1. Ludovico degli Arrighi: *La Operina . . . da imparare di scrivere littera Cancellaresca.* Composed about 1522 but exact date of publication not certain, Rome.

2. Giovanniantonio Tagliente, *Lo presente libro.* Venice, 1524.

3. Giovambattista Palatino, *Libro . . . Nel qual s'insegna à Scriver ogni sorte lettera.* Rome, 1540.

4. By Herr Rolf Kirmse of Duisburg.

5. Unpublished manuscript in the University of Leiden.

This article is a slightly revised and expanded version of a paper read at the Third International Conference on the History of Cartography at Brussels in September 1969. Grateful acknowledgements are made to the Trustees of the British Museum, the National Maritime Museum at Greenwich, the Plantin-Moretus Museum at Antwerp, the University Library at Uppsala, and Mr. T. R. Varekamp of Amsterdam, for help with photographs. Some material in the article was previously published in *The Journal of the Society of Italic Handwriting* and in *Mercator* by A. S. Osley (London: Faber and Faber, 1969).

The Development of Vidifont

Rudi Bass

Television news broadcasting requires alphanumeric composition processes that do not depend on handsetting or photographic preparation. Vidifont, a synthetic video version of the CBS News 36 alphabet, was especially designed for television requirements: (1) proportional-width and proportionally-spaced letterforms for legibility and maximum character count, and (2) a unique grid structure to reproduce ovoid letter curves and angle strokes. The development of Vidifont is outlined and illustrated; esthetic values in electronic letterform design are discussed.

Research into the factors that govern the acuity, perception, and legibility of type on television was begun at CBS in 1966. Comparative tests made on the closed circuit monitor led, under my direction, to the design of CBS News 36 (Bass, 1967). Although the characteristics of this typeface are based on the requirements of television reproduction, it is essentially a font to be composed by hand and to be "seen" by a video camera. The source of the CRT image remains a graphic product, whether reflective artwork or projected slide.

Television, and news broadcasting in particular, needs typesetting processes that do not depend on handsetting and the photographic preparation of typographic images. The computer-driven character generator creates and transmits letters without mechanical or optical typesetting and printing and without "taking a picture" of graphically prepared letterforms. Since television offers a ready interface for such video-compatible electronic character generation, it seemed desirable to transfer the applicable design characteristics of our special font to an electronic alphabet.

With the completion of the original CBS News 36 font, the Graphics Department of CBS News began a study of synthetic video alphabets. Such alphabets should not be confused with graphic letters designed for optical character recognition or for computer-driven optical type-

setting. Neither should we range them among computer-generated but not video-compatible alphabets. Both stroke-drawn or dot-matrix CRT displays of alpha numerics still require being "looked at" by a video camera. Since the transmission goes from phosphor (display CRT) to phosphor (receiving set), this method exaggerates the halation at the top of the light scale and the fall-off at the end of letter-strokes, a degradation always a characteristic problem of superimposed type on television (Fig. 1).

An examination of various synthetic alphabets resulted in these conclusions:

1. While the vertical grid of the matrix was determined by the scanning lines, the horizontal grid was not detailed enough to construct the variety of angles and curves necessary to create readily legible and esthetically pleasing letterforms (Figs. 2 & 3).

2. The dictates of the computer logic forced the letters into a procrustean* standard width that compacted wide letters such as M and W (Fig. 4). On the other hand, wide counters or large inter-letter spaces such as I L T A created uneven typographic color. There is some room for argument to what extent good typographic color contributes to legibility. I doubt that print measurements can be applied directly, since television exaggerates uneven brightness (Fig. 5).

3. At the time of design, no lower-case fonts were found.

In all fairness, it must be said that since many of these systems seemed to have been plotted by electronics engineers and not by typographic designers, we cannot fault these technicians for their pre-occupation with the engineering requirements of the system.

A synthetic font designed by the U.S. Air Force on a 9 × 11 matrix (Fig. 2) shows all the defects of graphic oversimplification, such as equal-space positions and letter structure held to horizontal, vertical, and 45° angle dot-strokes. A 28-line high system (Fig. 3) based on a character structure of uniform 5 × 7 ratio (i.e., 28 lines high and 20 elements of differentation wide) is made up of units of individual

*Procrustes, the hospitable giant of Greek mythology bid travellers to stay the night at his house. Short ones were stretched, tall ones were amputated to fit them properly into the bed he had prepared for them.

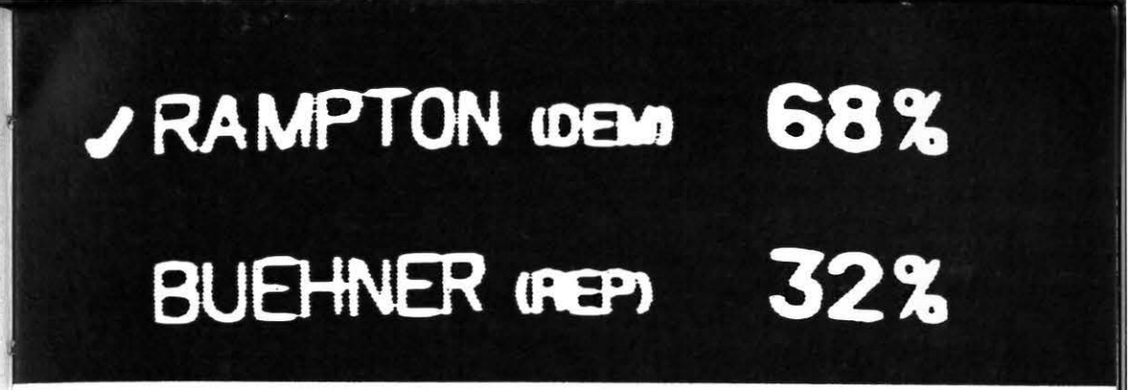


Figure 1. Television image of point-to-point CRT display. The uneven length of the vectors making up each letter results in uneven brightness. This exaggerates degradation, first on the original display and second on the receiver after transmission. Note not only the extreme halation, but the uneven letterheight, as in "BUEHNER."

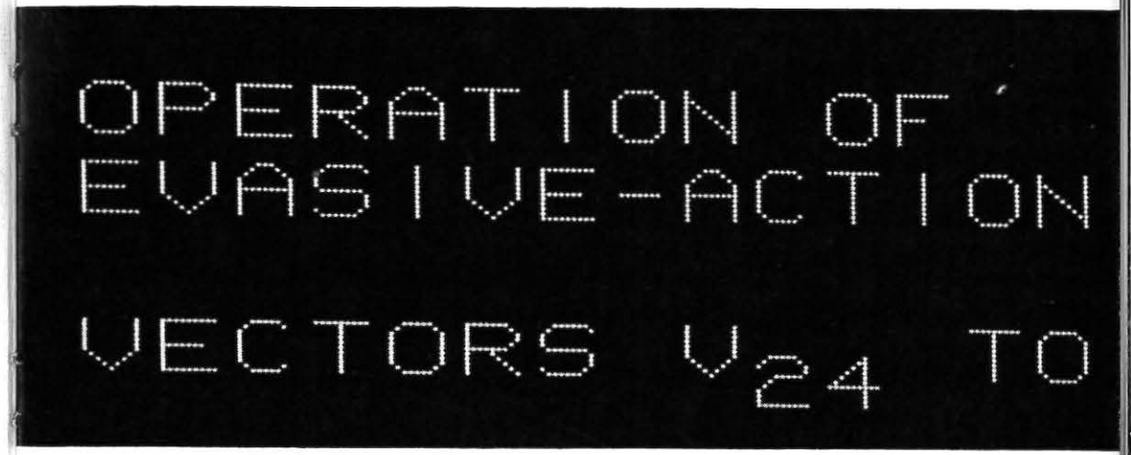
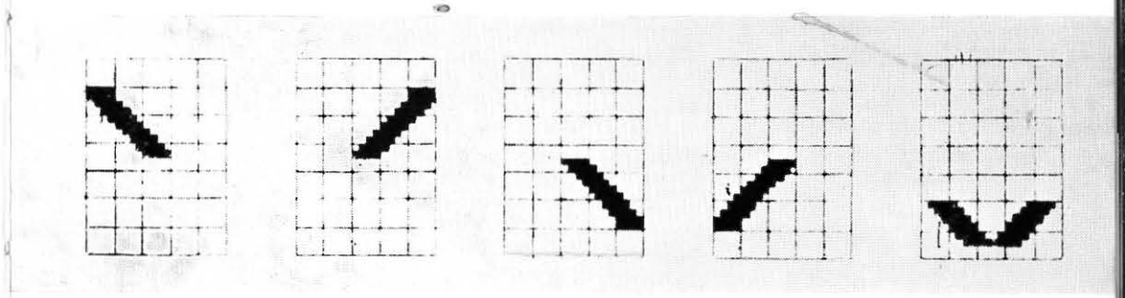


Figure 2. 9 × 11-grid synthetic letters, like others of similar construction, are awkward in form and show the random inter-letter spaces characteristic of equal-space systems, as in "ACTION."

Figure 3. Signal diagrams for a 28-line font. The 5 × 7 grid has four scanning lines for each vertical grid space, the four-fold delay gives four positions for each horizontal grid space. The first and second signal make up the inside strokes of the letter M.



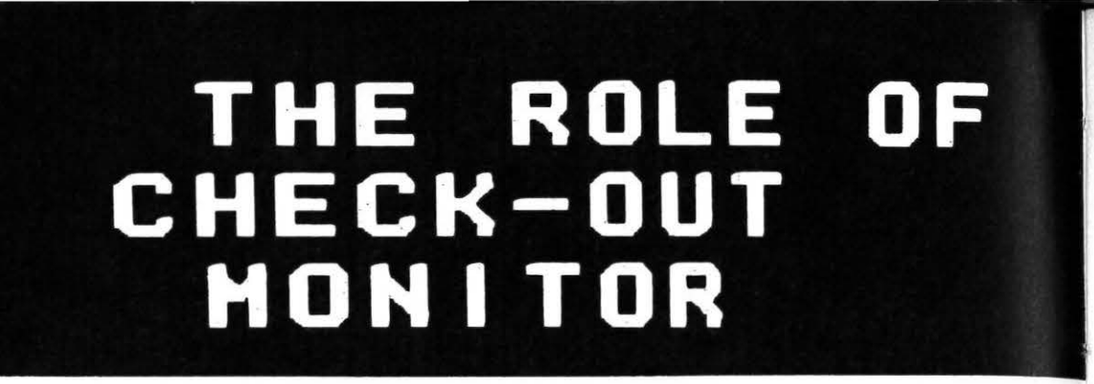


Figure 4. Video-image of the 28-line synthetic font. The 20 horizontal positions are not sufficient for definition. The equal-space construction results in visual confusion; note H and M.

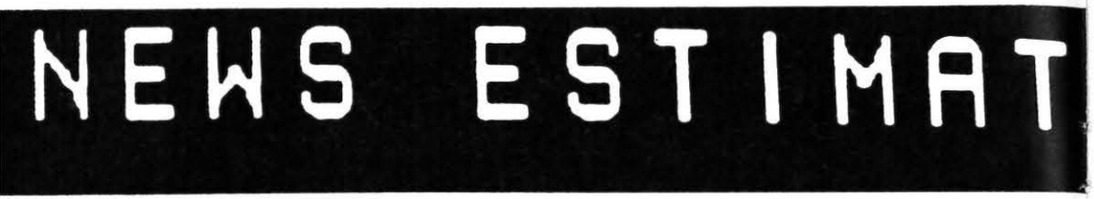


Figure 5. 28-line synthetic capitals, characterized by angular design and equal letter width, resulting in uneven typographic color, as in "ESTIMATE." Equal character slotting restricts count to 16 positions across the screen. The aspect ratio is distorted due to irregular linearity.

signals. The total letter image still is characterized by awkward angularity.

To subordinate esthetic considerations to technical needs—to let material create form—indeed, to elevate technical requirements to the level of esthetics is a tradition that is much older than the Bauhaus. Margaret Shanahan's early Salem alphabet (Fig. 6A) is based on a grid pattern determined by linen and cross stitch. Around 1834 Dr. Louis Braille perfected his alphabet for the blind (Fig. 6B), structured on a two-by-three dot matrix. A set of archaic Chinese characters is built on a logic system of strokes imposed on and governed by a seven-by-nine grid (Fig. 6C). And the deaf-mute alphabet (Fig. D) based on neither graphic nor electronic patterns is nevertheless defined by the pattern limits of one thumb and four fingers. Even contemporary graphic designers such as Wim Crouwel (Fig. 7), preoccupied with what seems to be the design logic of today's technology, are more than willing to narrow the areas of legibility.

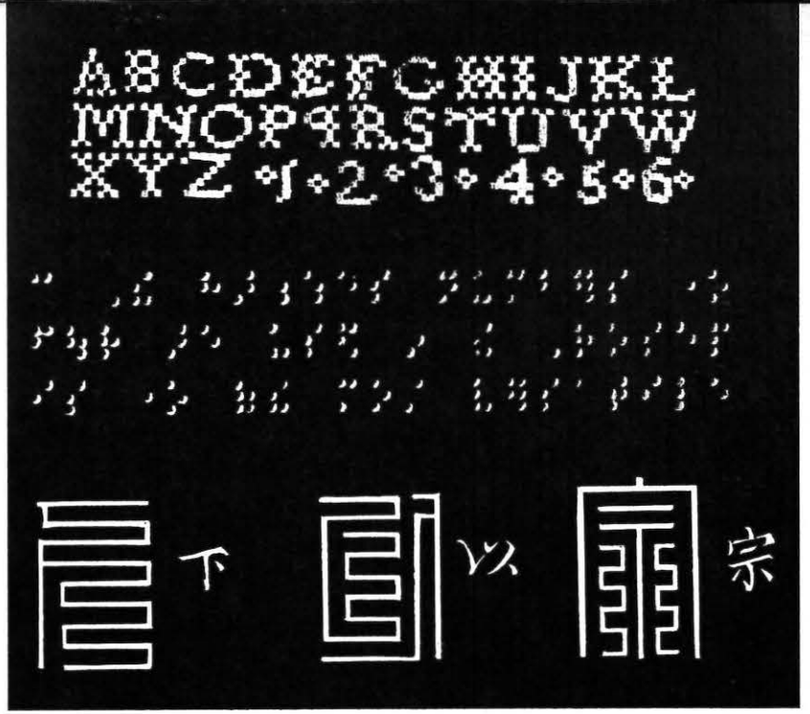
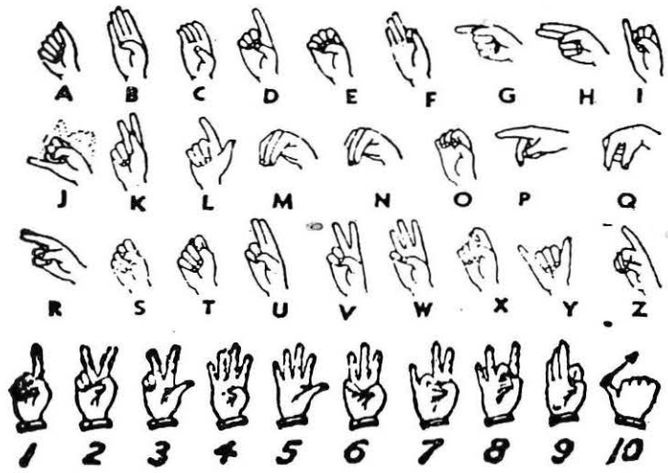


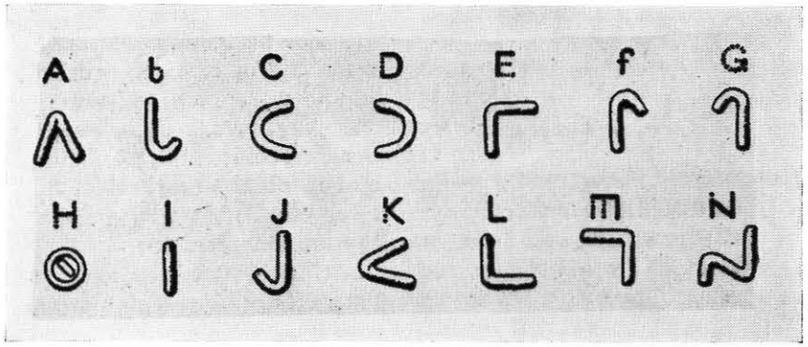
Figure 6. A. Eighteenth-century American sampler, basic 5 × 7 grid. Degraded negative forms emphasize, as in some synthetic video letters, the disproportion between heavy strokes and narrow counters.
B. Braille. Since tactile acuity is less than visual acuity, a 2 × 2 grid was chosen over a typical 5 × 7 matrix, a grid too restricted for letterforms but sufficient for abstract symbols.
C. Archaic Chinese characters; 7 × 9 grid.
D. Deaf-mute alphabet. Although the "grid" limitations are severe, the visual variations are considerable. The "font" even introduces motion within a single symbol (10), a concept impossible in print but theoretically attainable in a synthetic video font. (Note the "blink" built into the Vidifont system.)



But there are thresholds in character recognition that should not be crossed for the sake of simpler forms, if legibility is to be retained. Adaptability to the needs of electronics prompted Crouwel's severely structured and abbreviated letterforms. It was exactly the opposite intent—a desire to add recognition factors to the abstractions of the Braille alphabet—that caused Dr. William Moon of Brighton to design a new alphabet for the adult blind (Fig. 8). His 1847 letterforms anticipate, for altogether different reasons, some of the letters of the Crouwel font. While Moon's alphabet assists those who cannot see, the contemporary font refuses to help those who can see, for the sake of the assumed requirements of the cathode ray tube.

Figure 7. Alphabet designed for cathode-ray-tube typesetting by Wim Crouwel.

Figure 8. Alphabet for the adult blind by Dr. William Moon.



The viewer-reader's need to differentiate at a glance not only between individual letters but also between graphemes, words, and sentences means that awkward letterforms are not enough. Legibility demands a full range of angles and elegant curves. (I use the word "elegant" not to denote style but the way the mathematician uses it, meaning apt, proper, simple.) What then were the specifications for a synthetic alphabet that would combine video technology with the graphic qualities necessary for character perception?

1. A logic grid sufficiently detailed for the precise reproduction of the CBS News 36 font.

2. A memory capable of assigning un-equal spaces to all letters to allow for varying letter width and proportional letter spacing.

3. At least two font sizes, and a lower-case alphabet for the larger font.

4. It was clear that it would not be necessary to reproduce the "light traps" at the inside corners of the original CBS News 36 alphabet (Fig. 9). Since the synthetic alphabet is generated without optical reproduction of a graphic image, the problems of halations and flux would not pertain to the same degree. Another advantage of the digital generator is the fine control. Since character information is controlled by the sync references, there is no un-even scanning as with the traditional technique of super-imposition of type by optical means.

Because of the considerable display degradation on the average aging home television screen—badly tuned and beset with poor reception—it is important to aid the viewer-reader by transmitting as clear and differentiated a letterform as possible. Far from being a somewhat strange and "computerish" looking typeface, a synthetic video font at its best should combine all the traditional advantages of good typography with the precision and fine control that electronic generation affords.

With these parameters as background, I assisted CBS Laboratories in translating the CBS News 36 alphabet. CBS Laboratories personnel, under the direction of Stanley Baron of the Electronics Systems Department, developed the digital technology necessary to generate a synthetic video version (Figs. 10–19).

Vidifont, the resulting alphabet, consists of a 28-line font of capitals and lower-case letters and an 18-line font of capitals. Research

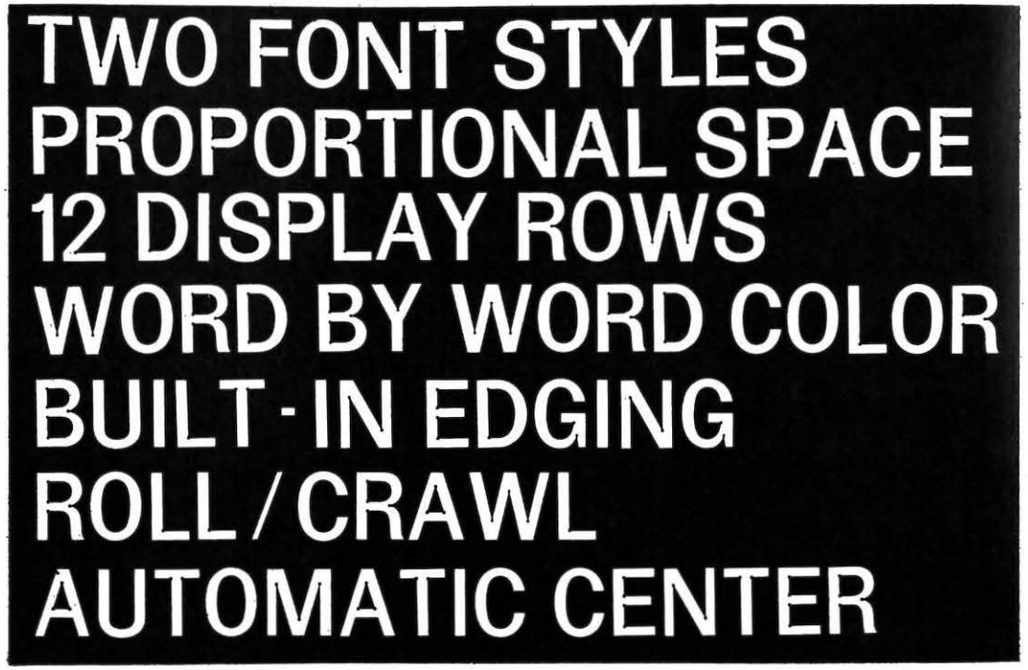
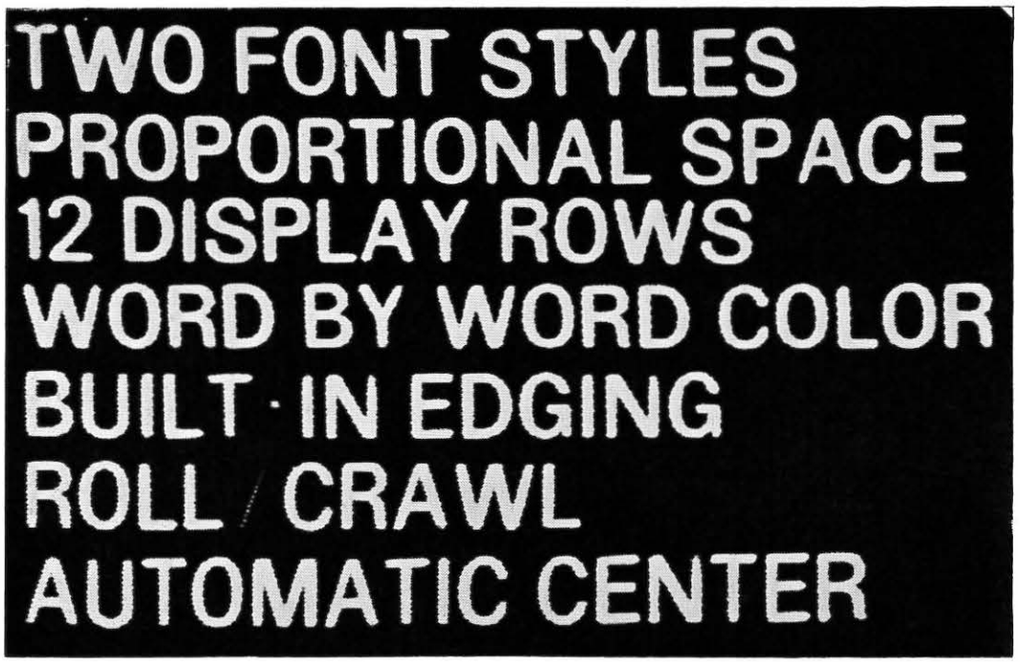


Figure 9. A. CBS News 36 capitals, print.
B. CBS News 36 capitals, video image of slide-chain projection. Note that the inside corners retain sharpness but stroke terminals show various stages of degradation.



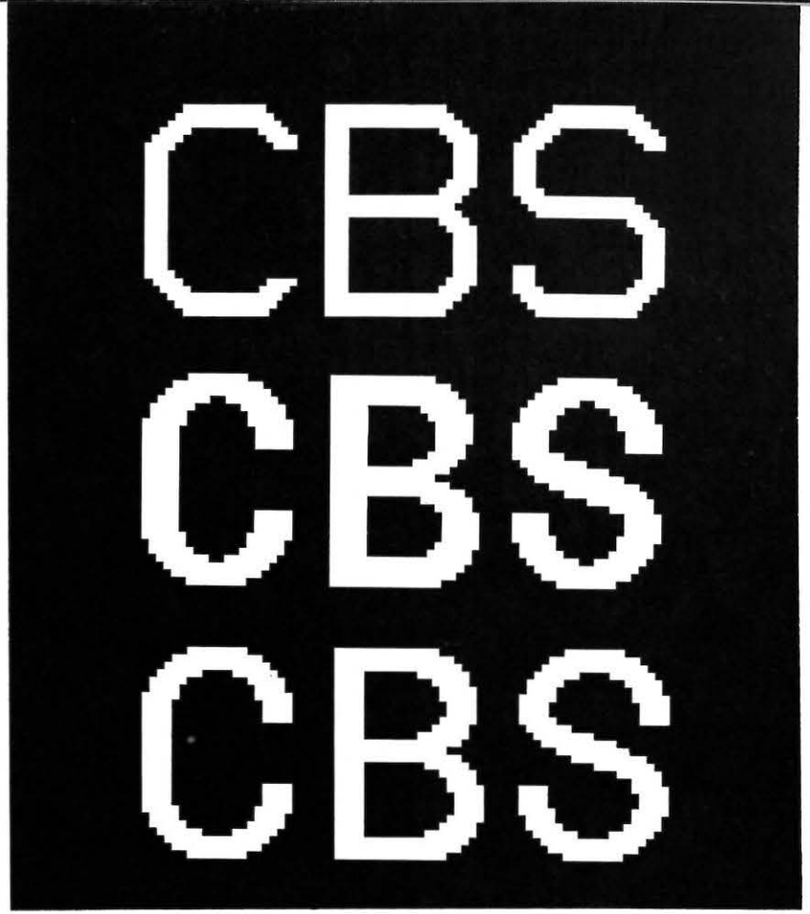


Figure 10. Diagram of initial variations of Vidifont letters. Stroke width varies from three to five elements. Four-element width was eventually chosen, but elements are halved to permit greater definition.

Figure 11. Video image of intermediate stage of Vidifont character. Curves are still flat-sided.

performed by Mitre Corp. (Bell, 1967) for the Air Force Systems Command, Electronic Systems Division, determined that 12 resolution lines per symbol height was the absolute minimum below which the viewers' error rate became unacceptable. The IBM Advanced Systems Development Laboratory, in looking into legibility requirements (Neil, 1967), concluded that 15 lines was an acceptable minimum, but that the preferred type display should be 30 lines high. The NBC recommended practice based on the Society of Motion Picture and Television Engineers safe action and title areas (SMPTE, 1968) calls for a minimum letter height of 4.5% of the vertical scanned area or "about" 22 lines, since the size of the actual scanned area is somewhat variable.

Vidifont's 28-line font is quite close to the recommended 30 lines and the 18-line font lies between the suggested minimum limits of 15 or 22 lines.

The system provides four basic functions: interface, timing and control, memory, and character generation. Keyboard entry governs all composition as well as the functions of line positioning, centering, tab set, roll, crawl, and blink; it permits deletion and close of a character, a line, or the full page; the display can be pre-set on a monitor and scanned-in on command, or composed in real time.

Like the original CBS News 36 font, the Vidifont alphabet has proportional letterforms. The letter I, for example uses only a quarter as much space as the letter W. This aids character-structure and legibility, and gives us a character count that makes full use of the limited "type-page" of the television screen.

An important aspect of Vidifont's technology is its unique grid structure. While Vidifont shares with all synthetic video systems its dependence on the horizontal scanning lines, its vertical grid details twice the number of signals. An average letter of 7 to 5 ratio (i.e., 28 lines high and 20 comparable elements wide) is actually built on the basis of 40 elements across its width. This permits the ovoid "basket" curves so necessary for letters such as O, C, G, or inverted curves such as S or lower-case a. The 1 to 2 ratio of the grid also accommodates the variety of straight slopes necessary to differentiate between symbols such as: 5 (82°), W (76°), V, A, M (73°), N, X, Y (63°), K, Z (58°), 2 (40°).

Although the translation of the original alphabet is quite precise,

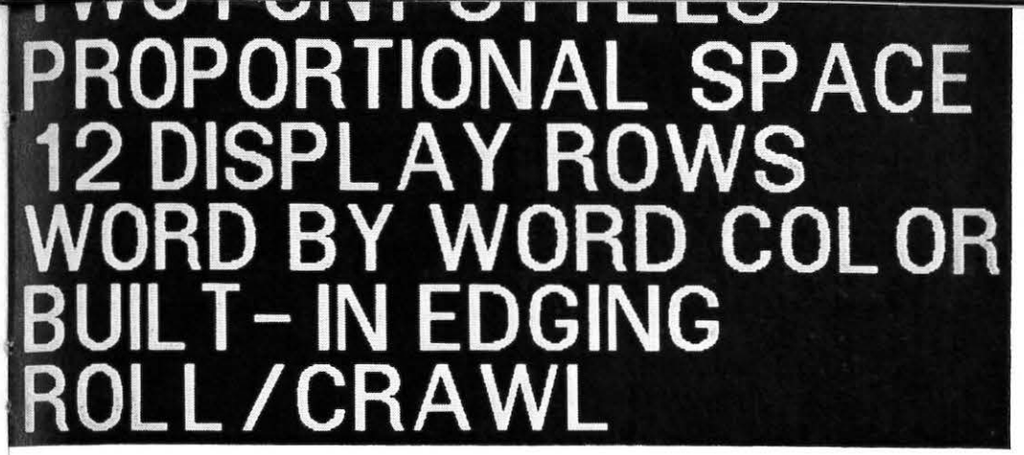


Figure 12. Vidifont 28-line capitals. Sharp monitor image retains precise stroke terminals. Font shows proportional character design of CBS News 36, but proportional spacing detector has not yet been completed, note "PA" in "SPACE."

there are specific differences that are due to trade-offs or other demands of the memory. The M and N, for instance, share the same commands to reduce memory. Therefore, the vertical strokes of the N are of unequal weight (Fig. 12). In the V the weight of the two strokes is reversed. Both these aberrations have since been corrected in a revision of memory functions. Memory demands also created a G that lacked the short straight down stroke of its original.

Since "type-page" size on television is bounded by the screen and margins—unlike print margins—are not certain, and because there are limits to the letter size the system as well as the eye can resolve, character count is perhaps the single most important factor in video composition. The proportional rather than the equal width construction of the Vidifont alphabet and the proportional spacing (yet to be completed) offer a very economical character count. The new font of 28-line caps permits an average of 22 characters to the line, as against a 16-letter count for a fixed-letter-width 28-line system. Aspect ratio can be further condensed 10% to allow for some added letters. Aside from this intended flexibility, video aspect ratio will fluctuate at times due to variables in linearity and result in the equivalents of "regular," "condensed," and "extended" versions of a print face (Figs. 10, 14 & 19). In such cases, the character presentation was improved by memory reduction. But in other instances, the numerals primarily, degradation that was unacceptable to the eye did occur and the font was revised to allow for individual character properties. Since

Figure 13. Schematic drawings of the Vidifont 28-line capitals. Note that the D in this drawing does not yet show the full curve since achieved. The N shows already equal verticals; the V has since been reversed to follow traditional weight.

Figure 14. Monitor image of the Vidifont 28-line capitals. Attenuated "condensed" scan helps to visualize grid structure of curves and angles.

Figure 15. Schematic drawings of the Vidifont 28-line alphabet.

Figure 16. Schematic drawings of the Vidifont 28-line lower-case alphabet.

numerals, unlike letters, cannot depend on context as an aid to character recognition, it was important to allow for sufficiently differentiated forms.

The memory's shift register insists on either all even or all uneven signal positions for curves and slopes along a scanning line within a given character, and a choice had to be made in some instances between two equally less-than-perfect solutions. Such incongruities aside, we consider the graphic quality of Vidifont an important step forward in synthetic video design.

The figures shown detail the present development of the font. The next stage of the system will provide proportional letterspacing, as well as an added font size.

Some thoughts about the relationship of esthetics to legibility might be in order. Most reading tests have dealt with measurements such as point size, weight, leading, reflexivity of paper, and other print-related factors. Now that the cathode ray tube presents new design problems, the question is asked whether drastically altered letterforms or even "non-objective" fonts might not only be easier to generate but be actually more legible. It is my view, not as a researcher but as a practicing designer, that esthetic values are not a random grouping of artful foibles, superimposed on solid measurable elements, such as length of ascenders or stroke-to-counter ratio. How we feel about the way type looks is a part of the historical development of letterforms and readers as well, with legibility the dialectic result of all these factors, along with blink rate and column width.

Varied as typefaces are, they share a common rhythm, a time-line pulse that should not be easily interrupted. It would be technically possible to let a radically new or disproportionate alphabet spring from the head of the computer, the Zeus of our time. I do not think it to be humanistically advisable. Even seemingly secondary design factors—such as the precise nature of curves or the interplay of interletter spaces and letter spacing—have their anthropocentric origins. They stem from the literally "graphic" (i.e., written) relationships of hand and chisel, quill and parchment, pen and paper. I do not think that they can be abandoned with impunity.

Ever since its first cultural revolution in 1919, China has attempted to broaden the printed base of its many spoken languages. It not only

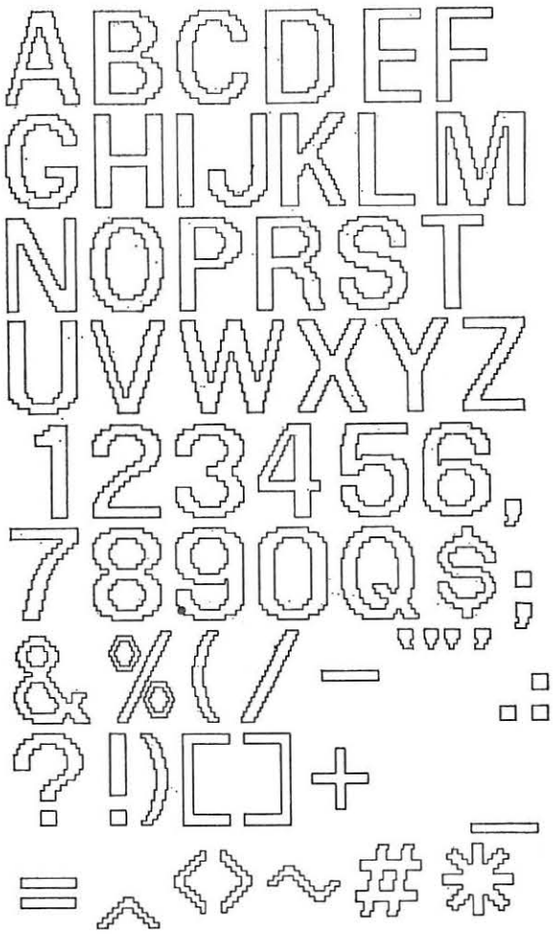


Figure 17. Schematic drawings of the Vidifont 18-line capitals.

Figure 18. Monitor image of Vidifont title, 28-line capitals. Wide scan extends letters beyond normal aspect ratio.

created the national phonetic letters and attempted to simplify and reduce the 40,000-odd ideographs to a manageable 1000, but even today it continues to some degree the use of the Pin-Yan Ju Man national romanization system to familiarize its people with the roman alphabet.

There is the growing danger that the proliferation of our media-oriented culture contributes to dehumanization and alienation.* We could well speculate whether unlettered cultures, where inter-personal relationships cohere without the mortar mixed with the 26 grains of sand our letters represent, are not as valid as ours. But for better or worse we must consider our alphabet and our neural and affective response to it is a part of our ecosystem. And, like water and air, we had better take care of it.

* Claude Levi-Strauss sees it as a loss of "authenticity": "We communicate with the immense majority of our contemporaries by all kinds of intermediaries—written documents or administrative machinery—which undoubtedly vastly extend our contacts but at the same time make those contacts somewhat "unauthentic" (1967). Norbert Wiener suggests that more information is possibly less information: "It is no wonder that the larger communities . . . contain far less available information than the smaller communities, to say nothing of the human elements of which all communities are built up" (1948).

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Creating a Mundurukú Orthography

Marjorie Crofts

Mundurukú, a Tupi language of an Amazon Basin Indian people, has had no written form. This article describes the practical problems of establishing an alphabet to match the spoken language as well as relate to Portuguese, the language of Brazil; e.g., whether or not to represent all phonemes, and basic questions on what constitutes a word, or a sentence. Printed materials in Mundurukú are illustrated.

When we realized that we would be able to "create" a Mundurukú[1] alphabet for a people who had never seen their language in print, we were excited. We were the first people to put this language into writing and make a practical alphabet with the aim of teaching the Mundurukú to read their own language. The speakers were illiterate in Mundurukú when we arrived. Five or six had learned to speak some Portuguese from the Franciscan priests, and three or four of these could read Portuguese. None had ever read Mundurukú. It was in our hands to open to them the whole world of reading.

1. Mundurukú is a Tupi language, as classified by Arion D. Rodrigues, (I.J.A.L. 24.3 [1958]). It is spoken by about 1,200 inhabitants of the upper Tapajos River and its tributaries of Das Tropas, Cabitutú, Cadiriri, Cururú, and São Manoel in the state of Pará, Brazil. Very few of these Mundurukú speak Portuguese. Some 350 Mundurukú live north of this principal location of the tribe, on the Canumã River in the state of Amazonas. The latter group speak Portuguese in their homes and only six or eight adults still speak the Indian language. Field work was carried on under the auspices of the Summer Institute of Linguistics and the Museu Nacional of Rio de Janeiro in this latter location during 1961–63 and in the Cabitutú River area since then. We have also enjoyed lovely hospitality for several months at various times at the Franciscan Mission on the Cururú River. My colleague, Margaret Sheffler, has co-authored with me all the literacy materials. There are about thirty fluent readers in the tribe now. Four or five of these had learned something about reading while in school for a year or two in Portuguese. The others learned as adults with no literacy background. Only three of these are women.