

Visible Language

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The research journal concerned with all
that is involved in our being literate

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Three different approaches were taken to try to improve the legibility of a textbook for secondary schools: (1) two columns of about 58 mm (15 picas) line width instead of one column of about 126 mm (32 picas) line width, (2) insertion of additional space between the constituents of the sentences to convey the phrase structure of the text, and (3) "visualizing" the information by structuring it vertically and horizontally in such a way that the total design is more appropriate to the visual medium. In an experimental test of a lesson in physics printed in a standard version and in the above three experimental versions, given to 600 students, only the third one ("visualization") showed an improvement over the standard version.

Introduction

In this study we have tried to solve some practical problems in the typographic design of a secondary school textbook:

- (1) Given a standard page format of 164 mm by 233 mm, would a physics text be more legible if printed in one column of about 126 mm (32 picas) line width, or if printed in two columns each of about 58 mm (15 picas) line width?
- (2) Would additional spacing between words, trying to convey the syntactic structure of the sentence, increase legibility?
- (3) Can we find a way of utilizing better the two-dimensional space of a printed page; can we design textbook pages more appropriate to the visual medium than traditional texts?

To answer these questions a lesson from a physics textbook for secondary schools was redesigned in three versions, given to 600 students, and the learning success achieved with the re-designed versions compared to the original version as a standard.

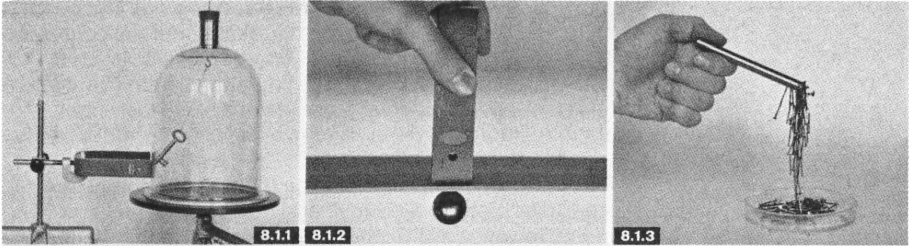
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Influences of typographic variables upon legibility of print have been under systematic psychological research at least since the 1930s, with a few studies dating back to the end of the last century. Results have been summarized, for example, by Tinker (1963, 1965), Zachrisson (1965), Spencer (1968), Plata (1974), and Rehe (1976). Most of these studies recommend an optimal line length of about 88 mm (18 picas) for 8- or 9-point type. However, this is not independent of the reader's age and reading skill nor of the contents of the text. Thus the recommendations conflict (Watts & Nisbeth, 1974), such that the optimal line length should be found for each individual purpose. Some considerations about relations between page size and column width can be found in Hartley (1978). Of course, the most natural thing for a textbook designer would be to find the optimal line length for his purpose and choose the book format accordingly. However, as learned in discussions with textbook publishers, things are not that easy. For various reasons (including the fact that children use school bags with little variation of size and format) textbooks must adhere to a standard format of about 164 × 233 mm overall and a page width of about 160 mm. The suggested optimal line length of 88 mm is too narrow for this page size, and two columns would not fit on the page. Would it be better, therefore, for the average reader of the respective age for which the textbook is planned to use a single wider column of 126 mm (32 picas) or two narrower columns of 58 mm (15 picas)? To answer this question a chapter from a textbook in physics for secondary school students (age about 12 to 14 years) was printed in two different versions to match these requirements. Version A (Figure 1) uses the traditional format of a single wide column, 126 mm (32 picas) wide; Version B (Figure 2) uses the double column format, each column 58 mm (15 picas) wide.



8.1.1. Der Magnet zieht den Schlüssel auch im luftleeren Raum an.

8.1.2. Die magnetische Kraft wirkt durch die Holzplatte auf die Stahlkugel.

8.1.3. Vom Magnetismus beeinflusste Nägel werden selbst zu Magneten.

8.1. Magnetische Erscheinungen

Die magnetische Anziehung. Wir alle haben gewiß schon Bekanntschaft gemacht mit jenen Eisenstücken, die die merkwürdige Eigenschaft haben, andere Eisenteile an sich zu ziehen. Man nennt sie *Magnete* und die damit im Zusammenhang stehenden Erscheinungen *Magnetismus*. Wir wollen uns ein wenig damit vertraut machen:

Versuch: Wir versuchen, auf welche anderen Stoffe ein Magnet anziehend wirkt: Kupferdraht, Messingschrauben, Aluminiumblech, Bleirohr, Holz, Stein, Kohle, Glas, Porzellan, nichts von alledem bleibt gleich dem Eisen an ihm haften.

So hat man viele Stoffe untersucht und herausgefunden, daß unter den natürlich vorkommenden Stoffen nur noch die Metalle Nickel und Kobalt vom Magnet angezogen werden. Man nennt sie zusammen mit dem Eisen *ferromagnetische Stoffe* (lat. ferum = Eisen).

Beim Experimentieren fällt uns auf: Die eisernen Nägel bewegen sich schon, wenn der Magnet nur in ihre Nähe kommt. Seine Kraft ist bereits ohne Berührung wirksam. Ohne sichtbaren Vermittler greift die Kraft an. Ob vielleicht die Luft ihr Träger ist?

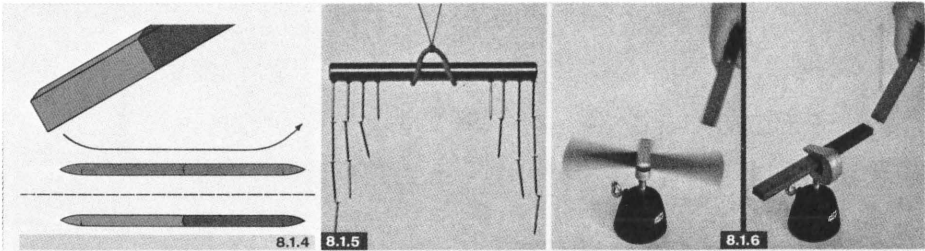
Versuch (Abb. 8.1.1): Wir hängen einen Schlüssel unter einer Glasglocke auf, aus der die Luft abgepumpt wird und nähern ihr den Magnet von außen: Offenbar ist auch die Luft nicht erforderlich, die magnetische Kraft weiterzuleiten. Es ist überhaupt kein Kraftüberträger wahrnehmbar.

Beim Versuch nach Abb. 8.1.1 entdecken wir außerdem, daß der Magnet auch durch das Glas hindurch wirkt, so als ob es gar nicht da wäre. Aber nicht nur bei Glas, auch bei Papier, Pappe, Holz, Blei, Stein und überhaupt bei allen nicht ferromagnetischen Stoffen können wir keine Behinderung des Magnetismus beobachten.

Versuch (Abb. 8.1.2): Da der Magnet auch durch die Tischplatte hindurch wirkt, lassen sich Eisenstückchen wie von Zauberhand bewegen.

Magnete machen Eisen magnetisch. *Versuch* (Abb. 8.1.3): Stecken wir einen Magnet in eine Schachtel mit Nägeln, so können wir beim Herausziehen gleich ein ganzes Büschel von ihnen erfassen. Wir bemerken, daß nicht alle Nägel unmittelbar am Magnet haften wie die Haare eines Pinsels, sondern daß sich zuweilen ganze Ketten von Nägeln bilden. Zwei, drei und manchmal noch mehr hängen aneinander.

Offenbar wirkt die Fähigkeit des Magneten, Eisen an sich zu ziehen, ansteckend, denn ein Nagel der Kette kann doch nur hängen bleiben, wenn sein Vorgänger selbst magnetisch ist. Woher hat er aber seine magnetischen Fähigkeiten? Doch wohl von seinem Vorgänger, und das erste Glied in dieser Kette ist der Magnet selbst.



8.1.4. Eine Stricknadel wird magnetisiert.

8.1.5. Der Magnet hat zwei Stellen stärkster Kraftwirkung: Die Pole.

8.1.6. Magnetpole können sich abstoßen oder anziehen: es gibt zwei Arten von Magnetpolen.

Diese Beobachtung legt auch die Vorstellung nahe, der Magnetismus »fließe« vom Magnet in den ersten Nagel und von dort, sich langsam abschwächend, von Nagel zu Nagel fort, bis schließlich seine Kraft nicht mehr ausreicht, einen weiteren Nagel zu halten. Man spricht deshalb auch von magnetischer Influxion (lat. influere = hineinfließen). Die beeinflussten Nägel werden so selbst zu kleinen Magneten.

Versuch: Entfernt man eine solche magnetische Nagelkette ganz langsam und vorsichtig vom Magnet, so verliert sie zunächst ihre unteren Glieder, bei größer werdendem Abstand fällt sie schließlich ganz auseinander.

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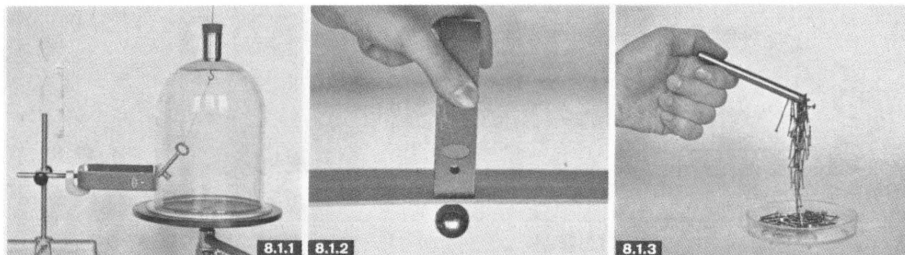
Versuch (Abb. 8.1.4): Streicht man wiederholt in der gleichen Richtung mit dem einen Ende eines kräftigen Magneten über eine Stricknadel, so wird sie selbst zu einem dauerhaften Magnet (Permanentmagnet; lat. permanere = verharren). Der ursprüngliche Magnet büßt erstaunlicherweise dadurch nichts von seiner Stärke ein, auch wenn man viele Stricknadeln magnetisiert. Seine Fähigkeit, Eisen anzuziehen, gibt er nicht einfach weiter, sondern er ruft neuen Magnetismus hervor. Das erfordert Arbeit. Sie wird beim Magnetisieren durch unsere Muskeln verrichtet.

Magnetpole. Unsere Versuche lassen uns erkennen, daß der Magnet nicht an allen Stellen gleichmäßig stark auf Eisen wirkt. Seine Anziehungskraft ist zu den Enden hin am stärksten, in der Mitte dagegen fast unmerklich (Abb. 8.1.5).

■ Die Stellen stärkster Kraftwirkung nennt man die Pole des Magneten.

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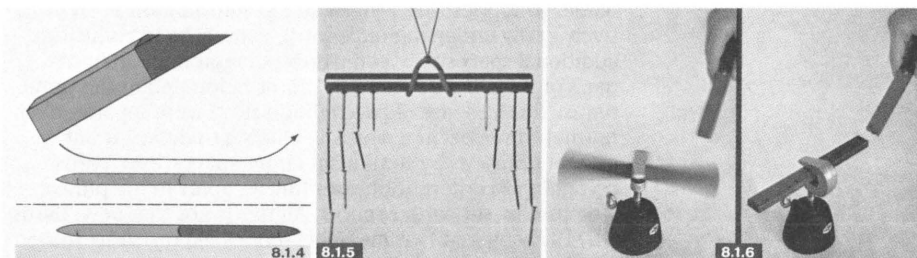
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When talking we do not utter all syllables and words at the same pace; we give our listeners an interpretation aid by conveying the semantical and syntactical structure of our phrases by pausing between sections or by speaking words faster when they belong together. Only part of this syntactic information is represented in the punctuation of the written form. We thought it might be of some help for the reader to suggest this otherwise lost information in an intuitively easily understandable form, namely by introducing additional spaces between words belonging to different parts of the phrase structure. Words belonging to the same phrase (in the sense of psycholinguistics) were separated by normal word spacing, words belonging to different but adjacent phrases by somewhat larger spaces, and words belonging to different phrases further apart in the phrase structure by still larger spaces. All this is not that new: Cyrus (1971) discovered that medieval scribes did the same thing.

We hypothesized that this additional interpretation aid would result in better legibility and understandability of printed text. We thought it might be possible to guide the eyes' saccades from one fixation point to the other by allowing the reader to grasp meaningful elements of the sentence rather than random sets of letters. Our hope for this effect was nourished by the findings of Andrews (1949) and North & Jenkins (1951) who found some improvement of legibility with

the so	square	style of	
called	span	typography	
as well as	with the	spaced units	style of pre- sentation.

Andrews thought that his square-span presentation would enable the reader to grasp more words with each fixation by making more use of peripheral vision in recognizing word patterns; North & Jenkins showed that the improvement is actually due to the larger spacing between groups of words. Payne (1967) found an improvement of reading speed with proportional spacing of several passages from the Davis reading test with no loss of comprehension, and more so with the more difficult passages of the test.

An intuitively appealing hypothesis is that we would get additional improvement of information processing by making the spaced units elements of the phrase structure of the sentence. This hypothesis is supported by findings by Fodor & Bever (1965) that phrases may be the perceptual units of spoken language; by Mehler, Bever, & Carey (1967) that eye movement fixations concentrate on the first half of phrase units; by Epstein (1967) who found that chunking facilitates the free recall of sentences; and by Anglin & Miller (1968) who presented to their subjects segmented sentences on a memory drum, each segmented in a phrase structure mode, and in a non-phrase-segmented mode "prepared exactly in the same way" as the phrase segmented material "except that the sentences were segmented exactly two words to the left of the phrase boundaries." In writing down "word for word, all they remembered of the paragraph," the subjects recalled "slightly but significantly" (about 6%) more words of the text presented in the phrase segmented mode than of that in the non-phrase segmented mode. Anglin & Miller interpreted this result as supporting the "psychological validity of phrase structure."

Cromer (1970), in analysing reading difficulties of college students, assumed that some poor readers organize the flow of information input just "different" from other readers; i.e., "in a word by word fashion rather than into meaningful units such as phrases, and they lose part of the meaning which is carried by combinations of words" (p. 472). Cromer expected that if material were preorganized into meaningful word groupings, comprehension for the poor readers would be facilitated. To test his hypothesis, Cromer presented a series of stories in four different typographic styles, one of which was a phrase segmented mode. His results showed that the poor readers indeed answered significantly more questions correctly on the phrase mode than on any other mode (where their scores were lower than those of their matched good readers). In other words, the poor readers "comprehended significantly less well than their matched good readers except when the material was presented in phrases, in which case they read as well as the good readers."

Carver (1970), inspired by Miller's (1956) idea that "chunking" may facilitate information processing, studied the effect of a "chunked" typography upon the reading rate and comprehension in a series of three consecutive experiments with a total of 104 mature readers. His "chunking" followed the guidelines by Klare et al. (1957), and thus the phrase structure of the sentences. However, he failed to find any important or statistically significant difference between his "chunked" typography and the standard format, neither in speed of reading nor in comprehension. Carver did not see his results in conflict with those more successful studies quoted above, nor with those by Graf & Torrey (1966) who found that chunking of the reading material improved comprehension scores if the material was to be read at a rate faster than the normal rate. Carver thinks there is an "important difference between the skills and activities involved in normal reading by mature readers, and those skills and activities involved when reading at a rate faster than normal, when recalling sentences, and when memorizing passages" (p. 296).

Hartley & Burnhill (1971), in an experiment to find rules for the optimal use of unjustified text, tested standard unjustified text versus an unjustified text where the line length was determined by grammatical constraints, i.e. "lines stopped between syntactic units rather than within them." Results showed no significant difference between these two modes, neither in the number of words read in seven minutes, nor in comprehension test scores, nor in preference. Thus, Hartley & Burnhill's results agree with those by Carver (1970).

To test our assumption of increased legibility with additional spacing between phrase ("chunked typography"), we designed Version C of our physics chapter (Figure 3). This required additional preparation. First, we had to decide how large to make the additional spaces. Making them too large would require longer saccades and thus decrease the speed of reading. On the other hand, the additional spaces had to be large enough to be discriminated from the regular space and between each other. In an extra experiment (using the method of threshold determination from psychophysics) we found with a sample of 200 fifth graders (age about 10–11 years) that in using a 9-point roman typeface the following spaces would be discriminated with an accuracy of more than 95%:

regular space	:	3 point
large space	:	8 point
very large space	:	11 point

Next, we had to decide where to put these additional spaces in our experimental text. This was done with the advice of Wolfgang Walther, a psycholinguist from Stuttgart, taking into account not only syntactical points of view (the phrase structure of the sentences) but also semantical ones (contents of the text). We had then a Version C of our physics lesson printed with these additional spaces but otherwise identical with the standard Version A.

We expected that reading text with these additional spaces would be rather unfamiliar for our experimental subjects, and therefore we wanted to prepare them for this new kind of presentation of text. A short story of about 1200 words was printed with additional spaces according to the syntactical structure of the text and given our subjects about a week before the experiment. The existence and meaning of the additional spacing was explicitly brought to their attention by their teachers.

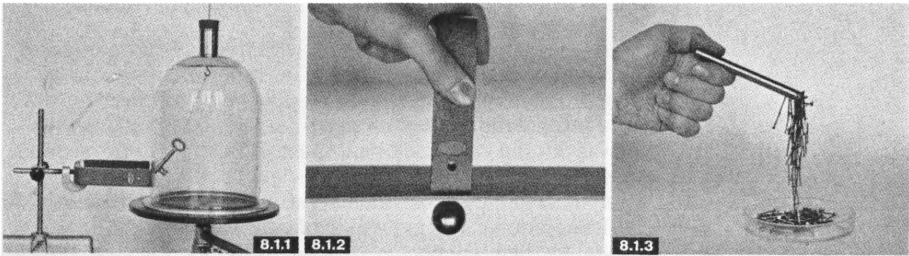
Visualizing the Information

In our fourth version of the text, we tried quite a different way of visually presenting text book information. We thought that with a more appropriate use of the visible medium we would need fewer words (using less repetition, less redundancy, since the information is "always there") and be able to utilize other more visual means of communicating connections, associations, and contingencies between parts of our text.

With this in mind, two typographers from Hamburg, Dierk Becker and Jörg Heinrich, designed a "visualized" version D of our physics chapter (Figure 4). Some of the ideas they used can be found in their thesis (Becker & Heinrich, 1969, 1970).

For our visualized version the original text was first rewritten; separating sentences containing basic information (column 1) from sentences containing additional explanations such as deductions, demonstrations, descriptions of experiments (column 2), and from auxiliary, historical, or other marginal information which connect the contents of the lesson to other areas of daily life (column 4). Figures were either placed in column 3 (next to their explanations in column 2) or in column 4, if they contained side information. Moreover, paragraphs and sentences belonging together (e.g., a basic sentence and its explanation or an experiment demonstrating it) were connected by means of a common yellow background.

With this presentation the reader was free of work through the chapter either horizontally (reading the basic information, then the demonstration and experiments next to it) or vertically (reading first all the basic information, then going into more details in the second column). Or the reader might get interested in the pictures first, go left to the explanation, and then to the basic information as a summary. We hoped that this kind of graphic design would appeal to our young readers as more motivating and interesting than regular columns of printed text, alluding a little bit to the graphic design principles of comic strips.



- 8.1.1. Der Magnet zieht den Schlüssel auch im luftleeren Raum an.
 8.1.2. Die magnetische Kraft wirkt durch die Holzplatte auf die Stahlkugel.
 8.1.3. Vom Magnetismus beeinflusste Nägel werden selbst zu Magneten.

8.1. Magnetische Erscheinungen

Die magnetische Anziehung. Wir alle haben gewiß schon Bekanntschaft gemacht mit jenen Eisenstücken, die die merkwürdige Eigenschaft haben, andere Eisenteile an sich zu ziehen. Man nennt sie *Magnete* und die damit im Zusammenhang stehenden Erscheinungen *Magnetismus*. Wir wollen uns ein wenig damit vertraut machen:

Versuch: Wir versuchen, auf welche anderen Stoffe ein Magnet anziehend wirkt: Kupferdraht, Messingschrauben, Aluminiumblech, Bleirohr, Holz, Stein, Kohle, Glas, Porzellan, nichts von alledem bleibt gleich dem Eisen an ihm haften.

So hat man viele Stoffe untersucht und herausgefunden, daß unter den natürlich vorkommenden Stoffen nur noch die Metalle Nickel und Kobalt vom Magnet angezogen werden. Man nennt sie zusammen mit dem Eisen *ferromagnetische Stoffe* (lat. ferrum = Eisen).

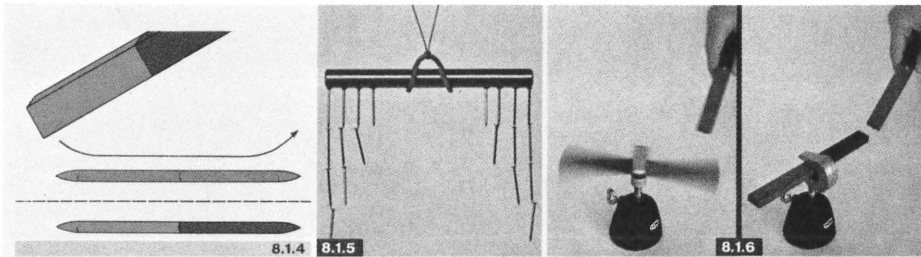
Beim Experimentieren fällt uns auf: Die eisernen Nägel bewegen sich schon, wenn der Magnet nur in ihre Nähe kommt. Seine Kraft ist bereits ohne Berührung wirksam. Ohne sichtbaren Vermittler greift die Kraft an. Ob vielleicht die Luft ihr Träger ist?

Versuch (Abb. 8.1.1): Wir hängen einen Schlüssel unter einer Glasglocke auf, aus der die Luft abgepumpt wird und nähern ihr den Magnet von außen: Offenbar ist auch die Luft nicht erforderlich, die magnetische Kraft weiterzuleiten. Es ist überhaupt kein Kraftüberträger wahrnehmbar.

Beim Versuch nach Abb. 8.1.1 entdecken wir außerdem, daß der Magnet auch durch das Glas hindurch wirkt, so als ob es gar nicht da wäre. Aber nicht nur bei Glas, auch bei Papier, Pappe, Holz, Blei, Stein und überhaupt bei allen nicht ferromagnetischen Stoffen können wir keine Behinderung des Magnetismus beobachten.

Versuch (Abb. 8.1.2): Da der Magnet auch durch die Tischplatte hindurch wirkt, lassen sich Eisenstückchen wie von Zauberhand bewegen.

Magnete machen Eisen magnetisch. *Versuch* (Abb. 8.1.3): Stecken wir einen Magnet in eine Schachtel mit Nägeln, so können wir beim Herausziehen gleich ein ganzes Büschel von ihnen erfassen. Wir bemerken, daß nicht alle Nägel unmittelbar am Magnet haften wie die Haare eines Pinsels, sondern daß sich zuweilen ganze Ketten von Nägeln bilden. Zwei, drei und manchmal noch mehr hängen aneinander.



8.1.4. Eine Stricknadel wird magnetisiert.

8.1.5. Der Magnet hat zwei Stellen stärkster Kraftwirkung: Die Pole.

8.1.6. Magnetpole können sich abstoßen oder anziehen; es gibt zwei Arten von Magnetpolen.

Offenbar wirkt die Fähigkeit des Magneten, Eisen an sich zu ziehen, ansteckend, denn ein Nagel der Kette kann doch nur hängen bleiben, wenn sein Vorgänger selbst magnetisch ist. Woher hat er aber seine magnetischen Fähigkeiten? Doch wohl von seinem Vorgänger, und das erste Glied in dieser Kette ist der Magnet selbst.

Diese Beobachtung legt auch die Vorstellung nahe, der Magnetismus „fließe“ vom Magnet in den ersten Nagel und von dort, sich langsam abschwächend, von Nagel zu Nagel fort, bis schließlich seine Kraft nicht mehr ausreicht, einen weiteren Nagel zu halten. Man spricht deshalb auch von magnetischer Influenz (lat. influere = hineinfließen). Die beeinflussten Nägel werden so selbst zu kleinen Magneten.

Versuch: Entfernt man eine solche magnetische Nagelkette ganz langsam und vorsichtig vom Magnet, so verliert sie zunächst ihre unteren Glieder, bei größer werdendem Abstand fällt sie schließlich ganz auseinander.

Wir erkennen daraus, daß das „Fließen“, wenn auch stark geschwächt, nicht der unmittelbaren Berührung bedarf. Wird die Entfernung zu groß, so verschwindet der influenzierte Magnetismus fast ganz. Nur ein paar Eisenfeilspäne bleiben an einem solchen Nagel noch hängen. Man spricht von Restmagnetismus oder *remanentem Magnetismus* (lat. remanere = zurückbleiben). Aber hierbei gibt es Unterschiede. Stahlstecknadeln und Stricknadeln bleiben stärker magnetisch als die gewöhnlichen Eisennägel. Man macht sich diese Eigenschaft bei der Herstellung von Magneten zunutze:

Versuch (Abb. 8.1.4): Streicht man wiederholt in der gleichen Richtung mit dem einen Ende eines kräftigen Magneten über eine Stricknadel, so wird sie selbst zu einem dauerhaften Magnet (Permanentmagnet; lat. permanere = verharren). Der ursprüngliche Magnet büßt erstaunlicherweise dadurch nichts von seiner Stärke ein, auch wenn man viele Stricknadeln magnetisiert. Seine Fähigkeit, Eisen anzuziehen, gibt er nicht einfach weiter, sondern er ruft neuen Magnetismus hervor. Das erfordert Arbeit. Sie wird beim Magnetisieren durch unsere Muskeln verrichtet.

Magnetpole. Unsere Versuche lassen uns erkennen, daß der Magnet nicht an allen Stellen gleichmäßig stark auf Eisen wirkt. Seine Anziehungskraft ist zu den Enden hin am stärksten, in der Mitte dagegen fast unmerklich (Abb. 8.1.5).

■ Die Stellen stärkster Kraftwirkung nennt man die Pole des Magneten.

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Wie wirken zwei Magnete aufeinander? Sie ziehen sich besonders stark an oder, das ist überraschend neu, sie können sich auch ebenso heftig abstoßen.

Magnetische Erscheinungen

Die magnetische Anziehung. Manche Eisenstücke haben die merkwürdige Eigenschaft, andere Eisenteile an sich zu ziehen. Man nennt sie **Magnete**. Außer Eisen und Stahl werden auch Nickel und Kobalt von Magneten angezogen. Man nennt sie zusammen mit dem Eisen **ferromagnetische Stoffe**.

Magnete machen Eisen magnetisch: Die Fähigkeit, Eisen anzuziehen, wirkt ansteckend. Z. B. kann in einer Nagelkette ein Nagel an seinem Vorgänger hängenbleiben, wenn dieser selbst oder auch nur sein Vorgänger an einem Magneten hängt. Man kann sich vorstellen, der Magnetismus „fließe“ vom Magnet in den ersten Nagel, und von dort, sich langsam abschwächend, von Nagel zu Nagel. Man spricht deshalb auch von **magnetischer Influenz**. Dabei bedarf es nicht der unmittelbaren Berührung, aber bei zu großer Entfernung verschwindet der influenzierte Magnetismus fast ganz. Nur ein schwacher **remanenter oder Restmagnetismus** bleibt noch übrig.

Magnetpole: Ein Magnet wirkt nicht an allen Stellen gleich stark. Seine Anziehungskraft ist an den Enden am stärksten, in der Mitte dagegen fast unmerklich. **Die Stellen stärkster Kraftwirkung nennt man die Pole des Magneten.**

Versuch: Wir untersuchen, auf welche Stoffe ein Magnet anziehend wirkt. Dies ist der Fall bei Gegenständen aus Eisen, Nickel oder Kobalt. Dagegen werden Kupferdraht, Messingschrauben, Aluminiumblech, Bleirohr, Holz, Stein, Kohle, Glas, Porzellan vom Magnet nicht angezogen.

Versuch (Abb. 8.1.1): Wir hängen einen Schlüssel unter einer Glasglocke auf, aus der die Luft abgepumpt wird und nähern ihr den Magnet von außen: Offenbar ist die Luft nicht erforderlich, die magnetische Kraft weiterzuleiten. Auch mit Glas, Papier, Pappe, Holz, Blei, Stein und überhaupt bei allen nicht-ferromagnetischen Stoffen können wir keine Behinderung des Magnetismus beobachten.

Versuch (Abb. 8.1.2): Stecken wir einen Magnet in eine Schachtel mit Nägeln, so können wir beim Herausziehen gleich ein ganzes Büschel von ihnen erfassen. Wir bemerken, daß nicht alle Nägel unmittelbar am Magnet haften wie die Haare eines Pinsels, sondern daß sich zuweilen ganze Ketten von Nägeln bilden.

Versuch: Entfernt man eine solche magnetische Nagelkette ganz langsam und vorsichtig vom Magnet, so verliert sie zunächst ihre unteren Glieder, bei größer werdendem Abstand fällt sie schließlich ganz auseinander.

Versuch (Abb. 8.1.3): Stecken wir einen Magnet in eine Schachtel mit Nägeln, so können wir beim Herausziehen feststellen, daß er nicht überall gleich stark ist. Seine Anziehungskraft ist zu den Enden hin am stärksten, in der Mitte dagegen fast unmerklich.

Abb. 8.1.1

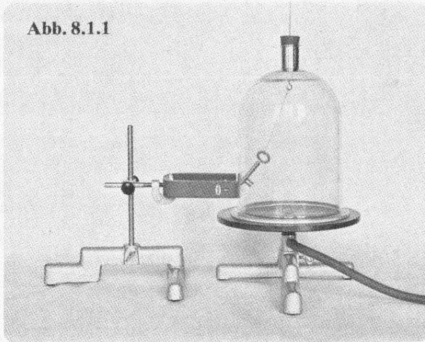


Abb. 8.1.2

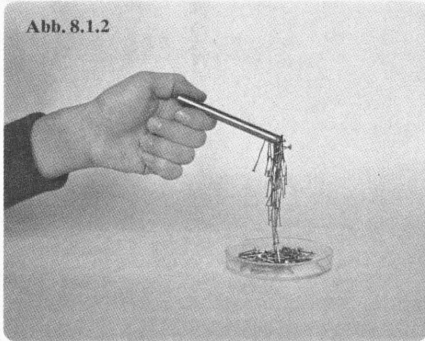
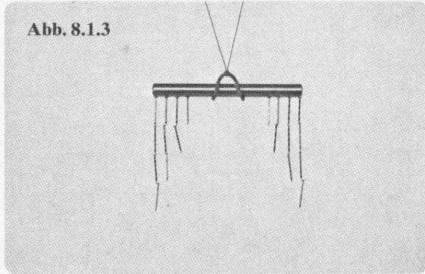


Abb. 8.1.3



Die Worte „Magnet“ und „Magnetismus“ kommen von dem Namen **Magnesia**. So heißt eine Halbinsel in Kleinasien, von der schon im Altertum bekannte magnetische Gesteine herkommen.

Aufgaben

1. Was versteht man unter einem Magnet?
2. Welche Stoffe sind ferromagnetisch?
3. Wie stellt man fest, ob ein Stoff magnetisch ist?
4. Was versteht man unter magnetischer Influenz?
5. Wie bezeichnet man die Stellen eines Magneten mit der stärksten Kraftwirkung?

Wirkung der Pole aufeinander: Zwei Magneten ziehen einander besonders stark an, können einander aber auch heftig abstoßen. Die beiden Pole eines Magneten sind verschieden. Haben zwei Magnetpole auf einen dritten die gleiche Wirkung, so sind sie gleich. Jeder Magnet hat zwei verschieden wirkende Pole.

Gleichartige Magnetpole stoßen einander ab, ungleichartige ziehen einander an.

Bezeichnung der Magnetpole: Die Magnetpole werden nach den Himmelsrichtungen benannt, in die sie sich bei freidrehbarer Aufhängung drehen: **Der nach Nordenweisende Pol heißt Nordpol, der nach Süden gerichtete Südpol.**

Teilt man einen Magneten, so werden nicht die Pole getrennt, sondern entstehen neue Magnete mit neuen Polen an den Enden der Teilstücke.

Die kleinsten Magnetchen, die man sich durch Teilung aus einem Magneten entstanden denken kann, werden **Elementarmagnete** genannt.

Bei der magnetischen Influenz wird ein dem Magneten nahes Eisen selbst zum Magneten. Da es angezogen wird, muß es so gepolt sein, daß es dem ihm nächstgelegenen Magnetpol gerade den ungleichnamigen Pol zuwendet. Ungleiche Pole liegen dann also benachbart und ziehen einander an. **Die Anziehung zwischen Magnet und Eisen beruht auf der Anziehung ungleichnamiger Magnetpole.**

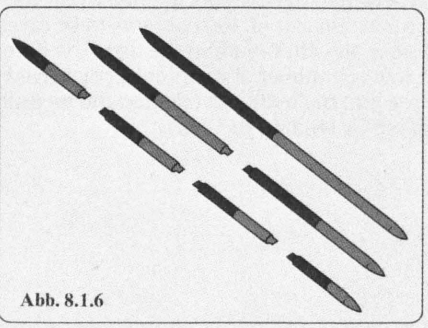
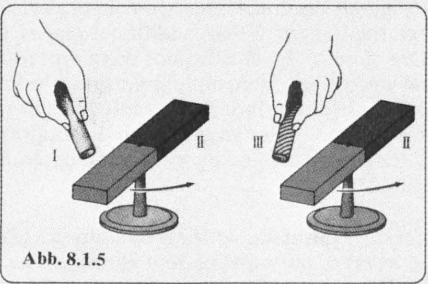
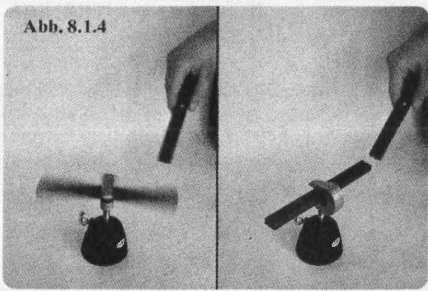
Versuch (Abb. 8.1.4): Der drehbar gelagerte Magnet sucht sich zu drehen, wenn man ihm den Pol eines anderen nähert. Immer ist es der gleiche Pol, mit dem er sich dem hingehaltenen Magnet entgegenstreckt bzw. von ihm abwendet. Wenden wir den Magnet in unserer Hand, so vertauschen die Pole des liegenden Magneten ihre Rolle.

Versuch (Abb. 8.1.5): Wir nehmen einen dritten Magnet so in die linke Hand, daß er auf einen drehbar gelagerten Magnet die gleiche Wirkung ausübt, wie der Magnet in der rechten Hand. Nun wissen wir: Beide Hände halten dem drehbar gelagerten Magnet gleiche Pole entgegen. Diese beiden Pole bewegen wir jetzt aufeinander zu und stellen fest, daß sie sich gegenseitig abstoßen. Dreht man einen Magnet um, so ziehen sie sich gegenseitig an.

Versuch: Hängt man Magnete an einem dünnen Faden auf, so orientieren sie sich nach einiger Zeit fast genau in Nord-Süd-Richtung. Danach sind die Pole der Magnete benannt.

Die Elementarmagnete. Versucht man, die beiden Pole eines Magneten zu trennen, so stellt man fest, daß dies nicht möglich ist. Man erhält stets wieder neue Magnete mit zwei Polen (Abb. 8.1.6). Da die Teilung eines Magneten nicht beliebig oft ausgeführt werden kann, gelangt man schließlich zu einem **kleinsten Magnet**.

Kneifen wir eine magnetisierte Stricknadel in der Mitte durch, so erhalten wir nicht die Magnetpole getrennt, sondern zwei kleine Magnete. Die beiden gerade getrennten Enden ziehen einander an. Drehen wir aber das eine Teilstück um, so spüren wir deutlich Abstoßung. Fügen wir die beiden Teile mit ihren Schnittstellen so gut wie möglich wieder zusammen, so verschwinden die neu entstandenen Pole, die Mitte wird wieder nahezu unmagnetisch. Könnte man das Gefüge vollkommen wieder herstellen, wir hätten wieder den ursprünglichen magnetischen Zustand.



Aufgaben

1. Wie wirken zwei Magnetpole aufeinander?
2. Wie kann man feststellen, welcher Pol eines Magnets der Nordpol ist?

Although the experimental variable we wanted to test in Version D (as compared to Version A) was typographic layout, we had to change more than just the position of text and pictures. To separate the three levels of text (main, explanatory, marginal), we had to rewrite most of the sentences. In total we actually shortened the text (from 1810 words to 1185 words), mainly by avoiding repetitions. We also added questions about the contents of the preceding columns in column four. Thus we changed more than one variable in designing the visualized Version D. In comparing its effectiveness against the traditional Versions A and B, therefore, it will be impossible to decide to which of these variables to attribute any differences.

As with Version C, we thought that Version D would require some familiarization with the new way of displaying information. Thus, we took another chapter from the same textbook, redesigned it in the same manner as Version D, and presented this to our subjects about one week prior to the actual experiment.

Experimental material

The material for our experimental study consisted of four versions of a chapter on magnets from a physics textbook: the standard (original) Version A, the two-column Version B of the same text, the Version C with additional spaces, and the visualized Version D. The illustrations were reproduced in full color and were identical in all four versions. In Version D, columns 1–3 were printed on a white background, with a light gray margin underlying column 4. Paragraphs belonging together were marked by means of a common yellow background.

These four differently designed versions of a physics lesson constituted the levels of our independent variable. The dependent variables were (i) time taken by the student to read, or work through the respective text, (ii) achievement gained from a text on the contents of the text, and (iii) students intuitive rank order of preferences for the four different versions.

To measure achievement (knowledge gained from the text) we developed a 20-item test on the contents to be given to the subjects before and after reading the text. The difference between scores (number of items correctly solved after minus before reading the text) was taken as the measure of knowledge gained by reading the text.

Experimental procedure

The experimental study was conducted in 18 classes of grades 6 to 8 in five secondary schools (Realschulen) in Niedersachsen, F. R. Germany. The students were about 12 to 15 years old. About one week before the experimental session, each class was given the short story with additional spaces and the "visualized" physics lesson, to help familiarize the students with these kinds of presentation.

The experimental session itself took about 90 minutes, the time of two regular school lessons. First, the students were given an initial achievement test with instructions to complete the test even without knowing much about the questions asked. It was made clear to them that this test was given only to find out how much they knew already from other sources about magnets, prior to reading the chapter from the physics textbook. The teacher or experimenter then explained the scope and purpose of the study, and silently demonstrated some of the physics experiments described in the text to be read. In some classes, the students also had some material on their desks to experiment themselves. (To our surprise, these classes actually did not take more time to work through the tests than classes without this opportunity.)

After the demonstration each class was divided at random into four groups of equal size; all members of each group were given the same version (A, B, C or D) of the experimental text. Students sitting together at the same table belonged to the same group, but groups were randomly distributed over the room. Each student had a printed version of the experimental text face down in front of him on his desk. At a sign given by the experimenter, each student turned it over and immediately started reading. It was made clear to the students that in spite of the timing procedure, it was more important to read the text completely and carefully than to finish in a short time. They were instructed to raise their hand when they had finished reading; the experimenter or helper then registered the time taken, collected the text sheets, and gave the student the second achievement test. After the second test was completed and turned in, each student was shown all four versions of the text and asked to indicate a personal rank order preference.

Results

The dependent variables of this experiment, reading time and achievement test scores, were analysed by means of analysis of variance between the four different versions of the text (Tables I and II). (In analysing the achievement test scores, after reading the text, achievement scores on the same text taken before reading the text were used as a covariate to reduce error variance.) Pairwise t-tests between the standard Version A and the new Version B, C, and D displayed in Table III indicated that the significant differences between means are not altogether due to a superiority of the new versions over the standard but rather to overall differences partly due to the inferiority of some of the experimental versions as well. This has to be taken into account in interpreting the results in more detail.

Table I.

Analysis of Covariance for Achievement Test Scores

<i>Source of variation</i>	Sum of squares	df	Mean square	F	$p \leq$
Test scores before (covariate)	3640.262	1	3640.262	714.833	0.001
Test scores after (dependent variable)					
Main effects	1648.644	21	78.507	15.416	0.001
Between versions A, B, C, D	75.703	3	25.234	4.955	0.002
Between classes	1580.371	18	87.798	17.241	0.001
Interaction	481.041	50	8.361	1.642	0.005
Total variance accounted for	5706.948	72	79.263	15.565	0.001
Residual (error variance)	2683.717	527	5.092		
<i>Total</i>	8390.665	599	14.008		

Without accounting for differences between classes

Between Versions A, B, C, D	68.273	3	22.758	2.892	0.034
Total variance accounted for	3708.536	4	927.134	117.819	0.001
Residual (error variance)	4682.129	595	7.869		

Table II.

Analysis of Variance for Reading Times

<i>Source of variation</i>	Sum of squares	df	Mean square	F	$p \leq$
Main effects	11904.508	21	566.881	39.652	0.001
Between versions A, B, C, D	237.226	3	79.075	5.531	0.001
Between classes	11701.906	18	650.106	45.473	0.001
Interaction	1713.995	50	34.280	2.398	0.001
Variance accounted for	13618.503	71	191.810	13.417	0.001
Residual (error)	7548.535	528	14.296		
<i>Total</i>	21167.038	599	35.337		

Table III.

Pairwise t-Tests between Standard Version A and Versions B, C, and D for Reading Time and Achievement Score

<i>Achievement Score</i>	<i>Version</i>	<i>N</i>	<i>Mean</i>	<i>Deviation</i>	<i>Result of t-Test against Version A</i>	<i>p ≤</i>
	A	150	4.2	2.9	—	—
	B	148	3.5	2.8	2.16	0.032
	C	151	3.8	2.7	1.27	0.206
	D	151	4.4	2.9	-0.45	0.651
<i>Reading Time</i>	A	150	17.7	5.4	—	—
	B	148	18.2	6.3	-0.72	0.471
	C	151	17.3	5.0	0.67	0.506
	D	151	16.6	6.8	1.54	0.124

Table IV.

Superiority (+) and Inferiority (-) of Versions B, C and D as Compared to Version A in Different School Classes

<i>Form</i>	<i>Version B</i>		<i>Version C</i>		<i>Version D</i>	
	<i>time</i>	<i>achievement</i>	<i>time</i>	<i>achievement</i>	<i>time</i>	<i>achievement</i>
1	—	+	+	+	—	+
2	—	+	+	+	+	+
3	—	—	—	—	+	+
4	+	—	—	—	+	+
5	+	—	+	—	+	—
6	+	—	+	+	+	+
7	+	+	—	+	+	+
8	—	—	+	+	+	—
9	—	—	—	—	—	+
10	—	—	+	—	+	+
11	+	+	+	—	+	—
12	—	+	+	+	—	+
13	+	—	+	+	+	—
14	—	—	—	—	—	—
15	+	—	+	—	+	—
16	—	—	—	—	+	+
17	+	—	—	—	+	—
18	+	+	—	+	+	+
<i>Total</i>						
<i>+/18</i>	+	6	10	8	14	11
<i>Total</i>						
<i>++/18</i>		2		6		8
<i>Total</i>						
<i>—/18</i>		6		5		1

Optimal Line Length

The two columns in Version B take, on the average, a little more reading time (18.2 minutes) compared to the standard Version A (17.3 minutes), and achievement after reading Version B is a little lower (8.46 points on the average) than after reading Version A (9.08 points). Pairwise t-tests between Versions A and B resulted in $t = -2.66$ ($p < 0.01$) (in favor of Version A) for achievement test scores (using the corrected error variance term), and in $t = 1.16$ ($p > 0.05$) for reading time. Based on these results, nothing can be recommended as to whether or not to use one or two column typographic design, given the page format used in school textbooks. In their personal preferences the students slightly preferred the two-column Version B over the standard Version A.

Additional Spaces

Version C (with additional different spaces between words) is read slightly but not significantly faster (17.3 minutes) than the standard Version A (17.7 minutes). The knowledge achieved after reading Version C (8.88 points) is slightly (but also not significantly) lower than after reading Version A (9.08 points). Pairwise t-tests between Versions A and C resulted in $t = -0.77$ ($p > 0.05$) for reading time. Students like Version C slightly better than Version A. However, the differences resulting from this experimental study are so small that it probably does not pay to implement this principle of structuring the sentences for textbooks in general, taking into account the considerable effort necessary to produce such texts. On the other hand, we must not forget that reading effectiveness is largely dependent on reading habits, and reading just one short story in the week preceding the experiment was probably too little experience to familiarize our subjects with this new way of transmitting language information.

Visualizing the Information

Reading the visualized Version D took the shortest mean reading time (16.6 minutes) and resulted in the largest gain of knowledge (average achievement test scores 9.42 points). Pairwise t-tests between Versions A and D resulted in $t = +0.5$ ($p > 0.05$) for achievement test scores, and in $t = -2.56$ ($0.01 < p < 0.05$) for reading time; i.e., Version D was read in significantly shorter time, and even with a little (insignificantly) more achievement gained. Besides that, it was most popular among the students in their subjective rank order preference. Thus this kind of textbook design seems to be most efficient among the versions tested in this study. In spite of the fact that pairwise t-tests between Versions A and D did not reach the conventional levels in significance, we consider this a relevant result in favor of the new form because of the unusual textbook design being unfamiliar to the subjects. The short lesson given to them in the new style one week prior to the experiment could hardly make up for the life long experience with the old style. This, together with the overwhelming popularity of Version D in the subjects' preference order (which probably has a strong motivating effect to work with such materials) lead us to recommend the design of textbooks in the style of Version D.

The largest source of variance were differences between participating school classes, with reading times as well as with achievement scores. Even with the use of the test score before reading the text as a covariate, consideration of classes as a source of variance reduces the error variance term considerably as can be seen by comparing the upper and lower part of Table I.

Interactions

In both reading time as well as achievement test scores there is a significant interaction between the main variable "classes" and "Versions." That means that differences in the effectiveness of the different Versions is not of the same intensity, nor in the same direction in the different classes. Some classes take more time reading Version D than Version A, whereas others take considerably less time, and still others only little less time. Similar interactions can be found for achievement scores, but these interactions are by no means related to those found in the reading times. In one class readers of Version D took on the average 3.3 minutes more time than readers of Version A, but gained on the average 2 points more than those. The "disadvantage" of taking more time is in this case compensated by a larger knowledge gain with Version D. It is not, however, our concern to discuss how to evaluate reading time and efficiency against each other. In other classes, however, both reading time and achievement scores are in the same direction favoring one version or the other. Such advantages are displayed in Table IV; pluses indicate superiority of the respective version over the standard Version A, minuses indicate inferiority. Table IV shows that Version B is inferior to Version A in both variables in six classes, but superior in only two classes, whereas Version D is superior to Version A in both variables in eight classes, and inferior in both variables only in one class.

Discussion

Our concern, with this study, has been the exploration of possibilities to improve the effectiveness of the typographic design of textbooks. "Effectiveness" has been measured by three variables: speed of reading, knowledge gained as measured in an achievement test, and subjects' preference as an indicator of their motivation to work with the material. "Possibilities of improvement" have been oriented at the practical feasibility given to a textbook publisher: the first (and simplest) means would have been to change line length by going from one-column pages to two-column pages (Version B). Our experiment indicated that this would be no improvement at all but rather result in slower reading and less knowledge gained.

The next step, Version C, would require extra work by both the publisher and the author in providing additional spacing to visualize the linguistic structure of the text. This resulted in only a little improvement in reading time and a little less knowledge gained — altogether insignificantly. This means of changing typography cannot be recommended based on these results. However, it should be kept in mind that this change in typography is contrary to the reading experience of our subjects, and may still be effective after longer training in reading this style of typography.

The most laborious task to change typography would be to transform textbooks into the typographic style of Version D. The whole text would have to be rewritten and restructured. However, the results are most encouraging to this task, at least when writing and designing new textbooks. The new style of Version D seems to be not only most appealing to the student (which is important from a motivational point of view) but also more effective both in terms of reading time and achievement gained — in spite of the fact that it is rather unusual for their reading habits.

Acknowledgements

We are grateful to the Ernst Klett Verlag, Stuttgart, for sponsoring the research reported here and to various members of the staff for their advice, especially Messrs. Pohle and Dorn. We are also grateful to Dierk Becker and Jörg Heinrich for designing Version D of our experimental material; to Wolfgang Walter for assigning the additional spaces in Version C, and to Christa Günther for experimentally determining the appropriate size of these spaces; to Drs. Duit and Häussler, Mr. Ehrenfort, Mrs. Faas and Mrs. Steenberg for their help in designing the achievement test; to the headmasters, physics teachers, and 600 students in the secondary schools of Delmenhorst, Ganderkesee, Harsum, Wiesmoor, and Wildeshausen, Lower Saxonie, for participating in the experiment; to Dr. Hartmut Fillbrandt and Dr. Scherzer for processing the data; and to two anonymous reviewers for some valuable hints for a revised version of the paper.

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The design of Demos typeface was the result of technical as well as aesthetic considerations. Demos was designed for the Hell CRT Digiset, an electronic composition process that creates type by vertical lines. Curves and angles appear smooth only after emulsion. Rather than falling back on hot-metal methods, the unique characteristics of the Digiset were used to determine the design, ever mindful that visual appearance is the final arbiter of any letterform design. All of the type for this issue of Visible Language has been set in Demos on the Hell Digiset; a few of the typographic elements have been set in the companion face Praxis.

In designing Demos typeface for the firm of Dr.-Ing Rudolf Hell GmbH (Kiel, Germany) specifically for its electronic typesetter, the Digiset, I encountered the various problems that beset any designer when he must match his own desire for aesthetic as well as perceptual quality with the necessary restrictions of technology. The results of this experience are what I wish to share in this essay.

Figure 1.



Visible Language
XIII 2 (1979)
pp. 134—149

Author's address:
Prins Mauritslaan 26
1405 CW Bussum, Holland

0022-2224/79/0400-0108
\$02.00/0

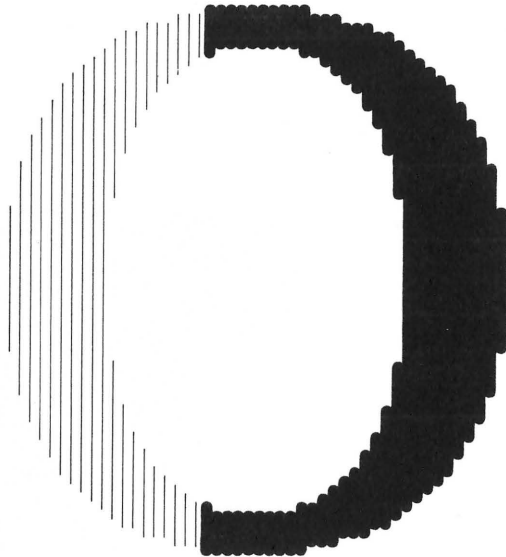
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Cleveland Oh 44106

The design of new typefaces for electronic typesetting has traditionally been carried out along lines derived from the method of adapting hot-metal faces to filmsetting. Practice was, and still largely is, to anticipate photographic reproduction distortion by exaggerating certain details, as is done with the extension and cutting out of corners (Figure 1). But one is left in doubt about what the final result will be. Will the thorns and cuts still be visible in print? Or will they disappear through the several stages of reproduction? What happens if all point sizes are scaled from one set of matrices? Quality control becomes precarious, since the original image can hardly be compared with the printed result.

Filmsetting is an uncertain business that we have yet to master completely. In many ways it is a more complicated process than hot-metal setting, with different influences on type forms. And we will never fully be able to master it if we continue to apply hot-metal standards to filmsetting designs.

Rather than work against the requirements of the electronic process, I designed Demos to work with it. The Hell Digiset builds up characters from vertical lines on photographic material (Figure 2). The photographic material used in faster filmsetters cannot produce an absolute separation of black and white areas; there is always a gradual transition, a soft edge. This effect causes the well-known rounding off and filling up of corners (Figure 3).

Figure 2.



The design of Demos rests on the principle that a halftone dot is usually underexposed and tends to shrink. Then, on the offset plate as it is overdeveloped the dot tends to regain its original size; printed with an excessive amount of ink, it enlarges a few additional microns. Through all these stages the dot retains its circular shape (Figure 4). With similar treatment a typeface with sharp corners becomes more and more blunted and loses its sharp character at every stage. But when all vulnerable details are rounded off in advance, letters retain their basic shapes as do halftone dots (Figure 5).

Figure 3.

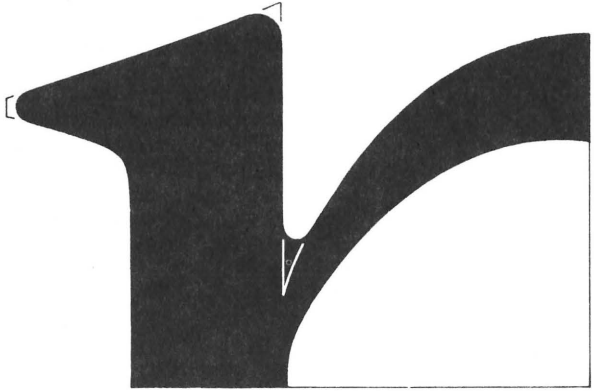


Figure 4.

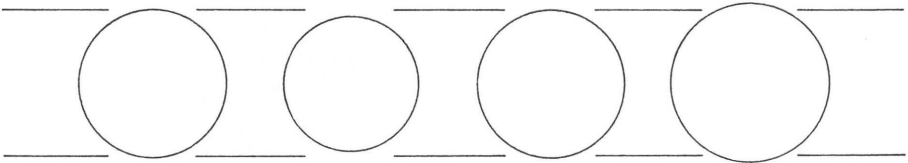
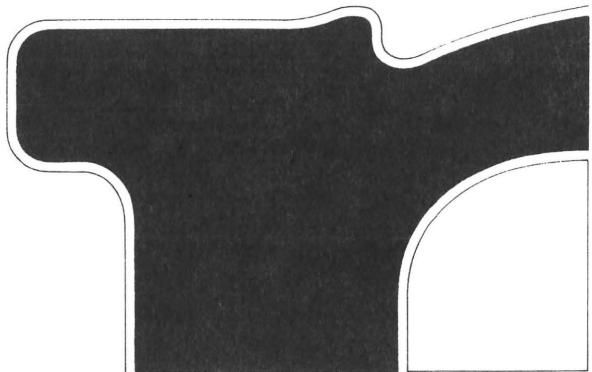


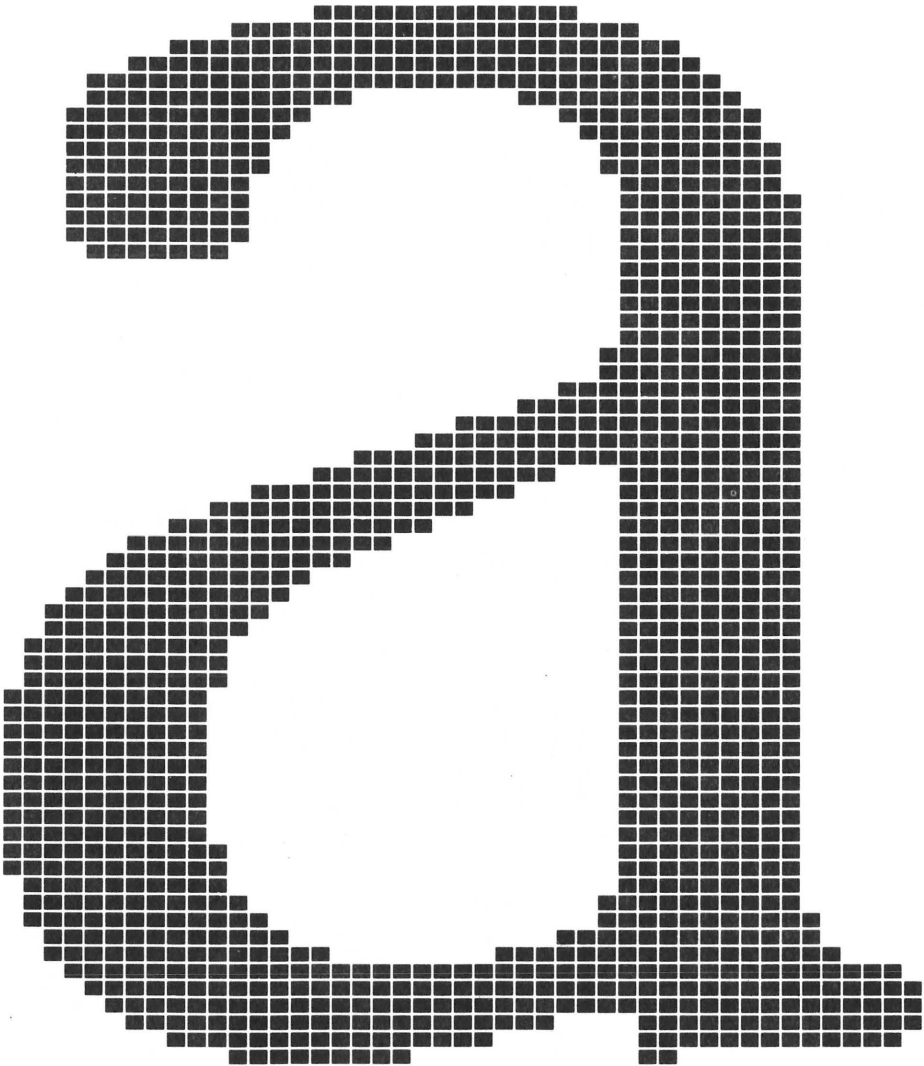
Figure 5.



Demos was conceived specifically for the cathode ray tube (CRT) grid, a recent innovation in typeface design. (Hermann Zapf's Marconi, which appeared in 1976, was the first type design made especially for CRT typesetting.) I made sketches and original drawings on the CRT grid for type sizes 8- to 16-point Didot (no metric measurements yet), with 100 horizontal positions per em horizontally and 120 positions vertically. Coordinates, which together form the characters, are read into the computer and are recalled without the aid of a visible matrix. The Digiset equipment produced since 1976 can set from 6- to 16-point from this master (Figure 6).

Figure 6.

An example of an original drawing showing the CRT grid.



Not every curve works out well in the grid. Horizontal and vertical lines pose no problems; neither do lines at an angle of approximately 45° (Figure 7). But curves formed between 45° and the horizontal or the vertical do cause problems; the longer and smoother a curve must be, the more difficult it is to realize. Thus before I started designing, I sorted out within the grid the combinations of steps which in an impressionistic way present themselves as smooth curves to the reader's eye (Figure 8) and which dissolve due to emulsion characteristics in the photographic process (Figure 9). The emulsion results in a 50% reduction of notches as the type transfers from film to plate (Figure 10). Remember also that the grain of the paper is often coarser than the unevenness of the contour at the end of the process of film to plate (Figure 11).

Figure 7.

An enlarged 45° line on the CRT grid (left) and how it appears when printed.

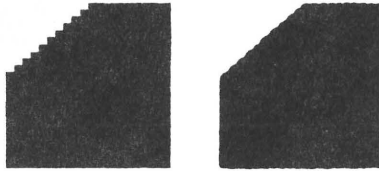
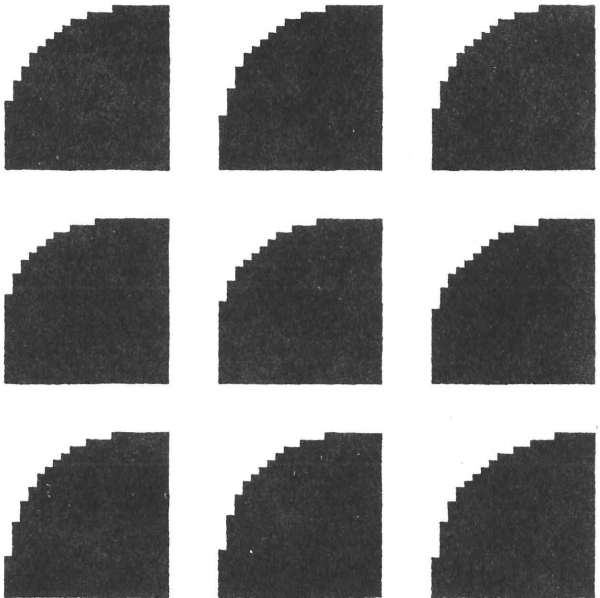


Figure 8.

One of the specimen pages used to check the smoothness of various curves in the CRT grid. Curves were evaluated with a reducing glass from a distance of two meters.



Another reason why all corners of Demos are rounded off is that the cathode ray has a half-circular ending and therefore all outward corners are rounded off automatically in the grid for the most frequently used text sizes of 8- to 12-point.

Figure 9.

An experimental print to show what photographic emulsion does to the contours of a CRT letterform.



Having determined the most favorable curves and with a set of other elements and measurements — the thickness and width of horizontal and vertical parts, transitions from thick to thin, junctions, horizontal and vertical proportions, the weight and the formation of serifs, etc., all determined through a series of tests — I started to make the final drawings.

Figure 10.

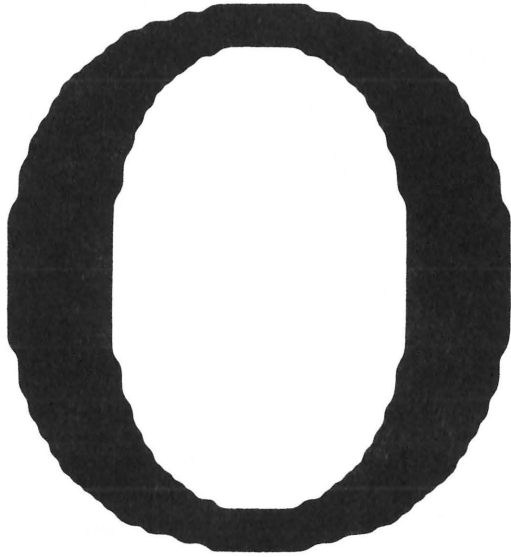
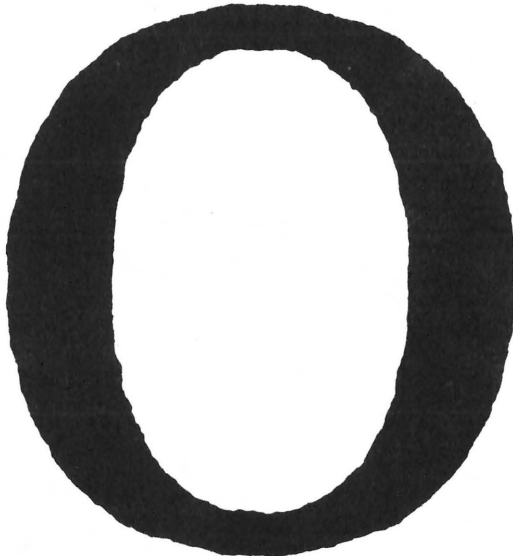
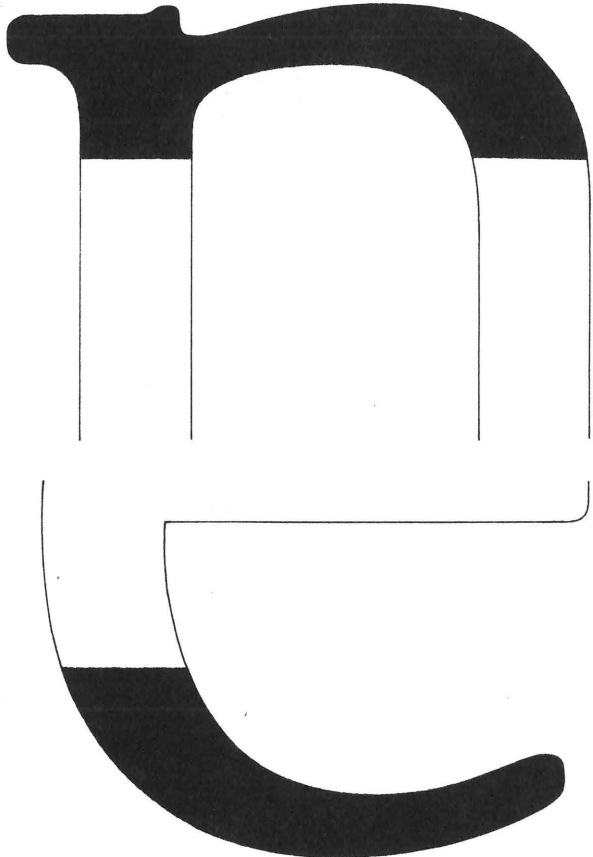


Figure 11.



To be economical of space Demos has a large x-height: 55% of the distance between the top of an ascender and the bottom of a descender. In 10-point Times New Roman (Monophoto), for example, the ratio is 50%. Too often a large x-height requires extra leading, thus nullifying most of the saved space. To keep leading to a minimum and as an aid to the formation of words and lines, every character is stressed horizontally (Figure 12). Such an effect also results in wide open counters, giving the typeface a large look and allowing for a choice of type size one or even two sizes smaller than is possible with most current designs (Figure 13).

Figure 12.



In this way the text area can be reduced considerably; in comparison with many other designs, Demos can save up to 15% in space. And when a point-size is set on the narrower width of a smaller point size (e.g., 9-point on 8-point width), another 10% is added, allowing production of less bulky dictionaries, encyclopedias, and telephone books (Figure 14). Being a bit shorter than the ascenders, capitals and numerals blend easily with the large lower-case (Figure 15).

Figure 13.

Demos 9-point (top), 9-point one point leaded (middle), and bold 9-point one point leaded (bottom).

Europa has two distinct types of climate; a north suited to the production of fine cream and dairy produce, excellent beef and wonderful bacon; and a south that produces olives for olive oil, vines for wine of all kinds, luscious southern fruits, vegetables and sea food. France is the only country in Europe that includes both types of climate, and therefore has a range of foodstuffs second to none.

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Figure 14.

Demos 9-point on 8-point width without leading (top) and one point leaded (bottom).

Europa has two distinct types of climate; a north suited to the production of fine cream and dairy produce, excellent beef and wonderful bacon; and a south that produces olives for olive oil, vines for wine of all kinds, luscious southern fruits, vegetables and sea food. France is the only country in Europe that includes both types of climate, and therefore has a range of foodstuffs second to none.

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Figure 15.

Demos 16-point. Top line shows the substitute form of letter g.

HaHbHcHdHeHfHgHhHiHjH

HaHbHcHdHeHfHgHhHiHjH

H1H2H3H4H5H6H7H8H9H0H

o1o2o3o4o5o6o7o8o9o0o

tusmuziek. Aanvankelijk werden de nieuwe religies in Rome verboden. Maar dat was niet vol te houden. In 204 v. Chr., tijdens de oorlog tegen Hannibal, werd de cultus van Kybele, de grote moedergodin uit Phrygië, naar Rome gebracht. De vreemde priesters namen hun eigen muziekinstrumenten mee: de Phrygische tibiae

With high quality offset lithography a typographic image can be faithfully reproduced (Figure 16), but in mass production type can be severely affected, especially on coarse papers (Figure 17). Rotogravure plays havoc with any delicate detail (Figure 18). To remedy some of the problems, I specified in the design brief that the Demos letterforms should be tolerant; throughout the design I have kept all details simple and firm: sturdy serifs, joints at obtuse angles, a strong color, and no extreme thin strokes.

Reduction and Enlargement.

As with most typefaces for CRT composition and for filmsetting, Demos is subject to linear reduction and enlargement within size-groups; e.g., one set of matrices designed with the 10- and 12-point sizes in mind is used for 6- to 16-point sizes. This practice could make the larger range of sizes look too heavy and too wide; conversely, the smaller sizes may look cramped. I don't think this problem will ever be solved satisfactorily except through the use of the smallest possible size-groups. It helps, however, when the typeface is made relatively wide, when the difference between thick and thin parts is not pronounced, and when the face is comparatively heavy.

Figure 16.

An enlargement of Demos 8-point printed by offset lithography on smooth paper.



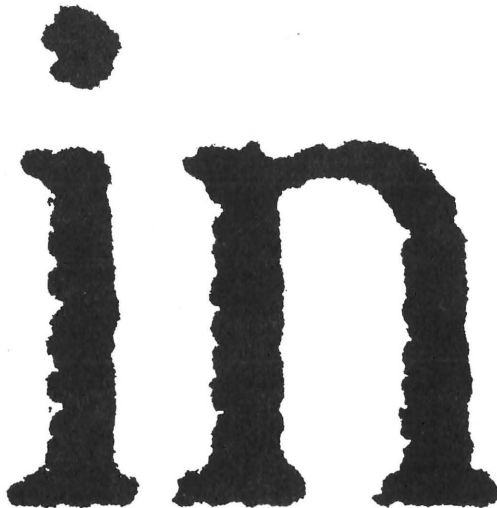
Figure 17.

An enlargement of Demos 8-point printed by offset lithography on rough paper.



Figure 18.

An enlargement of Demos 12-point printed by rotogravure.



An electronically generated typeface can also be slanted (Figure 19), compressed, and extended electronically. But when a typeface is conventional in design, such distortions can spoil the overall look of the face. In the future it may be possible to start with a simple basic design which can be fattened, slanted, stretched, or fitted with serifs according to printing techniques and papers or by the contents of the text. This is being done experimentally with computer programs for modifications, such as the Ikarus program by Rubow-Weber in Hamburg. Conventional typeforms, however, are often too delicate and complicated to be distorted without ill effects. It can be made easier by lessening distortion and keeping the design simple. The horizontal stress of the characters of Demos allows for relatively successful condensation and expansion.

Figure 19.

eerst wordt de tekst gezet, of liever gezegd

Figure 20.

Praxis medium 9-point one point leaded, normal width (top) and on 8-point width (bottom).

Europa has two distinct types of climate; a north suited to the production of fine cream and dairy produce, excellent beef and wonderful bacon; and a south that produces olives for olive oil, vines for wine of all kinds, luscious southern fruits, vegetables and sea food. France is the only country in Europe that includes both types of climate, and therefore has a range of foodstuffs second to none.

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Figure 21.

A test line of Demos italic.

Hamburgos grub sorgsam um Hugos Harro
amburgos grub sorgsam um ugos arro
Hamburgos grub sorgsam um Hugos Harro

As a companion face to Demos I have also designed the sans-serif typeface Praxis (Figure 20). It harmonizes with Demos in shape, weight, vertical and horizontal proportions, and many constructional details, and is executed in five different weights. An italic to Demos is also in execution (Figure 21).

General Considerations.

Techniques should be allowed to influence a design but not to dictate it. Nor should any technique in particular (digitation, CRT, optics, photography, offset lithography) be allowed to dominate or be the cause of obvious design characteristics, at least when the typeface is intended for continuous reading and for general use. The characters of a text face are subject to optical distortion in the reader's eye by their continuous repetition, constant change in combination, speed of reading, and the half-conscious reading process. Wherever necessary, details of Demos that were originally shaped by formulas based on technical considerations were reshaped by design insight.

When the subject of Mr Denby fell of its own weight, he essayed other equally irrelevant themes, but each time the very deference of Dick's attention seemed to paralyse him, and after a moment's stark pause the conversation that he had interrupted would go on without him. He tried breaking into other dialogues, but it was like continually shaking hands with a glove from which the hand had been withdrawn—so finally, with a resigned air of being among children, he devoted his attention entirely to the champagne.

Rosemary's glance moved at intervals around the table, eager for the others' enjoyment, as if they were her future stepchildren. A gracious table light, emanating from a bowl of spicy pinks, fell upon Mrs Abrams' face, cooked to a turn in Veuve Cliquot, full of vigour, tolerance, adolescent good will; next to her sat Mr Royal Dumphy, his girl's comeliness less startling in the pleasure world of evening; then Violet McKisco, whose prettiness had been piped to the surface of her, so that she ceased her struggle to make tangible to herself her shadowy position as the wife of an arriviste who had not arrived.

Then came Dick, with his arms full of the slack he had taken up from others, deeply merged in his own party.

Then her mother, forever perfect.

Then Barban, talking to her mother with an urbane fluency that made Rosemary like him again. Then Nicole. Rosemary saw her suddenly in a new way and found her one of the most beautiful people she had ever known. Her face, the face of a saint, a viking madonna, shone through the faint notes that snowed across the candlelight, drew down its flush from the wine-coloured lanterns in the pine. She was still as still.

Abe North was talking to her about his moral code: 'Of course I've got one,' he insisted, '—a man can't live without a moral code. Mine is that I'm against the burning of witches. Whenever they burn a witch I get all hot under the collar.' Rosemary knew from Brady that he was a musician who, after a brilliant and precocious start, had composed nothing for seven years.

Next was Campion, managing somehow to restrain his most blatant effeminacy, and even to visit upon those near him a certain disinterested motherliness. Then Mary North with a face so merry that it was impossible not to smile back into the white mirrors of her teeth—the whole area around her parted lips was a lovely little circle of delight.

Finally Brady, whose heartiness grew moment by moment, to

Twee vakbonden zoeken contact met VMF-leiding

Utrecht, 16 april—De Industriebond CNV en de beamptenbond Unie BLHP hebben zich tegenover de raad van bestuur van VMF bereid verklaard het overleg te hervatten over alle problemen, die zich bij het concern voordoen. Als voorwaarde vooral stellen de twee bonden dat bij de plasticmachine-fabriek SPPM in Hengelo een 'zo groot mogelijke werkgelegenheid' in stand wordt gehouden. De raad van bestuur staat op het standpunt dat het VMF-bedrijf SPPM moet sluiten.

Volgens een woordvoerder van de Industriebond CNV is de bereidheid om het overleg te hervatten een allerlaatste poging. 'Wij hebben de hoop, dat de VMF-top inziet dat er acties komen en dat onder die druk nog kan worden onderhandeld.'

In een brief aan de VMF-top hebben beide vakbonden laten weten uiterlijk maandag 18 april voor 's-middags zes uur een reactie op hun aanbod te verwachten.

Burgemeester en wethouders van Hengelo hebben met 'verontwaardiging en verbazing' kennis genomen van het antwoord van de raad van bestuur van de VMF op een brief van het college over gevolgen voor de werkgelegenheid van de aangekondigde sluiting. Het college sprak in zijn brief 'ernstige teleurstelling' uit over het niet aan-

vaarden van het aanbod van het ministerie van economische zaken van een achtergestelde lening van 15 miljoen gulden voor voortzetting van de SPPM.

Het gemeentebestuur zei in de brief erop te rekenen dat de raad van bestuur van VMF Stork alles in het werk zou stellen de werkgelegenheid in Hengelo te behouden. In het antwoord stelt VMF Stork dat men gaarne verneemt welke positieve stappen door het gemeentebestuur zijn genomen voor de werkgelegenheid in Hengelo. 'Onzerzijds,' aldus de brief, 'hebben wij de afgelopen jaren de grootst mogelijk inspanningen getoond hetgeen blijkt onder meer uit het feit dat wij SPPM gedurende tien jaar hebben voortgezet zonder dat ook maar enig jaar winst werd gemaakt.' (ANP)

**A Monastic Dilemma Posed by the Invention of Printing:
the Context of *De laude Scriptorum Manualium*
by Abbot Johann Trithemius (1462—1516)**

*By no means was the invention of printing universally looked upon by contemporary witnesses as an unqualifiably progressive step in the history of mankind; in the monastic scriptorium, for example, the printing art came into direct competition with the long-cultivated art of handcopying. A Benedictine abbot living in the age of incunabula, the Abbot Trithemius of Sponheim near Kreuznach in Germany, composed his *De laude scriptorum manualium* (1492) in support of the proposition that the handcopying of texts is in many respects superior to printing. However, the author was not hostile to the printing art in principle, viewing it on balance as a divinely-inspired aid in the facilitation of his campaign to renovate in contemporary dress the golden age of monastic erudition. Far from being a reactionary in the face of the printing revolution, Trithemius was one of printing's most vigorous Renaissance advocates.*

Of all the remarkable achievements of man coming to the support of the progressivists in the so-called "quarrel of the Ancients and Moderns" marking the early modern period, none has more dramatically underscored the advancement of modernity over antiquity than the invention of printing in the mid-fifteenth century.¹ Not all witnesses to the printing revolution, however, have been equally persuaded that it represented a genuine step forward in the evolution of human society. Among those least inclined to adopt an unqualified enthusiasm toward the novel art, we should not be surprised to find, were the custodians and taskmasters of the monastic scriptorium, the abbots and their priors, whose scribes were increasingly finding their labors obviated and seemingly made superfluous by a method of book production of far greater efficiency than handcopying and ensuring a far more widespread circulation of a given text.

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Among such abbots who stood at the crossroads in the transition from hand-inscription to printing was the highly erudite and reform-minded Benedictine monk Johann Trithemius (1462—1516), who had assumed his post at Sponheim, in the diocese of Mainz, in the year 1483 and thus at a moment when printing was still in its birth pangs.² And so convinced was Trithemius in the value of the traditional monastic mode of book-production that, at the instance of an abbot-friend, he sat down at his desk in the year 1492 and penned a treatise in commendation of the art of hand-copying. Never mind that, to assure the greatest possible circulation of this tract, Trithemius gave over the manuscript for publication to the Mainz printer Peter von Friedberg, whose printing shop, according to Trithemius' biographer Klaus Arnold, "could almost be called the Sponheim Abbey press."³ What interests us here is the fact that in this writing, under the title *In Praise of Scribes (De laude scriptorum manualium)*, Trithemius took a forthright position comparing printing unfavorably to handcopying. In this regard the cardinal chapter in the sixteen-chapter *Praise of Scribes* is the seventh, bearing the heading: "That monks should not stop copying because of the invention of printing."⁴

Questiones super octo libros physicorum Aristotelelis.
Johannes Dullart, Paris, 1506.



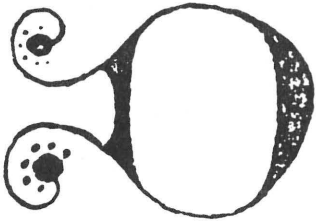
The keynote of this chapter is sounded in its opening admonition to monks:

*Brothers, nobody should say or think: "What is the sense of bothering with copying by hand when the art of printing has brought to light so many important books; a huge library can be acquired inexpensively." I tell you, the man who says this only tries to conceal his own laziness.*⁵

In other words, Trithemius takes up a stance at the outset against the argument, which he must have often heard to his great displeasure from some of his own monks who were finding themselves ill-at-ease in the cloister's scriptorium, that the art of manuscript copying had largely been made redundant and anachronistic by printing. In accusing those espousing this argument of laziness or sloth — thus, of the medieval capital vice *acedia* — Trithemius is consciously in keeping with an attitude traceable to the pristine beginnings of monasticism when the scriptorium was instituted by Cassiodorus and his monastic successors under the working assumption that the vice of sloth can as effectively be cured by labors of the mind as by labors of the body.⁶ But it is not Trithemius' sole intention here to leave his monkish readers with a *moral* admonition against succumbing to a capital vice. It is also his determination to put into the heads of his readers the definite *physical* advantages of handcopying over printing.

The principal advantages of handcopying over printing explicitly singled out by Trithemius in his seventh chapter can be reduced to four. In the first place the handcopied parchment has much greater longevity than the text printed upon paper, so that, he says, whereas "the word written on parchment will last a thousand years," by the same token "the most you can expect a book of paper to survive is two hundred years."⁷ In the second place, inasmuch as the printers are dependent on handcopyists for their texts, there are in existence many more titles of unprinted works than printed ones; given this situation, Trithemius points out, "no matter how many books will be printed, there will always be left some unprinted and worth copying." In the third place, the monastic scribe "is free and as a scribe enjoys his freedom"; that is to say, the scribe is independent in his choice of texts and other matters pertinent to his art, and in the process can produce a more accurate version of a given text on the spot without having to concern himself with constraints placed upon him by a printer. And in the fourth place handcopied texts are generally of an aesthetically superior quality as compared to their corresponding printed texts, often being adorned with beautiful illuminations and decorous lettering, and are usually more accurate besides in their spelling and syntax.⁸

Incipit liber dñi Johānis tri-
themiij abbatis in spanbem De laude scriptorum. ad dñm
Berlacū tuiciensem abbatem.



De laude scriptoz, facturi sermonem: illius
 inuocamus auxiliū: qui syncens scriptoribus,
 eterne vite claritatē pmisit in premiū.
 Nampe qui ad iusticiā erudiūt plurimos:
 fulgebūt sicut stelle in ppetuas eternitates.
 Quod nō solū de illis intelligendū esse qui
 de sua vena cūdūt noua: sed etiā de his q̄ vetera trāscri-
 bunt. in sequentibus dño largiente monstrabim⁹: Nam
 quāntūcūq; vtilis sit doctoris traditio: absq; ministerio
 scriptoris ad noticiā posteroꝝ nequaq; deducta. Quicqd
 em̄ boni agimus. quicqd fructuose docerimus: in obliuio-
 nem cito rapitur: nisi scriptoꝝ studio līs cōmendetur.
 Scriptores ergo virtutē dant verbis: memoriā rebus:
 vigorem temporibus. Hos si de ecclesia tollas: vacillat
 fides. caritas friget. spes decidit. ius perit. cōfunditur lex.
 in obliuionē transit euangelū. Deniq; si scriptura defce-
 rit. dispergetur populus. deuotio extinguetur. pax catho-
 lice vnitatis cōfusa turbabitur. Sed absq; scriptoribus
 non potest scriptura diu salua cōsistere: que et casu fran-
 gitur: et vetustate corrūpitur. Impressura em̄ res papu-
 rea est: et breui tempore tota cōsumitur. Scriptoz autē
 membranis cōmendans litteras: et se et ea que scribit. in
 tempus longinquū extendit. Unde ipse ecclesiā dicit. fidē
 conseruat. hereses destruit. vicia repellit. mores instruit.
 et dat incrementa virtutibus. Scriptoz deuotus qualē
 describere intendimus. deum laudat. angelos lenificat.
 iustos homines confortat. peccatores emendat. humiles
 cōmendat. bonos conseruat. superbos debellat. condem-
 nat pertinaces. Scriptoz pietate insignis. dei prece est.
 quia voluntatem eius et p̄sentibus annūciat et futuris:
 promittens bonis vitam eternā: penitentibus veniam:
 negligentibus penam: contemnētib⁹ damnationem.

Beyond these four distinct advantages of handcopying over printing specifically pointed up by Trithemius in his *Praise of Scribes*, he was also well aware of a fifth advantage which arose from the peculiarly monastic context of manuscript production. For though Trithemius could scarcely deny that a given text printed upon paper could be produced more cheaply than a corresponding handcopied text inscribed upon expensive parchment or vellum, he was also made aware by experience that, inasmuch as his budget for book purchases was ordinarily restricted, it was often cheaper to borrow a text for a period and have it copied by his monks than to buy a printed book from outside the cloister. If the monks of the scriptorium could not compete with the printers in the quantities of texts issuing from their labors, this very recognition, in the light of the limited financial resources of the cloister, could be cited to underline the appeal for a more vigorous, not less vigorous, exertion of energy in the monastic scriptorium.

All of this, if we were to leave it here, would appear quite enough to warrant placing Trithemius squarely on the reactionary side in the quarrel between Ancients and Moderns. But on further reflection it is not difficult to demonstrate that such a conclusion, arrived at on the basis of the *Praise of Scribes* alone detached from the overall corpus of Trithemius' writings, is premature and misleading, failing as it does to take into account the broader context within which Trithemius made his appeal in support of the scriptorial art. To help correct this indeficiency I will here attempt to show that, far from viewing printing as an obstacle to the pursuit of *vera eruditio monastica* which he located at the heart of his efforts on behalf of Benedictine reform, Trithemius looked upon printing as a potentially advantageous agent of monastic erudition. Read against this larger backdrop, the *Praise of Scribes* will be adjudged as little more than a *pièce d'occasion* directed at a specific problem of the cloister posed by the invention of printing, provoked by obstreperous monks seeking an excuse to evade the strenuous duties of the scriptorium. In the broader scope, it will be shown, Trithemius fully recognized in the printing art a marvelous — indeed, even a divinely inspired — instrument to promote the cause of monastic learning. In an age when the monastic way of life was increasingly becoming placed on the defensive in a development which was to culminate in the Protestant repudiation of the Benedictine ideal, Trithemius will be seen to have looked favorably upon the printing art as a highly useful tool to help facilitate the restoration of what he dubbed, with a nostalgic glance backward into the Benedictine past, the "golden age" of ancient monasticism.

Of all Trithemius' achievements at Sponheim, we learn from the abbot's autobiographical *Nepiachus* (1507), none surpassed in the abbot's own esteem his compilation of a magnificent cloister library "of about two thousand volumes, both handwritten and printed, on every subject and science which is held of utility among Christians."⁹ Thus, by Trithemius' personal testimony in this and other like references to his illustrious abbey library, his remarkable success in book-gathering was greatly aided by the technological breakthrough known as printing. Though Trithemius does not inform us of the precise ratio between printed and handcopied texts comprising his library, we can assume that many, if not the majority, were typeset. Many times does he make allusion to the greater availability and cheapness of printed volumes as compared to their handcopied counterparts, and we can assume that as he set about building up one of the finest collections of books in Europe with a minimum capital outlay he took full advantage of that fact.¹⁰

The printing press. The smaller printer's mark used by Josse Bade in Paris, ca. 1520.



Trithemius' express purpose in this as in all other aspects of his promotion of Christian learning was to restore his beloved institution of monasticism to its ancient purity. One of the more eloquent statements of this purpose gracing his writings is set forth in his *Book of Complaints (Liber penthicus)*, brought to completion in 1493 and thus the very next year after the *Praise of Scribes*, which opens on the mournful note befitting the title: "When I recall to mind the pristine comeliness of our [Benedictine] Order, I am made so sad at how vehemently it is suffering deformity that I am more inclined to shed tears than to compose this discourse." But finding that his ink mingles quite well with his tears, Trithemius has resolved to move ahead with his objective, namely, to help recover "the golden centuries of this most blessed Order which once prevailed (*huius sacratissimi ordinis aurea quondam secula*) when, by means both of learning and of sanctity (*doctrina et sanctitate*), it irrigated the Church as though it were the river of Paradise."¹¹ And Trithemius makes it clear in various further writings that, to the contrary of being considered an impediment to that worthy goal of a Benedictine *renovatio*, printing should be viewed as a potentially invaluable ally in the implementation of a monastic *renovatio*.

That we might better appreciate this strictly monastic function of printing in the eyes of Trithemius it will be worth our while first to grasp his basically sympathetic response to printing at large. To do so we can do no better than turn to Trithemius' historical account of the invention of printing in his *Hirsau Annals*. For there we discover, under the year 1450, not only that Trithemius was an enthusiastic champion of the new art, but that a distinct tinge of pleasure he felt when he reflected upon the invention is that it occurred upon his own German soil. "In those days in the city of Mainz, located in Germany on the banks of the Rhine (and thus not in Italy as some have falsely written)," Trithemius commences his narrative, "was invented and devised by the Mainz citizen Johann Gutenberg that marvelous and previously unheard-of art of printing and the impression of books."¹² Going on to observe that Gutenberg did not lack important allies to help him bring his invention to a successful conclusion, most notably his fellow Mainz citizens Johann Fust and Fust's son-in-law Peter Schoeffer (Petrus Opilius), Trithemius bursts forth at the close of his account with an encomium to the *ars impressoria* scarcely to be outdone by the most uncritically rapturous advocates of the printing technique:

O blessed art of printing, long to be remembered as belonging to our age! Once there was lacking all which you are now scattering [quod fundis, a play on the word fundere, meaning both "to scatter" and "to cast" or "to melt"] throughout the world. All men now adorn you with the highest praises. Owing to your inventor every language shines forth its rays. Now that this marvelous art (ars haec mira) has been discovered and you have been made our guide, it is henceforth permitted to an unlettered person (parvo) to become as learned as he will.¹³

Moreover, in his later astologically conceived *Mystical Chronology* (1508) Trithemius goes so far as to suggest that there is more than the touch of humanity in “this marvelous art,” that there is also resident therein a touch of divinity. Thus, on the heels of a generally pessimistic depiction of events under the governance of warlike Mars exemplified by such catastrophes as the fall of Constantinople to the infidels and the violent Anglo-French conflict within Christendom subsequently known as the Hundred Years War, Trithemius notes as if to mitigate somewhat our harsh memory of those days that “in the same period the art of printing was newly invented at the German metropolis of Mainz, and this by virtue both of marvelous [human] industry and of a gift of divinity (*mirabili industria, muneris divinitatis*).”¹⁴

Trithemius’ insinuation that there was an inspiration greater than human working in Gutenberg’s invention of printing is echoed in the dedicatory epistle, significantly and fittingly addressed to the Sponheim abbot, prefacing an edition of works by the English Scholastic philosopher William of Ockham appearing from the press of the Lyons printer Johann Trechsel in 1494. According to Ockham’s editor, Josse Badius, who in the next year was to found the famous Paris press known as the *Praelum Ascensium*, printing is “a divinely contrived skill” (*divina imprimendi facultas inventa*) which can rightfully claim, among others, two outstanding contributions to the unprecedented propagation of learning in the present day. The first contribution resides in the fact that, owing to printing, there have now been brought to light “by a certain indelible permanence” (*indelebili quadam diuturnitate*) not only many modern works but many ancient ones as well, restored “in their original lustre,” whose manuscripts have fortunately managed to escape the ravages of time. The second contribution of printing to the unprecedented dissemination of learning cited by Badius in his dedicatory epistle to Trithemius dwells in the relative cheapness of printed books, thereby making their contents more readily accessible to the average man.¹⁵

Johannes Trithemius. Portrait by Master "HB" in Musée Condé, Chantilly.



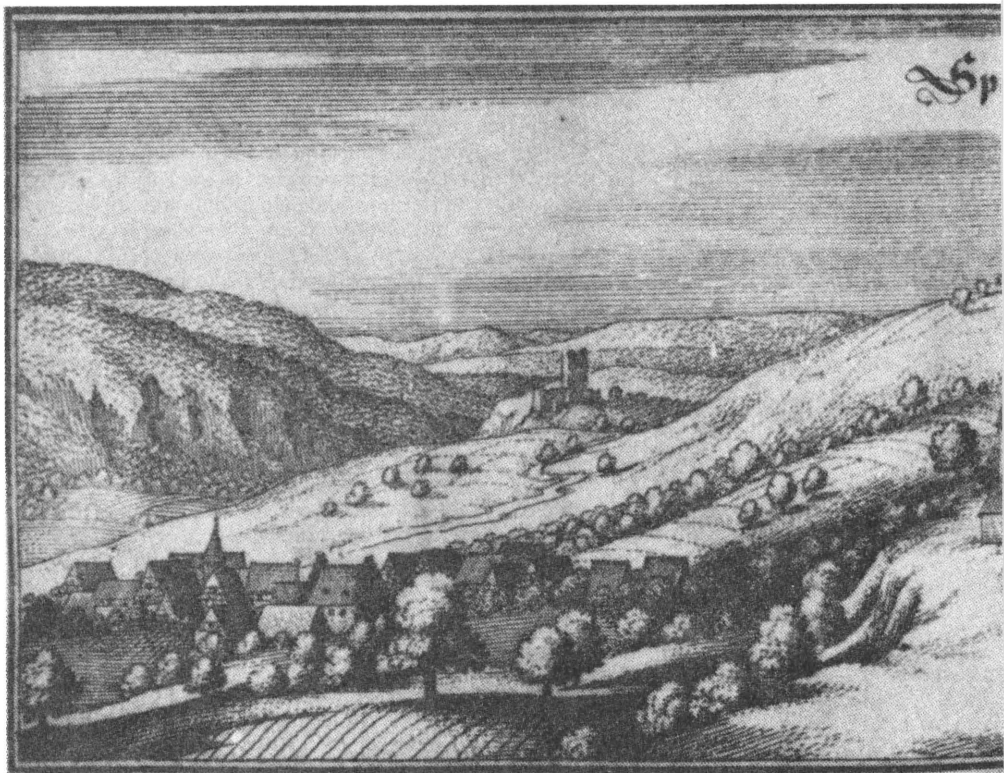
The *Praise of Scribes* composed two years earlier, we have seen, can be interpreted as turning both of these arguments on their head. For it not only emphasizes the greater durability of parchment over paper, but it also implies that, though in absolute terms a printed text is less costly to produce than a handcopied text, given the free labor of the monastic scriptorium it could still be cheaper for a monastery to produce a given handcopied text than to buy its printed version outside the cloister's walls. But at bottom Badius' two major arguments in support of printing can be seen to be compatible with Trithemius' more narrowly conceived comparison of the handcopying and printing arts. Concerning the first point of Badius, namely, that printing gives a given text "a certain indelible permanence," it need only be pointed out that when Badius was using this expression he was thinking of the perpetuity of the text independently of any single copy. Trithemius, on the other hand, who in his book-collecting was acutely sensitive to the durability of individual copies of texts, construed the notion of permanence in the more restricted sense of the perpetuity of an individual book as a physical entity. And with respect to the second point of Badius, namely, that printed texts are cheaper than handcopied texts and thus more easily available to those wanting in sufficient funds to pay for expensive parchment, Badius was laying his accent upon the general democratization of knowledge, in lay as well as in clerical quarters. Trithemius in his *Praise of Scribes*, alternatively, was more concerned with the unpaid labor of the monks working within the cloister's scriptorium and on the relatively limited sphere of usage those texts required in their role as vehicles of monastic erudition.

Yet even in keeping with this latter view of the advantage of handcopying over printing within a strictly monastic setting, Trithemius was not oblivious to the corresponding advantage of printing should a particular text or group of texts become unavailable or disappear altogether from the cloister's library, or if, as in his own personal case, an abbot were to become unhappily alienated from his books and thereby compelled to begin his book-collecting anew. Thus, as Trithemius wrote to a friend soon after moving to a second monastic home at Würzburg so as to relieve his correspondent's feelings on his behalf regarding the loss of his magnificent Sponheim library:

*The world today is abounding with volumes, and so many books are becoming published in our age that no one can read them all. For the art which is called printing was discovered in the time of my infancy at Mainz, the mother city of the Franks, which daily produces an almost countless number of texts by ancient and modern authors alike.*¹⁶

One of the more illustrious instances of this observation, Trithemius goes on to point out, is furnished by "Johann Amerbach of the city of Basel, a learned and exceedingly upright man" who, at the forefront of the printers gracing the present age, "in the year just passed (*viz.*, 1506), after the required emendations were made, printed all the books he could find of the blessed Augustine in fifteen volumes." And if that were not enough, likewise flowing from Amerbach's Basel press were works by St. Jerome, St. Ambrose, and St. Gregory the Great.¹⁷ Hence Trithemius was not excessively worrying that he would now have to start over again from near-scratch in the aggregation of a respectable monastic library. For if he were to require more than the few books which were currently at his side in his relatively straitened circumstances at Würzburg, thanks to the marvelous invention of printing, he could easily duplicate many of his Sponheim titles at a relatively inexpensive cost.¹⁸

Sponheim Abbey, 1645.



As a humanist in much the same mold as various of his German humanist associates making up the Rhenish Sodality located at Heidelberg, including Conrad Celtis and Jacob Wimpheling, Trithemius was not of a mind to overlook the obvious utility of printing in helping to promote the study of the ancient languages.¹⁹ In this regard we need only recall one of the more prominent compliments paid by Trithemius to printing in his already cited encomium to the *ars impressoria* contained in his historical account of its invention in the *Hirsau Annals*: "Owing to your inventor every language shines forth its rays." But as a peculiarly monastic breed of humanist, setting him apart from his lay acquaintances of the Heidelberg humanist circle in spite of his shared advocacy of their literary ideals, Trithemius also took cognizance of a more specialized application of the humanist program of language study to the uniquely monastic way of life. For it was not only his broad-based aim to disseminate language throughout the world, but it was also his narrow-based aim to restore *vera eruditio monastica* which he believed to have reigned supreme in the so-called "golden age" of monasticism.



One of Trithemius' more instructive writings to this point consists of an oration delivered to his fellow abbots of the annual Bursfeld congregation at Erfurt in 1492, in the same spirit as its nearly contemporary *Book of Complaints* plaintively lamenting the deterioration of the Benedictine Order. If there might once have been some excuse for the ignorance of letters in the cloister, Trithemius scolds his audience, this excuse has since lost all credibility. For whereas "once there was a great penury of books, dependent on their being procured at very high prices and great expense," Trithemius reproachfully reminds his Benedictine listeners, "now a great abundance of volumes is daily brought to light by the art of printing on every subject, by means of which our salutary teaching is generously propagated."²⁰ And but a year later Trithemius came forth with a catalogue of illustrious Benedictines, the core of his subsequent *Catalogue of Ecclesiastical Writers*, in the introduction of which he made the identical point to his Order at large. "Behold how opportunely all things now smile upon the studious," Trithemius is now seen to exclaim in a distinctively optimistic vein, "for whom the novelty of the printing art brings forth into the light many thousands of books." As a happy result of the invention of printing

*every man is now able, at little cost, to be learned, and it is a fortunate age (felix aetas) which has acquired this gift from God. Once there was a great scarcity of books, when they were prepared at a great price and expense. But now there exists a large abundance of volumes, and this in every kind of literary subject, by means of which each and every person is now easily able to achieve completeness in the knowledge of letters.*²¹

Scribes at Work. A woodcut from Petrarch's "Gluckbuch", Augsburg, 1539.



That this felicitous state of affairs holds for monks in their specific profession as well as for mankind in general is pressed home by Trithemius in a full-scale biography of a great Benedictine precursor composed in the next-to-last year of the writer's life, 1515. The subject of this biography is the ninth-century abbot of Fulda Rabanus Maurus, a man who, by a providential coincidence, ended his days as archbishop of the self-same city of Mainz which some six hundred years later was to give birth to the art of printing. In the Rabanus biography Trithemius severely takes the members of his profession to task for failing to come up to the linguistic standards set by his highly erudite subject precisely at a moment in history when they have been granted a novel means for learning difficult ancient languages, most notably Greek, with much greater ease than was permitted to Rabanus and his contemporaries. For owing to the marvelous invention of printing, so Trithemius tries to shame his monkish colleagues, never has the time been more propitious for learning Greek. Yet, ironically, the ignorance of Greek is everywhere in evidence throughout the monasteries — and this even though there has never existed a greater abundance both of books in Greek and of instructors to help in transmitting the contents of these books to zealous students as in the current century.²²

In sum, the Rabanus biography but restates a working axiom of Trithemius' monastic program which, in spite of the apparently more circumspect posture displayed toward printing in the *Praise of Scribes*, consistently remained at the crux of the abbot's call for monastic erudition. This axiom is that all the means at the monk's disposal, the novel art of printing included, should be employed to restore, as expressed in the *Book of Complaints*, "the golden centuries of this most blessed Order which once prevailed when, by means both of learning and of sanctity, it irrigated the Church as though it were the river of Paradise." Admittedly Trithemius could not ignore the possibility that printing could also have the opposite effect than that which he was promoting, since it could just as readily be utilized by the servants of the Devil to disseminate false and wicked ideas as by the servants of God to disseminate true and good ideas. Surely this dual capacity of printing was what the abbot had in mind when he envisaged a chapter in his projected but never written encyclopedia of demonology, *Concerning Demons*, under the heading: "Whether the art of printing is more useful than injurious to the Church?"²³ But as was likewise understood by Trithemius, the possible abuse of printing no more invalidated its feasibility as a potential agent of monastic reform than did the abuse of any other art or science with which man was endowed. It is this illicit abuse of the printing art with which Trithemius was primarily concerned in his *Praise of Scribes*, not its licit use. For when monks invoked the art of printing to detract from rather than to enhance the glorious ideal of *vera eruditio monastica*, according to Trithemius, they were, either inadvertently or deliberately, doing more to advance the cause of Satan than of God in the world.

1. For the background of this debate see Hippolyte Rigault, *Histoire de la Querelle des Anciens et des Modernes* (Paris, 1856), coining the phrase "quarrel of the Ancients and Moderns"; Richard F. Jones, *Ancients and Moderns: A Study of the Rise of the Scientific Movement in Seventeenth Century England*, 2nd ed. (Berkeley, 1961, 1965); and Hans Baron, "The *Querelle* of the Ancients and the Moderns as a Problem for Renaissance Scholarship," *Journal of the History of Ideas*, XX (1959), 3–22, reprinted in Paul O. Kristeller and Philip P. Wiener, ed. *Renaissance Essays from the 'Journal of the History of Ideas'* (New York, 1968), pp. 95–114. For a sixteenth century reference specifically mentioning printing as a foremost instance of the advancement of modernity over antiquity see Jean Fernel, *De abditis rerum causis* (1548), cited by Sir Charles Sherrington, *The Endeavour of Jean Fernel* (Cambridge, Eng., 1946), p. 136: "The world sailed around, the largest of earth's continents discovered, the compass invented, the printing press sowing knowledge, gun-powder revolutionizing the art of war, ancient MSS. rescued and the restoration of scholarship, all witnessing to the triumph of our New Age." Cf. Francis Bacon, *Novum Organum* (1620), I, 129, in Fulton H. Anderson, ed., and James Spedding et. al., tr. *The New Organon and Related Writings* (Indianapolis/New York, 1960), p. 118: "It is well to observe the force and virtue and consequences of discoveries; and these are to be seen nowhere more conspicuously than in those three which were unknown to the ancients, and of which the origin, though recent, is obscure and inglorious; namely, printing, gunpowder, and the magnet. For these three have changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation; whence have followed innumerable changes; insomuch that no empire, no sect, no star seems to have exerted greater power and influence in human affairs than these mechanical discoveries."
2. Of the considerable literature on the invention of printing and its earliest development only a few examples can here be singled out: Theo. L. DeVinne, *The Invention of Printing* (New York, 1876; Detroit, 1969); Pierce Butler, *The Origin of Printing in Europe* (Chicago, 1940); S. H. Steinberg, *Five Hundred Years of Printing* (Baltimore, 1955; rev. ed. Bristol, 1961); Curt F. Bühler, *The Fifteenth-Century Book* (Philadelphia, 1960); Marshall McLuhan, *The Gutenberg Galaxy: The Making of Typographical Man* (Toronto, 1962); Rudolf Hirsch, *Printing, Selling and Readers* (Wiesbaden, 1967); Colin Clair, *A History of European Printing* (London, 1976); and Elizabeth Eisenstein, *The Printing Press as an Agent of Change*, 2 vols. (New York, 1978).
3. See the edition and translation prepared for the Hill Monastic Manuscript Library (formerly Monastic Manuscript Microfilm Library), of St. John's Abbey, Collegeville, Minn., *Johannes Trithemius: In Praise of Scribes (De Laude Scriptorum)*, ed. Klaus Arnold and tr. Roland Behrendt, O.S.B. (Lawrence, Kansas, 1974), introd., p. 15. See also p. 14 for the circumstances behind the composition of this work, with the abbot prompting it identified as Gerlach of Breibach, residing in the Benedictine cloister of Deutz near Cologne. Trithemius' model for his *De laude scriptorum manualium* is Jean Gerson's pre-printing *De laude scriptorum* (1423). For Arnold's full-scale biography of Trithemius see his *Johannes Trithemius (1462–1516)* (Würzburg, 1971), treating the *De laude scriptorum manualium*, pp. 62 ff.
4. Trithemius, *Praise of Scribes*, ed. Arnold, pp. 63 ff., with the Latin text on the opposite pages, pp. 62 ff., bearing the corresponding heading: "Quod propter impressuram a scribendis-voluminibus non sit desistendum." Besides appearing individually in Friedberg's printing of 1494, this tract may also be found in a collection of Trithemius' monastic writings under the title: *Opera pia et spiritualia*, ed. Johannes Busaeus, S. J. (Mainz, 1604, 1605), pp. 741 ff.
5. *Praise of Scribes*, p. 63.

6. On the monastic origin of the notion *acedia* (*acidia*, *accidia*) see Siegfried Wenzel, *The Sin of Sloth. Acedia in Medieval Thought and Literature* (Chapel Hill, N.C., 1967), pp. 1 ff. Conceived by the Eastern desert fathers as one of eight (later reduced to seven) capital vices, the idea of *acedia* (in Greek, *akedia*, literally “non-caring”) made its way to the west principally through the mediation of Jean Cassian. For its classic western definition see Cassian, *De coenobiorum institutis libri XII*, lib. X, cap. 1, in Jacques Paul Migne, ed. *Patrologia cursus completus; series latina*, 221 vols. (Paris, 1844–64), 49:360: “tedium or solicitude of heart” (*taedium sive anxietas cordis*). The sixth century monk Cassiodorus, well read in Cassian, directly anticipated a favorite device of Trithemius by playing on a secondary meaning of the word *studium* — “study” as well “zeal” or “diligence” — to prescribe the appropriate antidote to languorous *acedia*. Thus see Cassiodorus’ interpretation of the words: *Dormitavit anima mea prae taedio*, Psalm 118:28, in Migne, *Pat. lat.*, 70:846: “Hanc autem animae dormitationem Cassianus servorum optimus institutor accidiam vocat (Lib. X, *Instit.*, cap. 4), quam magno studio monachis persuadet.” A direct result of Cassiodorus’ secondary meaning of the word *studium* is his *De institutione divinarum*, in Migne, *Pat. lat.*, 70:1105 ff., and *De artibus ac disciplinis liberalium artium*, in *Pat. lat.*, 70:1149 ff. According to H. O. Taylor, *The Mediaeval Mind*, 2 vols. (Cambridge, Mass., 1959), I, 94: “For he [i.e., Cassiodorus] was the first influential man to recognize the fitness of the cloister for the labours of the pious student and copyist. It is not too much to regard him as the inaugurator of the learned, compiling, commenting and transcribing functions of monasticism.” That Trithemius was greatly appreciative of Cassiodorus in this regard is indicated in many places throughout his writings, most noticeably in his *De scriptoribus ecclesiasticis*, in *Opera historica...*, ed. Marquard Freher, 2 parts (Frankfurt a/M, 1601; facs. ed., Frankfurt a/M, 1966), I, 241 ff.
7. *Praise of Scribes*, p. 63.
8. *Ibid.*, p. 65.
9. Trithemius, *Nepiachus, id est, libellus de studiis et scriptis propriis a pueritia repetitis*, in Johann Georg Eccard, ed. *Corpus historicum mediæ aevi* . . . , 2 vols. (Leipzig, 1723), II, col. 1828. The *Nepiachus* was composed by Trithemius soon after his arrival in a new monastic home, St. James in Würzburg, which abbacy he officially assumed in place of his previous one of St. Martin at Sponheim in October of 1506. Thus he was reflecting within its pages upon a library which he unhappily had been forced to forsake. The reasons which we can infer from his writings for his reluctant decision to exchange Sponheim for the relatively obscure monastery at Würzburg are many, all having to do with a falling out between himself and his monks. Among the criticisms leveled by the Sponheim residents against their abbot, thereby having the effect of alienating Trithemius from his community, the following can be singled out: his all too frequent absences from Sponheim on behalf of the Bursfeld reform movement, his preoccupation with his library and excessive expenditure of monastic funds for its growth, his disturbance of the cloister’s tranquillity by inviting many outsiders to visit him and his library, his overly severe attitude toward monastic observance, and his anachronistic insistence — more directly relevant to the subject at hand — upon hard labor in the monastic scriptorium at a time when the invention of printing had largely dispensed with the need for it. On Trithemius’ Sponheim library see S. K. Padover, “German Libraries in the Fourteenth and Fifteenth Centuries,” in James Westfall Thompson, ed. *The Medieval Library* (Chicago, 1939), pp. 464–65; Roland Behrendt, *The Library of Sponheim Abbey under Abbot Trithemius (1483–1506)* (Latrobe, Pa., 1958); and Arnold, *Trithemius*, pp. 56 ff.

10. In this regard Trithemius distinguishes between the higher prices of books in the first decades of printing when printed books were relatively few in number and their cheaper prices later when they were in greater number. Thus, in the *Nepiachus*, in Eccard, ed. *Corpus*, II, col. 1827, Trithemius notes that his predecessor as abbot, Johann von Kolenhausen, had succeeded in adding only some thirty volumes to the ten or so which had existed at the time of the Bursfeld reformation of the cloister in 1459, but indulgently adds a significant reminder so that the earlier abbot will not be placed in too bad of a light. In his book-gathering activities, Trithemius points out, his predecessor suffered two definite disadvantages as compared to his own efforts in the same capacity. In the first place, we are told, Trithemius has happily been blessed by divine favor with more money for the purchasing of books than was the previous abbot, and in the second place the prices of books have considerably diminished during his long abbacy as a result of their much greater multiplication and proliferation.
11. Trithemius, *Liber penthicus, sive lugubris de statu et ruina monastici ordinis*, cap. 1, in Bus., *Opera pia*, p. 807. See also Arnold, *Trithemius*, pp. 46–7.
12. Trithemius, *Annales Hirsauigienses*, 2 vols. (St. Gall, 1690), II, 421. For a lengthy passage, in English translation, from this account see DeVinne, *Invention of Printing* (see above, note 2), p. 474. But the author, pp. 475–77, has detected many particular errors in Trithemius' narrative.
13. *Ann. Hirs.*, II, 422.
14. Trithemius, *De septem secundeis, id est, intelligentiis sive spiritibus orbes post deum moventibus libellus, sive Chronologia mystica* . . . in Freher, *Opera historica*, I, sig. ***2^f.
15. Badius to Trithemius, Lyons, 12 September 1494, dedicatory epistle to *Dialogus magistri Guillelmi de Ockham* . . . (Lyons, 1494), reprinted in Philippe Renouard, *Bibliographie des Impressions et des œuvres de Josse Badius Ascensius, Imprimeur et Humaniste, 1462–1535*, 3 vols. (Paris, 1948), I, 87.
16. Trithemius to Jacob Kymolanus, Würzburg, 16 August 1507, *Epistolae familiares libri II*, II:44, in Freher, *Opera historica*, II, 556. Concerning Trithemius' transfer to Würzburg see above, note 9.
17. On Johann Amerbach see Hanns Bohatta, *Einführung in die Buchkunde: Ein Handbuch für Bibliothekare, Bücherliebhaber und Antiquare*, 2. Aufl. (Wien, 1928), p. 71, containing a brief biography; Peter G. Bietenholz, *Basle and France in the Sixteenth Century: the Basle Humanists and Printers in their Contacts with Francophone Culture* (Genève, 1971); and Arnold, *Trithemius*, p. 71 and *passim*. I am grateful to the referees enlisted by the present journal for calling these references to my attention.
18. *Epist. fam.*, II:44, in Freher, *Opera historica*, II, 556.
19. Arnold, *Trithemius*, pp. 74 ff. Trithemius' associations with the Heidelberg humanists, many of whom visited him at home in Sponheim over the years where they were given free access to the abbot's library as well as to his person, can be traced back to his pre-Sponheim days.
20. Trithemius, *Orationes*, II: "De ruina s. Benedicti et reformationis Bursfeldensis laudibus," delivered 26 August 1492 at Erfurt, in Bus., *Opera pia*, p. 855. On the Bursfeld reform movement and Trithemius' leading part in its spread see Arnold, *Trithemius*, pp. 22 ff.
21. Trithemius, *De viris illustribus ordinis s. Benedicti libri IV*, lib. II, cap. 145, in Bus., *Opera pia*, p. 61.
22. Trithemius, *Vita b. Rabani Mauri libri III*, lib. I, cap. 4, in Johannes Bollandus and Godefridus Henschenius, S. J., *Sancta sanctorum*, I: Februarii. Dies 1–6 (Antwerp, 1658), 528. This tract, dedicated to the current archbishop of Mainz Albert of Brandenburg, is reprinted in Migne, *Pat. lat.*, 107:67–106.

23. Trithemius, *De daemonibus libri XII*, lib. I, cap. 9: "Utrum ars impresoria plus sit utilis quam nociva ecclesie," in Arnold, "Additamenta Trithemiana: Nachträge zu Leben und Werk des Johannes Trithemius, insbesondere zur Schrift *De demonibus*," *Würzburger Diözesan-Geschichtsblätter*, XXXVII—XXXVIII (1975), 259. On Trithemius' demonist and magical preoccupations see Arnold, *Trithemius*, and my two articles: "The Shift from Mystical to Magical Theology in the Abbot Trithemius (1462—1516)," *Studies in Medieval Culture*, ed. John R. Sommerfeldt and Thomas H. Seiler (The Medieval Institute, Western Michigan University, 1977), 147—60, and "Was Paracelsus a Disciple of Trithemius?," *Sixteenth Century Journal*, X (1979), 70—82.

The illustration of Sponheim Abbey, the 1494 page from *De laude scriptorum*, and the portrait of Johannes Trithemius are taken with kind permission from Roland Behrendt's translation (edited with an introduction by Klaus Arnold), Johannes Trithemius, *In Praise of Scribes*, Lawrence, Kansas: Coronado Press, 1974.

The model presented extends current theorizing about reading by relating the underlying processes of skilled and average readers to those of poor readers. While the non-mediated reading process for skilled readers is immediately directed to the meaning of a word, the reading process for poor readers is mediated by the interpretation of the individual letters constituting the word. The continuous interaction between the interpretation of single letters and reading for meaning of the word is what determines the slow reading rate for poor readers. An empirical study was carried out to demonstrate the viability of the present approach. A series of measures were derived to compare the reading process for good and poor partially sighted readers. The locus of the difference in reading rate between the two groups of subjects was confined mainly to the peripheral subprocesses of reading whereas the deeper and more semantic levels of the reading process were less affected.

The general purpose of the present paper is to present a theoretical model of reading which takes into account the principal differences between skilled and deficient readers. The experimental study reported was primarily concerned with the latter. The general contention is that the reading processes for these two groups differ quantitatively and qualitatively but that these processes can be linked together in the present model.

It is becoming more clear that a great deal of research is necessary in order to understand what kind of psychological processes underlie the process of reading. Recent investigations (e.g., Calfee, Chapman & Venezky, 1972; Estes, 1975; Gough, 1972; Kolers, 1970; La Berge & Samuels, 1974; Posner, Lewis, & Conrad, 1972; Smith, 1971; and Thompson & Massaro, 1973) have provided interesting and important beginnings. Theoretically, these contributions have been based on an information processing framework; empirically, the most characteristic feature has probably been the use of skilled or average readers as subjects in the experiments. Little research on reading has been carried out using poor readers. According to Smith (1971) there is an important qualitative difference between poor and skilled readers. The former most commonly use a strategy that is characterized by a mediated reading process; the strategy for the latter is typically nonmediated. Mediated reading of a word, for example, means that each letter constituting the word has to be read and interpreted; nonmediated reading means that the reading directly accesses the meaning of the word. In the same way a mediated reading with respect to some larger unit, a phrase or a sentence, is carried out via the reading of its constituents, i.e., the words. In nonmediated reading the reader can gain access to the meaning of the phrase or sentence directly, not via the words separately.

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In the context of a general information processing framework, the present paper aims at proposing a reading model for one particular group of people: the partially sighted. The most typical feature of the reading process for this group of individuals is a word-by-word mediated acquisition process or an acquisition process which is mediated by a letter-by-letter reading. The model to be presented is an attempt to conceptualize such mediated reading processes.

The model postulates a general information processing system that encodes the information into increasingly deeper conceptual levels. This system is assumed to consist of a perceptual system and two memory systems. One of these memory systems is dominated by an orthographic-phonological character and the other by a semantic-cognitive character. The information held in the former is successively encoded into new chunks by means of abstract rules. When this chunking takes place, the locus of the new memory representation is changed to a more semantic level. In a very general sense the rules are extracted knowledge about the world. In a more specific sense these rules are assumed to be organized in levels from simple orthographic-phonological to complex semantic-cognitive ones.

The perceptual system is probably best described as a window through which information is passed to a limited capacity-temporary buffer, the orthographic-phonological memory. This window is moved by an active agent in accordance with both the information actually stored and the specific rules used. The information in the orthographic buffer is assumed to remain at this level until it can be integrated and hence encoded into new chunks at deeper levels. When the information in the buffer storage is encoded and transferred to a deeper level, the buffer memory is emptied and the new information can be perceived and subsequently encoded. The information in the semantic memory system is assumed to be processed in much the same way. The information is buffered until it can be encoded into new chunks at still deeper levels.

This level-of-processing model (c.f. Craik and Lockhart, 1972) will be used here as a frame of reference for the present study of the reading process for the partially sighted. One important bottleneck in their processing of information is at the perceptual phase. Their reading is characterized by a very limited perceptual window and a slow process of registration. Another critical aspect is how well the information in the orthographic store is integrated and passed on to the semantic store. One could expect that the limits of their temporary buffer often will be exceeded as a consequence of the small pieces of information registered. The partially-sighted reader is then supposed to be engaged in an interaction between information processing at the orthographic and semantic level in order to be able to encode the information into a new chunk at a deeper level.

It is assumed that the limited perceptual ability and the subsequent interaction between information processing at different levels are the critical factors responsible for the very slow reading of the partially sighted. Based on the model outlined, one would not expect any difficulties at deeper levels of information processing due to the visual handicap. However, most partially sighted have very little experience of reading and thus there might be considerable difficulties in using various semantic rules.

At this stage of research it would be premature to try to test the model outlined above by means of deduced hypotheses. Instead, the present investigation was designed as a descriptive study of the reading process of the partially sighted within the framework of the model proposed. Then, measures reflecting information processing at different stages had to be defined. This was done by comparing actual reading performance with the reading performance of a system that simply added chunks on one level to new chunks on a deeper level. In this reading system orthographic reading time (ORT) for a m -letter word could be written

$$ORT_m = \frac{m \cdot T_p}{n_p} \quad m > n_p \quad (1)$$

where n_p is the number of letters that the perceptual system can grasp at one fixation (i.e., one perceptual chunk) and T_p the time needed for this process. Accordingly, orthographic reading time for k words could simply be computed by adding ORT for each word.

The semantic subsystem adds orthographic chunks, i.e., words to larger units semantic chunks. Semantic reading time (SRT) for k words is then

$$SRT_k = \frac{k \cdot T_s}{n_s} \quad k > n_s \quad (2)$$

where n_s = the size in words of one semantic chunk and T_s orthographic reading time for n_s words.

It should be mentioned again that the mathematical system described above is not intended to be a model of reading; it simply serves as a tool for defining the measures used. The measures used were based on two reading rate functions showing reading rate in seconds/letter as a function of word length and length of sentences respectively (Figure 1).

The perceptual measures derived from these functions were: the amount of information that can be grasped into one fixation (field of fixation, n_p) and the time needed for this process (fixation time, T_p). Fixation time was measured as reading rate for one-letter words. If fixation time is assumed to be constant, then reading rate in seconds/letter should decrease with increased word length up to the point where the length of the word is larger than the amount of information that can be grasped during one fixation. Hence the fixation field could be defined as the length of the word corresponding to the first minimum point in the word reading rate function.

Ability to integrate information on an orthographic level (orthographic integration ability) was defined as the difference between actual reading rate for long words and orthographic reading rate of the additive system described above. According to (1) the reading rate of this system is T_p/n_p independent of word length. T_p/n_p could therefore be computed from the word reading rate function as the reading rate for words of optimal length.

A mediated reading without intervening transformations into semantic chunks at a deeper level by means of semantic rules would imply that reading time for k -word sentences could be predicted by simply adding reading time for each word, as in the additive system described above. Reading rate for words and sentences would then be the same. Thus by computing the difference in reading rate between words and comparable sentences a measure could be derived that reflects degree of mediation. This measure, referred to as semantic interpretation ability, was defined as the difference between mean reading rate for sentences of varying length and mean reading rate for isolated words of the same length as those in the sentences.

Ability to process information on a semantic level was also measured by comparing actual performance with the performance of the additive system described above. The measure derived (semantic integration ability) was defined as the difference between actual reading rate for long word sentences and semantic reading rate of the additive system which, according to (2), is independent of the length of the sentences. It was then assumed that one semantic chunk (n_s) corresponded to the optimal length of sentences, i.e. to the minimum point in the sentence reading rate function.

Thus the purpose of the present investigation was to describe the reading process of the partially sighted by means of the measures proposed. More specifically, the objective was to test the relevance of this description by comparing good, average, and poor partially-sighted readers, and by studying how training in reading and the visual handicap affected the reading process.

Method

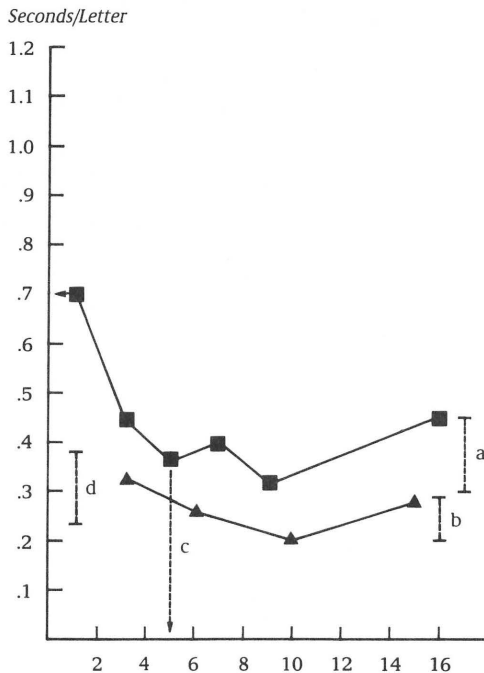
For the purpose of the present experiment, a test package was constructed that included a letter test, a word test, a sentence test, and a paragraph test. Reading rate in seconds/letter in each test was measured and plotted against number of letters/word and number of words/sentence respectively. From these reading rate functions the measures proposed above were derived as shown in Figure 1. In addition three classification measures were registered: reading rate for isolated words, sentences, and paragraphs.

Figure 1

Idealized reading rate function describing how the reading measures proposed were determined.

- reading rate as a function of letters/words
- ▲ reading rate as a function of words/sentences

Note: (a) orthographic integration ability, (b) semantic integration ability, (c) fixation field, (d) semantic interpretation, (e) fixation time



The letter test simply consisted of five randomly selected uppercase letters (A, D, N, R, T). The word test consisted of five different subtests each of which consisted of five different Swedish nouns. The five subtests consisted of words of varying length (words of 3, 5, 7, 9, and 16 letters). The words were selected from a large Swedish wordbook and were, according to the authors' best judgement a study of the familiarity of Swedish nouns within taxonomic categories, (Nilsson, 1973), considered as being common.

The sentence test consisted of four subtests, each consisting of three different sentences. The length of the sentences within each subtest was constant but varied across subtests (3-, 6-, 10-, and 15-word sentences). The three sentences within each subtest consisted of words of varying length (3-, 5-, and 9-letter words for the three sentences respectively in each subtest). Thus, in sentences with three words the first sentence consisted of three 3-letter words, the second sentence consisted of three 5-letter words, and the last sentence involved three 9-letter words. The first sentence containing six words consisted of six 3-letter words, the second sentence consisted of six 5-letter words, and so on to the last sentence of 15 words, which consisted of 15 9-letter words. A few minor deviations from this principle were necessary in order to obtain meaningful sentences. The rationale for the use of this type of sentence construction was to make comparisons between word and sentence tests possible.

The paragraph test consisted of two different text passages from a Swedish novel by W. Moberg. According to the authors' best judgement and an index of readability (LIX, Björnsson, 1968), the paragraphs selected were considered as being of average difficulty. The two paragraphs were assumed to vary only in length: the first consisted of approximately 50 words; the second was about 100 words long. This particular novel was selected because it is fairly uncommon, the rationale being that subjects should not be aware of the text prior to the experiment. (Questioning the subjects after the experiment revealed that no one was familiar with the text. In addition to this test package (referred to as test A) a parallel test was constructed (test B) with other words and sentences but designed according to the same rules.

In summary, the format of the test given to each subject was a series of twelve subtests: one letter test, five word tests each consisting of five different words, four sentence tests with three different sentences for each test, and two paragraph tests (about 50 and 100 words long, respectively). The overall duration of a test session (including all twelve subtests) varied between 20 and 30 minutes per subject.

Subjects

The investigation was carried out at a rehabilitation center for the partially sighted and all subjects participated in the experiment individually during their course in reading. A total of 41 subjects were tested with the reading tests. All subjects were partially sighted and most of them had obtained new optical reading aids at the center. These aids were used during the tests. Various types of visual handicaps were represented. The visual acuity measured with conventional distance test charts varied from about 0.05 to 0.3. The age of the subjects varied between 20 and 50.

Procedure

Thirty subjects were tested with test A (group A1) and eleven with test B (group B1) at the beginning of a course in reading. At the end of the course, eleven of the subjects in group A1 were tested with test B (group A1B2) and four of the subjects in group B1 were tested with test A (group B1A2). The number of subjects in each group was not experimentally controlled but was a consequence of practical circumstances.

All tests were given to the subjects in the same order. The reason for this was to successively increase the difficulty for each subject. The order of the tests was the description outline above. Each test was presented to the subjects on a sheet of paper and the subjects were instructed to read each test aloud. Reading time for each test, measured by a stop watch, was the time required to read the test aloud from the beginning to the end. The comprehension of the sentences and paragraphs was controlled immediately after each test by means of a simple recognition test and recall test, respectively. The duration of the whole test session varied between 20 and 30 minutes.

Results
*The Effect of
 Reading Ability*

In order to study the effect of reading ability, the partially-sighted subjects in group A1 were subdivided into three separate groups with respect to the performance for the paragraph test. Inspection of these data showed that the cut off points 35 and 60 words/minute gave three separate groups (Figure 2) referred to as poor, average, and good readers. Mean performance scores are shown in Table I.

Table I reveals two striking effects. First, for each group the reading of letters seemed to be much slower than the reading of words, sentences, and paragraphs. Second, the poor readers could not utilize the semantic content in the text. On the contrary, the reading of sentences was slower than the reading of words. The opposite was true for good readers; they read sentences faster than words. The differences discussed were significant as shown by the analyses of variance carried out on these data (Table I). The fact that poor readers could not utilize the semantic content suggests that their reading was more of a mediated character than that of the good readers.

Figure 2

Histogram over reading rate in the paragraph test for group A1.

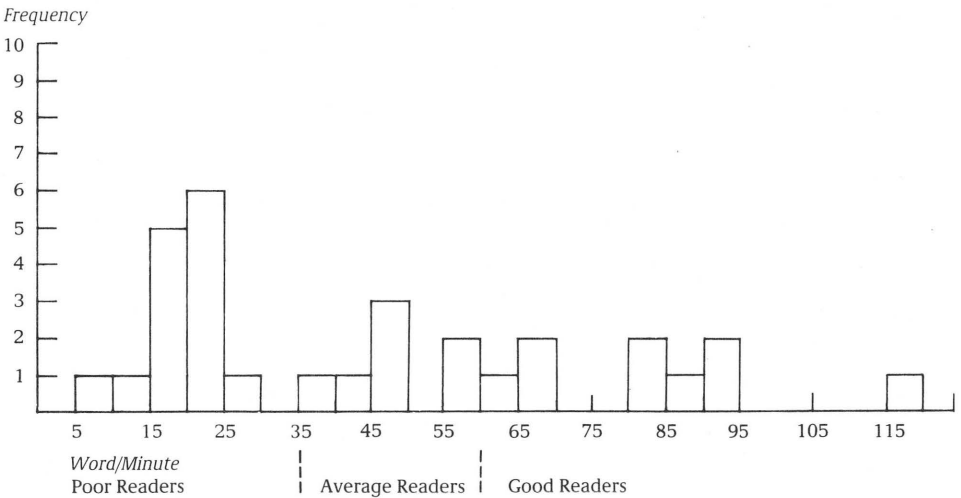


Table I

Mean performance (measured in seconds per letter) for the partially sighted (group A1) with good, average, and poor reading ability in the four different tests concerning the reading of letters, words, sentences, and paragraphs.

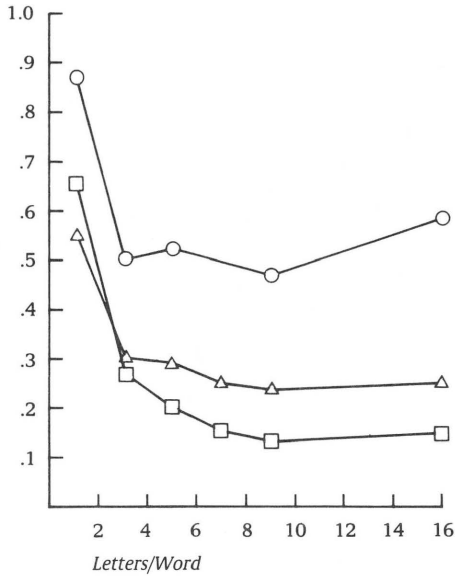
Subjects	Letter test	Word test	Sentence test	Paragraph test	Significance
Good (n=9)	0.66	0.18	0.15	0.15	p < 0.01
Average (n=7)	0.54	0.25	0.24	0.24	p < 0.01
Poor (n=14)	0.87	0.51	0.58	0.66	p < 0.01

Figure 3

The reading rate functions obtained for poor (○), average (△), and good (□) readers in group A1. Means over groups are given.

Word Test

Seconds/Letter



Sentence Test

Seconds/Letter

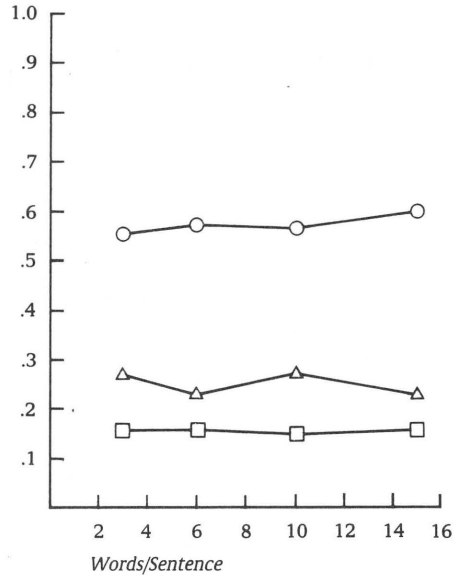
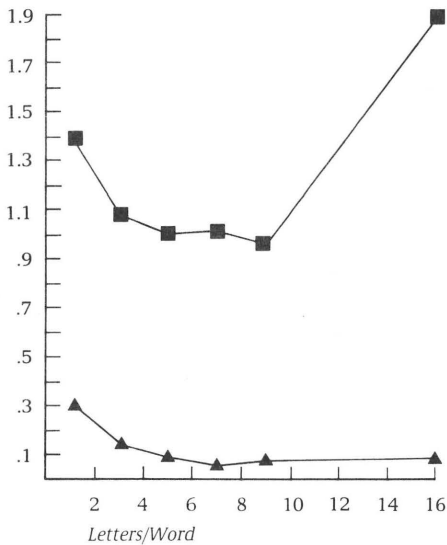


Figure 4

The reading rate functions of the poorest (■) and best (▲) reader in group A1.

Word Test

Seconds/Letter



Sentence Test

Seconds/Letter

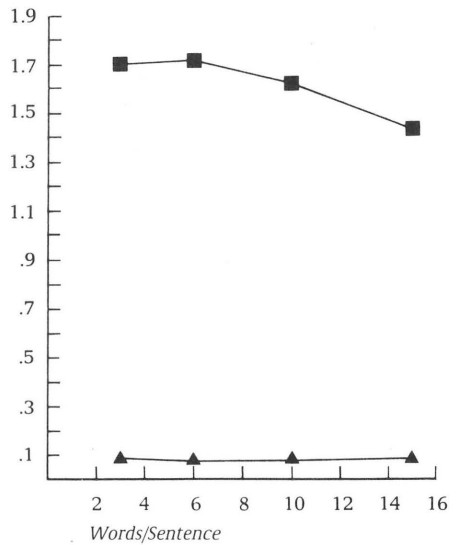


Figure 3 shows the reading rate functions obtained for the poor, average, and good readers, and Figure 4 shows an example of two individual curves (the best and poorest reader).

The reading rate function for the poor readers demonstrates a typical "window effect" in the registration process. Reading rate increases within the fixation field, decreases when the window is moved, then increases again, and so on. Table II shows the measures proposed and the result of an analysis of variance (Kruskal-Wallis one-way analysis of variance).

Figure 3 and Table II point to some interesting differences between poor and good readers. First there was a significant difference with respect to the fixation field (the first minimum point in the word reading rate function). The fixation field increased systematically with reading ability from about five letters in the poor group to about twelve in the group of good readers. However, fixation time (reading rate for one-letter words) did not differ significantly. Next, a striking difference was found for the two measures of orthographic and semantic integration ability. Poor readers had a much lower reading rate for long words and sentences — as compared to words and sentences of optimal length — than good readers. Thus the reading process of poor readers could not be described simply as an addition of chunks on one level to new chunks on a deeper level. Good readers on the other hand obtained integration values close to zero, which means that the formation of new chunks produced only a slight decrease in reading rate. The importance of the integration process (especially at an orthographic level) was also demonstrated by the correlations between reading rate in the paragraph test and the measures discussed, and by a multiple analysis of regression (Tables III and IV). Finally, there was also a slight (Table IV) but significant (Tables II and III) systematic difference for the measure semantic interpretation. Poor readers had a faster reading rate for words than for sentences, while the opposite was true for good readers. Accordingly it does not seem necessary for good readers to read each word in order to form semantic chunks.

Table II

Summary table for partially sighted (group A1) with respect to the assumed processes of registration, integration, and interpretation.

<i>Subjects</i>	<i>Fixation field</i>	<i>Fixation time</i>	<i>Orthographic integration ability</i>	<i>Semantic integration ability</i>	<i>Semantic interpretation</i>
Good (n = 9)	11.89	0.66	0.02	0.02	0.05
Average (n = 7)	6.43	0.54	0.05	0.03	0.03
Poor (n = 14)	4.57	0.87	0.21	0.15	-0.08
Significance	p < 0.001	p > 0.05	p < 0.01	p < 0.01	p < 0.01

To summarize, the results of this study indicate that important properties of the reading process of the partially sighted are both the ability to register information *and* the ability to integrate the information registered to orthographic and semantic chunks.

Table III

Correlations between reading rate in the paragraph test and the processes of registration, integration, and interpretation (n = 30)

Fixation field	Fixation time	Orthographic integration ability	Semantic integration ability	Semantic interpretation
-0.56*	0.42*	0.83*	0.38*	-0.53*

*p < 0.05

Table IV

The results of a multiple regression analysis (n = 30) with reading rate in the paragraph test as the dependent variable and the subprocesses of registration, integration, and interpretation as independent variables.

Dependent variable: Reading rate in the paragraph test.

Multiple correlation coefficient: 0.96

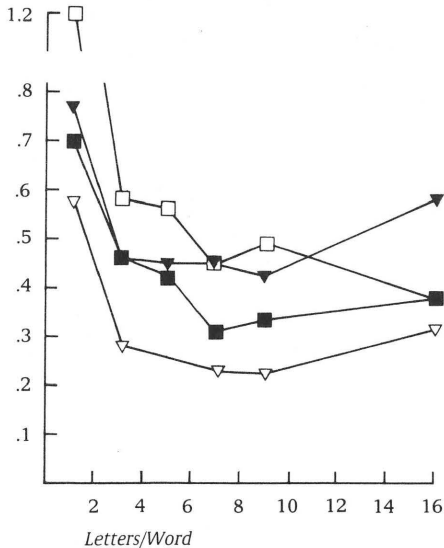
Beta weights:	
1 Orthographic integration ability	0.77
2 Semantic integration ability	0.24
3 Fixation time	0.24
4 Fixation field	-0.22
5 Semantic interpretation	0.08

Figure 5

The reading rate functions for readers with (1) good visual acuity and a normal field of view (Δ), (2) good visual acuity and narrow field of view (\square), (3) low visual acuity and normal field of view (\blacktriangle), and (4) low visual acuity and narrow field of view (\blacksquare).

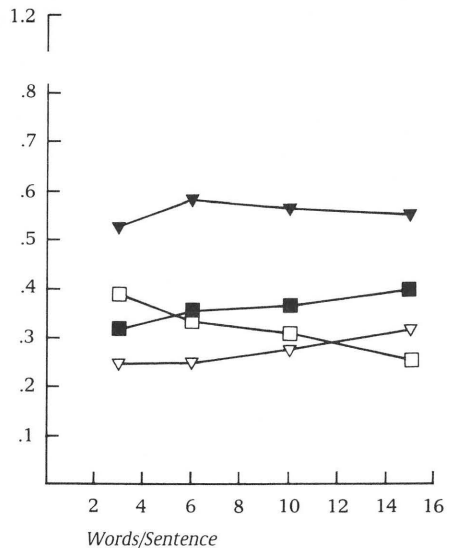
Word Test

Seconds/Letter



Sentence Test

Seconds/Letter



An attempt was made to study the effect of visual acuity and field of view on the reading process by subdividing the subjects in group A1 according to their medical diagnoses. However, a medical diagnosis was available only for 20 subjects. These subjects were subdivided into four groups: (1) high visual acuity-normal field of view, (2) high visual acuity-narrow field of view, (3) low visual acuity-normal field of view, (4) low visual acuity-narrow field of view. The reading rate functions of the four groups and the measures derived by these functions are given in Figure 5 and Table V.

The results of this analysis should be considered with caution because of the low number of subjects, the unequal cell frequencies and the complexity of the eye diseases described in terms of visual acuity and field of view. However, the main differences between the four groups may tentatively be summarized as follows: (1) A low visual acuity was a more serious handicap with respect to reading than a narrow field of view. (2) The main differences between the four groups of readers concerned their ability to integrate information on an orthographic level and their ability to form semantic chunks. Orthographic integration and semantic interpretation ability decreased with decreased visual acuity and increased with a decreased field of view. (3) There were also several interesting interactions between visual acuity and field of view, e.g., the long fixation time and large fixation field characterizing subjects with a high visual acuity but a narrow field of view. However, these sparse data do not allow such detailed analyses.

Table V

The results of the effect of visual acuity and field of view on the different reading measures.

<i>Visual acuity</i>	High*	High	Low	Low
<i>Field of view</i>	Normal	Narrow	Normal	Narrow
<i>n:</i>	8	4	6	2
Paragraph test	0.35	0.33	0.56	0.49
Sentence test	0.29	0.33	0.56	0.37
Word test	0.32	0.61	0.52	0.43
Fixation field	7.63	9.50	7.50	6.00
Fixation time	0.58	1.20	0.77	0.70
Orthographic integration ability	0.12	0.00	0.24	0.08
Semantic integration ability	0.08	0.04	0.08	0.15
Semantic interpretation	-0.03	0.22	-0.12	0.03

* *High visual acuity:* 0.1 – 0.3

Low visual acuity: < 0.1

Thus, it seems that readers with a low visual acuity have serious difficulties in encoding the information into new chunks, while the opposite seems to be true for readers with a narrow field of view. The main problem of the latter may be traced to the fixation process. These findings should be regarded as preliminary and should therefore be given further consideration in future research. The result was unexpected and suggests that unreliable but unrestricted information (low visual acuity) is relatively more difficult to encode into new chunks than reliable but restricted information (narrow field of view).

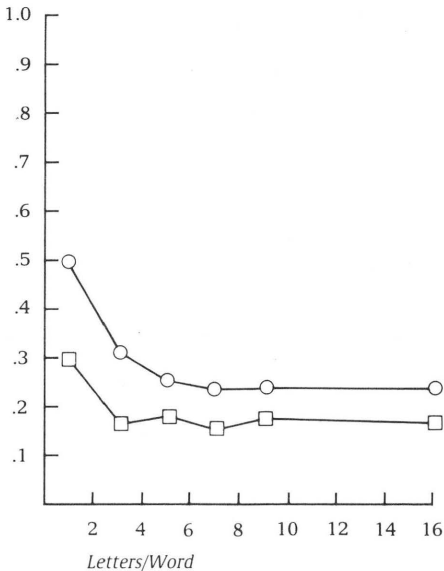
The Effect of Training

The course in reading was focused on practice to fixate, eye movement practice, and practice in the usage of optical reading aids. The effect of this training on the reading process of the partially sighted was studied by matching the four subjects in group B1A2 to four subjects in group A1B2. That is, the members of a matched pair were tested according to the following schedule. *Subject 1*: Test A — course in reading — Test B; *subject 2*: Test B — course in reading — Test A. By this design the differences between subjects and tests were under control. Reading rate in the paragraph test given at the beginning of the course was used as the matching variable. The course lasted for about 40 hours. The reading rate functions obtained before and after training are shown in Figure 6; the individual measures are presented in Table VI.

Figure 6 Reading rate functions before (○) and after (□) a course in reading. Means over groups and test versions are given.

Word Test

Seconds/Letter



Sentence Test

Seconds/Letter

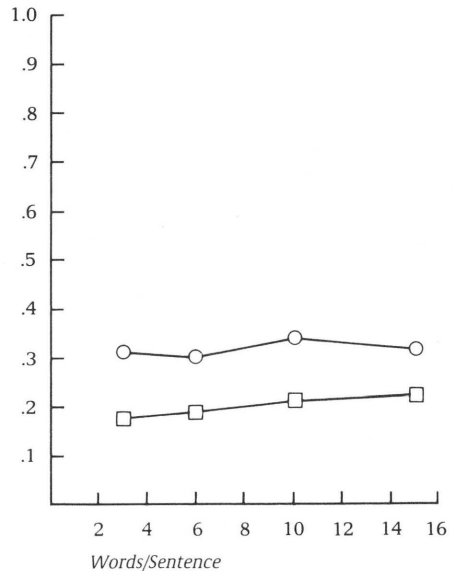


Table VI and Figure 6 show that the course in reading resulted in an increased reading rate on paragraphs, sentences, and words. However, only the measures fixation time and orthographic integration ability were affected by the training method used. It should be mentioned that most of the increment in reading rate could be explained from the decrease obtained in fixation time, which was very large as compared to the increase obtained in orthographic integration ability.

The result of this analysis thus demonstrates that exercises to fixate for the partially sighted increase reading rate mainly as a consequence of decreased fixation time. This fact points to the importance of the fixation time variable in the mediated reading process of the partially sighted, although other properties of the reading process may be more important, as suggested by the analyses of the effect of reading ability and visual handicap on the reading process.

Table VI

The effect of a course in reading training

Before course in reading

Subject	Reading group	Paragraph test	Sentence test	Word test	Fixation field	Fixation time	Orthographic integration ability	Semantic integration ability	Semantic interpretation
1	A1	0.30	0.47	0.47	3	0.60	0.00	0.00	0.02
2	A1	0.24	0.21	0.23	7	0.40	0.06	0.06	-0.02
3	A1	0.24	0.20	0.29	9	0.80	0.05	0.08	0.00
4	A1	0.43	0.31	0.25	3	0.40	0.12	0.14	-0.09
5	B1	0.47	0.38	0.28	3	0.40	0.09	0.20	-0.13
6	B1	0.24	0.21	0.18	3	0.20	0.11	0.03	-0.05
7	B1	0.23	0.20	0.26	5	0.60	0.00	0.07	0.02
8	B1	0.58	0.57	0.46	5	0.60	0.02	0.04	-0.11
		0.34	0.32	0.30	4.75	0.50	0.06	0.08	-0.05

After course in reading

1	B2	0.37	0.35	0.27	7	0.40	0.00	0.20	-0.08
2	B2	0.17	0.20	0.20	3	0.40	0.02	0.04	-0.03
3	B2	0.24	0.19	0.18	7	0.40	0.00	0.07	-0.04
4	B2	0.35	0.28	0.20	5	0.20	0.10	0.12	-0.09
5	A2	0.27	0.28	0.21	3	0.20	0.10	0.08	-0.08
6	A2	0.16	0.13	0.16	5	0.20	0.06	0.08	0.00
7	A2	0.14	0.14	0.16	3	0.40	0.00	0.05	-0.01
8	A2	0.13	0.10	0.11	5	0.20	0.01	0.08	-0.01
		0.23	0.21	0.19	4.75	0.30	0.04	0.09	-0.04

Subjects no. 1 and 5, 2 and 6, 3 and 7, 4 and 8 are matched.

The present work was designed as a descriptive study of the reading process of the partially sighted within a levels of processing framework. This model was operationalized by means of two reading-rate functions describing reading rate as a function of word length and length of sentences, respectively. From these functions a number of measures were derived assumed to reflect different levels of information processing. The reading rate functions obtained from the partially sighted indicated that:

- (1) Important properties of mediated reading include both the ability to register information *and* the ability to form chunks at deeper levels by integrating the information registered with already stored information both on a peripheral and semantic encoding level.
- (2) Reading rate of the partially sighted is mainly determined by their ability to integrate information at a peripheral level but can be improved by fixation and eye movement practice. This practice primarily influences fixation time, leaving the other more important properties unaffected.
- (3) A low visual acuity is more critical for reading than a narrow field of view. This is inferred mainly from the measures reflecting the ability to integrate information at a peripheral level and the ability to use the semantic content of the text.

It is concluded from the present study that an understanding of the reading process of the partially sighted has to consider both peripheral and cognitive processes. For some visual handicaps the main problem in reading seems to be related to the process of integration of information, for other to the fixation process. However, these processes are in a complex way interrelated to information processing at a deeper cognitive level and these relations have to be understood in order to design effective training procedures.

The level-of-processing model of mediated reading proposed in this paper served only as a conceptual tool and was not tested in any critical way. However, the results were quite encouraging with respect to the usefulness of such a model. It was possible to isolate the reading process at different levels and to trace differences between different groups of readers to differences in information processing capabilities at these levels. Finally, the model focused the analyses on the interaction between perceptual and cognitive information processing, which is rather a neglected area of research.

Obviously, more empirical work is needed before definitive statements about the proposed model can be made. The present study has shown that the model is useful as a descriptive tool at least with respect to the mediated reading process of the partially sighted and it might be as relevant for readers without a visual handicap when they read in a mediated way.

The authors thank Ian Begg, Ronald Cohen, Anders Edward, Leslie Shaps, and Bo Åström for valuable comments on the research reported here.

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Despite the mechanization and mass production of typography, some letter design still retains the aesthetic qualities of individual, hand-executed design. My work is influenced by studies of calligraphy and optical illusions. In addition, the innovative lettering of American graphic artists has shown me semantic influences of letter design in which form contributes to meaning. Nowhere is this concept more alive than in the logotype, the letterform symbol that reflects the essence of a company or institution.

The inspiration for my design of lettering and logotypes springs from a faith in the creative and aesthetic importance of hand-executed design. Calligraphy in particular has always interested me deeply; my formal training in typography and typesetting and my interest in design meet in calligraphy. Only the calligrapher takes his time in writing — which, to some people, may seem an anachronism in our era of the ballpoint pen. Calligraphy is, moreover, a medium of infinite possibilities and one can apply to it both the rigor and fantasy that it demands.

In connection with typographic work, I have experimented with optical illusions that can be created in letterforms. The variety of kinetic visual effects has particularly affected my design of logotypes. The contrast of black and white and the resulting vibrations and moire effects, for example, are evident in the alphabet designs. Observing and practicing the optical effects that create a sense of movement and other visual delights are enriching and instructive exercises for the designer, especially for one who wants to create distinctive letterforms.

In addition to calligraphy and kinetic effects, my designs for logotypes have been influenced by American designers. With my background in classical typography, I was shocked and delighted by what is often called the psychedelic style of 1967/68. The West Coast produced those wonderful posters by Moscoso and Wes Wilson, among others. Becoming acquainted with this movement while it was still developing, I was strongly impressed by its graphic aspect, most of all by the kind of typographic delirium it exuded. It was the antithesis of all I had learned — of my entire formal education — and of all that was then being practiced in Europe. I can still hear the disparaging comments of many French designers and typographers about those famous posters and the typography I found so marvelous, so splendidly design conscious. In the United States, where advertising surely depends on an easy-to-read typographic style, psychedelic typography must have seemed an outright challenge.

Visible Language
XIII 2 (1979)
pp. 184—191

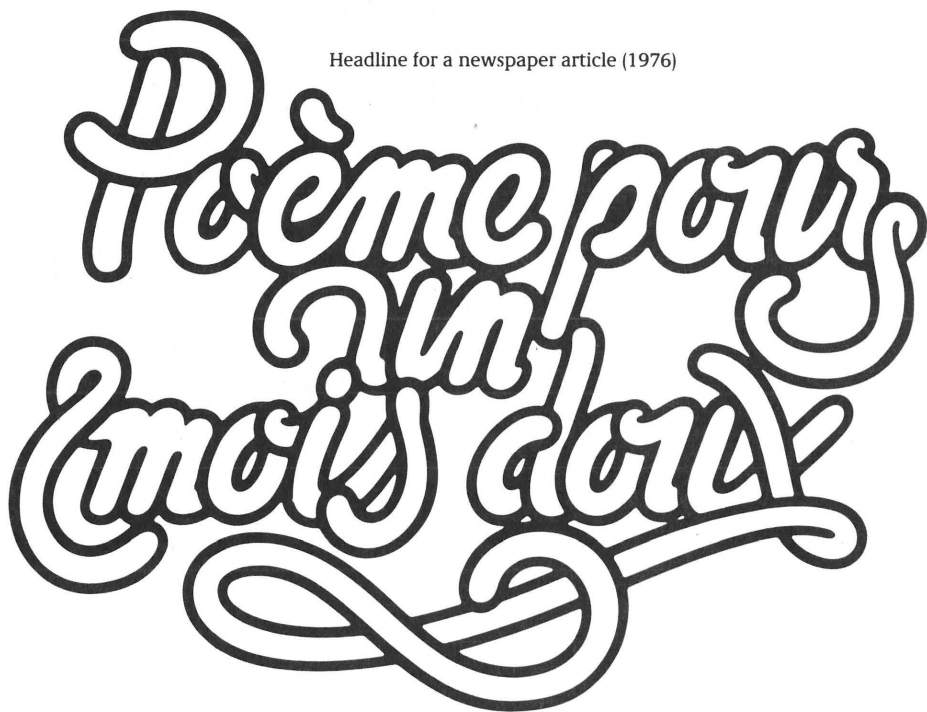
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Logotype for an illustration exhibition (1975)



Headline for a newspaper article (1976)

Traveling through the United States only reinforced my convictions; I merely had to look into the bookstores and record shops or simply around me on American streets to realize that the sign, the letter, the art of typography was being handled in a completely different dimension than in Europe. And I was profoundly impressed meeting and getting to know a number of American designers of my own generation; Tony DiSpigna, Michael Doret, Gerard Huerta of New York and Mick Haggerty of Los Angeles have been for me — and continue to be — models from whom I could learn new concepts of typographic design. I am much indebted to them.

A logotype consisting of the word "LASER" in a bold, sans-serif font. Each letter is contained within a separate black rectangular box with a white background, and the boxes are arranged in a single horizontal row.

A logotype consisting of the word "GRAPHICS" in a bold, sans-serif font. Each letter is contained within a separate black rectangular box with a white background, and the boxes are arranged in a single horizontal row.

Logotype for an audio-visual firm (1975)

Logotype for a movie and audio-visual firm (1976)

A logotype for the name "manuel otero". The text is centered within a square field of diagonal black and white stripes. The word "manuel" is on the top line and "otero" is on the bottom line, both in a lowercase, bold, sans-serif font.

The psychedelic style and other American innovations also taught me a great deal about the function of letterforms. The frequent near-illegibility that marked much psychedelic lettering, for example, demanded attentive, observant reading. Precisely because the letters were difficult to discern gave them additional impact. And this becomes part of our recognition that the *form* of an alphabet also contributes to the meaning of a verbal message. This semantic significance of letterforms is a concept that is reflected in all of my work; when well-conceived, the letter *forms* can convey a message, serve as an illustration, constitute an image, tell a visual story in a matter of seconds.



Logotype for a printing firm (1974)

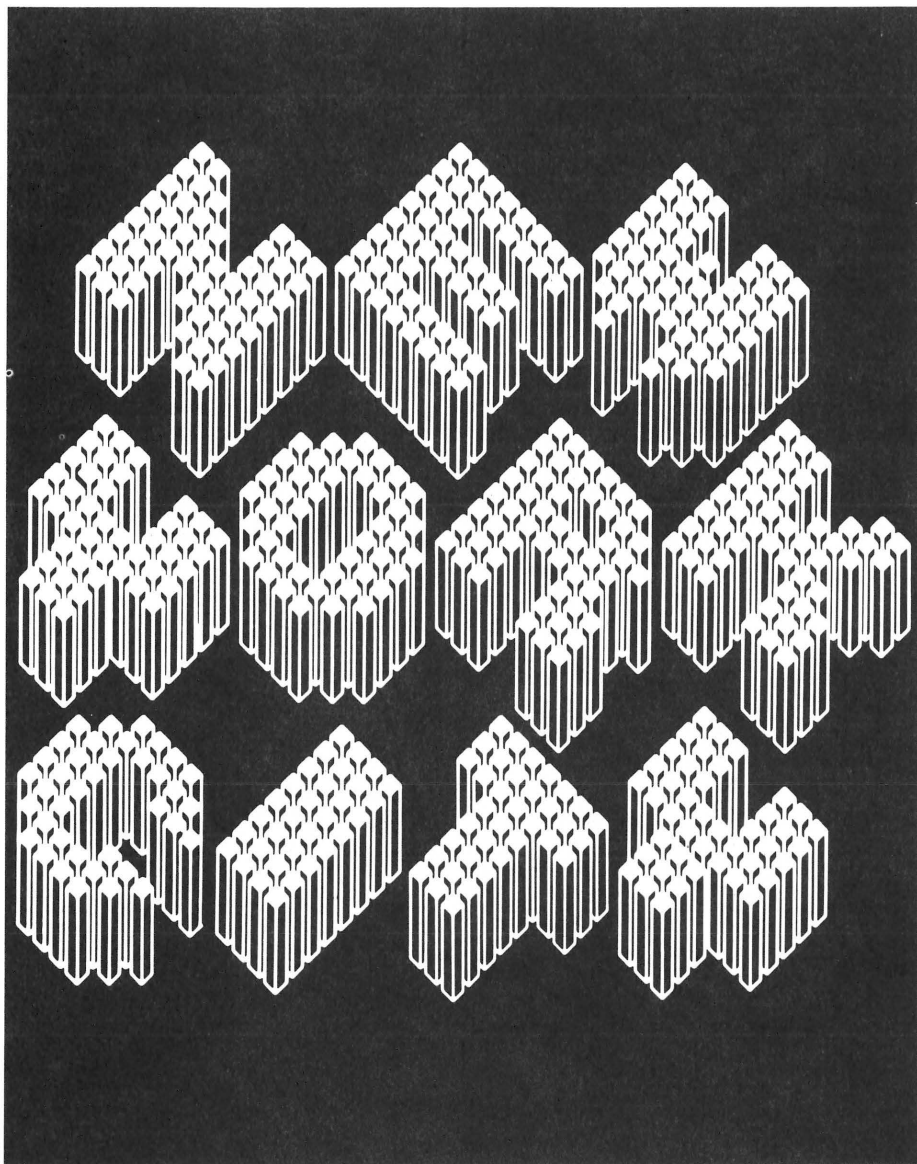
Logotype for a photographer (1977)



Logotype for a photographer (1974)

In 1973 I designed 24 photo-alphabets for the Atelier Holenstein. Although I tried to overcome the restrictions previously faced in dealing with traditional typesetting methods, I was not satisfied with the results. Developing the book *Fantastic Alphabets* gave me the opportunity to create alphabets no one had previously dared to conceive, neither for letter-transfer nor for photo-titling. It gave me the chance to work toward an entirely different kind of typography, one I had hoped for many years to help shape.

A new alphabet: Building (1976)



Exploring a letterform in the context of the alphabet is fascinating. There is so much one can do and express with a single letter, including the injection of a note of playfulness which, if judiciously applied, best exemplifies this new typography. Whenever I can, I introduce more and more often an element of whimsy into my word-images — to depict stories in the guise of letters.

Lettering for promotional posters (1977)

NATURE
BRICOLAGE
TRESORS
TRAVAU
CUISINE
LA FRANCE
ACTIVITES
ENFANTS
MODE
EVASION
SANTE
BEAUTE

Headlines for a series of articles on retired people (1978)

CELEBRES
FOU
BRUIT
RENCONTRE
CLUB
CLANDUSTIN

Designers and typographers are now generally aware that the art of typography can be given new life and is capable of transformation and evolution. And one of the most appropriate ways to express this transformation remains the logotype, the short and incisive typographic symbol that must, in a few letters, reflect the essence of a product or characterize an industrial enterprise.

Logotype for a children's sports periodical (1977)

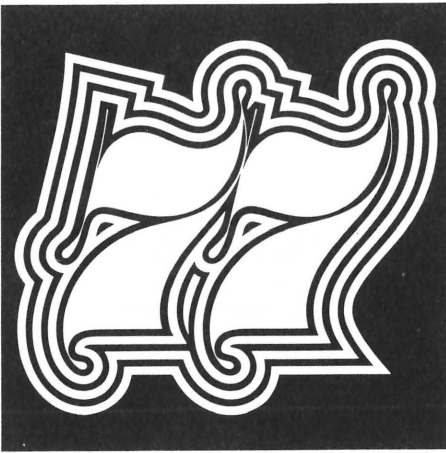
A logotype for a children's sports periodical. The word "SKATE" is rendered in a bold, rounded, and highly stylized font. The letters are thick and have a slightly irregular, hand-drawn quality. The 'S' is particularly large and curved, and the 'K' has a very thick, blocky appearance. The overall style is playful and energetic, suitable for a children's sports magazine.

Logotype for a fashion shop (1973)

A logotype for a fashion shop. The word "Framboyan" is written in a very bold, black, and highly stylized font. The letters are thick and have a rounded, almost bubbly appearance. The 'F' is particularly large and has a decorative flourish. The overall style is reminiscent of mid-20th-century fashion branding, conveying a sense of luxury and style.

Logotype for a children's book (1975)

A logotype for a children's book. The words "Rêves d'Enfants" are written in a highly decorative, cursive, and flowing font. The letters are thin and have a delicate, almost ethereal quality. The 'R' is particularly large and has a long, sweeping tail. The overall style is elegant and whimsical, suitable for a children's book.



My greeting cards (1977–79)



Der Entwurf einer Druckschrift von *Gerard Unger*

Der Entwurf der Schrift Demos war das Ergebnis technischer und ästhetischer Betrachtungen. Demos wurde für den Hell CRT Digiset geschaffen, ein elektronisches Setzgerät, das Buchstaben aus senkrechten Strichen generiert. Kurven und Winkel erscheinen erst durch die Belichtung und nachfolgende Bearbeitung als glatt. Statt auf die Verfahren des Bleigusses zurückzufallen werden die besonderen Eigenarten des Digiset benutzt, um den Schriftentwurf zu bestimmen, wobei immer daran gedacht wurde, daß die visuelle Erscheinungsform das letztendliche Gütekriterium jeder Buchstabenform ist.

Ein experimenteller Versuch zur Verbesserung der typographischen Gestaltung von Lehrbüchern von *Dirk Wendt*

Drei verschiedene Ansätze wurden versucht, um die Lesbarkeit von Lehrbüchern für Realschulen zu verbessern: (1) zwei Spalten mit etwa 58 mm (15 Cicero) Zeilenlänge anstatt einer Spalte mit etwa 126 mm (32 Cicero) Zeilenlänge, (2) Einfügung zusätzlicher Wortzwischenräume zwischen den Konstituenten der Sätze, um die Satzstruktur des Textes deutlich werden zu lassen, und (3) „Visualisierung“ der Information durch eine vertikale und horizontale Struktur, durch welche die Gestaltung dem visuellen Medium insgesamt angemessener erscheint. Bei einer experimentellen Erprobung an einer Physik-Lektion, die in einer Standard-Version und in drei experimentellen Versionen entsprechend den oben beschriebenen Ansätzen gedruckt und 600 Schülern vorgelegt wurde, zeigte nur die dritte experimentelle Version („Visualisierung“) eine Verbesserung gegenüber der Standard-Version.

Ein klösterliches Dilemma, ausgelöst durch die Erfindung der Druckkunst: Der Kontext des *De laude scriptorum manualium* von Abt Johann Trithemius (1462–1516) von *Noel L. Braun*

Die Erfindung der Druckkunst wurde von ihren zeitgenössischen Zeugen keineswegs uneingeschränkt als Schritt zum Fortschritt in der Geschichte der Menschheit betrachtet; in den klösterlichen Schreibstuben beispielsweise trat die Druckkunst in direkten Wettbewerb mit der langgehegten Kunst des Abschreibens. Ein Benediktinerabt, der zur Zeit der Inkunabeln lebte, der Abt Trithemius von Sponheim nahe Kreuznach in Deutschland, schrieb sein *De laude scriptorum manualium* (1492) zur Bestärkung der Auffassung, daß die handschriftliche Übertragung von Texten in vieler Hinsicht dem Druck überlegen ist. Der Verfasser steht jedoch keineswegs der Druckkunst prinzipiell feindlich gegenüber; er erwägt sie als göttlich inspiriertes Mittel zur Erleichterung seines Feldzuges zur Erneuerung des goldenen Zeitalters klösterlicher Gelehrsamkeit in zeitgenössischem Gewand. Trithemius war weit davon entfernt, ein Reaktionsär gegenüber der Revolution der Druckkunst zu sein, sondern einer der lebhaftesten Anwälte der Druckkunst in der Renaissance.

Der indirekte Leseprozeß sehbehinderter Leser *von Hans Marmolin, Lars-Göran Nilsson, und Hans Smedskammar*

Das vorgestellte Modell erweitert die gegenwärtigen theoretischen Ansätze, indem es den grundlegenden Leseprozeß bei geübten und durchschnittlichen Lesern mit dem bei schlechten Lesern in Verbindung bringt. Während der unvermittelte Leseprozeß des geübten Lesers auf die Bedeutung des Wortes ausgerichtet ist, wird der des schlechten Lesers durch die Interpretation der einzelnen Buchstaben vermittelt, aus denen das Wort besteht. Die ständige Interaktion zwischen der Interpretation des einzelnen Buchstaben und dem Lesen der Bedeutung des Wortes bestimmt die langsame Lesegeschwindigkeit der schlechten Leser. Es wurde eine empirische Untersuchung durchgeführt, um die Möglichkeit des vorgestellten Ansatzes zu demonstrieren. Es wurde eine Reihe von Maßen erhoben, um den Leseprozeß guter und schlechter sehbehinderter Leser zu vergleichen. Der Kern des Unterschiedes zwischen den beiden Versuchspersonengruppen war hauptsächlich auf periphere Teilprozesse des Lesens begrenzt, während die tiefergehenden und eher semantischen Ebenen des Leseprozesses weniger beeinträchtigt waren.

Typographie anders gesehen *von Jean Larcher*

Trotz der Mechanisierung und Massenproduktion in der Typographie behalten einige Buchstabenformen immer noch die ästhetischen Eigenschaften individueller, handgefertigter Gestaltung. Meine Arbeit wurde von Studien in Kalligraphie und optischen Täuschungen beeinflusst. Außerdem hat die innovative Buchstabengestaltung amerikanischer Graphiker mir semantische Einflüsse auf die Buchstabengestaltung gezeigt, bei denen die Form mit zur Bedeutung beiträgt. Dieses Konzept ist nirgends lebendiger als in der Logotype, dem Buchstabensymbol, das das Wesen einer Firma oder Institution wiedergibt.

Le dessin d'un caractère *par Gérard Unger*

Le caractère Demos concilie le technique et l'esthétique. Il a été dessiné pour la Digiset de Hell, une composeuse électronique à tube cathodique et trame verticale. Les courbes et les angles sont arrondis par émulsion, c'est-à-dire par des méthodes très éloignées du plomb, car ce sont les particularités de la Digiset qui ont été mises en œuvre sans jamais perdre de vue que c'est sur l'image du caractère que porte le jugement esthétique qui est toujours déterminant en la matière.

Recherches en vue d'une meilleure présentation des manuels scolaires *par Dirk Wendt*.

Trois dispositions différentes ont été essayées en vue d'améliorer la lisibilité des manuels scolaires du second degré: (1) deux colonnes justifiées sur 58 mm (13cic) chacune, au lieu d'une colonne de 126 mm (28cic), (2) un espace plus grand entre les éléments des phrases pour mieux en faire ressortir la structure, (3) un traitement vertical et horizontal tendant à une meilleure globalisation de l'ensemble. L'expérience portait sur un cours de physique dans sa présentation traditionnelle et dans les trois dispositions ci-dessus. Le tout fut distribué à 600 étudiants. Seule la troisième disposition fut considérée comme meilleure que la mise en page traditionnelle.

Comment l'invention de l'imprimerie a posé des problèmes aux moines: Le *De Laude Scriptorum Manualium* de l'Abbé Trithème (1462—1516) *par Noël L. Brann*.

Il ne faudrait pas croire qu'en son temps l'invention de l'imprimerie fut universellement accueillie comme un progrès évident dans l'histoire universelle: pour les scribes monastiques, elle était un concurrent direct de la transcription traditionnellement manuelle. C'est ainsi que l'abbé Trithème de Sponheim, près de Kreuznach, en Allemagne, écrivit, en 1492, un *De Laude Scriptorum manualium* pour rappeler que la copie manuscrite des textes est à bien des égards, supérieure à la typographie. Toutefois ce n'était pas une hostilité a priori, car pour lui l'imprimerie était aussi un instrument divin pour l'aider dans la campagne qu'il menait en vue de rééditer sous une forme plus moderne, les chefs-d'œuvre de l'âge d'or de l'érudition monastique. Loin de se poser en réactionnaire face à la révolution typographique, Trithème fut un des plus vigoureux champions de l'imprimerie à l'époque de la Renaissance.

La lecture intermédiaire des lecteurs déficients *par Hans Marmolin, Lars-Göran Nilsson, et Hans Smedshammar.*

Le modèle proposé est un prolongement des théories courantes en matière de lecture, en ce sens qu'il étend aux mauvais lecteurs ce que l'on sait sur les bons lecteurs et sur les moyens. Le bon lecteur va droit au sens du mot. Le mauvais épèle les lettres. C'est ce stade intermédiaire de l'épellation au cours de la recherche du sens des mots qui ralentit la lecture. Une expérience a donc été organisée pour établir la validité de cette théorie. Une série de mesures ont été élaborées en vue de comparer le processus de la lecture de quelques bons et de quelques mauvais lecteurs dont la vision était déficiente. La différence dans la vitesse de lecture des deux groupes s'est située principalement dans les mécanismes périphériques, tandis que les couches profondes, au niveau sémantique, étaient moins affectées.

Une typographie différente *par Jean Larcher*

En dépit de toutes les mécanisations et de la production de masse certains dessins de caractères portent encore la marque distinctive, individuelle du travail à la main. Mon travail est le fruit de recherches calligraphiques et optiques. Certains dessinateurs américains m'ont mis sur la voie d'un graphisme sémantique où la forme influe sur le sens. C'est particulièrement observable dans les logotypes où le dessin des lettres est censé refléter l'image de marque d'une entreprise ou d'une institution.

El diseño de un carácter de tipografía *por Gerard Unger*

El diseño del carácter Demos fue el resultado de consideraciones tanto técnicas como estéticas. Demos fue diseñado por Hell CRT Digiset, un proceso de composición electrónica que crea el carácter por intermedio de líneas verticales. Las curvas y los ángulos sólo aparecen suavizados después de una emulsión. En vez de recaer en métodos que usan metal caliente, las características únicas del Digiset fueron usadas para determinar el diseño siempre cuidadoso para que la apariencia visual sea el árbitro final en el diseño de cualquier forma de letra.

Un enfoque experimental hacia el perfeccionamiento del diseño tipográfico de libros de texto *por Dick Wendt*

Se han tomado tres enfoques diferentes para tratar de perfeccionar la legibilidad de un libro de texto para escuelas secundarias: (1) dos columnas de un ancho de alrededor de 58 mm (15 ems) en vez de una columna de un ancho de alrededor de 126 mm (32 ems), (2) la inserción de espacio adicional entre los componentes de las oraciones para transmitir la estructura de la frase del texto y (3) «visualizando» la información estructurándola vertical y horizontalmente de manera tal que el diseño total sea el más adecuado al medio visual. En una prueba experimental de una lección de física impresa en una versión corriente y en tres versiones experimentales que corresponden a los tres enfoques anteriormente mencionados y dada a 600 estudiantes, sólo la tercera («visualización») mostró un mejoramiento sobre la versión corriente.

Un dilema monástico planteado por la invención de la imprenta: el contexto de *De laude scriptorum manualium* del abad Johann Trithemius (1462—1516) *por Noel L. Brann*

La invención de la imprenta no fue de ninguna manera vista por testigos contemporáneos; en el scriptorium monástico, por ejemplo, el arte de la imprenta se vió en competición directa con el arte largamente cultivado de la copia manuscrita. Un abad benedictino que vivió en la era del incunábula, el abad Trithemius, de Sponheim, cerca de Kreuznach, en Alemania compuso su *De laude scriptorium manualium* (1492) en apoyo a la proposición que la copia manuscrita de textos es en muchos respectos superior a la imprenta. Sin embargo, el autor, en principio, no era de ninguna manera hostil al arte de la imprenta, viéndolo en saldo como medio divinamente inspirado para facilitar su campaña para renovar con un atuendo contemporáneo la edad de oro de la erudición monástica. Lejos de ser un reaccionario en frente de la revolución de la imprenta, Trithemius fue uno de los abogados de la imprenta más vigorosos del Renacimiento.

El proceso mediado de lectura en lectores de vista parcial *por Hans Marmolin, Lars-Goran Nilsson, y Hans Smedshammar*

El modelo presentado hace extender la corriente teorización sobre la lectura relacionando los procesos subrayados de lectores promedio o bien entrenados con los de nivel bajo. Mientras el proceso no-mediado de lectura para lectores expertos se dirige inmediatamente al significado de la palabra, los procesos de lectura para lectores de nivel bajo está mediado por la interpretación de las letras individuales que constituyen la palabra. La interacción continuada entre la interpretación de letras aisladas y la lectura en busca del significado de la palabra es lo que determina el curso lento de la lectura en lectores pobres. Se llevó a cabo un estudio empírico para demostrar la viabilidad del presente enfoque. Se derivaron una serie de medidas para comparar los procesos de lectura en buenos y en pobres lectores de vista parcial. El lugar exacto de la diferencia en la velocidad de lectura entre los dos grupos de materias fue limitado principalmente a los subprocesos periféricos de lectura mientras los niveles más profundos y semánticos del proceso de lectura se vieron menos afectados.

Cómo enfocar la tipografía en forma diferente *por Jean Larcher*

A pesar de la mecanización y de la producción masiva de tipografía, el diseño de algunas letras todavía retiene las cualidades estéticas del diseño individual ejecutado a mano. Mi trabajo se ve influenciado por estudios de caligrafía y de ilusión óptica. Además, la inscripción innovadora de artistas gráficos americanos me ha mostrado las influencias semánticas del diseño de letra en el cual la forma contribuye al significado. Este concepto no se encuentra en ninguna parte tan vivo como en el logotipo, el símbolo letra-forma que refleja la esencia de una compañía o de una institución.

The Authors

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Figure 6a. Brief representation of processes and stages in visual word recognition.

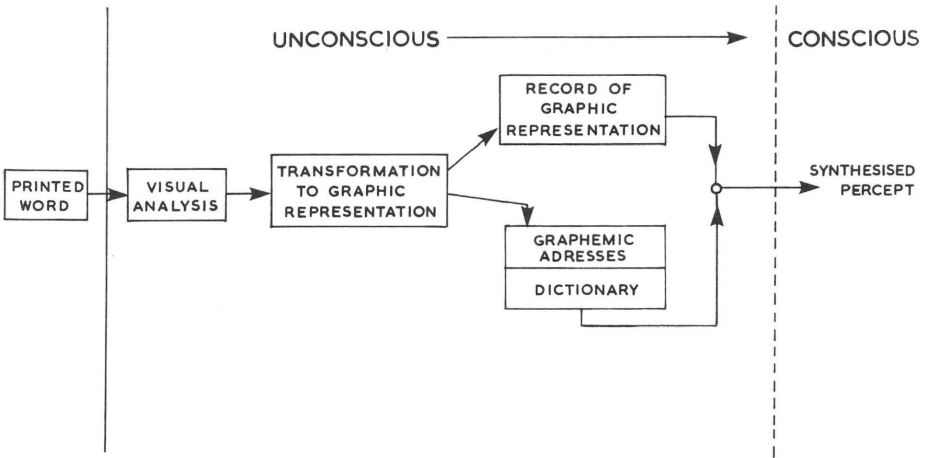
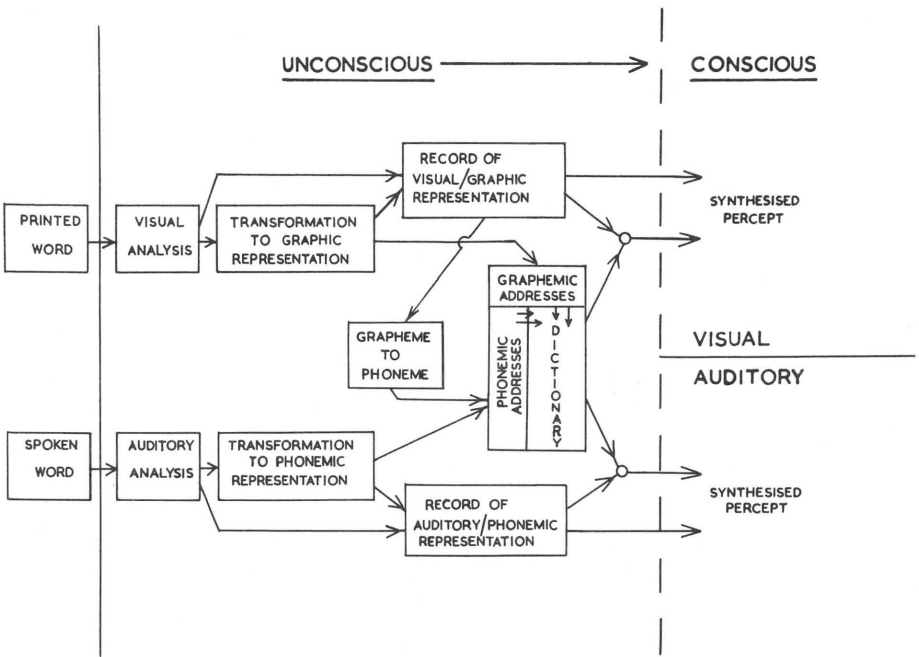


Figure 6b. Representation of processes and stages in visual and auditory word recognition.



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