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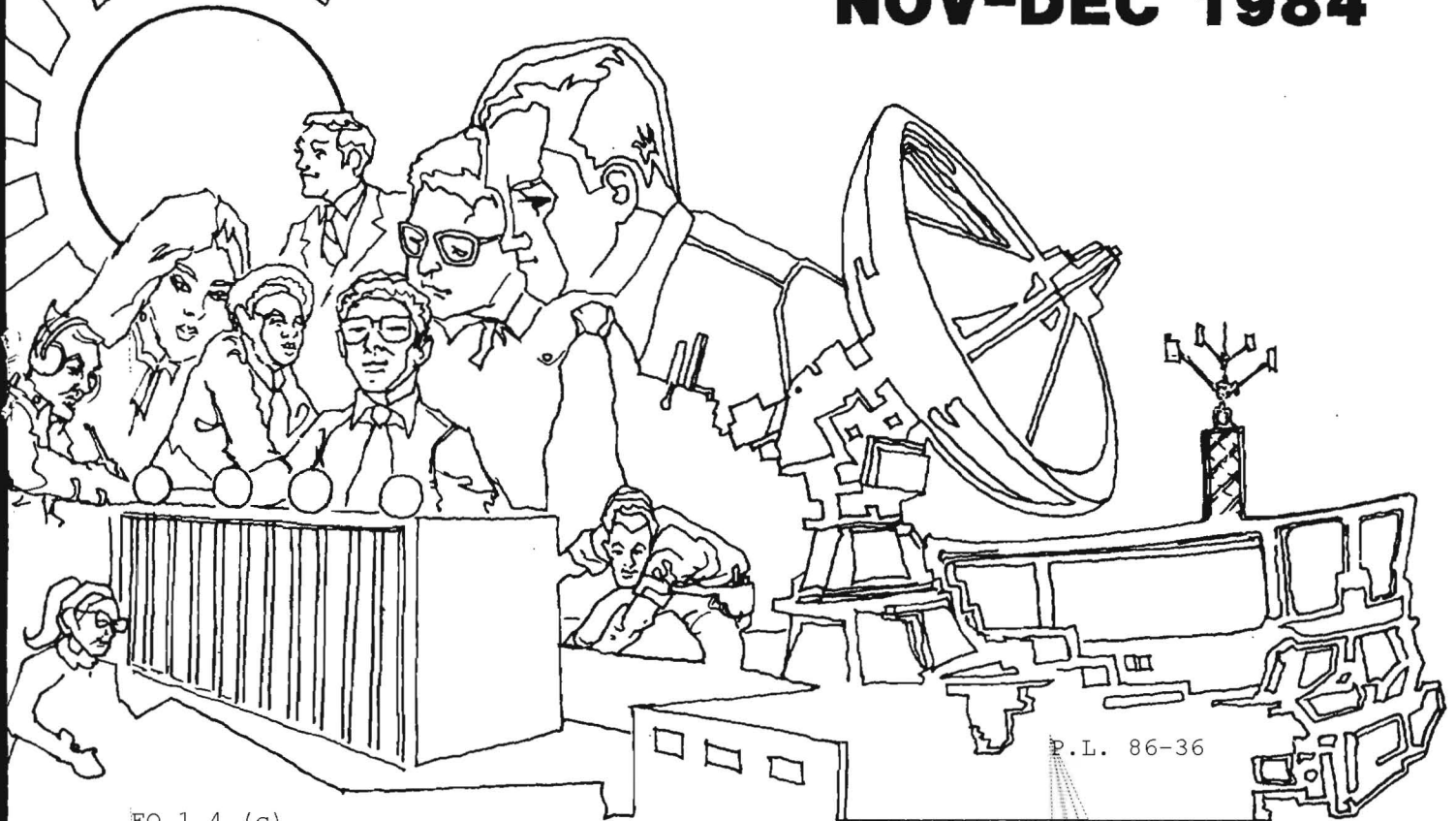
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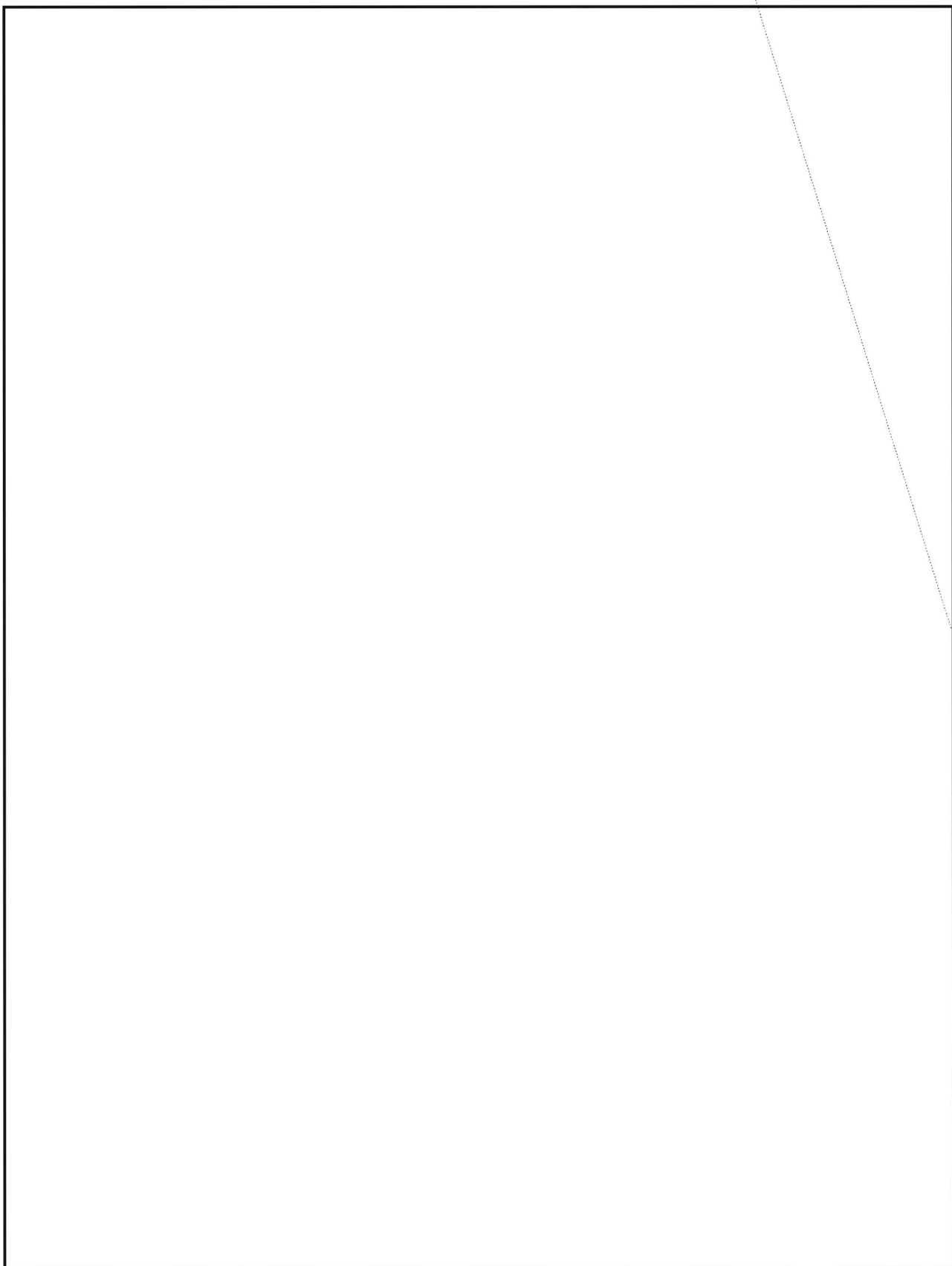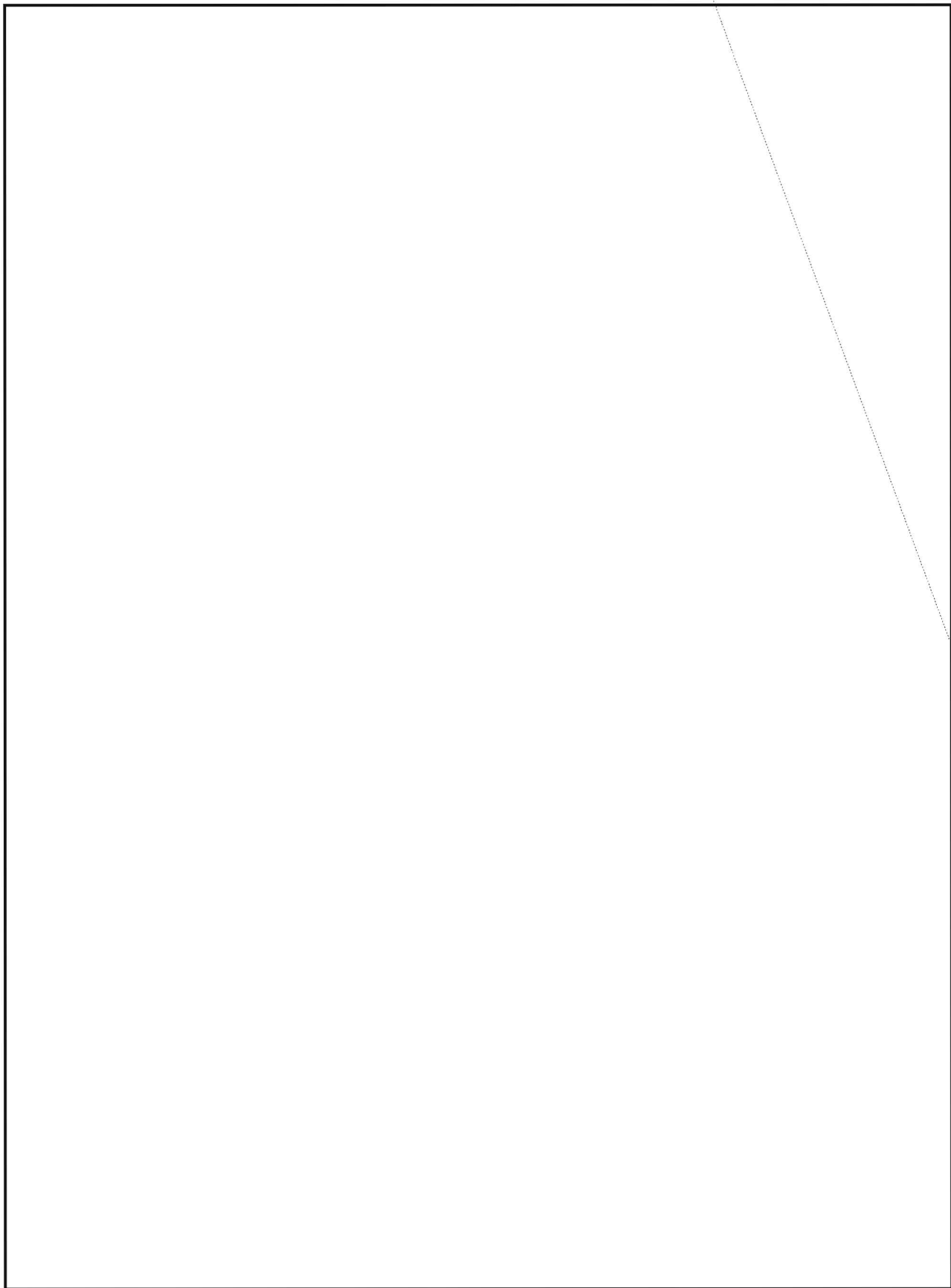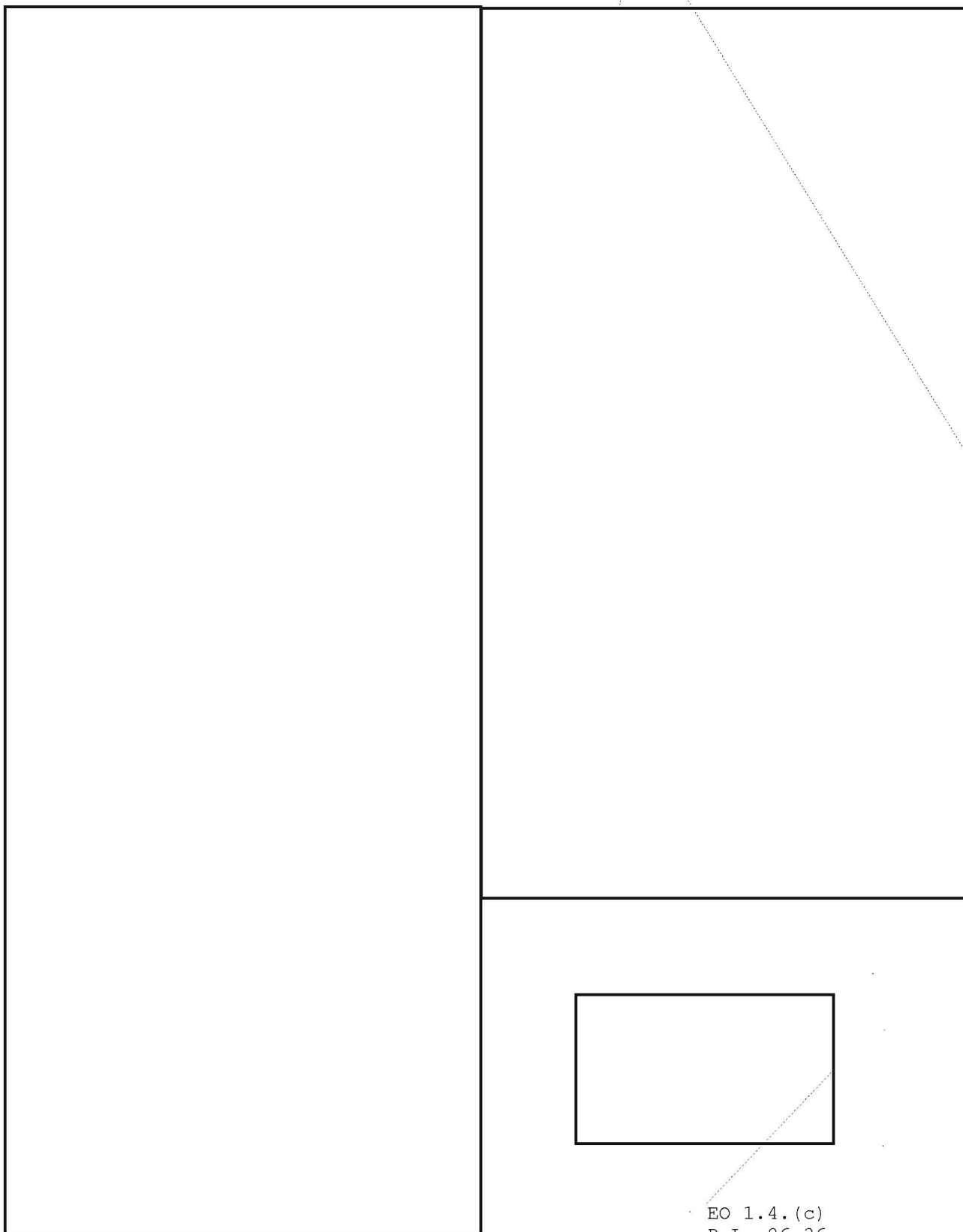
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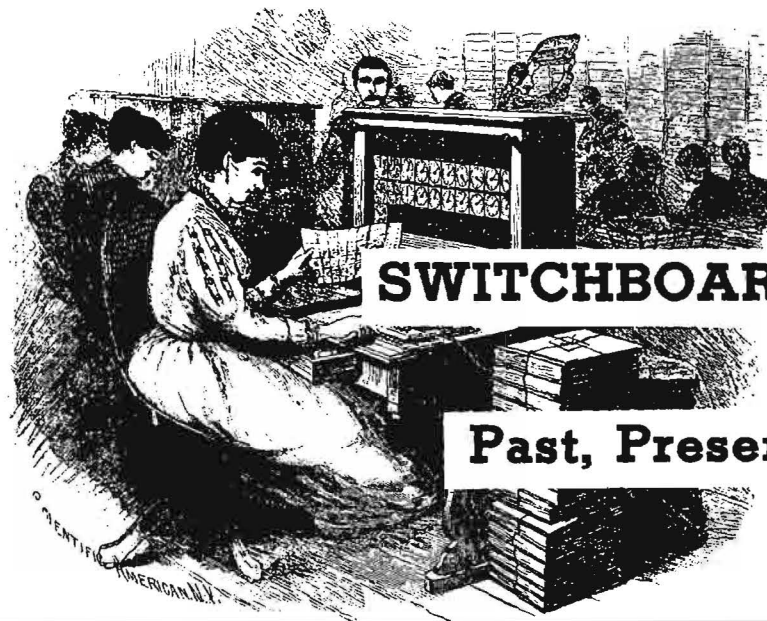
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We forgot to have our *CRYPTOLOG* subscriptions moved!

Will someone tell

tor us?

P.L. 86-36

No! Harold P.L. 86-36
EO 1.4.(c)
P14, 8A187!

Roger!

OUT OF

MY DEPTH [U]

EO 1.4.(c)
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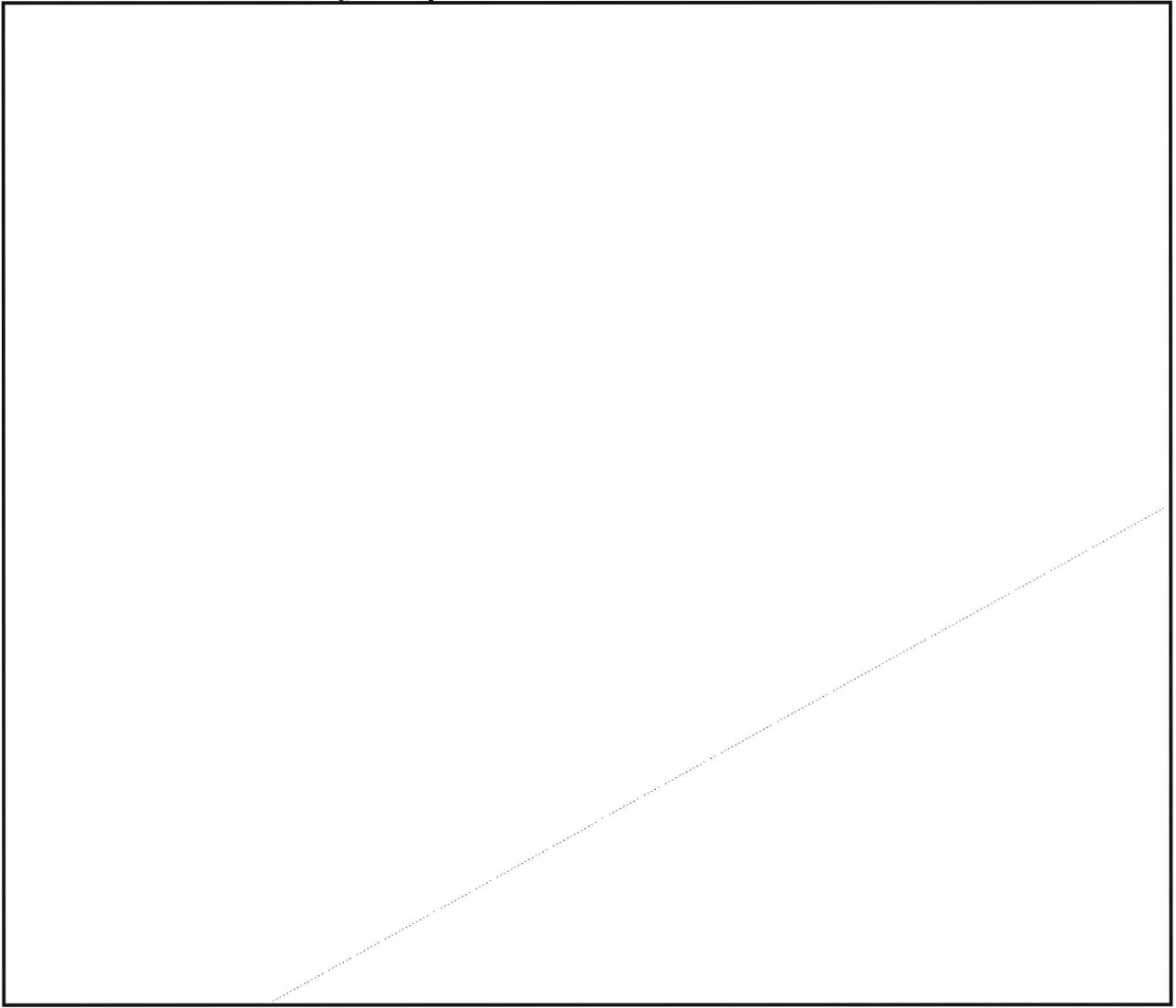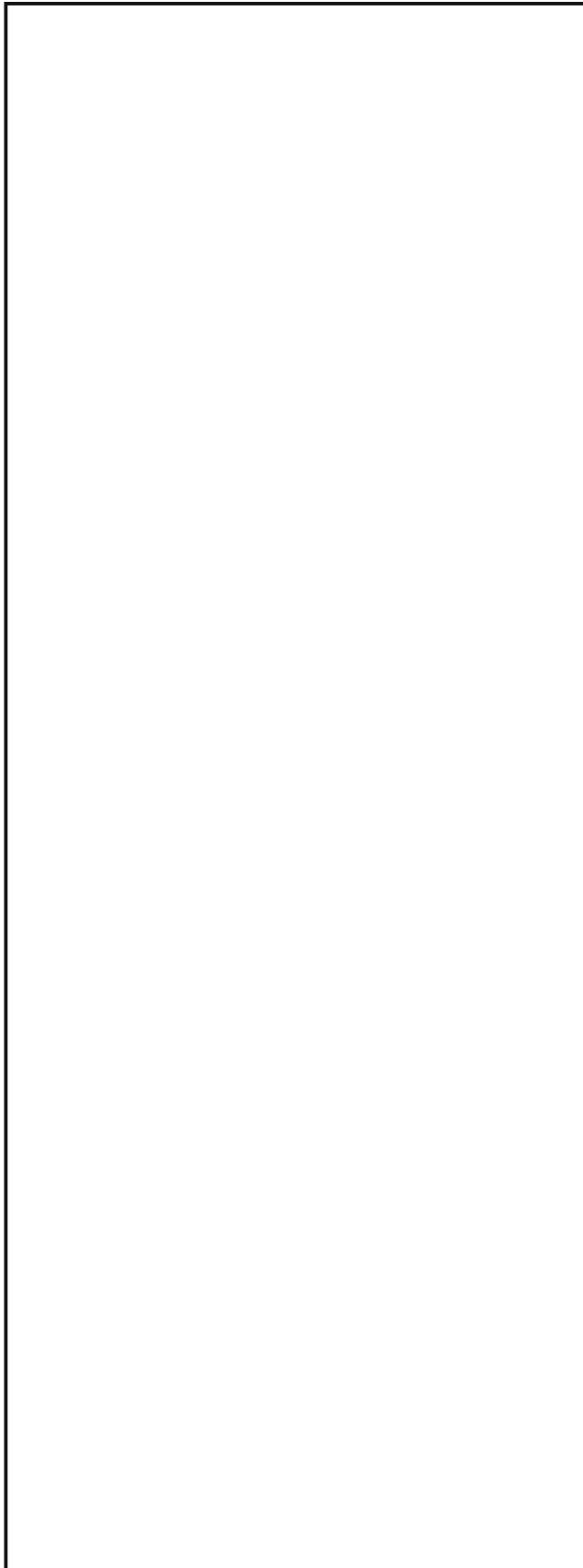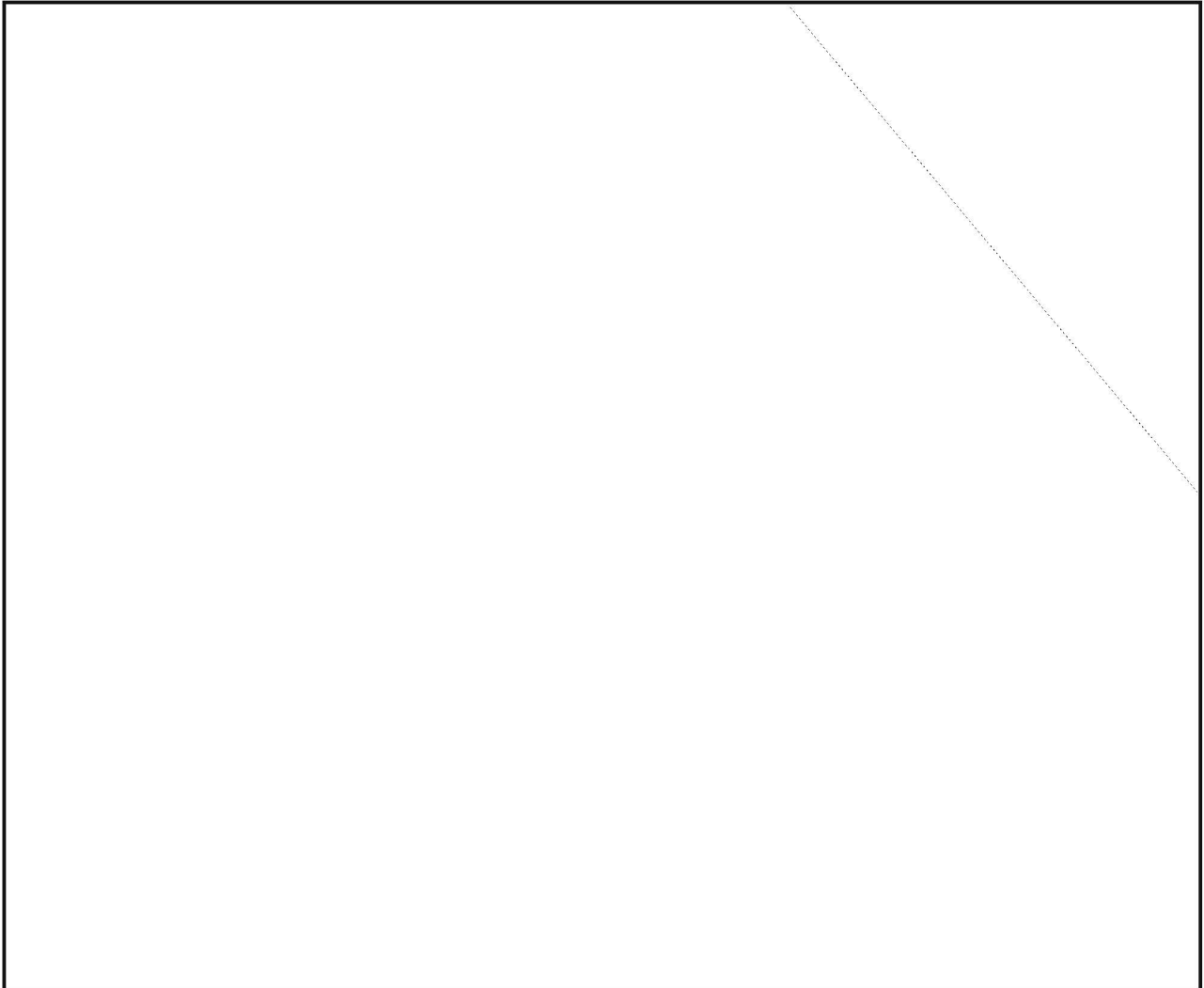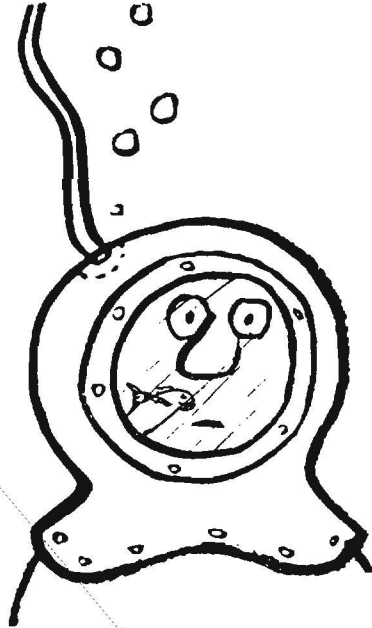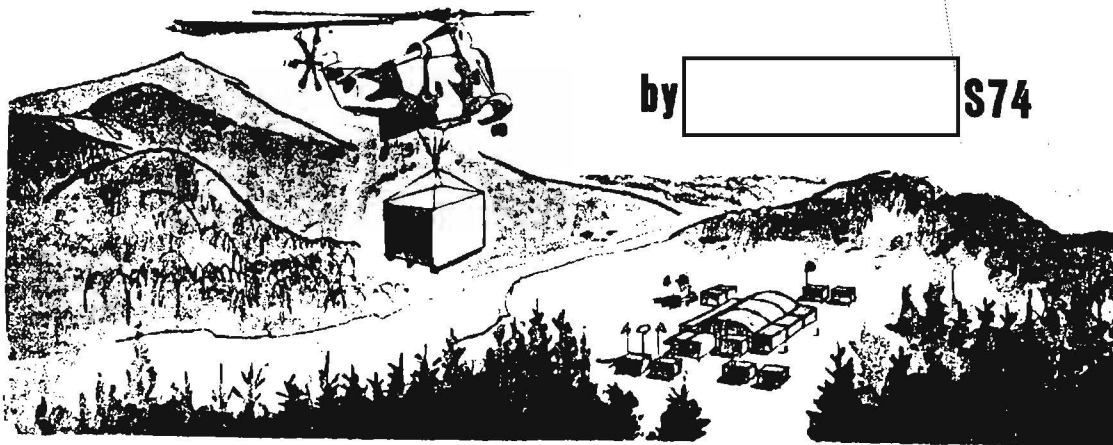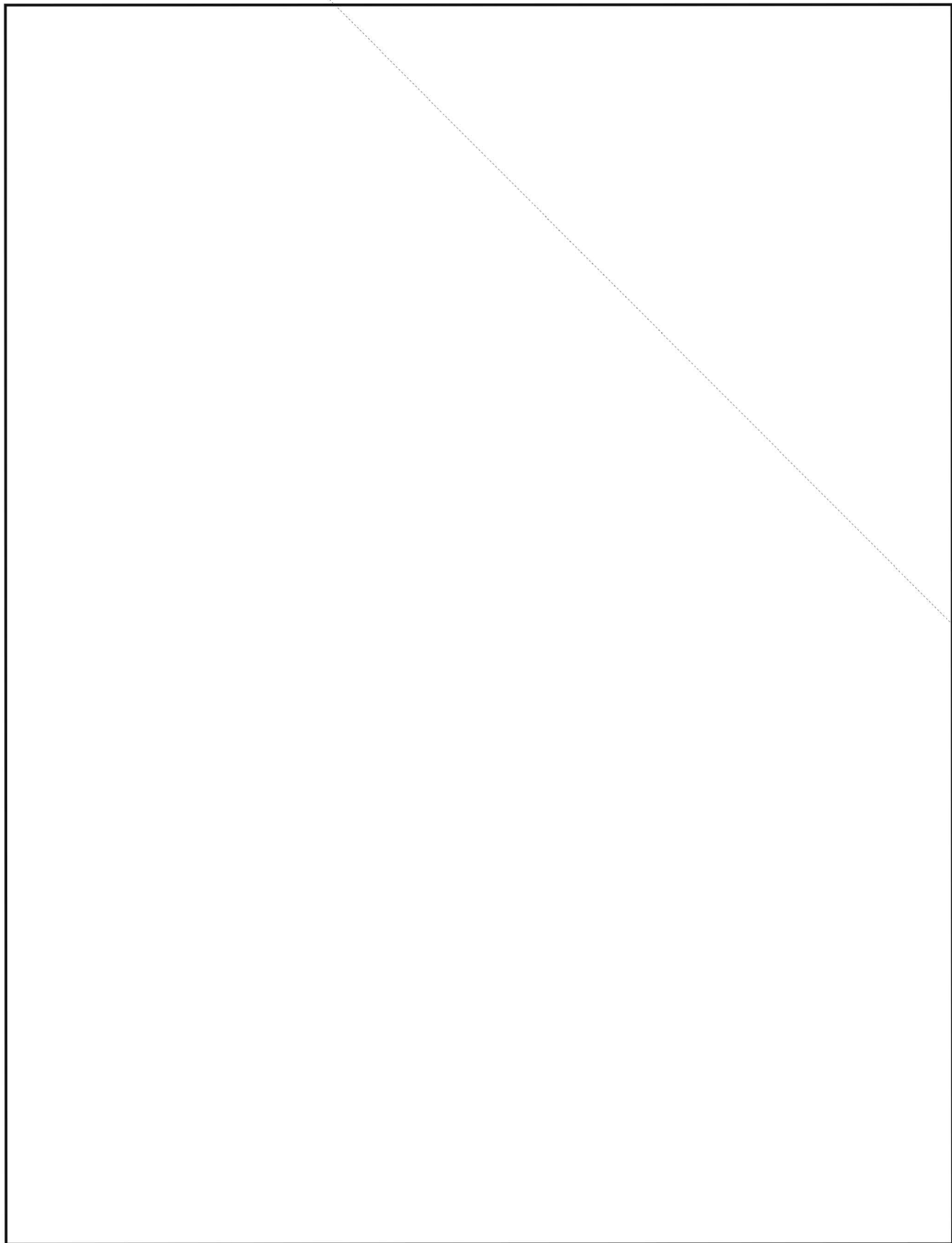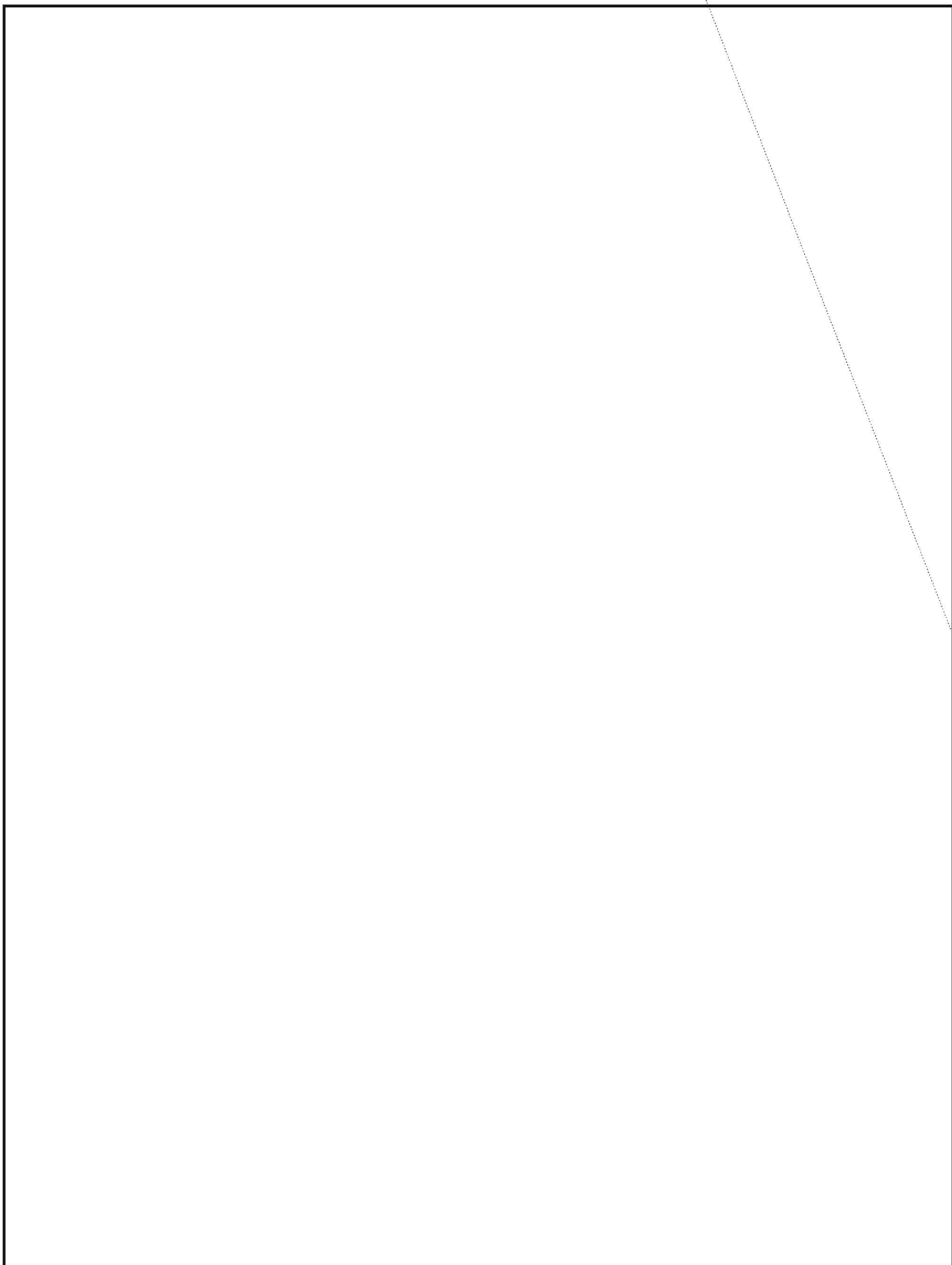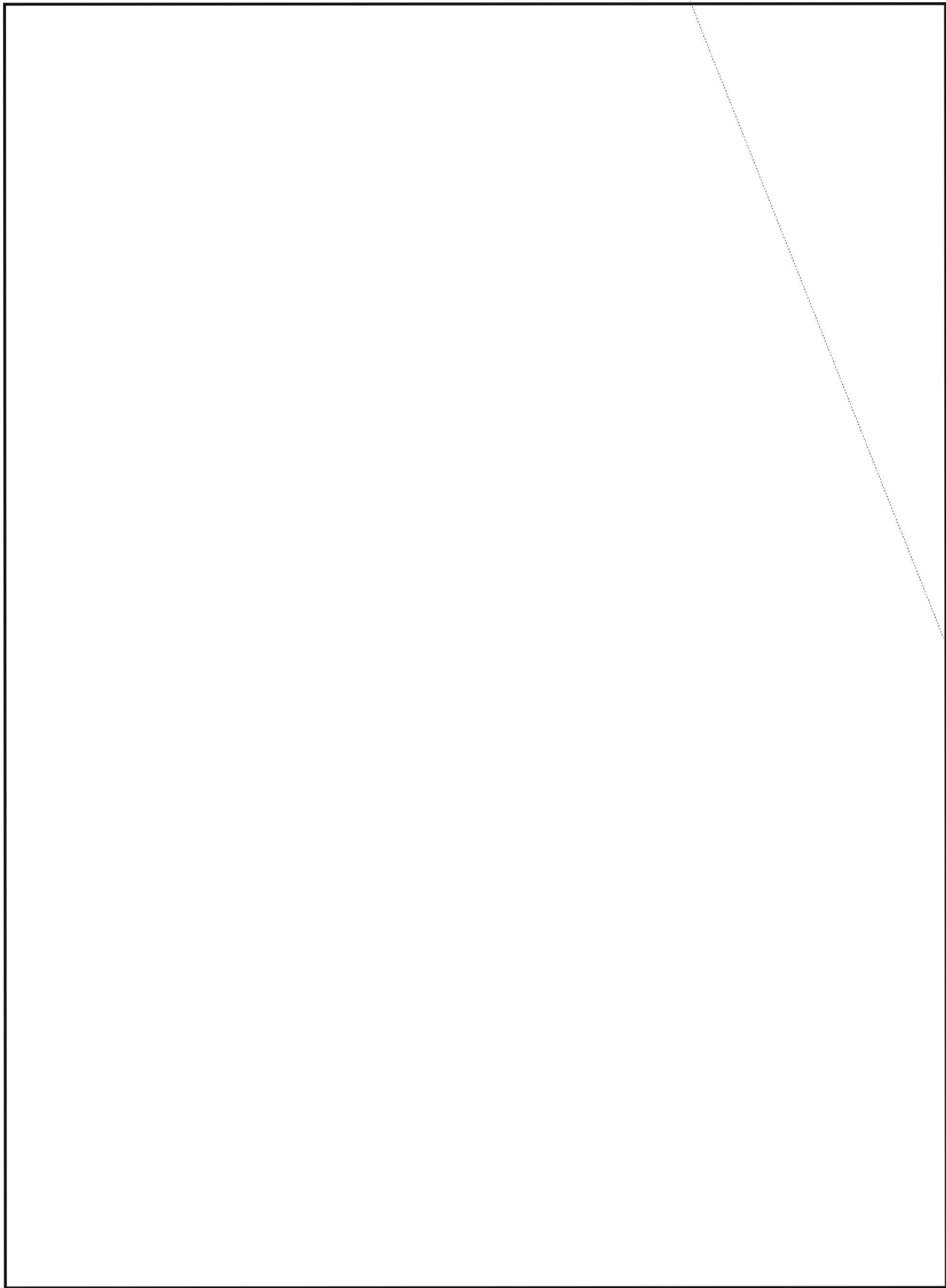
EXPLORING

A DOS DISKETTE (U)

by [ ] P13

INTRODUCTION

Many data systems professionals will go through an entire career using a personal computer and handling small diskettes without really having an idea of how data is organized on them. There is nothing magic about it and, in fact, it isn't really difficult to understand where and how information is being stored and what it looks like on the disk.

This paper will attempt to explain how a 5 1/4 inch floppy disk is organized under PC-DOS 1.1, written by Microsoft for the IBM-PC. We will be using an IBM-PC and two double-sided double-density disk drives.

Most information was obtained from the Peter Norton book, Inside the IBM-PC, one of the most useful books on small computers I have found, and the IBM DOS 1.1 manual--very useful both as to information and as a cure for insomnia.

The diskette data displays were obtained through the use of the Peter Norton utility DISKLOOK.

Microsoft went to great lengths to have the software overhead take up as little room on the diskette as possible. This, obviously, makes good sense. A small computer isn't much good to you if the operating system takes up the entire disk. As a consequence, the directory and allocation table look rather cryptic, but once explained they are easily understood.

LOOKING AT THE DISKETTE

Formatting

When a user removes a blank diskette from the box for the first time he has two choices. He can use it as a frizbee or he can turn it into a reliable storage medium for use in his personal computer. We will address the second possibility with the full knowledge that we do not exclude the first possibility at any step of the process.

When you run the FORMAT program, as you already know, the diskette under DOS 1.1 is divided into 40 tracks per side, 8 sectors per track, with a boot record, directory, file allocation table, and, optionally, an entire operating system. Ok, let's format it.

Exploration

We'll now take our formatted diskette and place it in drive "B"--the one on the right. In the left drive we'll place the Norton Utilities and type in DL for DISKLOOK. This assembly language program will allow the user to look at the floppy diskette in the right drive sector by sector.

After DL is typed a self explanatory list of options comes up on the screen. We choose one that allows us to select a particular sector, side, and track. We'll start by looking at the 'Boot Record', which is on the first sector of the disk.

Side 0, Track 0, Sector 1
1st sector of Boot record

```
EB279003 01140000 00000000 00000000 00000000 00000000  ..'......................
00000000 00000000 00000000 000000CD 19FA8CC8 8ED833D2  .........................3..
8ED2BC00 7CFBB860 008ED88E C033D28B C2CD1372 69E88500  .....I..`.....3.....ri....
72DD2E83 3E037C08 74062EC6 06647D02 BB00002E 8B0E037C  .r...>.I.t....d).........I.
51B0092A C1B4008B F05633D2 33C08AC5 2EF63664 7D8AE88A  .Q..*.....V3.3.....6d)....
F48BC6B4 02CD1372 2D5E592E 2936057C 741F8BC6 2EF72665  ........r-^Y.)6.It.....&e.
7D03D8FE C5B10151 BE08002E 3B36057C 7C052E8B 36057CEB  .).......Q....;6.II...6.I..
C0EA0000 6000BE67 7DE80200 EBFE32FF 2EAC247F 740B56B4  .....`..g).....2...SIt.V..
0EBB0700 CD105EEB EFC3E933 FFBB0000 B90400B8 0102CD13  ........^....3.............
1E72338C C88ED8BF 0000B90B 0026804D 2026804D 202047E2  ..r3..........&.. &.M  G..
F4BF0000 BE8B7DB9 0B00FCF3 A6750FBF 2000BE97 7DB90B00  .......)......u.. ...)....
F3A67502 1FC3BE1B 7DE8A2FF B400CD16 1FF9C30D 0A4E6F6E  ...u.....).............Non.
2D537973 74656D20 6469736B 206F7220 6469736B 20657272  .-System disk or disk err.
6F720D0A 5265706C 61636520 616E6420 73747269 6B652061  .or..Replace and strike a.
6E79206B 65792077 68656E20 72656164 790D0A00 0100020D  .ny key when ready........
0A446973 6B20426F 6F742066 61696C75 72650D0A 004D6963  ..Disk Boot failure...Mic.
726F736F 66742C49 6E632069 626D6269 6F202063 6F6D3069  .rosoft,Inc ibmbio  com0i.
626D646F 73202063 6F6D3005 C606772F FF837EFC 00750B80  .bmdos  com0...w/..~..u...
7EF73B75 05C60676 2FFF89EC 5DCA0400 00000000 00000000  .~.;u...v/...]............
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000                                       ...........
```

Figure 1 - The Boot Record

This record serves one purpose. It instructs the operating system in read only memory (ROM, as it is known to its friends) to go to the location on the diskette containing the rest of the operating system and read it into memory. If the system is there, it is read in; if not, control returns to the boot record and an error message is printed out.

So as the prompt comes up, we type in 0 for the side, 0 for the track, and 1 for the sector. Zero for the side? Real people start counting at 1, computer people start at zero. OK, why didn't we start at track zero? There is no track zero! Tracks on the PC were numbered by a computer person who skipped class the day they learned how to count. Tracks start at 1, everything else at 0.

As soon as this information is entered, the screen display comes up with 6 columns of hexadecimal numbers on the left, and a few readable words and other symbols on the right. This is the sector we requested, and is a display of the Boot Record.

Looking at the boot record (Figure 1), you can see rows of hexadecimal numbers broken into six columns with an ASCII translation next to each row. Since the boot record is in machine language we would not expect to see many ASCII characters and, in fact, we don't. Look down, now, at the 13th row and below. There we do see a translation and we probably recognize it. We are, of course, looking at the error messages that we get when we have put a non-system diskette in drive A and attempted to boot up. To keep the boot record as small as possible, Microsoft wrote the program in machine language but the messages to the user had to be in ASCII characters.

The Directory

The next two sectors contain what is known as the File Allocation Table (FAT). We will skip the FAT for a moment and proceed to sector 4, still on side 0.

Sectors 4 through 11 have the directory. This area contains all the information necessary for the operating system to retrieve files requested by the user, to sort them by time and date, if required, and to perform other operations as needed.

Looking at the directory (Figure 2), we do see some sort of information in the first couple of lines, and we'll get to that shortly, but for the most part we see rows of F6's and, every so often, an E5. When we formatted the

disk, the program took all 40 tracks (0 - 39) and put a pattern of 11110110 (F6 in hex) on them. It then went to the directory area and, each 32 bytes put an E5. The E5 signifies the beginning of a file record. Now, a sector will hold 512 bytes of data and there are 8 sectors allotted for the directory. Eight sectors will have space available for 4096 bytes (8 x 512). Since there are 32 bytes per record, a DOS 1.1 diskette can hold 128 files (4096 divided by 32).

The first few lines of the directory do appear to be telling us something. Microsoft organized the entries in the following manner:

With this information, we'll try to understand the directory.

Starting at the first line of Figure 2, we can see some readable characters. The first ten bytes contain the hex equivalent of the ASCII characters for PROJECT.BAK. We can see this translation on the right. So, bytes 0 through 10 show that the first entry in our directory is PROJECT.BAK.

Byte 11 has a 00 as it is supposed to be-cause it is not a hidden file or a system file. The user has the opportunity to make a

BYTE

0 - 7   File name (an E5, at offset 0, indicates that the the file has been erased).

8-10   Filename extension

11   File attribute 02 = hidden file, 04 = system file, 00 for all other files.

12-21   Reserved; this implies that in a future version of this operating system some or all of these bytes will be used to further describe the file.

22-23   Time the file was created or last updated. Time is mapped according to the following rules:

| 23 | 22 |
| hour | minutes | seconds |
 15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00

hours   = binary number of hours (0-24)
minutes = binary number of minutes (0-59)
seconds = binary number of two-second increments

24-25   Date the file was created or last updated. Mapping is done as follows:

| 25 | 24 |
| year | month | day |
 15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00

year = 0 - 119 (1980 - 2099)
month= 1 - 12
day = 1 - 31

26-27   Cluster number of the first cluster in the file.

28-31   File size in bytes. The first word contains the low order part of the size. Both words are stored with the least significant byte first.

```
Side 0, Track 0, Sector 4
1st sector of Directory
50524F4A 45435420 42414B00 00000000 00000000 0000914D    .PROJECT BAK............M.
E4080200 00360000 324A554C 59202020 42414B00 00000000    ......6..2JULY   BAK......
00000000 0000ABA4 E3081000 80100000 E5F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6    ...........................
F6F6F6F6 F6F6F6F6                                        ..........
```

Figure 2 - The Directory

file hidden so that in a directory search the particular file in question will not appear. Bytes 12 through 21 have 00's as they are supposed to.

Bytes 22 and 23 have the time as you can plainly see. You say you don't plainly see that? It really is a little confusing, so lets take a look:

For the file PROJECT the time is written as 914D. This can be represented as 1001 0001 0100 1101. Referring to our file description on page 14, the first thing we do to translate this is to reverse bytes 22 and 23. So we would get 0100 1101 1001 0001. Now, the leftmost five bits represent the time. This means we have:

$$(0 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + 1$$

which equals 9 AM; if it were 9 PM, we would get 21 (2100 hours).

The next 6 bits represent the minutes. Using the same logic as before, we get 44. The last bits give the number of 2 second increments, 10001 would give us 17 indicating 34 seconds.

Well, that's how the time is represented—somewhat confusing but it does minimize the space needed and that is important to an operating system.

Bytes 24 and 25, which contain an E408, represent the date, and again, we'll examine this closely:

We first switch them.

08E4 = 0000 1000 1110 0100

Now the first seven bytes represent years past 1980. In our case 0000100 represents 4, indicating that the file was made in 1984. The next four digits, 0111, represent the month: 7 (July). The last digits 00100 represent the day, 4 in our case.

So, now we know that PROJECT.BAK was placed on the disk on July 4, 1980 at 9:44 in the morning.

Bytes 26 and 27 give the starting cluster. We will look at that further when we examine the FAT but suffice it to say right now that this file starts at cluster 2.

Bytes 28 - 31 contain the file size with the first word containing the lower order part of the size and both words stored with the least significant byte first. This is

```
Side 0, Track 0, Sector 2
 1st sector of File Allocation Table
FFFFFF03 40000560 00078000 09A0000B C0000DE0 000FF0FF  .....@..`.................
11200113 4001FF0F 00000000 00000000 00000000 00000000  .. ..@....................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
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00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 00000000  .........................
00000000 00000000 00000000 00000000 00000000 F6F6F6F6  ..:......................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6                                       ..........
```

Figure 3 - The File Allocation Table

basically the same idea that Microsoft used when storing the time and date so we won't go through it again, but the file size is 13,024.

There, without much stress we have been able to understand how file information is stored in the directory by DOS 1.1.

The File Allocation Table

In addition to sides, tracks, and sectors, the diskette is also divided into clusters with two sectors per cluster. Since a sector can hold 512 bytes of data, a cluster can hold 1024. The function of the File Allocation Table is to keep track of which clusters are holding which files' data. If data is to be put onto a diskette it is allotted room in 1024 byte chunks at a time. If a file only consists of 1 byte it is still allotted 1024. This may seem wasteful, but every cluster requires a corresponding entry in the FAT. If we decrease the size of the clusters, we increase the size of the FAT and, therefore, increase the amount of time that must be spent looking in the FAT for the next cluster. The designers of this operating system evidently felt that 2 sectors per cluster was just about right.

Since there are a total of 640 sectors per diskette, there are 320 clusters. How many bytes do we need to represent a cluster? Clearly 1 is not enough, it could only represent numbers from 0 to 255. Two would be fine (up to 64k could be represented) but this takes up too much room. Microsoft settled on 1.5 - 12 bits. So, when we talk about offsets in the file allocation table we are talking about groups of three hex characters (a byte and a half!). Since a nibble is half a byte, how about a 'chomp' for a byte and a half?

Let's first look at offsets 0 and 1 in the FAT in Figure 3. Remember, when we talk about an offset in the FAT, we are talking about 1 chomp--a byte and a half. We see FFF for offset 0 and then another FFF for offset 1. The first FFF tells the operating system that we have a double sided diskette. If it were single sided there would be an FFE. The FFF at offset 1 is a filler reserved for future use by IBM or Microsoft.

As mentioned above, the first cluster of our first file is #2, which corresponds to track 0, sectors 3 and 4, of side 1. These relative correspondences can be found in the IBM DOS 1.1 manual, Appendix C. After the operating system has read that cluster, where does it go next? Does our file continue at

```
Side 0, Track 0, Sector 4
1st sector of Directory
E5524F4A 45435420 42414B00 00000000 00000000 0000914D  ..ROJECT BAK...........M.
E4080200 00360000 324A554C 59202020 42414B00 00000000  ......6..2JULY   BAK......
00000000 0000ABA4 E3081000 80100000 E5F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6  .........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6  .........................
```

Figure 4 - Directory With First File Erased

the next cluster or is it located at some entirely different location on the disk. Or, for that matter, is there a next cluster? This is where the FAT comes in. We read the first cluster which happened to be cluster #2. We are now interested in the next cluster of our data. You take the cluster that you have just read, and if it is an odd number you subtract 1 (in this case you don't do anything because 2 is not odd). You then go into the FAT 2 positions and write down the next two chomps that you find. You should be writing down 034 000.

In general, if we have 6 hex digits:

h1 h2 h3 h4 h5 h6,

we unscramble them to form two words:

0 h4 h1 h2   0 h5 h6 h3.

OK, let's try that with the 034 000. In this case, the h1 = 0, h2 = 3, h3 = 4, and h4, h5, and h6 equal 0's. Rearranging our numbers we get: 0003 0004. Now, we were interested in cluster #2. Since it is even, we use the first byte (0003), if it were odd we would have used the second byte (0004).

Looking at the FAT again, it does appear that the clusters were assigned in order. Suppose we were interested in the 15th cluster. We count in 14 (remember, with an odd number--15--we subtract 1) groups of 3 hex digits at a time. We come to 0FF0FF. The digits are unscrambled according to the above formula, and we come up with 000F 0FFF. Since 15 is odd, we are interested in the second of the two words. 0FFF is clearly too large a number to represent a cluster and, yes, as you have probably deduced, it indicates an end of file. The 15th cluster of PROJECT.BAK is the

last cluster of our file. There is no 16th cluster.

As you can see the FAT is quite important. It is so important that there are two copies of it on the diskette, one in sector 3 and one in 4. If one cannot be read, for whatever reason, hopefully the other one can be. Both the FAT and the directory are read into memory when the system is brought up and are kept there.

```
Side O, Track O, Sector 2
1st sector of File Allocation Table
FFFFFF00 00000000 00000000 00000000 00000000 00000000 ......................
11200113 4001FF0F 00000000 00000000 00000000 00000000 .. ..@.....................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
00000000 00000000 00000000 00000000 00000000 00000000 ......................
```

Figure 5 - FAT With First File Erased

Removing Files

Suppose that for reasons of privacy we decide that we don't want anyone to see the file PROJECT.BAK so we erase it. Looking at the revised directory (Figure 4), there is an E5 in place of the first character of the file name but it doesn't appear that anything else has changed.

If we look at the FAT (Figure 5) it appears that the sectors that were being used for PROJECT.BAK are now available. They, of course, are the ones starting at offset 2 (chomps), and continuing for the entire line.

Looking through the diskette (which we will do shortly) you would find that PROJECT.BAK is still there and, in fact, has not been touched.

So, as you can seen, when a file is erased the FAT is changed to indicate that the area taken up by that file is now available. The first character of the file name is changed to an E5. But that's it. The file is still there! If you create a new file, chances are that you will write over the old one but if you erase the file, and then remove the diskette from your computer, you have not done much of anything to assure privacy. If someone decides to go searching through the disk, the FAT could not be used but the name in the directory could probably be recreated and the

file could be found. There are, in fact, programs that could make very educated guesses as to what the FAT probably looked like and recreate it for you.

Editing Files

Suppose we decide to edit the first of the two files on our diskette and, in fact, make it longer. What happens? I'll take a file known to be longer, give it the same name as the first file now on the diskette and we will see what happens.

Looking at the new directory (Figure 6), it would appear that the date and time have changed and the file size is bigger. The starting cluster did not change.

Now lets look at the FAT (Figure 7). The starting cluster is the same as before but look at offset #15. Remember we used to have OFF0FF, which translated to an end of file. If we look at the entry there now, by using our calculations we see that this new longer file takes up the same spaces that the older shorter one did, and then routes itself around the second file, 2JULY.BAK. This is an interesting and important feature of DOS 1.1. A less sophisticated operating system, such as the UCSD p-System would always look for a contiguous area large enough to hold the entire file. If such an area were not found, the user would get an 'out of space' error when, in fact, there may very well be more than enough room. DOS, however, would not do this.

```
Side 0, Track 0, Sector 4
  1st sector of Directory
50524F4A 45435420 42414B00 00000000 00000000 00002791 .PROJECT BAK...........'..
84080200 808E0000 324A554C 59202020 42414B00 00000000 .........2JULY   BAK......
00000000 0000ABA4 E3081000 80100000 E5F6F6F6 F6F6F6F6 ..........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 ..........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 ..........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 ..........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 ..........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 ..........................
E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 ..........................
F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 ..........................
F6F6F6F6 F6F6F6F6 F6F6F6F6 F6F6F6F6 E5F6F6F6 F6F6F6F6 ..........................
```

Figure 6 - The New Directory

```
Side 0, Track 0, Sector 2
  1st sector of File Allocation Table
FFFFFF03 40000560 00078000 09A0000B C0000DE0 000F5001 .....@..'..............P..
11200113 4001FF6F 01178001 19A0011B C0011DE0 011F0002 .. ..@..o.................
21200223 40022560 02278002 29A002FF 0F000000 00000000 .! .#@.%'.'..).............
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
00000000 00000000 00000000 00000000 00000000 00000000 .........................
```

Figure 7, The New FAT

It simply places the file, a cluster at a time, onto the disk. The clusters do not have to be contiguous. Of course, there must be enough clusters available.

An ASCII File

We've looked at an assembly language program (the Boot record), the FAT, and the directory. It would be instructive to look at a couple of ASCII files. The first one that we will look at will be exactly that--a pure ASCII file, and the second one will be an 'almost' ASCII file--a file make by a wordprocessing program.

Figure 8, has a few phrases from "The Midnight Ride of Paul Revere".

This is quite readable without anyone's help. Notice that in the middle of the second line, there is a 0D and then a 0A. This is an ASCII 13, which is a carriage return, and then an ASCII 10 which is a line feed.

The file in Figure 9 was created by one of the more popular word processing programs, Wordstar. So that we may better understand what we are looking for, we will first take a look at the file as it would appear in print:

discussion of the necessities of comparing the architecture of micro-processors rather than simply relying on a benchmark or two when attempting to determine the merits of two or more different devices.
In discussing the 8086, it should also be understood that we are discussing the 8088. Any reference in this report to the 8086 also implies the 8088. Where there are differences

Looking at the translation on the right side of Figure 9, it seems almost readable. The first thing that appears to be slightly wrong, however, is that the last ASCII character of each word is not quite right. What's wrong with it? Lets look at the first line. Looking at the string 69 73 63 75 73 73 69 6F EE, we know that the word should be 'discussion', but where is the 'n'? Lets look at the EE:

EE = 1110 1110

If we removed the most significant bit we would have:

110 1110

which is a decimal 110 or an ASCII 'n'. Since only seven bits are required to represent the standard ASCII characters, it appears, then, that what Wordstar did is use the most significant bit of the last character in a word to indicate end of word.

In Wordstar and most other wordprocessors, the typist does not push the carriage return except at the end of a paragraph. As we can see from the above quote, after the word 'comparing' (Figure 9, line 2) there should be a carriage return and line feed. At the beginning of the 5th column in the second row we see an E7. As before, we strip away the left most 1, giving us a hex 67 which is an ASCII 103, the 'g' that we expected. Next to that is a hex 20, a space, and then an 8D.

Pulling our usual operation with the leftmost 1, we would get 0D = 13, a carriage return. Next to that is a 0A = 10, a line feed, then another line feed and carriage return. So it appears that carriage return, line feed combinations which are inserted by the wordprocessor have a 1 in the leftmost position of the carriage return byte.

We can verify this by looking at the end of line 10. There we have a carriage return inserted by the user--end of paragraph. Notice that this time we have 0D 0A 0D 0A whereas before we had 8D 0A 8D 0A. This is how Wordstar knows when it has gotten to the end of a paragraph.

If you have ever wondered why you couldn't use a standard wordprocessor to write Pascal programs, you are probably beginning to see the problem. Since each byte is eight bits and ASCII character representation only requires the least significant seven bits, the wordprocessor has the remaining 128 characters that it can put to very good use. The compiler cannot always recognize these characters.

In the case of Wordstar there actually is a mode which will allow you to write programs but, to allow this, Wordstar has to sacrifice some of its versatility.

Side 1, Track 5, Sector 5
1st sector of TESTREC

```
4C697374 656E206D 79206368 696C6472 656E2061 6E642079   .Listen my children and y.
6F752073 68616C6C 20686561 720D0A6F 66207468 65206D69   .ou shall hear..of the mi.
646E6967 68742072 69646520 6F662050 61756C20 52657665   .dnight ride of Paul Reve.
72652E0D 0A4F6E20 74686520 31387468 206F6620 41707269   .re...On the 18th of Apri.
6C20696E 2037352C 0D0A6861 72646C79 2061206D 616E2069   .l in 75,..hardly a man i.
73206E6F 7720616C 6976650D 0A77686F 2072656D 656D6265   .s now alive..who remembe.
72732074 68617420 66616D65 6F757320 64617920 616E6420   .rs that famous day and .
79656172 2E0D0A0D 0A486520 73616964 20746F20 68697320   .year.....He said to his .
66726965 6E642C20 69662074 68652042 72697469 7368206D   .friend, if the British m.
61726368 0D0A6279 206C616E 64206F72 20736561 2066726F   .arch..by land or sea fro.
6D207468 6520746F 776E2074 6F6E6967 68740D0A 68616E67   .m the town tonight..hang.
2061206C 616E7465 726E2061 6C6F6674 20696E20 74686520   . a lantern·aloft in the .
62656C66 72792061 7263680D 0A6F6620 74686520 4E6F7274   .belfry arch..of the Nort.
68204368 75726368 20546F77 65722061 7320612073 6967   .h Church Tower as a sign.
```

Figure 8 - An ASCII File

Side 1, Track 0, Sector 5
3rd sector of PROJECT.BAK

```
69736375 7373696F EE206FE6 207468E5 206E6563 65737369   .iscusio. o. th. necessi.
746965F3 206FE620 636F6D70 6172696E E7208D0A 8D0A7468   .tie. o. comparin. ....th.
E5206172 63686974 65637475 72E5206F E6206D69 63726F2D   .. architectur. o. micro-.
70726F63 6573736F 72F32072 61746865 F2207468 61EE2073   .processor. rathe. tha. s.
696D706C F9207265 6C79696E E7206FEE 20E1208D 0A8D0A62   .impl. relyin. o. . ....b.
656E6368 6D6172EB 206FF220 7477EF20 776865EE 20617474   .enchmar. o. tw. whe. att.
656D7074 696EE720 74EF2064 65746572 6D696EE5 207468E5   .emptin. t. determin. th..
206D6572 6974F320 6FE62074 77EF206F F2208D0A 8D0A6D6F   . merit. o. tw. o. ....mo.
72E52064 69666665 72656EF4 20646576 69636573 2E0D0A0D   .r. differen. devices.....
0A202020 202049EE 20646973 63757373 696EE720 7468E520   ..    I. discussin. th. .
38303836 AC2069F4 2073686F 756CE420 616C73EF 2062E520   .8086. i. shoul. als. b. .
756E6465 7273746F 6FE42074 6861F420 77E52061 72E5208D   .understoo. tha. w. ar. ..
0A8D0A64 69736375 7373696E E7207468 E5203830 3838AE20   ....discussin. th. 8088. .
20416EF9 20726566 6572656E 63E52069 EE207468 69F32072   . An. referenc. i. thi. r.
```

Figure 9 - A Typical Sector from a Wordprocessor

CONCLUSION

There you have it--a walk through a DOS 1.1 diskette. There was nothing very hard or complicated about what was seen or done and, hopefully the reader has gained some information about an object that is very important in their professional life--a 5 1/4 inch diskette.

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HUMAN FACTORS (U)
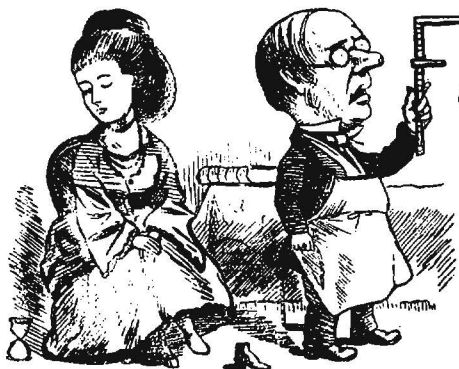
by [   ] **P13**

Many people tend to think that human factors specialists produce nothing but reports, papers, and advice (usually too late and largely unheeded!). A recent article in the Human Factors Society monthly Bulletin vividly counteracts this limited impression.

"...Buried within human factors R&D work are lots of products that have value, that will solve real problems, and that can and will command the respect of the 'hard' disciplines....For too long we have too often been known as the discipline that produces nothing more than long, boring, cumbersome technical reports. And you know about technical reports—they usually end up on the shelf, never to be read."

A survey made by the author, William B. Askren (Air Force Human Resources Laboratory, Wright-Patterson Air Force Base) revealed a wide range of practical "products" within various projects carried out by his organization and others. He lists them as follows, in order from concrete to less tangible:

    prototypes, mockups, drawings
    handbooks, training curricula, training
       manuals, users' guides
    algorithms, models, task analyses
    classification schemes, software, methodol-
       ogy, questionnaires, analysis formats
    requirements, regulations, standards,
       specifications
    costing data, human capacity information,
       evaluation criteria
    proposals, recommendations, plans, alterna-
       tives
    definitions, descriptions, examples, illus-
       trations
    hypotheses, concepts, relationships

Askren continues, "I would propose that it is incumbent upon those of us engaged in human factors R&D projects or application efforts to help our customers define their research re-quirements in such a way that specific products are identified. Secondly, each product should be made a separate deliverable to the customer. If a technical report is to be prepared as part of the effort, it should be thought of as an adjunct to the products."

I heartily agree, and I believe a large part of the problem arises in the total ignorance on the part of most people about the meaning of "human factors" and what its practitioners can do. At our Agency in particular, most people (if they have heard of human factors at all) seem to think of it as concerned with the "subjective" aspects of terminals, furniture, etc. Human factors is everything that is left over when you take away "hardware", "software", and "cost"! Human factors, these people think, is restricted to "vague", "emotional" things like whether a chair is "comfortable", a screen is "readable", or a console is "attractively styled". We really need to do a strenuous job of education to demonstrate to people that human factors can provide concrete, useful products that make a difference to the success of a project. In fact, at our Agency, a great many things that should be done with the advice and aid of human factors specialists are being done by engineers and technicians without the faintest regard for any but technical considerations. Many things that are defined as "hardware" and "software" are really basic human factors issues and problems. For example, what about control of the cursor on a VDT? Our managers define this as "software" or "hardware", because it is implemented in a board or program. But isn't the behavior of the cursor a central issue for the USER of a system? I think cursor behavior is a HUMAN FACTORS issue, not just "software" or "hardware. What do you think?

SOME RECENT ARTICLES AND PUBLICATIONS

Readability of Text Scrolled on Visual Display
Terminals as a Function of Window Size
R.L. Duchnicky and P.A. Kolers
Human Factors Journal, Vol. 25, No. 6,
December 1983, pp. 683-692.

ABSTRACT: "Readability of text scrolled on
visual display terminals was studied as a
function of three different line lengths, two
different character densities, and five dif-
ferent window heights (either 1, 2, 3, 4, or
20 lines). All three variables significantly
affected reading rate, but to markedly dif-
ferent extents. Lines of full and two-thirds
screen width were read, on average, 25% faster
than lines of one-third screen width. Text
appearing at a density of 80 characters per
line was read 30% faster than text in a format
of 40 characters per line. Text appearing in
windows four lines high was read as effi-
ciently as text in 20-line windows, and text
in one- or two-line windows was read only 9%
more slowly than text in 20-line windows.
Comprehension of the passages did not vary as
a function of window size, indicating that
subjects maintained a constant level of
comprehension by varying their reading rate.
Implications of the results for mixing text
and graphics and for limited-capacity elec-
tronic displays are discussed."

Ergonomics in Technical Communication
Peter Martin
IEEE Transactions on
Professional Communication,
Vol. PC 27, No. 2, June 1984, pp. 62-64.

ABSTRACT: "The technical communicator must
be a 'human engineer' because a communication,
like a computer system, can be a technical
success but a practical failure if its design
discourages its use. Four parallels between
technical communication and user-friendly sys-
tems are discussed: (1) Its overall structure
should be apparent to the user; (2) it should
be congenial without being chatty or too per-
sonal; (3) its nomenclature and syntax must be
consistent throughout all functions; and (4)
its logic must not trap users in loops but
should lead them straight to their goals."

Not Seeing is Relieving:
Invisible Writing With Computers
Stephen Marcus and Sheridan Blau
IEEE Transactions on
Professional Communication,
Vol. PC 27, No. 2, June 1984, pp. 69-72.

ABSTRACT: "Word processors with adjustable
video screens are used to test students' writ-
ing facility with and without visual feedback.
Lack of visual feedback seems to have a salu-
tary effect in forcing concentration onto em-
erging thoughts rather than words and sen-
tences. It also prevents interrupting the
train of thought to edit and correct every few
sentences. 'Local editing' is regarded as
counter-productive because it deals with indi-
vidual words and lines instead of reconceptu-
alization and reorganization. For some stu-
dents, however, the lack of feedback per se
was disturbing and thought disrupting."

(NOTE: This is a really intriguing paper, with
some provocative concepts. Especially in-
teresting are the subjects' quoted comments on
the inability to see what they had written,
and the effects on their thinking. MED)

A Study of Revising and Editing
at the Terminal,
Jean A. Lutz
IEEE Transactions on
Professional Communication,
Vol. PC 27, No. 2, June 1984, pp. 73-77.

ABSTRACT: "This paper presents the results
of a comparative study of experienced writers
editing and revising at a word processor and
with pen and paper. Seven writers performed
four writing tasks, each of which provided
several kinds of data. Among these are sta-
tistical analyses and graphs of a chronologi-
cal record of changes made in both modes and
summaries of interviews with the subjects
after each writing task. Results suggest that
the word processor directly alters a writer's
composing style."

(NOTE: this is another highly interesting pa-
per. It brings up a point that I have never
seen expressed before, but which seems to
agree with my own subjective experience over
many years of composing, revising my own writ-
ing, and editing others' writing both on paper
and at a terminal. It appears likely that the
terminal provides a somewhat smaller, more
linear, and more restricted psychological
"window" into a document than a book or sheets
of paper. It functions more like a tape and
less like a random access memory. This is no
problem for most writers with their own compo-
sitions, since they have a relatively clear
concept of the structure at a high level.
When editing others' papers, however, or using
reference materials, the smaller mental "win-
dow" can be a hindrance. Even in my own writ-
ing, I often prefer to print out a draft and
make final revisions on paper to get a feel
for the document as a whole. If the terminal
does, indeed provide a smaller, more linear
psychological "window" for the user in con-
trast to printed books or pages, there are im-
portant implications for automation of some of
our analytic tasks. I recommend this article.
MED)

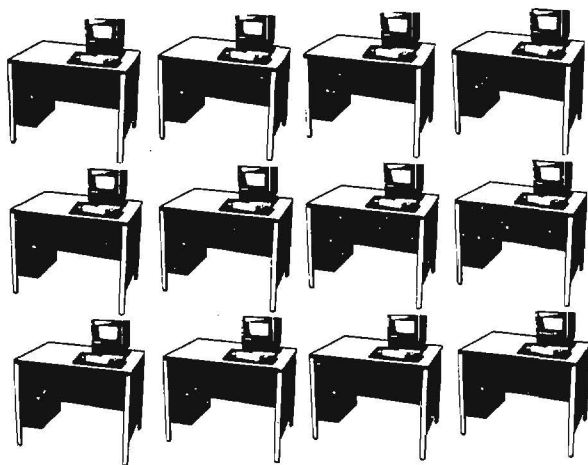# CAN YOU TOP THIS (U)

?

from E. Leigh Sawyer, B

1961. End of a lengthy TDY to sites in Europe [ ] Ready to go home. Pan-Am flight out of Orly. All on board. Capacity load of passengers, freight, mail, and fuel. 707 trundles out to end of runway. Swings around for takeoff. Final checks. Can see all sorts of funny control devices in wing sliding back and forth, going up and down, and so on. Observe that wing is remarkable hunk of engineering. All set now. Jets on full power. Brakes released. See man near runway with hands over ears. Must be dickens of a noise out there. Pretty close to rotation now. Plane lifts off. Strange thing. No familiar clunk noise as soon as wheels leave runway. Stranger thing. Angle of climb barely perceptible. Terrifying thing. Plane airborne 10 to 15 seconds and still only 20 feet off the ground. More terrifying thing. Plane is yawing badly left and right. First reaction is rapid calculation of ongoing insurance and special flight insurance to know how much wife will get. Total acceptance. This is where I buy the farm. For the next half hour, pilot earns pay for next five years. Wins fight to claw plane up to 2,000 feet. Intercom comes on. Pilot's voice. Cool, confident. The father image ("Daddy's taking us for a ride today"). "Lost engine on takeoff beyond rotation. Airplane didn't want to fly. Sorry for inconvenience. Will circle Orly for next hour dumping fuel." Landed safely. Passengers wined and dined during engine change. Duty free liquor store open. Most of passengers were floated on board three hours later. Seemed very carefree. I passed out before takeoff. Woke up over middle of Atlantic. Pilot comes to mind. Pushing 60. Gray hair. Probably logged over 1,000,000 miles. Thank you, pilot, God bless you.

Wayne,

Have you ever considered the endless number of unusual experiences, both humorous and serious, that have befallen TDYers all over the world? They would make for a very entertaining book. How about a Cryptolog feature called something like "Can You Top This?" If people responded to it, it could ultimately make for a very intriguing collection of anec-\dotal tidbits. Attached is a case in point.

E. Leigh Sawyer

P.L. 86-36

PERSONAL COMPUTING

IN A GROUP (U)

by [   ] A63

Introduction

(U) This paper is a slightly expanded version of a paper given at the CISI Spring Conference in May 1984.

Relevancy of the topic. The subject matter of this paper is particularly relevant for at least three related reasons. First, personal computers are relatively new at NSA. In fact, they arrived on a large scale less than a year ago beginning around November 1983. Second, they are numerous. It is estimated that there are over 2,000 personal computers at NSA at present. Third, because they are new and because there are a lot of them, questions are being raised regarding their usefulness and their capability of being applied to every day agency problems as well as their effect on the organizations that have acquired them.

Currency of the data. Since they are so new at NSA, it is not illogical to assume that any study concerning personal computers that is undertaken at this time will find the data in a state of flux. It is, therefore, worthwhile to note that all the data that was gathered for this study is current as of April 1984 and is subject to change.

Definition by features of 'personal computer'. In order to properly discuss any subject, it is useful to define it in sufficient terms so that any misunderstanding resulting from its mention will be minimized. Accordingly, for the purposes of this paper, we define 'personal computer' to be a single user micro computer programmable by the user, and

with a price under $10,000. The three essential features in this definition, as discussed below, effectively define the set of 'personal computers' to include systems such as IBM PC, IBM PC/XT, TRS 80, and Apple II, to mention just a few.

On the other hand, examples of systems not members of the set include the Hewlett Packard 9845, Wicat Systems 150WS, and the Xerox 860. The first does not meet the set criteria since its cost is in the $30,000-and-above range. The second is a multiuser microcomputer system with a base price in excess of $10,000 and thus it fails to satisfy two out of the three set criteria. The last system does not qualify as a member of the set since it is a dedicated word processor and not programmable by the user.

Single user. The 'single user' feature means that the resources of the computer are not shared and are for the exclusive use of a single user under normal circumstances. Although there is at least one operating system for microcomputers out on the market that is advertised as a multiuser system (Venix, a UNIX look-alike), the vast majority of personal computers are not equipped with the required hardware or software to handle more than one user at a time.

Average cost under $10,000. Although the 'price under $10,000' feature seems arbitrary at first glance, there is some supporting evidence for such a choice. In the April 1984 issue of PC WORLD, 46 personal computers were compared in terms of cost and hardware features. They ranged in price from a low of $1995 to a high of $14,995. It is notable, however, that only one system out of the 46 reviewed cost more that $7300--the GRiD Tempest, a briefcase portable with 256K of RAM, 384K of bubble memory, and a 300/1200 bps modem to list just a few features. The average cost for all 46 personal computers reviewed was $3723--well under $10,000.

Programmable by user. The 'programmable by the user' feature was included as part of the definition to exclude turnkey systems dedicated to a specific function--such as standalone word processors. Normally, these kinds of microcomputers do not have the software necessary to allow the average user to write and execute programs on them.

Collection of the data. An informal phone survey was used to determine the organizations within A Group that have personal computers. A questionnaire was then prepared that covered the following topics:

(1) type and quantity of personal computers;

(2) off-the-shelf personal computer software used;

(3) applications on personal computers;

(4) operational policies regarding personal computers;

(5) problems and concerns relating to personal computers; and

(6) personal computer hardware and software support.

The questionnaire was then applied in personal interviews arranged with each organization in A Group that was determined to have personal computers. A total of 34 organizations were interviewed.

Although the results of the interviews revealed a fairly large proportion of interesting and innovative applications using personal computers, a detailed description of these ap-

plications is beyond the scope of this paper.

Topic arrangement. The topics covered in this paper are roughly the same as those covered in the questionnaire. Section 2 covers the distribution of personal computers in A Group. Sections 3 and 4 deal with off-the-shelf and custom software and the way in which they are applied. On the other hand, the final sections deal more with the human aspect: section 5 examines operational policies for personal computers, section 6 takes a look at users' problems and concerns, while in section 7 user support for personal computers is investigated.

2. Distribution of personal computers in A group

This section looks at several aspects relating to the distribution of personal computers throughout A Group: the distribution of current hardware in relation to the distribution of proposed hardware, the ratio of users to personal computers, the types of personal computers and the quantity of each, the functional break-down of personal computers, and the distribution of personal computer usage.

Figure 1

PCs In A Group By Office
Current and Proposed Equipment

Totals: 92 current + 129 proposed = 221
Current PCs   Proposed PCs
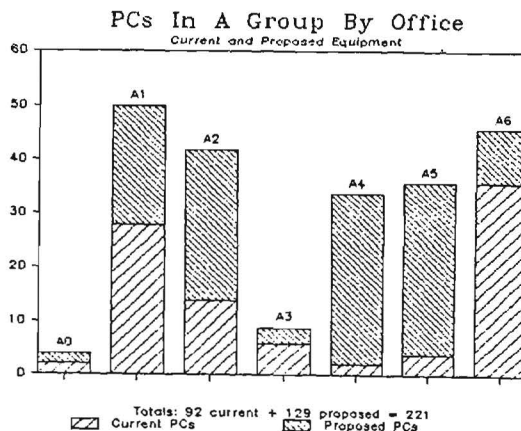
Current and proposed quantity of personal computers. In Figure 1, the data show that A Group currently has a total of 92 personal computers with another 129 systems proposed for the next six-month to one-year period. It should be pointed out that some organizations indicated that they would like to acquire a quantity of agency standard terminals (AST) in the coming year. Since, however, the AST has not yet been officially selected, it remains an unknown and for this reason data of this type were not included with the data for proposed acquisitions.

The distribution by Office is as follows. A0 currently has two personal computers and would like an increase of two in the next year for a total of four. A1 has at present 28 and desires 22 additional units for a total of 50. There are currently 14 personal computers in A2 and 28 new units are desired for the coming year for a total of 42. A3 would like to increase its current six units by three for a total of nine. A4 presently has two personal computers and would like 14 units in the coming year. A5, with four personal computers at present, would like to add 32 new units in the coming year. Finally, A6 currently has 36 personal computers and would like 10 additional units in the coming year.

Numerical comparison of users to personal computers. The data indicate that throughout A Group there is an overall user-to-personal computer ratio of 3.39 to 1 with 312 users for 92 personal computers. As shown in Figure 2, these data are broken down by Office with the greatest concentration of users and personal computers appearing in A1, A2 and A6. The totals are as follows:
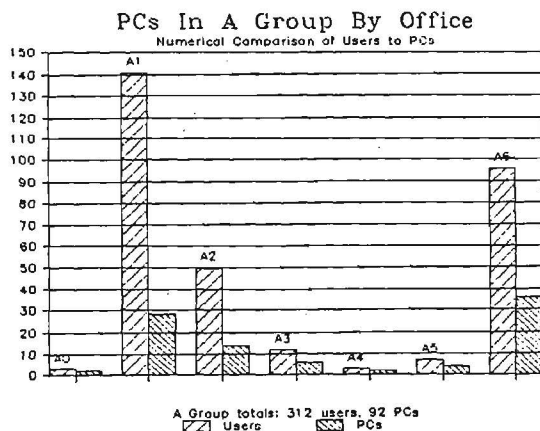
A0: 3 users, 2 personal computers (1.5 : 1)
A1: 141 users, 28 personal computers (5 : 1)
A2: 50 users, 14 personal computers (3.6 : 1)
A3: 12 users, 6 personal computers (2 : 1)
A4: 3 users, 2 personal computers (1.5 : 1)
A5: 7 users, 4 personal computers (1.8 : 1)
A6: 96 users, 36 personal computers (2.7 : 1)

Types of systems and their distribution. The data in Figure 3 show that there are only five types of personal computers in A Group that satisfy the criteria outlined in Section 1.3 above. These are: IBM PC (74 units), IBM PC/XT (9 units), Radio Shack TRS 80 (5 units), Apple II (2 units) and Tri-information Systems BTS 2000 (2 units).

Typical equipment configurations. In investigating the equipment configurations for each of the five types of personal computer, it will be noticed that color monitors are conspicuously absent. One of the main reasons for this absence seems to be that color monitors currently are TEMPEST approved only for zones 4 through 5. Another general trend due to the TEMPEST character of the equipment is the almost total lack of hard disk drives. There are only seven personal computers in A Group with hard disk drives at present.

Figure 3

Types Of PCs In A Group
92 Total Units

BTS 2000 (2.2%)   APPLE II (2.2%)
IBM PC/XT (9.8%)

TRS 80 (5.4%)

EO 1.4. (c)
P.L. 86-36

IBM PC (80.4%)

Figure 2

PCs In A Group By Office

Numerical Comparison of Users to PCs

A Group totals: 312 users, 92 PCs
Users   PCs
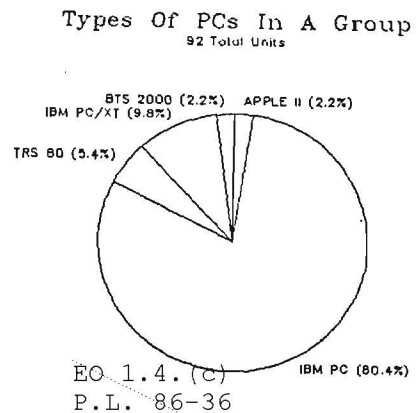
configurations include 2 floppy disk drives and a printer--usually a dot matrix graphics printer. Typical equipment configurations for each of the five types of personal computer are listed below.

IBM PC. Most of the IBM PCs have 2 floppy drives, 1 printer, a monochrome monitor and 128K, 256K, 384K or 512K of RAM--depending in part on how they were acquired. Those units acquired through the PCIC come with 512K of RAM, while personal computers acquired by sole source or competitive bid vary in the amount of memory and type of peripherals according to the organization's requirements at the time. IBM PCs used only as dumb terminals do not, in general, have printers.

IBM PC/XT. As a general rule, the standard configuration for IBM PC/XTs is 512K of RAM, 1 floppy drive, 1-10M hard disk drive, 1 printer and a color monitor. As indicated elsewhere, seven of the nine IBM PC/XTs have color monitors.

Radio Shack TRS80. Aside from the usual personal configuration of 2 floppy drives (one has 3 floppy drives), 1 printer and a monochrome monitor, the TRS 80s have either 48K or 128K of RAM.

Apple II. While both Apple IIs have 2 floppy drives and a printer, one has 48K of RAM and a monochrome monitor and the other has 184K of RAM and both a color and a monochrome monitor.

BTS 2000. Both BTS 2000s have 64K of RAM, 2 floppy drives, 1 printer, a monochrome monitor, and 3 communications ports.

Functional break-down. The question posed here was how many personal computers are being used solely as dumb terminals as opposed to, stand-alone computers. As indicated in Figure 4, there are personal computers in A1, A2, and A5 that are used only as dumb terminals. 86% (or 79) of the current personal computers in A Group are being used only in stand-alone mode, while 14% (or 13--8 in A1, 4 in A2 and 1 in A5) are being used as dumb terminals.

Figure 4

PCs In A Group By Office
Stand-alone vs Dumb Terminal Usage

Stand-alone   Dumb terminal
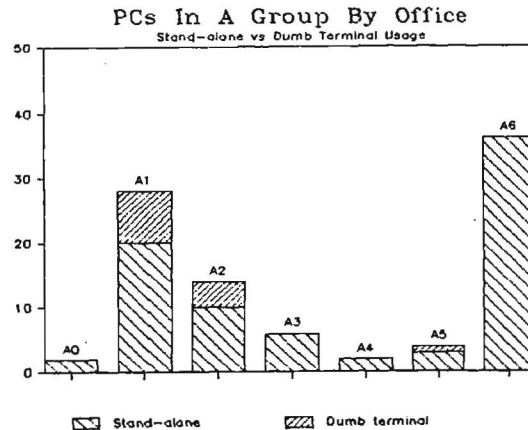
Present and future acquisition methods. Three principle means of acquiring personal computers have been used in A Group:

(1) PCIC;

(2) sole source procurement; and

(3) loan from another organization.

64% of the organizations interviewed indicated they would not change their method of acquiring personal computers in the coming year.

Use of personal computers on a daily basis. The data in Figure 5 indicate that the average time per day that personal computers are used in A Group is 5.77 hours. Personal computer usage broken down by Office is most in A1, A2 and A4. It should be noted that a contributing factor to the high daily average in A1 is the fact that six personal computers are being used as dumb terminals 24 hours per day. The Office averages are as follows:

Figure 5

4. Applications

PC Use In A Group By Office
Average daily PC use

A Group Average: 5.77 Hrs/Day
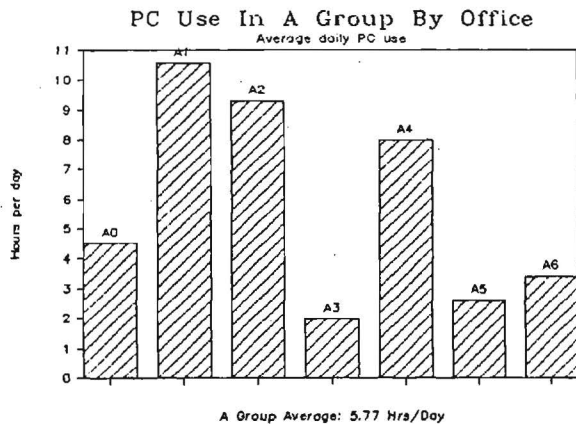
AO: 4.5 hours per day
A1: 10.6 hours per day
A2: 9.3 hours per day
A3: 2 hours per day
A4: 8 hours per day
A5: 2.6 hours per day
A6: 3.4 hours per day

3. Off-the-shelf software

Figure 6 shows the off-the-shelf software that is currently being used in A Group. Organizations were also asked to subjectively rate the software they use on a 1 to 10 scale of poor to excellent. The results are shown in column three. Note that the software with the greatest number of users (seven or more) is available through the PCIC. Looking at the packages (exclusive of the operating system MS DOS) which have the greatest amount of users, it is interesting to note that 56% of the dBaseII users had specific complaints--which may account for its 6.8 overall rating. On the other hand, only 33% of Word Star users and 37.5% of Lotus123 users had complaints about these packages. The complaints referred to were in response to question number 10 of the questionnaire: "what needs of your organization are not being met by current off-the-shelf software?"

Three general categories of applications are examined in this section: applications with off-the-shelf software, applications with custom designed and written software and applications which interface off-the-shelf software with custom written software. It should be noted, however, that there are currently only two examples of the third category in A Group. For this reason as well as the fact that one of these applications uses only off-the-shelf software, Figure 7 treats them as commercial software applications.

The purpose of the data arrangement in Figure 7 is to show how organizations use their personal computers. Notice that 50% of the 34 organizations interviewed have applications using off-the-shelf software only while 35% of these organizations have applications using both off-the-shelf software and custom-written software. Only 6% have only custom-written applications, while 9% have no applications. Organizations with no applications are, in general, using their terminals as dumb terminals only.

Applications with off-the-shelf software. Off-the-shelf software is being used in A Group in three principle ways: for text processing, for management or project tracking systems, or for data base applications.

Text processing. The software being used for this type of application is Word Star, Volkswriter, Easy Writer, Edix + Wordix, and Professional Editor. At least four organizations indicated that they use Word Star as a program editor, while one organization uses it to produce graphics-like charts.

Tracking systems for management and projects. The software used in this type of application is Lotus123, Multiplan, and Supercalc--the spreadsheet packages. In general, these applications are relatively small.

Data base applications. For the purposes of this survey, a data base on a personal computer is classified as small (less than 50,000 bytes), medium (50,000 to 175,000 bytes), and

Figure 6

PERSONAL COMPUTER OFF-THE-SHELF SOFTWARE IN A GROUP
Average Rating by Users on a 1-10 Scale

software name	hardware	rating	number of responses
APPLE DOS	APPLE	8	1
APPLE PASCAL	APPLE	8.5	2
CONDOR	IBM	7.8	2
CP/M	APPLE	7	1
o DBASE II	IBM	6.8	16
DDIT	IBM	9	1
EASY WRITER	IBM	4.5	2
EDIX + WORDIX	IBM	8	1
LATTICE C	IBM	7.3	5
o LOTUS 123	IBM	8.8	8
MAXIMANAGER	TRS 80	8	1
o MS DOS	IBM	7.7	22
o MS DOS BASIC	IBM	8	7
o MULTIPLAN	IBM	6.6	7
NORTON UTILITIES	IBM	9	1
OPEN ACCESS	IBM	8	1
PC CRAYON	IBM	6	1
PC FILE 3	IBM	8	1
PC/IX	IBM	8.5	2
PFS FILE	IBM	7	1
PFS REPORT	IBM	7	1
PL/I-86	IBM	8	3
PROFESSIONAL EDITOR	IBM	6	2
PROFILE 3 PLUS	TRS 80	10	1
QUICKCODE	IBM	9	1
QUNIX	IBM	8.3	2
QUNIX C	IBM	7	2
R:BASE 4000	IBM	9	2
SCRIPSIT	TRS 80	8.3	3
SUPERCALC	IBM	6	2
SUPERSCRIPSIT	TRS 80	7	1
VOLKSWRITER	IBM	9	1
o WORD STAR	IBM	7.8	21

Figure 7

APPLICATIONS WITH PERSONAL COMPUTERS IN A GROUP
===
(34 divisions or branches interviewed)
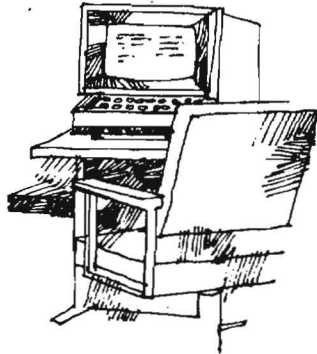
IN-HOUSE
CUSTOM-WRITTEN
APPLICATIONS

		none	one	multi
	none	3	2	0
COMMERCIAL				
SOFTWARE	one	8	2	0
APPLICATIONS				
	multi	9	7	3

TOTAL ORGANIZATIONS: 20   +   11   +   3   =   34

large (over 175,000 bytes). For the data base software currently being used, it is a given that a data base is limited to the size of the disk--with the exception of those systems with hard disks this means an upper limit of about 300,000 bytes (exclusive of any indexes).

The software used is mostly dBaseII with a very small number of applications using Condor and R:Base 4000. dBaseII applications range from small data bases to large data bases with typical applications being inventory control, personnel tracking, job profile tracking, and clearance tracking. For organizations using dBaseII, ten have small data base applications, two have medium data base applications, and four have large data base applications.

Applications with custom designed and written software. The most varied applications are those that are custom designed and written using a programming language such as BASIC, C, or Pascal. Although, as Figure 7 shows, only 41% of the organizations interviewed have written any custom designed software, they are broken down into seven functionally different applications. These applications are categorized by Office as follows:

A1: a text editor written in C and two separate device control software projects written in C and BASIC, respectively

A2: collection processing and reporting in the field

A3: signals analysis software using Pascal on an Apple II

A5: graphics written in C

A6: text format translation from personal computer format to a format compatible with PWB, written in BASIC and collection management software written in C

Applications interfacing different software packages. A1 has a budget planning system that interfaces Lotus123, Word Star and dBaseII. A6 has an educational software application that interfaces dBaseII with custom software written in BASIC.

5. Operational policies and procedures

In general, it seems that there is an absence of formal operational policies regarding personal computers due to the lack of large enough concentrations of personal computers in any one organization. The two exceptions in A Group, A4 and A6, are discussed below. The remainder of A Group organizations have in general some informal procedures they follow that deal with security and training, for the most part. Informal security procedures include periodic back up of files, locking up data diskettes at night, ensuring that the personal computer is turned off at night, while training involves either getting a manual and learning by trial and error, using an automated tutorial, if available, or having an experienced user tutor the new user.

On the other hand, both A4 and A6 have formal written operational policies (A4's is still in draft form). The topics covered in the draft version operational policy of A4 are: security, standardized files, procurement of software, supplies, management of hardware, and assistance.

A63, with the largest single concentration of personal computers in A Group, has two operational policies: one dealing with installation and the other with operation. The IBM PC Hardware/Software Installation Plan covers:

[] installation phases;
[] installation personnel;
[] installation schedule;
[] equipment control;
[] identification of standard software package;
[] software distribution plan;
[] identification of IBM PC supplies to be stocked; and
[] training schedule, material, and categories.

The IBM PC Hardware/Software Policy deals with the following topics:

[] hardware management;
[] acquisition and distribution of supplies;
[] maintenance;
[] software evaluation;
[] software management;
[] training; and
[] security.

6. Problems and Concerns

The final question on the questionnaire asks the interviewee to list any problems or concerns the organization has, in general, regarding personal computers. Out of a total of 34 organizations interviewed, 25 indicated that they had such problems and concerns. A total of 66 problems/concerns were listed for an average of 2.6 per organization. The responses fall roughly into six categories:

[]   acquisition and installation of hardware and software;
[]   training and support;
[]   general operation and maintenance of hardware;
[]   human interface with the hardware and software;
[]   intermachine communications; and
[]   security.

Acquisition and installation of hardware and software. Sample responses were:

[]   no dust covers are provided or are generally available;

[]   not enough personal computers are available: waiting for the AST impedes acquisition of personal computers which it may render obsolete;

[]   there are too many bureaucratic levels to go through in the procurement process;

[]   supplies are hard to get and there are many delays;

[]   there is a need for color graphics, but the standard configuration does not have a color monitor; and

[]   there is no mechanism for upgrading the personal computer hardware.

Training and support. Among the problems listed were

[]   software manuals are difficult to understand and use;

[]   personal computer training and support is not centralized, thus causing the user to waste time and effort learning by trial and error;

[]   there is an overall lack of planning for training and support and not enough to go

around;

[]   training at the branch and division level needs to be conducted regarding the usefulness of personal computers; and

[]   software evaluations need to be centralized, published and distributed on a regular basis to the users.

General operation and maintenance of personal computer hardware. Typical problems listed in this category were:

[]   the graphics printer is too slow;

[]   personal computer response time is too slow; and

[]   there is not enough memory or peripheral storage for some applications.

Human interface with personal computer hardware and software. Some sample responses in this category were:

[]   the keyboard is poorly designed and therefore difficult to use accurately;

[]   images on the monochrome monitors are fuzzy and difficult to read, which causes eye strain;

[]   the available software and documentation are too complex for user requirements and difficult to understand;

[]   there is not enough space to put the personal computers;

[]   the graphics printer is too loud and disturbs co-workers; and

[]   several personal computers in the same area give off enough heat to make the room uncomfortably warm.

Intermachine communication. This category includes problems expressed concerning networking as well as communications to a host computer. Sample problems listed were:

[]   networking is not being addressed despite a requirement for it;

[]   the reliability of file transfer between a host and personal computer is doubtful;

[] there is a need to have communications hook up to main frames;

[] there needs to be an efficient, quick method for inputting large quantities of information from a host computer; and

[] there is a need for Xerox 860 compatibility.

Security. Problems listed under this category included:

[] there is a need for a removable hard disk capability;

[] organizations fear the proliferation of compartmentalized data;

[] there is no password security; and

[] TEMPEST should be done before acquisition of hardware.

7. Support

The questions addressed in this section deal with where A Group personal computer users currently get hardware and software support, if any, and the existence of a local, centralized support within A Group.

Sources currently cited by A Group users. Figure 8 shows that seven sources for personal computer support were cited. These include: 'individuals in A Group', A109, A63, B6, the PCIC, T2, and T3. Interestingly enough, eleven organizations (32%) indicated that they receive no support at all. A slightly larger number indicated that A63 provides support-- although it should be borne in mind that four- teen of the organizations interviewed are in A6. In other words, it would seem that the role of A63 to provide computer applications support for all of A Group is not yet widely understood--at least in the context of personal computers.

Figure 8

According to official A63 memoranda dated 22 February and 1 May, A63 is equipped to provide the following support to A Group personal computer users:

[] hardware/software consultation,

[] software demonstrations and training;

[] hardware demonstrations and training;

[] off-the-shelf software evaluations; and

[] a personal computer users group.

The PC users group meets once a month for an hour and is an excellent opportunity for A Group users to exchange ideas and discuss mutual problems. In addition to these services, A63 currently provides personal computer applications development support to A606 and A2.

8. Conclusions

PCs have been in A Group only a relatively short length of time and thus it should be stressed that the situation regarding PCs in A Group is transitory and will likely change in many ways. There is naturally some reticence on the part of prospective users who are used to the power of a main frame to recognize the utility of the PCs. At the same time, in-house training and software evaluation were not initially available to user's on an official basis and are only now starting to develop. As a result, inexperienced users are experiencing some frustration and hence many PCs are not being fully utilized. Other reasons include the fact that most organizations do not have communications to main frames yet although they have a requirement to work with data stored on the main frame.

Current PC Hardware/Software Support
Sources Cited By A Group Users
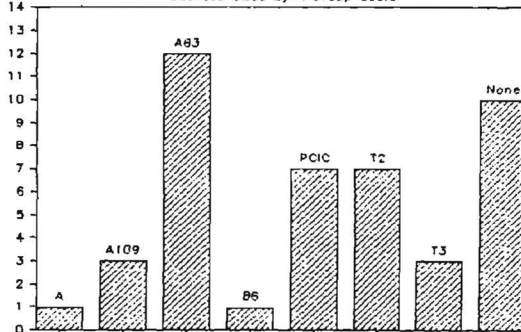
(Dual sources cited in some cases)
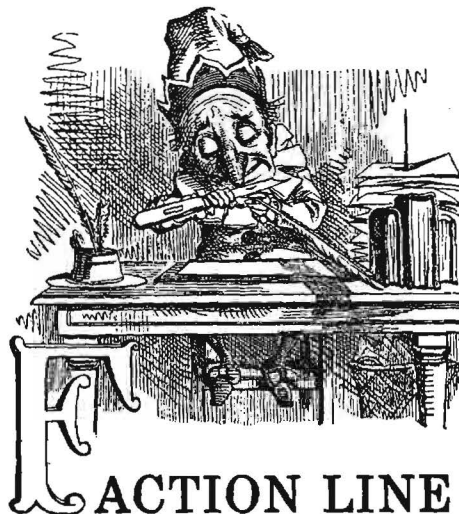
FACTION LINE (U)

Dear Faction Line:

Something must be done before it is too late! We are approaching a situation akin to the "critical mass" in the cafeteria. I refer to the "to and fro gang." You can see them any day wandering about looking for a table, knuckles growing white holding their trays as desperation assails them, their eyes flickering endlessly in 360° sweeps, and their food, so near yet so far, growing cold. What is needed are bold and innovative measures. A few of these are addressed as follows.

Make people eat faster. This may be subdivided into two categories: (1) chewing and (2) gulping. It is suggested that M7 monitor chewing and gulping norms as they currently exist on the part of those eating in the cafeteria. Based upon physiological stress standards as they affect the alimentary tract, it is believed that more rapid chew and gulp rates may be achieved. Special courses or seminars to this end could be established in order to enable personnel to meet newly prescribed standards for chewing and gulping. In order to raise motivations, a new skill field in this area should be established which could lead to certification and even bonuses, e.g., FLAP (Food Loading Acceleration Pay). Further, for those achieving chew/gulp rates (CG/r) faster than prescribed, compensatory leave should be allowed. This could be achieved by a time card check in/check out system at the entrance to the cafeteria or even possibly tied into the new badge system by assigning everyone a "GIN" (Gastronomic Intake Number).

Use larger forks: doubling the size of forks would double intake. In this regard, forks should be provided in two configurations: one twice the length and one twice the width in order to conform to varied oral specifications. The large fork factor (LFF) when combined with CG/R would materially accelerate consumption time (CT). In short, LFF + CG/R = CT. The same approach should be used for spoons, and, when peas are on the menu, knives. Thus we can also add both large spoon factor (LSF) and a large knife factor (LKF). Therefore, even when a person has soup, and a hot plate with peas, it still obtains that

$$CG/R + LFF + LKF + LSF = CT.$$

Use higher tables or lower chairs. This lessens the distance the arm must travel between plate and mouth. The optimum distance is suggested as two inches, as opposed to the more normal distance of 18 inches. This would increase by a factor of 9 the rate of food intake (9 x RFI). When combining RFI with increased CG/R and the realization of LFF/LSF/LKF, CT should be reduced to approximately three minutes, a savings of 27 minutes based upon current standards. When calculated against a loss of $300,000,000 per annum for the nonproductive cafeteria time of 15 extra minutes a day beyond the prescribed half hour, the savings of 27 minutes a day would add $540,000,000 of production rate per annum beyond the normal work year of the federal establishment. With perhaps $40,000,000 of this employed to subsidize free antacids, the new cost-out of increased production rates would still be substantial. Lets move out smartly! It is time to clip the wings of this octopus!

Cal 2. Lator

NSA-Crostic No. 59

by David H. Williams

> Here's another puzzle in the cryptic vein. If you're not familiar with this type of definition, and would like to give it a try, call the author on 1103s, and you'll be sent an explanation of how these clues are put together.

★	★	1 V	★	2 S	3 C	4 P	5 G	6 D	7 E	8 I	9 B	10 A	11 T	★	12 G	13 U	14 S	15 J
16 E	★	17 R	18 M	★	19 Y	20 P	21 B	22 G	23 M	24 S	★	25 V	26 P	27 E	28 A	★	29 K	30 A
31 P	32 B	33 C	34 G	★	35 S	36 B	37 A	38 K	39 G	★	40 N	41 H	42 L	43 G	★	44 N	45 V	46 L
★	47 Y	48 L	49 T	50 B	51 D	★	52 Q	53 P	★	54 Q	55 I	56 S	57 Y	58 N	★	59 I	60 S	61 F
62 A	63 V	64 P	65 H	66 G	67 D	★	68 Y	69 M	70 I	71 P	72 S	73 G	★	74 U	75 E	76 I	77 D	★
78 E	79 J	80 Y	81 D	82 O	83 I	84 G	★	85 A	86 C	87 F	★	88 V	89 D	90 H	91 Y	92 O	93 I	94 G
95 J	★	96 G	97 P	98 S	99 Q	100 E	101 X	102 A	103 T	104 K	★	105 E	106 V	107 R	108 B	109 C	110 G	★
111 W	112 U	★	113 Z	114 E	115 a	★	116 J	117 C	118 P	119 B	120 N	121 O	122 U	123 G	124 I	★	125 X	126 G
127 I	128 D	129 P	130 E	131 O	★	132 M	133 U	134 S	135 E	★	136 G	137 X	138 P	139 B	140 Y	★	141 I	142 a
143 E	144 Y	145 B	146 P	★	147 J	148 A	149 P	150 W	151 E	★	152 a	153 R	154 N	★	155 I	156 S	157 A	158 X
159 C	160 F	161 T	162 P	163 Y	164 F	★	165 O	166 H	167 I	★	168 T	169 D	170 Z	★	171 F	172 P	173 a	174 T
175 Y	★	176 B	177 D	178 Z	179 M	180 P	★	181 D	182 K	183 W	★	184 S	185 Y	186 R	187 B	188 R	189 I	190 P
191 G	192 E	193 C	★	194 R	195 B	196 P	197 C	198 I	199 A	200 H	★	201 P	202 B	203 I	204 G	205 A	206 H	★
207 a	208 F	★	209 P	210 B	211 V	212 J	213 Q	★	214 I	215 E	216 N	★	217 T	218 S	219 L	dhw	★	★

A. Did Dale counterfeit tickets to battle-ground (2 wds)

102 30 205 10 199 28 85 62 157 37 148

B. When visiting with a boor, never sing Dorothy's great song (3 wds)

108 21 139 195 50 202 36 119 210 32

145 9 187 176

C. Call this Greek by phone on Roman 10

117 109 33 3 197 159 86 193

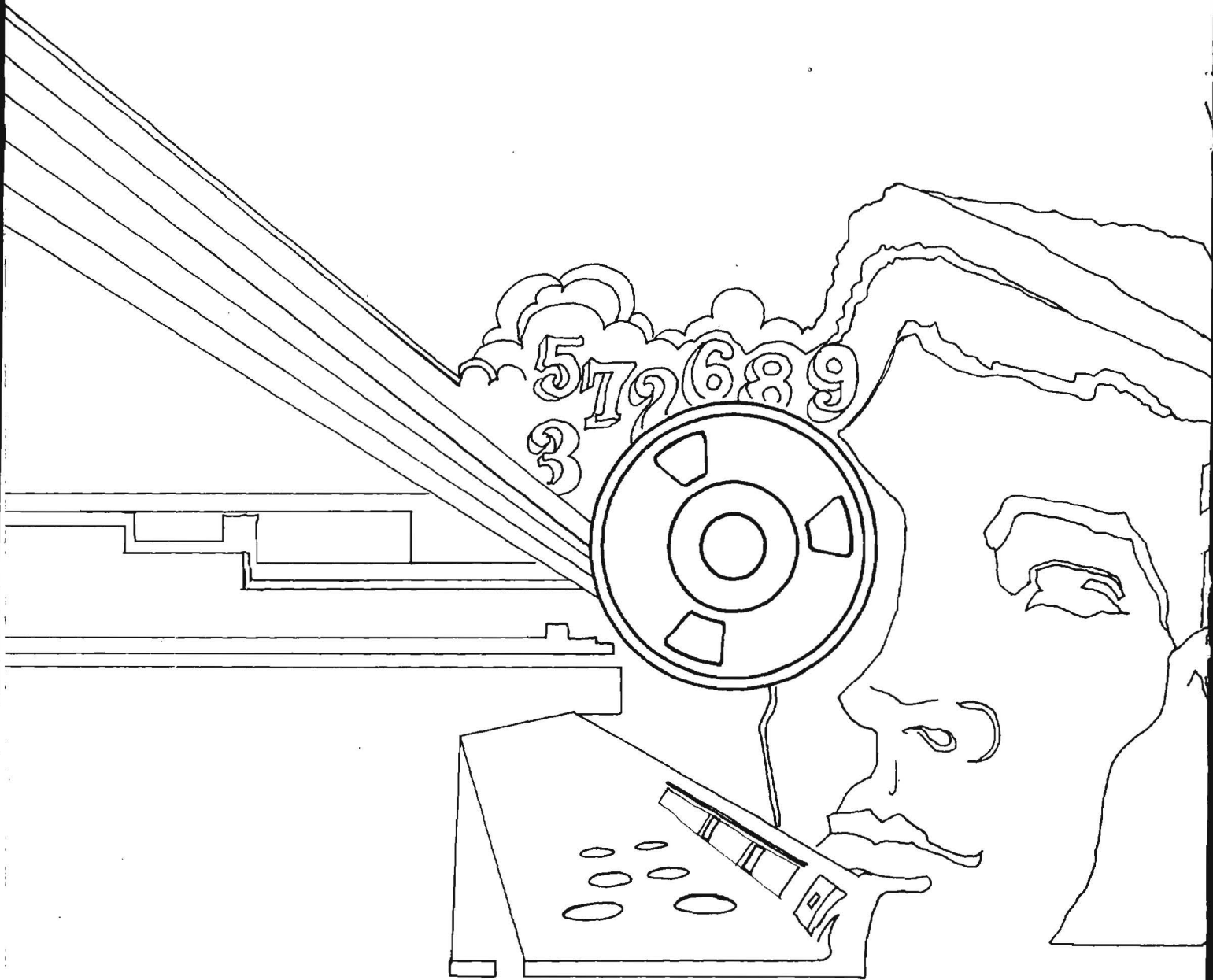D. Ax me not where to bury this (2 wds)

67 169 77 177 81 128 6 51 89 181

E. Where the much bejeweled lady wore her sixth ring (4 wds)

192 143 135 105 7 215 27 100 75 78

151 114 130 16

F. Ease peas are for the doctor

$\overline{61}$ $\overline{208}$ $\overline{160}$ $\overline{171}$ $\overline{164}$ $\overline{87}$

G. Try to use Indian blight in indiscernible circumstances

$\overline{191}$ $\overline{39}$ $\overline{84}$ $\overline{22}$ $\overline{110}$ $\overline{12}$ $\overline{126}$ $\overline{66}$ $\overline{34}$ $\overline{204}$

$\overline{5}$ $\overline{73}$ $\overline{43}$ $\overline{136}$ $\overline{96}$ $\overline{123}$ $\overline{94}$

H. Frank camera

$\overline{90}$ $\overline{65}$ $\overline{166}$ $\overline{200}$ $\overline{41}$ $\overline{206}$

I. "The New Colossus": The *other* structure with which Alexander Eiffel was associated (3 wds)

$\overline{93}$ $\overline{127}$ $\overline{8}$ $\overline{70}$ $\overline{189}$ $\overline{55}$ $\overline{203}$ $\overline{214}$ $\overline{141}$ $\overline{59}$

$\overline{155}$ $\overline{83}$ $\overline{76}$ $\overline{198}$ $\overline{124}$

J. He wanted Ned, Dee and Sam

$\overline{15}$ $\overline{79}$ $\overline{212}$ $\overline{95}$ $\overline{116}$ $\overline{147}$

K. Cross off King Tut's middle name

$\overline{38}$ $\overline{29}$ $\overline{104}$ $\overline{182}$

L. Ran into little Edward and gave him his share

$\overline{219}$ $\overline{48}$ $\overline{42}$ $\overline{46}$ $\overline{167}$

M. Bury between

$\overline{69}$ $\overline{18}$ $\overline{132}$ $\overline{23}$ $\overline{179}$

N. These reptiles enjoy tea amid the cardinal points

$\overline{58}$ $\overline{120}$ $\overline{40}$ $\overline{44}$ $\overline{154}$

O. Literally, Greek magma

$\overline{131}$ $\overline{165}$ $\overline{121}$ $\overline{82}$ $\overline{92}$

P. In a state of stimulation, it has a fixed period of expiration (3 wds)

$\overline{201}$ $\overline{118}$ $\overline{149}$ $\overline{4}$ $\overline{196}$ $\overline{64}$ $\overline{180}$ $\overline{20}$ $\overline{53}$ $\overline{172}$

$\overline{129}$ $\overline{31}$ $\overline{26}$ $\overline{138}$ $\overline{162}$ $\overline{190}$ $\overline{71}$ $\overline{97}$ $\overline{209}$ $\overline{146}$

Q. Auto pioneer after whom *two* cars were named — the other one being the Reo

$\overline{52}$ $\overline{54}$ $\overline{213}$ $\overline{99}$

R. That liver I ate made me feel very macho

$\overline{186}$ $\overline{153}$ $\overline{107}$ $\overline{17}$ $\overline{188}$ $\overline{194}$

S. That mineral I bent seemed to go on and on and on

$\overline{156}$ $\overline{2}$ $\overline{24}$ $\overline{72}$ $\overline{184}$ $\overline{60}$ $\overline{218}$ $\overline{56}$ $\overline{134}$ $\overline{35}$ $\overline{98}$ $\overline{14}$

T. This Latin is amid late back type of drug

$\overline{11}$ $\overline{168}$ $\overline{217}$ $\overline{103}$ $\overline{174}$ $\overline{49}$ $\overline{161}$

U. Tossed with rewarding results

$\overline{112}$ $\overline{133}$ $\overline{13}$ $\overline{122}$ $\overline{74}$

V. Enchanted, he marched off

$\overline{25}$ $\overline{45}$ $\overline{1}$ $\overline{63}$ $\overline{211}$ $\overline{106}$ $\overline{88}$

W. Caesar's white road

$\overline{111}$ $\overline{150}$ $\overline{183}$ $\overline{216}$

X. This African grain is not efficient

$\overline{158}$ $\overline{101}$ $\overline{125}$ $\overline{137}$

Y. When I saw rainbow effect on iced screen, I cried

$\overline{144}$ $\overline{140}$ $\overline{57}$ $\overline{47}$ $\overline{175}$ $\overline{19}$ $\overline{68}$ $\overline{185}$ $\overline{80}$ $\overline{163}$ $\overline{91}$

Z. Los Angeles Ram's embraceable one

$\overline{178}$ $\overline{113}$ $\overline{170}$

a. He laughed as he bantered with the African queen

$\overline{115}$ $\overline{152}$ $\overline{142}$ $\overline{207}$ $\overline{173}$