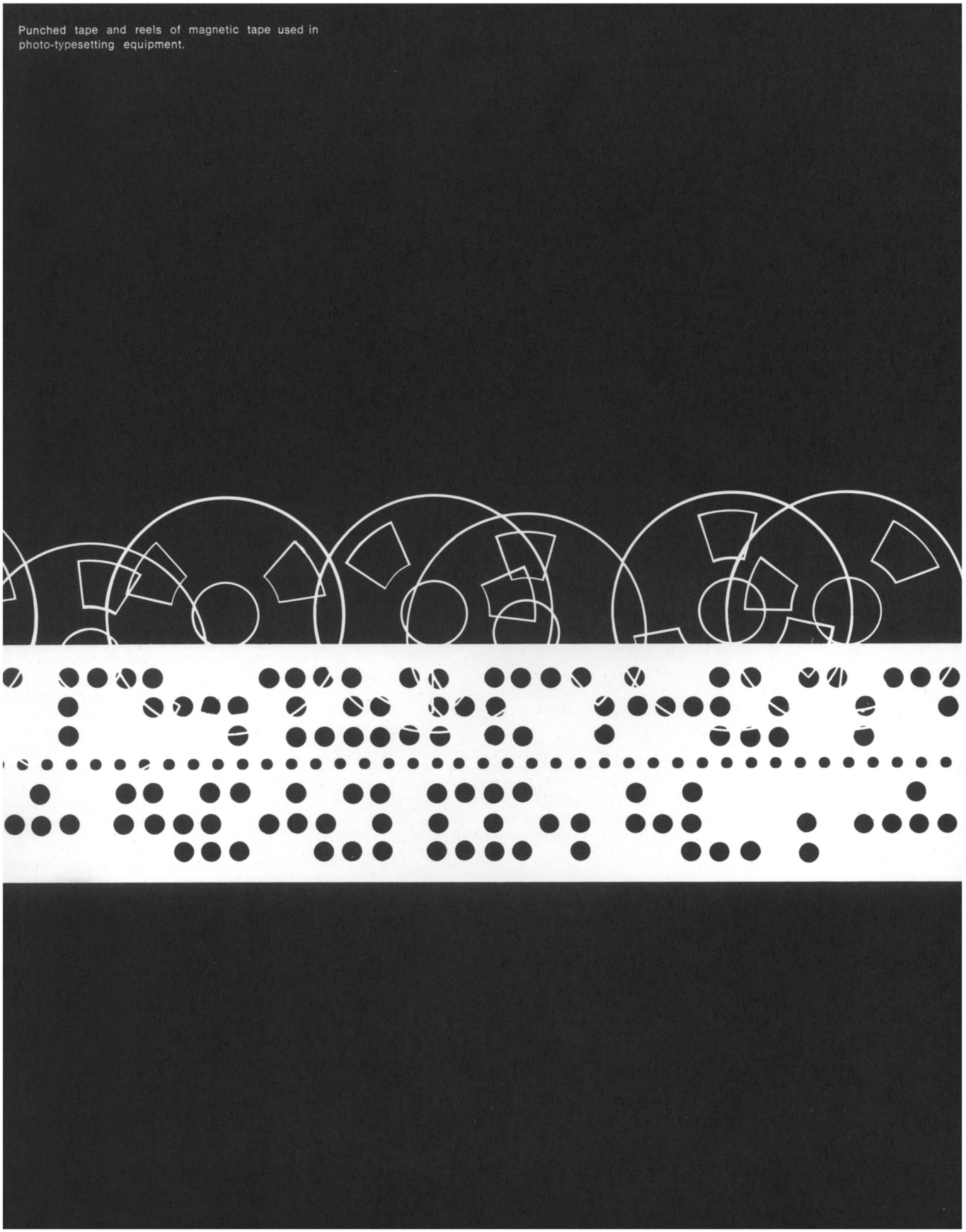

Punched tape and reels of magnetic tape used in photo-typesetting equipment.

Kenneth G. Scheid is president of K. G. Scheid and Associates, Pittsburgh, and formerly head of the Graphic Arts Department at the Carnegie Institute of Technology. He is interested in design education and the fundamental changes which are occurring in the design field today.

Scheid points out that publishers, editors, graphic designers, printers and typesetters are constantly being influenced by current developments in computer technology. It is now technically possible to establish systems in which the process of editing, setting type and printing is fully computerized. Newspapers and large publishing companies are most interested in these developments. Some papers in the United States already use systems where the reporter types out his story on an electric typewriter which simultaneously produces a tape for automatic typesetting. The editor's corrections are merged with the reporter's tape and fed to a computer which controls a phototypesetter or a linotype machine. It is possible to produce systems where the editor sits in front of a television screen and calls up copy to appear on the screen, adds or deletes lines with an electronic stylus or light ray pen, then pushes a button causing the edited version of the copy to appear on the screen. He presses another button and the computer will have the type set and ready to print. Although this seems very futuristic, the elements for such systems are available, and as Mr. Scheid explains, work is being done which will change the functions and activities of the graphic designer, the typographer, the book designer and the layout artist.

In the very near future, graphic designers will have to concern themselves with these techniques, familiarize themselves with the technological possibilities and evaluate the aesthetic qualities involved.

COMPUTERS, PRINTING AND GRAPHIC DESIGN

by Kenneth G. Scheid

Printed communication can be achieved by means of an ever-widening variety of systems with modern technology. The most familiar one for capturing information in visual form is the typewriter, and the carbon copy process is very efficient in producing a limited number of useable duplicates. The camera is another common method especially useful for presenting nonverbal information, and photographic printing is a very efficient means of supplying a limited number of duplicates, provided that these copies are not needed instantaneously. A third familiar device is the printing press — ranging in scale from the office duplicator to massive newspaper and magazine units that permit virtually unlimited numbers of ink-on-paper copies to be produced rapidly and at low cost.

The selection of the most satisfactory system for a particular communications purpose and audience size, at any given stage of technological development, involves consideration of three major requirements:

1. Unit cost
2. Communications speed
3. Communications effectiveness

There is usually a trade-off among these factors. For example, a single letter will generally best be typed out on an office typewriter, at a unit cost of a dollar, in about fifteen minutes, with the design effectiveness that an individually-typed communication permits. However, when a letter should be copied a number of times, it will probably not be typed but run through a copying machine at an approximate cost of ten cents in less than a minute, because the communications effectiveness is entirely adequate compared to the cost of copy typing. Because of the fact that one might be willing to pay a slightly higher price for a graphically more effective result, a wide market has developed for the executive typewriter, which gives deep black, sharp and proportionally-spaced letter images. But no one is very likely to have the type for a single letter set and then printed, regardless of the quality of the result thus achieved.

To write the same letter to many persons, one would have to choose between typing each letter individually, duplicating an original and inserting personalized information, or typing automatically except for the manual insertion of the personalized material. The choice of process would be governed by the number of copies needed, equipment available, labor and time required, and the graphic effectiveness of each result.

Suppose, instead of a letter, a lengthy document which includes photographs and drawings — some even in color — has to be communicated to a large audience. Efficient printing systems for making thousands of copies would be offset lithography, gravure or letterpress printing. Here the type probably would be set in metal or by a photo-setting machine on film. The costs would be low — first, because the process permits the recording of far more information in a given area and thus economizes on paper, press time, binding time and mailing costs; second, the level of graphic effectiveness is highest; and third, despite a higher initial cost, the unit cost, when spread over thousands of copies, is comparatively low.

This example can be matched by numerous others. Cost, speed and design effectiveness govern the selection of systems for printing newspapers, journals and magazines of various circulations, advertising material, schedules, books, packages and business forms.

Rapid developments in computer technology have made improvements possible in the cost, speed and graphic effectiveness of printed communications. Some of the more important developments include the tape-punching typewriter, the tape-driven typewriter and typesetter, the magnetic or optical scanner, the high-speed chain printer, computerized typesetting employing the high-speed phototypesetter, computer-generated typesetting, versatile graphic arts film, the long-run offset plate,

Electronic retina computer reader produced by the Recognition Equipment Corporation, Dallas. This optical scanner reads the author's manuscript directly, eliminating the intermediate production of a punched tape. Reading systems of this type work with a speed of up to 2400 letters per second, and read various sizes of typewritten manuscript sheets.

the paper offset plate, the offset duplicator, the electrostatic duplicator, the color separation scanner, the web offset press, plus a whole series of improvements in paper, inks and other materials used in prinitng.

In selecting a printing system, one must integrate new technological developments into the reproduction process. Since that part of the process which precedes the production of multiple copies on a press is to a considerable extent an information storage, processing and conversion function, the computer becomes a possible new source for cost reduction, increased speed, and improved graphic effectiveness. The following are some of the functions which computers perform in printing systems.

INFORMATION RECORDING

Text and numerical data can be stored in the computer for subsequent processing and retrieval by means of a keyboard-punched paper tape or direct keyboarding, magnetic tape, punched cards or optically-scanned typescript. The most useful system to date has been the one which uses the keyboard early in the editorial-printing cycle by making use of typewriters that simultaneously produce a paper tape and printed proof copy or direct signals to the computer. (If the printed copy, usually called "hard copy," need not be exact, various "shorthand" codes for common words and operations can be used to reduce the number of keystrokes required to store the information in the computer.) Where the raw information is in voice form, a stenotype keyboard with a punch or signal-generating attachment might be used to convert the voice directly to input tape or input signals, in which case the computer must have the capability of translating all stenotype codes to natural text. This would require a dictionary memory unit which is not yet economical. Scanners, on the other hand, can read manuscripts typed in pre-selected faces, but their cost is very great and they may only be useful in cases where speed is vital, volume is massive, or the information does not require another keyboarding for optical reading.

IBM Datatext computer system: This system allows up to 80 customers at different locations to use a single computer to type, edit and up-date text material.

The advantages of the punched tape or direct keyboarding are not only the relatively low capital costs, but also the fact that the keyboard can be used to re-type edited copy or multiple copies automatically, with operator intervention only when new information is inserted, in which case a new tape or signals directly to the computer can be simultaneously produced.

EDITING

The information stored in the computer can be edited in a number of ways. Perhaps the most direct approach is to use the original hard copy for making final author's alterations, editorial changes, and proofreading corrections, and then to keyboard only the corrections and merge them in the computer with the original information. This editing process can continue through whatever number of revisions is necessary without redundant keyboarding.

Other approaches include a) reading the output of a chain printer (a computer output device which prints alphabetical or numerical characters with a speed of up to 1000 lines per minute) and then keyboarding the corrections only; b) reading corrections in by optical scanning; and c) reading copy on a cathode ray tube display and making changes directly with a light pen, an electronic device for drawing or erasing.

REORGANIZATION

One of the most valuable functions performed by a computer occurs when the same set of information has to be printed in several different forms. For example, an alumni directory may list graduates alphabetically, then by class, then by location, then by type of degree and, finally, by occupational groups. With the com-

Computer installation produced by the Digital Equipment Corporation, Maynard, Mass., and installed at the *Worcester Telegram and Gazette,* Worcester, Mass., for newspaper typesetting.

puter there is only one keyboarding for each alumnus needed because the various sortings can be performed automatically. Bibliographies, indexes, abstract searches, catalogues and many other reference works can be similarly processed. Where statistical data is to be presented in a variety of ways, recomputations and reorganization is likewise possible.

TYPOGRAPHY

The best-known use of the computer in printing is to perform a whole sequence of typographic composition functions that are normally done by layout or pasteup artists, keyboard operators, strippers and make-up men. One gives the computer a complete set of design instructions covering such matters as line, column and page measure; type faces and sizes to be used; indents, run-around, tabular formats and other variations from straight columnar form; limits in letter-spacing, word spacing and line spacing; hyphenation and justification desired, if any; rules concerning paragraph and page endings and the position of page numbers and footnotes.

Once these design instructions are established, the computer then makes the necessary calculations, hyphenates words by reference to rules of logic and a stored dictionary of exception words, and organizes the information in such a way that, on command, a fully programmed paper or magnetic tape is produced to drive a typesetting device. At the present time the advantage of the computer is greatest for setting columns of straight matter. Where hyphenation can be designed out of the format, or performed manually by an operator at the computer input/output keyboard, computer cost is reduced. While there are a number of programs that give a so-called area make-up which is used especially for display advertising, page make-up is less common but it is likely to grow as the technology of typesetting improves.

TYPESETTING SPEED AND VERSATILITY

Apart from its high speed in performing the typographic composition functions described above, the computer, as noted earlier, permits a substantial net reduction in the quantity of keystrokes required to produce printed communication, and also speeds up the keyboarding rate by eliminating the traditional requirement of the operator to make justification and hyphenation decisions as he proceeds. Because keyboarding is the most time-consuming operation in printing, these improvements can make substantial savings possible in the total printing costs. In addition, the operation of the new high-speed phototypesetters can best be controlled by a system of electronic circuitry that might be described as a special purpose computer. Such computers are needed to achieve the high speeds and also to operate film-setting devices which have the ability to produce a far wider range of type faces than is found in conventional manual machines.

NON-VERBAL IMAGES

Assuming that the composition unit is the page, film images of photographs, drawings, graphs, paintings, etc. have to be inserted by hand, which seriously slows down the printing cycle. This pictorial matter should also be processed through the computer, halftoned, and placed in position on the page simultaneously with the text matter. No such system is in operation today, but several are under development to be used for special publishing purposes, and at least one is being outlined for the production of a completely made-up newspaper page. The linking of an electronic color separation scanner to the system is being considered, so that even process color negatives could be produced and placed in position as well.

It is likely that this use of the computer will be most important where the non-verbal matter is created in the computer, as in the case of engineering drawings, charts, graphs and scientific symbols. For simple conversion of pictures and other outside source material to printing form, the computer may not at present be an economical substitute for the existing efficient graphic arts processes.

The computer offers some interesting economies where subsequent editions of a printed

communication are to be published. For example, if a book has been printed using a specific typographical arrangement, a later edition with different typography would normally need a completely new keyboarding. Not so with the computer, if a tape of the original information has been retained. It is then only a matter of processing this information in terms of the revised design and driving a typesetting machine automatically to produce the new typography.

The prospects for the use of computer technology in printing systems increases because of reductions in the cost of computers. These reductions appear in the form of lower-priced general purpose computers, the possibility of time sharing from central in-plant computers or from computer service bureaus, and the increasing availability of computer time for printing purposes at low costs on computers that users have initially installed for other purposes. These cost reductions continue to increase the computer's economic advantage over human operators in the performance of typographic composition and other functions.

PRESS SYSTEMS, PHOTOTYPESETTING AND COPYPROCESSING

Other technological developments that also add to the growing economic advantage of the computer are the following:

PRESS SYSTEMS

All of the important improvements on press systems such as speed, cost and quality, involve the use of printing plates or surfaces that are made from images stored on paper or film instead of metal. These improvements include the perfection of high-speed web offset printing of newspapers, magazines and books, the development of thin, photochemically-prepared letterpress plates, the continued improvements in rotogravure, and the probable emergence of a versatile electrostatic printing technology. For all these processes it is more logical to set the images directly on paper or film, rather than going through a metal casting and subsequent conversion process. Thus metal typography will tend to be replaced by phototypography.

PHOTOTYPESETTING

The first real breakthrough in typesetting speed since the invention of the linotype machine came with the perfection of the phototypesetter. As a result of this improvement, a phototypesetter in the same price range as a tape-operated linecaster can set twenty or more characters per second, 80 times faster than a tape-operated linecaster at only about 12 times the cost of such a linecaster. In contrast to that, a manually-operated linecaster can mix up to four type faces or type sizes and set only about three characters a second, or, if tape driven, about eight characters per second. Phototypesetters set a full page of a telephone directory in less than a minute. Phototypesetters with even faster speeds based on electronic character generation and capable of replacing the high-speed chain printer are under development. All these new systems must be operated by a paper- or magnetic-tape, and their real

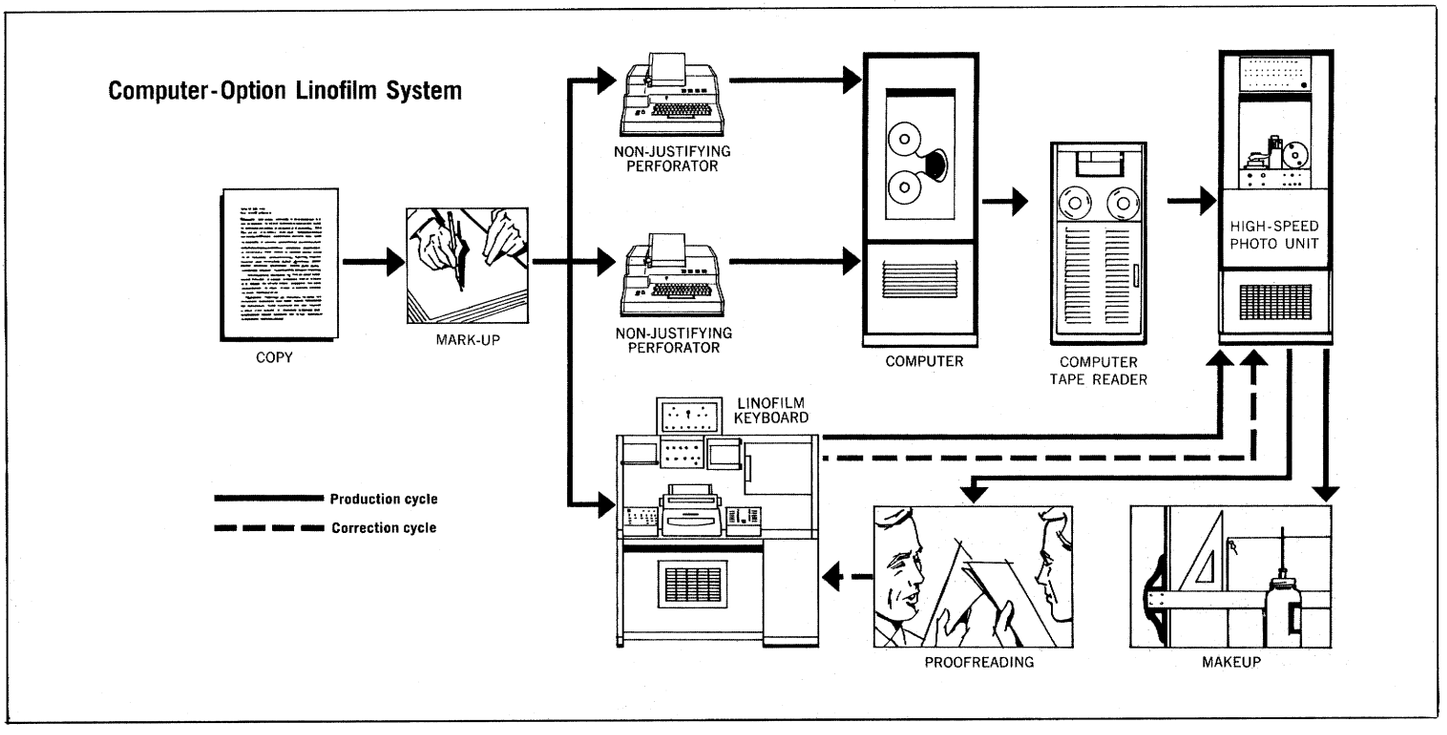

Diagram showing production and correction cycle of the Linofilm computer system.

advantage becomes apparent when this tape is produced through computer processing.

COPY PROCESSING AND INPUTS

The use of the computer to edit and re-organize text in the pre-typesetting stage, as well as the development of editing typewriters which produce paper tapes, also adds to the value of the computer as a printing system. Computerization also eliminates redundant keyboarding by early inputting in the system. Moreover, since keyboarding will remain the most expensive operation in the process, the earlier it is done the more likely that it can be performed at a much lower cost by office typists than at a much higher expense by typesetters or production workers in the printing plant. Furthermore, the newer systems will reduce the cost and increase the speed of making corrections, since they will be made from hard copy at the outset under the more direct control of the publisher, rather than after the information has been typeset and must be galley read.

Other input processes, such as the optical scanner mentioned earlier, are also being developed to take advantage of the computer's capabilities. Most of them are geared to a situation where information is already stored on tape which then can be accepted directly by the computer without the usual keyboarding.

Computer-oriented systems are bound to have important consequences for publishing and printing markets, production costs, industrial structure and manpower requirements. It is not clear yet how these systems will alter the functions or processes of graphic design. This is not to say that designers can neglect becoming well-acquainted with this new technology, for there are aspects of it in which they must become involved. More importantly, it is an evolving technology with still-to-be-imagined usefulness to which the creative, inventive, knowledgeable designer may ultimately make vital contributions.

Already in the immediate future, the graphic designer may be asked to contribute to the evolution of these systems in these ways:

1. He may be requested by clients or employers to evaluate proposals to change from conventional printing processes to one of the computerized systems. In particular, his role may be to investigate and appraise possible gains or losses in design effectiveness that may accompany cost reductions and speed increases. One can hope that he will take the initiative in this involvement, for otherwise a stream of new, knowledgeable computer printing specialists may set the decision parameters to which his skills should be applied.

2. He may be far more intimately concerned in cases where his employer is seriously considering the installation of a computerized system. Indeed, given the "office," characteristics of these systems, there may be a considerable number of large corporations or other users of printed communication, as well as large publishers, who will choose to install their own partial or complete typesetting systems. Where this is the case, the designer will find it necessary to participate actively in selecting the computer equipment and developing programs and methods.

In either of the above instances, graphic designers will become involved in the making of typographic plans that in turn become central elements in the printing systems program. These include:

(a) Specifying what typographic composition and pictorial composition capabilities the system is to have, and which of them shall be automatically performed.

(b) Specifying the type faces and sizes that the system should be capable of outputting, and the mixing capabilities that are needed. In addition, the designer may want to prescribe minimum quality standards for computer-generated type characters.

(c) Determining whether the system can produce effectively if certain typographic conventions, such as hyphenation, justification, word spacing criteria, etc. are dispensed with.

(d) Prescribing layout and page make-up systems, for example, using mathematically-described grids that permit easy, early planning and copyfitting, and that allow maximum use of automatic processing.

(e) Working experimentally with the light pen at a cathode ray tube interface with a system, to build into it a creative capability that may become its most interesting design aspect.

(f) Collaborating with systems designers and programmers to assure that design factors are fully considered in the most effective way.

The graphic designer may find that these new systems will substantially expand the need for design services in the production of printed communication. For example, if typewriter printing gives way to phototypesetting of much internal communication, including computer printout, it will certainly pay many users to employ design services in setting up these more effective systems.

These comments simply serve to open up a rational consideration of the computer's future role in graphic design. Indeed, this is all one can now accomplish: to alert the design profession and to encourage it to explore, whenever possible, the graphic potential of new technologies.