BRAILLE RESEARCH NEWSLETTER

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edited by

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Editorial

Since publication of the last issue, there has been a meeting of the editorial board to discuss the future of the Newsletter. The board decided to continue publication for at least another year, and to keep the Newsletter free of charge to contributors. For economic reasons it was decided not to produce a braille edition, but the American Foundation for the Blind will record the Newsletter on cassette. The audio version can be obtained free of charge by sending a blank cassette to L.L. Clark.

Ink print backnumbers (Nos. 1, 2, 3, 5 and 6) bound as a single volume are obtainable from Warwick Research Unit for the Blind for $15 (payment with order please).

At long last Newsletter No. 4, which is the proceedings of June 1976 workshop in braille codes held in New York, is now available in both ink print and braille. Copies can be purchased from L.L. Clark, American Foundation for the Blind.

The BRAILLEX System

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1. Definition

BRAILLEX may be defined as an electronic information storage and recall system for braille and spoken language, developed to the specific needs of the user. For performing its basic functions, the BRAILLEX system to a large extent is independent of software composed by central institutions.

2. Basic functions

The BRAILLEX system is designed to incorporate the following basic functions:

(i) Register or card index function

This function permits unsequenced information to be stored in braille and/or spoken language after the input of a code word. A selective readout of the information is obtained by simply calling up the specific code word.

(ii) Dictionary function

This function provides an answer in the search for alphabetically or numerically sequenced terms as are presented, for example, in a dictionary.

An internal logic circuit is the key to achieve a marked reduction of the access time in the search for alphabetically or numerically sequenced terms.

(iii) Selective talking-book function

This feature is intended to enable the user to supplement by personal coding of terms, pages, etc., any talking book that is available or being compiled so that selective recall of the book contents is possible at any time.

(iv) Tactile book-reading function

This function makes it possible for the user to read continuously any braille-written books that have been transcribed on braille cassettes.

3. Design features of the set

Size:

comparable to a portable electric typewriter;
front width 420 mm;
depth 500 mm with handle in the retracted position, 545 mm with handle in the drawn-out position;
overall height, including supporting feet and operating keys 178 mm (height of housing 155 mm)

Weight:

16 kg. The set has been designed to serve as a portable unit. Although it cannot claim to figure among pocket-size units, a conveniently located handle makes transportation easy.

Power supply:

220/110 V AC, 50/60 Hz, adjustable.

Power requirements:

50 to 70 VA, depending on momentary duty.

Principal components

External memory: standard commercial C60 or C90 cassettes; special cassettes as being used for data processing purposes are not needed. The C60 cassette is recommended when operations require frequent fast forward and rewind. All data, such as code words, spoken language and braille input as well as internal control impulses are stored on a single track; for recall operations, the tape passes along a special half-track head.

Cassette deck: a special-type deck is used to safeguard ultimate precision of fast forward and rewind stops.

Braille keyboard: a conventional braille keyboard is used, consisting of 6 keys and one space bar. The keys operate electrically and are adjusted to a relatively soft touch so that high typing speeds may be achieved at a minimum of physical fatigue.

Tactile braille display: the set incorporates a braille display with 32 characters of the 6-point pattern.

Internal electronic control and memory: the system uses the advanced microprocessor technology. RAM-, ROM- and EPROM modules are installed for internal memories.

Auditive component: this section basically embodies all functions offered by modern cassette recorders including manual speed control (speed acceleration). For auditory output, a loudspeaker or an earphone can be used.

Operating keys: arrangement of these keys has been based on ergonimic considerations. From this point of view, the set comprises 3 stages according to its basic functions: the first level is essentially provided by the braille-keyboard. The second level comprises the braille display which is arranged to prevent fatigue of the user's hand even when reading more extended chapters of information.

This level also comprises all functions that are related to the reading procedure, for example reading and re-reading of lines. On the left side of the braille display, the second level comprises the cassette deck designed for horizontal insertion of the cassette.

The front end of the third level accommodates the operating keys for the programming and storage functions while the rear end of the third level is provided for operating keys which are not needed during normal working periods.

Adjacent to the cassette deck, the user will find the selecting keys for the cassette mechanism, such as "Rewind to start position", "find out the tape position" where recording can be continued.

Connection plugs, for example to teleprinter, computer, etc., are provided on the rear side. A flexible plug-in cable is provided for connection to the power source.

4. Scope of application

The BRAILLEX system has been designed as a modern technical aid to serve the specific needs of the blind and severely visually impaired persons. It can be used in both the professional and private spheres.

The following examples may be cited to illustrate the versatility of the system:

(i) professional: telephone operators, office employees, lawyers, judges, students, teachers, managers, independent entrepreneurs of various branches,

(ii) private: storage of addresses, telephone numbers, kitchen recipes, data of any hobbies, such as QSL codes of amateur radios, memo-books..., to give only a few examples.

Attention should be given again to the most essential feature: no preprogrammed tapes are needed for any of the applications listed above; the user is free to devise his own programmes and to compile his own records.

5. Operational modes

(i) Register or card index function

Example: telephone directory.

The user first inserts a standard C60 cassette into the cassette deck. If a blank cassette is used, he will enter the first information at the beginning of the tape; a partly programmed tape requires the fast speed key to be depressed to initiate the search for the free tape section.

A code word - in this case the name of the subscriber - is first entered in braille through the braille keyboard. This code word will also appear on the braille display. After checking the word for correct spelling, the key "store code word" is operated to transfer this code word to the tape where it is stored under a binary code. The user will now add the related information in braille or, optionally, in spoken language. For the braille entry, he will write the telephone number on the braille keyboard. The written information can be checked on the braille display. When the information has fully been entered, the user will operate the key "store information" to transfer the information from an intermediate memory to the magnetic tape.

The last step of the storing procedure is to press the key "end of information" which places a symbolic full stop on the magnetic tape. The information frame is now exactly defined. If the user decides to store the information in spoken language only, he will enter the code word and will then operate the microphone for recording the information on the magnetic tape. Upon completion of the information frame, he will finalise

the record by depressing the key "end of information".

These few machine instructions are sufficient for the programming practice.

Writing on the braille display is a continuous closed-circuit process, that means the user does not need to give attention to an exact limitation of lines and length of lines. Upon reaching the 27th of the 32 characters that fill the line, the first 6 characters are erased to clear the space for new characters; consequently, the user is in a position to write continuously with a permanent spacing of 6 characters.

All braille information is first stored into an electronic memory which is sized to store 2048 characters. As soon as 1024 characters have been stored, a signal is released for the operator to press the "enter information" key which will cause the contents of the memory to be transferred to the magnetic tape. While this transfer is being performed, the operator may continue entering information which is now stored into the second half of the memory until, upon release of the signal, the operator gives a new instruction for the transfer of the information to the magnetic tape. This alternate procedure of intermediate and final memorising avoids any loss of time for the operator.

An outstanding characteristic of the BRAILLEX system is that any information may be stored at random by the user, but can be recalled in the desired sequence (a sorted listing of names, for example).

The average access time for the readout of unsequenced information is approximately 30 seconds.

The total capacity of the magnetic tape depends on the kind of input, i.e. braille or braille plus spoken language. In addition, the information holding capacity depends on the number and length of the code words which

the user elects to enter. On the average, however, a C60 cassette will hold approximately 300,000 braille characters which is the equivalent of about 300 conventional book pages of braille.

The length of a code word has been limited to 256 characters, a figure that is unlikely to occur in practice. The user is free to store a great number of code words which may be recalled selectively at his discretion. If he enters, for example, the code words "A-B-C", he may recall the coded information at his option by selecting either A or B or C or even ABC. Whenever, for any of the code words, the user is doubtful, for example, about the correct spelling of a term, he will enter a question-mark for the unknown letter. If he does not remember, for example, whether the name Hunter should be spelled Hunter or Hanter, he will enter a question-mark in place of the questionable letter. The microprocessor-based technology embodies the necessary functions to select and display the right answer.

A similar circuitry permits to ask for a basic subject and all words connected with it. If the user requires a term incorporating the radical "social", he will instruct the unit through this address and will receive a display of all words starting with "social", such as social welfare worker, social help, etc. This circuitry is particularly important in the search for and retrieval of a term with which the user is not yet familiar.

It is imaginable that the user does not remember all of the code words that are recorded on the tape. A special circuit will then enable him to transfer the entire volume of code words into the internal memory. Upon his recall instruction, the memory will display code word by code word so that the user's reading work may be compared to the reading of an index by a sighted person.

As far as the search for and retrieval of unsequenced information is concerned, the user will first press a key for full rewinding of the tape. He will then enter the

specific code word through the braille keyboard and subsequently press the "search" key. The tape starts and will stop at the place where the first information to the code word related has been stored. The binary code of this word is compared with the binary code on the magnetic tape. If the two codes are identical, the cassette deck receives an instruction to stop and to display the information. After presentation of the first information to the specific code word, the user only needs to operate the "search" key to receive the next information that was memorised in connection with the same code words. This procedure permits a rapid recall of the tape-recorded information. It is not necessary for the user to have all information completely displayed each time. If he recognises that the displayed part of the information is not the section which he actually needs, he simply operates the "search" key to have the tape advanced to the next place where information relating to the specific code word is memorised. This possibility to scan the information display enables the user to locate quickly the chapter which he needs at the moment.

The last information is displayed again upon pressing the "repeat" key. This function will prove to be a valuable feature when the operator is disturbed during the display, by a telephone call, for example.

The braille display is read continuously and by lines. A key arranged on the right end of the braille display reacts to a slight touch so that the speed of recalling the next line is compatible with the normal reading speed of the user. An additional key is provided to advance and go back by lines within an information block of 1024 characters at a speed of 5 lines in 2 seconds = 0.4 second per line.

(ii) Erasing information

Although it is self-evident for a system as the BRAILLEX presented here that erroneous entries can be corrected, it is deemed justified to call attention to this feature because it has used to be an item of primary interest in subject-oriented discussions.

When the operator recognises that he has committed a typographical error in entering a code word or information, he simply depresses the "clear" key to erase the erroneous entry by characters (through a short impulse) or by lines (through a more extended impulse).

If the user desires to revise any information recorded on the magnetic tape, he may select either of the following two procedures:

> If the new information is of the same length as or is shorter than the existing record, the user simply writes the new and correct information on the same tape section. The previous entry is simultaneously erased in the same way as on a cassette recorder.
>
> If the new information is more voluminous than the information to be replaced, it is recommended that the latter be supplemented or superscribed by an additional information, for example "revised", with subsequent programming of the new information on the free tape section. The selective readout described in detail before permits rapid retrieval of all information relating to the same code word.

(iii) Dictionary function

This function is intended for handling sequenced information, that means information which is available in alphabetical or numerical order comparable to black-print information.

The Foundation for Rehabilitation at Heidelberg, Federal Republic of Germany, has been entrusted with the task to organise the centralised compilation of dictionaries and encyclopedias. It may, therefore, be expected that standard braille cassettes will be available to the user in a not too distant future.

As compared to the register or card index function, the dictionary function features the marked advantage that a built-in logic control system eliminates the need for a full rewind of the tape to locate a specific term. The logic circuit which receives its instructions from the selecting key mentioned before decides by itself whether the term can be located most quickly by either fast forward or rewind.

Consequently, the access time is considerably reduced as compared to the function handling unsequenced information only.

(iv) Selective talking-book function

This function embodies two different working ranges:

(a) Compilation by the user of his personal talking books with simultaneous entry of code words. The programming procedure is the same as described before, except that no braille information is necessary.

(b) The coding of existing talking books. This possibility is believed to provide an extremely valuable aid for the blind person. While listening to the talking book information he may stop the set to enter a code word or specific term through the braille keyboard. This operation is bound to cause a certain loss of sound (max. 0.5 second) which should be, however, of little practical importance.

This interesting feature of the BRAILLEX system enables the user to convert his sound records into a more efficient tool for his daily work. The readout speed of the records can be adjusted to the personal abilities of the operator.

(v) Semi-selective tactile book reading function

This function is practically incorporated in the functions described before. The BRAILLEX system evidently enables the user to read braille books transcribed on magnetic tape cassettes. Although these braille books contain no code words, the information can yet be recalled by page numbers, chapters or paragraphs in a manner similar to the Braillocord unit.

6. System design and case history

The object in view emerged from the basic idea to create for the blind and partially sighted persons a special working instrument that would permit personal programming and recording of both braille and spoken language information and selective recall of this information.

The conceptual design was presented in 1968 by Dr. Werner Boldt, Professor at the Dortmund University of Educational Sciences, Department of Special Education and Rehabilitation of the Visually Handicapped, Dortmund, Federal Republic of Germany. The idea was materialised and the system engineered by F.H. Papenmeier, Electronics, D-5840 Schwerte, Federal Republic of Germany, in close cooperation with Prof. Boldt.

The following phases of development are worth citing:

1975: The first prototype of the BRAILLEX-system was presented to the public in October. Various details of this prototype have been improved further within the

following months. Demonstrations and tests gave rise to a number of suggestions for features to be incorporated into the production-stage version of the set. The basic concept of the idea of the BRAILLEX system was affirmed on the occasion of numerous demonstrations both in Europe and the USA. More than 1000 persons of a great number of ages and nationalities have had an opportunity to acqaint themselves with the system.

1977: This year saw the successful completion of the trial phase and the final development of a production-stage version of the BRAILLEX system. As compared to the first prototype, designers have succeeded in materialising numerous advantages and improvements, particularly by the aid of the advanced microprocessor technology.

Preparations for the production stage of the set are being initiated in January 1978.

1978: Regular production of BRAILLEX-systems; availability is scheduled for mid. 1978.

The development has been sponsored by Deutsches Blindenhilfswerk e.V., Grabenstrasse 179, 4100 Duisburg 1, Federal Republic of Germany, in close cooperation with the Federal Ministry of Research and Technology, Bonn.

7. Scheduled extensions of the BRAILLEX system

The modular design of the BRAILLEX system permits incorporating a number of desirable and useful additional functions at moderate cost and relatively little technical expense. The following descriptions refer to some optional functions that are already part of a firm extension schedule. These optional functions can be realised simply by installing an additional printed circuit board without any need to modify the set itself. If the user of the BRAILLEX system wants to have available the PL function (programmed learning, for example, a defined printed circuit board will be replaced by a print which

is provided with this optional function. Consequently, the user is in a position to shape the system in line with his personal requirements.

Some details of optional functions:

(i) Module "Programmed Learning"-PL

This function was already realised in the forerunner of the BRAILLEX system, the Braillophon set. Among other features, the PL module enables the student to check by direct comparison the correct spelling of words entered by him through the braille keyboard. Incorrect spelling will release a signal so that the student may be able to correct his own entry and to evaluate his personal learning progress. In addition, manifold programme structures can be realised by the chance of multiple choice.

(ii) Module "Combination with an electric typewriter"

This module offers the following possibilites:

Checking the typewritten text by tactile reading on the braille display, "filing" the typewritten text in braille on the magnetic tape with previous entry of a code word, recalling at any time the "electronic copy" for reading on the braille display after entering the relating code word, for example letter to "Hunter".

(iii) Calculator module

This module can be added to incorporate the function of an independent calculator which receives the instructions for the mathematical problems in braille to furnish the readout of the results in braille. Solutions and results can be stored on magnetic tape, if desired.

(iv) Further optional functions

Provision will be made if justified by the demand.

Design of closed-circuit systems, telecommunication, EDP terminals. These are but a few examples. It remains to be investigated to what extent the BRAILLEX system can be adjusted to satisfy further needs; the microprocessor technology opens many ways to approach new problems.

(v) Display for partially sighted persons

Finally, it should be mentioned that the BRAILLEX set can be modified to serve primarily the needs of partially sighted persons. In this case, the braille display is replaced or supplemented by an electronic indicator (video display). The braille keyboard can be replaced by a normal alphanumeric keyboard.

8. Some commercial data

(i) Delivery

Preparations for the production stage of the sets are being initiated in January 1978. Under these circumstances the first sets for which firm orders have been received will be available at Spring or early Summer 1978.

(ii) Price

Actual calculations have yielded a price in the order of DM 10,000 (circa US $4750) for delivery ex works.

(iii) Sale and service

Until further notice, sales and service will be handled directly by F.H. Papenmeier, Electronics, P.O. Box 1620, Talweg 2, D-5840

Schwerte 1, Federal Republic of Germany.
Telephone (02304) 16005 - Telex 8 229 622
pea-d

The creation of an international sales and service organisation is envisaged as and when justified by actual production figures.

Research Perspectives on the Braille Code

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It has now been well over a year since the "Discussion Paper on the Desirability of a Joint Research Project on the Braille Code, Extending the Use of Braille, and the Improvement of Reading Skills", by J.L. Douce of Warwick University and M.J. Tobin of University of Birmingham (both U.K.) appeared. The paper was published in the Braille Automation Newsletter (now Braille Research Newsletter, or BRN), and in the AFB Journal of Visual Impairment and Blindness, or JVIB. In it, the authors called for discussion of the possibility of investigating the present braille code for possible revision to increase space saving, ease the task of learning the code, and reducing the costs of producing it.

At the June 1976 Workshop on revisions in the braille literary code at AFB, Dr. Tobin reiterated the aims of this project, and called for U.S. collaboration in the enterprise. At that time, it was emphasised by Robert Gildea, the chairman of the workshop, that any recommendations for change must be submitted to the Braille Authority of North America (BANA) for action - something that had not been done in the past regarding proposed changes in braille rules. In a parallel situation, Douce and Tobin propose that the outcome of their study would be submitted to the National Uniform Type Committee (NUTC) in the U.K.

Since the discussion document appeared, a number of activities have proceeded quietly. First, the BANA appointed a special officer to consider revision of braille rules. Second, discussions with U.S. specialists in braille, psycholinguistics, reading, and braille production have occurred regarding international collaboration in this effort. Third, a major study of letter

frequencies in standard ink print has appeared. Fourth, the first study of contractions in braille vs. frequency with computer-assisted techniques has been published.

On the occasion of Dr. J.M. Gill's (Warwick Research Unit for the Blind) visit to the USA in October/November 1977, it was judged opportune to convene a small and informal seminar which would consider this whole area of work; he consented to chair the meeting. It was held at AFB in New York on 9th November, 1977.

One of the most significant facts emerging from the meeting is that the Department of Health and Social Security (DHSS) in the U.K. has funded the British end of the research, and precisely in accordance with the plan sketched in the Douce and Tobin discussion paper already referred to. Work at Warwick began officially on 1st October. The first product has already been reported out: "An Analysis of Braille Contractions", by Gill and Humphreys, appeared in BRN No. 5 (July 1977). There are already some surprises in this study: with a sample of just over one million words translated, five contractions accounted for 23 percent of the space saving, but all the 23 simple upper word signs together account for 8.2 percent.

The thrust of the Warwick effort will be to examine the question of space saving first. The data base, or corpus of words transcribed, will be increased to about 3.5 million words; and a careful effort will be made to reflect the actual literature read in braille (books, short documents, profile abstracts of scientific literature, etc.). This will at the same time create a machine-readable data base that can be used for further studies. Such further studies may include the preparation of braille product in variant codes purported to ease reading difficulties, increase reading speed, or reduce the time to learn the braille code. These samples will then be utilised by the Birmingham team with populations of beginning and of skilled braille readers.

The funding period for the study is three years. It was emphasised that this is a scientific study, and the objective will be to produce results and conclusions that can act as a reliable guide to decision makers in the NUTC regarding the future of braille codes.

The need for collaboration in assessing the ease of learning, speed of reading and writing, and the ease of transcribing ink print into braille manually, was pointed to as the primary objective in the study. This need has two consequences: the first is that such a wide-ranging program of studies requires the cooperation of competent researchers in the entire English-speaking community: studies with users of braille material are time-consuming and difficult to mount, and only a very limited number can be undertaken with the relatively few funds available in the U.K. grant. The second consequence is that the primary focus of the U.K. effort is not on the modification of computer-assisted transcribing of ink print into braille: it is anticipated, however, that changes that make braille more consistent in the application of its rules for contractions and format will make the task of specifying computer programs to accomplish the same result easier, and thus permit faster and cheaper automatic production of braille materials.

Collaboration of persons in the entire English-speaking community is essential also on another ground: to preserve the common code. There is always the danger that if the British undertaking leads to changes in braille produced in the U.K., while no changes are introduced elsewhere, the codes used in the English-speaking community will tend to diverge, and increasingly so, over the next decades. There is no wish to initiate another "war of the dots"; nor to underscore Wilde's observation that we are divided by our common language; nor to create a tactual Tower of Babel!

The distinguished U.S. braille specialist, and chairman of the former U.S. Braille Authority (the predecessor of the BANA), Mr. Bernard Krebs, once observed that the most efficient way to change the braille codes was to eliminate contractions not to modify or re-code their meaning. This is, in fact, the aim of the first experiment to be undertaken at Warwick, which will eliminate 117 of the current 190 or so contractions, and then assess the ease of reading of the resulting braille output.

Format will also be examined. It seems apparent that some significant proportion of the rules for format are based on formats for visual reading. That these may not be optimal for tactual reading is the moot point that will be examined in some detail.

The design of the formal experiments to test ease of learning, of reading and writing, and of varying speeds of reading - all have yet to be formalised. Here, again, the participation of qualified researchers from countries other than the U.K. - including funding local experimental efforts which fit into the whole research enterprise dealing with these complex issues - has yet to be done. It is likely that one or more small conferences organised for this purpose will have to be held, and the floor is open for suggestions about how this might best be done.

The number of anecdotal and observational data related to braille and its use is very large. They range from the supposition that provision of sufficient "jumbo" braille" would increment braille readership 50 percent, to the observation that the two to five errors in contractions in 50 pages of computer produced braille output are not noted by readers; from the hypothesis that a nine-dot braille cell standard would enormously increase the capability of the system to deal with mathematics and music, to the assertion that the major impediment to faster reading speeds is the quality of teaching of braille. And there are many practical questions to be answered,

for example, What should be the fate of the capital sign? What is the impact of tactile sensitivity loss with age on braille usage? What is the impact of diabetes in this respect? Is self-teaching of braille a viable possibility? What are the implications in the decline of braille teachers? Is such decline specific to geographic or cultural boundaries? Will enhancing the availability of braille increase its use? What is the importance of "perfect" braille in practice?

The number of such questions simply underscores the modesty of the effort now under way in the U.K. and the need for help from other countries in achieving the aims of the Douce and Tobin proposal. One needs psychologists, specialists, and informed consumers, as part of the world-wide investigation. It is apparent that change is in the air in the U.K. and the U.S.A. regarding braille, and this opportunity must be used wisely and well.

Photographic Generation of Tactile Displays for the Blind

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Aerodyne Research, Inc. (ARI) has developed surface relief photography methods which it believes should have application in converting photographs of scenes, maps, or any other data into tactile representations. The relief achievable is comparable to that normally employed for braille.

Developed photographic film always has some surface relief, but it is usually small and often too small to sense with the fingers. By enhancing the natural relief we can change the ordinary visual display into a tactile display. Using rather common optical and photographic methods we can change the image encoding format from its normal height-of-area-proportional-to-scene-brightness form to:

(i) a display in which there are uniformly-spaced "bumps" with height proportional to scene brightness

(ii) a display in which there are uniformly-spaced "bumps" of equal height but with diameters proportional to scene brightness.

(iii) "negatives" of all of the display listed so far, or

(iv) a display in which primary colours are represented by some agreed upon "bump" shape such as the orientation of rectangular "bumps"

Certainly many other variations could be devised.

The tactile displays could be printed either one or hundreds at a time from a single photograph. The size of the display is arbitrary. Processing is straightforward. For thousands of copies, one would want to press copies in plastic from a metalised negative master. Depending on the number of copies, the sophistication of the equipment, and the rate at which copies are made the price per copy could run from a fraction of a cent to several dollars (large area, one-of-a-kind).

The method of choice in producing these relief images is to use photopolymer coatings for recording either directly or (as discussed above) from an ordinary photographic negative of the scene. Using these methods (some of which are proprietary) we have produced images with several millimetres of relief.

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J.M. Gill

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Braille: A Bilingual (French/English) System for Computer-Aided Braille Translation

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The BRAILLE system uses a technique new to computer Braille production, to handle contracted French and English Braille, and bilingual (French/English) texts as well. The basic strategy is to divide the text up into its component words, gather all occurrences of a given form into adjacent positions in the file, and then translate each different form once, substituting for all occurrences of the form, and then resort the material into text order for final formatting. This approach allows generation of very high quality Braille at speeds in excess of 10,000 words per c.p.u. minute on an IBM 370/168.

The manual contains all the information necessary for use of the system by someone familiar with computing techniques. The first two sections contain detailed descriptions - with copious examples - of the input conventions used in preparing a text for the system, a complete set of Job Control Language, and practical suggestions for running jobs. The final section is designed to facilitate maintenance and improvement of the system. Each program is carefully presented in a description covering all files and important variables, followed by a summary of the logic of the main program and of its subroutines.

To facilitate implementation of the system by interested parties, the authors will also furnish a system tape, containing object decks for all programs, and the tables used by the programs, plus source decks for each program. The manual (148 pages) costs $10 and the system tape $50.

International Register of Research on Blindness and Visual Impairment

The second edition of the Register has been compiled by Warwick Research Unit for the Blind in collaboration with the American Foundation for the Blind. The Register is divided into three sections:

(i) List of projects on non-medical research and innovative practice for the blind and visually impaired.

(ii) List of the main organisations, in each country, of and for the blind and visually impaired.

(iii) List of sources of information including periodicals, abstract journals, information services and reference works.

This register is an essential reference book for anyone working with the blind, deaf-blind or partially sighted.

Copies can be obtained from Warwick Research Unit for the Blind, University of Warwick, Coventry CV4 7AL, England. Prices: ink print $10, grade 1 braille $30, grade 2 braille $30. Payment, in any negotiable currency, should accompany the order.

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This conference will be held in Madrid during 11th - 13th April, 1978. Further details can be obtained from Organizacion Nacional de Ciegos, Jose Ortega y Gasset 18, Madrid 6, Spain.