PROCEEDINGS

CONFERENCE ON NEW PROCESSES FOR BRAILLE MANUFACTURE

1968

organized and sponsored by the

Center for Sensory Aids
Evaluation and Development
M.I.T.

the late John K. Dupress, Director

hosted by and held at

The American Printing House for the Blind
Louisville, Kentucky
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ACKNOWLEDGEMENTS

The Sensory Aids Evaluation and Development Center wishes to express its appreciation to:

The American Printing House for the Blind for hosting the conference:

The Social Rehabilitation Administration of the Department of Health, Education and Welfare for their support of the conference under Contract SAV 1057-67:

The Hartford Foundation for additional support;

The International Research Information Service of the American Foundation for the Blind for issuing these proceedings:

All the participants in the conference for giving so generously of their time and knowledge.

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PREFACE

John Kenneth Dupress planned and would have chaired the conference described herein had he not died suddenly on December 29, 1967. It would have been his fourth formal effort as director of the Center for Sensory Aids Evaluation and Development to foster a technological approach to braille generation, following as it did the Center-sponsored braille conferences of June 1965, November 1966, and May 1967. These formal meetings, the earlier informal discussions of the ad hoc Committee on Sensory Deprivation, as well as the hardware and computer developments supervised by Mr. Dupress at the Center and his persistent promotional efforts on behalf of communications for the blind stand as memorials to John.

The braille program provides interesting insights into the character of John Dupress. First, he recognized very early the urgency of establishing a creative collaboration between the blind and those administratively and institutionally responsible for their welfare and technologists engaged in communication systems research and development. Not only did he recognize this need but he himself established the rapport. The current sensory aids efforts at M.I.T. are the direct consequence of John Dupress's convincing and persistent cataloging of the needs and of the opportunities.

Secondly, war-blinded and a dedicated professional and avocational devotee of audio, John, though himself not an extensive user of braille, was convinced that more prolific, easy and rapid access would increase the employment of braille and make more effective those who used it.

Thirdly, John appreciated and prosecuted a systems approach. While the stress in these proceedings and their predecessors is on a tactile display, John's vision embraced an information processing system for the blind which would produce via computer processing not only the braille form of output, but audible speech as well, including speeded or time compressed versions. The DOTSYS computer programming system designed to accommodate to these outputs and to accept a wide variety of inputs including the automatic reading of type compositors tapes used for commercial production of inkprint are among the tangible benefices he leaves behind.

These proceedings along with those of the Mobility Conference, the last meeting he chaired, and the Center's annual report are dedicated to John's memory. The continued program of the Center and of all his friends in work for and with the blind will extend and perpetuate his presence.

Robert W. Mann
Chairman, Steering Committee for the
Center for Sensory Aids Evaluation
and Development

COMPUTER TRANSLATION OF GRADE II BRAILLE
American Printing House for the Blind

Robert L. Haynes*

PRODUCTION

Since the installation of a 709 computer system at the American Printing House for the Blind, 261 titles have been translated to braille. These titles consisted of 697 braille volumes or 98,711 braille plates. The majority of titles were literary books. Some magazines and text books have also been translated. Production in the past year included a number of titles that presented special problems. Among these were 10 volumes of Music in a New Found Land, and 10 volumes of Men, Women, and Pianos. While translating these two books intermittent space was reserved for music code. Also, Canterbury Tales was translated into six volumes of poetry format. The results of computer translation in 1967 indicate that in all probability any literary book can be translated effectively by the 709 system.

SYSTEM DEVELOPMENT

In December, 1967 a new braille translation program was put into operation. This program written by John Siems reflects the experience of translating over 200 titles. Also, a braille translation benchmark was developed for the System 360, and a program to simulate the 360 on a 709 was completed.

FUTURE PLANS

During 1968 a data transmission system between the Printing House and Perkins will be tested. This system accepts ink-print data at the Printing House over telephone lines. The inkprint is translated to braille and transmitted back to Perkins, where braille will be printed on an automatic braille writer.

Experimental production from compositor tape is an important item for 1968. This procedure reduces the amount of keypunching involved in braille translation.

A math translation program is being developed by Schack Associates. This program is sponsored by the Office of Education Grant 2-6061190-1578 and should be in operation in the near future.

A study will be made to determine the practicality of using System 360 for braille translation at APH. If there is an indication a 360 might be installed, an assembly language program will be developed during the coming year.

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*American Printing House for the Blind. 1839 Frankfort Avenue, Louisville, Kentucky.

MEMORANDUM ON BRAILLE TRANSLATION

Some types of data encountered when translating inkprint into braille:

1. New words.

   Vietnamese

2. Variant spellings.

   greate (for great) Conectecotte (for Connecticut)

3. Rarely used words.

   bioengineering salmonellosis

4. Letter sequences whose translation depends upon meaning.

   do (verb) do (musical note) said (verb) Said (place)

5. Compound words divided at the end of an inkprint line. Determination of whether or not to use a hyphen is based upon how the word appears elsewhere in the text.

6. Run together words.

   "an Idon'tcareifittakesahundredyears attitude"

7. Foreign words. Foreign words are translated in Grade I. A distinction must be made between foreign words which are names and those which are not. Names are put in Grade 2.

8. Acronyms. Translation depends upon whether or not the initials stand for separate words.

   SHARE SEATO DAR

9. Initials followed by periods. Spacing in braille may vary from inkprint depending upon whether or not the initials stand for a person's name.

   Washington D. C. D. C. Jones

10. Single letters. Sometimes a letter sign must be prefixed in braille.

    Ward C. C. Arnold A (article) big red A

11. Prepositions. Contraction in braille depends upon meaning.

    note "to" in the phrase "be friendly to all your"

    ...how wrong you can be about a person you have taken the trouble to be friendly to all your life, but at least...

    It is difficult to be friendly to all your neighbors.

12. Italics.

    a. Words italicized in inkprint are not always italicized in braille.

    b. Italicizing of a series of words in braille may be indicated in different ways depending upon whether or not the words are a title.

13. Measures. Abbreviations which follow numbers in inkprint precede the numbers in braille.

14. Hyphenated but not compound words. The hyphen is used in braille but may not end a line.

    say-ing   th-th-them

15. Numbers separated by colons. Braille representation of time differs from representation of a reference.

    He came at 6:30. Genesis 3:12

16. Numbers separated by a hyphen. Usually the number sign is not repeated but there are exceptions.

    1956-58   5:10-5:20

17. Dash. A long dash in inkprint becomes a braille single dash if it is punctuation. A short dash in inkprint becomes a braille double dash if it represents an omission.

18. Blank lines. The effect of a blank line upon the format of the braille page depends somewhat upon nature of the preceding and following text material.

19. Chapter titles. Occasionally the number of lines required for a title in braille varies from the estimate based upon inkprint. This in turn may affect the ending of a page to begin the next chapter.

The list above is not intended to be complete. The types of situations mentioned are not hypothetical but are based upon normal work in translation. All things considered, the application of data processing to braille translation has been successful. Correct translation of the types of data mentioned above is achieved by a procedure which includes:

a. Occasional editing of inkprint copy by a braillist.
b. Insertion of some special control symbols by the keypunch operators.
c. Pre-translation reading of the text by the computer to locate a number of types of potential difficulties.
d. Scanning by a braillist of a test prooflisting of the format.
e. Proofreading of the braille text.

Occurrence of particular items given above tends to be infrequent. However, occurrence of one or another of the types of data mentioned tends to be frequent. That is, if there are ten problems each of which can be expected to occur once in every ten books, then one type of problem can be expected to occur in every book.

It would appear that braille translation involves a combination of data processing and human decision making. A goal in data processing is to make the human intervention increasingly easier and more significant.

REPORT OF NEW BRAILLE TRANSLATION PROGRAM AT APH

John R. Siems*

(Work on this project was done under
Office of Education Grant 2-6061190-1578)

A new program to translate inkprint into Grade 2 braille has been written at APH for the IBM 709. Testing of the program as part of the braille production system was begun about two months ago.

This development is part of an effort to unify a number of principles which have appeared to be valid for braille translation by computer. Some of the principles are from the original braille translation program written for the 704 by IBM in cooperation with APH. Others are those which have been incorporated in program changes and additions made at APH along with experience in braille translation work. The 709 program will test the effectiveness of a combination of concepts or logical structure which might become a basis for other programs.

While the program employs principles which have been used before, in many cases a different method is used for effecting these principles on the computer. The program also has been extended in some areas.

Approximately 9,400 words of 709 storage is required by the program for tape to tape operation. An additional 4,200 word area is used for storing input and output data when reading and punching cards. This is a total of 13,600 words. Translation proceeds at the rate of a little more than 12 braille pages per minute or approximately 2,300 words of text per minute.

Where there has been an extension of program capabilities, some of the aims have been to provide for somewhat easier operation, to give more flexibility, to increase accuracy of translation in some instances, and to make available added format control.

Under the new program, specifications for the braille book such as page size and page number are supplied by the dollar sign type of codes. Normally these codes will appear at the beginning of the input text but they may be inserted within the text. For example, if two or three volumes are translated in one run, the volume numbermay be changed by inserting the volume number symbol before each volume.

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*The American Printing House for the Blind, 1839 Frankfort Avenue, Louisville, Kentucky.

Format type such as literary or textbook is determined from a symbol in the input. Previously this was done by inserting cards in the program deck.

As a further aid to operation, the running head for a book is now translated by the program. If desired, it may be changed within a volume. Braille editing occasionally requires that the heading of the first page of a book be different from the heading of successive pages.

The processing of dollar sign codes containing numerical factors has been changed. Instead of matching the entire code with a table entry, only the alphabetical part of the code is matched with the table. The number is treated as a variable. This gives greater flexibility for titles, letter headings, outlines, and indexes where the number of lines or number of spaces indented must be indicated. The desired value, even if unusual, may be used without checking to see that it has been provided for in the program.

Input to translation is treated as a succession of characters or of groups of characters rather than as spaced words. This makes it possible to translate more accurately a long series of words joined by hyphens or dashes. Such series have been encountered in several literary works.

In the new program a larger number of preceding and following characters is available for examination while a unit is being translated. This should be advantageous in some instances.

In the case of numbers preceded by an apostrophe, the number sign can now be inserted properly by the program. Where it was previously necessary in a combination such as, '68, for the keypunch operator to give an indication of the number sign, the operator may now follow copy. Steps have been taken also to prevent division of fractions from associated whole numbers at the end of a line. In braille, two numbers joined by a hyphen may be separated at the end of a line if both are whole numbers but may not be separated if the first is a whole number and the second is the numerator of a fraction.

The magazine feature of leaving a blank area for braille page number, when this is preferable to inserting the actual number, has been extended to literary format. This should help make it possible to use the computer to do work on title pages which has usually been done manually.

Another feature of the new program which is helpful for title pages and elsewhere is the alternate rightmargin. An alternate line length may be specified for lines which are not to be extended as far to the right on the page as full lines. In a table of contents, for example, description lines may be left shorter than the lines which show page location and extend to the normal right margin.

Provision has been made for indicating, by means of input symbols, insertion of colon lines or centered lines of dots in the braille text.

The facility for setting up columned material has been augmented. The number of columns which may be used across the page has been increased. It is also possible, using the new program, to specify either left or right alignment of material in a particular column. In a table containing both alphabetical and numerical information, it may be desirable to have some columns in which the left-hand characters are vertically aligned and other columns in which the right-hand characters show vertical alignment.

Along with the new braille translation program, a new braille output program has also been developed. This program will enable the computer to punch braille cards from a braille tape. It provides, too, for the printed listing of the results of translation in which braille cells are represented either by printed dots or by two-digit octal numbers.

The listing from the output program can be made to show, beneath each braille line, the inkprint equivalents of the braille signs. Where a braille character or series of characters can stand for more than one sign, the program is designed to show in the inkprint line which sign has been used. For example, two L characters in braille may represent successive signs for the letter "l" or they may together consitute the sign for "little". In one case, the inkprint line would have LL; in the other case, it would have the letters LITTLE enclosed by parentheses. As part of braille production procedure, a test translation is often made of a group of problem words apart from context. In this situation it is of value when checking for possible translation errors to have the signs clearly identified. For example, if a braille word having the characters AGE occurred in translation, the accompanying inkprint line from the output program would show whether the word was made up of the signs for "a", "g", and "e" (correct braille usage), or was a combination of the sign for"again" and the sign for "e" (incorrect braille usage).

The work which has been done on the new program has been done recognizing that in putting inkprint into Grade 2 braille, there are decisions which, at the present time, cannot be made by computers. Attaining the desired result requires some human participation. Part of the purpose of the program is to provide resources for increasing the effectiveness of this participation. Also included in the purpose is minimization of the amount of such participation. For this reason, provision has been made in the program for handling some problems which have a low probability of occurrence but which do occur and would, if they were not covered by the program, cause the translation process to require more attention.

A Test of the IBM 360 in Relation to Braille Translation Work

In view of interest in braille translation by third generation computers, it seemed desirable to develop a benchmark program in this area for the IBM 360 series.

A problem was required which would be of the type encountered in braille translation and which would be primarily a test of internal processing capability. The problem selected was that of locating and marking in an inkprint text all of the occurrences of the letter groups which are sometimes contracted in braille. Whether or not the contraction should be used in the specific case was not made part of the problem. Letter groups, even if overlapped, were to be indicated by parentheses.

Text example: READ CONE OTHER RECEIVE

Processed: R (EA) D (C(ON)E) O((TH)(E) R) (RECEIVE)

A program to "Mark Letter Groups for Possible Contracting" was written for the 360 in Assembly Language. Another program to solve the same problem was written for the IBM 709 system, a system now being regularly used in braille production. Test data containing the letter groups of the 189 braille contractions was given as input to both programs with identical results.

When the 360 program was assembled the processing part of the program exclusive of table and input/output routines required approximately 960 bytes of storage. For the 709, the processing part of the program required approximately 340 words. The input/output routines for the 360 required much more storage than input/output for the 709 in the specific systems which were used.

Running time was as follows:

Test material: 17.472 words of text from "Architecture of America"

Time on 709: 5 min. and 2 sec.

Time on 360 Model 30: 5 min. and approximately 25 sec.

Words per minute on 709: 3470

Words per minute on 360/30: 3220

Input and output was on magnetic tape and consisted of 1707 input records and 2240 output records. In the operation less than 6 records were read per second and about 7 records were written per second, so that time for reading and writing should not have been significant.

Experience with this program indicated that the 360 series was effective in solving a problem related to braille translation. The system compared favorably in several respects with the 709 which has been used effectively in braille translation for several years. The 360 required only about two-thirds as much storage for the processing part of the program as the 709 required. The 360 program was also assembled from fewer source statements. The closeness of the speed of the Model 30 to that of the 709 suggests that a 360 series computer of the next larger size, Model 40, could be expected to equal or exceed the speed of the 709 in translating ink-print into Grade 2 braille.

Programs for 360 Simulation on the IBM 709

In 1967 work was done toward simulation of the IBM 360 series by the 709. This project makes it possible to use the IBM 709 system at the American Printing House for the Blind to develop and make preliminary tests of programs for a 360 series computer. The effort parallels the general research aims of exploring machine requirements for braille translation and of exploring new programming approaches.

Two simulation programs have been developed to enable the 709 to process machine instructions used by the 360 and to effect the 360 pattern of storage. Input and output capabilities of the 360 are not directly simulated. The purpose is to test the applicability of the 360 logic and data structure to specified problems.

Under control of a "Simulate 360 Execution" program the 709 will accept most of the 360 Standard Instruction Set except input/output instructions. Features such as addressing individual bytes, use of fixed and variable length operands, complement arithmetic and register operation become available. A special instruction will supply data to storage in 8-bit format from a 709 input unit. Another special instruction will move data from storage to a 709 output unit. The system simulates storage of 96,000 bytes.

A second 709 program, "Simulate 360 Assembler", converts source statements which have been written in 360 Basic Assembler Language to 360 object code. The program is designed to provide hexadecimal instructions, hexadecimal constant equivalents, storage allocation, and base register assignment from free form source language data. Errors in operation codes or syntax are printed out by the program. Following assembly, a listing of the 360 program is provided and an object deck may be punched for use with the "Simulate 360 Execution" program.

A 360 program which was assembled and tested on the 709 using simulation was later successfully assembled and run on a 360 series machine by changing only the input and output statements. If additional use confirms the validity of the simulation programs, they should be helpful for further testing and research.

QUESTIONS:

A. Nemeth: "You mentioned treating numerical code as a variable. Could you explain that a little more?"

J. Siems: "I'm referring to codes which specify a number of spaces or a number of lines. For example, we have a code for doing indexes, $DX followed by the number indicating the number of spaces of indention. Formerly we had in our table DX2, DX4, DX6, and so on and we always found that we were specifying something which we didn't have so now we use just $DX and any number which follows it will be processed."

ONGOING RESEARCH AND DEVELOPMENT AT APH

Virgil Zickel*

It is a real pleasure to welcome each of you to the American Printing House for the Blind and to the 1968 braille technical conference. While similar conferences have been held in the East during the past few years, this is the first one to be held at APH since those held here in 1954, 55, and 56 as part of a research program sponsored by the Library of Congress. We are glad that so many of you have found it possible to meet with us. We hope that you find the conference stimulating, productive and satisfying. If we can help in any way to make yourvisit more meaningful, please let us know. This morning we plan to take all of you who wish on a tour of the plant, at which time you will be given some literature outlining the history, policies, and purposes of the Printing House. I believe that you will find this information quite complete. To sum this up briefly--the Printing House is a non-profit organization whose purpose is to manufacture at cost braille books and magazines, large type books, the talking book, and various other aids for the education and comfort of the blind and partially sighted person. In reporting to you on the research and development related to braille production, Bob Haynes will report on those projects relative to the use of the computer in the translation of inkprint to braille. I shall confine my remarks to the work that is being done toward more efficient production of braille and to improving its quality using conventional processes.

The need for an improved Stereograph machine has been recognized for a good many years, and as soon as possible after the close of the war, work was started on a new design which resulted in the Lee machine, a model of which is operative and can be seen in our Stereograph room as part of the tape control project. This machine was extremely accurate, but it was much too slow, complex, and costly. However, it served as a springboard for further research and development which resulted in the table top machines we now have in operation. The first model of this type was put in production approximately five years ago. During this time the basic design of the machine--the frame configuration and control functions have been tested, improved, and are now very well accepted. The present machine has a high degree of accuracy--dot height can be maintained within .002", fast--it is capable of up to ten characters a second, and very dependable. Actually the three, card-controlled machines now used as the output for the computer have been operating for approximately two years with only minimal maintenance.

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* Plant Manager, The American Printing House for the Blind, Louisville, Kentucky.

One area where further work is needed is on the keyboard. Actually while a vast amount of information is available on typewriter key action, the six key operation of the Stereograph requires simultaneous depression of a number of keys and very little formal work has been done in this area. However, some basic work is underway, and an improved keyboard should be in the testing stage this summer. Further work also should be undertaken to lessen the noise resulting from the impact of the matrix against the plate. The normal suspension of the plate which permits interpointing results in the plate acting as a sounding board aggravating this problem. Several ways have been suggested to correct this condition, such as enclosing the embossing area and the use of dampening materials; however, this does not permit inspection and correction. Therefore, it has proven to be impractical so far.

The Lavender Braillewriter has been in production for over three years, and several thousand of these machines are in regular use. This machine was thoroughly tested prior to release, however, as usual, some problems appeared in the field that had not been encountered earlier. Some of the changes found desirable were--installation of a steel track or guide for the carriage, single point boring of roller bearing holes, and reinforcing the plastic case with bosses to resist damage in shipping. We feel that the machine is now accurate and will provide years of dependable service. These improvements are being added to each writer as it is returned to the Printing House for service. Also included is a mask which eliminates completely ghost dots. Ghost dots have always been a problem with embossing devices where more pins are presented to the paper than it is desired to emboss. On the Lavender machine these dots were very small, so small in fact that they were not disturbing to the average reader; however, they were a real problem for those people who were training to be proof readers. The touch has also been improved. This was brought about in part by redesigning the key top resulting in much lower unit pressure. One suggestion that we have found impractical to implement is the capability to move the embossing head at will to either the right or the left. Movement to the left is, of course, normal when indexing to the next line; however, to move in the opposite direction, we must use the space key. This does not appear to be a major problem; however, research will be continued and as soon as this can be accomplished at a reasonable cost, it will be done.

The Printing House now produces more than 70 braille magazines requiring more than a freight car load of paper each month. As you know, the cost of labor and materials is increasing steadily, and appreciable changes in the cost structure usually make more sophisticated machines and methods feasible. To meet these changing conditions, a research and development program directed toward more efficient handling of this vast amount of paper has been underway for some time. As in other areas of braille production, conventional gathering, folding, and binding equipment cannot be used. Therefore, special machinery may have to be built. This program may take several years to complete; however, some concrete results should be seen during the coming year.

In March of 1966, an experimental plastic braille pocket slate was put into production. These early models were made of polystyrene. The general idea proved so popular that a complete redesign was undertaken to make it easier to use and generally more satisfactory. The guide section has been altered to facilitate location of the desired position, the die section corrected to provide optimum feedback, and Lexan, a very durable material, specified. These changes are now in the approval stage. When approved, the slate should provide the best possible slate--the cost is 50 cents, including a stylus. Both machines and the slate are available for inspection.

It has been a pleasure making this brief report. If you have any questions, I would be glad to answer them.

DISPLAY DEVICES FOR COMPUTER TRANSLATED BRAILLE

Theodor D. Sterling*

There is today a proliferation of "reading devices" that present to the blind reader brailled materials in a variety of forms. These devices may be viewed as "display" consoles or peripherals for braille that has been translated and formatted automatically. All these devices share two properties:

1. They are necessary instruments to display a braille which has been produced, translated, and formatted automatically by a computer, and
2. They represent a variety of convenient ways by which translated material may be made available immediately and on request to a blind individual.

It is very important to keep in mind that none of these display devices are really independent instruments. As a "reading machine" they involve a computer in one form or another. The display device functions as the end process of a sequence of events in which a high speed processor has done the actual translation and presents the results of its activity to a reader. It is thus a display device in the true sense of the word -- a peripheral appendage to the high speed processor, it must be designed in such a way that its "input" is a computer-produced signal and that its output is something a blind person can read. To translate a computer-produced signal into a format convenient to read for the blind individual may be more costly in some instances than in others. Not only are these devices then restricted in terms of the signal they may be able to accept but their design is always constrained by a serious problem of cost.

The High Speed Printer

One of the most useful display devices developed as a routine appendage to the computer is the high speed printer. The printer produces a whole line of print at one time, varying between 120-140 characters in length. An endless roll of paper is pulled through the print mechanism at a speed that produces

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* Professor, Department of Applied Mathematics and Computer Science, Washington University, St. Louis, Missouri.

anywhere between 300 to 2,000 lines of print a minute.

There are basically two types of high speed print mechanisms.

In one, a row of individual hammers are activated to impact with great speed against a rapidly revolving chain that contains the needed characters (letters, numbers, etc.). The paper is sandwiched between the hammers and the print chain. The second basic device (usually called the Analex printer) does not have a print chain but its complete character set is contained on many adjacent revolving wheels. To print a line, all these wheels are stopped so that a desired character appears on the surface facing the paper. A print bar is then brought forward forcing the paper against the roll or line of characters.

The high speed printer can be made to emboss braille by adjusting the pressure between hammer and print chain or between print bar and print line in such a way that some symbols or characters will pierce partially through the paper. The most suitable characters for braille production are periods, commas, asterisks, or hyphens. Using proper pressure, such a character is printed on one side of the paper and in the process a raised dot is embossed on the other side.

The embossing can be made more pronounced by using proper backing materials. Two types of backing materials have been found to give optimum braille. One is garter belt, the other a strip of corn plaster. After some experimentation with print pressure, character and proper backing materials, the high speed printer can be made to produce a dot which is relatively easy to read.

Braille is assembled from embossed dots by the use of two columns and three print rows for each symbol. A space occupied ordinarily by three print lines and two print columns makesup the six necessary spaces for the braille cell. Since it is necessary to use a space between braille cells, it takes three rows and three columns to produce an individual braille character. This means that one line of braille on the high speed printer consists of approximately forty braille characters.

Because of the high speeds of processing and formatting typical input for modern computers, translating time is actually faster than print time. Thus braille can be produced at the maximum rate at which the high speed printer can operate. This means that the ordinary six to seven hundred line a minute printer can emboss braille at the rate of 6,000 characters a minute. The production of braille for faster or slower machines is proportionate to these figures.

The size and height of a dot will depend, of course, on the mechanical characteristics of the printer and the backing material that is used. Since braille is produced as a direct result of ordinary printing procedures, the spacing between the embossed dots of each character will depend on the spacing between the lines and between characters in the print mechanism. Usually the high speed printer uses ten characters and six lines to an inch. Since each character is formed by three print lines and two columns, the distance between parts of a character are then a tenth of an inch between the two columns, and one sixth of an inch between two adjacent dots in a row. High speed printer produced braille differs then from ordinary braille by size of dots and spacing between them. However, this difference does not represent an obstacle to reading. High speed printer produced braille can be read with very little practice. While it is not as easy to read as ordinary braille, for the purposes to which high speed braille is put, the output is quite sufficient.

One of the major applications of high speed braille has been its day-to-day uses for blind computer programmers. The technique of producing braille directly off the high speed printer enables the blind programmer to obtain his printout in a suitable format without involving any changes in the printing mechanism or costly and time-consuming translation procedures. The convenience of having a high speed brailling mechanism available has also led many blind programmers to the use of this type of braille for translating manuals and specifications for computer programs. Since more and more of programming language manuals for computers are produced on magnetic tape, sections of the manual or reference areas may be computer translated to braille and produced directly on the high speed printer.

Because of the extreme convenience of this form of braille, manufacturers of high speed printers have attempted to modify the print mechanisms so that it may produce a better and more of a regulation sized braille.

Both the IBM and Analex printers can be obtained today with inexpensive modifications that will produce slightly better dots and space them more conventionally.

The IBM and the Analex printer differ in one important respect. The IBM high speed printer uses a row of hammers. Since this row is straight and has no play in it, each line of braille produced is straight and does not waver. The Analex printer has a certain amount of play between adjacent wheels, unfortunately, so that the row of print may be slightly wavy. While this small amount of waviness is hardly noticeable and of no consequence for visual reading, it sometimes produces errors and is generally more difficult to understand. Thus while the physical quality of braille produced by both machines is about the same, the failure to produce a straight line on the Analex printer is somewhat of a disadvantage. However, the disadvantage is not so great as to rule out the Analex printer as a useful device.

Offline Display

Once the high speed processor has translated ordinary print into a brailled equivalent, display may be produced in any output form compatible with the processor. There are a number of alternatives available. For convenience we may look at two classes.

1. The high speed processor produces messages which are directly carried, via telephone lines, to a data phone which forms a terminal. A modification of terminal then produces a readable display.
2. The high speed processor produces the translated and formatted material in the form of a permanent output (such as a magnetic tape, paper tape, or a deck of cards) which is hand carried to some other location where it is fed into a special machine designed to read this type of output and produce readable braille from it.

However, the two classes of display are not sharply distinct from each other. For instance, an online device such as the paper punch may be connected to the end of a telephone line where a paper punch tape is produced which is fed later on through a special machine that converts the holes in the paper strip to sequences of readable raised dots.

Online Devices

One of the most common online devices is a typewriter. Most high speed computers can use a number of different typewriters as terminals. Terminals consisting of a specially built braille writer (such as the IBM braille typewriter) may be produced. While the present IBM braille typewriter is not built for this purpose, the ordinary online typewriter could be modified to drive the brailling mechanism.

In a similar vein, the existing Perkins automatic braille typewriter could be made suitable as an online terminal.

The ordinary teletypewriter has been modified by workers in the Lawrence Radiation Laboratory, University of California, Livermore (An Inexpensive Braille Terminal Device, Anderson, G.B. and Rogers, D.W., April 28, 1967, in press - address requests to authors at Lawrence Radiation Laboratory) to produce a braille in very much the same way as the high speed printer does. The print head of the teletypewriter was replaced by a round sleeve which carried on it a number of braille print faces. These print faces embossed the paper sufficiently for a blind person to read their output. The program was then written which translated output into its braille equivalent and sends it as a series of signals to the teletypewriter which then produces the necessary braille. This mechanism has the advantage that it is extremely inexpensive (the type head costs in the order of $2.00 to produce) and has been used with great success by one of the outstanding blind mathematicians and computer scientists in the field. A somewhat more complex model was developed by another blind scientist at MIT. Here a specially built device produced a row of braille by use of a drum. This terminal is online to Project MAC at MIT where communications between the blind computer scientist (electrical engineer in this instance) and the central processor are retranslated and reformatted.

One online device which has not been used to present braille but rather regular letters has been developed at the Stanford Research Institute. This device consists of a number of vibrating points over which a signal may travel. This device can be used potentially as a braille printout since it could be coupled to a data phone and formatted in such a way that the braille signal would travel over the fingers of a blind individual.

One simple way to produce braille online is by the use of a paper punch mechanism. The ordinary paper punch (a Tally in this case) was modified so that its impact would not punch a hole in the paper but rather indent the tape. Proper formatting at the computer end can then make the paper tape produce a readable braille. The only difficulty with this process has been that ordinary inexpensive paper tape does not lend itself very well to good braille and that the mylar tape which produces an excellent braille is very expensive to use. Very much the same process has been developed by Mr. Morrison of the Bell Telephone Company by using the ordinary teletype tape mechanism. The same process which makes it possible for a teletypewriter to receive messages can be modified to produce a paper strip with braille embossed on it.

Indirect Offline Devices

A permanent record may be produced which serves as an input to another machine.

The best example is, of course, the mechanism by which braille is produced automatically at the American Printing House for the Blind. Here the computer produces a series of IBM punch cards which serve as signals to a special milling machine which embosses a printing plate.

The same principle may be used by building a number of devices which could present the signals (stored in these permanent records) in a format that a blind person can read.

Punched paper tape turns out to be one of the most useful hard media for such purposes. Once produced, the holes in the tape may be used to activate a large number of reading devices working on the principle of the "player piano" with the punched paper tape serving as the playroll. A large number of these devices have been produced and described by Mann and his students at MIT. They need no further discussion here.

One interesting note is that the automatic Perkins brailler may also be driven by a punched paper tape. It is thus possible to produce a punched tape and mail it to a location where an electric Perkins brailler exists. This can then be used to produce a hard copy of braille print.

A Word About Cost

As with any mass produced network making use of on and offline devices, the state of the art in automatic braille producing is such that cost is still a major problem.

The cheapest and most inexpensive way to produce braille is to make use of online batch processing. In this procedure the material to be translated is submitted to the computer, translated, reformatted, and immediately produced on the high speed printer. To keep costs down for offline application, we would recommend the production of punched paper tape or preferably magnetic tape as a product of the batch translating process. This output could be mailed then to some other location at which a suitable translating device is located.

Online devices to which data must be sent over the phone lines are expensive for two reasons. They are slow and tie down an undue amount of computer time. They require expensive "software", either by timesharing or multi-processing, which not only increases the cost of translation considerably (roughly three times as much actual computer time is needed to produce braille on a time-shared mode than in batch processing) but producing the necessary software to use a multiprocessing system or to attach an offline device to an existing multiprocessing system are extremely costly at this time.

BRAILLE ELECTRIC TYPEWRITER

John Pramuk*

Dr. Sterling mentioned a standard typewriter. "Standard" is exactly the philosophy behind this braille embosser as we are trying to maintain it as close as possible to a typewriter. Now for a user, the great advantage of this unit would be a heavy transference of typing skill to brailling skill, making it far easier, particularly for volunteers, amongst whom you have a wide range of typing skills and at the beginning no brailling skills at all, to learn braille faster. Most blind people who know braille also know how to type. Of the surveys we ran, upwards of fifty of the respondents took the liberty, when we suggested it, to give us comments. Over half of them were on typing, even though they were all very expert users of braille.

This typewriter has all 63 cell configurations. You get Grade I braille immediately with an expert typist. You can get Grade II dependent on the skill of the operator. It is not, therefore, a Grade I machine or a Grade II machine. Rather, it is dependent on the skill of the operator.

Now, for all outward appearances, we have what is a regular IBM electric typewriter. We have modified it as follows: it will accept any standard braille paper; it has an automatic carriage return; it has a light, sure response which you associate with an electric typewriter; and, most important, it has electric control of impressions, the hammer or embossing action. You can distinguish a sound difference from a low setting to a high setting. This comes into play and is a pretty good advantage if you are going from 80 pound paper to 100 pound paper to an original and one copy on 20 pound bond, for instance, where you might want a couple of quick lower quality copies. The A-Z placement on this keyboard, the numbers, and almost all punctuation symbols are in the standard electric placement. Again "standard" because, again, we're trying to trade very heavily, and we hope successfully, on making brailling a little more like typing, thus eliminating some of the unfamiliar steps a person has to go through in learning braille. Initially with this unit, you won't have to concentrate on dot configurations although in the process of learning braille, you will undoubtedly learn this. On this unit, however, you don't have to worry about number sign being dots 3,4,5,6. If you hit the right key, the machine will provide that for you. In addition, it has the standard keyboard

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*IBM Corporation, New Circle Road, Lexington, Kentucky.

arrangement in the lower case. Now, when you normally type on a regular typewriter, one stroke in ten is in a shift position. Using this machine for Grade II, you'll double that to one stroke in five. You're still spending 80% of your time in the lower case, which is a very familiar arrangement to most people, particularly the volunteers who are starting out or are in the process of learning braille configurations, rules of usage, and new machine skills. We have de-emphasized or eliminated the serious concern in two of those areas so that you can concentrate on the most difficult area in braille, the area of rules of usage.

Now, in effect, what we have done is to put special type in the machine. We have a rubber sleeve, very similiar to a bicycle tire, for lack of a better description, over the platen or rubber roller so that there is a soft resilient material into which the type can emboss. We have, again emphasis on "standard", a standard electric tab, space bar, margin set, and tab set. Obviously there is no ribbon mechanism. We have taken the typomatic or repeat features off the machine, preventing you from getting the machine gun action for the underscore, backspace, space bar, and carriage return. This was done in deference to the blind people who would use the machine. Also, they all tend to use up amounts of space and the emphasis in braille, because of its size, is to be very conservative in the use of space.

The machine has one unique feature on it that we think will help and that is, if I make a mistake, I can correct it. We found that, in field testing this and regular typewriters, a little bell goes off in the typist's head when she makes a goof upwards of 75% to 85% of the time that she makes a mistake. She kind of realizes it as she makes it. If this is the case here, I can backspace and use the correction lever that's slightly off the keyboard. You notice that it appeared to be a typing action, but without any carriage motion. In effect what we have done is to throw up a type bar which, instead of having dots on it has little empty cells or holes that push the incorrect cells out. Actually, it is the action of the platen against the piece of paper into those little cells in the correction lever that erases it. It works surprisingly better than a flat hammer surface. There is no carriage motion because that particular action is not connected to the carriage movement mechanism. You are now in the position to put in the correct braille character.

To proof copy in the machine, you turn it up, having readable braille right there. On the other hand, if I'm down toward the bottom of the page and I can't turn it up, I would turn it back. Now I have readable braille coming out from back here. We were able to do this because we have the type literally upside down in the basket which holds the type. The result is that we have readable braille coming out of the machine.

The machine is 70-80% assembled in our regular line. Now that's important from IBM's point of view because the more we can get from our regular production line, from our standard Model D electric typewriter, the easier it is for us to get this out at the standard typewriter price which is $490 for commercial accounts, $441 for government accounts, and $375 for school accounts where we've always had an educational discount policy.

In closing I would like to say that we stress the fact that, although we are trying to keep the cost down, our utmost consideration is to make it as standard as possible, trading most heavily on the average person's ability to type. Indeed, typing, at least personal typing, is a required subject in most high schools. In schools for the blind, they generally know typing as a prerequisite for graduation from eighth grade. Most people who are blind, who read braille,also type. Thus we are leaning on typing skill to make more braille available to the blind.*

QUESTIONS:

A. Nemeth: "Using the IBM typewriter, if a blind person forgets what the last thing is he has written, can he easily check?"

J. Pramuk: "Yes, sir. You can roll the paper up or down (depending on its position in the machine) and easily check what the last thing was which you wrote."

A. Nemeth: "It seems to me that you could make simulated (inkprint) braille by putting a ribbon into the machine. Please note, I'm not asking for both on one machine."

J. Pramuk: "You could do this by putting a carbon behind the paper."

R. Gildea: "How much would it cost to make a Selectric ball with nothing but the 63 braille cells (smaller than regulation size of course, but what difference does size make if you are visually reading it?)?"

*The above is a summary of the presentation given by Mr. Pramuk.

M.I.T. BRAILLE EMBOSSER

William E. Greiner*

The development of a high-speed braille embosser has been a continuing project at M.I.T. for the past several years. It is designed to fill the gap in the production of braille between the skilled volunteer braillists on the one hand, and the elaborate, bulk production facilities of the large braille printing houses on the other. Its function is to produce relatively small quantities of longer works, or multiple copies of material such as classroom notes, short newspapers, and tests from a variety of inputs including a braille keyboard, punched paper tape, and direct computer transliteration of English input to Gradell braille from a teletypewriter. This last mode of operation is, of course, most significant, for it requires of the user absolutely no knowledge of braille.

Recent work on the embosser has concentrated in four major areas. The first two are of a rather technical nature. One concerns conversion of the existing paper advance mechanism to one which will accept fanfolded, sprocket-driven paper similar to that which is presently used in computers. The advantages of this type of advance are that it assures accurate line-spacing and that it enables us to use heavier paper, thereby reducing the likelihood of broken or open dots.

The second area in which work has been performed concerns the electronic logic circuitry which controls the operation of the brailler. The original transistor circuits have been reconstructed to take advantage of the new, inexpensive integrated circuit modules. In addition, logic circuits have been designed to permit easier proof-reading, better knowledge of where the printing head is located, and to provide automatic paging for the new advance mechanism.

A third area of research activity was concerned with the development of an electronic braille keyboard to be used with the embosser. In addition to the standard key arrangement for the two-handed operation used in other devices such as the Perkins Braillewriter, it was decided to attempt to permit the user to braille with only one hand. This capability was considered a useful feature not only in the obvious case for people who had lost the use of one arm, but also for those who might either be copying braille or who might be brailling rather complicated material, such as a mathematics quiz. The final design permits comfortable and effortless operation of the embosser through a variety of features including buttons to automatically advance to the beginning of a new line or to permit proof-reading of what has just been printed; a warning bell near the

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* Graduate Assistant, Mechanical Engineering Department, M.I.T.

end of each line; and a pointer to indicate exactly where the printing head is located in the event that the user must leave and continue brailling at a later time.

The final stage of the work was concerned with the evaluation of the braille equipment in a realistic environment, away from the technicians and non-braillists of the laboratory. We installed the embosser, a keyboard, and a teletype console linked to the M.I.T. computer at the Perkins School for the Blind in Watertown, Massachusetts. Within the month that the equipment has been available to the teachers, they have used it to produce history tests, sewing instructions, mathematics word problems, personal letters, and announcements. Their comments on the quality of the braille and the accuracy of the computer transliterations have been invaluable, and their interest and enthusiasm - both young and old, sighted and blind - have been most encouraging. Their approval of the system helped to more than justify the efforts of those involved in its developments, and their comments will most certainly help to finalize the design of the embosser in the very near future.

REPORT ON THE BRAILLE READER

Philip S. Blackman*

The Braille Reader which I am working on is a device to continuously display braille in the raised dot standard form while taking advantage of the compact storage capacity of punched paper tape. There have been several approaches to the objective of convenient display coupled with reduction in the bulk and weight associated with embossed paper books. Work on other schemes and devices (such as those using steel balls, vibratory reeds, or pins in linked metal blocks) and previous work on the Braille Reader have all contributed to design improvements in the present reader.

The overall configuration for the present reader is as follows. A generally rectangular box, less than 14' x 7' x 3 1/2', contains all the elements to the system. It is portable and can be set up on any flat area the size of the base. Two paper tape bins detach from the top surface and are attached to a read head on the right hand side of the machine. The paper tape is fan folded, permitting random access, and moves from one bin across the read head to the other.

The display appears in a window toward the rear edge of the machine and is about 8 1/2 inches long. A slight downward slope of the front edge is designed to support the heel of the hand. Controls for speed, forward-reverse, and on-off are at the left hand side. The speed control is located where it can be varied by the brailling hand. This should permit the individual to reach his top speed at desired comprehension. (Top machine speed is in excess of 250 words per min.).

The position for reading the machine is about only 2" high with the 7" tall bins on the right side. (The bins project about 4" to the rear and 2" to the front of the machine.)

The portion of the reader which has received the most attention in order to achieve a satisfactory design is the belt and pin display. Of the many alternatives contemplated or tried, the present choice best satisfies the operating criteria and the limitations of production techniques.

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A strip of material having a neutral axis near the bottom surface (i.e., the top surface spreads more than the bottom surface compresses when the belt curves over a pulley) is drilled with a row of the 2 x 3 matrices of the standard braille cell. Each hole is a countersunk hole with straight walls. It is designed to accept the pins which will be sensed as braille dots. These pins have a semi-spherical head connected to a short shaft. (There is a lip on the end of that shaft to prevent the pin from falling out of the belt once it is inserted.)

The diameter of the semi-spherical head is slightly larger than the countersunk hole. Thus if it is in the up position, the rim will be supported by the belt and the "dot" can be read. Those "dots" which are not to be read can easily be pushed down into the countersunk hole though. This is because the hammers which do this are located where the belt bends around the pulley and sufficiently expands the openings to accept the pin heads. When the belt is flat under the read window, however, all pins are locked in their respective positions.

The belt is made of cotton and rubber and has good resistance to oil, moisture, heat and cold, good dimensional stability, flexibility, and can be made into a continuous loop.

A complete prototype of the machine as described will be assembled and tested in the coming months. Limited testing has been done on an older prototype.

QUESTIONS:

E. Foulke: "With reference to the moving belt display, what are the differences between this and John Wheeler's at IBM?"

R. Mann: "The device Phil is working on is attache case size, portable, and need only be plugged into a 110 a.c. line. It is completely mechanical in its tape reading and the erection of the pins. There is a very simple mechanism for doing this. It does not require an electric tapereader or electromagnets for pin erection as did Wheeler's device. It will also be equipped with a keyboard for punching paper tape. The function of the two approaches are otherwise identically the same."

A. Nemeth: "How many cells at a time are exposed?"

P. Blackman: "We have about 8-9" of braille, approximately 30 cells. The length is not restricted. It can be longer or shorter. We have chosen that which would be the standard width of a page."

A. Nemeth: "How much more cost would be involved to make a tape which runs not horizontally but vertically?"

P. Blackman: "Results from experiments have shown that the single line moving horizontally, left to right, has been the most effective mode of presentation."

T. Sterling: "I would like to insert here that this is not an either/or situation. The more devices the better."

H. Freiberger: "How are the pins held?"

P. Blackman: "The belt is drilled with a countersunk drill. It makes countersunk holes to accept the pin which has a hemispheric top. When the belt is in a flat position, the lip of this hemisphere catches on top of the belt and cannot be pushed through with normal finger pressure. When the belt moves to the station where the information is presented, where the pins move in and out, it's curved. The top surface opens and accepts the pin which will drop into it if hammered by the hammer. Now it moves into the read position. Those pins which are up remain up while those which are hammered down remain down."

C. Rodgers: "When you conducted tests on the belt reader, did you give any consideration to the handedness? The ambidextrous reader would feel at a disadvantage with just one line. One line is fine but you must remember that one of the functions of textbooks for teaching mathematics and other subjects is to help the blind student conceptualize space settings."

R. Mann: "With reference to our experience with the present device, it is the successor of 3 or 4 previous versions, several of which have been evaluated over a considerable amount of time by blind users. Our experience pretty much confirms our impression of John Wheeler's belt...i.e., when they work, they are pretty satisfactory."

At the close of the panel, Dr. Woodcock gave a short summary of his work on the electrified Perkins and the specially modified model 33 teletypewriter.

Lou Goldish gave a brief summary of his report, "Braille in the United States: Its Production, Distribution, and Use," published by the International Research Information Service of the American Foundation for the Blind, explaining its special value to the participants of the conference.

BRAILLE TRANSMISSION SYSTEM FOR THE INSTRUCTIONAL MATERIAL CENTER

410 South Michigan, Chicago, Illinois

Ray E. Morrison*

The Instructional Material Center for the Visually Handicapped is a part of the Educational Materials Coordinating Unit, Department of Special Education, Office of the State Superintendent of Public Instruction, Springfield, Illinois.

Its purpose as established by the Illinois General Assembly, House Bill 1407, June 1965 is to provide:

> (1) Staff and resources for the coordinating, cataloging, standardizing, production, procurement, storage, and distribution of educational materials needed by visually handicapped children and adults...
>
> "The educational materials coordinating unit shall have as its major purpose the improvement of instructional programs for handicapped children and the in-service training of all professional personnel associated with programs of special education..." (The School Code of Illinois)
>
> In June, 1966, the U.S. Office of Education approved a three-year research and demonstration project which will supplement the State legislation. The project funded under Public Law 88-164 will enable the Office of the Superintendent of Public Instruction to demonstrate to the nation how a State agency can provide and disseminate educational materials to visually handicapped children and adults. It will also provide a professional library.

It is proposed to establish an experimental braille transmission system, according to the attached sketch, to provide, in a minimum time, specialized braille instructional material to schools having a comprehensive braille teaching unit.

This system will use newly developed braille encoding and embossing units connected together over telephone lines by means of standard telephone company Dataphone units.

Its use would be as follows: The braille resource supervisor at Wheeling, needing a special braille text available at the Chicago Material Center, would make a call over the telephone switched network to the Chicago Center using the "Alternate Voice Mode" of the data set. The Chicago Center, in turn, would answer by voice, to determine the need of the Wheeling supervisor.

Then, if the requested text were available on perforated tape, it could

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*Supervisory Engineer, Illinois Bell Telephone, 225 West Randolph Street, Chicago, Illinois 60606

be transmitted to Wheeling automatically in the "Data Mode" over the same circuit established by the telephone call.

If the requested text were not available in perforated, tape form, Chicago would transmit it using the braille coded keyboard and,at the same time, would produce a perforated tape for future use.

The braille transmitting equipment at Chicago could be one of the units developed by Dr. Woodcock or by the author. Both are equally suitable. The receiving end at Wheeling would consist of a standard Teletype Corporation receiving selector (LRS) connected by a control unit to the newly announced I.B.M. braille typewriter.

At a later date, if this project proves useful, it can be expanded to include any braille teaching unit in the state.

The author will be pleased to furnish more detailed information about this program or on any other projected braille transmission problem.

STATE OF ILLINOIS

DEPARTMENT OF SPECIAL INSTRUCTION

PROPOSED DATAPHONE AND ALTERNATE VOICE CIRCUIT

33/35 TTY Equipment modified for braille	Tel. Co. Data and Aux. Tel. Sets	Telephone Switched Network	Tel. Co. Data and Aux. Tel. Sets	Receiving selector -control- page embosser (braille)

CHICAGO MATERIAL CENTER

410 South Michigan

WHEELING SCHOOL

Tel. Co. Data and Aux. Tel. Sets	Receiving selector -control- page embosser (braille)

FUTURE LOCATIONS

REM 1/16/68

REPORT FROM THE COMMITTEE ON PROFESSIONAL ACTIVITIES OF BLIND PROGRAMMERS OF THE ASSOCIATION FOR COMPUTING MACHINERY

Theodor D. Sterling*

The Association for Computing Machinery is the professional society of individuals in the academic area of computing, in areas of research and development, and in many industries. ACM has at present a membership of 23,000 individuals of which roughly half occupy university posts; the rest are in research and industrial organizations.

In 1963, ACM formed a committee to concern itself specifically with professional problems of the blind programmer or potential programmer. This marks perhaps the first time in the history of professional organizations where such a committee was formed. However there are a number of peculiar circumstances which make computing and computers of special importance to blind individuals. Because of the ability of computers to translate material from one language to another (in the case of the blind from print to braille) and to formulate display for any sort of device, the computer becomes a major link in the communication between blind and blind individuals and between blind individuals and sighted society. The vastly enlarged opportunities for employment which are offered to blind individuals who can avail themselves of this entre to the general communications network has been demonstrated very dramatically by the ease with which many blind persons are moving into the field of computer programming. This is one of the many fields in which the blind individual can now be active independent of sighted help with greater ease because the communication link can be established between the blind individual and his need to read relevant materials.

It is the purpose of this committee to study opportunities newly open to blind individuals because difficulties in the communication link are or can be overcome and at the same time to guard against special problems that might arise to threaten such links once they are established. For this purpose the committee consists of individuals representing the computer profession as well as fields of rehabilitation. The committee also makes use of expertise available in the professional membership of ACM whenever this proves to be necessary.

The immediate job for the committee was to remove obstacles between the blind individuals and the profession of programmer. This path was chosen

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* Chairman, Committee on Professional Activities of Blind Programmers, ACM.

because the field of programming was open to blind individuals and was also closest to the experience of the members of the committee.

The committee has taken up a number of functions which it hopes will smooth the path of blind individuals in this field.

The committee has laid down standards for training which are enforced through the association. The committee serves to accredit schools which purport to train programmers who are blind. To evaluate a school, the committee sends a visiting team consisting of three experts of national renown who are also familiar with problems of blind programmers to the school for a rigorous examination of training methods and resulting competence of blind trainees. Once a school has been duly approved, its graduates receive all the help the committee can provide for placement and other matters. The effectiveness of this phase of the committee's work can be gauged by the fact that there are very few unemployment problems among blind programmers.

The committee serves to assure that proper techniques and routine programs exist for the large variety of different machines which will provide the necessary braille printouts on which professional programming hinges. At present this means making sure that brailling routines written for different computers are available for general use and the encouragement to produce brailling routines for computers on which blind individuals work.

Associated with this activity is the tremendous need to establish communications among the blind programmers and with blind individuals interested in that profession. While the committee does not support at this time an organized information center, it is aware of where information is available and serves as a general information exchange. However, the committee is planning to set up an information center precisely for purposes of programming of which Mr. R. Gildea will be the central hub.

The committee serves as a public relations tool within the professional organization. Through publications, speakers, and correspondence, members of the association are being made aware constantly of the valuable role blind professionals play in computing. At the same time, if through a number of circumstances a blind programmer or a blind applicant meets problems in placement or on the job, the committee apprises his supervisors and employers of proper techniques to make it possible for the programmer to do his job more effectively.

Because of the uncertainty with which training is done for programming in general (whether sighted or blind) and because so many of the schools which offer programming training are either incompetent or little more than rackets, the committee has taken a firm position and will not make its services available to any but to those blind individuals who have been trained in those schools accredited and approved by the committee.

This policy may be difficult to implement in the future because a number of states have initiated actions which might very easily harm the total professional picture of blind programmers. In the desire of establishing local facilities or to utilize already existing local facilities, many states have sent students to schools within the states. However, the training of blind computer programmers requires a well-trained, a technically competent, and a dedicated group of individuals who not only are professionally competent as teachers and computer workers but are aware as well of specific problems of the blind in this field and who have mastered the bags of tricks which blind computer programmers need for the successful performance of their jobs and are able to teach them to blind students. The result of the diffusion of effort has been very undesirable. A number of blind individuals have now been trained by various states who do not have the capability to compete successfully in the world of programming. Not only will these poorly trained individuals have a difficult time to compete on their own but they will make it increasingly difficult for properly trained individuals to obtain jobs. This problem is brought to the attention of various states through the Association but has taken on serious enough dimensions so that the American Association of Workers for the Blind has agreed to circulate a special notice of concern.

The committee is also assessing a number of technical problems which have to be resolved to keep the field of programming open to blind workers. Foremost of these are the changes from conventional compiler and assembly languages to the new generation of programming languages. Because of the close association with operating systems and the great flexibility which they permit, these languages also result in voluminous outputs to the programmer. The amount of communication is so large that brailling techniques existing now, even the very fast high speed printer techniques, are simply too time consuming to be practical. The problem has to be resolved by selecting from the total output to the programmer only those parts which may be of immediate importance and permitting the blind individuals to call out different parts of the communications from the compiler for purposes of inspection. Since such a modification represents a complex system problem, the committee is right now evaluating the design of such modifications and assessing the cost of implementing them.

Another major problem facing blind programmers is the impending introduction of the electrostatic printer. Because of the overwhelming need to speed up display, a printer has been developed which eliminates the mechanical imprinting. Instead a chemical process takes the part of the mechanical impact and characters are burned on or superimposed chemically on specially treated paper which moves very quickly through the print unit. This process does not permit the embossing of braille through mechanical impact. As a result, the blind programmer may be deprived of his direct communication link with the machine.

The committee is considering two separate lines of attack to the solution of this problem.

Another set of problems is presented to the blind programmer in installation in which he has to communicate to the machine through an on-line device. Problems are especially severe for such instances where the programmer has to work on multiprocessing and/or timesharing applications. Again, a device is needed which makes immediately available a display in the format a blind person can read. The technique of using a modified teletypewriter may be an inexpensive and practical solution for programmers who work from an on-line typewriter. The committee is investigating right now ways and means to make this technique available to those blind programmers who are in need of such communication link.

Because the committee is an arm of the Association for Computing Machinery and because the Association is predominantly concerned with problems in computer science, the committee has undertaken also a number of activities which may be more properly viewed as applications of computer science to problems of the blind in general than to problems of blind programmers. The committee is especially interested at this time in sponsoring joint conferences between computer scientists and blind individuals who are aware of advanced instrumentation so that new opportunities in signal translation may be properly evaluated.

HIGHER LEVEL COMPUTER LANGUAGE FOR COMPUTER TRANSLATIONS

Robert A. J. Gildea*

During the November 18, 1966 Braille Research Conference at M.I.T., John Dupress asked me to investigate a recommendation I made. The recommendation was that we urge people who are writing braille translators to do so using higher-level programming languages. I sent a questionnaire letter to approximately 62 individuals, agencies, etc., and received eight replies. Notably absent were replies from the computer-oriented people. I telephoned a few individuals, whom I knew, for their answers. The letters I received were mostly from people who are connected with braille presses. They responded to one paragraph of my letter requesting their comments on what they felt should be the considerations for people who are in the business of braille translation by computer. Their responses showed a sensitivity towards some of the problems. I would like to report in detail at some future meeting the results of the survey.

I urge that a higher-level programming language be used for two reasons: One, a program's transferability across equipments and two, a program's visibility to the rest of the interested population. The advantage of transferability across equipments is apparent. By visibility, I mean the ability to examine what is required for grade II translation. More expertise and orientation are required to read an assembly level language than an algebraic or algorithmic language. The advantages of using a higher-level language are significant. The disadvantages can be erased later. The considerable amount of time and effort saved developing the program using a problem-oriented language will normally allow for the minor changes required for enhancement of its performance in speed or resource utilization. Those who look at the problem from a fairly broad viewpoint and have enough experience, would tend to look at the minor disadvantages as surmountable, and to look at the benefits as rather great advances.

I would now like to bring up another subject in order to plant a seed for tomorrow's discussion. I think it is mandatory for the community of braille manufacturers, workers for the blind, the technically oriented blind, and all others who are in this room to state their needs and requirements for braille manufacture. With these needs and requirements stated, a design can be approached which can meet them. To date, I have not found an adequate statement of the needs of braille presses. The specifications must be given in more detail than that stated in APH's charter or stated by Volunteers Service for the Blind,

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or Howe Press or others in separated discussions. Pertinent technical work can be performed only after more defining and detailing of the needs.

Appendix B to the Proceedings of the May 18, 1967 Conference on "New Processes for Braille Manufacture" was written by me for Dr. Waterhouse. I have yet to hear any comments concerning that suggestion and I would like to stimulate some feedback so that through such a dialog, the administrators interested in developing translation systems, the technical people interested in building systems, and the people interested in having the service provided can come to an adequate fruition in the reasonable future.

QUESTIONS:

A. Nemeth: "Are you speaking in terms of a standard higher-level language or one to be made up specifically?"

R. Gildea: "I think the former is the better step for the time being. Ted Glaser suggested that, for definition purposes only, the braille rules be coded in the LISP language which is certainly flexible enough to handle them syntactically. I think that it is a good concept."

K. Ingham: "Presumably, the attempt here is to have a language that can thus be put in many machines. Well, is the requirement for braille production such that you are going to need many machines? Is it really worth it, considering all the production requirements, to use a higher language for braille translation? Is Lou Goldish here?"

L. Goldish: "Putting in consumer form what Bob Gildea is trying to say--here sit many people who say "We're held down in our production by not enough capacity." who say as Mrs. Beck said, "I'd like to take my cards out to the local insurance company computer and see if they can run it." It is my opinion that perhaps five or six locations in this country have braille presses with sufficient capacity that they could use translation programs run on service bureau level. What we would like to do is to contact these people to find out if they are really interested, thus making it worthwhile, so that we can provide them with, let's say, a reel of tape and a little direction on what machinery they need so that they can set up their own facility for producing the plates and for going to their local computer service center to have the material translated. I think that there might be a demand for this, and this is what we're asking them to tell us."

R. Gildea: "There are now over a dozen grade II or equivalent translators that have been written, are being written, or are being contemplated, and I think there are not even two of them on the same machine."

P. Duke: "I have an immense variety of requests from people. How do I get these people information? The computer translation program is no problem. It's been done. The problem is input preparation, not computer processing."

R. Mann: "The issue is no longer whether it can be done, but how to do it in response to the demands of the producers, the blind population, and all involved."

R. Gildea: "I have a request. I want to direct it to everybody in the room, but most especially to those responsible for braille manufacturing. Who among you are interested in sitting down and writing some of these things down so that we can take the next step in the dialog?

The languages that I was referring to, Dr. Ingham, were such languages as ALGOL, FORTRAN, things of this nature."

P. Duke: "Dr. Sterling, the macro languages, the power built into the new tape operating systems, the automatic dumps, memory snapshots, modular structuring, etc. will make it damn tough to get anything off on-line in braille without obtaining permission from management to violate or doctor up an entire system."

MATH TRANSLATION PROGRAM

Ann and Joseph Schack*

We would like briefly to describe the work that is underway on the Math translation program which will be implemented here at the Printing House as part of the currently operating braille translation program on the 709. It will be designed to produce books of a certain sort (elementary school texts at the outset).

First of all, relating to Literary braille, there are a few symbols in the Math code which differ from symbols in the Literary code standing for the same printed sign. In Literary braille, numbers are represented by the first ten letters A-J preceded by the number sign. In the Nemeth code, numbers are represented by the lower cell version of the first ten letters of the alphabet. Thus the Literary 4 is , the Math 4 is . These lower sign numbers are not unique codes; certain punctuation signs are represented by the same braille symbols. For this reason, the number sign or numeric indicator is still used, and a new indicator, a punctuation indicator, is introduced.

Another area of difference is in grouping symbols. Certain grouping symbols (parentheses, braces, brackets) are represented by two different braille symbols depending on the nature (literary or mathematical) of the material they enclose.

Also, as in the case with grouping symbols, certain punctuation signs (, . etc.) may be represented by two braille codes depending on the nature of the material.

Finally, there are new symbols for mathematical signs which are not found in literary material, i.e., integral signs, arrows, fraction lines, etc.

Now, in addition to these differences. we have also some rules about the use and nonuse of contractions as they might affect the reader's understanding of a mathematical expression. Some of these rules are very nice and easy. For example, if there is a word which might be contracted in Literary braille in direct contact with a mathematical expression, it wouldn't be contracted. Similarly, there are new rules for the contraction and spacing of TO, INTO, and BY when they are in a mathematical expression.

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Then, there is the area of rules which is less clearly defined such as the use of short form words or contractions in a context which might cause confusion to the reader. To quote a sentence from the Nemeth code book, "The hypothesis about AB is untenable." For those of you who know Literary braille, the word "about" is contracted "AB." Thus the reader would read "The hypothesis about about is untenable." Although a more difficult rule to program, it can be handled in most cases. For example, the braille symbol for the integral sign is the same as the contraction for THE. When they are in contact, the word THE should be spelled out.

A less complicated difference, although one which may cause some problems is the handling of certain capitalized material. For example, when a group of capital letters represents a mathematical expression (the triangle ABC), the capital sign should precede each letter. Handling this will probably require a special code from the keypunch operator, since a computer program cannot determine whether a group of capitalized letters is a word or a math expression.

There's another aspect of Math braille which is really not an aspect of the Math code itself but rather an aspect of mathematical text as produced in print. This has to do with special kinds of formats —i.e., certain spatial arrangements on a page in presenting a series of exercises to be performed or presenting worked out examples in division, multiplication, etc. Also, very frequently in arranging a series of equations, there are spacings that are determined by trying to line things up on a certain sign or symbol, e.g., an equal sign. In general, our aim is that the braille arrangement should reflect the inkprint arrangement as much as possible.

Our general philosophy in writing this program is first of all to make sure that it is expandable. Because the original emphasis is on developing a program which will translate elementary school texts, the table structure and plan for subroutines are designed to simplify expansion to handle more advanced mathematical texts.

In addition, the philosophy of our program is concerned with the keypunch operator for, as in Literary braille, he will prepare the text. We want to minimize the amount of extra punching and, therefore, training required of the operator. The keypunch operator need have no knowledge of braille nor of higher mathematics. An average high school background in math should be sufficient to enable her to keypunch the text. Thus, speed and accuracy are maximized. New format codes have been designed to simplify the operators task and have been tested by the operators at APH. For example, an array of exercises will be preceded by a simple format statement which will indicate the number of rows and columns. The operator will then punch the numbers in a stream. The program will supply the spaces necessary for the program arrangement. It turns out that the aspect of the program that is doing the spatial arrangement probably poses, although it would be the biggest problem for a braillest, one of the less difficult problems for the computer to handle.

As is well known to you all, any math textbook is a combination of Literary and Math braille. There would be no point in our writing a separate math program which would include the ability to take care of all the literary material. The Math program will serve essentially as a pre-processor box, which will analyze the input information, insert additional codes where necessary, and then pass these codes to the literary translation program. Since elementary school texts are a mixture of literary and mathematical material, it was decided that the present program should do all the translation into braille. The Math pre-processor will make use of an internal expanded code which, when it is located in an expanded Grade I table, will provide the proper braille code. These internal codes will be used for such symbols as numeric indicator, punctuation indicator, etc. — symbols for which there is no inkprint equivalent. The input analysis performed by the Math box is planned in such a way that completely literary material can be identified and passed along as quickly as possible in order to speed the translation process.

The kind of table that will be required for the Math processor is, relative to the literary table, a much smaller one. It will include abbreviated mathematical expressions, a few whole word contractions and a selected list of short form words. This table will not include the braille equivalents, but will be used to identify mathematical expressions and to flag words which should not be contracted. Where necessary, the Math box will pass along to the Literary program the special codes which initiate, and terminate Grade I translation.

Present emphasis is on subroutines which will handle the insertion of indicators (numeric, punctuation, etc.). This will require analysis to determine whether material is literary or mathematical. The structure of the main program is such that additional subroutines can easily be included.

QUESTIONS:

K. Ingham: "What do you do with strings of alphabet letters which are of mathematical significance but which are also contractible braille?"

A. Schack: "In some of these cases, we will have to ask for a flag from the operator to tell whether it is a mathematical expression or not."

R. LaGrone: "What do you do with hyphenation?"

A. Schack: "Hyphenation is in the literary program. As it currently operates, we do not hyphenate and we've made no attempt to hyphenate."

BRAILLE OUT-PUTS FROM READING MACHINES

Kenneth R. Ingham*

Since the summer of 1956, the Cognitive Information Processing Group in the Research Laboratory for Electronics at Massachusetts Institute of Technology has been engaged in the development of reading machines for the blind. At present, the Phase I reading machine has been completed. The in-put to this machine results from an opaque scanner consisting of two photo-multiplier tubes receiving light reflected from the printed page. The light source is a beam focused onto the page from the screen of an oscilloscope. The beam is positioned with the aid of a special purpose computer which provides the interface between the scanner mechanism and a medium-sized digital computer.

The scanning algorithms which direct the contour tracing of the ink print characters generate code words derived from the east-west and north-south extrema of the print. The last evaluation tests indicate that the error rate of the scanning is less than one character per 1000 scanned.

The out-put from this system consisted of spelled speech. However, continued research toward a Phase II machine has resulted in the implementation of a synthetic speech generator and a grade II braille translator. Since this conference is concerned mainly with braille research, I will not discuss further the speech out-put modes.

It is important to note that the development of this and future reading systems is basically part of the M.I.T.-R.L.E. Research Program and no application toward production is intended. Therefore the braille programs were written with the research possibilities uppermost.

The heart of the translator is the dictionary whose entries contain four pieces of information. The first is a code which characterizes the type of braille contraction. The second is a count of the ink print letters representative of the entries, and the third and fourth pieces of information are respectively the ink print and braille representations. Furthermore, the entries are stored alphabetically according to the last letters in the print string. In addition, the longest contractions or abbreviations are listed in an alphabetic group.

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The translation begins when a "word" is detected. A "word" is defined as a string of print characters between spaces and/or carriage returns. The comparison of the string with a given dictionary entry begins with the end of the print string in order to take advantage of the languages' bias for contractible suffixes. When a match is found, a braille string is placed in the out-put buffer, and the translator looks for more in-put. One of the reasons for this dictionary oriented translation is that the entries may be augmented or removed with very little difficulty. Also the braille code used may be expanded to 7,8, or 9 dot braille by reading-in a new dictionary without changing the translator. This permits not only research with more complex stimulus patterns but permits a study in code optimization as well.

The above program is used to drive an embosser built by the Mechanical Engineering Department at M.I.T. However, plans for field versions of the reading machine include the implementation of other tactile displays. These may include such a device as the bead belt display built in the C.I.P.G.

The braille translator is addition to producing grade I and 2 braille has also a mathematics code. Unfortunately, there are two very large problems which we encounter at this point. First, while we have no great difficulty with a scanned literary in-put, the problems with two dimensional ink print such as in the representation of mathematics are enormous. Secondly, even if one were to depend upon human intervention in the inputting of highly formatted material, the amount of such intervention for technical material might be so great as to make the development of sophisticated math translators not worth the effort.

I would very much appreciate comments concerning these questions from those at this conference who are working in this area.*

* This work was supported principally by the National Institutes of Health (Grants I Pol GM-14940-01 and I Pol GM-15006-01), and in part by the Joint Services Electronics Program (Contract DA28-043-AMC-02536 (E)).

QUESTIONS:

H. Freiberger: "Could you elaborate on the image presentation system with 64 wires?"

K. Ingham: "Essentially what it is is an oval shaped roller, the top surface of which is flat enough to give you a 1 1/2' x 2' wide surface which can be felt by a braillist. The wires are strung out horizontally, 64 of them. On the right end, say, you have a number of gates with beads or eyelets which slide onto the wires and a computer operated program will open the gates, allowing the beads to spread out on the wires which will be moving from right to left. The beads will travel with the wire as soon as they are released and, depending on when you release them, you'll get a picture or even text, if you wish, displayed.

One of our ideas is that we will do some 9 dot and 8 dot experimentation with this sort of system.

You have 64 wires but there is an unlimited number of beads.

We also hope to experiment with different sized eyelets as stimuli."

C. Rodgers: "Just what is the nature of the tactile display?"

K. Ingham: "The current output device that we are using on the reading machine is the mechanical engineering embosser which was described here yesterday. We actually have it online to the machine. The scanner will find a word, the program will pick it up and then punch it immediately on the embosser. The end result is a hard paper copy."

THE ROLE OF IBM IN RESEARCH AND DEVELOPMENT OF AIDS FOR THE BLIND

R. E. LaGrone*

Although this time period was allotted for a discussion by IBM on the production of braille on large computers, circumstances have dictated that we change this topic. We have elected rather to place in proper perspective the part IBM has been playing for over a score of years in the research, development and production of aids for the use of the blind. I shall begin by presenting to you a brief outline of past events and then endeavor to review current research being conducted.

Mr. T.J. Watson, Sr., for many years IBM's President, had long been interested in the development of devices which would serve to further the independence of the blind individual. This interest is also being shared by Mr. T.J. Watson, Jr., IBM's current President. This fact together with eagerness for new ideas found fertile ground.

One of the first endeavors was the Bryce Braille Reader, developed by Mr. John Wheeler and named after a prominent IBM scientist. This instrument is very similar in nature to the display device demonstrated at the conference yesterday, having a paper tape input and displaying information on a neoprene belt through which small metal pins were automatically pushed to form the braille characters. Information was formed character by character until a line 10 inches long was formed. The belt was propelled by an electrically driven motor whose speed could be regulated. Development was begun on this instrument in 1945, and it was displayed at many agencies and institutions for the blind. General David Sarnoff had at one time expressed an interest in setting aside wireless teletype frequencies for the production of input tape to the reader in order to produce a newspaper or such other information as is disseminated by wireless teletype. Due to the difficulty at that time of obtaining proper materials for the reader, the project was shelved. It has recently been revived, however, and it is expected that an improved prototype model will be available shortly.

The Banks braillewriter was developed and manufactured by IBM in one of our California assembly plants.

The IBM Model D electric braille typewriter, which you saw demonstrated yesterday, was the result of much blood, sweat, and tears on the part of

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* Systems Programmer, IBM, Gaithersburg, Maryland.

its developers, Mr. Pramuk and Mr. Harp of our Office Products Division. At many points in its development (and the Spindle Top Project was only one of these), the device was nearly ready for announcement but imperfections were found at the last moment and the project had to continue until a perfected device could be marketed.

The acquisition by the American Printing House for the Blind of the IBM 709 and the preparation of the appropriate software by Fred Brooks, Bob Mertz, and Ann Robinson Schack (at the time all IBM employees), represented a major break through in the area of computerized braille grade II translation. The system's implementation and later improvements made under the able guidance and supervision of Mr. Bob Haynes and Mr. John Siems of the American Printing House for the Blind staff must surely stand as a landmark in the evolution of braille and its production. Inherent in the system design, unfortunately, were factors which restricted the type of application to a select few. Except for maintenance of the hardware, this project was dropped by IBM, and further research and development was carried on by M.I.T., Schack Associates (an independent programming group), and the American Printing House for the Blind.

Another braille grade II translator program was written by Tom Reifsnyder for the IBM 1401 with no special features. With a blind child in an integrated public school system, Tom soon realized the problems involved in manual transcription of ink print text books into braille. Under this system, the volunteer braillest flagged contractions and indicated formats by marking asterisks and other special characters in the text books. The material was then punched onto cards and these cards were used as input to the program. The program translated the text by means of built-in dictionary. Output was punched cards. These punched cards were used as input to a card-to-printer program which had the added capability for making multiple copies. The printer used was an IBM 1403 with a piece of elastic between the paper and the print hammers and with the printer clutch set to eight lines per inch. In April 1967, this program and its documentation was made available as a public service through the local IBM branch office.

When I joined the company in June 1965, the computing industry was just beginning to feel the impact of the inroads being made by the blind programmer. IBM Systems Engineers and Sales Representatives, when requested to provide support for blind individuals on their accounts, could not do so because they themselves did not have the answers. I, therefore, accepted the responsibility for setting up a central distribution point for information, the evaluation of existing devices and devices under development, and suggesting new ideas for aids to be developed. Accomplishments in these areas include:

1. Experimentation with various machine flow charting programs as a means of communication between the blind programmer and his sighted colleague.
2. Evaluation of various types of punched card readers, performance of new braille display devices, such as modified high-speed printers, typewriters, etc.
3. Development of System/360 braille translation software for the use of blind programmers.

Concerning the last-mentioned point, two System/360 braille programs are now in use. Both are general purpose programs designed to accept as input cards and magnetic tape. The output goes directly to the printer as in the Reifsnyder method. One of the tape input options provides for formatting as specified by the control characters on the Text-90 print tape. Text-90 Automated Documentation System is the medium through which many of the IBM computer manuals were prepared and disseminated. One version of the program is run either as free-standing object deck, independent of any operating system, or the program source statements can, with the proper control cards, be stored in a library and executed from there. The second version System/360 braille utility program is designed especially for Operating System/360 and is designed to operate under control of the operating system, taking advantage of the OS/360 characteristics. This version of the program may also have as inputs direct-access devices supported by OS/360. These programs are also available through the local IBM Branch Office to users of System/360 as a public service. There are many type IV customer-contributed program documents on Text-90 as well as some computer manuals. Shortly after the conclusion of this effort, the Publications Department threw us a curve and converted to Text-360 for the publication of their manuals. This has necessitated a reprogramming effort which is now underway. A DP Techniques Brochure will shortly become available explaining the nature of braille, how to obtain braille translation programs for the 1401 and the 360, and how to obtain the above-mentioned print tape.

A related activity, but one which is destined to find a much broader scope of application, is the present investigation now underway on the problem of an up-to-date braille grade II translation system for the IBM System/360. The problems involved are infinitely more complex than are those encountered in the simple one-to-one correspondence braille translation programs which are so readily available. The basic problem to be solved by this effort is to relieve the burden of the volunteer braille transcriber. Correlated to this is the problem of making a braille translation service acessible to as many people as possible. This is in contrast to the present system now used at the American Printing House for the Blind and hopefully will not be a duplicated effort. Another problem is the selection and/or combination of the most modern programming techniques. Although the Schack techniques have, up to now, been the most practical, we are sure there must be other ways. The Nemeth techniques with the self-updating features may prove to be superior to Schack, especially in the area of intra-word translation. Still other ideas exist which are currently under investigation.

The high-speed printer, the typewriter, the documents on external storage media, the third-generation large capacity storage computer—— all are with us today. A 360 braille grade II translation system is therefore the next logical step.

RECENT DEVELOPMENTS IN COMPUTERIZED MATHEMATICAL BRAILLE

Abraham Nemeth*

Although I have been requested to speak on the subject of "recent developments in computerized braille", I shall not confine myself to this subject alone, but shall also present a point of view for the encipherment of literary braille not hitherto mentioned here or in any literature that has come to my attention.

With respect to computerized mathematical braille, I must first tell you that I have not been working in that field. Nevertheless, I do have some thoughts on the matter which may be of some interest here.

A little history of how the Nemeth Code came into being will point the way for its implementation on a computer. In the days when I was studying undergraduate and graduate college mathematics, I enlisted the services of my wife to do the necessary reading. Although she does not have much formal training in this subject, a way of reading the mathematical signs evolved between us that made the comprehension unambiguous. For example, she would say: "x to the...power, plus y to the...power", etc.

Because of this method of reading, it was possible to write down what she read at dictation. To do this, it was merely necessary to devise a set of shorthand braille symbols for such expressions as "the fraction", "end of fraction","end of radical", "to the", "power", etc., and this collection of shorthand characters is what has become known in the Nemeth Code as the set of <u>Indicators</u>.

Now the computer implementation of this technique almost suggests itself. It is merely necessary to devise a set of keypunches for these same expressions and to program the computer to translate these keypunches into their corresponding braille indicators.

Although this is undoubtedly an oversimplification, it does go a long way toward effecting computerized mathematical braille. It is a reflection of the close, almost one-to-one correspondence, between the printed text and its braille equivalent which the Nemeth Code makes possible.

With regard to the literary braille aspect to which I referred earlier, I hereby submit in its entirety a transcript of a piece of correspondence which passed from me to Mr. Robert LaGrone of IBM. Its contents concern precisely the point of view for the encipherment of literary braille which I had in mind during my opening remarks.

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Technique for Accumulating Information

A <u>cumulative information</u> code furnishes information concerning the part of the word (more properly, the unit of context) already enciphered. A <u>classification</u> code is associated with each character. By combining the cumulative information code with the classification code to form an augment for a table lookup, it is possible to

(1) specify the action required for the new character, and

(2) replace the cumulative information code by a new one, if necessary, thereby updating the information which is available as a result of the character just deciphered.

In the report which I wrote, it was necessary to use two-digit numbers for these codes, but with modern computers, a single alpha-numeric character will do. The body of the report describes the general procedure, but the appendix actually specifies the codes used and the action that must be taken for each combination of the two codes. This information is in tabular form.

Tabular Material

My research did not provide any means for the encipherment of tabular material, pictorial material, etc., however, if the editor supplies information to the key punch operator as to the amount of space occupied by such material in the printed text, the program can be made to skip enough spacein the braille transcription for the insertion by hand of such material at a later time.

Volume Breaking and Tables of Contents

The appendix to Section 1.4.2.2 of my dissertation addresses itself to these matters. If the computer can store two complete braille pages at a time (inquiring about 2,000 alpha-numeric characters) then the computer can automatically break the text into braille volumes and compare a table of contents for each volume if the following information is made available:

(1) number of cells per braille line
(2) number of lines per braille page
(3) optimum number of pages per braille volume
(4) number of characters on a line of print
(5) number of lines on the printed page
(6) number of pages in the printed text
(7) list of page numbers in the printed text containing suitable break points for braille volumes.

By keeping in storage two full braille pages, the calculation of the space required for foot notes as well as their insertion at the proper place can also be automatic. Similarly, center headings can be placed either on the current page if there is enough space left for some of the material which follows this center heading, or it can be deferred to the top of the next page if there is no such room.

Technique of Word Segmentation

Before enciphering the word as a whole, an attempt is made to divide the word into segments, these segments being prefixes, roots, and suffixes for an exact match. Even when an exact match is found for a prefix, the letter sequence is regarded only as a potential prefix subject to later confirmation. Confirmation consists in finding an exact match of the next letter sequence with a root. If a prefix is confirmed in this way, it is enciphered as though it were a word in its own right; if no confirmation exists, no separate encipherment is undertaken. In this way, contractions which overlap a prefix and a root are avoided, as is required by the rules of English Braille, Grade Two. A bonus consequence of this technique is the ability to hyphenate in a large number of cases. For, if there is room on the braille line for a prefix but not for the root which follows, the prefix plus a hyphen (if there is room) is placed on one braille line, while the root is placed on the next braille line. A string of prefixes can also be confirmed by an adjacent root, in which case each prefix in the string is enciphered separately. Again, a hyphen can be placed between any two such prefixes when there is no more room on the braille line for the next segment. A few examples will, perhaps, clarify the concept.

In the word PROMISE, each of the segments PRO, MIS, and E encounters an exact match in the table of prefixes. However, no confirming root is present; accordingly, this word is enciphered as a whole-all possible contractions (in this case none) are used, and no hyphen is attempted, although in this case the dictionary permits hyphenation after the M.

In the word INFRACTION, INFRA is recognized as a prefix, but is not confirmed by any insuing letter sequence. However, further checking shows that IN is a prefix which is confirmed by the root FRAC. If necessary, a hyphen will be placed after the N. In this case, further programming is required to avoid the IN contraction if it is to be followed by the hyphen. On the other hand, INFRARED will be properly segmented since RED is a root and, if necessary, a hyphen will be placed after the A. In any case, the AR contraction will be avoided.

In DENTIST, DE will be recognized as a prefix, but no confirmation is available. Therefore the word will be enciphered as a whole and the EN contraction will be correctly used. This word will not be hyphenated.

In UNDERIVED, UNDER is recognized as a prefix, but is not confirmed as such by any subsequent segment. Further comparison with a table of prefixes shows that UN is a prefix followed by the prefix DE. Confirmation comes from RIV as a root. Each of the two prefixes is enciphered separately and the hyphen will be placed after the first or after the second prefix, if required. In any case, the ER contraction is avoided, as is also the contraction for UNDER.

In STOREROOM, no prefix is encountered. However, the root STORE is followed by the root ROOM. The roots are enciphered separately and the ER contraction is avoided. If necessary, a hyphen will be placed after the first root. I hope I am clear!

Music and Mathematics

My research did not envision either of the codes relevant to these subjects. The structure of the Nemeth Code is such, as to be very amicable to computer programming. Essentially, one need only devise codes which are in a one-to-one correspondence with the names of the indicators in the Code.

THE DEVELOPMENT OF AUTOMATIC BRAILLE TRANSLATION IN GERMANY

Gunther Lamprecht*

Historical Survey

The first attempts to produce braille prints by means of electronic computers for the German language started in 1962. In that year Professor Werner learned from Mr. Mansholt, a blind school teacher from Hannover, that first experiments had been made in the USA to generate braille-prints by means of computers. It was realized that this method should in the long run help to produce books cheaper than by manual production and that it may help to overcome the shortage of braille punching people in our institutions. In addition, it should help to produce more books than are now available for the blind community. So, the first project on automatic braille translation was started. We did not expect a generally positive agreement, because Professor Strehl, in an earlier publication, pointed out that he didn't think automatic braille translation was feasible. You will hear that he was correct in a certain sense. At first we, therefore, avoided public attention in order to work unperturbed. To demonstrate the principal feasibility of automatic translation, a program was produced for the IBM 650 and run at the University of Hamburg in the summer of 1962. The results were in braille I which contains only a small number of contractions, but the difficulties described below already appeared. This machine, however, was too small for the production of Grade 2 braille. Therefore Mr. Dost had to rewrite the translation program so that it could be used on an IBM 704 and later on an IBM 7090, in the German Computation Center (Deutsches Rechenzentrum) Darmstadt. It was written in FAP code and was probably comparable to the program already available within the U.S. written by Mrs. Schack. The very first trials in Germany were printed either in inkprint and proof-read by German blind school teachers or punched onto braille paper by students who copied the output of our IBM computer. These copies were passed from one person to another and so we got advice from a circle of friendly people for our project.

Encouraged by these persons, we dared to present a sample to a larger community by the kind cooperation of the American Printing House for the Blind, in particular, Mr. Zickel. The sample was punched onto metal plates and these metal plates were used in Marburg to produce a larger number of braille prints.

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In 1964 it was realized that it is impossible to produce perfect translation of inkprint to German braille and therefore a first proposal was written by teachers from the blind schools in Hamburg and Hannover and the result was published by Mr. Dost and Mr. Seibt. In 1965 the project had progressed so far that we could report publicly about it at the 25th Congress of blind school teachers at Hamburg. The reception of these plans was quite positive.

In the last year the computation center of the University of Munster received an IBM 360/50 and Mr. Dost rewrote the translation program for this computer. The program language PL/I was used, because it facilitates the handling of character strings and it is easier to adapt to variations than the machine code. Of course, using this high level language reduces the production speed of the translation by a factor 10 to 15. Later on it is planned to rewrite the program in the assembly language, as soon as the program has reached a certain state of perfection.

In the last year, an automatic brailler of the American Printing House for the Blind was delivered. It was financed by a grant of the Deutsche Forschungsgemeinschaft (German Science Foundation). Unfortunately it took several months for this brailler to reach Germany and apparently it didn't fare too well on the trip. So, we had to make some repairs before we could use it. It is now working excellently.

In this short survey I could not mention the very good suggestions and advice we have got during the time in particular of many of those working in the USA and we wish to express out sincere gratitude for this help we received.

The particular problem of translating German into braille

In the German language, like in English, there are some letter combinations that are abbreviated in Grade 2 braille as contractions. Of course this can principally be done by a machine that recognizes those letter combinations. The difficulties arise from the fact that one rule of the German braille states that a contraction must not be used if the letters belong to different generic parts of the word. Now this causes a great problem in the German language because one may concentrate many words to one composite. For instance HAUSTURSCHLOSS means lock of the door of the house and one could end up with monsters like HAUSTURSCHLOSSHERSTELLERVERBANDSVORSITZENDER which is written without any hyphen or break as one word. Obviously in forming such composite words, one can easily get such combinations of letters which are to be contracted in a word but must not be contracted across a boundary of two parts of a word. This will cause difficulties for the translation program due to the fact that a translation program only considers letters of the letter string to be operated on.

To be specific, let me make a few remarks on our translation program. The input are IBM cards containing the inkprint text. The output are again IBM cards containing the braille in a form assessable for the brailler of the American Printing House for the Blind. The program consists of two main parts. One program uses the given braille rules to generate the dictionary. The second program then uses this dictionary to generate the translation proper. The translation works on the letter string by which the inkprint text is given and translates pieces for which it recognized a unique translation.

We do not store all contractions and words (that take some special rules and exceptions) in lexicographical order and go along by a look-up mechanism but have a different way of arranging the entries of the dictionary for a number of tables and, in this way, we gain rather high translation speed.

I do not want to go into the details of the program (which I have brought along as a microfilm) but I would like to emphasize that we can easily handle every rule that is only concerned with the sequence of letters regardless of the meaning of the neighboring letters, that is, the meaning of the word. On the other hand, it was already pointed out that there are quite a number of rules that cannot be taken care of. The question is what to do in order to get a clean translation. There are several possibilities.

a) One is to store a dictionary of the total German language and associate the correct braille translation. This way is not feasible due to the limited capacity of all computers and the slow speed obtained this way.

   Certainly the analysis of the German language makes it possible to take into consideration some rules of the language by additional entries of our present dictionary and additional storing of what we call pseudo contractions. But it does not change the principle impossibility of this method.

b) A different way is the following. In preparing the black type text, one may insert characters between letter strings that may not be contracted. For instance, a slash between HAUS and TUR in the word HAUSTUR. This method was used in our very first examples. We disposed of it because the rate of typing errors is enormously high and because we plan to use linotype-tapes in the future which are coming directly from a printing house and do not contain this additional information.

c) Another way is to add to the automatic translation manual proof reading and final editing of the text. This method is certainly practical and I understand that it has been used at the American Printing House, but we do not like it very much because we want to obtain a truly automatic way of producing braille.

d) Finally we may leave the errors that arise in the translation. We have some good reason to do so. There are only a few German blind that know all rules of the complicated braille system. In order to give an impression of this system, let me give some quotation from an article by K. Britz, published in 1963 in "Der Blindenfreund". "The description of the braille system is laid down in German braille on 100 pages of the large format of braille, in English about 50 pages in a small format of braille, in French about 30 pages of a small format of braille, in Swedish about 8 pages of a small format of braille." The error quote in our present program which works with quite a number of rules approximately fitted to the language (for instance to distinguish between prefixes and suffixes and the stem of a word) averages one error on two pages. This is not very high but we would still like to get rid of it.

Proposed Solution to the Difficulties

Our request is: Change the rules of Grade 2 braille that only the sequence of letters of the black type are used to determine the Grade 2 braille characters.

It seems that the time is due for such a reform. In the last 15-20 years, different proposals have been made for changes of the braille rules. We like to quote the proposals of Mr. Britz, who is teaching in Marburg, van der Mey, who is assistant of Mathematics in the Netherlands, and the working group of blind school teachers of Hamburg.

The group of persons reading braille in the German language has an estimated number of 20,000 (in every age group and every level of intelligence). Since the braille literature already available should be preserved, the present braille rules should be changed to as few as possible. One could set up the following guidelines for this (compare Seibt and Dost, 1965).

1) The available braille type literature should be readable due to the new rules.

2) Older readers need not change their reading habits, need not learn the new rules for accepting the new literature.
3) The new Grade 2 should be a unique translation of the black type writing without any regard to the meaning of the word.
4) The new shorthand should be easy to read and the rules should be easier than the present one.
5) The increase in volume of the braille prints should be limited to a minimum.

If one considers the now already available examples of the German language produced automatically, one gets a very favourable result with regard to these guide lines. This has encouraged us to start larger experiment which I will describe below.

The rules of the German braille printing are fixed by a commission which is made up of representatives of Switzerland, Austria, East, and West Germany. I have learned that the commission that was in session permanently for the last year, although there was perhaps only one session in one year, has not made any decision at this time with regard to the different proposals. Unfortunately, in addition to the inherent problems, political problems are added to the difficulties since the representatives actually belong to different political systems. On the other hand, it is hoped to avoid a splitting of the braille rules into eastern and western ones, because otherwise our work would be paralysed. We do not expect the commission to come to a decision in the near future.

This may be an advantage with respect to our work. The new experiment we want to start is namely the following. The Printing House of a big newspaper is willing to give us the linotype tapes of some articles of a weekly newspaper. This will save us the time of producing the black type tapes on IBM cards. The linotype tapes will be read on the tape-reader of the IBM 360/50 of the Munster Computation Center. They will be translated into braille. The automatic brailler will then punch the metal plates. These metal plates are sent to the Blindenstudienanstalt Marburg, where the copies should be produced. As far as we can see, the technical difficulties are solved and the costs of this experiment seem to be covered by a donation. We hope that in the near future, we can put out this paper in braille (about 20 braille pages) only one or two days later than the ordinary paper is out.

Our translation program is extremely flexible, written in the high level program language PL/I. It is easy to adjust to other rules. Thus we may test different proposals of the commission on the braille rules by producing a translation and furnish the material for the decision. Thus the commission need not make a decision beforehand, but can really try what is produced. So far the response of our work was always positive. One has, however, to keep in mind that we have contact primarily with good willing people. The newspaper is planned for distribution to about 500 people. This is not much compared to the 20,000 blind of German tongue. However one has to keep in mind that many people stick to other means of information, for instance to the spoken word of a radio and the library of audible material rather than to the tiresome reading of braille. In addition, political reasons may cause this experiment to be bound to the western part of Germany. Nevertheless we hope to reach 500 people that will let us know of their criticisms and possibly make proposals for changing the braille rules.

It seems to us that the time for the described work is rather fortunate. At present the Blindenstudienanstalt Marburg got a new energetic director. The blind schools are headed by openminded supervisors that sympathize with our work. We cooperate rather closely with the blind school teachers that know the trouble of communicating the braille rules. Of course we still may have to cope with the organizations of the blind. We will try to pursue the same way we have done so far. We will first pragmatically generate some examples, show our results and we will be open to discussion in order to improve what we have done. There will be certainly a lot of obstacles but we are rather optimistic that there will be a feasible solution for generating braille automatically at the end of this way.

Let me finally make a few remarks.

During one meeting on aids for the blind it was remarked that Germany hardly produced any instrument for the blind in the last 20 years. It seems that the situation is improving now. The Blindenstudienanstalt Marburg was able to hire an engineer with a masters degree to take over the development of tools for the blind. I had the chance to visit the Marburg laboratories of the Blindenstudienanstalt two weeks ago and I think I am allowed to say that the Marburg stereotype brailler which was used in producing the metal plates for decades in Marburg will pretty soon be connected to a paper tape reader in order to automatically emboss braille prints too. The paper tapes can be produced by our program for instance. In fact I have seen that the prototype of this machine is already operating quite well. I think it is no secret that the machine is to be announced in the public soon.

COMPOSITORS TAPE TO BRAILLE:

PLANS FOR PRODUCING A BOOK AND MAGAZINE

Ann and Joseph Schack*

Very briefly, DOTSYS is a system of programs designed to take as input compositors tape used to set type and convert the compositors tape information to a form suitable for input to the braille translation program. Originally the program was a series of programs, or boxes, which could be linked in various configurations to achieve a particular translation. The system was designed to run on the 7094 computer at M. I. T. which operates on a time-shared basis (CTSS).

As has been demonstrated several times at M. I. T., the system produces an intermediate file which contains the special format codes which are currently inserted by the keypunch operator. The system includes a Braille box and a Format box. These, however, are demonstration programs and are not as inclusive as the production program which is operating at APH.

We are now engaged in a project to produce a magazine and a book, using as input compositors tape. There are a series of modifications that must be done in order for this to become a production system.

The first thing is to modify the demonstration program, i.e., the compositor conversion program which currently exists for the M. I. T. computer so that it can be operated on the 709 at the Printing House. These modifications will include rewriting those parts of the program which are CTSS dependent. The INPUT, TELCON, and UNICON boxes will be made "free-standing" and an interface will be provided between these boxes and the present production program.

The original program used as input unjustified compositors tape which had been used as input to typesetting programs. These tapes, in addition to the complete text, had special format codes which were interpreted by the typesetting programs. The programming problem is, then, to take the information on the compositors tape, reject what is not needed, inset the information that is necessary for braille translation and thereby reproduce exactly what the keypunch operator would have produced copying the printed text and following the instructions for keypunching input into braille. Each compositor has different typesetting programs and therefore different sets of input conventions. (Two versions

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of TELCON were written — one to handle UPI tape and one for the Poole Brothers tape.) Because of this, it has been decided to revise TELCON to convert output tapes. These tapes will contain only codes to operate the linotype equipment which is fairly standard and, thus,we can gain some measure of consistency and minimize the need for revisions to handle new tapes.

Currently, the braille editor reviews and annotates the inkprint copy of a book before it is keypunched or brailled. The braille editor at the Printing House, having the book in front of him or her,can go through and make certain critical decisions: should we indeed italicize this word, should we set this in such a way, etc. When a punched paper tape is the source document, new editing procedures must be developed. For this system the output from UNICON will be printed. This is the intermediate file referred to earlier which contains all the text material plus the necessary format codes. This would then represent a hard copy of the book along with the necessary information for translation. An editing program will be provided which will enable the braille editor to change, delete, insert, or retype single letters, words, or streams or words wherever necessary. The edited file will then serve as input to the braille translation program.

At the moment we are very busy looking at a series of tapes and galley proofs from TIME magazine which we have received in the last few weeks. The modifications necessary for the teletypesetter tape conversion program will be determined in part by the conventions that are used by the typesetters. TIME material raises some problems which, although not insurmountable, are certainly not trivial.

First, with regard to the tape codes, some differences in type face arrangement will require changes in the TELCON table. Also, certain conventions, mostly dealing with format, will necessitate some re-programming in addition to the rewriting necessary to handle output codes.

Second, in addition to the text material, these tapes also contain instructions to the operators of the typesetting equipment. These instructions would have to be identified and eliminated from the file to be translated.

In addition, we have encountered typographical errors and missing material. Missing heads and misspelled words cannot be identified in the program. These problems would be handled by the editing program mentioned earlier.

The progress we are reporting today has to do with the production of a book as well as the magazine. We have received a lot of cooperation from the publisher and from the printer but we have not yet made the final selection and, therefore, cannot tell you about some of the problems that undoubtedly will exist in the book tapes. We suspect that there will be far fewer problems in a tape used to set a book than in a tape used to set a weekly periodical which must be timely and, therefore, which must require some last minute changes. We expect to review tapes for one or two books in the very near future.

OPEN PANEL ON PLANNING FOR COMPUTERIZED BRAILLE

Robert W. Mann, Chairman

Panel Members: Paul Duke, Robert Gildea, Robert Haynes, Kenneth Ingham, Robert LaGrone, Abraham Nemeth, Joseph Schack.

R. Mann: The format I've elected is to have computer-oriented people on the panel, placing the responsibility on production agencies, users, or those people who are just plain confused to generate questions to be directed to the computer people as to the present state of affairs and the prospects for the future.

Questions:

L. Goldish: I have a unique position in being that I am neither a producer nor a computer buff. The first thing I would like to find out is would the producers be interested in having some sort of packaged program whereby, through some means, either compositors tape or punched cards, etc., which they could take to a service bureau, who would do the computational manipulations with the output returned to produce braille copy.

R. Mann: I think, Lou, that this is an abortive question. It's a little like future directors of the Boeing Company asking the Wright brothers whether there would be a market for airplanes!

L. Goldish: The reason I ask this is because there are other things to consider. For example, I have heard of horse trading but I have never heard of stereograph trading and the first thing that I encountered in Louisville was two groups for the blind, trying to trade a stereograph between them and the first thing that was shown up is that there seems to be a shortage of production of stereographs. Now, if you're going to have all of this great computational system, you're going to have to think about setting up a production line or some sort of shop for producing them. There have been various rumblings that we have such a large number of computational programs now and there are certain commercial establishments which don't want to tell other people what they're doing. They are going to standardize the braille market. We're going to have to bow to them if we want to use it, or they're going to end up holding this thing in their hands and nobody wants to use it because it doesn't fit the type of thing that they can use. You've got to consider not just what your instructions are going to be to the computer but what your instructions are going to be to the people who are going to use it.

J. Beck: We have a job-shop operation at Volunteers Service and our question is how should we prepare input and how should we prepare output?

R. Gildea: I think that you did prepare input and output on a magazine recently in cooperation with APH. You used their service center which Lou just mentioned. As I understand it, JACK AND JILL has been in braille production but this time it was sent to the Printing House which converted it into punched card input, ran the 709 program. prepared plates and sent you the plates. I don't see anything wrong with that. I think that it is a good solution.

P. Duke: Dr. Mann, we need to look not at the electronic aspects but at the agency. Agencies are relatively small. Agencies have a fantastically low operating budget. Agencies rely on voluntary or involuntary help both competent and incompetent. Agencies, aside from APH, have relatively poor plant facilities. Agencies usually orient themselves towards preparation of data for the professionally employed blind adult and for the blind student. The work for the Volunteer Services at APH was done informally and it did present serious problems. Plates were not standardized. Printers were not standardized. There were a few minor corrections and errors. Paper size was not standardized. etc., etc. Cost is prohibitive. You cost per page will double, triple, or even quadruple. I think, though, that we can safely say that we can cut your time by 70% or more. Now this is the context of the situation which we are working it. As analysts and programmers, we should address ourselves to this situation.

R. Gildea: To the point of costs which Paul mentioned, I don't want to get on that bandwagon of promising to quadruple your costs. I think maybe we can ask a producer (APH) what the cost is.

R. Haynes: Computer braille runs right along the same price. Of course with the minimum wage increases we're going to shortly be redoing our cost and our price scales and I would think that at that time there may be some thought that we could do it with the computer for less than we could do it manually. (But this takes into consideration that our computer time is free.) Now I'd be glad to outline some of the problems which you might be thinking about with reference to the computer system.

The first problem that we encounter is the nature of the English language and how it's presented on the printed page and how this applies to braille rules. Now you don't have any standardization of the copy which you are handling and this presents a problem if you are always handling different types of copy. I might give you an idea of a small problem which added to 200-300 similar problems makes a large problem. You're in the middle of translating a book and you find a word that is misspelled. You want your translation to be correct. Do you read the context to determine whether they misspelled that word purposefully or do you think that it is an error in the copy for you to correct? Your input, it seems to me, on a short run system, would be a real problem because copying cards in keypunch fashion for us at APH is practical because we're going to produce a lot of copies from our plates. To copy into a machine readable form for input to produce one or two copies of braille is the problem. It seems to me that it would be a problem which you would have to overcome somehow before it would be practical to translate inkprint into braille for limited editions. Human intervention in the computing area is a major item, especially if you were going to do this in a service bureau environment. I have a list here of 19 items which call for human intervention in the computing process. We found that human intervention for the braille translation is a must. This doesn't make our system impractical but it surely might have a bearing on the bureau environment. I couldn't imagine paying $150/hour for a computer to have that time tied up with some human intervention. And, again, on short run braille, there would be a problem in the output. Now I'm not saying that, because it is practical here at APH, it's going to be practical in an outside environment. There are many problems--but not insurmountable ones.

P. Duke: I want to bring this back to the agencies. Let's consider cost as irrelevant. Is it worth your while? Our studies say that a textbook translation can take from four months to two years. Would you be willing to pay 5 cents a page to bring it out in a month? As far as the APH system, what Bob Haynes said is true. As far as their system goes, it is a beautiful system. It is completely inadequate, not as a computer translation system, but as an information translating and processing system to serve the agency online or otherwise. It will not serve the small agency on the corner that is depending on it. To get JACK AND JILL out, 68 pages, doubled the cost. And, if you throw in my transportation, tripled, not counting any salary services or time off from RCA. They've been more than generous.

R. Mann: In all fairness, Paul, the first model of anything is expensive.

P. Duke: I'm not arguing that Bob. How can we bring this down to the independent agency? You cannot handscribe. It's physically impossible. You cannot train volunteers. It takes two years to train a person in Grade II braille transcription. If we could at least do it in Grade I braille. It may be bulky, but let's get it out. I'm talking about the development of a production system for the agencies.

M. Droege: We are in a unique position at Clovernook. We don't want a computer as yet. There are a couple of reasons: First of all, Clovernook was founded to employ blind individuals. Eighty per cent of Clovernook's employees are visually handicapped. If we should install a computerized translating system, a large percentage of our trained braillists would be out of work or have to be retrained. Another factor to be considered-- the money involved in setting up a computer would still be prohibitive for a private agency. Since the computerized translating system has not yet been perfected and the cost per braille page is still higher than the ones produced on a manually operated stereotype machine, I would like to see a better and more efficient stereotype machine developed that would make better use of the braillists' training and abilities.

J. Swail: We've been talking around one point for a good part of the day. I think that there are two quite independent problems here. There is the problem of setting up the mass production as at APH and Clovernook. For this you need a high level computer program if you do it by computer. You need to obey all the rules of the braille system. But the student who is served by the small agency or the professional man who wants one copy is a different problem. Have any of you people seen what kind of braille these people read anyway? A very inexperienced typist could type this on a typewriter and with a very simple conversion by computer to braille. Sure, there would be lots of mistakes but you would read it in context. You could print it up with something like the IBM brailler.

K. Ingham: We do have equipment, translation programs and machinery to emboss which would be highly competitive with volunteer hand transcribing. I, as a user, would bet that we would even be happy with odd shaped braille pages and the rest of it. This is quite acceptable.

R. LaGrone: In this respect, I'd like to talk a little about the research at IBM and some of the things that have come out of it. We've talked to several superintendents of schools of various cities. We've also talked with agencies. A lot of the school systems now already have computers. The schools also integrate the blind with the sighted. This creates a few problems. The blind must have the same books as the sighted. They rely on transcribers. We've already talked about the problem of delays of four to six months...even years, and then, when they finally do get the book, it's obsolete because the school system has decided to change the text. So, therefore, we get rapid type of input (the type discussed before). We put it through the computer and run it on one of our Kistner display devices and make a few copies and we can come out very quickly with a type of braille.

A. Nemeth: I'd like to elaborate a little on what Bob LaGrone is saying. I have found that in working with the blind you suffer from a disease monolithicitis... everything must be uniform and 100% correct. This is the one thing that I think causes most of our troubles. In the world of the sighted there is no such thing. One publisher will publish it one way and another will publish it another way. Perhaps we could progress to allow for a little tolerance in individuals and still make perfectly good braille to read.

L. Clark: Would the panel be willing to sketch for us several alternative delivery systems for braille, utilizing different configurations of equipment input and output, to serve the several populations involved? I think, for example of Dr. Waterhouse's very clear statement of the need for exact braille for children: in his view, not one error can be tolerated when one is teaching a child how to read and how to spell. Yet, for professional adult blind persons, unstandardized braille can be accepted.

K. Ingham: I think that there is a common denominator which will also serve to answer your question. I think the wisest move would be to consider a centralized braille translation machine and a centralized library of braille translated magnetic tapes which can be distributed at reasonable speed for single copy or other.

P. Duke: I do not think that standardization is the problem because by very essence in data processing, there will be some standardization.

C. Rodgers: This morning I was talking to Mr. Lapin in his office. We were not talking about braille. We were talking about large type. He showed me a large type book for children. The interesting thing about the book is that it was 17" x 12". Now I'd love to see a little child in school sitting with his sighted peers with a monster like that. The reason that I bring this up is that it is all too easy to say let's throw out standards. Nor am I advocating monolithicitis, that disease which Dr. Nemeth mentioned before. Granted there has to be a tolerance for mistakes, but let us not discard completely norms which are calculated to facilitate tactual legibility and insure a measure of physical comfort to the reader -- large type or braille.

R. Gildea: I would like to mention that for a less than perfect braille, I would recommend the consideration of the small PDP8 machine such as Ted Glaser had at Project MAC, with a regular typewriter input and the output which would be brailled by any of these devices which we've seen demonstrated here, but with the addition of a magnetic tape unit. The magnetic tape would copy the input so that it would be saved. The mainline of the system which I propose is an electric typewriter, the small computer, with a 1.8 grade braille computer program, and any of the embossers which we have seen this morning. I think anything of this nature could be put together (hardware) for on the order of $10,000-$12,000.

K. Ingham: May I just add one sentence to that? I am not sure of the 19 points of Bob Haynes, but I point out that, given the input made from some sort of typewriter, the 709 at AHP has so much down time that all the translation for single copy type braille could be done without any infringement on the current use of the machine and all you would need to really worry about would be to have a supplementary translator which eliminated the need for these interventions. Bob Haynes could call his perfect version for APH and others could have their 1.8 braille. The whole point is to start building up tape libraries so that the rerun time is reduced until it is reasonable.

R. Mann: Les, I don't know whether yours was intended as a leading question. It just so happens that I have the proceedings of several previous braille conferences. In the November 1966 proceedings, there is a diagram in which I tried to set out, in a comprehensive fashion, alternative input and output elements in the overall braille processing, information system.

I chose on the right hand side of that diagram to itemize the following kinds of braille copy utilization. Maybe this will be response to your inquiry. If it doesn't, then we ought to hear from users and others who have had experience with braille to determine what has been left out. I listed several main categories: single copy, real-time, multiple access. You only want one or maybe a couple of copies. You want it right away and you are going to get the translation by communicating with the computer. But since you can't possibly tie up the whole computer yourself, it will be the kind of computer which services a number or hundreds of people simultaneously. A person with such an access might use his terminal in a variety of ways e.g., they might be just "talking" with themselves. A blind child learning braille might strike the English keyboard and see what the braille cells were like. A teacher who didn't know braille might be preparing a braille copy of an examination to hand out to the blind child in the classroom the next day. A professional might be using such a facility to implement his own work.

A second category of devices are for when immediacy is not so important. The material would be relatively brief and you only want one copy. Since the terminal should be a portable, braille reading device, coded information should be mailable and disposable. This led us to punched tape but it equally could be magnetic tape with centralized computer translation and subsequent mail transmission of the information to a reading device.

A third category is what I call several copy, lengthy, batch process, bulky, fragile. These include information for which there is not a large braille demand e.g., material that a blind physicist or lawyer would like to have. Here one could utilize the kind of high speed lineprinter that

IBM and Honeywell have developed. The braille could be embossed on-line with the central processing unit doing the translating from, say, teletypesetter tape. Or the actual generation of the embossed braille might be received from the large computer and produced by a much more compact and economical mag tape reader driving a chain printer.

None of these suggested categories compete directly with current volume production using the press embossing operation.

While I believe this is a useful way to categorize braille utilization, it doesn't answer many of the questions posed here today. For example, to what extent should one attempt to centralize certain aspects of the process? A great deal of publishing takes place in N.Y.C. If one seriously intended to avoid the key punching operation and go directly from type compositor's tape to braille, it's clear that one of the likeliest places to do this is N.Y.C. Someone has to go out and retrieve from the publishers these type composition tapes, carry them to a place where there is a tape reader and then efficiently process and store the information. Now, should this same central facility also be the locus of translation into braille with telephone lines to various subscribers? Or should there be a proliferation of small PDP8s for example, which would become almost personal appendages to individuals or small groups who need access to braille? Probably the solution won't be either/or. The question is, what kind of a mix? How do we plan? How do we encourage th most appropriate mix to effectively meet the needs of all those who need access to braille?

R. LaGrone: I'd like to place before you something which is really just a figment of my imagination but I don't believe really too far from reality. Let's select the country of Japan. The Library of the Diet in Japan has 85 prefectoral regional systems throughout the country. They have a centralized information system on which they catalogue a lot of titles and authors of books. The store is on an IBM 2314-2321 data cell drive and let's say that around the various prefects we have various printing devices such as the 1403 on-line printer. We have written a program to run and we have a certain man who has requested a book. He calls in and says he would like a copy of "X" book or journal. The system runs through to see if there is a compositor's tape of some sort which can immediately be translated. If not, then we can prepare input and get it done. Assuming that the others are done, we have a centralized clearinghouse for all these. We get it out and immediately. We can run one or two or three copies of this on our on-line printer near the location of this man and get it immediately to this person. That's an example of a centralized place. Another example is where we have a lot of computers around and a lot of devices but where the mag tape or the storage devices are in a different place than the computers.

R. Mann: I think the problem is how do we get from here to there? How do we convert from our present inadequate basis to the future?

P. Duke: I would like to propose an M.I.T. agency oriented braille translation system which would be composed as follows:
A device onto which I could put a blind or sighted typist, volunteer or paid, who will type and put grade I images on mag tape. I want this device also to give me simultaneously a hard copy so that I may proof-read it. I want to pick up this mag tape and another reel of tape on which I've had my translation program loaded, go to a computer someplace and ask them to donate, or purchase the time. I need maybe an hour a week if I'm really loaded. Then I want to tell the Man: "Here are your instructions: Push that button and on drive 3, you will come out with a tape. Return this tape to me.", whereupon I sit down and look at it. I then take this and feed it through an M.I.T. embosser or that IBM typewriter, etc. But I don't want a computer in my shop.

K. Ingham: It seems to me that we keep coming around to the question of library storage. Is there amongst you any consideration for a serious library storage of this information which is from now on going to be building up very rapidly? Is it going to be strictly limited to zinc plate storage and hard paper copy storage? Or, are you contemplating digitized storage?

R. Haynes: No, Ken, we aren't because we have it in metal plates and, if we want to produce it again, we just put the plates on a press. Of course, we also have an inventory of books so that if one wants to buy a book, we wouldn't take a mag tape and print it. We would sell them one out of our inventory so that particular application, though it's a good one for short run, doesn't apply particularly to our operation because, as you see, it is two completely different type operations.

K. Ingham: On the other hand you do have this central file which lists hand transcribed books and so forth around the country. Don't you find it frustrating not to have your hands on this information?

R. Haynes: That's right, Ken, but the scope of our materials center is not to actually supply the material but to supply information about the material so that's a little bit out of the scope of the center as it's established now. Now, whether that will change or not is to be seen.

R. Mann: Let me observe, Ken, that there's another inventory problem, above and beyond the appropriate format of the converted braille material. That's going to be deciding what kind of compositors tapes you want to retrieve in order to anticipate their availability when somebody says that they would like to have a braille version of a particular text or journal article. Remarkable as it may sound, this beautiful piece of recorded information (the type composition tape) is thrown unceremoniously into a waste basket and carted to the dump. We're going to need an inventory system which makes some apriori judgements on information to be collected so that it will be available when needed.

L. Clark: The American Foundation for the Blind has been asking questions recently about upgrading its system 360. It occurs to me that during this thinking and planning stage that, if there would be any virtue in doing so, I would be willing to ask our management to consider getting funds for the additional series of activities: contacting publishers, getting hold of compositors tapes, and translating these to mag tape, and storing them. I'm asking a very concrete question of braille producers: whether we, as one of the elements in this service system, should actually undertake the effort of finding funds, of getting a programmer, of finding the publishers' tapes, retrieving them, translating them to mag tape and doing something with them.

K. Ingham: Don't even go to the users around you. Go to us. If you had this storage available to you, we would translate it on our machines, scrounge a machine somewhere and we would actually worry about getting production in a limited range (1-3 copy range).

R. Mann: I think what Ken is saying has some very profound implications and let's not lose sight of them. As a result of a very interesting set of coincidences with respect to capability there is a growing group of computer-competent blind people who happily have access to machines in a variety of ways. These people represent a potentially enormous resource in terms of the translation of information into forms readable by the blind. These people can significantly supplement the present producers.

K. Ingham: What we need is raw input and we need to be sure that that raw input stays around for awhile so that we get it or someone else can get it.

L. Clark: Is it the consensus of this group, then, that I should go ahead and make the effort?

K. Ingham: By all means and count on me to help.

L. Goldish: In my report, I've already figured out that, from an economical point of view, it is definitely worthwhile. If you're paying a certain amount for storage, for example, it will cost you about 95 cents per month in storage space alone to keep your zinc plates and it will cost you approximately half a cent a month to store mag tape and I think that, as the producers get more involved and know what's going on, the economic argument is very strong and they'll show more interest in it. According to my figures, a single copy from mag tape on an M.I.T. embosser, if you've got the right type of equipment, will cost $4.00.

J. Pramuk: I'm going to be crassly commercial and make a suggestion as far as small agencies are concerned. Let's forget about volumes, because then you can start justifying plate making here at APH. I'll proceed by reminding you of Dr. Nemeth's remark: "Grade I is better than nothing." In a non-school situation, forget your computers, etc. You have a keyboard on the IBM Braille Typewriter ready for a person who knows typing only and, if you can put up with an error every two or three pages in this situation, you have a pretty fine machine which is here and now. That's not speculation.

V. Zickel: I have a feeling that the answer to the question that was posed earlier concerning the position of the presses and producers has not been very well answered. Maybe I'm misinterpreting that but I wonder would it be in order for you, Professor Mann, to redo your diagram and update it? I think this would sum up better than the written material.

Closing remarks by Mr. Finis Davis.

R. Mann: John Dupress would have been pleased.

APPENDIX A

NEW PROCESSES FOR BRAILLE MANUFACTURE

The American Printing House for the Blind
1839 Frankfort Avenue, Louisville, Kentucky
February 8 and 9, 1968

AGENDA

February 8th

9-9:50 a.m. Summary of ongoing activities at the American Printing House including services, research and development, and production. Robert Haynes, John Siems, Virgil Zickel.

9:50-10 a.m. Coffee break and informal discussion.

10-12 noon. Tour of the APH plant.

12 noon - 1:30 p.m. Lunch.

1:30-3:30 p.m. Panel on computer outputs and braille displays including the modified IBM electric typewriter, the M.I.T. embosser, the IBM converted printers, teletype embossing equipment, and other braille displays. T. Sterling (head), P. Blackman, W. Greiner, J. Pramuk.

3:30-3:45 p.m. Coffee break and informal discussion.

3:45-4 p.m. Braille program at the Instructional Materials Center, Chicago. R. Morrison.

4-4:20 p.m. Report by the Committee on Professional Activities of Blind Programmers of the Association for Computing Machinery. T. Sterling.

4:20-4:30 p.m. Higher computer language for braille translation. R. Gildea.

4:30-5 p.m. Report on progress and plans with math translation program. A. Schack.

February 9th

9-9:20 a.m. Braille as output for reading machines. K. Ingham.

9:20-9:30 a.m. Large computer braille translation at IBM. R. LaGrone.

9:30-9:50 a.m. Review of work in math translation. A. Nemeth.

9:50-10:05 a.m. Coffee break and informal discussion.

10:05-10:35 a.m. Methods used in working with the German blind community. G. Lamprecht.

10:35-11 a.m.	Review of progress on project to produce one book and one magazine from compositors tapes. A. Schack
11-12:30 p.m.	Open panel on planning for computerized braille. R. Mann (head), P. Duke, R. Gildea, R. Haynes, K. Ingham, R. LaGrone, A. Nemeth, J. Schack.