifying the Font Families in the Bush Memos**  
**Completed 3 December 2005**

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I would like to express my appreciation to those who helped me complete this project, and to the Council for Programs in Technical and Scientific Communication (CPTSC) and the Association for Teachers of Technical Writing (ATTW) who supported my right to do this research.

I would especially like to express my appreciation to the administrators of Utah State University who protected my right in this effort when the research and I were attacked by bloggers who opposed it. From the President of USU to the Head of the English Department, they all closed ranks around me, protecting me from what could have been the end of my career. I will not soon forget that support.

**DISCLAIMER**

I had four reasons for attempting this project. First, I was curious. I couldn't help but wonder what information might actually be gleaned from the materials some document experts said were hopeless. Secondly, I was challenged. The enigma in these documents was too challenging to pass up. Third, I wanted to "flex the muscles" of my lab. Although it is small, it is powerful, and I have excellent tools at my disposal. Finally, I had some ideas about something I call "false color fingerprinting" that I wanted to test.

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## **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 defensible 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 November 1963 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.

The lab contains a variety of computers ranging from a simple, DOS-based machine for archiving DOS-based documents from 5-1/4" disks to a P-4 capable of capturing and managing images scanned at 9600dpi in high resolution (a page at that resolution would be larger than 80X100 feet).

## Nature of the Studies

This is a visual study, a search for microscopic, visual clues. I would be uncomfortable attempting to run some mathematical analysis of spacing or kerning or leading. The first part of this study is to find undamaged characters that permit me to recreate an alphabet that is a close match to the one used in the memos. 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.

|                     |  |
|---------------------|--|
| <b>Cross stroke</b> | The line across a vertical character (e.g., t).                  |
| <b>Crossbar</b>     | The line connecting two vertical lines (e.g., H).                |
| <b>Ear</b>          | The upper right tab common on the lc, “g.”                       |
| <b>Font</b>         | A typeface in a specific size and style (e.g., Stymie 10pt. Bf). |
| <b>Font Family</b>  | A collection of fonts that share identifiable characteristics.   |
| <b>Serif</b>        | The short stroke at the top and bottom of characters.            |
| <b>Shoulder</b>     | The upper left or right quadrant of a rounded character.         |

|                   |  |
|-------------------|--|
| <b>Slab</b>       | A broad, flat serif typical of Typewriter typefaces.                 |
| <b>Spur</b>       | A specialized serif that evolves from the character to a point.      |
| <b>Stem</b>       | Stroke in vertical characters (e.g., F, B, and I).                   |
| <b>Stroke</b>     | Used to describe nature of lines in characters. (e.g., thin stroke). |
| <b>Typeface</b>   | The generic name of a family of fonts. (e.g., Stymie).               |
| <b>Typestyle</b>  | I use “typestyle” and “typeface” interchangeably.                    |
| <b>Typewriter</b> | A specific typeface developed circa 1905 by Remington.               |
| <b>typewriter</b> | 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 fewer 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 have been able to find comparable examples in other documents, can recreate them using a typewriter, and believe I can effectively explain what causes them.

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 of 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" and "a" are doubly condensed while the "m" is extended to the width of a capital character. 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, and I believe that because the character sizes in these memos are grossly inconsistent, it is not possible to honestly examine spacing issues.

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.


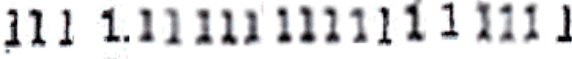
| 1 TNR   | 1 My Reproduction   | 1 Alternative |
|---|---|---------------|
|  |  <p>Even the worst of these seem to have slab serifs for bases. The bases with the arches may indicate they are slightly concave being exaggerated by the digitizing process.</p> |               |

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. These templates can then be used to recreate the characters. The "1" is especially important because it is unique to one typeface family – Slab Serif.

Although this is a single character, it becomes an important part of identifying the font family as “Slab Serif” in general and “Typewriter” in particular. Other characters treated in the same manner verify my conclusion.

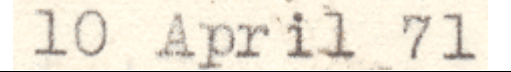
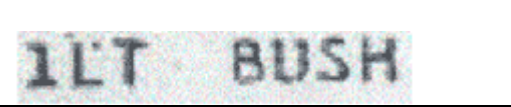

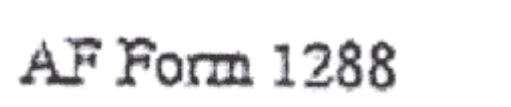
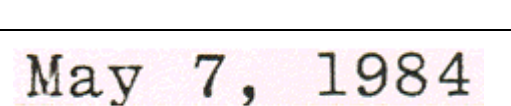
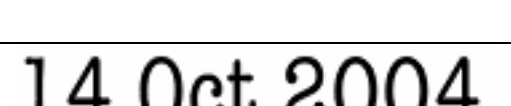
The “1” depicted above is found in a font family called “Slab Serif.” The Slab Serif family can be further subdivided into “Clarendon,” “Typewriter,” and “Slab Serif.”

**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 -1923 (civilian).                 |
|   | Bush pay statement form (military).                            |
|  | From Bush memo (military).                                     |
|  | From Bush memo (military).                                     |
|  | From article written with a civilian typewriter.               |
|  | From contemporary ITC American Typewriter condensed (digital). |

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 imperceptible 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       |
| 1 1 1 | Bookman Oldstyle   |
| 111   | Palatino           |
| 111   | Modern # 20        |
| 111   | Century            |
| 111   | Century Schoolbook |
| 111   | 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.

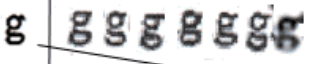

| g TNR   | g My Reproduction   | n/a Alternative |
|---|---|-----------------|
|  |  <p data-bbox="609 336 1372 399">The "g" I used to represent these was typed on an IBM Typewriter. To get the "g" represented here, I condensed the IBM "g."</p> |                 |

Figure 3. Example of a Typewriter font taken from an IBM typewriter used to replicate the “g’s” in the Bush memos.

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.

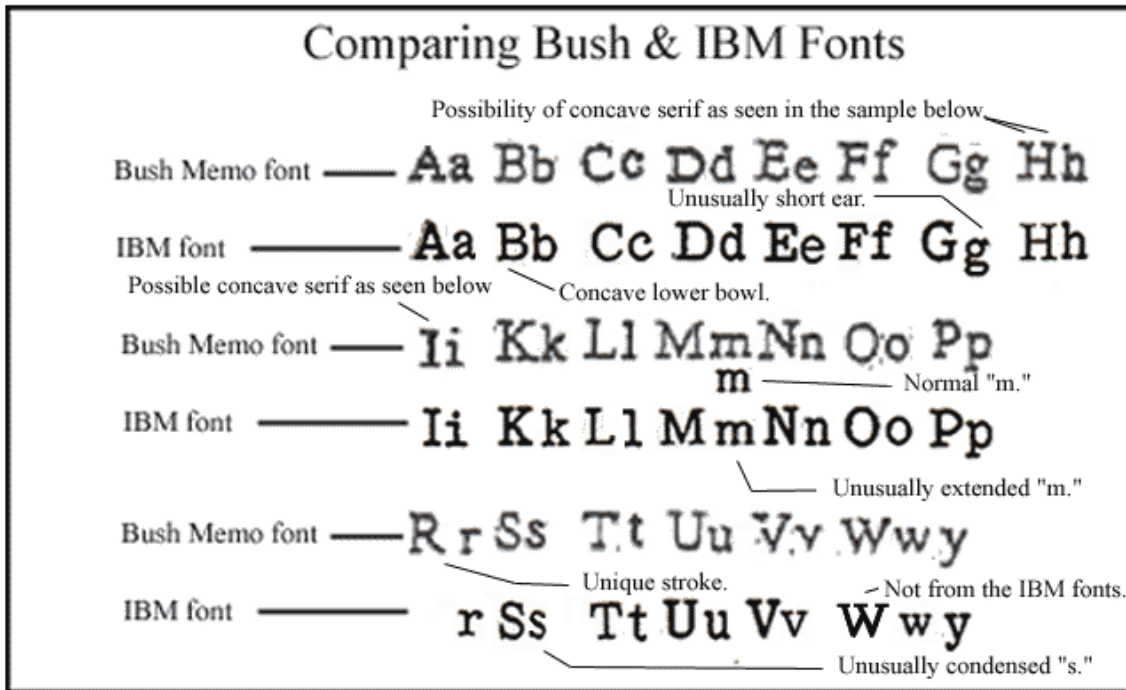


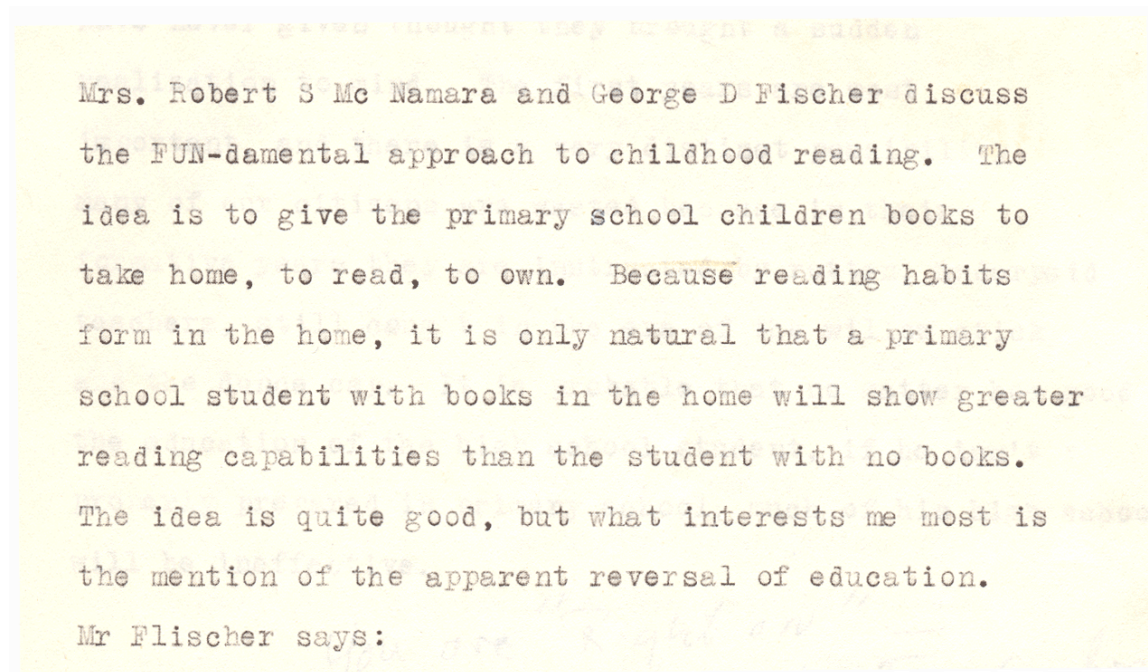
Figure 4. This is a comparison of direct matches that existed in both the Bush memo and comparable documents in our archive. Capitals are not compressed. Lower case characters are compressed, except the “m,” which is extended. The lower case “s” and “a” are doubly compressed.

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).



**Figure 5. Paragraph typed on 1923 Underwood, demonstrating existence of Typewriter typeface dating back at least that far. Typewriter 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 memos 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 kaffuffle, 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 five 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 of the memos speculate that the documents are inauthentic for a number of reasons. They suggest that certain characters such as the number “4” (missing a bottom serif) were not used on typewriters. They argue that there is a problem with the superscript “th.” They suggest that proportional typing as inconsistent with typewriters of the time and certainly not available to a National Guard Center. They further claim that the font used in the memos is Times New Roman (never used on typewriters), and they have done “studies” based on proportion and space to prove that the font used in the memo must have come from a word processor.

### **Their suggestions are all incorrect**

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.”).

Mr. David  
TASC  
Technical  
2340 Alamo  
A 11

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 typewriter is beyond question. Shortly after the Bush memos came available, the White House released the following memo done with a typewriter using proportional type and produced by the Texas Air National Guard, and IBM is on record as saying that the superscript “th” was an available option.

**I am pleased to forward for your personal files your appointment as a First Lieutenant in the National Guard of Texas and your Federal Recognition in the Air National Guard of the United States. This Certificate and order should be carefully preserved as they are the official documents confirming your Appointment and Federal Recognition.**

**FOR THE ADJUTANT GENERAL OF TEXAS**

Figure 7. The memo announcing Bush’s promotion to 1st Lt., was created with proportional text, was made available by the White House and was verified as authentic, produced by the Texas Air National Guard in 1971.

### Assuming TNR and Predictable Ratios

Nobody assumes the above memo is done in Times New Roman. Yet, a large community began their discussion by assuming the Bush memos were done in Times New Roman. It is critical to demonstrate you have identified the font family before doing anything else. In one study, the “scholar” 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 (see quality of copy in figure 7). 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 character sizes, they will discover that some characters are 30% longer than other, comparable characters. If the characters can be different sizes, it follows that the spaces between them are also different sizes, and there can be no realistic

method for determining final line lengths. 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.

### **Foolish Hypotheses**

In a sense, their problem begins and ends with their approach to the examination and their hypotheses. Their hypotheses are that the memos are Times New Roman and that they were produced in word. In their resulting study it becomes necessary to prove their hypothesis. But these should be examinations, not experiments. In an experiment it is reasonable to attempt to prove your hypothesis. Examinations, however, should be approached with open minds, no specific agendas, and with no effort to prove something. The hypothesis for my study is that it may be possible to examine the Bush memos and glean information about their source. The nature of the hypothesis permits any option to be true. If I can find no information, there is no harm and no foul. If I find information, I report it. If I find trends, I report them as well. The scientific process actually begins with exploration, examination, and discovery based on broad questions. These lead to conclusions which permit us to form more specific hypotheses. In some cases (e.g., research engineering) these hypotheses can lead to experimentation. In other cases (e.g., paleontology) they may not.

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?”

In short, I can find no claim made by the critics that passes even *prima facie* scrutiny.

### **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 it was a Typewriter font called “American.”

The Typewriter variants share many characteristic with IBM's 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 within a family.

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 (with one exception discussed later). 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.

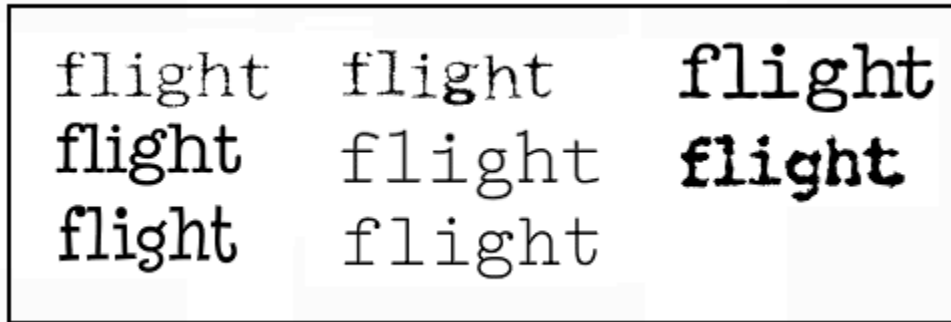


Figure 8. The above provides examples of variations in Typewriter, digitized. In some cases, the examples are taken directly from antique typewriters and digitized for use on computers. The Bush memos are done in a species from this genus.

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.

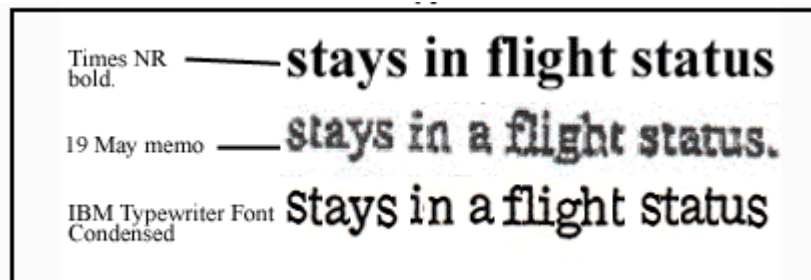


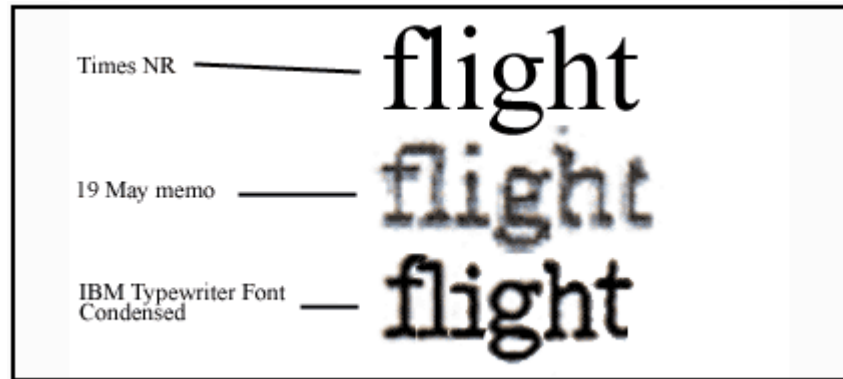
Figure 9: Comparing Times New Roman, the Bush memo and the IBM font condensed. Note the slightly curved serifs in the "f," "l," and "i." These curves are often found in the IBM Typewriter font. One can see the same convex bases in both the Bush memos and the IBM font. Their occasional exaggeration is a predictable artifact of digitizing at relatively low resolution. There is some similarity in the cross strokes on the "t's," but cross strokes are design features that vary within font families and cannot be used to identify them.

In the above example, 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 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.

NOTE: I have received criticism for the following 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 subtle phenomena. 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 origin or cause that makes it possible to look at a thing and understand the effect. 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.

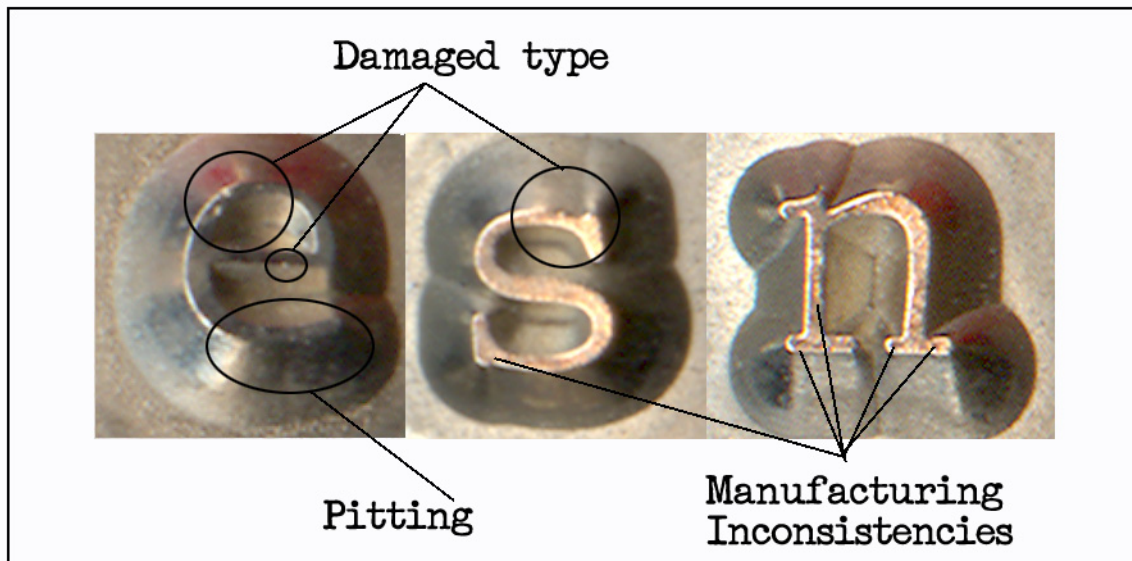
## ARE THE MEMOS TYPED?

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 8 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.

### 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 the characters are so small, they are manufactured with subtle inconsistencies. These inconsistencies may be identifiable. Because type is used and abused, it becomes damaged and worn. A well used typewriter should have indications of one, the other, or both (figure 11). If I am able to find and replicate the effect of damaged type, it should provide evidence that this document was typed.



**Figure 11. Examples of damaged type, pitting, and manufacturing inconsistencies commonly found on well used typewriters. Notice that the “e” is much more worn than the “n.”**

Because platens and paper are inconsistent, the results of damage or wear will also be inconsistent when compared to what we would expect from 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 consistently high quality and contrast. A manufactured flaw in a digital font should show up with little variation (see figure 24).

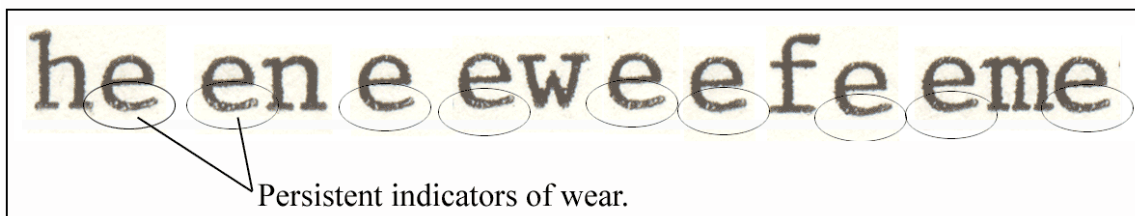
Because electric typewriters pound the paper and the platen, there is the possibility of seeing distortion caused by the pounding. For example, in a digitally printed document, all characters that overlap will simply merge. Those of us who remember typing, also remember that we frequently typed using 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 ARTIFACTS**

In some cases, the author used an lower case “L” instead of a “1.” This was consistently done if the “1” appeared as a part of a word (e.g., 1st Lt). Some have speculated that this was done to keep from producing a superscript “st.” I suggest that it shows a preference that comes from a background of using a manual typewriter. The “L” requires the ring finger of the right hand while the “1” requires the little finger of the left hand. Typing a “1” with a manual typewriter (when the manual typewriter had a “1”) was awkward if not unpleasant. In my own experience, I used the “L” for “1” in touch typing, but used the “1” when typing groups of numbers because I hunt-n-pecked with only four fingers when doing them.

### **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 12.** 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 and inconsistency in the stroke and failure to achieve full density blackness.



Figure 13. 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.


| Missing Left Cross Stroke  | Missing Top of Stem | Partial Left Cross Stroke and Top of Stem                            |
|--|---------------------|--|
| Lt. 1th<br>stan<br>ation<br>Fur.<br>Intr<br>to the<br>ght re<br>list of<br>st Lt<br>(flight)<br>status   | 147 th<br>est fo    | gust 19'<br>tr.<br>he trai<br>ed tran.<br>that<br>ght<br>ptor<br>ust |
|  <p>Damage or wear in this area would cause the results depicted in the above examples.</p> |                     |  |

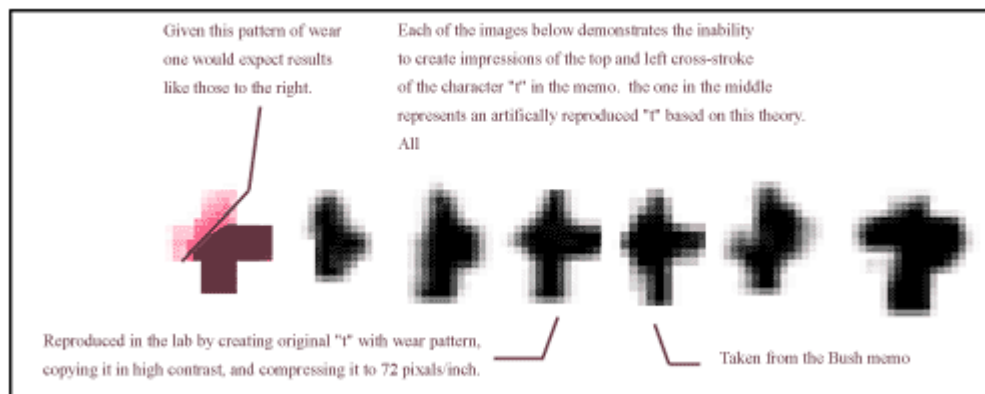
Figure 14. The above examples are consistent throughout all four memos. In all cases in these memos, the left half of the cross stroke and/or the ascender of the “t” is incomplete.

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 15. 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.**



**Figure 16. 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.**

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.

### 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 pits in the upper left shoulder, and the other side in two places. A third scratch or pit appears to occur below the bowl. Examples of comparable pits may be seen in the "e" in figure 11.

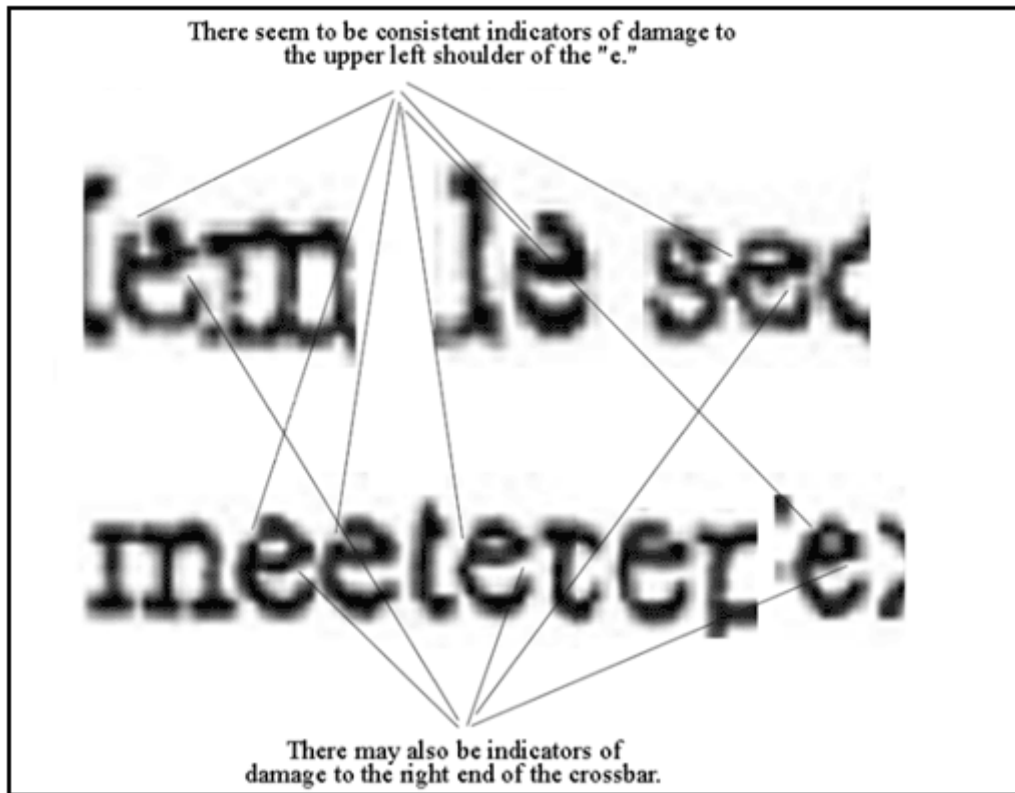
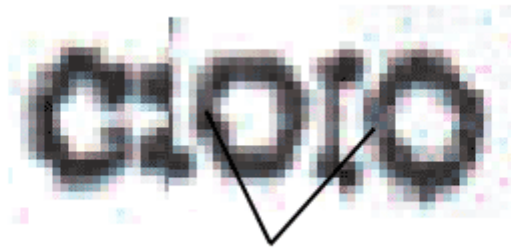


Figure 17. The upper left shoulder of the "e" shows signs of damage throughout the memos. (Image scanned at 4200 lines/inch)

The "c" and the "o" (figure 18) 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.



Possible weakness in the "o," but it is not consistent with the "e."

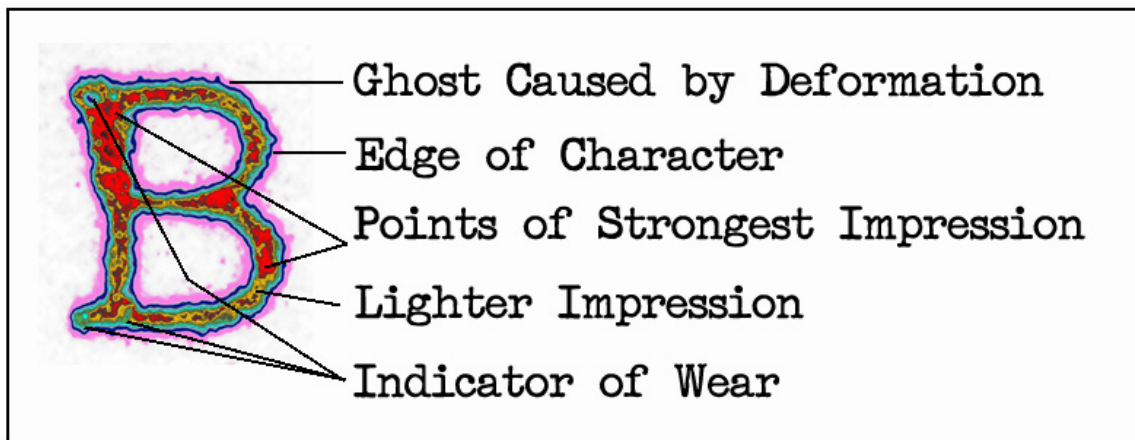
**Figure 18.** Although there is some movement in the shoulders of round characters, there seems to be no cropping. The “c” and the “o” do not share the weakness in the upper left shoulder that the “e” displays.

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**

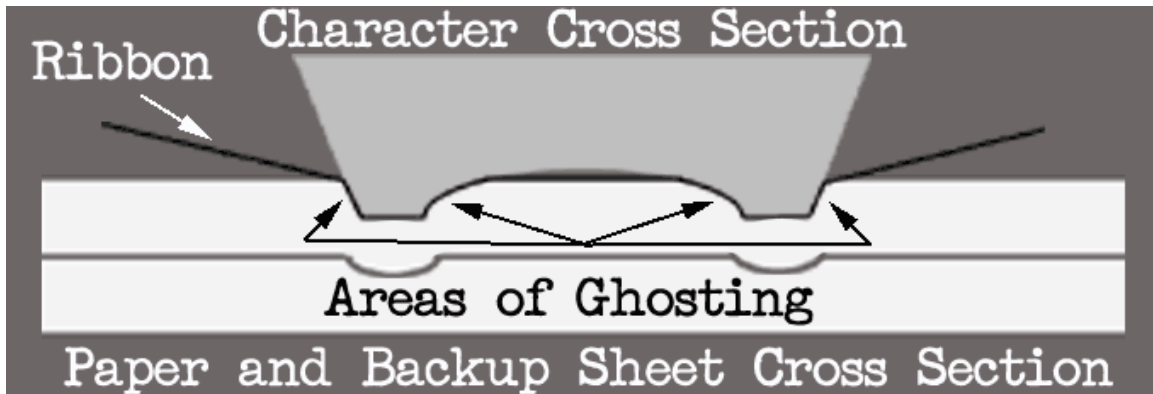
If a document is typed, there may be variations in impact based on placement of the platen, quality of the platen, variations in paper quality across the page, etc. Worn type will be especially prone to being affected by patterns in the paper or platen. If the paper is harder or if the key strikes a 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.

There are other issues concerning typed characters. The impact of the character and the subsequent deformation of the paper creates a ghost of gray around the character. This ghost is microscopic and difficult to see. It can, however, be made more visible using a process I call false color fingerprinting.



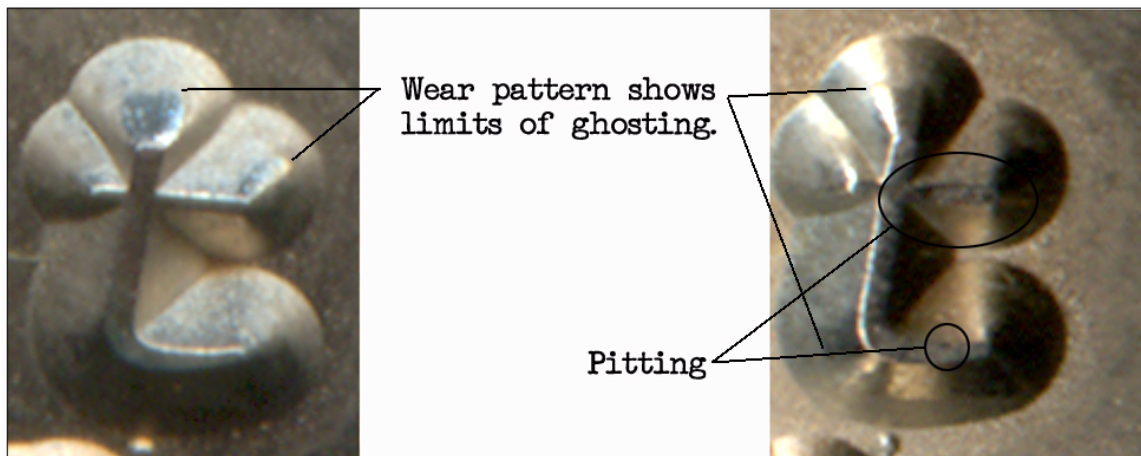
**Figure 19.** False color image of a typed character.

The ghosting is created as the key pinches the ribbon and paper against the edge of the impression. The ghosted area represents a part of the paper that is compressed and smooth but receives little ink (figure 20). It becomes a pale line that delineates the character. If the character is overprinted by a second character, the line often withstands the impact and remains in place around the first character. Interestingly, when that happens the imprint of the second character stops at this line. In no case does the second character overprint the first character.



**Figure 20.** As the character impresses itself into the paper, a hard dark image is impressed onto the page, but a lighter image is also impressed around it.

The area of impact that causes the ghosting can be seen in the wear on the characters on the typewriter.



**Figure 21.** Wear pattern caused by the impact of the character imbedding itself into ribbon and paper. Note that in the image on the left the "t" shows rounded edges on top and on the left part of the cross stroke – very much in keeping with my previous argument about the incomplete "t."

After the character is typed, the page remains somewhat deformed. The next character makes an impression on new paper but fails to make its impression in the depression created by the previous character. When characters overlap, the first character is always preserved at the expense of the second character. If the characters do not quite overlap, the ghosting is preserved, creating a lighter crescent in the second character. This occurs

only in impact printing, so if we see the second character deformed by the first character or if we see the crescents we can know that the characters were typed.

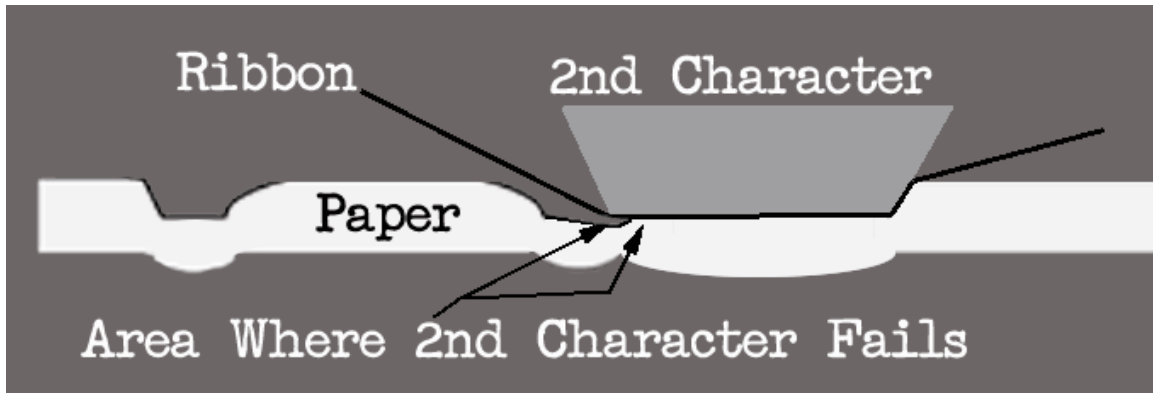


Figure 22. When the second character is printed on top of the first character, the impression of the second character fails where it overlaps the first character.

An example of the above discussion demonstrated in typed characters can be seen in figure 23.

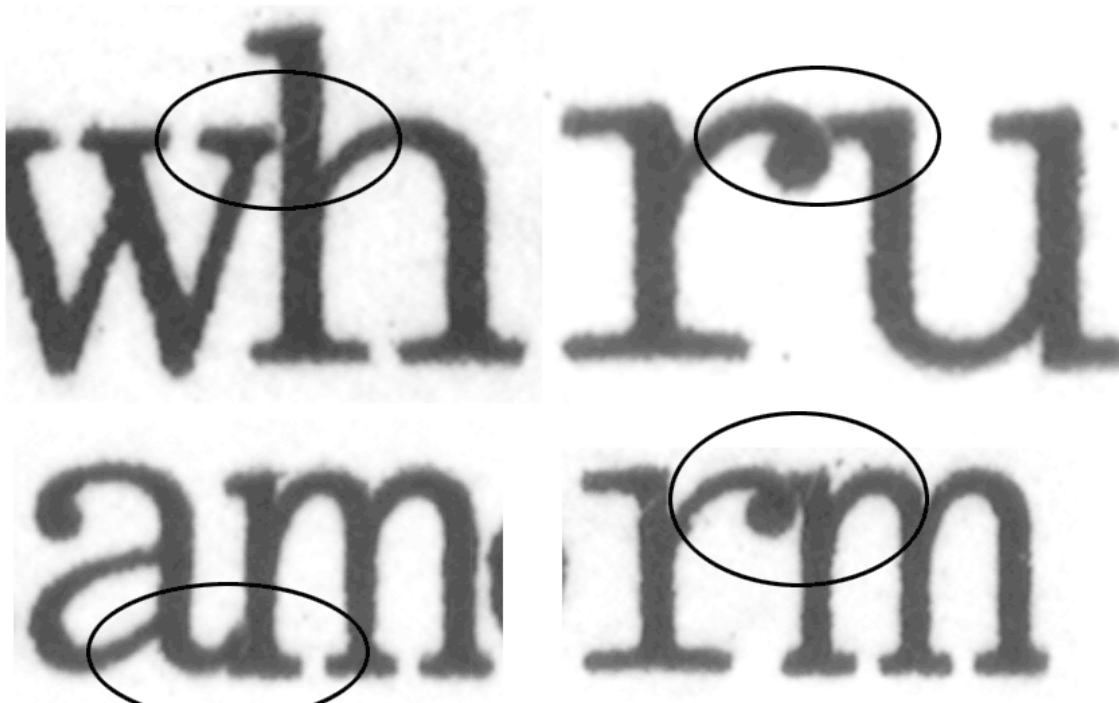


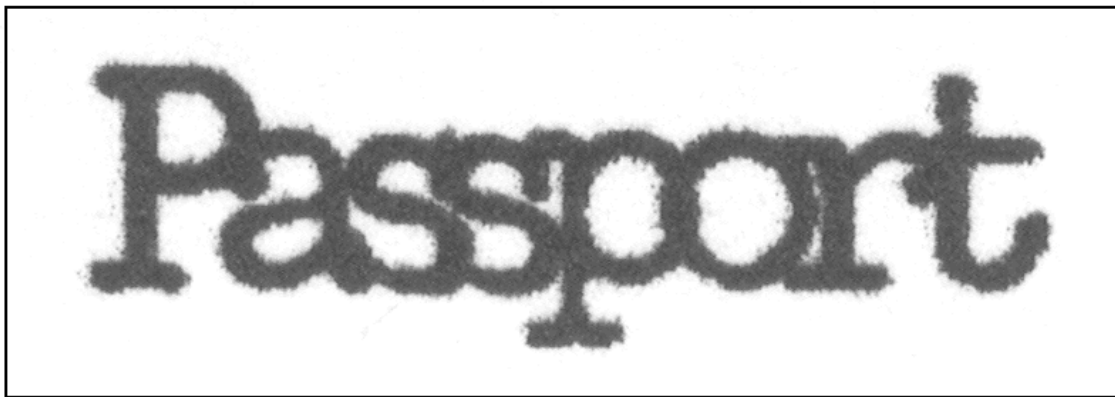
Figure 23. Although sometimes subtle, virtually every overlapping second character will be incomplete. Where the character demonstrates a defect (e. g., “wh”) a white crescent is often formed in the second character.

It is a simple matter to replicate this process. A person need only type a document on an IBM typewriter using a Pica ball but elite spacing. The effect is microscopic, but if the typist then scans the finished product at 4800dpi, he or she will find numerous examples where the first character is preserved at the expense of the second. Figure 23 presents several taken from such a test.

In the case of the “wh” above, although the first character was unable to make a complete black impression, the second character was still unable to fill in the blank space, demonstrating that the second character is not overprinting the first character. This pattern occurs only with overlapping typed characters.

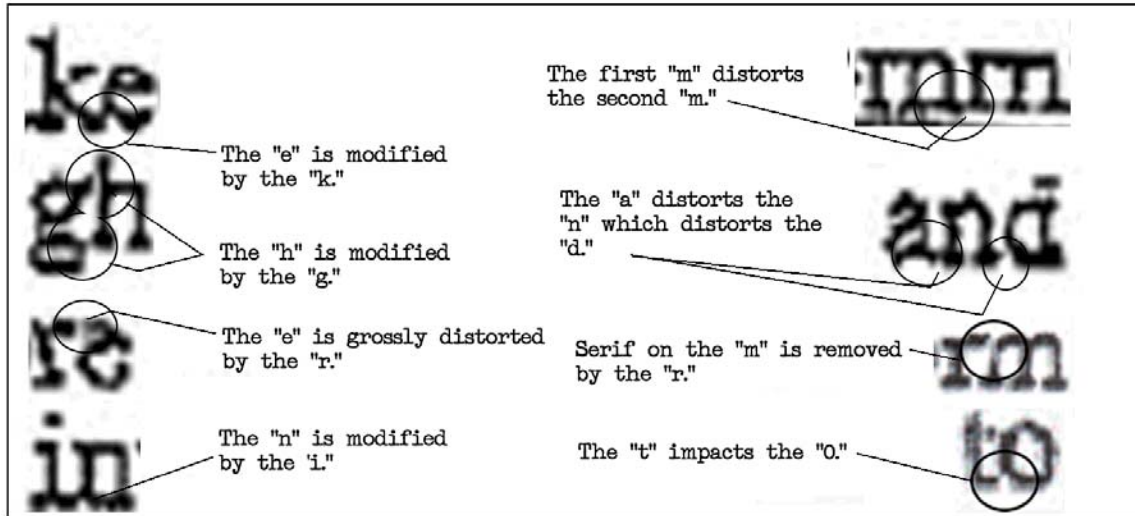
### **Inkjet Printing**

Inkjet printing also creates ghosting, but this is caused by overspray. Given this condition, when characters are very close, the space between them tends to fill in, and there is no difficulty with the second character overprinting the previous character. A digitally printed document, photocopied and scanned will look like the samples in figure 24. Digitally printed characters overprint each other without difficulty.



**Figure 24. If the word “passport” is produced so that the characters overlap, there is no sense of one character in any sense modifying the adjacent character. Instead, there is some tendency for space between the “o” and the “r.”**

The next figure presents a number of examples taken from the Bush memos. In each example, where the characters overlap, the first character is preserved at the expense of the second character. The Bush memos are filled with examples such as those in figure 25.



**Figure 25. Demonstration of the 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. In each case, the first character impacts the second character.**

In the case of the two “m’s,” the left serif on the second “m” is almost completely eliminated by the serif on the first “m.” Similarly, with the “rm” combination, the “r” completely eliminates the upper-left serif on the “m.”

In each example, the first character is preserved at the expense of the second character. The characters seem to interfere with each other in a manner precisely in keeping with a physical, mechanical process.

In short, the nature of the interaction of the characters in the Bush memos seem to be more consistent with typing than digital production.


## 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 physical nature of the memos that indicates they are faked. All my evidence points toward a mechanical production process and away from a digital process.

If I use the Typewriter font I developed above, I can produce a good representation of the original memos. I can also produce typewriter-based conditions that could have produced the memos. This is not to say that there are no other combinations of conditions that could have produced the other effects but that I found no conditions that do not involve impact printing. Furthermore, the typeface seems to be consistent with typewriters used in the military at the time in question.

MEMORANDUM FOR 1st Lt. George W. Bush, [REDACTED], Houston,  
MEMORANDUM FOR 1st Lt. George W. Bush, Houston,  
Texas 77027.  
Texas

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

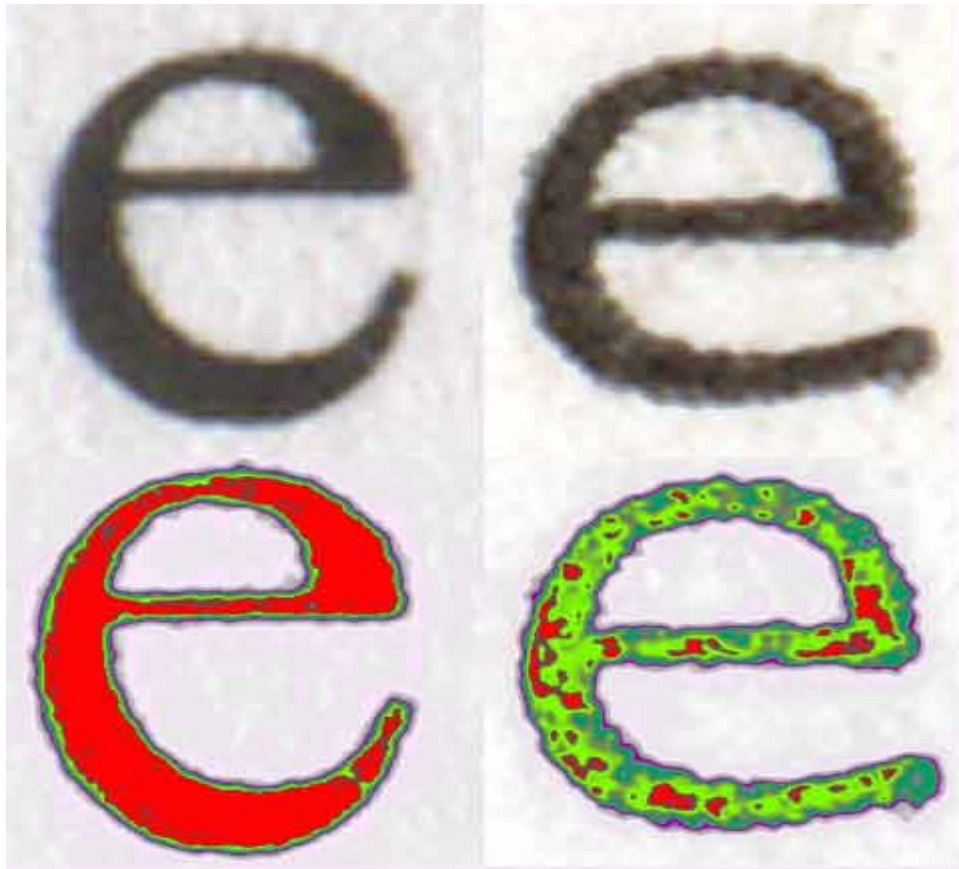
1. You are ordered to report to commander, 111 F.I.S., Ellington AFB, not later than (NLT)  
1. You are ordered to report to commander 111 F.I.S., Ellington AFB, not later than (NLT)  
May, 1972, to conduct annual physical examination (flight) IAW AFM 35-13.  
May, 19 to conduct annual physical examination (flight) IAW AFM
2. Report to 111<sup>th</sup> F.I.S. administrative officer for schedule of appointment and additional  
Report to 111 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. 

**Figure 26. Facsimile of the text in the push memo, recreated using the font replicated from the original. The point of this exercise is to demonstrate that I can create a reasonable replica of the original font. If my replica is accurate, the font used for these memos is from the Typewriter family of fonts.**

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.

#### **NEXT STEP**

I believe that I have demonstrated that the memos were typed. However, it is still possible to do additional tests. As you can see in the top "e's" below, it is very difficult to see subtle differences in characters. One is digital and one is typed, but how might one tell them apart? Numerous other research communities have overcome that problem by applying false colors to the differences. It is possible that a researcher can create a tool using false colors to highlight differences in these characters that are otherwise difficult to see. I believe that I can calibrate a false color process sufficiently to differentiate between laser printing, inkjet printing, and impact printing if I have originals to compare. In this case, once color has been applied, the differences become obvious. The digital "e," of course, is the more nearly perfect one.



**Figure 27: Comparing a digital “e” to a typed “e” shows differences but it is difficult to establish sufficient difference to make the claim that I can consistently tell them apart. A technology called “false color fingerprinting” shows promise for making the differences clear.**

Furthermore, it seems possible to distinguish between digital text and mechanical text even after numerous photocopies (Figure 28).

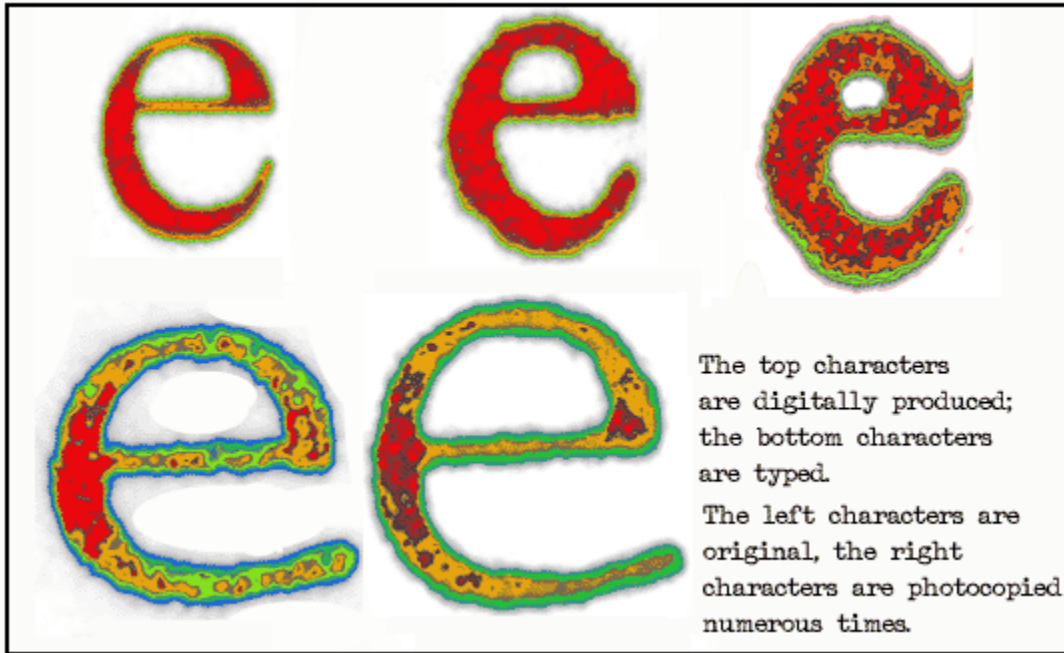


Figure 28: The top “e” was photocopied ten times in high contrast at a dark setting.

### OTHER 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, see if there are indicators that imply typing or digital printing, 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 – the memos are done in Typewriter typeface. I have answered the second question with, “the memos are probably typed.” 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.