BRAILLE RESEARCH NEWSLETTER

(Braille Automation Newsletter)

No. 5, July 1977

edited by

J.M. Gill and L.L. Clark

Warwick Research Unit for
the Blind
University of Warwick
Coventry CV4 7AL
England

American Foundation for
the Blind
15 West 16th Street
New York 10011
U.S.A.

Contents

Editorial

With this issue, the Braille Automation Newsletter changes its name to Braille Research Newsletter. We shall continue to use the former heading as a sub-heading for the purpose of continuity in libraries and to identify ourselves as to origin. The reason for a name change is in fact a recognition that the automatic generation of braille depends, from the point of view of optimal design, upon a consideration of the changes that eventually will occur in the braille code as a natural result of continual review by braille authorities to keep the code up-to-date. The point is that one can hope that whatever changes occur of an evolutionary nature in the braille code can also contribute to easing the task of automatic transcription of ink print into braille with the assistance of computer software.

We are careful to point out that the change in name is <u>not</u> a challenge to the braille authorities to change braille codes so that they will make transcription with computer assistance easier: we share the belief that man's work ought to be aided by machines where possible, but that man ought not thereby to be ruled by his machines! We emphasize, therefore, that discussions of research into legibility, intelligibility, learnability, and rationality of the several braille codes is part of the domain within which we operate. By doing so, we hope to open the field of discourse in these pages to those who are struggling mightily at the moment with the difficult and vexing questions of revisions in the codes that make sense among common language families; that respond to what is being discovered about the reading habits and behaviour of braille readers; and that consider the question of the influence of difficulties in learning braille on its easy acquisition as a reading code for those using tactile embossed materials. No hidden agenda is implied!

Issue Sequence

If, as seems likely while this is written in mid-June, that Issue No. 5 of this Newsletter will appear before Issue No. 4, a word of explanation is in order - if not only for the sake of those bedevilled librarians to whom we referred earlier! As indicated in our Issue No. 3, the fourth issue of the Newsletter would contain an editorial statement, and the content of the Proceedings of a workshop on the braille codes held in New York in June of 1976. That issue is a joint publication of the Association for Computing Machinery, the American Foundation for the Blind, and Warwick Research Unit for the Blind. Very simply, the production difficulties encountered in editing such a massive document have caused us to put off its publication date time and again. It would seem, however, that Issue No. 4 will appear some time during the Summer.

Questionnaire

Here we have a hidden agenda, and it is, simply, to assess whether you have found the Newsletter to be useful enough in your work that you would be willing to pay for it! We are asking this question even before deciding whether or not we will seek other sponsorship for the publication of the Newsletter. The reason is that we anticipated, in initiating this publication, that its interested audience around the world would be small; we are surprised, and of course pleased, to find that we were in error and the list is growing monthly - no doubt due at least in part of the interest of nonresearchers in the kind of thinking and construction in which researchers and developers are engaged. The cost of catering to this large a group of interested persons has gone beyond the rather meagre resources available to produce the Newsletter. We are faced with the need to limit its distribution only to bona fide researchers, a difficult role to enforce at best; or to open up its distribution to anyone interested at a modest price, which appears to us a better choice.

Your cooperation in ticking off your responses to these matters on the sheet enclosed would be warmly welcomed.

Automatic Translation by Computer of Music Notation to Braille

J.B. Humphreys

A system is being developed for input and digital storage of music notation using a computer, with automatic translation to the braille music code. The intention of the project is to produce braille music without any knowledge of braille being required of the person operating the system.

Investigation of existing systems involving computers for production of braille music suggests that none so far encountered approaches fully-automated transcription, most being described as "computer-assisted translation". In each case either intervention is required at the input stage by a skilled music braillist or the braille output is not exactly in accordance with the standard braille music notation (refs. 1-6). In view of the shortage of skilled music braille transcribers relative to the demand for braille music, there therefore remains a need for a system capable of producing acceptably accurate braille music quickly with minimal or not intervention by skilled braillists.

A computer program on the Sigma 5 computer at Warwick University for the input, storage, editing and translation to braille of inkprint music notation has now been developed to the point where it has been used to produce a good approximation to the braille transcription of a short piece of piano music.

The music notation is input on a graphical display unit connected on-line to the computer. While this is still commercially more expensive than the traditional punched card input, it appears to be a more suitable medium for music notation, which is essentially graphical rather than textual. Braille output is produced on an LED 120 braille embosser.

A graphical display unit normally has two forms of input: an ordinary alpha-numeric keyboard, and a means of addressing positions on the display screen, usually a joystick or light pen. The latter could in theory be used extensively in conjunction with the keyboard to specify the music notation by building up an image of the printed score on the screen and having software sort the information into order and make sense of it. This method has the advantage that the input operator would require virtually no knowledge of music notation, but would require considerable programming effort to implement and would be likely to be relatively slow to use. A more conventional alphanumeric code has therefore been adopted for the specification of the music notation itself while the joystick is used to identify particular musical items already displayed on the screen for editing purposes.

A number of alphanumeric languages for input of music notation to a computer have been used by various researchers for purposes of music analysis, cataloguing or printing (ref. 7). Many have limitations dependent on the particular project they were designed for, and there is no universally accepted standard code either for input or for digital storage of music notation. The Ford-Columbia language (ref. 8) developed for music printing is claimed to be capable of representing all aspects of printed music notation, but documentation for this language has only recently been published. The input language and data structure for storage of the music notation in the present project have therefore been designed specifically for this project, although hopefully with a capability for wider application.

The input language is interactively interpreted rather than compiled. Forms of input using punched cards have encountered particular problems with proofreading and correction of the data. The use of an interpreted language allows two immediate checks on the input: firstly, any character which in a particular context cannot be interpreted according to the syntax of the language is rejected, with a message to inform the operator that this has been done: thus a bar line would not be accepted if the time count did not comply with the time signature, unless the check were specifically overridden by the operator; and secondly, the music is displayed graphically on the screen in an approximation to the printed score as it is input, enabling the operator to compare the music as displayed with the music as printed and correct the stored music as necessary, either before continuing or later. This also has the psychological advantage for the operator of immediate feedback.

The input language used is now adequate to encode the features which are relevant to the braille transcription of most of the general inkprint music symbols. Features of the inkprint not relevant to the braille, such as beaming together of notes, have not generally been incorporated but could be included without difficulty if for example it were required to produce a good quality print version from the digitally-stored music. More obscure notation and signs used only for particular instruments have also not yet been included but again the input language and data structure are flexible enough to be extended to include these as and when necessary. The language allows considerable abbreviation of repetitious passages for the convenience of the operator and is generally designed to minimise the number of keystrokes required. However, all music is stored in full and there is no obligation on the input operator to notice any repetition in the music.

The data structure for digital storage of the music is independent of the input language. This permits revisions and improvements in the input language without invalidating music already stored, and allows a fairly free format for input but a fixed format for storage. Digital storage comprises a random-access disc file containing three linked lists of blocks of data items representing respectively inkprint music and unformatted and formatted braille. Data fields for individual items are of variable length, for compact storage and easy extension of the range of symbols which can be represented. Random access is particularly necessary to enable the use of linked lists for editing and for detecting repeated bars and passages in the translation to braille. It is assumed that in general a piece of music is too long for a significant part of it to be held in core storage at any one time.

Editing facilities have been developed to permit insertion or deletion of complete bars at any one point, and editing during input of the bar currently being input, as well as comprehensive editing of any specified bar after inputting is complete. Editing of a specified bar is requested by giving the bar and line numbers. The required bar is displayed on the screen and individual items may be inserted, deleted or modified using the joystick to identify items. Inserted items are displayed at the appropriate position on the screen. Deleted items are crossed out. The display may be refreshed at any time during the editing of a bar, with deleted items removed and the rest properly spaced. The file is not changed until the operator gives the instruction to end the edit.

All operations on the inkprint music representation are equally available for the braille representation with little extra complexity in the program since both are stored in a similar form. Although the goal of the program is to produce perfect braille, this may not be attainable in practice because some rules of braille music depend on musical knowledge which may not be readily computable, so it is desirable to have a capability for editing the braille produced by the translation process. Incidentally, braille may be input directly from the keyboard regardless of whether or not it represents music, thereby assisting the digital storage of braille codes which have not yet been transcribed automatically.

Archiving routines have been included in the program to enable individual pieces of music to be saved on and subsequently recovered from magnetic tape for permanent storage.

The translation from inkprint to braille has been divided into two separate passes. The first pass, the translation proper, produces and stores bar by bar a braille representation of the music. This pass includes such things as detection of repeated bars. The second pass, formatting, produces from this unformatted braille a representation of the final braille output, formatted according to the bar-over-bar layout of standard braille music notation (refs. 9-10). This division into two passes appears generally simpler than a single-pass translation, and also allows access to the braille if necessary at the intermediate stage. Although the translation is partially dependent on the final layout, the feature which would cause the greatest difficulty, splitting of bars at the end of a line, is not normal practice unless a bar is too long to fit onto a single braille line, in which case any format dependencies can be detected during the first pass. Certain braille features, octave signs and doubling, are re-marked at the beginning of a braille parallel. These have been included in the first pass at all places where they are potentially required, and flagged to be deleted where necessary during the second pass.

The program has been used to input, correct and translate to braille a sample part of a reasonably straightforward piano duet: the primo part of the second movement of the Sonata in D (K.381) by Mozart. The braille version of this sample was distributed with a questionnaire and request for comments and criticism to about 40 blind musicians, and a number of schools and organisations for the blind. Replies have been received from most of the recipients, and most of those who have replied have expressed an ability and willingness to help in the further evaluation of this project.

The braille transcription distributed contained a number of errors and omissions, some known at the time it was distributed and others revealed by the musicians' comments. These fall into three categories: features which were not incorporated into the translation algorithm at the time the sample was produced, minor programming errors in the translation algorithm, and minor discrepancies between the braille music code as defined in the manual (ref. 9) and that in current use. Where the manual is not clear on particular points or conflicts with current usage, de Garmo's Introduction to Braille Music Transcription (ref. 11) has been used as a reference to determine the correct braille translation. The program has since been corrected and extended to produce an almost accurate transcription of the sample piece of music, as compared with that produced manually by a transcriber of the Royal National Institute for the Blind (RNIB), who has kindly provided a correct braille version of part of the piece of music in question.

Problems encountered so far in translation have arisen particularly from the various braille abbreviation devices which do not occur in the inkprint. Since the translation is required to be fully automatic there can be no assistance with these at the input stage. The translation algorithm must detect, for example, repetition of beats or part-beats within a bar, whether these actually save any space in the braille, repetition of whole bars or passages, whether one part is played in unison with another, where doubling should be used, where simple short slurs or long slurs or bracket slurs should be used. These features require that neither the input nor the output of the translation stage can be strictly sequential. It is necessary to examine previously translated bars to determine whether a bar currently under consideration is a repeat of an earlier bar. It is sometimes necessary to insert braille cells before others which have already been output: for example, at the end of a passage where the left hand is played an octave below the right hand, it is necessary to go back to the previous bar to mark this.

Tests for repetitions involve more than a direct comparison of inkprint representation: for example, in a repeated bar, an expression mark may still be in effect and therefore not re-marked in the print, or a repeated beat within a bar may contain notes where accidentals or fingering are not re-marked.

Further problems arise where the order of the braille does not quite follow the order of the print: thus "p dolce" in the sample referred to above becomes "dolce p" in the braille, according to the rule that signs of wider application should come first. It is in matters such as this that it is desirable to obtain the opinion of typical braille music readers as to whether slight deviations from the strict braille definition are acceptable.

Future developments include translation of a wider variety of types of music and more complex notation than has been so far tackled. Braille versions of the four separate voice parts of Mozart's Requiem Mass and the Associated Board of the Royal Schools of Music 1977 Grade V Pianoforte Examinations have been obtained; an attempt will be made to reproduce these as accurately as possible from the inkprint scores using the automatic translation program. Vocal works will present additional problems in that the words (if in English) are to be transcribed into grade two braille, and as in the music itself, use of repeat signs is common for repeated words and phrases. Extra slurs are also required in the music to indicate the correspondence between notes and syllables where this would not otherwise be clear. Single-line non-keyboard instrumental music in braille is divided into segments, the length of which may vary within limits so that the segmentation reflects the natural structure and phrasing of the music. There does not seem to be any simple way of determining automatically where the division should be made.

References

1. Computer-assisted Translation of Braille Music: Progress Reports, May 1971 to August 1975; American Printing House for the Blind, Louisville, Kentucky.

2. SAMBA and RUMBA: Systems for Computer-assisted Translation of Braille Music, W. Watkins and J. Siems; Braille Automation Newsletter, August 1976.

3. Computer-assisted Transcription of Braille Music, Sally Wilkinson; Braille Automation Newsletter, August 1976.

4. Computer Printing of Braille Music Using the IML-MIR System, P. Howard Patrick and Patricia Friedman; Computers and the Humanities, Vol. 9, pp 115-121, May 1975.

5. Computers and Music Braille, P. Howard Patrick and Rosalind E. Patrick; Braille Automation Newsletter, August 1976.

6. An Introduction to Computer Printing of Braille Music Using the IML-MIR (Intermediary Music Language - Music Information Retrieval) System, P. Howard Patrick, Music Department, The American University, December 1976.

7. Several papers in: Musicology and the Computer: Three Symposia, edited by Barry S. Brook; City University of New York Press, 1970.

8. The Ford-Columbia Input Language, Stefan Bauer-Mengelberg; in Musicology and the Computer.

9. Revised International Manual of Braille Music Notation 1956, Part 1, Western Music, compiled by H.V. Spanner; World Council for the Welfare of the Blind.

10. Revised International Manual of Braille Music Notation 1956, 1975 American Addendum; American Printing House for the Blind, Louisville, Kentucky, 1975.

11. Introduction to Braille Music Transcription, Mary Turner de Garmo; Division for the Blind and Physically Handicapped, Library of Congress, Washington, 1974.

Acknowledgements

This project is funded by the Science Research Council. Computing facilities are made available by SRC, and other facilities by the University of Warwick.

Braille Books from Compositors' Tapes

C. Brösamle

This is a report on computer-assisted production of braille books from compositiors' tapes. The procedure has been developed within the framework of the research project "Rationalisation of the Printing of Braille Books" at the Stiftung Rehabilitation (Rehabilitation Foundation), Heidelberg, West Germany (Ref. 1).

Summary

With the aid of a programme system, compositiors' tapes can be prepared for use as input for the University of Munster's braille translation programme. The texts are re-coded, the control signs for the type-setting system are removed, and new ones for the translation and layout runs are provided. Certain steps in the preparation procedure which cannot be included in this system necessitate a certain amount of manual work in a dialogue at the monitoring display. After translation of the prepared texts, the braille texts are recorded onto compositors' tapes, which, for example, may be used as input for a stereo-typer. This procedure is contrasted with the manual copying of black print books, with particular attention being paid to the question of time requirements.

1. Compositors' Tapes in Book Printing

A large percentage of contemporary literature is prepared for printing by means of paper tape, cassettes or similar. In using compositors' tapes as output medium for braille books, one encounters the disadvantage that they generally contain mistakes. Corrections are made later, frequently directly in the texts, and are therefore absent from the tapes. The raw material includes control codes for the type-setting computer in question for the setting of the various type faces, special characters, and letters from foreign alphabets. Other control signs indicate the formal layout of the text.

2. Preparation of the Compositors' Tapes

The points mentioned in 1 and the fact that there are various type-setting systems with different codes and control signs mean that a two-phase preparation of the text is required:

The first phase is carried out by a programme which deals with all aspects not concerned with content, and with all alterations specific to the type-setting system, e.g.:

- Re-coding
- Marking of capital letter sequences (Roman numerals, abbreviations)
- Marking of italic and boldface passages
- Marking of special characters and letters from foreign alphabets
- Conversion of the control code into an easily readable form, useful for easy location of parts of the text where manual intervention is necessary, e.g. footnotes, passages requiring special layout.

The second phase comprises proof-reading of a completed transcription and the revision of the text at the monitoring display.

The proof reader marks mistakes, or even missing parts of the text, and determines how special parts of the text are to be rendered in braille. This is necessary, as braille is not so versatile as black print as far as layout is concerned.

At the terminal the following are carried out:

- Correction of the text, insertion of missing parts

- Transformation of marked characters into a transcriptable form
- Adaptation of footnotes
- Marking of parts of text that are to be printed in braille shorthand
- Insertion of simple tables and formulae, if necessary in direct notation; "135" appears as braille characters 1, 3 and 5
- Adaptation of italic and boldface passages. Only the most important passages should be marked in this way, as too many special characters impede the smooth reading of the braille text.

A series of auxiliary routines assist in the preparation of a text at the monitoring display in such a way, that repeatedly occuring and for a particular text specific alterations can be carried out automatically rather than "by hand", i.e. manually, after appropriate adjustment of the routine. These may be started and controlled from the terminal, and the dialogue phase can be considerably reduced in this way.

The length of the manual adaptation phase is to a large extent determined by the quality requirements for the braille text. If certain flaws are tolerated in the structure of the text, and possibly certain mistakes (perhaps individual foreign words in grade 2 instead of grade 1), then more of the steps involved in production may be carried out automatically. Here a compromise between the quality of the braille text and the time needed for its production must obviously be made.

Following the phase at the computer terminal, the text is translated into braille grade 2 using the Munster translation programme (Prof. H. Werner), and the layout is determined. For output, paper tapes for controlling stereo-typers, magnetic tape (e.g. for archiving), and IBM 1403 high-speed printers with braille embossing option are available.

3. Some Problems

Although the dialogue phase at the monitoring display - and therefore manual intervention - have a firm place in this procedure, not all the problems of transcription into braille are solved thereby.

(a) Footnotes must appear either in the text or at the end of the chapter, since they cannot be placed automatically at the foot of each appropriate page in the text.

(b) Page references in the text can only be transformed into the corresponding reference in the braille text once the translation has been made. A way round this problem is to substitute chapter references, which in any case remain unaltered.

(c) The list of contents cannot be produced until formatting has been completed and the braille page numbers have been determined.

(d) Tables, formulae, etc. are also problematic. It is very time-consuming to prepare them in the black print text at the monitoring display so that they can be automatically translated into perfect braille by the translation programme. It would certainly be simpler to transcribe them, together with the list of contents, directly on paper tape, at the text editing machine for braille and insert them into the text which has been translated by computer. Experiments on these lines are planned.

4. The Time Needed for Preparation

Within the framework of the project, we have transcribed six works of approximately 200 pages - some 0.5 million characters each, including control signs, - (all references to black print text) into braille. On average the following length of time was taken:

Proof reading	1.5 days
Dialogue at the monitoring display	1.5 days

In addition, time for input of paper tape, carrying out of phase 1, translation, printing, etc. must be taken into account. For these tasks, we are assisted by the personnel of the computer centre.

Comparing the amount of time needed for computer input using compositor's tape with that needed for typing, proof-reading and editing the whole text on a terminal the above mentioned 3 days must be related to approximately 5.5 day as figured in J.M. Gill, "The use of Digitally Stored Text of Braille Production" (Braille Automation Newsletter, August 1976), where we found in estimations of 44 hours needed for 100,000 words, which corresponds to approximately 0.5 million characters in 5.5 days. This is also confirmed by reports from our own typists. With the second method one additional day is required for preparation of text e.g., insertion of control signs.

Complicated texts require longer for their preparation whatever method of input is used. This comparison shows that the use of compositors' tapes as raw material for braille books makes a worthwhile contribution to their preparation for printing, even taking into account the fact that a more highly qualified personnel is necessary than in cases where only typing is required.

5. Choice of Books

A great deal of thought should go into the selection of books. While titles should of course be chosen which appeal to the blind reader, the paper tapes at the printer's are mostly thrown away, so that it is only possible to obtain them during the actual printing of the book.

Therefore, paper tapes must be collected "on speculation" so that they are available if required. This leads to the problem of archiving. The problem of (unintentional) censoring should also not be underestimated, since there is certainly only a very small proportion of literature available that is suitable for publication for the blind - and particularly "off beat" books are out of the question. In this instance, readers and braille publishers must work in close co-operation in order to produce a fair and reasonable supply of braille literature.

6. Conclusion

It is planned to transcribe more books into braille in a 1 year major experiment. Attention will be given to the choice of books, the time required for production of a book, and the reactions of blind readers to those produced.

References

1. J.L. Douce: Rationalisation of Braille Book Printing. Braille Automation Newsletter, August 1976.

2. C. Brösamle, U. Lehmann: Braille Books from Compositors' Tapes (Braille-Bücher aus Druckerei-Datenträgern). Heidelberg, 1976, Stiftung Rehabilitation.

3. G.M. Grunwald: Prospects for Utilisation of Compositors' Tape in the Production of Braille. Argonne National Library, 1970.

A Note on Hybrid Braille Production

P.W.F. Coleman

Abstract

This note reviews the possible types of braille production techniques, and then postulates a means for optimising the current technology at any point in time.

Introduction

By a Hybrid Braille Production System I mean a (hopefully optimal) combination of purely manual, mechanical or electronic devices and techniques in a braille production system. By Braille Production System I mean any method of producing braille documents, particularly in quantity.

There is a spectrum of such systems: one end is represented by the braille writing frame (slate), backed up by hand editing, correction, printing (in manual presses), collation, binding and distribution; the other by a system where print documents are electronically scanned, translated to braille by digital computer, corrected using a computer editor, and either sent over telephone lines to the blind user or retrieved by him from a data base, in either case being read using an electromechanical or electronic braille display.

A subdivision of electronic devices is programmable devices - digital computers of all sizes and types. And therefore one component of this technology is the program, including editors and formatters, and in particular the braille translation program.

The first braille Bible was at the bottom end of the spectrum: each dot was separately punched into brass plates using a hand metal punch; corrections were made by similarly adding dots or by flattening them with a hammer; plates were used in a manually-operated press; collation and binding were manual, and distribution as near so as makes no difference. The National Library for the Blind in Britain even eliminated the manual press, and during a recent postal strike used hand-to-hand delivery of books - but by then they used mechanical braillers and binders.

The Thesis

Much of the above may have had a very familiar ring to many readers: dots are still hammered out or put in by hand; there is still manual intervention in the processes of collation and binding, to say nothing of despatch. Electronic scanning (Optical Character Recognition - OCR) is a thing of the future to most of us, while sending braille down telephone lines, accessing data bases and electronic braille displays are mere pipe dreams which the reactionary blind would not tolerate even if we could supply them.

So we are stuck with our hotchpotch of manual, mechanical and electronic devices and techniques and "any combination of the three" as they say on "Twenty Questions". What a hopeless, irretrievable mess to be sure!

Or is it? A more positive view sees braille publishers as participating in an evolving technology, which began with the manual and will end with the electronic - when the publisher may become the custodian of a data base on a compact computer facility, whence he can send his customers digital cassettes of information, or which the customer can access directly from home or office.

Meanwhile, at any stage of the way to this goal, the publisher must make the optimum use of what is available, and not be content with waiting for tomorrow: however it is my contention that making the most of today is exactly what he is not doing, and that high among the reasons for this is lack of positive encouragement from the braille technologists themselves - even a positive discouragement. We tell them: "Tomorrow we'll have your mathematics or music translation program for you", when they are living in today, not tomorrow.

They need very real encouragement to take any step at all, for they are reactionary by nature - bound by limited incomes needing protection coupled with a lack of technological awareness (not even print publishers are the most technically aware!).

Examples

Software

Thus, for example, we have at present translation programs for literary text but not for mathematics or music. So why not, in preparing mathematics texts, input the literary text on its own for computer translation; where mathematical text occurs, this could be omitted, and a command substituted which would cause the computer to draw attention to (or flag) this point in its printout of the resulting file, giving the editor a reference number by which it knows this point; (the file, in this case, would be the braille file resulting from the translation process).

A skilled mathematics braillist could then enter the mathematics text by hand through a braille terminal, making use of each reference number to enable the computer to insert each portion of text into the correct position in the braille file.

The computer could then print down the completed document in braille for proofreading and subsequent on-line correction by that same braillist.

The point of such a system is that it makes the best use of both equipment and personnel. At present we have the wasteful position of a braille transcriber with a very special skill producing humdrum literary text which just happens to include material demanding his special knowledge.

In the system under review, non-mathematical braillists would enter the literary component of the text into the computer; skilled braillists would then spend their time proofing and correcting prepared braille (literary) texts, while the precious resource of the mathematical braillist would spend all his time either brailling mathematics or proofing and correcting it. Analogous arguments apply to music, computing and science generally.

Additionally, this would obviate the need to wait for the appropriate braille translation program before at least partially automating production, with the resulting increase in the volume of technical braille material available, and the optimal use of human and machine resources.

Hardware

At the hardware level, optimisation includes moving from card punching to direct data entry, with its additional built-in data vetting/verification and correction. It also means taking advantage immediately of any new input media and formats. It matters nothing that few publishers in your country use compositors' tapes: if just one does today, others will tomorrow, for the technologist can predict that trend. Get tooled up to take advantage of that publisher's output today, and you'll be ready for the others tomorrow. The input device (tape drive) is already available, and researchers already have the necessary preprocessing programs for reading these tapes and converting their codes and commands. What are we waiting for?

Optical Scanning

Optical character recognition is another possible technique that could be applied here and now. Kurtzweil has shown the feasibility of a device to read typescript, and a similar system for standard book fonts inputting directly to a computer would obviate the need for compositors' tape in most cases.

Where the device came across unreadable script, it could either project it on to a screen for immediate manual input (probably too wasteful), or flag it in a printout for later handling - maybe direct braille input as with mathematics as described previously. Such material might include foreign scripts (including Greek and Italic), tables and diagrams, as well as mathematics or music.

Another use of such a system would be in proofreading: the blind proofreader could have another version of the scanner similar to Kurtzweil's, which would read aloud the material while he checked the braille; like the present device, it would be switchable to spelled speech where this was required. Foreign text would, of course, still require sighted intervention, but this could well be minimal in most books.

To those who object that such a scanner would have an unacceptably high error rate, I would suggest that, apart from half a loaf being better than none, any such errors arising during original input would show themselves in proofreading as a discrepancy between the machine's spoken output and what was in the braille being proofread - I suspect it would be unlikely for the machine to make the same error at the same point during different runs, not least as two different machines would be used.

In the event of such a discrepancy, the proofreader could be provided with a check button, which would cause (say) ten retries, from which the machine could output a majority verdict - normal computing practice.

(To further cries, I would make the point, as a braille user, that the braille publishers are not the perfectionists that they would have us and others believe; the standard of braille currently produced by one well-known "firm" leaves a lot to be desired.)

Conclusion

But in the long term this whole process of hybridisation should lead to the optimal solution, the completely electronic system. This is no mere fantasy, for already the world of print is moving inexorably towards electronic facsimile transmission and reproduction at a rate undreamed of ten years ago.

Blind people will then have potential access to huge volumes of information if they can only read it. Perhaps braille publishers should be looking to a change in role when they will become purveyors of braille character, graphic and facsimile displays. This change in role might include initiating and financing research and development of such devices, so that their customers are not caught at a disadvantage to their sighted friends.

Such devices might contain their own braille translation programs using, for example, microprocessors, enabling them to make material from normal print data bases. This innate intelligence might also be used to provide the owner with his personal information storage and retrieval system (see my paper in the next issue).

If we must believe the plea of braille publishers that they are short of funds, they must take hybrid systems seriously. We in Britain are finding it more and more difficult to recruit transcribers for even straight literary braille, and their working life is generally all too short, as new pastures and higher pay beckon. The absence of specialist braillists is a continual headache: for many months now has the RNIB been advertising for music transcribers!

In the face of this, we must make the best use we can of them, and this implies the maximum use of all the available technology, i.e. a commitment to hybrid production systems.

The Expansion of Braille Production in Sweden

B. Hampshire and S. Becker

During the past year or so a research and development program has been in progress to expand and to improve the braille production facilities at the Synskadades Riksforbund (Swedish Federation of the Visually Handicapped).

After an initial study of the size and needs of the braille-using population, a new system has been proposed to supplement the existing traditional braille production methods. The rationale behind the new system has not just been to increase the amount of braille that can be produced by the SRF, but also to maintain a high quality of braille embossing, to improve the working environment of the manual transcribers, and to avoid any redundancies within the braille printing house, in which visually handicapped people are employed at each stage of the production.

The new system will eventually utilise two methods for encoding braille. One will use skilled braille transcribers and the other a braille translation program. This latter input route is still being evaluated.

The Manual Input System

This represented in Figure 1.

It consists of five main units - three manual encoding units, an ink print matrix printer (a braille line printer, mainly intended as part of the output system, will also be available to produce proofreading material in braille), and an editing/correcting visual display unit.

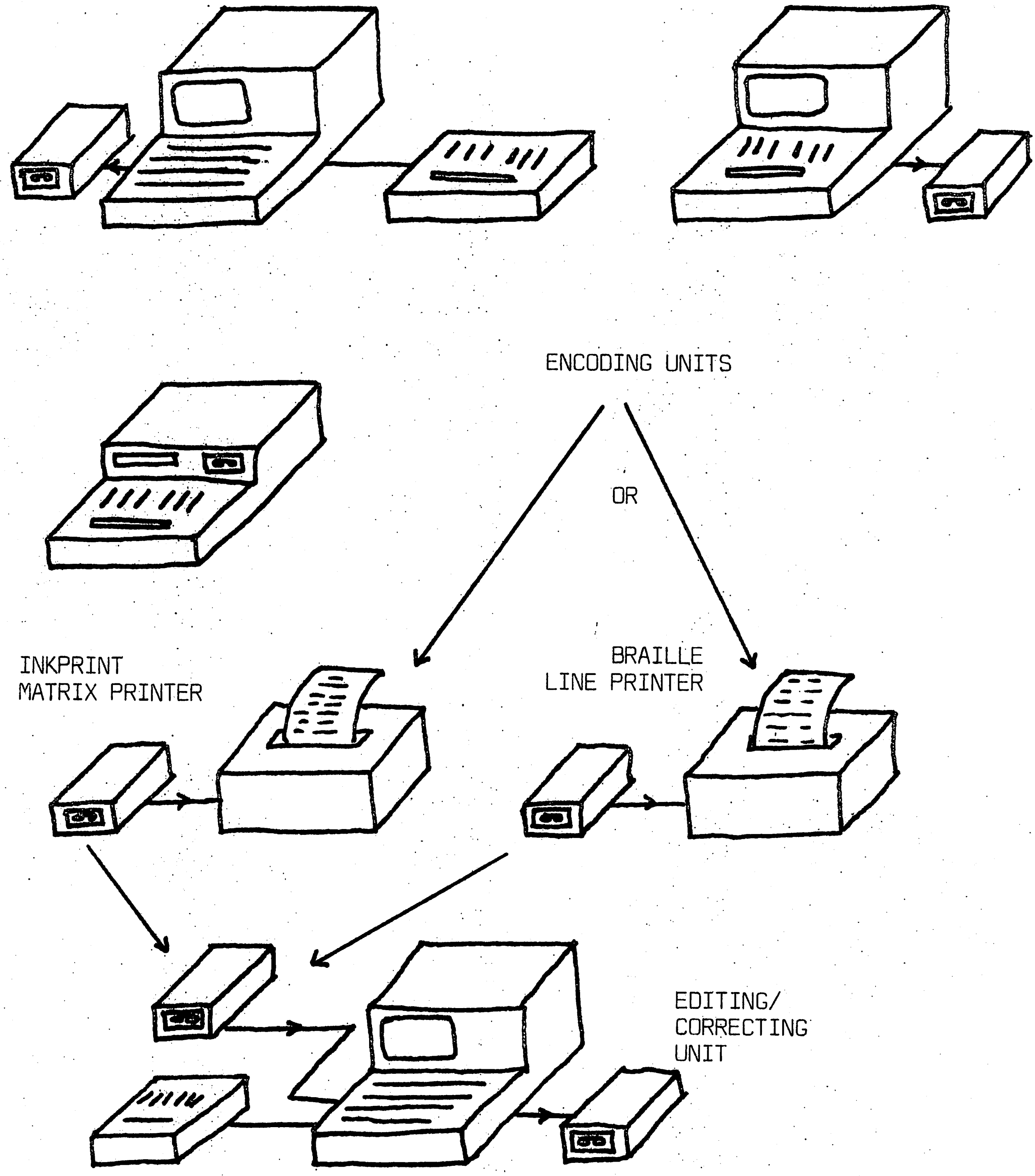

FIGURE 1: Diagram of Input System.

Manual Encoding Units for Straightforward Prose Text

For this kind of material one unit, based on a standard encoding unit, with a character display showing the last 32 characters written, will be used. Other features include keys for the deletion of last written character, word, and line; a display that will show the number of characters written on the current line, number of lines written on the current page, and the current page number. Also, it will be possible to check the last 128 characters written without deleting them. An electronic chord keyboard, based on the Perkins layout, will be used by the transcribers.

Complex and/or Specialised Text

For this kind of text, especially where complex formatting is required, encoding units with a display capable of showing up to 25 lines will be used. Furthermore, as a result of using such a visual display unit, the last 8,000 characters will be available for checking, and there will also be greater facilities for setting out and correcting text. Both these encoding units based on a visual display unit will have the chord keyboard. However, one will have a keyboard based on the standard QWERTY layout, but with extra keys so that all the braille characters can be written.

Although all three of these units have some correcting facilities, use of these will be kept to a minimum. The correction will be carried out as a separate production stage after proofreading.

Proofreading Material

From the above encoding units a data cassette coded in braille will be produced. From this cassette it will be possible to produce proofreading material either in ink print or braille. For the ink print copy there will be a matrix printer which will produce a unique ink print character corresponding to each braille character. These same characters will be used for the displays on the encoding units. In this way an ink print format which will be precisely the same as the eventual braille format will be produced.

A braille line printer (sequential printer) will be available for producing proofreading material in braille. This will be the same printer as used at the output stage.

Editing/Correcting Unit

This unit will be based on the Hewlett Packard HP 2640 visual display unit. It will consist of, in addition to the VDU, two keyboards (one chord type, the other based on the standard layout), and two data cassette recorders - one for reading the original uncorrected cassette and the other for writing the final corrected text. The editing unit contains a micro-processor which allows "letter strings" of up to 16 characters to be searched at 500 chs/sec. and full text editing facilities. The internal memory can hold 8,000 characters (8 - 10 pages of braille).

The availability of a chord keyboard with this unit allows it to be used as an extra encoding unit for complicated text, and the QWERTY-based keyboard allows persons not familiar with the braille code to edit uncontracted braille text.

After correction the cassette can then be used in one of the output units.

All the above units will be supplied by a Stockholm based firm - Tele-ekonomi AB - who will also carry out all the necessary interfacing work.

Computerised Input System

Developments within the printing industry have been utilising computers to an increasing extent during the text preparation stage. Photo typesetting equipment controlled by mini-computers which are fed with text encoded on cassettes or other types of magnetic tape are becoming the dominant production equipment.

SRF intends to develop a computerised input system which will be able to take advantage of these texts already available on computer readable media. Such utilisation of already written texts makes this input route potentially very price competitive with the manual methods. This is less true, however, if the text must be keypunched specially for braille production.

Further investigation into these aspects of a computerised input system is ongoing. It is hoped that an initial program should be ready for testing at the end of the year. At first, developments will be carried out using a large-scale computer system at a commercial service bureau.

Output Units

Two output units will be available. One will be the standard automated Marburg stereotype machine. Although this is rather slow, its quality is proven and the existing press facilities will be continued to be utilised. This will be used for material required in multiple copies (c.a. 25 or more).

Post-Embossing Operations

Naturally, any increase in production of braille also implies an increase in gathering and stitching capacity. For this part of the system two new methods will be introduced. The first is an automated gathering, folding, and stitching machine similar to the ones currently in use at the Scottish Braille Press, Edinburgh and the

American Printing House, Louisville. Such equipment will especially improve and expand the production of braille magazines.

The other new method to be introduced is that of "spiral binding" - a method involving the insertion of a wire spiral in the back of the sheets to be bound. This method of binding is in widespread use for ordinary print books as well as in a number of braille printing houses. This binding technique is simple to carry out, relatively cheap, and allows the book to be opened out flat or even turned back-to-back without damage to the binding - a useful feature for braille books.

On-going Work

At the present time (June) detailed specifications of the equipment are being prepared. This should be completed so that ordering can take place during the Summer. Such a schedule implies that the manual input system and stereotype should be under text during the Autumn. The sequential braille printer and the automated gathering machine, however, are not likely to be in use before early 1978.

As well as the development of the centralised braille production facilities (a detailed report on this work is in preparation), some investigations into small-scale braille production and the production of raised graphic material are also in progress.

Plate Embossing Device

P.D. Gibbons and E.L. Ost

Triformation Systems Inc., is presently developing a device for embossing metal plates. Called the PED-30, the embossed metal plates are used as masters for producing thousands of copies of the brailled material.

The heart of the PED-30, the embossing mechanism, utilizes a reciprocating die and interposer blocked embossing pins to accomplish the embossing function. The power train consists of an electric motor and fly-wheel assembly connected to an electronically controlled clutch and speed reducer, turning two counter-rotating crankshafts which drive the die through pairs of connecting rods.

The metal plate transport mechanism is driven by a permanent magnet stepping motor taking multiple steps for each row of dots. Prior to insertion into the PED-30, the plate to be embossed will be clamped at one edge with an alignment bracket. This assembly is then clamped to a transport saddle riding on two horizontally positioned parallel steel rods which extend outward from the entrance of the die area. When the operator depresses the load command button, the stepping motor will advance the entire plate into the machine and through the die. While this is occuring, the die is stationary due to de-activation of the drive train clutch. When the plate has been advanced a pre-determineddistance into the machine, a plate position indicator signals the control electronics to halt the plate.

Simultaneously, the power train clutch is activated and a request for data is made on the input data interface. The data source, such as an encoded tape cassette or computer, can transfer the entire page of information to be embossed into the PED-30 at a high transfer rate which, in the case of the computer, releases the data source for other transactions.

When enough data is accumulated for one line of information, the control electronics will begin looking for a timing signal from the mechanism in order to achieve synchronization of the two. When the signal is received, indicating the interposers may now be selected, the control electronics will energize the data solenoids in a pattern consistent with the configuration to be embossed. As the motion of the die continues, the zinc plate is pressed down onto the stripper plate. The stripper plate in turn is displaced downward. As the stripper plate is pressed down, the embossing pins which have had their interposers energized, will be forced to remain in position. Those which have not are free to travel downward with the stripper plate. The die continues to press the zinc plate displacing the metal and forming the dot.

As the die completes its downward travel and begins to move up, the stripper plate and zinc plate go up with it. Any embossing pins which may be inclined to stick in the plate are stripped out as they reach their upper limit of travel as the stripper plate will continue up pushing the zinc plate off the pins.

At this point another timing signal from the mechanism indicates to the control electronics that the zinc plate is free to be advanced into position for embossing the next row of dots. The stepper motor is then energized to perform that task. This cycle will continue until the page of data in memory is exhausted. At which point the control electronics will de-energise the power train clutch and advance the embossed plate out of the machine.

Designed with a standard RS232 communication interface, the control electronics utilises a read only memory to translate the input data into the desired braille configuration. This 'dot' data is then stored in a random access memory, as several passes must be made to extract the dot information in the sequence required by the mechanism, i.e. the top two dots (1 & 4) of all the cells in any given line are embossed at the same time. Then the middle two dots (2 & 5) and finally the bottom two dots

(3 & 6).

When embossing is complete on one side of the plate, it may then be inverted and embossed on the reverse side to produce up to 2560 interpoint braille characters per plate. Each line can have up to 40 characters with a maximum of 32 lines per side.

The PED-30 will have the capacity to operate at a speed of 30 characters per second and can emboss a page of information in 40 seconds. The average time to emboss an entire plate will be approximately two minutes, or about thirty plates per hour.

Braille Systems

J.E. Sullivan

Duxbury Systems offers a family of translation systems for converting text to Standard (contracted) English Braille, contracted Spanish Braille, or uncontracted braille in six languages. These translators can be used for widely varying brailling applications such as:

(i) Books and periodicals
(ii) Business memoranda
(iii) Word processing
(iv) Wire service news reporting
(v) Legal briefs
(vi) School notes and circulars
(vii) Online information retrieval
(viii) Computer aided instruction
(ix) Bank and credit account statements
(x) Sales brochures

Any size readership from single-copy to press-braille volume can be served. In essence, these translators permit typing skills or even automated input to serve where otherwise the relatively rare ability to transcribe braille would be required. Thus the capacity of high-volume producers can be increased without placing further demands on the time of skilled braillists, and, even in organisations lacking sighted persons who know braille, high-quality braille can be made as available to the blind student or worker as print is to his sighted colleagues.

Text to be translated may be generated manually or automatically. In most cases, the same procedure or device that is used to produce print - for example, typing on a standard keyboard, computer output, or composition machine tapes - can be tied directly to the translator. System options include the ability to edit the text and to control formatting and other aspects of the translation.

The complement of equipment at a user's site might include a standard keyboard-and-display terminal for text entry and system control, disk unit for inkprint and braille text storage, embossing terminal for producing the braille, and, for the translation function, either a microcomputer or access to a remote computer via telephone coupling (available on a local-call basis in more than 40 cities across North America). It is possible, by arranging for embossing at another user's site, to start with as little as a teletype or equivalent, acquiring additional local capability as volume builds. In all upgrades, including that of replacing the remote computer access by a local microcomputer, existing equipment is generally augmented, not replaced.

These translators represent a mature technology, the fruition of over seven years' experience in practical braille automation. Several large braille producers have already selected these systems for production use. For more information on how these systems can meet your needs, call or write: Joseph E. Sullivan, President, at Duxbury Systems, Inc., 123 Lowell Drive, Stow, Massachusetts 01775, USA.

Cost Estimation Guide

Prices given below are for general planning purposes only and are therefore approximate; exact prices will depend upon the total configuration, options selected, time and locale of remote service, and in some cases the brand name of components used (for example, either Data General or Digital Equipment processors can be used in the translator). Also, these estimates do not include user-related costs such as personnel, overhead, telephone, and supplies. Quotations will be furnished on request.

1.	Data entry terminal - CRT[1], upper and lower case:	$1300

2.	Printing terminal - u/l case, 30 & 60 chars./sec.:	$2700
3.	Floppy disk storage unit, single drive with editing and filing system, removable diskettes:	$3300
4.	Floppy diskettes, 300,000 chars. capacity, each:	$9
5.	Embossing terminal - 10 cells/sec.(2):	$6500
6.	Telephone data coupler:	$400
7.	Translation service, per original braille page(3):	$0.33
8.	Minicomputer-based translation unit, 360,000 chars. per hour capacity	$32,000
9.	Microcomputer-based translation unit, 200,000 chars. per hour capacity(4):	$24,400

Two examples:

System Components	Equipment Costs	Per-Page Costs
Items 1, 3, 5, 6	$11,500	$0.33
Items 1, 3, 5, 6, 9	$35,900	$0

Notes:

(1) cathode ray tube, i.e. video screen display

(2) Higher-speed embossers and automatic stereographs for press braille plates may also be ordered. Brailling devices costing as little as $2000 are also available.

(3) at 1000 characters per page

(4) estimated

The Duxbury Braille Translator is a program capable of very general text-to-text translation under the control of tables specifying the particulars of the translation to be performed. The program is especially suited to inkprint-to-braille text translation, and tables are available for the contraction (grade II) rules appropriate to the official Braille code for several languages. It improves upon previous programs employing similar principles in many respects, notably: input text differs little or not at all from its usual ink print form; the table logic is more expressive, permitting even better fidelity to the braille rules; a much wider range of special formatting controls is provided. Such controls include: automatic braille page numbering; formatted ink print page number; automatic paragraphing, line breaks and tabulation; running centred titles and centred headings; columnar arrangements centred, left-aligned, right-aligned, decimal-point aligned, or mixed; poetry format; hanging indentation; adjustable margins and page length; and many variants of these.

The Translator is FORTRAN-coded and operates on any Data General NOVA or ECLIPSE or Digital Equipment 11-series computer with FORTRAN support and at least 25k words of memory (plus operating system). Conversion to other equipment is specially quoted. Typical translation speeds (English tables, approximate words per minute): NOVA 800, 1000 wpm; ECLIPSE C300, 1500 wpm; DEC 11/34, 1400 wpm; DEC 11/70, 3100 wpm.

The English (American) tables, in conjunction with the Translator, provide a translation with a very high degree of conformity to Standard English (American) rules. Because some of these rules are ambiguous or require judgments that cannot be made by a practical automatic process, perfect conformity may require annotation of input (or editing of output before actual embossing.) Full controls to force or prevent contractions are provided. However, in practice the need for such controls has been found to be minimal. The English tables have provision for grade I as well as grade II English, and grade I for Latin, Italian, French, German and Spanish text in English context.

The Spanish tables implement Spanish Braille in grades I or II (contracted).

Similar tables for French Braille, when complete, will implement French Braille in grades I or II.

The Table Preparation Program reduces tables in a human-oriented (source) form to a machine-oriented (object) form, the latter being the form directly accessed by the Translator. With this program and the table source (separately licensed), it is possible to modify the tables for special needs - e.g. to enter the correct translation of unusual proper names, or to rename formatting controls for compatibility with other systems. The program runs in the same environment as the Translator.

The Duxbury Text Editor is a line-oriented editor suitable for preparing and editing text to be translated. It runs in the same environment as the Translator, but on Data General Equipment only. Its chief advantage over the editor provided with the DGC system is that it permits multiple simultaneous editing stations to be set up; it is also much simpler for the novice to learn and use.

Braille Translation by Telephone

Duxbury Systems will make available to the customer an account suitable for general time-sharing service on a Digital Equipment 11/70 (under the RSTS/E Operating System). This account will have access to the Duxbury Braille Translator for purposes of translating ASCII-coded English or Spanish into a contracted braille equivalent code (capable of driving a suitably configured Triformations, Inc. LED series embosser or equivalent; other codes by special quotation).

Service is normally at 300 baud, implying a capacity of approximately 54 1000-cell braille pages per connect-hour. Service may be accessed by direct call to Belmont, Massachusetts or by local call in numerous cities via TELENET.

An initiation of service, manuals describing use of the translator system and related system facilities will be provided.

Storage on the host computer system is available, though storage is not normally necessary for braille translation if a local storage means is available.

DOTSYS and "DUXSYS"

In August, 1970, the world's first truly "portable" braille translation system was installed at the Learning Resources Center of the Atlanta Public Schools in Atlanta, Georgia. The software component of this installation, i.e. the translator program itself, was the fruition of many months of effort by a four-man team at the MITRE Corporation of Bedford, Massachusetts, under sub-contract to the Massachusetts Institute of Technology. This translator, called DOTSYS III, was programmed in the commonly available COBOL language and thereby had a property not found in any of the few high-quality translators that preceded it: namely, it could with relative ease be made to run on any of a large variety of computing systems, not just the one for which it was originally designed.

This quality of portability, plus its reputation for high fidelity to the English Braille (grade II) rules, led many other organisations to adopt its use. Eventually, several of these considerably advanced DOTSYS III's capabilities, and in some cases reprogrammed it in a language more efficiently implemented on their particular computing equipment.

In the latter part of 1975, two of the original MITRE team began technical planning towards a substantial revision and improvement of DOTSYS III, to take advantage of five years' experience with this type of translator and also five years' of advancement in the state of available computer hardware. The new program was to run on a mini-computer costing far less than the previous minimum DOTSYS configuration, and was to be programmed in FORTRAN IV, a language of about the same overall availability as COBOL and considerably more popular on minicomputers.

These developments led to the founding of Duxbury Systems, Inc. in April 1976 and the first installation of the Duxbury Braille Translator in July, 1976. Because DOTSYS III is in the public domain (available from the Harvard-MIT Rehabilitation Engineering Center), the question naturally arises whether the additional cost of the Duxbury Braille Translator, which is a proprietary product, is commensurate with its advantages. We feel that it is, for the following reasons:

(i) Support for the system's programs and tables is provided by a commercial enterprise committed to its continuing maintenance and enhancement both legally and as a practical business matter. DOTSYS III does not enjoy such a base of support. Though users of DOTSYS III naturally are willing to be helpful to each other, as a practical matter their respective systems have evolved in such different directions that the problems and fixes of one system are rarely relevant to those of another system.

(ii) By comparison with DOTSYS III, the design of the Duxbury Braille Translator is much more reliable and extendable, both because the designer was deeply involved in the DOTSYS III design, implementation and evolution and therefore, learned from its mistakes as well as its successes, and because current design technology - structured design and programming, data-flow modularisation - was applied from the beginning. In this regard, it must be borne in mind that DOTSYS III was a prototype (DOTSYS II) that was incrementally modified to incorporate practically all of its present formatting features and much of its translation ability beyond the basic finite-state algorithm. About 80-90% of the present DOTSYS III program is an addition or modification to DOTSYS II; hence it is not surprising that DOTSYS III is considered by many who have worked with it to be difficult to maintain or extend.

(iii) The Duxbury Braille Translator runs about as fast (1000 wpm) as DOTSYS in less core (about 44K bytes vs. 70K bytes) and on a much less expensive machine (NOVA class vs. IBM 360 class). On the DEC 11/70, the Duxbury Translator runs at over 3000 wpm.

(iv) Generally speaking, the Duxbury Braille Translator will accept tables usable by DOTSYS III, though some format changes are required. Because of certain added capabilities in the Duxbury Translator, however, the converse is not true in general. Thus it will be possible to incorporate the integrated experience of DOTSYS users into the Duxbury tables, but more difficult to go the other way. This consideration would of course apply even more to new table developments such as Spanish Braille (now available) or French Braille (in design).

(v) The Duxbury Translator accepts "natural"-appearing mixed-case input, automatically recognising paragraphs and, where appropriate, line endings and even table columns. DOTSYS III expects upper-case input, with true capitals flagged by a preceding special character. DOTSYS III also relies more heavily on explicit formatting commands. (Some, though not all DOTSYS installations have added preprocessors to overcome some of these deficiencies.)

(vi) Many new features have been added besides those already mentioned, among them:

(a) a second right-context character test for contraction table entries, which extends the power of the translation algorithm;

(b) separate table preprocessing, saving set-up time each run;

(c) ability to insert capitals (USA rules) or not (Canadian and British practice);

(d) variable page width and depth;

(e) page number reset control;

(f) multi-line running titles;

(g) automatic guide-dot insertion where required such as in table of contents;

(h) automatic ink print page number formatting;

(i) hanging indentation;

(j) conditional page eject;

(k) centring (as well as left-, right- and decimal-point-aligned) tabs; and

(l) variable poetry indentation.

Duxbury Systems, Inc. appreciates all inquiries regarding its principal product and would be pleased to discuss or expand any of the above points. Contact: Joseph E. Sullivan, President, at the above address.

Prices

Services

1. Telephone Translation Service

   (a) Basic Costs:

Documentation and service initiation (one-time charge)	$ 50
Monthly minimum charges under (b-d)	$ 5

(b) Connect time (direct call to 617 489 exch.)

8 a.m. - 5 p.m. Eastern time	$ 14.50/hr.
Other times	$ 11.50/hr.

Access via TELENET (local call in numerous cities) - add $3.50 to $7/hr. (depending on city) to above rates

(c) Data storage at computer facility

Each block (=512 chars. or fraction)	$ .90/mo.

2.	General consulting	$ 30/hr. + exp. $1100/wk. + exp.
3.	Courses in DS software product use	$ 350/day + exp.

4. Delivery and installation of leased or purchased DS software products (any combination of products delivered at one time):

(a)	Installation and demonstration at customer site	$1100 + expenses (5 days max.)
(b)	Transmittal on media suitable for customer installation (if feasible)	$ 150 + expenses

Either option includes one year warranty.

5.	Extension of warranty (provided warranty has been continually in force)	$ 120/year

Note: Expenses include all costs to DS directly incurred in filling a customer order, except for DS personnel time and ordinary overhead.

Software Products

Software products are offered as a customer license to use the software on a designated computer only.

A 10% discount is applicable to the second and subsequent copy of any one software produce license ordered by a single customer.

One of the delivery and installation options in the previous section must be ordered with any combination of software products.

1. Duxbury Braille Translator
   Object license — $11925
   Must be ordered with one or more of:
   (3a), (4b) or (5b)

2. Duxbury Braille Table Preparation Program
   Object License — $ 3515
   Prerequisite: (1)
   Must be ordered with one or more of:
   (3b), (4b) or (5b)

3. English (American) Braille Tables

   (a) Object License — $ 3310
   Prerequisite: (1)
   (b) Source License — $ 3310
   Prerequisites: (1), (2) and (3a)

4. Spanish Braille Tables (see DS-D7323)
   (a) Object License — $ 3830
   Prerequisite: (1)
   (b) Source License — $ 3830
   Prerequisites: (1), (2) and (4a)

5. French Braille Tables
   - (a) Object License — $ 4880
     Prerequisite: (1)
   - (b) Source License — $ 4880
     Prerequisites: (1), (2) and (5a)

6. Duxbury Text Editor Program
   - (a) Object License — $ 2200
     Prerequisite: (1)
   - (b) Source License — $ 3000
     Prerequisites: (1), (6a)

Hardware and Complete Systems

DS does not presently manufacture hardware of any kind. Accordingly, the hardware (and manufacturer-supplied software) prices listed herein are not controlled by DS and, though based upon information available to DS at the time of compilation, cannot be guaranteed. DS will assist the customer in custom configuration design, if required, at its regular consulting rates. DS will also assume hardware ordering and multi-vendor integration responsibility at no extra charge for Data General, Digital Equipment, and Triformation, components, and for a fee of 10% of list for other components.

Typically, hardware prices exclude user-related costs such as delivery, installation, supplies, site preparation and maintenance beyond any warranty offered. Maintenance can be estimated at 1% of purchase cost per month.

Estimates of capacity are approximate. A braille page is assumed to be 1000 cells in size for estimating purposes.

Alternative embossing means such as automatic stereographs or alternative text entry means such as compositor's tape may be added to all systems.

1. Data Entry and Embossing Station for use with telephone service

Lear-Siegler ADM-3 CRT terminal, u/l case	$ 1300
Sykes COMM-STOR single diskette system, filing and editing capability	$ 2865
Triformation LED-1 10 cells/sec. embossing terminal	$ 6500
Telephone data coupler (many brands)	$ 350 approx.
Total	$11015

Translation capacity: 54 braille pages/hr.
Embossing capacity: 36 braille pages/hr.
For applications involving fewer than 1200 braille pages per month to be translated, this station in conjunction with telephone translation service offers an economical alternative to computer purchase. Approximately $1900 can be saved from the above price, at the expense of flexibility and ease of text editing, by substituting the following unit for the single diskette system:

Techtran 815 single cassette tape drive	$ 950

2. Data General MicroNOVA-based complete text entry and braille translation system

Lear-Siegler ADM-3 CRT terminal, u/l case	$ 1300
MicroNOVA computer 32K words (64K bytes) memory dual diskette drive disk operating system and editor numerous features	$12465
DS Braille Translator object license	$11925
DS English Tables, object license	$ 3310
Triformation LED-1 10 cells/sec. embossing terminal	$ 6500
Embosser interface	$ 250
Total	$35750

Translation capacity: 200 braille pages/hr.
Embossing capacity: 36 braille pages/hr.
This system offers complete in-house text preparation, translation and embossing capability. Ten

"slots" remain available in the computer for additional devices.

3. Expanded Data General-based systems
The preceding basic system may be augmented in any or all of the following ways, depending on user need:

(a)	Printing terminal in place of CRT Substitutes 60 cps DGC DASHER for ADM-3; permits hard copy of text, computer instructions, etc.	$ 1150 add'l
(b)	High-speed embosser Substitutes LED-120 for LED-1; raises embossing capacity to 423 braille pages/hr.	$ 7000 add'l
(c)	Larger, faster computer Substitutes NOVA 3/12 for MicroNOVA; raises translation rate to 360 braille pgs./hr., thereby leaving more machine time for text entry and editing, and also offering a more expandable and flexible computer for other purposes.	$ 3055 add'l
(d)	With Duxbury Editor object license Permits simpler editing and, with addition of more terminals, multiple editing stations.	$ 2200 add'l

4. Digital Equipment DEC 11/34-based complete system

DEC 11/34 computer and terminals 48K words (96K bytes) memory multiplex channel dual RK05 (2.5M bytes each) disks 4 CRT terminals (expandable) 1 hardcopy terminal (expandable) multi-tasking operating system numerous features	$61100
DS Braille Translator object license	$11925

DS Table Preparation Program object license	$ 3515
DS English Tables, object license	$ 3310
DS English Tables, source license	$ 3310
Triformation LED 120 embosser	$13500
Total	$96660

Translation capacity: 490 braille pgs./hr.
Embossing capacity: 432 braille pgs./hr.
This configuration is suitable for large-scale braille production; it permits text to be entered by up to 5 persons concurrently with translation or embossing operations. Memory, terminals, embossers, or other devices such as magnetic tapes, paper tapes, very large disks, automatic stereographs, optical character readers, etc., can be added.

An Analysis of Braille Contractions

J.M. Gill and J.B. Humphreys
Warwick Research Unit for the Blind

Introduction

Grade 2 English braille uses 190 contractions in order to save space and reduce the time taken in reading and writing. From time to time studies have been proposed which investigate whether the contraction system is optimal for space saving, speed of reading and writing, and for ease of learning by both children and adults. The first step, in any such study, is an analysis of the frequency of the present use of contractions.

A survey was undertaken by Lockhead and Lorimer (1954) which analysed half a million words. This study was extremely time-consuming since the whole text was manually analysed and the occurance of each contraction noted by a group of skilled braille transcribers. However computers offer a fast method of statistically analysing data which is already in digital form.

Kederis, Siems and Haynes (1965) used a computer to analyse 291,000 words for American grade 2 braille. The sample was taken from books (mainly fiction) of which over 60% were for children; numbers accounted for less than 0.1% of the input characters. They found that contracted braille used 26.5% fewer characters than the ink print for their sample text.

Method

A computer program was modified to automatically analyse the frequency of use of braille contractions. The analysis program used 13k words of store and processed text at 7468 words per minute. The data used in this study was documents requested by blind individuals as part of an evaluation of a computer-based braille production system (Gill and Humphreys, 1976). The data consisted of 1,073,339 words which can be considered typical of those used in short documents but not of literature in general.

The computer program has been designed to be capable of analysing the effects of any proposed changes to the rules of contracted braille. This facility will be essential to assist those studying the revision of the braille code.

Results

Table 1 shows the frequency of use of contractions in order of space saved over uncontracted braille. The total number of spaces saved over uncontracted braille is the product of the total number of occurences and the number of cells saved. The cumulative percentage of space saved is the running total of the number of spaces saved divided by the total number of spaces saved expressed as a percentage.

The entry in the table marked SPACE refers to the space omitted between certain contractions (AND THE); this entry is not present in previous studies of the braille contraction system.

The use of a system of contractions saved 1,257,640 braille cells for the test data of 1,073,339 words. The first 13 contractions account for over 50% of the space saving, and the first 36 contractions for over 75%. The last 11 contractions occur, in total, only 38 times in over one million words.

The contractions AND, FOR, OF, THE, WITH account for 23% of the space saving but all the 23 simple upper word-signs together only account for 8.2%.

Table 1 The frequency of contractions in order of space saved over uncontracted braille. An asterisk indicates a single cell contraction.

	Contraction	Total number of occurences	Total number of spaces saved over uncontracted braille	Cumulative percentage of space saved
1	* THE	69028	138056	10.98
2	* AND	31810	63620	16.04
3	* ING	28452	56904	20.56
4	* ER	52968	52968	24.77
5	* IN	50238	50238	28.77
6	* TO	23833	47666	32.56
7	* OF	36767	36767	35.48
8	* EN	36232	36232	38.36
9	* ED	35857	35857	41.21
10	ATION	11760	35280	44.02
11	* ST	33134	33134	46.65
12	* FOR	15556	31112	49.13
13	* AR	29164	29164	51.45
14	* THAT	6644	19932	53.03
15	* WITH	6624	19872	54.61
16	* EA	17628	17628	56.01
17	* CH	17189	17189	57.38
18	TION	8584	17168	58.74
19	* CON	8378	16756	60.08
20	MENT	8081	16162	61.36
21	* OU	13829	13829	62.46
22	* WHICH	3395	13580	63.54
23	* COM	6693	13386	64.61
24	* THIS	4363	13089	65.65
25	(SPACE)	13067	13067	66.68
26	* FROM	4131	12393	67.67
27	* TH	12064	12064	68.63
28	* BLE	5738	11476	69.54
29	* BY	5589	11178	70.43
30	* OW	10361	10361	71.25
31	* SH	9187	9187	71.99

32	*	BE	9078	9078	72.71
33	*	HAVE	2965	8895	73.41
34	*	WILL	2880	8640	74.10
35		SHOULD	1994	7976	74.74
36	*	WAS	3768	7536	75.33
37	*	YOU	3672	7344	75.92
38	*	NOT	3555	7110	76.48
39		PART	3424	6848	77.03
40		THERE	2243	6729	77.56
41		SION	3348	6696	78.10
42		WORK	3331	6662	78.63
43	*	WH	6600	6600	79.15
44	*	DIS	3248	6496	79.67
45		ANCE	3243	6486	80.18
46		BLIND	2086	6258	80.68
47	*	SHALL	1518	6072	81.16
48		THEIR	1901	5703	81.62
49		WOULD	1817	5451	82.05
50		ENCE	2725	5450	82.48
51	*	PEOPLE	1062	5310	82.91
52	*	IT	5274	5274	83.33
53	*	AS	5215	5215	83.74
54		ALLY	2411	4822	84.12
55	*	WERE	1535	4605	84.49
56		UNDER	1516	4548	84.85
57		CHILDREN	752	4512	85.21
58		TIME	2196	4392	85.56
59	*	HIS	2124	4248	85.90
60		THESE	1409	4227	86.23
61		ONE	4080	4080	86.56
62		ITY	4062	4062	86.88
63	*	BUT	2029	4058	87.20
64	*	MORE	1268	3804	87.51
65		INTO	1249	3747	87.80
66	*	GH	3693	3693	88.10
67		YOUR	1832	3664	88.39
68		QUESTION	595	3570	88.67
69		ABOUT	1145	3435	88.95
70		BETWEEN	686	3430	89.22

71		THROUGH	671	3355	89.48
72		OUND	1653	3306	89.75
73	*	CAN	1618	3236	90.00
74		BEFORE	800	3200	90.26
75		SOME	1598	3196	90.51
76		OUNT	1570	3140	90.76
77		SUCH	1502	3004	91.00
78		WHERE	992	2976	91.24
79		FIRST	945	2835	91.46
80		RIGHT	924	2772	91.68
81		EVER	1378	2756	91.90
82		COULD	837	2511	92.10
83		BRAILLE	619	2476	92.30
84		AFTER	824	2472	92.50
85		NECESSARY	412	2472	92.69
86	*	VERY	819	2457	92.89
87	*	CC	2456	2456	93.08
88		DAY	2339	2339	93.27
89	*	OUT	1150	2300	93.45
90	*	FF	2252	2252	93.63
91		BECAUSE	446	2230	93.81
92		NESS	1102	2204	93.98
93		RECEIVE	551	2204	94.16
94		LETTER	512	2048	94.32
95		HAD	2040	2040	94.48
96		CHARACTER	285	1995	94.64
97		ALSO	996	1992	94.80
98		THOSE	610	1830	94.95
99		LITTLE	456	1824	95.09
100	*	EVERY	449	1796	95.24
101		ONG	1716	1716	95.37
102		MUST	835	1670	95.50
103	*	LIKE	556	1668	95.64
104		MANY	801	1602	95.76
105		GOOD	792	1584	95.89
106		AGAINST	369	1476	96.01
107		TOGETHER	279	1395	96.12
108		OUGHT	454	1362	96.23
109	*	STILL	339	1356	96.33
110	*	DO	1301	1301	96.44
111		EITHER	316	1264	96.54

112	* SO	1243	1243	96.64
113	KNOW	614	1228	96.74
114	IMMEDIATE	201	1206	96.83
115	* DO	1187	1187	96.93
116	* KNOWLEDGE	146	1168	97.02
117	FRIEND	270	1080	97.10
118	* RATHER	213	1065	97.19
119	ACCORDING	150	1050	97.27
120	GREAT	522	1044	97.36
121	NAME	521	1042	97.44
122	MUCH	512	1024	97.52
123	WORD	510	1020	97.60
124	ALTHOUGH	203	1015	97.68
125	* JUST	335	1005	97.76
126	FUL	1004	1004	97.84
127	THEMSELVES	166	996	97.92
128	WORLD	328	984	98.00
129	SAID	491	982	98.08
130	ITS	963	963	98.15
131	YOUNG	321	963	98.23
132	AGAIN	314	942	98.30
133	CANNOT	228	912	98.38
134	LESS	441	882	98.45
135	ALWAYS	290	870	98.52
136	HERE	421	842	98.58
137	ALREADY	210	840	98.65
138	* CHILD	203	812	98.71
139	PAID	387	774	98.78
140	UPON	382	764	98.84
141	* GG	760	760	98.90
142	HIM	753	753	98.96
143	MOTHER	188	752	99.02
144	ABOVE	369	738	99.08
145	HIMSELF	180	720	99.13
146	* QUITE	160	640	99.18
147	PERHAPS	152	608	99.23
148	FATHER	149	596	99.28
149	LORD	282	564	99.32
150	* ENOUGH	110	550	99.37
151	BELOW	164	492	99.41

152	ITSELF	121	484	99.45
153	BEHIND	117	468	99.48
154	QUICK	152	456	99.52
155	TODAY	135	405	99.55
156	WHOSE	132	396	99.58
157	ACROSS	129	387	99.61
158	* GO	387	387	99.64
159	* BB	352	352	99.67
160	* US	352	352	99.70
161	ALMOST	117	351	99.73
162	AFTERNOON	55	330	99.75
163	RECEIVING	62	310	99.78
164	SPIRIT	77	308	99.80
165	YOURSELF	61	305	99.83
166	TOMORROW	39	234	99.85
167	BEYOND	57	228	99.86
168	DECLARE	53	212	99.88
169	NEITHER	48	192	99.90
170	O'CLOCK	46	184	99.91
171	AFTERWARD	25	150	99.92
172	MYSELF	50	150	99.94
173	HERSELF	36	144	99.95
174	ALTOGETHER	20	140	99.96
175	BESIDE	25	100	99.97
176	BENEATH	17	85	99.97
177	OURSELVES	14	70	99.98
178	CONCEIVE	11	55	99.98
179	TONIGHT	10	50	99.99
180	DECLARING	7	35	99.99
181	DECEIVE	8	32	99.99
182	REJOICE	7	28	99.99
183	PERCEIVE	6	24	100.00
184	YOURSELVES	3	18	100.00
185	ONESELF	4	16	100.00
186	THYSELF	2	8	100.00
187	PERCEIVING	1	5	100.00
188	CONCEIVING	0	0	100.00
189	DECEIVING	0	0	100.00
190	REJOICING	0	0	100.00

Conclusions

This study did not include speed of reading or ease of learning contracted braille so the data should not be used as the sole basis for modifying the braille system. However from this data it is clear that the present system is not optimum for space saving. This study has clearly demonstrated the viability of using a computer to assist in analysis, and indicates the potential of such a program for assisting in studies of the braille code.

References

Gill J.M. and Humphreys J.B. "A Feasibility Study on a Braille Transcription Service for Short Documents" Braille Automation Newsletter, August 1976, pp 19-24.

Kederis C.J., Siems J.R. and Haynes R.L. "A Frequency Count of the Symbology of English Braille Grade 2, American Usage"
The Education of the Blind, Dec. 1965, pp 38-46.

Lockhead H.M. and Lorimer J. "Report of the Survey of the Frequency of All the Contractions of Standard English Braille Grade Two"
Scottish Braille Press, 1954, 49 pp.

Using Redundancy for the Syntactic Analysis of Natural Language

Application to the Automatic Correction of French Text

J. Courtin

The first part of the paper outlines the structure of the P.I.A.F. System (Programme Interactif d'Analyse du Francais) which is composed of:

(i) A system containing a general finite state transducer

(ii) A system for syntactic analysis

The finite state transducer has numerous applications, in particular morphological analysis. It uses:

(i) A set of grammatical rules

(ii) A set of models, each of which is associated with a set of rules

(iii) A dictionary, each element of which reference one model.

By means of an interactive editor "PIAFEDIT", the user can write, modify, and exploit the components of the transducer.

The system for syntactic analysis is composed of two modules:

(i) A dependency system, based on an algorithm described at the PISA Conference, is used as a "relationned filter" and gives one or several interpretable structures.

(ii) A contex-free system, used as a grammatical filter, permits the validation of the structures obtained via dependency.

These two modules are independent and can be activated in parallel (to accelerate the analysis) or in series, as is the case of the detector of orthographic errors "PIAFDET".

The second part of the paper describes one of many possible applications of the P.I.A.F. system which has been programmed in our laboratory: an automatic corrector of written text "PIAFCOR" based on:

(a) Automatic detection of lexical and syntactic errors (by "PIAFEDIT" and "PIAFDET").

(b) Automatic correction of erroneous graphemes realised by:

(i) the use of the general transducer as a translator "grapheme-phoneme" furnishing all possible graphemes having the same pronunciation as the initial erroneous grapheme.

(ii) These graphemes are controlled by the syntactic analyser using the two modules in parallel.

Finally, an example is given of a session at a terminal, illustrating various possibilities and conversational facilities of the P.I.A.F. system.

TOBIA

On 26th May, 1977, the Centre for Transcription par Ordinateur en Braille Integral et Abrege (TOBIA) was established at the Paul Sabatier University in Toulouse, France. The centre aims to provide braille material for students, blind schools and braille libraries, as well as undertaking research projects concerning braille.

The present team consists of four people:

Mlle. M. Truquet (leader)

J. Frontin (computer-assisted translation of music into braille)

Mlle. D. Levy (computer-assisted translation of mathematics into braille)

Mlle. Vidal (typist)

The Centre is run by a management committee and has a mandate for 5 years.

Congress in Toronto

At the Quinquennial Congress of Information Processors (August 4-8 in Toronto, Canada), members of Visually Impaired Data Processor International are planning to demonstrate how visually impaired and blind people can program computers and perform related tasks such as tending inquiry terminals, and how positions in the Internal Revenue Service and Social Security Administration can be handled.

Recent Publications and Reports

"Braille System will Help Double RNIB Reading Matter".

Computer Weekely, 12 May 1977, p. 3.

The new RNIB computer-based system for braille production will be based on two minicomputers and situated in a new printing works in North London.

"Computer Braille Arrives"

CNIB National News of the Blind, Vol. 37, No. 1, Summer 1976, pp 4 & 7.

Briefly describes the Canadian National Institute for the Blind's new computer-based system for braille production.

Gill J.M. "Psychological Abstracts in Braille: A Preliminary Report".

Warwick Research Unit for the Blind, November 1976, 6 pp.

A small-scale evaluation of a system for automatically producing selective listings of abstracts for blind psychologists. The pilot scheme involves production of over a million braille cells per month.

Grunwald A.P. and Biesemeier P.J. "Testing Argonne's Braille Machine".

Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439, USA, 1977.

A small-scale evaluation by the developers of a braille reading system which involves storing the braille digitally on magnetic tape. To read the tape, the braille is embossed on an endless belt which circulates under the reader's fingertips.

"International Guide to Aids and Appliances for Blind and Visually Impaired Persons".

American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA, 1977, 256 pages, price $3.

This is the second edition of the International Catalog and is more comprehensive than the first edition. More than 1500 devices of 270 distributors in 28 countries are listed; these are only those aids and appliances that are claimed to be in serial production. This should prove to be an invaluable reference book.

Schauder D.E. and Cram M.D. "Libraries for the Blind - An International Study of Policies and Practices".

Peter Peregrinus Ltd., England, 1977, ISBN 0 901223 91 3, 152 pages, price £10.35.

This book, which is based primarily on research done in 1971 and 1972, reviews the history of braille and talking book libraries for the blind in developed countries. It also covers financial and administrative responsibility, selection, production and acquisition of materials, organisation, printed catalogues and personnel. Many sections of the book seem to be from publicity handouts put out by the organisations for the blind, and there does not seem to have been any attempt to verify this information.

Address List

1. Andersson L.
Projekt ab Alea, Henriksbergsvagen 104, S-136 67 Handen, Sweden.

2. Bagley P.R.
Information Engineering, 3401 Market Street, Philadelphia, Pennsylvania 19104, USA.

3. Beatty Prof. K.O.
Chemical Engineering Department, North Carolina State University, Raleigh, North Carolina 27607, USA.

4. Beck Mrs. J.M.
Volunteer Services for the Blind, 919 Walnut Street, Philadelphia, Pennsylvania 19107, USA.

5. Benham T.
Science for the Blind Products, 221 Rock Hill Road, Bala Cynwyd, Pennsylvania 19004, USA.

6. Berkowitz Dr. M.
R.T.D.D., American Foundation for the Blind, 15 West 16th Street, New York, New York 10011 USA.

7. Biesemeier Ms. P.
Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439, USA.

8. Boldt Prof. Dr. W.
Padagogische Hochschule Ruhr, D 46 Dortmund, Londemannstr. 84, West Germany.

9. Bonder H.
P.O. Box 1075, Enschede, The Netherlands.

10. Boyles Dr. M.P.
Atlanta Public Schools, 210 Pryor Street, Atlanta, Georgia 30303, USA.

11. Brown D.
Canadian National Institute for the Blind, Computer Centre, 1929 Bayview Avenue, Toronto, Ontario, Canada.

12. Brown L.
14 Baylor Avenue, Westboro, Massachusetts 01581, USA.

13. Brown V.
Teletype Corporation, Little Rock, Arkansas, USA.

14. Cargill F.R.
Board of Vocational Education and Rehabilitation, St. of Illinois, 623 East Adams Street, Springfield, Illinois 62706, USA.

15. Chabarkapa M.
Savez Slepih Jugoslavije, P.O. Box 807, Beograd, Ustanicka 25-11, Yugoslavia.

16. Charpentier J.M.
L.R.R.P.H., Conservatoire National des Arts et Metiers, 292 rue Saint Martin, 75141 Paris Cedex 03, France.

17. Clark L.L.
R.T.D.D., American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA.

18. Coleman P.W.F.
Computer Unit, University of Warwick, Coventry CV4 7AL, England.

19. Curry Prof. S.M.
Department of Physics, University of Texas at Dallas, P.O. Box 688, MS #Fo2.3, Richardson, Texas 75080, USA.

20. Dalrymple G.F.
Sensory Aids Evaluation and Development Center, Building 31-063, 77 Massachusetts Avenue, M.I.T., Cambridge, Massachusetts 02139, USA.

21. Dorf Ms. M.
Division for the Blind and Physically Handicapped, Library of Congress, 1291 Taylor Street N.W., Washington D.C. 20542, USA.

22. Douce Prof. J.L.
Warwick Research Unit for the Blind, University of Warwick, Coventry CV4 7AL, England.

23. Dowling Dr. J.
Worcester Polytechnic Institute, Worcester Road, Worcester, Massachusetts 01609, USA.

24. Droege M.F.
Clovernook Home and School for the Blind, 7000 Hamilton Avenue, Cincinnati, Ohio 45231, USA.

25. Duran P.
Protestant Guild for the Blind, 456 Belmont Street, Watertown, Massachusetts 02172, USA.

26. Ekberg Prof. S.
Department of Telecommunication Networks and Systems, The Royal Institute of Technology, S-100 44 Stockholm 70, Sweden.

27. Evensen R.
Library of Congress, Division for the Blind and Physically Handicapped, 1291 Taylor Street N.W., Washington D.C. 20542, USA.

28. Evert C.F.
Department of Electrical and Computer Engineering, University of Cincinnati, Ohio 45221, USA.

29. Ferrell Prof. W.R.
Systems and Industrial Engineering Department, University of Arizona, Tuscon, Arizona 85721, USA.

30. Forthoffer D.
589 Gresham Avenue, Sunnyvale, California 94086, USA.

31. Fortier Dr. P.A.
Department of Romance Languages, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.

32. Foulke Dr. E.
Perceptual Alternatives Laboratory, University of Louisville, Louisville, Kentucky 40208, USA.

33. Friedman H.J.
Howe Press of Perkins School for the Blind, 175 North Beacon Street, Watertown, Massachusetts 02172, USA.

34. Gildea R.A.J.
Spectacle Pond Road, Littleton, Massachusetts 01460, USA.

35. Gill Dr. J.M.
Warwick Research Unit for the Blind, University of Warwick, Coventry CV4 7AL, England.

36. Grandjean E.
Mathematiques Appliquees - Informatique, University Scientifique et Medicale de Grenoble, 38041 Grenoble Cedex, France.

37. Grootenhuis Drs. J.
Nederlandsche Blindenbibliotheek, Noordwal 7, Den Haag, The Netherlands.

38. Hallenbeck Dr. C.E.
Psychology Department, University of Kansas, Lawrence, Kansas 66045, USA.

39. Hooper Ms. M.
1255 Pine Avenue, Clearwater, Florida 33516, USA.

40. Horvath Dipl. Ing. Z.
Trask Datasystem Ab, Stocksund, Sweden.

41. Humphreys J.
Warwick Research Unit for the Blind, University of Warwick, Coventry CV4 7AL, England.

42. Hyland T.
Triformation Systems Inc., P.O. Box 2433, Stuart, Florida 33494, USA.

43. Iguchi J.
Tokyo Helen Keller Institute, 4-170 Nishiokubo, Shinjuku-ku, Tokyo, Japan.

44. Ingham Dr. K.R.
American Systems Inc., 123 Water Street, Watertown, Massachusetts 02172, USA.

45. Jensen S.
The Danish Association of the Blind, Randersgade 68, 2100 Copenhagen, Denmark.

46. Kalin E.
Scientific American, 415 Madison Avenue, New York, New York 10017, USA.

47. Kalisky A.
National Physical Laboratory of Israel, Givat Ram, 91999 Jerusalem, Israel.

48. Kaplan Ms. J.
American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA.

49. Keeping D.
University of Manitoba, 118C Engineering Building, Winnipeg, Manitoba R3T 2N2, Canada.

50. Klitzner H.
Statistics Department, Baruch College/Cuny, 46 East 26th Street, New York, New York 10017 USA.

51. Knock E.
Arkansas Enterprises for the Blind, 2811 Fair Park Boulevard, P.O. Box 4055, Asher Avenue Station, Little Rock, Arkansas 72204, USA.

52. Konstantinov K.
Union of the Blind in Bulgaria, 172 Naitcho Tzanov Street, Sofia 1309, Bulgaria.

53. Kramer Mrs.
Lighthouse Library Services, New York Association for the Blind, 111 East 59th Street, New York, New York 10022, USA.

54. Krebs B.
2035 NE 164 Street, N. Miami Beach, Florida 33162, USA.

55. Kueppers Dr. Ing. H.J.
Stiftung Rehabilitation, D-69 Heidelberg, Postfach 101 409, West Germany.

56. Kuipers J.W.
Nederlandsche Blindenbibliotheek, Noordwal 7, The Hague, The Netherlands.

57. Lang Ms. E.
Data Operations Inc., 330 West 34th Street, New York, New York 10017, USA.

58. Lass Ms. M.
5300 Hamilton Avenue, Apt. 804, Cincinnati, Ohio 45224, USA.

59. Laurence G.L.
Royal Blind Society of New South Wales, Mitchell Street, P.O. Box 176, Burwood, New South Wales 2134, Australia.

60. Levine Ms. H.
5300 Hamilton Avenue, Apt. 1404, Cincinnati, Ohio 45224, USA.

61. Levine Mrs. L.M.
National Braille Association, 85 Godwin Avenue, Midland Park, New Jersey 07432, USA.

62. Lewin F.
Control Computing Laboratories, School of Electrical Engineering, University of New South Wales, P.O. Box 1, Kensingoony N.S.W., Australia 2033.

63. Lindstrom Dr. J.I.
Handikappinstitutet, Fack, S-161 25 Bromma 1, Sweden.

64. Looijen M.
Rekencentrum T.H.-Delft, Michiel de Ruyterweg 10-12, Delft, Netherlands.

65. Mann Ms. A.
907 Lake Shore Drive, Apt. 2606, Chicago, Illinois 60611, USA.

66. Mann Prof. R.W.
Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02319, USA.

67. Martin W.H.
4735 E. Hedges Avenue, Fresno, California 93703, USA.

68. Maure D.R.
R.T.D.D., American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA.

69. Maure Ms. S.
Braille Institute of America, 741 N. Vermont Avenue, Los Angeles, California 90029, USA.

70. Meischner Ing. G.
Gureg-Elektronik, D-8013 Munchen - Haar, Zunftstrasse 11, West Germany.

71. Merz J.R.
Automation Industries Inc., Vitro Laboratories Division, 14000 Georgia Avenue, Silver Sprint, Maryland 20910, USA.

72. Metters Dr. J.S.
Department of Health and Social Security, Alexander Fleming House, Elephant and Castle, London SE1 6BY, England.

73. Morris F.
Education Services Center, Computer Services, 2000 West Loop South, Houston, Texas 77027, USA.

74. Mulholland Ms. M.E.
American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA.

75. Mundy G.W.
Clovernook Printing House for the Blind, 7000 Hamilton Avenue, Cincinnati, Ohio 45231, USA.

76. Munoz Prof. E.
Escuela Tecnica Superior de Ingenieros de Telecomunicacion, Laboratotio de Electronica 2, Cuidad Universitaria, Madrid 3, Spain.

77. Murname Prof. J.I.
Department of English and Modern Languages, Ahmadu Bello University, Zaria, N.C. State, Nigeria.

78. Nahas J.J.
Department of Electrical Engineering, University of Notre Dame, Notre Dame, Indiana 46556, USA.

79. Nemeth Prof. A.
University of Detroit, 16240 Fairfield Avenue, Detroit, Michigan 48221, USA.

80. Oster J.
Port City Press Inc., 1323 Greenwood Road, Baltimore, Maryland 21208, USA.

81. Patrick Prof. P.H.
Department of Music, American University, Washington D.C. 20016, USA.

82. Penska J.
02-024 Warszawa, ul. Daleka 8 M 83, Poland.

83. Perry P.
IRS Publications Service Bureau, 1111 Constitution Avenue N.W., Room 1550, Washington D.C. 20224, USA.

84. Pielasch Dr. Dr. H.
Blinden-und-Sehschwachen-Verband der DDR, 102 Berlin, Poststrasse 4/5, German Democractic Republic.

85. Van Der Poel Prof. Dr. Ir.
Delft University of Technology, Department of Mathematics, 132 Julianalaan, Delft, The Netherlands.

86. Potter S.
State Services for the Blind, 1745 University Avenue, St. Paul, Minnesota 55104, USA.

87. Rabby R.
136 East 55 Street, Apt. 8E, New York, New York 10022, USA.

88. Raeder W.M.
National Braille Press, 88 St. Stephen Street, Boston, Massachusetts 02115, USA.

89. Rosenfeld Ms. J.
Hellen Keller National Center for Deaf-Blind Youths and Adults, 111 Middle Neck Road, Sands Point, New York 11050, USA.

90. Rottier Mlle. B.
SAGEM, Department Teletransmissions, 2 rue Ancelle, 92521 Neuilly, France.

91. Rouse R.D.
Hadley School for the Blind, 700 Elm Street, Winnetka, Illinois 60093, USA.

92. Ruch E.
American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA.

93. Sakai Prof. T.
Department of Information Science, Kyoto University, Kyoto, Japan.

94. Santana Dr. J.R.
University of Puerto Rico Faculty, Apartment B-7, Rio Piedras, Puerto Rico 00931.

95. Schenk H.H.
Deutsche Blindenstudienanstalt, D-355 Marburg/Lahn, Am Schlag 8, West Germany.

96. Schick Mrs. B.
Friedensstrasse 43, 7518 Bretten, German Federal Republic

97. Schopper J.
Bayer. Landesschule fur Blinde, D-8000 Munchen 60, Wintrichring 84, West Germany.

98. Simpson Dr. S.
Duxbury Systems Inc., P.O. Box 1523, Duxbury, Massachusetts 02332, USA.

99. Skovmand J.
Department of Development, Statens Institut for Blinde eg Svagsynede, Rymarksvej 1, DK 2900 Hellerup, Denmark.

100. Solente Mlle.
Conservatoire National des Arts et Metiers, 292 rue Saint-Martin, 75141 Paris Cedex 03, France.

101. Sorke W.
D-8941 Buxheim, Stifterstr. 2, West Germany.

102. Spanjersberg A.A.
Dr. Neher Laboratory, St. Paulusstraat 4, Leidschendam, The Netherlands.

103. Spanjersberg H.A.
University of Technology, Department of Electrical Engineering, Laboratory for Data Processing, Mekelweg 4, Delft, The Netherlands.

104. Spungin Ms. S.
American Foundation for the Blind, 15 West 16th Street, New York, New York 10011, USA.

105. Spychalski D.
Polski Zwiazek Niewidomych, Zarzad Glowny, 00-216 Warszawa, ul. Konwiktorska 9, Poland.

106. Srimanee S.
189/25 Lad-Phrao Road, Bangkok 9, Thailand.

107. Sullivan J.E.
123 Lowell Drive, Stow, Massachusetts 01775, USA.

108. Surlan Prof. Dr. A.
Elektrotechnicki Fakultet, Sarajevo, Lukavica, Postanski Pretinac 309, Yugoslavia.

109. Svetislav Zagorac,
Zavod za Slijepu Djecu, 71000 Sarajevo, Yugoslavia.

110. Swail J.C.
Radio and Electrical Engineering Division, National Research Council of Canada, Ottawa, Ontario K1A OR8, Canada.

111. Taylor J.A.
Columbus Technical Institute, 550 East Spring Street, Columbus, Ohio 43215, USA.

112. Tobin Dr. M.J.
R.C.E.V.H., 50 Wellington Road, Edgbaston, Birmingham, England.

113. Truquet Mlle. M.
9 rue Alain Lesage, Residence Semiramis, 31400 Toulouse, France.

114. Tschirner Dr. S.
Deutsche Zentralbucherei fur Blinde in Leipzig, 701 Leipzig, Gustav-Adolf-Strasse 7 (Louis-Braille-Haus), Postfach 245, German Democratic Republic.

115. Ussik V.
All Russia Association of the Blind, Novaja Plostchad 14, Moscow, USSR.

116. Vinding J.
Dansk Blindesamfund, Randersgade 68, 2100 Copenhagen O, Denmark.

117. Vliegenthart M.J.
Dravikstraat 24, Geldorp, The Netherlands.

118. Vrana Ing. K.
Vyvojove Dilny Cs. Akademie Ved, Hosova 4, Praha 1, 110.00 Czechoslovakia.

119. Werner Prof. Dr. H.
44 Munster/Westf., Besselweg 8, West Germany.

120. West Miss S.R.
Department of Health and Social Security, Alexander Fleming House, Elephant and Castle, London SE1 6BY, England.

121. Westland Ir. A.N.
Technological University Delft, Leeghwaterstr. 3, Delft, The Netherlands.

122. Wise T.W.
Triformation Systems Inc., P.O. Box 2433, Stuart, Florida 33494, USA.

123. Zawistowski W.A.
00-901 Warszawa, Computation Centre, P.O. Box 22, Palace of Culture, Poland.

124. Zimin B.
All Russian Association of the Blind, Novaja Plostchad 14, Moscow, USSR.

125. Zivko Jezdimir
Centar za Profesionalnu Rehabilitaciju i Zaposlajavanje Slijepih, 71000 Sarajevo, Nedarici, Lukavicka Cesta 6, Yugoslavia.