enter the files. The files previously used in the laboratory had the known spectra arranged by molecular weight, and great difficulty was encountered in identifying a sample if the molecular weight was unknown. With the present system, the chemical class can be combined with the peaks present in the spectrum to locate similar spectra of knowns. In addition, unknowns can be identified readily by nonprofessional laboratory assistants.

Chemists from non-mass spectral laboratories can use this system to check confirming spectra of their compounds. The use of the system does not require knowledge of mass spectrometry, and thus it can be used by anyone.

LITERATURE CITED

(1) Zemany, P. D., *Anal. Chem.* **22**, 920 (1950).
(2) Haefele, C. R., and J. F. Tinker, J. CHEM. DOC. **4**(2), 112 (1964).
(3) McLafferty, F. W., and R. S. Gohlke, ASTM E-14 Committee Meeting on Mass Spectrometry, New Orleans, La., 1954.
(4) Crawford, L. R., and J. D. Morrison, *Anal. Chem.* **40**, 1464 (1968).
(5) Termatrex, Jonker Corp., Gaithersburg, Md.
(6) McLafferty, F. W., "Mass Spectral Correlations," Advances in Chemistry Series, No. 40, American Chemical Society, Washington, D. C., 1963.

An Evaluation of TEXT360 for Producing Reports*

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TEXT360, designed by IBM for use with Operating System/360, is a text-processing system with capabilities for entering, updating, correcting, and rearranging information for the production of printouts in a variety of page formats. TEXT360 is oriented primarily to the printing industry, and the program provided by IBM has imbedded in it the standards of the printing industry. Consequently, we found it necessary to convert these standards to those we need for the production of manuals, bibliographies, and other documents in a research environment which requires the 8½ x 11-inch page size rather than the different sizes of the printing industry. The several problems we encountered in the use of TEXT360 are discussed, with suggestions for solutions to the problems.

Although computers have been designed for and applied in numerical operations primarily, there has been considerable activity in the use of computers with text material.[1,2] This activity, for the most part, has been directed to typesetting environments, such as for the production of newspapers, books, and journals. An excellent example of a technical journal which is photocomposed on the Photon Photographic Type Composing machine using computer-generated tape is the American Chemical Society's *Journal of Chemical Documentation*.[3] All applications with text material reported so far have had typographic needs as the objective. Consequently, most of the features for which the computers have been programmed are related to type font and style. These features are of minor importance in a research environment.

There are many operations in a research environment, such as at the Hercules Research Center, that require the production of manuals, reports, bibliographies, and other text material on a continuing and updating basis. Because changes must be made, such as new information added, old information deleted or corrected, or because the information needs to be communicated in different formats, these operations are relatively time-consuming and expensive. We have been interested for some time, therefore, in applying our computers to text processing of in-house literature. The sophisticated programming required for such text-processing became available with the advent of IBM's TEXT360.[4]

MACHINE REQUIREMENTS

TEXT360 requires for input an IBM 29 keypunch and for output a minimum computer configuration of a System/360 Mod 40 with 128K of core storage and the Universal Instruction Set, and an IBM 1403 printer with Universal Character Set. The type of print train or chain used on the printer is determined by the output requirements, e.g., all caps, upper and lower case, and 64- or 120-character sets.

FEATURES OF TEXT360

The several standard features of TEXT360 are:

1. Automatic hyphenation of words at end of line.
2. Right margin justification by spacing between words and by hyphenation.
3. Specification of line width and page length.
4. Automatic numbering of pages.
5. Automatic printing of running heads.
6. Provision for prescribed indentions.
7. Choice of one- and two-column formats.

Other functions provided by the system, although more complex to apply and to execute, include the generation of horizontal and vertical lines for tables and charts, the

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keeping of related material—such as a table—together in one column or one page without splitting, the generation of footnotes in the proper column or page, the generation of Table of Contents and List of Figures from headings and figures in the text, and updating features.

The updating features provide for deletion, replacement, or insertion at the character, word, line, sentence, paragraph, or page level, moving text from one location to another, and merging information from two tapes.

INPUT

The TEXT360 program requires, as input, punched cards produced on a 29 keypunch.

The cards are punched in continuous, free format, using all 80 columns or any portion of the card. When all 80 columns are used, which is the recommended procedure, the TEXT360 program processes the input continuously, treating column 80 of one card and column 1 of the next as adjacent columns. This absence of a boundary between two cards imposes a constraint on the keypunch operator: when a word ends on column 80, column 1 of the next card *must* be left blank, as a blank must be used between all words. On the other hand, there are also advantages: there is no need for program card control; keypunching can be a continuous operation; the hyphenation feature of TEXT360 frees the keypunch operator from the problem of breaking a word correctly as column 80 is approached.

There is an exception to the one-blank rule for words. The end of a sentence requires two blanks, although the program interprets a period, exclamation mark, question mark, and colon plus one or more blanks as the end of a sentence.

Our keypunch operators, who are proficient with alphabetic input, produced punched card text for TEXT360 at the rate of 50 words per minute, or approximately 185 cards per hour. They did not experience any difficulty in applying the special characters required by TEXT360 for:

1. A single capital letter, *
2. Start of all upper case, @, and end of all upper case, @@
3. Indicating a card is blank beyond a given column, /
4. Start of underscoring, $, and end of underscoring, $$
5. Edit codes, –
6. Alter codes, +

EDIT AND ALTER INPUT CODES

Input is a combination of text and TEXT360 specification codes. Two series of specification codes are used: Edit codes and Alter codes.

Edit codes are indicated by a minus before and after the code characters. These codes control capitalization, paragraphing, line spacing, centering of headings, indenting and hanging indention, tabbing, and footnoting. Edit codes are inserted in the text wherever needed, and are reasonably straightforward to execute.

Alter codes are indicated by a plus before and after the code word or words. These codes control over-all format characteristics, such as printing the title, subtitle, and data at the top of each page; listing of Table of Contents and List of Figures; automatic pagination; single- or double-spaced lines; one- or two-column format; line length; number of lines per page; right-margin justification; etc. There is no need to specify a code, however, if lines are to be single spaced, as the "default" condition will automatically yield single-spaced lines.

An alter code is punched on a separate card, i.e., free of text; all alter code cards are placed in front of the cards containing the text and for which the alter code cards are specifications.

The most powerful specification in the TEXT360 program is the alter code

+DEFINE? n = $x...x$+

which defines a multioperation format function. In this alter code, n is the defined code number (from 1 to 15), and $x...x$ are the individual codes which specify the multioperation format function—viz., centering a line, selecting predefined headings, indenting, hanging indention, starting a new page, skipping of lines, selecting text to be printed in a supplement, underscoring, and capitalization. This alter code is of particular value in the production of annotated bibliographies. For example, in the following annotated journal reference (Item 3 in Figure 3):

> 3. GAS CHROMATOGRAPHIC ANALYSIS OF ALIPHATIC AMINES USING AROMATIC POLYMERS. J. R. Smith and D. J. Waddington (University of York) *Anal. Chem.* **40**, 522 (March 1968). To reduce peak tailing, polyethylenimine, tetraethylene pentamine, or KOH were used as coating materials; their roles as modificants are compared.

n is assigned a value of 1 for the title, 2 for the reference, and 3 for the abstract.

The complete alter codes defining the format of the above example are:

+DEFINE? 1 = SlI0J4@H+	for the title
+DEFINE? 2 = I4J4+	for the reference
+DEFINE? 3 = I4J0+	for the abstract

In these alter codes,

S1	=	double space (one-line skip) before beginning n = 1
I0	=	no indention for item number (3 in this case)
J4	=	indent 4 spaces for continuing lines of the title
@	=	begin upper case printing
H	=	continue upper case printing to end of n = 1
I4	=	indent 4 spaces for beginning of n = 2
J4	=	indent 4 spaces for subsequent lines of n = 2
I4	=	indent 4 spaces for beginning of n = 3
J0	=	no indention for subsequent lines of n = 3

The three tab cards containing the three separate alter codes precede the text input. In the tab cards containing the text, the following three codes are inserted:

–?1– before each title
–?2– before each reference
–?3– before each abstract

To change the format in the above example to a triple space (two-line skip) between lines, no indention of title and reference carry-over lines, and a double space (one-line skip) before beginning abstract, the codes would be changed

from	to
+DEFINE? 1 = S1I0J4@H+	+DEFINE? 1 = S2I0J0@H+
+DEFINE? 2 = I4J4+	+DEFINE? 2 = I4J0+
+DEFINE? 3 = I4J0+	+DEFINE? 3 = S1I4J0+

The advantage, of course, is that major changes can be made through replacing only the alter code cards, in this case only three. The alternative would be extensive repunching of cards containing text.

Indirect use of the +DEFINE+ code has been built into TEXT360 through the edit code, –P–. By definition and programming, this edit code provides for an automatic skipped line between paragraphs and an automatic 3-space indention at the beginning of each paragraph. Or the –P– is the same as using S1I3J0 as the *x*. . .*x* term of a +DEFINE+ code. The –P– not only saves one of the fifteen +DEFINE+ codes for other use, but, more importantly, contributes to keypunching efficiency, as –P– is considerably easier to key than is –?*n*–.

A particularly valuable feature of TEXT360 is the ease with which text can be put in a single-column or double-column format. To convert text from single-column to double-column, the alter code, +SWIDTH*nn*+ (where *nn* = the character width of the column), is removed and replaced by the alter code, +DWIDTH*nn*+ (where *nn* = the character width of each of the two columns). In the case of single-column text, no code is necessary if the TEXT360 default width, 43 characters, is satisfactory.

OUTPUT

TEXT360 produces two types of output: a draft or proof copy and a fully-formatted clean copy on any size paper or master the computer printer can handle. The two different outputs are illustrated in Figures 1 and 2, respectively. Figure 1 shows the TEXT360 processing-system production of page and line counts, the +DEFINE+ codes used, and the revision bars for each line; Figure 2 is the same text without the processing system-produced notations.

Proofing of TEXT360 draft copy for input spelling or other errors is no more onerous than proofing typewriter-produced text. The system-produced notations are readily ignored because of their location outside the text to be proofed. There is some advantage to TEXT360 draft copy, inasmuch as the proofreader is working with draft copy and not final copy, which imposes some limitation of handling and marking, particularly with offset masters The major difference between computer- and typewriter-produced copy is, naturally, the reduced amount of time required to proof corrected copy, or proofing only the corrected text *vs.* proofing completely retyped pages.

One advantage of proofreading TEXT360 is that computer-controlled hyphenation is more reliable for non-technical words than hyphenation controlled by the average typist.

Two factors that control readability of TEXT360 output are the print chain or train used and the specification supplied in the alter codes which control the over-all page format.

TEXT360 was designed to be used with a print chain or train with upper and lower case characters. The processing system, however, can be used with a chain or train with all upper case characters.

The improvement in readability by using an upper and lower case train should, of course, be balanced against other in-house needs for upper and lower case printout, the scheduling problems which may arise from the use of more than one train, the disadvantage of the need for experienced help in changing trains, and the additional cost of $100 per month for an extra train.

USING TEXT360 IN A RESEARCH ENVIRONMENT

The alter codes which control over-all page format offer a wide variety of combinations on width of line for either single- or double-column output, single- or double-spaced lines, and total lines per page. These combinations range from the built-in publishing industry standards of 47 characters per double-column text in double-spaced output of 68 lines per page to whatever one chooses, subject only to the restrictions of minimum and maximum column width.

Converting from publishing industry standards to the more common 8½ × 11-inch page size of a research

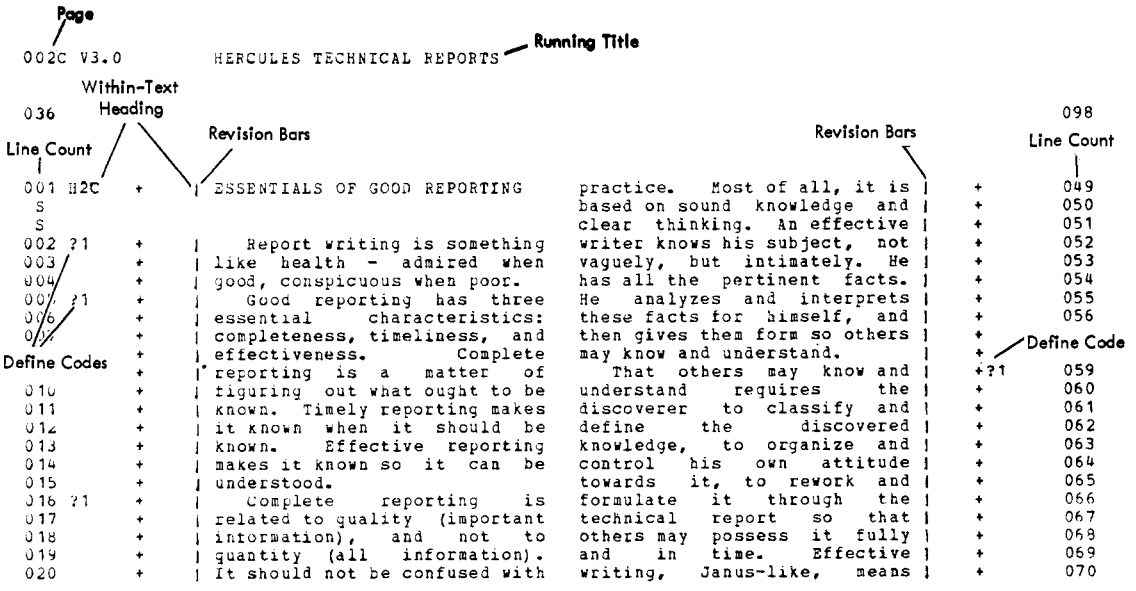

Figure 1. TEXT360 draft copy

environment becomes a matter of balancing the factors of all upper *vs.* upper and lower character trains against the type of document produced and how critical readability is to the users in an environment. For example, a telephone directory does not necessarily require the same readability as an annotated bibliography, although user incidence of the former is considerably greater, nor does an index to a large number of analytical methods require the same readability as the text of the analytical methods.

In those instances where readability is critical—e.g., in a bibliography, which requires use of upper and lower characters—the remaining decision to be made is single- *vs.* double-column text. Figures 3 and 4, respectively, clearly demonstrate the superiority of the single-column approach when the over-all width is kept within an 8½-inch page width with sufficient margin for filing in a ring binder. The excessive leading or spaces between words in the double column lines apparently is due to the fact that the TEXT360 processing system gives priority to right margin justification over hyphenation and priority to not hyphenating over hyphenating. This latter feature is more noticeable (Figure 4) when the text contains a large number of multisyllable words.

The ease of changing from single- to double-column format of any width provided by the alter codes of TEXT360 allows for unlimited trials with small input effort. It seems likely that such trials with each of the various typical document types in a research environment would be sufficient for selection of alter codes for any document within the same document type to meet a given readability criterion.

Computer time requirements vary considerably with the Model 360 computer used and, to some extent, within a specific model on whether an all-tape or an all-disk (except for output tape) system is used. The time requirements are also influenced by computer operation under batch, spooling, or multiprogramming.[5] Another factor is length of text being processed. Our experience indicates that the important factors are model size and length of run. Thus, a two-page run with a Model 40, all-disk approach except for output tape, under spooling, required about 10 minutes; a 30-page run with a Model 50, all-disk approach, without an output tape, under batching, required about 15 minutes.

HERCULES TECHNICAL REPORTS

ESSENTIALS OF GOOD REPORTING

Report writing is something like health - admired when good, conspicuous when poor.

Good reporting has three essential characteristics: completeness, timeliness, and effectiveness. Complete reporting is a matter of figuring out what ought to be known. Timely reporting makes it known when it should be known. Effective reporting makes it known so it can be understood.

Complete reporting is related to quality (important information), and not to quantity (all information). It should not be confused with practice. Most of all, it is based on sound knowledge and clear thinking. An effective writer knows his subject, not vaguely, but intimately. He has all the pertinent facts. He analyzes and interprets these facts for himself, and then gives them form so others may know and understand.

That others may know and understand requires the discoverer to classify and define the discovered knowledge, to organize and control his own attitude towards it, to rework and formulate it through the technical report so that others may possess it fully and in time. Effective writing, Janus-like, means

Figure 2. TEXT360 final copy

2. PULSED GAS CHROMATOGRAPHY.
E. Findl and K. Lui (Electro Optical Systems), J. Gas Chromatography 6, 165 (March 1968).
A modified frontal analysis technique using pulsed injection and continuous evacuation is presented for the analysis of a mixt. of CO2 and air.

3. GAS CHROMATOGRAPHIC ANALYSIS OF ALPHATIC AMINES USING AROMATIC POLYMERS.
J.K. Smith and D.J. Waddington (University of York), Anal. Chem. 40, 522 (March 1968).
To reduce peak tailing, polyethylenimine, tetraethylene pentamine, or KOH were used as coating materials; their roles as modificants are compared.

4. A UNIVERSAL CALIBRATION FOR GEL PERMEATION CHROMATOGRAPHY.
J. Grubisic and H. Benoit, J. Polymer Sci., Pt. B. Polymer Letters 5, 753 (September 1967).
GPC results can be considered as a combination of mol.wt. and viscosity. This method can be used for

Figure 3. Single-column text for a bibliography

2. PULSED GAS CHROMATOGRAPHY.
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4. A UNIVERSAL CALIBRATION FOR GEL PERMEATION CHROMATOGRAPHY.
J. Grubisic and H. Benoit, J. Polymer Sci., Pt. B. Polymer Letters 5, 753 (September 1967).
GPC results can be considered as a combination of mol. wt. and viscosity. This method can be used for mol.wt. detns.on unknown polymers; it should be especially useful and efficient for polymers sol.only at elevated temps.

Figure 4. Double-column text for a bibliography

PROBLEMS ENCOUNTERED WITH TEXT360

Because we were working with an 8½- × 11-inch page size, rather than the different page size of the publishing industry, we encountered some problems which were common to both nonchemical and chemical text preparation. Foremost among these common problems was converting from the 68 lines per page to an 11-inch page specification, or a total of 60 lines. We wished to make use of the alter codes which provide for printing a title at the top of each page and for printing page numbers within the half-inch top- and bottom-of-page margins, respectively. It seemed likely that the alter code for control of page depth, +DEPTH*nn*+, with a value of 60 for *nn* would do this. However, this was not the case. Our first printouts clearly showed that the processing system counted only lines in the text, and did not include lines skipped after the title (except on the first page), before the page number, between paragraphs, and before and after headings; that is, it ignored all edit skip, –S*n*–, codes wherever they appeared. We believe the only good solution to this page depth problem is TEXT360 program modification to provide a line count for page depth, i.e., text lines plus skipped lines.

We encountered three other problems with the processing system tapes. These were: (1) ignoring the edit code –@@– for shifting from upper to lower case when the original code for shifting to all upper case, –@–,

was contained in a +DEFINE+ code, (2) an automatic two-space skip after all periods (see abbreviations in Figure 3), and (3) the inability to maintain a block format because of the overriding priority of the right-margin justification feature (see beginning of titles for abstracts 3 and 4 in Figure 3). Type (1) could be controlled by keypunching, that is, the −@− could be part of the input rather than of a +DEFINE+. Control by the keypunch operator is, however, never a satisfactory solution. Program revision appears to be the best solution to this problem. The automatic two-space skip after all periods (Type 2) creates readability problems wherever a period is used other than at the end of a sentence, such as with initials or abbreviations. Unless the program can be modified to distinguish between the two types of periods, keypunchers would have to follow whatever rules are established to produce the best readability. Program revision to maintain block format (Type 3) seems unlikely and, short of canceling right-margin justification, we could think of no solution.

Chemical text presents unique input problems. TEXT360's use of the minus as the delimiter for edit codes and, to a lesser extent, the plus as the delimiter for alter codes are part of the problem. To obtain a minus or plus in the printed text requires keying /S and /A, respectively. For example, to obtain

2,4,6-tri-*tert*-butylphenol

requires punching

2,4,6/STRI/S$TERT$$/SBUTYLPHENOL

Linear formulas or equations present no special problems if there are no subscripts. Input for

RCOCl + R′OH = RCOOR′ + HCl

would be

@RCOC@@l /A *R′*O*H = @RCOOR@@′ /A *H*Cl

If the character set of the train provides for subscripts, these are keyed as //N.

CONCLUSIONS

TEXT360 has many advantages, particularly for nonchemical text, but unless program revision can overcome the disadvantages now in the processing system, we foresee no widespread use in a chemical research environment. Extensive program modification is very much indicated before TEXT360 can be considered for the preparation of chemical text.

ACKNOWLEDGMENT

We wish to thank Wilmington Office members of International Business Machine Corporation for their aid in this study.

LITERATURE CITED

(1) Barnett, M. P., "Computer Typesetting. Experiments and Prospects," M.I.T. Press, Cambridge, Mass., 1965.
(2) Boyd, J. A., "Photocomposition" in "Perspective World Report 1966–1969 of the Photographic Industries, Technologies and Science," L. A. Maunheim, Ed., p. 271–9, Focal Press, London, 1968.
(3) Kuney, J. H., B. G. Lazorchak, and S. W. Walcavich, J. CHEM. DOC. **6**, 1–2 (1966).
(4) Reed, S. L., "TEXT360," International Business Machines Corp., 1967.
(5) These terms are defined in deference to one of the reviewers.

In *batch* processing, input card decks of several programs are collected and run through the card reader together; when one program terminates, control returns to the monitor, which then transfers control to the next program.
In *spooling*, input and edited material are stacked in queues and processed as the necessary device becomes available.
In *multiprogramming*, several programs are executed concurrently in a shared environment, with the objective of keeping all independently operable input/output devices busy. The programs operate in an interleaved manner within one computer system.