# NATIONAL BUREAU OF STANDARDS REPORT

10 642

## A STUDY OF COURT REPORTING SYSTEMS
## VOLUME II
## EXPERIMENTAL PHASE

Technical Analysis Division
Institute for Applied Technology
National Bureau of Standards

Prepared for the National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration of the Department of Justice under NI 71–042 IA and for the Federal Judicial Center. The fact that those agencies furnished financial support of the activity described in this publication does not necessarily indicate their concurrence in the statements or conclusions contained herein.


U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
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[3] Located at 5285 Port Royal Road, Springfield, Virginia 22151.

# NATIONAL BUREAU OF STANDARDS REPORT

**NBS PROJECT**
4314538

**NBS REPORT**
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# A STUDY OF COURT REPORTING SYSTEMS
# VOLUME II
# EXPERIMENTAL PHASE

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U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

## PREFACE

The initial impetus for this study was provided by the proposed use of the computer to translate stenotype notes to their English equivalent, offering a potentially large reduction in the time necessary to transcribe these notes manually. The use of this new technology to produce court records was seen as offering possible relief to that portion of congestion and delay in the criminal courts system attributable to backlogs in transcript production.

In order to obtain an objective evaluation of the feasibility of computer-aided transcription of stenotype notes in the criminal courts system, the National Institute of Law Enforcement and Criminal Justice, in conjunction with the Federal Judicial Center, sponsored this study by the Department of Commerce's National Bureau of Standards (NBS). In addition to evaluating the computer-aided transcription process, the study afforded an opportunity to survey the state-of-the-art of legal reporting in general. The study had two limited objectives: (1) identification and analysis of representative examples of criminal courtroom reporting techniques, and (2) design and execution of an experiment through which the characteristics of each reporting system could be examined. With such system attributes as time

and cost documented, it should then become possible to weigh the advantages and disadvantages of each given system for use in a particular courtroom environment.

This study report has been prepared in four volumes:

(a) Volume I - Decision Factors, summarizes the project activity, presents system descriptions, and offers a decision technique for selection of court reporting procedures. This volume is intended for general distribution.

(b) Volume II - Experimental Phase, describes the laboratory and courtroom phases of the experiment. This volume is designed to provide background detail for those readers particularly interested in the data gathering and analyses performed in the course of our work.

(c) Volume III - Summary of State Laws, provides background on the legal requirements and constraints for court reporting throughout the United States.

(d) Volume IV - Annotated List of References.

The judicial enthusiasm for the study was demonstrated by the willingness of court systems to cooperate with the study team and to participate in the test phases of the program. President Judge D. Donald Jamieson and Court Administrator Edward J. Blake, Esq. of the Philadelphia Court of Common Pleas provided courtrooms* for part of the

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*The presiding judges of the courtrooms, the Honorable Joseph L. McGlynn, Jr., and the Honorable James T. McDermott, were unfailing in their interest, enthusiasm and cooperation. This support contributed substantially to our efforts.

testing, as well as the time and expenses of two of their court reporters, Mr. Allen Kaplan and Mr. Bernard Goldstein, together with their typists, Mrs. Helen DiPietro and Mr. Vincent Murphy. Chief Justice Thomas Kavanaugh of the Supreme Court of Michigan arranged for the provision of the time and expense of one of their court reporters, Mr. James Mann, to participate in the tests. Mr. William M. Madden, Esq., Deputy Administrator of the Illinois Courts and Mr. Leroy Hoskins, Administrator of Official Court Reporters, also arranged, with the help of the Illinois Law Enforcement Commission, for the participation in the tests of one of their court reporters, Miss Sarah Walker. In addition, the Executive Officer of the Superior Court of the District of Columbia, Mr. Arnold Malech, and his Chief of Court Reporters, Mr. Anthony Nigro, arranged for the participation in the tests of two of their court reporters, Mrs. Isabelle Cormier and Mrs. Sylvia Colebreuner.

This study was conducted by the National Bureau of Standards' Technical Analysis Division under the general direction of Richard T. Penn, Jr. and Walter G. Leight. Day-to-day control was exercised by Ernest H. Short, Project Leader. The project staff was composed of representatives of the fields of the law, psychology, operations research, and computer systems analysis and included the following members of the Technical Analysis Division:

Mr. Ernest H. Short, Project Leader

Dr. Nancy Kingsbury

Miss Jenny Eldreth

Mrs. Suellen Halpin

Mr. Miles Ruthberg

Mr. John Rick

Credit and thanks are due to the ladies who typed the report: Miss Frances Jones, who graciously bore the many burdens of a very demanding staff throughout the course of the project; Mrs. Mary Abbott, Mrs. Theresa Conrad, and Mrs. Frances Hilten.

Finally, deep appreciation must be expressed for the magnificent cooperation of all participants in this program, and most especially the professional reporters and transcribers who took part in the experimental phase.

ABSTRACT

In order to determine the feasibility of computer-aided transcription for application in a courtroom environment, the National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, Department of Justice, and the Federal Judicial Center jointly requested that the National Bureau of Standards, Technical Analysis Division conduct a study to determine (1) the operational characteristics of the currently available computer transcription system, (2) its potential for use in the courtroom, and (3) the potential reduction of delays now encountered in transcript preparation. The project also entailed the collection of time and cost data for other court-reporting systems and an investigation of legal or other constraints.

Six official court reporters and two professional transcript typists participated in a two-phase experimental program. For three weeks material was recorded under laboratory conditions so that the characteristics of the material could be closely controlled. Subsequently, two weeks were spent in operating courtrooms in Philadelphia's Court of Common Pleas.

The experience gained in the laboratory and in the courtroom has demonstrated that computer-aided transcription for court reporting purposes is technically feasible. However,

the specific system tested is currently subject to a number of deficiencies and some inefficiency. Although this system may not be readily compatible with the writing styles of all reporters, computer translation offers the potential of a significantly large saving of time in high volume transcript production, provided that some compromise in appearance (but not accuracy) of the record is acceptable. First run computer copy must currently undergo extensive proofreading and a costly, time-consuming editing procedure to achieve traditional standards of typed copy neatness.

Based on this study, two recommendations are made:

1. Further research and development efforts should be supported to remedy deficiencies of current computer transcript techniques and to enhance the capability for preparing court transcripts.
2. Consideration may be given to using a computer system as an interim measure to relieve excessive transcript backlogs, but subject to availability of suitable computer hardware; selection and training of reporters; improved editing techniques; and judicial acceptance of certified, hand-corrected transcript, perhaps characterized by loss in neatness, but not in readability nor in accuracy.

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# I. INTRODUCTION

It has become increasingly evident in recent years that the citizen's right to a "quick and speedy trial" in criminal cases is not routinely satisfied. Several elements of the courts' procedural system have been cited as possible sources of delay; one element which is frequently mentioned is the time required for typed transcripts of court proceedings to be produced. Delays of several months are common in obtaining transcripts in criminal cases. (It may take years in civil cases.) Some delays result from the less-than-optimal scheduling of cases and orders for transcripts: courts are frequently in session for only a part of the year, and interested parties often order transcripts only when the requirement becomes urgent.

The increase in man-hours required to produce the large number of transcript pages resulting from activity in today's courts constitutes a substantial source of delay. The growing number of cases coming before the courts, the trend toward more frequent exercise of the right of appeal, and the scarcity of trained court reporters all combine to produce a situation where major innovations will be necessary merely to prevent the present delays in the court reporting system from becoming worse, let alone substantially reducing them.

Several techniques of court reporting are currently applied in Federal and state court jurisdictions. These include methods of shorthand recording (manual and machine) and the use of electronic audio recorders. With all of these methods, preparation of transcripts requires a time-consuming transcription phase, in which the shorthand abbreviations or the electronic record are translated into English and typed in an approved transcript format, often tying up the skilled reporter in activities outside the courtroom.

A major impetus to the increased use of computers in recent years is their enormous potential for reducing the man-hours required to perform tasks of matching or exchanging elements from two definable sets. The matching of shorthand abbreviations with their English language equivalents is essentially such a task. Thus a computer-aided transcription system for shorthand potentially offers a major opportunity for substantially reducing the time required to produce a written record of courtroom proceedings, while continuing to base that record on the notes of a skilled court reporter.

The most commonly employed method of courtroom recording is machine shorthand. The reporter may subsequently type the transcript from his own notes, may dictate for a typist who prepares the transcript, or may use the services

of a skilled notereader-typist; in each case, considerable time is required to produce the transcript.

Machine shorthand has several characteristics conducive to a transcript process less demanding on the time and transcription skills of the reporter. Notes are made by use of a keyboard which causes combinations of letters to be printed on a paper tape. Such mechanical transmission of symbols makes possible the perfect reproducibility of symbols over time. If keys are struck, the information transmitted (i.e., letters printed) will be independent of who struck the keys or when they were struck. In contrast, symbols generated in a less mechanical system (e.g., manual shorthand) are not identical when written by different reporters, or indeed by the same reporter at different times. Furthermore, using a keyboard permits the information to be recorded by means other than (or in addition to) printed letters on paper tape, without alteration of the interface with the reporter (i.e., the keyboard itself).

Machine shorthand is based on a series of phonetic abbreviations. Although shortcuts and personal idiosyncrasies exist, the phonetic shorthand unit tends to be standardized. The combination of mechanically reproducible symbols and a widely used, standard (and for the most part clearly definable) set of abbreviations reduces much of the translation of shorthand symbols to a one-to-one matching task.

Recent advances in the use of computers to perform language matching functions have led, in particular, to the development of a computer-aided transcription program. Several approaches to the shorthand translation problem have been explored, but to date only one system has reached an operational stage. During the early stages of the development of this operational system, however, it was used almost exclusively in a conference setting. Since court recording takes place in a specialized and particularly demanding atmosphere, additional testing was required to determine whether this computer-aided transcription system is, in fact, appropriate to and ready for courtroom use.

In order to determine the feasibility of computer-aided transcription in court reporting, the National Institute of Law Enforcement and Criminal Justice of the Department of Justice,and the Federal Judicial Center jointly requested that the National Bureau of Standards, Technical Analysis Division conduct tests to determine (1) the operational characteristics of the computer transcription system, (2) its potential for use in the courtroom, and (3) the effect such a system might have on reducing current delays in transcript preparation.

The procedures and results of the NBS experiments are described on the following pages. Two caveats must be noted at the outset:

1. This study was conducted with only a few participating reporters. This restriction was required both by the limited resources available and by the inherent undesirability of situating a large number of reporters in a single courtroom. As a result, only the conclusions specifically discussed herein are considered to be directly supportable; further generalizations might be inferred, but cannot be warranted at this time.

2. The computer-aided transcription system for machine shorthand, which is the primary subject of the project and this report, has already been demonstrated in an operational environment, but has been limited until now to the preparation of transcripts of conferences and similar events. For this experimental program the system was, for the first time, introduced into a courtroom environment. Since the vocabulary and transcription requirements of courtroom use are in many respects distinctively different from situations previously encountered, a considerable part of the time was, of necessity, used to refine and develop the system. Much of the program was therefore exploratory and an examination of feasibility, rather than a straightforward evaluation.

The remainder of this volume is divided into the following major sections:

II. Background, which provides descriptions of currently used court reporting systems and the computer-aided transcript system."

III. Experimental Conditions, including discussion of preliminary training, and the laboratory and courtroom experimental phases.

IV. Analysis and Results, for both the laboratory and courtroom phases.

V. Conclusions and Recommendations,

and

Appendices A through F.

## II. BACKGROUND

### 1. Conventional Court Reporting Systems

No matter what technique he uses, the task of the court reporter is the same: to make a record "...verbatim by shorthand or other mechanical means [of] such court sessions or other proceedings as are specified by statute or rule or order of the court, and to promptly transcribe those proceedings when requested by any party to them who has agreed to pay the prescribed fee."* However, the skills and time required to produce the transcript will depend on the system used.

In this section of the report, the three methods of court reporting which were studied are briefly described. The purpose of this discussion is to familiarize the reader with the methods in order to furnish a background for understanding the project activity. Further, since experimental situations are inherently artificial and may produce results which are not typical of normal day-to-day operations, a brief survey of the literature available about these reporting methods was conducted to obtain estimates of transcript production time under ordinary conditions. To the extent that these estimates are reliable, some indication is obtained of the comparability of the results of the study with the real world transcription process.

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* Charles Parker, Jr., and Norman R. Tharp. The Court Reporting System in the United States District Courts. Washington, D.C.: Administrative Office of the U.S. Courts, 1960, p.7. An extensive list of references on court reporting topics will be found in Vol.IV of this report series.

The "transcription process" is considered throughout the following discussion to be the sequence of activities directly related to the preparation of the final hard-copy typed transcript, after the in-court period of recording. Several limitations must be noted about the estimates presented here. A transcript page, according to one survey, usually has 25 lines with about 250 words per page.* However, the average length of a transcript page produced during the current study was found to be approximately 175 words. Furthermore, content of pages in ordinary copy (and in this study) may vary substantially depending on the type of material being transcribed (e.g., colloquy as opposed to question-and-answer) or the format traditions of the jurisdiction involved.** Thus, these estimates should be taken as "ball park" figures only, and no rigorous statements comparing them can be justified.

## 1.1 Machine Shorthand

Machine shorthand (stenotype) was developed during the early part of the 20th century in an effort to derive a shorthand format which took advantage of the relative frequencies of certain letters in different locations within words of the English language. A keyboard was designed to accommodate the system and, with almost no changes, is the same one in use today.

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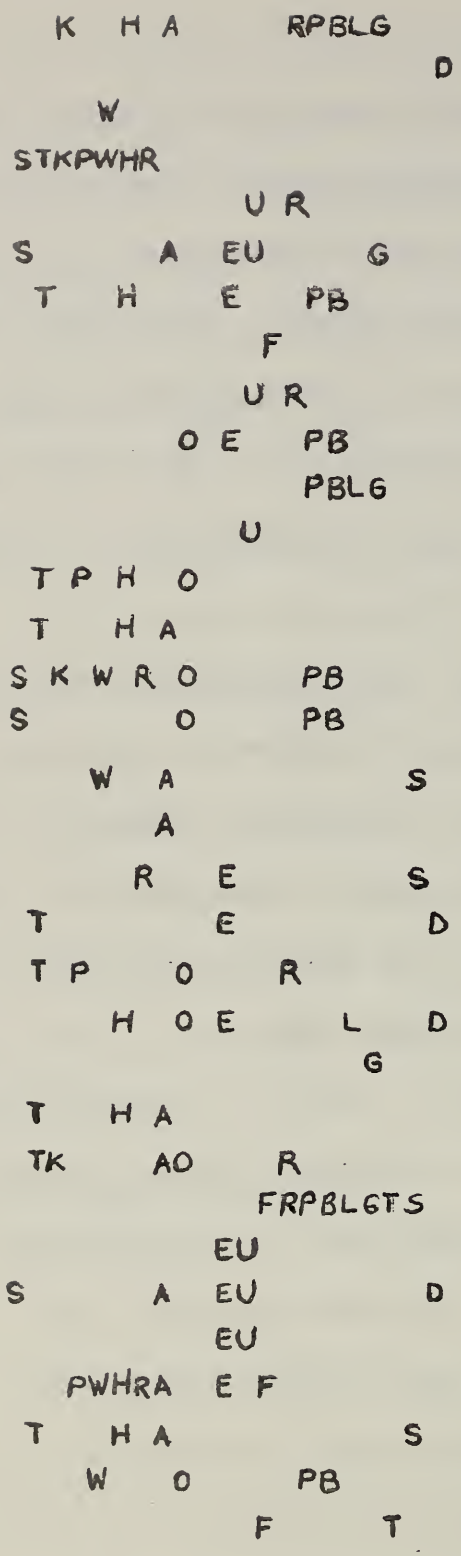
* Parker and Tharp, Court Reporting System, p. 29.
** See Volume III for digests of state laws on court reporting, some of which stipulate formats.

There are 23 keys on the keyboard, arranged in three rows. Consonant clusters which occur frequently at the beginning of words are located on the left, consonant clusters which tend to occur at the end of words are on the right, and vowels are in the middle. Some consonants occur on both sides of the keyboard. Consonants which are not directly represented on the keyboard are formed by combinations of keys (e.g., right hand PB is used to represent "n").

One or more keys may be depressed simultaneously to represent a part of a word, a whole word, or a phrase. As each "stroke" (the smallest element in the shorthand system) is made, the associated letters are printed on paper tape and the tape automatically advances vertically. Thus each stroke is represented on a separate line of the paper tape.

Stenotype shorthand is phonetically based to record segments of language strings, avoiding redundancy where possible. A language string (word, phrase or sentence) is represented as a stroke or sequence of strokes. Punctuation can be indicated, but spaces between words or sentences are not. An example of a segment of stenotype record is shown in Figure II-1.

Once the paper tape containing these shorthand notations has been made, any of several methods may be used to transcribe the notes. The most direct method requires the court




| | |
|---|---|
| K-D | charged |
| W | with |
| S-R | Q: (Question:) |
| UR | you are |
| S-G | saying |
| T-B | then |
| F | of |
| U-R | your |
| O-B | own |
| P-G | knowledge |
| U | you |
| T-O | know |
| TA | that |
| S-B | Johnson |
| W-S | was |
| A-D | arrested |
| T-R | for |
| H-G | holding |
| T-A | that |
| T-R | door |
| F-S | A: (Answer:) |
| EU | I |
| S-D | said |
| EU | I |
| P-F | believe |
| T-S | that's |
| W-B | one |
| F-T | of the |

Figure II-1

Sample Stenotype Paper Tape Record

reporter to spend considerable time (perhaps 1 1/2 times his stenotype recording time) away from the courtroom to produce the transcript. As a variation, a skilled notereader may type the transcript from the reporter's notes. This notereader may be a student whose recording speed is not yet up to the standard required in the court, but he must be familiar with stenotype abbreviations and with the style of the reporter whose notes are being transcribed.

A ten-year old survey of a sample of U. S. District Courts revealed that reporters or notereaders typing transcript directly could produce an average of 10 pages of transcript per hour.* Other estimates suggest that transcript production rates between 8 and 12 pages per hour are typical. Colloquy material takes longer, yielding only 5-6 pages per hour.

In a second transcription method the reporter dictates from his notes into a dictation machine; a typist then prepares the transcript from the tape or disc from that machine. This method is widely used in many urban court systems, where trained reporters are scarce relative to demand, and qualified typists are available to free the reporter for courtroom activity.

It has been estimated that the dictation step alone may require as much as 25% more time for completion than was spent in the court actually taking a record.** The other part of the

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*Parker and Tharp, Court Reporting System, p.29.

**Letter from Griffin Bell to the Honorable Tom Clark, October 1969, p.3.

task, that of typing the actual transcript, has been estimated to be accomplished at an average rate of 13 pages per hour. Ordinarily these two tasks occur sequentially; however, in situations requiring daily or rushed copy, it is possible to overlap the two tasks by all but a few minutes, by dictating a short portion of the text onto one tape, which the typist starts with, then using a second tape, switching from time to time and always staying ahead of the typist.

## 1.2 Manual Shorthand

Shorthand methods which use nonalphabetic manually written symbols to represent phonetic units of speech are nearly as old as civilization. Modern methods of manual shorthand such as Gregg or Pitman are frequently used in court reporting, particularly in lower or specialized courts. The essential concept underlying manual shorthand is the use of identifiable symbols (typically curves, lines, or dots) for phonetic units. These can be combined to indicate words and phrases.

Since the symbols are handwritten, some variation in their exact formation is unavoidable. Further, experienced shorthand writers tend to develop a number of special symbols or variations which may or may not obtain widespread usage. Such variance in the formation of the symbols creates a situation in which it is difficult for others to translate the symbols back into conventional English. As a result most manual shorthand reporters must transcribe their own notes.

It has been estimated that 7 to 8 pages per hour is the average production rate for transcript taken from manual shorthand notes.*

## 1.3 Audio Recording

Electronic recording of proceedings, in place of or in conjunction with the work of the official court reporter, has been employed in several locations. Audible events occurring during the court session are picked up by strategically located microphones and recorded on magnetic tape. In general practice, someone is assigned to check that the recorder is operating properly; notes about the events can also be listed to aid in transcription. In courts where transcript requests are rare the tape recorders are sometimes left unattended.

Two major types of recording systems are currently in widespread use in court systems: single track and multitrack. Single track recording combines the information picked up by several microphones and records that information on one track of an audio tape. Use of several microphones allows sounds to be picked up from different locations in the courtroom, but once recorded on the tape, they can no longer be separated. In some circumstances, this feature may make speaker identification difficult or even impossible. In contrast, multitrack systems record the sounds picked up by each of several microphones, and the combined recording on all the tracks can be listened to simultaneously or separately, thus facilitating the distinction between similar or overlapping voices.

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*Local court estimate.

Audio recording is an official method of making the court record in several states, including Alaska. An average of 15 pages of finished copy per day is prepared from single track tape recordings when the option of transcription is exercised. Finished copy is obtained in Alaska only after several readings for accuracy by the transcriber and the Transcript Supervisor or his assistant.* Other reports suggest that four pages per hour is a fair production rate, or that 35 pages is considered average acceptable output for a day's work.** The recent introduction of typing systems with semiautomatic editing functions has increased production to 50 pages per day.

Multitrack recording systems have been introduced for court use only recently, and substantive data on production rates is not currently available. However, it appears that the ability to switch from track to track provides an opportunity for the transcriber to identify a speaker with more certainty, but at the expense of a slower transcription process.***

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* Samual M. Blumberg, Jr. Report of a Survey of the Electronic Recording System in the State Courts of Alaska. United States Court Reporters Association, 1969, (mimeo) p. 4.

** Harry L. Libby, "Report of Survey of the Alaskan Courts System, " Handbook on Electronic Recording. National Shorthand Reporters Association , 1965, p.49.

***Transcript production times for a random selection of three transcripts prepared from multitrack recordings in a local court ranged from 16 to 27 pages per seven-hour day.

## 2. Computer-Aided Transcription System

As research into the use of computers to translate material from one language to another developed in the late fifties and early sixties, the concept of "translating" machine shorthand language into English was a natural consideration. The earliest linguistic logic for this process was developed in conjunction with a Russian-English language translation problem. This early work lay dormant until the late sixties, when serious development work towards a software system for general purpose computers was undertaken.

A private company* was formed in 1969 by a small group, including individuals who had engaged in precedent work in stenotype translation in private industry and in Government. They subsequently developed a stenotype translation software system for the IBM 360 series; it is presently operating on an IBM 360/40, with a 128 K memory.**

### 2.1 Basic Approach

Stenotype notes for input to the computer are recorded simultaneously with the reporter's original paper tape record. The stenotype machine is modified so that a battery operated (rechargeable at present) electronic incremental recorder is

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*Several firms or individuals may have developed similar approaches to computer-aided transcription. As of the date of this test, however, this was the only firm demonstrating a system which was operational, hence was the one contracted to provide services for this experimental effort.

**Certain commercial equipment and materials are identified here in order to specify the experimental procedure. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that the equipment or material identified is necessarily the best available for the purpose.

attached by cable. (See Figure II-2) Depression of the stenotype keys causes electrical contacts specific to the keys being depressed. These contacts are recorded on computer-compatible magnetic tape (or narrower tape whose contents are transferable to tapes meeting computer requirements). Exactly the same information is recorded on the computer tape as appears on the conventional stenotype paper tape.*

The basic premise of the computer translation software program is a dictionary search procedure. Two types of dictionaries exist within the program: a general or main dictionary, consisting (at the start of this study) of more than 110,000 standard stenotype-to-English equivalents; and a set of subdictionaries, one for each reporter who uses the system, consisting of stenotype-to-English equivalents (frequently personal "shortcuts") which are idiosyncratic to the individual reporter.

The program operates in a sort-match-resort algorithm. Input strokes are "tagged" in numerical sequence and sorted into an order identical to that of the main dictionary. The sorted input data are then merged and matched against the dictionaries (the reporter's subdictionary first), with matches being exchanged for English equivalents. These

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*Shadow strokes may record electrically and not show on the paper tape (see pages 31 and 49), and equipment malfunction could cause failure to record (see page 59 and Appendix D).

Figure II-2: Modified Stenotype Machine with Attached Incremental Recorder

equivalents are then sorted back to the order of the original input, and printed by a high speed computer printer with an upper and lower case print train. Non-matches, if they occur, are shown as the transliteration of the keys struck, printed between two asterisks.

The present software package operates in a sequential mode (i.e., read, process, print) and was run on an IBM 360/40. The contractor indicates that the program has been run on more powerful systems with a substantial decrease in computer time. In addition, the multiprogramming capability of the IBM 360 series might also be conducive to enhanced efficiency by means of overlapping procedures, rather than adhering to strict sequential operation.

Since stenotype is a shorthand system which attempts to take advantage of the natural redundancy in the English language by eliminating information unnecessary for human processing, the stenotype-to-English matching is a not uncomplicated task for a computer. There are several difficulties peculiar to this type of program, as described in Appendix F. For example, in stenotypy, spaces are not used to delineate the end of a word, nor is punctuation always indicated. Consequently, in the computer translation process, these "natural" boundaries cannot always be clearly detected.

The most difficult problem to contend with is homographic ambiguity. The phonetic basis of all stenography allows (and even encourages) similar sounding words to be represented identically although spelled differently. Thus, a homonym (or near homonym) in the spoken language becomes, to the computer, a homograph, in and of itself indistinguishable from its homonym (e.g, "here" and "hear" become "HER"; "her" is also "HER").

These and related problems (e.g., reporter-recognizable "typographic" errors or the open-ended set of possible abbreviations in a phonetic shorthand) make the production of "correct" copy on the computer's first translation attempt quite difficult. Current procedures to approach these problems, including subdictionary additions prior to each computer run, arbitrary choices based on frequency of occurrence or some other criterion, and extensive reporter retraining have been only partially successful.

## 2.2 Editing or Second-Pass Procedures

Computer operation on the original shorthand symbology produces a "first run" of the transcript which may be corrected subsequently during an editing procedure. The first run transcript can be printed in a special coordinate format, giving page and line number before each line, and word position in the line by small numbers under each word.

Corrections, keyed to line and word location, and encompassing any number of words, are entered into the master text file (currently by keypunch and cards). This eliminates the necessity of retranslation, but does require a second print cycle.

## 2.3 System Experience

The study reported herein is a "feasibility" study, in that for the first time a computer-aided transcription system has been applied to the reporting of court proceedings. The technique had previously been used to speed the transcription of notes in the recording of conferences (including the record of the Conference on Computers and Court Administration held at the National Bureau of Standards in November, 1970, and the Criminal Justice Conference, Huntsville, Texas, April 1971), and had also found application as a rapid input technique for computer-operated photocomposition of books.

The special problems endemic to the courtroom environment have acted to delay the application of computerized translation to courtroom recording. Court reporters must function under legal requirements for a verbatim record, as well as constant pressure in a frequently emotional atmosphere, characterized by a highly specialized and precisely used vocabulary. The contractor felt that the problems created by this environment would have to be

handled in a separate development effort. In part, the study reported here has been designed to examine these special problems and to assess the utility of the computer transcription process in this distinctive environment.

## III. EXPERIMENTAL CONDITIONS

Two aspects were of particular concern in assessing the feasibility of the computer-aided transcription system for court reporting: the potential savings in turn-around time for the production of transcripts for a variety of records; and the adequacy of the computer transcript, in comparison with that produced by the reporter, as an official record of court proceedings.* As a basis for this information, a broad range of recordable material was required. A sample of other court reporting systems was included in the study in order to take advantage of the opportunity to collect analogous data for those techniques. This also permitted recourse to the literature on system performance to verify that the material used in the study reflected the type normally encountered in a realistic environment.

A number of different court reporting systems are currently in widespread use. As mentioned earlier, machine shorthand is perhaps the most common, but other techniques include manual shorthand, audio recording (with or without

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*Time savings and transcript adequacy cannot, of course, be separated from the factor of system cost. Computer-based systems tend to require high initial investment and relatively high unit cost for low-volume processing, but substantial reductions in unit cost in high-volume situations. The cost to court systems will depend on the availability and cost of computer time locally and on other variables. Details on cost may be found in Volume I.

a monitor present in the courtroom), and closed microphone recording. In the selection of a representative sample of systems for this study, closed microphone recording (whereby the reporter vocally repeats the proceedings word-for-word into a special type of audio recording device) was considered to be a variation of conventional audio recording. Thus, manual shorthand and multitrack audio recording (with a monitor present) were deemed sufficient to provide a representative (although somewhat limited) set of comparative baseline data.

It was clear at the outset that actual courtroom study of the computer-aided system would be essential to a comprehensive feasibility study. However, it was not practical to undertake the extensive courtroom testing required to ensure a range of recording conditions broad enough for a full evaluation of the system. Further, it seemed advantageous to include some trials under controlled conditions, wherein the degree of clarity of the material to be recorded could be established in advance. Consequently the study was designed to take place in two phases, the first under controllable conditions and the second in actual courtroom operations.

Planning proceeded for several months, then actual operations took place in three steps over a ten-week period. A four-week pretest training phase was conducted

by the contractor's staff for the four machine shorthand reporters; this phase began on May 17, 1971 and formally concluded June 11, 1971. The controlled laboratory phase of the study took place at the National Bureau of Standards facility at Gaithersburg, Maryland; it began June 14, 1971 and continued for 15 working days, concluding on July 2, 1971.

The week of July 5-9 was not used for study purposes, due in part to the holiday occurring that week, and in part to the desire to accommodate a prior commitment for several of the reporters. The final study period, during which the recordings were made in a courtroom environment, took place in Philadelphia, Pennsylvania, beginning July 12, 1971 and concluding on July 23, 1971, after 10 working days.

1. Study Participants

The events which take place in criminal court procedures and the demands of recording those events for the official record are, to a great extent, both particularly challenging and unique. For realistic determination of the feasibility of a computer-aided transcription system, it was therefore essential to utilize practicing official court reporters as study participants. With the coordination of the Federal Judicial Center and

the enthusiastic cooperation of the several jurisdictions, six official court reporters and two professional transcript typists, from a total of four court jurisdictions*, were made available by their courts to participate in this study. Each participating reporter is qualified to certify transcripts as official court records.

1.1 Machine Shorthand Reporters

A meaningful examination of the computer system should entail the participation of enough reporters to determine whether the system is applicable to reporters with a wide range of techniques and skills. It was felt that four reporters would be the minimum number to reflect a meaningful variation in technique, while at the same time four would not be too many to sit simultaneously in an operating courtroom. It was also desired that the most commonly used conventional techniques for transcribing stenotype notes be included in the study. Consequently, two of the four participating stenotype reporters typed the required transcripts from their own notes. (With the increasing scarcity of trained court reporters, this method of transcription is no longer as widely used as previously, particularly in urban jurisdictions.

*Identification of these reporters and relevant details of their experience are presented in Appendix A. It cannot be stressed too highly that the successful conduct of this study would not have been possible without the exceptional cooperation of the jurisdictions involved and, in particular, the professional and cooperative participation of the six reporters and two typists.

However, both reporters are skilled typists and agreed to transcribe in this manner for comparative purposes.) The other two stenotype reporters accomplished the transcription process in two steps: they dictated from their notes into a dictating machine, and these dictation recordings were then turned over to a professional transcript typist to prepare the actual transcript.

1.2 Additional Reporters

Two other court reporting systems were included primarily to provide a general basis for establishing the relationships among representative systems within the experimental situation, but with only one reporter for each of these two systems.* The reporter transcribing from the audio recording was experienced in that system, although she generally reported court proceedings by machine shorthand.

The manual shorthand writer used her regular reporting technique. The requirement to obtain basic data for this system was satisfied during the first (laboratory) phase. It therefore became possible to limit the number of

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*A larger number of reporters would be necessary for a more complete investigation of the performance characteristics of each of the systems. Time and money constraints precluded this type of full-scale evaluation. Instead, it was agreed in advance to limit this phase of the experiment to a sampling of the comparative relationships in the test situation.

participants in the courtroom phase, and the manual shorthand writer participated only in the experimental phase.

Audio recording equipment could be unobtrusively installed in the courtroom during that phase to provide a supplementary record of the proceedings at little cost. Consequently the reporter transcribing from audio recording participated in both phases of the study.

1.3 Effect of Jurisdictional Differences

The participating reporters, coming from four different jurisdictions, are accustomed to somewhat differing court situations. Two of the reporters were drawn from the District of Columbia Superior Court; the others were experienced in the courts in three other geographically separated urban court systems. Each jurisdiction has its own specified requirements and traditions as to transcript format and specific transcription elements. During the course of the experiment, each reporter prepared transcripts according to the format and rules prevalent in his own jurisdiction.* The study, however, was primarily concerned with the adequacy of the computer transcripts as compared with the conventionally produced transcript from the same reporter's paper tape, so any differences among the reporters' transcripts were not considered in the data analysis.

*These differences may have been responsible, in part, for differences in volume of transcript observed among participants during the study.

2. Pretest Training

Optimal use of a translation system for stenotype depends on two types of action to "tune" the reporter to the computer system. First, the superstructure of personal shorthand coding, developed by each reporter and exceptional to the large body of common stenotype coding, must be entered into a subdictionary specific to that reporter. This is accomplished by an analysis of a sample (of at least 35,000 words) of the reporter's work from the intended operational environment. About 80% of the needed special forms will normally be acquired in this first effort. The remainder of these special forms (those of less frequent occurrence) are acquired during actual operations, generally at a decreasing rate. By comparing the lists of special forms noted from a group of reporters, common forms not yet included in the main dictionary are exposed and entered.

Concurrent with the initial analysis, note is taken of any idiosyncrasies which may cause ambiguities. These are discussed with the reporter with the objective of mutual accommodation, either by his voluntarily distinguishing the codes or by context entries in the dictionary or, infrequently, by both. During this early period, the logic of the computer translation

system is explained so that the reporter comprehends what actions can be the cause of errors. He is also taught how to give the computer special instruction codes from the keyboard (formatting, spelling character-by-character, entering proper names, etc.). The specific instructions involved are described in Appendix B.

Since the stenotype reporters participating in the study normally work in jurisdictions (i.e., Detroit, Chicago and Philadelphia) remote from Washington, D. C., the initial training phase could not be conducted as efficiently as might otherwise be desired. Representatives from the contractor visited each reporter in his own jurisdiction, generally on a weekly basis, during the four week training period. Initially, a body of stenotype notes with accompanying transcript was obtained from each reporter, and examined in detail to begin compilation of the reporter's subdictionary entries.

A stenotype machine, modified for electronic incremental recording, was supplied to each reporter for his use over a period of time during his regular court reporting duties.* Notes, transcripts, and initial computer

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*Delays in obtaining a modified stenotype machine for one reporter prevented the use of the machine at all during local courtroom sessions in the training period. As a result, computer transcripts for that reporter were not available at all for initial analysis until the laboratory phase records were processed.

translations of these records were examined further to enlarge the personal subdictionaries, and to expand the main (general) dictionary with forms found frequently in courtroom use.

Although only a limited number of reporters could participate in this program, it was anticipated that they would manifest variations in those characteristics of reporting technique which are critical to optimum use of the computer system. Of primary importance in this regard is the reporter's consistency of writing style. Even if a reporter uses a large number of idiosyncratic shorthand forms, his notes can be reliably translated by the computer if he consistently uses the same form for a specific word or phrase.

Initial evidence, derived from examination of the reporters' stenotype notes during the training phase and of the computer translations, suggested that the reporters participating did, in fact, demonstrate a range in technique and potential adaptability to the computer system.* For example, two of the reporters utilize a long vowel representation which, although not uncommon, does not conform to the coding system on which the present

*The extent to which a reporter may or may not be "adaptable" to the computer system is in no way a reflection on his capabilities as a court reporter. On the contrary, it is a limitation of the computer system that for perfect first run computer translation, the reporter must have used only shorthand forms which are in the dictionaries, used them always exactly the same way, or have noted and made appropriate corrections of every new word or fingering error.

computer program is based. To accommodate this difference, special software was written to convert (prior to translation) that group of vowel representations, when they occurred, into the form used in the existing program. This procedure resulted in a unique set of stenotype-to-English equivalents for those reporters, which had to be entered into their respective subdictionaries.

In addition, one of these same two reporters uses a very large number of one-stroke phrase codings, but does so consistently. Consequently, this problem does not affect the reporter's compatibility with the computer system, but entails a longer-than-average analysis to generate a workable subdictionary.

One reporter was found to have a stenotype keying style which resulted in a relatively large number of "shadow strokes," that is, finger actions which are of insufficient pressure to depress the key fully, yet which may cause depression enough to close the electrical contact which activates the incremental recorder. Such partial depressions normally register on the paper tape as faint letter representations, hence the incorrect part of the shorthand notation is recognizable on the tape. However the electrical contact generally either occurs or does not: if a shadow stroke results in a full contact registered

by the incremental recorder, it results in a "finger error" which effects the computer translation process.*

Consistent shadow strokes (which might be caused for example, by a finger dragging on its "home key" when a nearby key is depressed by an adjoining finger) can be accommodated in the computer system by entering additional items into the reporter's subdictionary which reflect the shadow stroke configuration. Random or inconsistent shadow strokes, or actual fingering errors, cannot be accommodated except by correction after the original translation is available, unless proper notation is made when they occur. Naturally, then, truly sloppy stenotype technique would be incompatible with an interactive computer system. No such incompatibility was encountered, but the tendency to produce shadow strokes produced a relatively higher "error rate" in computer translation for this reporter, as well as a requirement to "pack" his subdictionary with a large number of special forms.

At the other end of the consistency scale, one of the reporters was found to use an exceptionally "clean" stenotype writing style. Thus, the group participating

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*See pp. 75-76 and Appendix F for further discussion of sources of error in the computer system transcript.

in the study bracketed a broad range of adaptability to computer translation, from one who had a straightforward style highly amenable to computer processing to others with a variety of stylistic idiosyncracies requiring adaptation of the reporter to the computer system, or of the system to the reporter.

Several difficulties developed during the training phase which tended to reduce the overall effectiveness of the formal training efforts. Travel requirements and the resulting once-a-week contact limited the direct interaction between the reporters and the contractor's tutors. As a result, the primary "training" effort was directed almost exclusively towards building the system capabilities for each reporter (the subdictionaries and the main dictionary courtroom vocabulary), and only a minimum amount of actual training of reporters to work with the computer system was accomplished.

The limited amount of recording for computer translation accomplished in the reporters' home jurisdictions, and the delays associated with transferring the records to computer compatible tape (see page 46) prevented any substantial analysis of the computer translations until after the start of the laboratory phase of the study.

It should be noted that during this training period several events occurred which generated considerable

controversy about the purposes and usefulness of the study effort, distracting both the reporters and the contractor personnel from their pursuit of the training objectives.*

All of these delays and difficulties combined to require the real "tuning" of the reporters and of the system to be continued through the entire laboratory phase, and even through the first three days of the courtroom activity. At that time, any further dictionary expansion or training efforts were prohibited so that a series of records could be processed to reflect a static stage of development of the computer system, and its current operational capabilities could be assessed.

3. Phase I - Performance in the Laboratory

A determination of the feasibility of any new system requires that the system be examined objectively over a wide range of conditions of interest, and that the characteristics of at least some of those conditions be known or controllable. For a courtroom reporting system, actual courtroom study is mandatory, but conditions in a courtroom are generally unpredictable, and a sufficient breadth of experience could not be guaranteed within the short period of time available for an operational test. Therefore, prior to the initiation of the courtroom work, a preliminary laboratory experiment was conducted to assess the performance of the computer-aided"

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*See pages 50-53.

transcription system under prescribed and predetermined conditions. Particular effort was made to provide a variety of materials to be recorded, ranging from simple, clear dictation to texts of the type heard in courtrooms.

## 3.1 Physical Facilities and Equipment

Several rooms were set aside at the National Bureau of Standards facility at Gaithersburg, Md., for the conduct of the laboratory experiment. Presentations of material to be recorded were made in a large, classroom-size room. Reporters were permitted to place their chairs in any position which they found convenient.

Two basic modes of presentation were used during this phase of the study. Prerecorded taped materials were presented by playing the tapes on a monaural tape recorder with built in speaker. Few difficulties were noted with the sound quality, despite the lack of separate speakers, and those which did occur were attributable to the quality of the tapes. The other type of presentation was a 16 mm film shown on a sound projector. For presentations during the latter part of the experiment, beginning on Day 12, a supplementary speaker was introduced for the projector, moving the sound source from the location of the projector (in the rear of the room)to the front of the room. No noticeable improvement in sound quality was achieved by this effort, however.

A schematic drawing of the locations of the tape recorder, projector and screen, and the reporters' usual positions for each type of presentation is presented in Figure III-1. Since the manual shorthand reporter was the only one who required a light source during the actual taking of the record (stenotype is operated by a touch system, and audio recording requires little monitoring for a single sound source), room lights were turned off during the film presentations. A supplementary table light was provided for the manual shorthand writer.

The two machine shorthand reporters who employed typists remained in the presentation room to complete their transcripts. The four people involved simultaneously utilized the dictation and listen functions of dictating machines and two typewriters, necessitating the use of a large room to minimize noise interference. The other two machine shorthand reporters and the manual shorthand reporter used a nearby (smaller) conference room to transcribe. Another nearby room was set aside for the audio recording transcriber. Due to scheduling difficulties within NBS, different rooms were used for transcribing from time to time, but the preparations of individual transcripts were never interrupted, and all rooms used were in the same building as the presentation room.

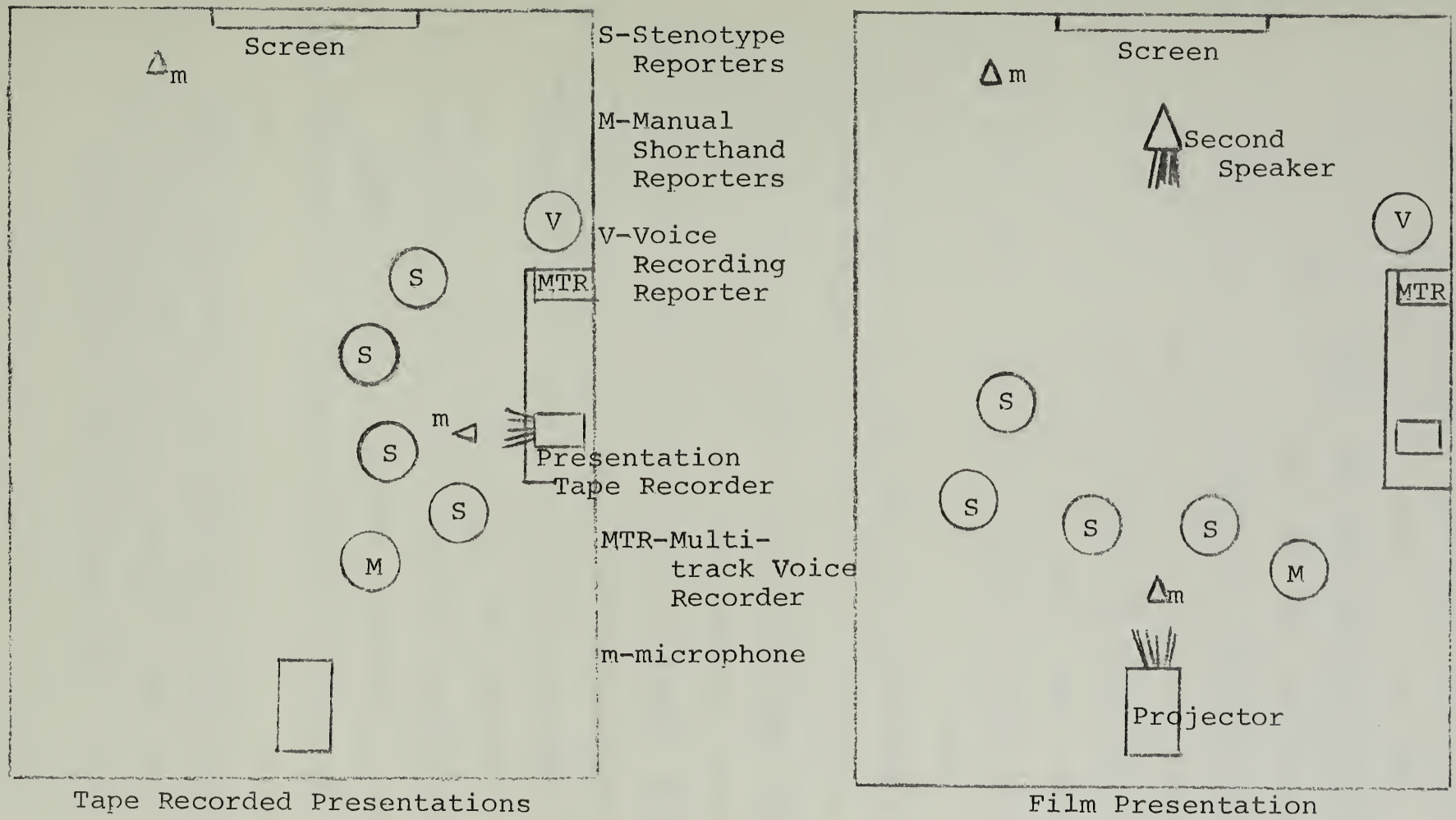


Figure III-1

Usual Configuration of Equipment and Reporters for Laboratory Phase (Not to Scale)

Almost all of the equipment required by the reporters was provided by NBS or the computer transcription system contractor. Five stenotype machines (including a stand-by), specially modified for incremental electronic recording were provided for the machine shorthand reporters. The four reporters provided their own stenotype machine tripods. The two reporters who dictated their notes for a typist also provided their own dictating machines and tapes.

A six track audio recorder and microphones, identical to the systems currently in use in the Superior Court of the District of Columbia,were provided for this test through the auspices of that Court. Only two microphones were installed for the laboratory phase, hence only two tracks were used. One of the microphones, a directional type, was installed in the general area where the other reporters were sitting. A second, omni-directional microphone was installed on the opposite side of the room. (The microphone locations are indicated in Figure III-1.)

Shorthand tablets and pens were provided for the manual shorthand writer. Specially printed transcript paper, with line numbers indicated in standard format, was also provided for all reporters.

Eight typewriters (including two stand-bys), with tables and chairs, were provided for transcript preparation. Since some of the reporters were accustomed to

different model typewriters, some initial difficulty was experienced in adjusting to changes in touch and in machine speed capabilities. Additional difficulties developed, especially during the early part of this phase, when a number of the typewriters (which were rented) suffered mechanical failures. These machines were repaired or replaced with minimum direct interference with the production of transcripts, although some peripheral frustration from repeated problems of this kind became apparent.

3.2 Schedule

Two presentations, averaging 15 to 30 minutes' duration, were scheduled for each day of the study. Reporters were asked to report around 9:00 a.m., and the first presentation usually occurred at approximately 9:30 a.m. However, no rigid time schedule was followed. A short warm-up period was provided prior to the beginning of each presentation.* A brief break ( 5 to 10 minutes) was taken after the first presentation. The second presentation immediately followed the break. Reporters dispersed to their respective transcription rooms following the second presentation, and began preparing transcripts.

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*Warm-up for the first presentation consisted of a portion of a "take" from National Shorthand Reporters Association Dictation Tape #260-1, at speeds from 220 to 260 words per minute. Reporters warmed up for the second presentation by using a short part of the film.

Since all transcription sessions were monitored by Project Staff, breaks (including lunch) were permitted at the reporters' option. In general lunch breaks were not taken, however. Reporters preferred to complete work on their transcripts and return to their hotel.* The majority of the reporters could complete a normal day's transcripts by 2:00 p.m., frequently earlier. The manual shorthand writer and the audio recording transcriber tended to work later.

The only major exception to this general schedule occurred at the end of the last week of the laboratory phase. In order to accommodate the reporters' concerns about returning home in holiday traffic, presentations scheduled for Thursday and Friday of that week were combined, and all four presentations were given on Thursday morning. Reporters prepared transcripts in the same order that would have held for two days' presentations, but all transcripts were completed on Thursday.

### 3.3 Presentation Materials

Essentially three types of materials were presented during the laboratory period: selections from National Shorthand Reporters Association Dictation Practice Tapes; tape recordings of other types of dictation, generally speeches; and installments

*Once transcripts were completed for the day, reporters were free to do as they pleased; several utilized the additional time to complete work on pending transcripts from their own jurisdictions.

of a filmed trial record. The dictation tapes provided a simple and completely clear recording of familiar material, providing a test of the computer system under near-optimal recording conditions. Other taped material was designed to use the system under somewhat more difficult conditions, but still utilizing only a single speaker and legal topics with familiar terminology. (Some materials planned for inclusion in this latter category were discovered to be unacceptable for reasons not predicted in advance; e.g., voice differences too small to indicate a change of speaker for tapes including more than one speaker, or tapes which were audible but somewhat indistinct, making the stenographic record difficult without the speaker(s) being visible. These tapes were replaced with additional NSRA dictation tapes, resulting in a larger number of those presentations than originally planned.) The film was presented to provide a recording situation which simulated actual courtroom work.

An itemized list, by day, of the specific material used for the presentations is given in Appendix C. Dictation tape material was selected from two NSRA tapes (Nos. 210-1 and 200-1). These tapes included material dictated at speeds from 165 to 210 words per minute, with the faster speeds occurring in question-and-answer material. Each presentation consisted of two or three "takes" from the tape, each from five to eight minutes in duration. In

general, one or two question-and-answer takes and one literary dictation were included in each presentation. Literary dictations involving material from sources other than legal ones were avoided; thus most of the literary dictations were judges' charges, or opening or closing statements. Question-and-answer takes were all civil testimony material.

Only three other taped dictations were used during the course of the study. Two were recordings made for the Trial Lawyers Tape of the Month series, produced by Trial Lawyers Service Company; each was of approximately 30 minutes' duration. Unfortunately, these tapes were originally produced to be played on a cassette tape recorder, and even transferring the recording to tape compatible with the recorder for presentations used during the test did not clear up all the sound fidelity problems. The third recording was of a speech delivered by Chief Judge Harold Greene, Superior Court of the District of Columbia, on the occasion of the Joint Opening Session of the District of Columbia Court of Appeals and Superior Court of the District of Columbia. The original speech was recorded on a multitrack audio recorder identical to those used in the D. C. courts, and it, too, was transferred to tape compatible with the recorder used for experimental presentations. Again some loss in sound quality was experienced. Two other similar

tapes were presented (Presentations 1 and 3), but quality was considered so poor by the reporters as to constitute an unfair test, and consequently no transcripts were prepared.

The film used for this study was originally produced by the National Educational Television Corporation for broadcast over its television network.* The film is entitled "Trial: The City and County of Denver vs. Lauren Watson." It is a film record, edited for television viewing purposes, of an actual trial held in Denver, Colorado, in 1968 in the court of the Honorable Zita L. Weinshienk. The editing included the addition of filmed interviews with the trial participants, as well as a narrator and credits; these additional elements occurred throughout the film, but were omitted from the records made by the reporters for experimental purposes.

The film was originally presented in four 90-minute segments, and was provided to NBS in four sets of three 30-minute reels.** In general, one reel was presented daily, with a record made only of that portion which portrayed actual trial activity. Thus, the "court record" varied somewhat in length from day to day, depending on the amount

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* The film was, in fact, broadcast during the 1970-1971 television season, but none of the reporters participating in the test had seen it before.

**National Educational Television representatives arranged for the film to be provided by the Audio-Visual Center of Indiana University.

of narration or interview material which was included in that reel. The resultant record-taking periods ranged approximately from 17 to 25 minutes.

Some difficulties were encountered with sound quality in the film; not all of the trial activity was clearly recorded in the filming process, and editing occasionally created ambiguity as to who was speaking. This was not significant for the experiment, however, since comparisons were to be made between the transcript prepared by a reporter and the transcript produced by the computer program from that same reporter's notes. Thus, whatever part of the film could not be picked up did not appear in either transcript of a given reporter.

In an effort to reduce some of the problems inherent in trying to record a trial which took place in an unfamiliar city, as well as to increase the similarity to actual courtroom conditions which would normally be familiar to the reporter, "cue sheets" were prepared for each film presentation. These included the names of the attorneys, witnesses, and judge, as well as the spellings of proper names and legal references which occurred during the filmed testimony. This information was taken from scripts of the film provided by NET.

## 3.4 General Procedures

No formal instructions were given to the reporters

regarding methods of work. It was suggested that they proceed as they would normally in day-to-day production of ordinary transcript. Since it was not possible to provide erasable bond transcript paper for this experiment, neatness of the final copy was not considered, and corrections by cross-out were permitted. Transcript format decisions were left entirely to the individual reporters; format differences essentially reflect the practices of different court jurisdictions.* Individual questions about inclusion or exclusion of specific kinds of material or the handling of special problems were dealt with as they occurred. The only restriction was that any decision would apply equally to all reporters.

Each reporter or typist was monitored and timed by a Project Staff member while the transcript was being prepared. The four reporters preparing their own transcripts (i.e., the two stenotype reporters and the manual shorthand and audio recording transcribers) were timed to determine the number of minutes required to type the transcript from their notes or recording. Time was measured to the closest half minute. The two reporters who dictated their notes for a typist were timed to determine the number of minutes required to dictate. Separately, the time needed for typing was determined as well as the elapsed time from the start of dictation to the last word of typing. This latter time was frequently considerably

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*See page 27.

less than the sum of dictation and typing times since the reporters used several tapes in relays and worked in parallel with their typists, who lagged somewhat behind. These two reporters alternated typists on successive days which minimized the likelihood of any systematic average time bias due to differences in typing speed, if any.

Approximately 77,500 words on 450 pages of transcript were prepared by each reporter during the laboratory phase. This is equivalent to approximately three full days of courtroom activity.

### 3.5 Computer System Procedures

In addition to measuring the time required to produce transcripts by conventional means, all elements of the work required to produce the computer-translated transcripts were also monitored by Project Staff. Tapes (in cartridge form) from the incremental recorders were mailed to Illinois to be transferred to computer-compatible magnetic tape.* These computer tapes were returned to NBS five to seven days later.

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*The requirement to mail the cassettes to an out-of-state location for conversion to computer-compatible tape is a temporary logistics problem. At present, only one such facility is available, located at the facility of the manufacturer of the modified stenotype machines. However, a capability for converting the 1/4 inch tape could be located nearby for operational usage. Modified stenotype machines also exist for producing computer tape directly, but they could not be obtained for this study. In either case, the delay experienced as part of this study would not occur in an operational system.

For efficiency, large quantities of material should be processed by computer at one time. Consequently, computer transcripts were produced in "batches", with three to seven presentation records for a single reporter constituting a "batch." The time required for each phase of the computer run, as well as sampled loading and other peripheral operation times, was recorded or measured by Project Staff.

The contractor utilized the results of the computer translations, as they were obtained, to update the main and subdictionaries throughout the three weeks in the laboratory. Accordingly, the dictionary actually in use grew from run to run. Much of this effort had originally been planned for accomplishment during the training phase, but circumstances prevented adequate dictionary development at that time. At the beginning of the laboratory effort (including training), the main dictionary contained more than 110,000 elements. The number of arguments (stenotype-to-English equivalents) added to the dictionaries through the end of the laboratory program is shown in Figure III-2; the main dictionary was increased by 40% during this period.

During the third week in the laboratory, after substantial work had been done to improve the dictionaries, computer transcripts from one reporter's second-week presentations indicated such a high number of apparent fingering errors*

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*See Appendix F.

Figure III-2

Number of Dictionary Additions Made Through Laboratory Phase (Including Pretest Training)

| | |
|---|---|
| Main Dictionary | 4579* |
| Subdictionaries | |
| Reporter A | 1096 |
| B | 790 |
| C | 1125 |
| D | 482** |

* Main dictionary contained approximately 110,000 elements at the start of the NBS program.

** Low, in part, because of lack of pretest records (see page 29).

that the stenotype machine used was thought to be defective. Similar problems appeared when the stand-by machine was substituted although there was a noticeable improvement in computer transcripts. The initial diagnosis of machine failure caused several records to be left unprocessed.

Manufacturer's tests of the machines at the conclusion of the study revealed no malfunction (see Appendix D). However, the point in the keystroke when the electrical contact was made was found to have shifted in several of the machines, so that an electrical contact might be made without any symbol appearing on the paper tape. (The machines had been initially adjusted so that electrical contact would not occur without some faint representation appearing on the paper tape.) This increased sensitivity of the electrical contacts would produce a large number of apparent errors, particularly for a reporter with a tendency toward shadow strokes (see page 94 ).

In addition to the mistaken belief of malfunction, which led to discarding some records, the cartridge tape record for two presentations for another reporter was destroyed (and, hence, the transcripts also) when the cartridges were damaged during shipment to Illinois. These two difficulties unfortunately resulted in a reduction of the size

of the experimental sample. The specific computer transcripts which are either missing or questionable are noted in Figure III-3.

3.6 Problem Areas

When skilled professionals participate in a program which might be interpreted as a direct comparison of people or techniques, the program is likely to be subjected to intensive scrutiny. Particularly when controversial techniques or vested interests are at stake, emotions may directly or indirectly influence the conduct and interpretation of experimental efforts. Many earlier "tests" of court reporting have suffered from such lack of objectivity.

Both prior to and during the laboratory phase of this experiment, several events occurred which might have had a serious impact on the results. Other factors did, indeed, influence the results, as described below.

(1) For several weeks prior to the initiation of the laboratory phase, incorrect and misleading information travelled along the court reporters' "grapevine" concerning the goals and mode of conduct of the proposed NBS study. Some doubts were entertained regarding the objectivity of the NBS program, and one reporter who had been scheduled to participate refused to take part.

Figure III-3

Computer Transcripts Processed,

Questionable,or Unavailable

| Presentation | Stenotypist A | B | C | D |
|---|---|---|---|---|
| 1 | --------not processed---------- | | | |
| 2 - 4 | + | + | +? | + |
| 5 - 8 | + | + | +? | + |
| 9 - 14 | + | + | +? | + |
| 15 - 19 | + | + | +? | + |
| 20 - 22 | + | + | +? | + |
| 23 - 24 | + | + | a | + |
| 25 - 28 | + | + | + | + |
| 29 - 30 | + | + | + | b |

\+ - Complete transcript.

+? - Complete transcript, but partial machine realignment resulted in high "error rate."

a - Diagnosis of machine failure - no record.

b - Cartridge damage - no record.

As a result of misinformation, some of the reporters who did participate freely expressed their substantial reservations about the purpose and objectivity of the project when they first reported to Gaithersburg. Many of these difficulties, if not all, were settled immediately upon realization of the causes for concern and the clarification of the facts.

(2) Quite naturally, any situation which is or appears to be a "test" introduces some amount of tension and concern among the participants. This "test effect" is usually most apparent in the early stages of a prolonged study, but may continue. In some cases, such an effect acts to degrade individual performance. However, in the current study, the "test effect" seemed to cause each reporter to work toward substantially improving performance, particularly in transcript production time since neatness was not to be considered. Observations during the study suggest that the participating reporters were, in fact, acting under considerable tension to produce the best possible results.

(3) A second, related, factor also acted toward reducing transcription time, at least for the stenotype reporters: the inclusion in the study of an audio recording system. The introduction of audio recording in lieu of reporters is particularly controversial in the court reporting field, and

we consider that many of the studies and reports on the relative utility of these systems reflect their authors' narrow viewpoints. Considerable effort was required throughout the entire NBS study period to counter the impression that the reporters, particularly the stenotype operators, were being "tested against" the audio recording system. All phases of all systems were timed to establish valid benchmarks for planning purposes, but not to determine which system was "fastest."

While some of this difficulty was overcome, the presence of the audio recording system resulted in an obvious and admitted (by the reporters) attempt to "beat" the time associated with that audio recording system. This effort and the test effect alluded to above combined to result in transcript production rates which, compared to reported values and from direct observation, are probably close to the upper limit possible, at least for the particular stenotype reporters participating.

(4) Only a minor effort was made during training by the contractor to teach the reporters to use techniques which would fully utilize the attributes of the computer system, and efforts to increase these skills were not encouraged. The pressure to improve transcript production time seemed to discourage the reporters from "writing for the computer," that is, attending to even those few details of corrections and formatting which they had learned as means of optimizing

computer system use. The stenotype reporters in general tried to utilize special codes, but incomplete familiarity and lack of contractor encouragement seriously limited the success of this aspect of training. Implications of this problem are discussed in the Analysis and Results section.

(5) Additional minor problems with reporter motivation developed from the frustration caused by machine failure, particularly the repeated failures of the typewriters, and by the relative inability of the stenotype reporters to interact with the contractor's representatives in the examination of computer transcripts. (This latter problem was in part due to the delays involved in transferring the electronic record to computer-compatible tape.)

It should be emphasized that the "test effect" and the presence of the audio recorder tended to reduce transcription times substantially below those which might have occurred with "ordinary copy;" other difficulties were either eliminated in discussions with the Project Staff or had no apparent effect on the outcome of the study. It is to their credit (and probably reflects the standards of the court reporting profession) that the reporters and typists who participated could accept the tensions and misunderstandings which occurred without allowing them to interfere materially with the work at hand or with attaining the goal

of the project. Every participant, whatever his reservations or concerns, engaged his task throughout the study on a best-effort basis, and did so with continued good humor.

## 4. Phase II - Performance in the Courtroom

As the final stage in assessing the feasibility of computer-aided transcription, a two week tryout in working courtrooms was arranged. Through the cooperation of the President Judge and the Court Administrator for the Philadelphia Court of Common Pleas, two courtrooms were selected for one week each to provide a representative selection of criminal case proceedings. The judges in both courts were informed in advance of the purpose and requirements, and they cooperated enthusiastically.

### 4.1 Physical Facilities and Equipment

During both weeks in the courtrooms, testimony was recorded by the five participating reporters simultaneously. Testimony was recorded for approximately one hour each day. The reporters were seated in the courtroom as conveniently as could be arranged given the physical configuration and equipment in the particular court, but could not be collocated.*

Recording during the first week (July 12-16) was conducted in a waiver court, in which the judge accepts pleas or tries

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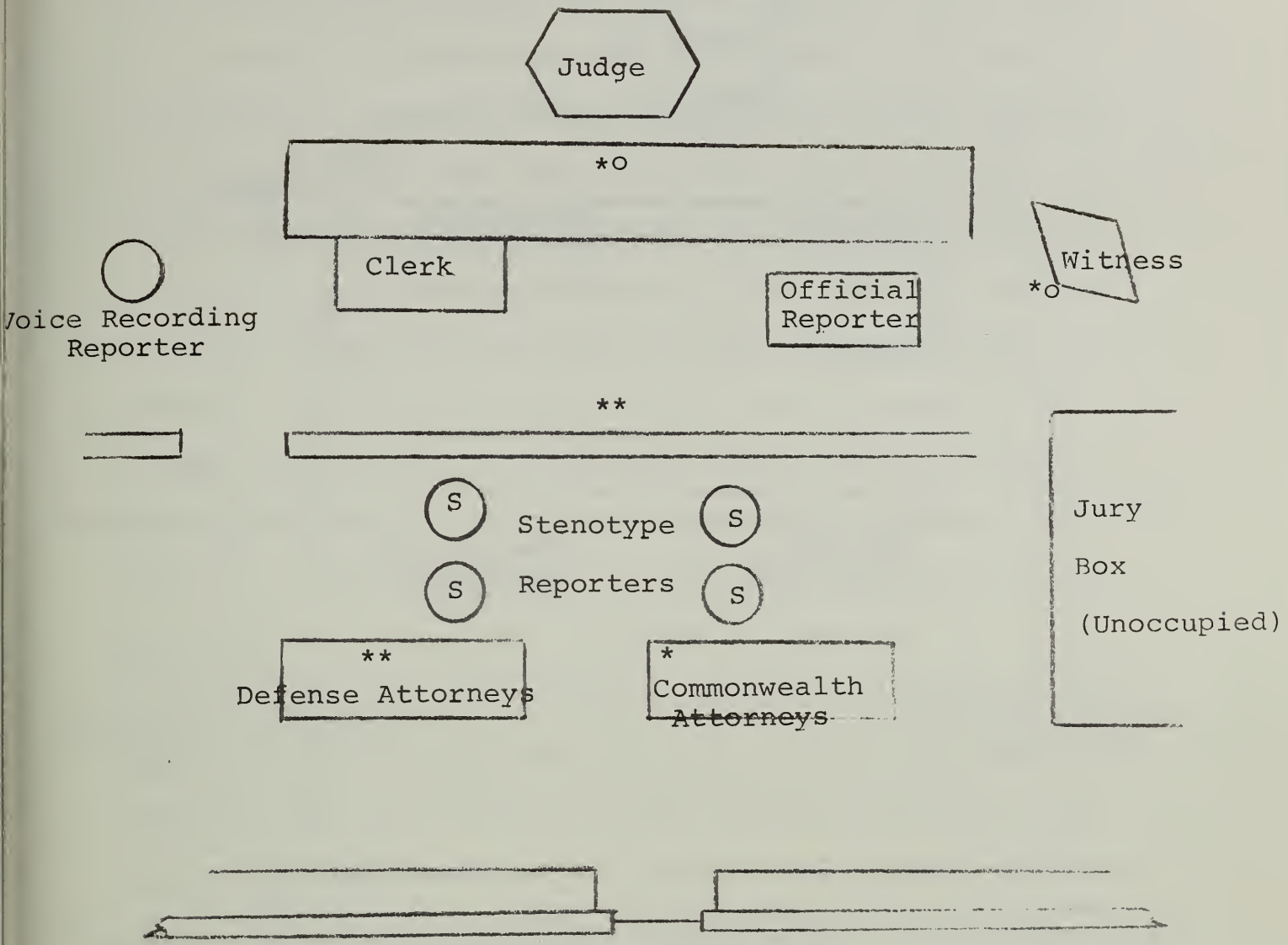
*This may be another source of the difference in volume of transcript production. See footnote on page 70.

cases without a jury, the right to a jury trial having been waived by the defendant. The locations assigned to the reporters, and those of the other key figures in the court, are shown in Figure III-4. Directional and omni-directional microphones for the audio recording system, as well as those for the courtroom speaker system, are noted.

The four stenotype reporters changed their specific positions slightly during the first two days, depending on the location of the speaker. Some difficulty was noted by the two reporters on the left in hearing the attorneys when they approached the bench. However, records made for experimental purposes were almost entirely of witness testimony, so this difficulty did not affect results substantially. This particular courtroom was air-conditioned by window units, which were noticeably noisy. The noise caused some general difficulty in hearing at first, but the Judge, upon noting the problem, arranged for the cooling systems to be turned off during testimony recorded for study purposes.

The configuration in the courtroom during the second week (July 19 - 23) was somewhat different (see Figure III-5). Again, microphones for the voice recording system and courtroom speaker system are indicated. There was not sufficient room between the area

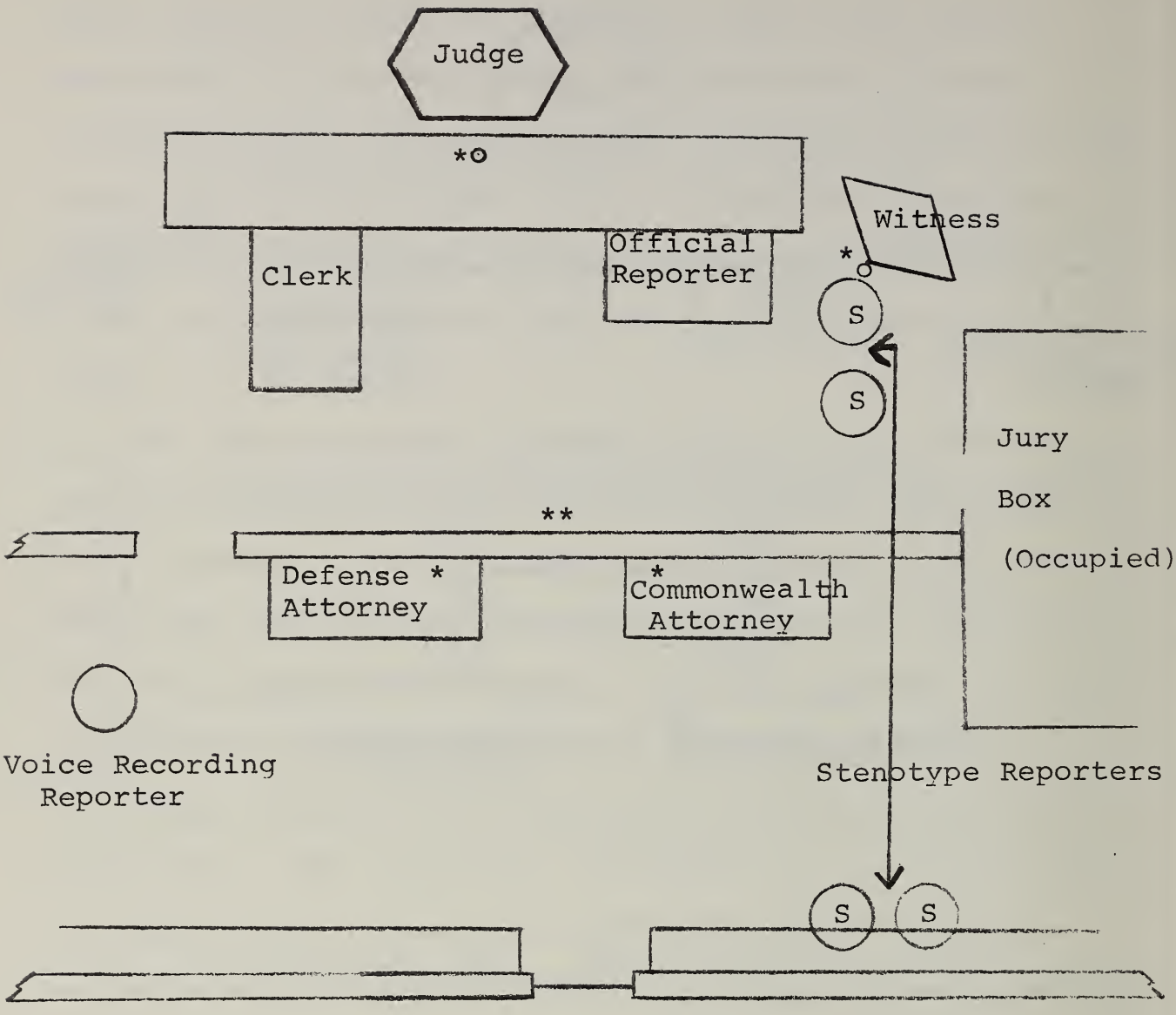



* Directional microphone.

** Omni-directional microphone.

o Courtroom speaker system microphone.

Figure III-4: Courtroom Configuration:
Philadelphia Court of
Common Pleas
Room 256, Judge Joseph McGlynn,
presiding
July 12 - 16, 1971
(Not to Scale)




* Directional microphone.

**Omni-directional microphone.

o Courtroom speaker system microphone.

Figure III-5: Courtroom Configuration:
Philadelphia Court of Common Pleas
Room 453
Judge Thomas McDermitt, presiding
July 19 - 23, 1971.
(Not to Scale)

occupied by the attorneys and that occupied by the judge and witnesses to accommodate five stenotype reporters. Consequently, two were seated immediately to the right of the official court reporter, while the other two were located on the right-hand witness waiting bench, well to the rear of the attorneys' tables. This location caused substantial hearing problems for these two reporters, with resultant loss of testimony in their records. The problem was particularly apparent when trying to record the Commonwealth Attorney, who faced directly away from them for a substantial part of the time, and who unfortunately also had laryngitis for most of the week.

The same modified stenotype machine was used by each reporter as in the laboratory phase. The incremental recorder attached to one of these machines failed at the end of the first week and was replaced early the following week. (Two computer records - Days 6 and 7 - for that reporter are missing as a result.) The Philadelphia representative of the manufacturer of the multitrack audio recording machine installed a system in each courtroom which was identical to the system used during the laboratory phase, except that four or five microphones were used, thereby providing more voice tracks.

Arrangements were made to use several nearby rooms for the preparation of transcripts. The two stenotype reporters

who prepared their own transcripts used vacant jury or witness rooms adjacent to the courtrooms. (The judge's anteroom adjoining the courtroom the first week was tried out for transcript preparation initially, but activity there was found to be too distracting.) The reporter transcribing the audio recording occupied a small office on the floor between the two courtrooms for both weeks of the study. The two reporters who dictated their notes for typists were from the Philadelphia court; they prepared their transcripts in a courthouse office to which one of them was regularly assigned.

Typewriters similar to those used during the laboratory phase were provided for each reporter, along with transcript paper and other supplies. Several typewriters failed during the first few days in the court; these were replaced, but one of the typists elected to use her own typewriter part of the time since it was available. As in the earlier phase, two reporters dictated their notes into their own dictating machines.

## 4.2 Schedule and General Procedures

Although it was possible to set minimum requirements for a basic amount of daily transcript to allow a reasonable assessment of the computer system, the actual scheduling of the record taking was entirely a function of developments in the court. Reporters and Project Staff arrived

in the courtroom prior to the opening of the morning session, which usually took place between 9:30 and 10:30 a.m. Equipment was set up so that record taking could begin at any time.

Reporters observed court activity and took notes to warm-up, as desired. When it appeared that testimony of a type and duration suitable for study purposes was about to begin (e.g., witness testimony, as opposed to attorney/judge exchanges at the bench), a signal was given by a designated reporter and all reporters simultaneously commenced record taking. A similar signal was given by the same reporter when approximately 20 to 40 pages of testimony had been taken, or when it seemed clear that no further suitable testimony was likely to occur during that session.

During the first week in the waiver court, court activity was sporadic. Although court usually convened before 10:00 a.m., suitable testimony was frequently not available until after 11:30 a.m. However, record taking was completed before the court was recessed for lunch break.

The jury trial heard during the second week in court was a major trial which occupied the court for the entire week. However, court actions were such that, on Tuesday, suitable testimony was not available until the afternoon

session, so reporters returned to the courtroom after lunch. Since the presentation of evidence for the case concluded on Thursday, it was decided to complete the record taking that day with sufficient testimony to provide double the normal day's transcript pages.

A Project Staff member monitored each room where transcripts were prepared. After completing the record taking for the study, reporters dispersed to these rooms as soon as it was possible to leave the courtroom without undue disturbance. (An additional reporter in court was responsible for the official record.) Breaks were allowed for lunch, but were rarely taken. In general, conventional transcripts for any one day were completed the same day. There were two exceptions to this general procedure: transcripts for testimony recorded on Friday of the first week were prepared on Monday and Tuesday of the following week, along with the transcripts for those days. Transcription of the double length record taken on Thursday of the second week was begun on that day, but completed on the following day.

Reporters were instructed to produce transcripts with the same general approach as in the laboratory phase. Timing by Project Staff was also done in the same way as in the earlier phase, with the time required to type (or dictate and type) the transcripts for each reporter each day recorded to the nearest half minute. The two

reporters utilizing typists again alternated typists as they had during the laboratory phase. (The typists did not attend the court sessions.)

In most cases, the stenotype reporters completed their transcripts by early afternoon. The audio recording transcriber tended to remain substantially later. Once the transcripts were submitted the reporters were free until the following morning. (The two reporters from Philadelphia usually attended to their normal official duties. The out-of-town reporters generally returned to their hotel.)

4.3 Computer System Procedures

Incremental recorder cartridges containing records taken during the first three days in Philadelphia were sent immediately to be converted to computer-compatible tape, and computer transcripts were made as soon as that tape was available, early in the second week of the courtroom phase. The contractor, using these first run transcripts along with the reporters' stenotype notes and discussions with the reporters, then made final adjustments in the main and subdictionaries. The remaining records (Days 4 - 9) were held and computer translation was accomplished only after the conclusion of the courtroom study.

No further modifications in the dictionaries were permitted after processing the first three courtroom

days. The total number of entries added to the dictionaries after the analysis of the transcripts of these three days is shown in Figure III-6. These entries represent primarily stenotype-to-English equivalents specific to the courtroom environment, and represent a 2% further increase in the size of the main dictionary.

The remaining incremental recording tapes were transferred to computer-compatible tape, and computer transcripts were produced for the four reporters for all nine days' records as soon as possible after the conclusion of the courtroom activity. (The computer run at this time also produced a second set of transcripts for Days 1-3 to reflect the final dictionary adjustments made after reviewing the earlier runs for those days.) Computer operations were monitored and timed by Project Staff, as in the earlier phase, at the contractor's computer facility.

Computer transcripts for all four reporters for Days 6 - 9 were printed by the computer in a special "edit print" mode, which included the required coordinate system (lines and words-in-line numbered) for editing procedures. Part of a sample page showing these coordinates is reproduced in Figure III-7. During the week following the activity in the courtroom the contractor staff examined the first run transcripts for Days 6 through 9, making the necessary notations for input to the final editing run for those transcripts. NBS Project Staff monitored all editing sessions

Figure III-6

Dictionary Additions After First
Three Days of Courtroom Phase

| | Phase I total | Additions | Total |
|---|---|---|---|
| Main Dictionary | 115,000* | 2515 | 117,500* |
| Subdictionaries | | | |
| Reporter A | 1096 | 658 | 1754 |
| B | 790 | 332 | 1122 |
| C | 1125 | 848 | 1973 |
| D | 482 | 506 | 988 |

*approximate

Figure III-7: Sample page of Computer First Run Transcript in "Edit-print" Format

16.1 Q Now sir I'm shcwing ycu *gelths* exhibited number
1 2 3 4 5 6 7 8 9

16.2 consider two which is a single barrel shctgun, sawed crf stock
1 2 3 4 5 6 7 8 9 10 11

16.3 and sawed off barrel and ask ycu sir are you able tc identify
1 2 3 4 5 6 7 8 9 10 11 12 13

16.4 that shotgun?
1 2

16.5 A I can't directly identify the shctgun because I cn-
1 2 3 4 5 6 7 8 9 10

16.6 -ly saw the barrel. I didn't see the rest of the shotgun.
1 2 3 4 5 6 7 8 9 10 11

16.7 Q Do ycu notice the barrel sir?
1 2 3 4 5 6 7

16.8 A Yes.
1 2

16.9 Q What color is that barrel?
1 2 3 4 5 6

16.10 A Gcld plated.
1 2 3

16.11 Q Does that appear to be similar to the one that was
1 2 3 4 5 6 7 8 9 10 11 12

16.12 pointed at your midsection?
1 2 3 4

16.13 A Yes, it was.
1 2 3 4

16.14 Q Now sir ycu may take that away from the witness,
1 2 3 4 5 6 7 8 9 10 11

16.15 thank ycu. Now, after Ellis was told to lie down and the
1 2 3 4 5 6 7 8 9 10 11 12

16.16 gentleman went to the cash register which is against the west
1 2 3 4 5 6 7 8 9 10 11

16.17 wall were you able frcm ycur position down on the flocr to hear
1 2 3 4 5 6 7 8 9 10 11 12 13

16.18 any conversation that may have taker place?
1 2 3 4 5 6 7

16.19 A Well, during the ccurse cf the time I dcn't knew
1 2 3 4 5 6 7 8 9 10 11

16.20 when but they told Ellis they was gcing to kill him.
1 2 3 4 5 6 7 8 9 10 11

16.21 Q And how many times did you hear the men tell Ellis
1 2 3 4 5 6 7 8 9 10 11 12

and timed the relevant procedures. Cards containing the editing information were read into the computer,and final edited copy was printed for Days 6 through 9.

## 4.4 Case Characteristics

Cases heard in the waiver court, during the first week in the courtroom, were primarily routine felony cases, ranging from receipt of stolen goods to robbery and narcotics cases. A summary of the cases for which records were taken for study purposes is shown in Appendix E. Cases heard were generally short, involving only one or two witnesses. Occasionally, an entire case could be recorded for the purposes of the experiment.

The courtroom used during the second week in court was the site of a major jury trial, with the defendant charged with first degree murder. *Voir dire* examination for jury selection, "opening and closing arguments," and the testimony of witnesses for both prosecution and defense were recorded for study purposes. A summary of the specific testimony used is also presented in Appendix E.

# IV. ANALYSIS AND RESULTS

## 1. Overview

Two primary questions are posed in the evaluation of computer-aided transcription in court reporting: What are the potential time savings over conventional techniques in transcribing court records? And can the computer system provide a transcript suitable to serve as an official court record? Thus, two major variables are central to the assessment of feasibility, namely transcript turn-around time (compared to conventional methods) and the degree to which the computer transcripts "match" those produced by the court reporters from the same notes.*

The following sections of this report describe both the methods of analysis used in evaluating the computer transcription technique, and the specific findings of the two operational phases. Since the study was designed to determine this system's potential for use in the courtroom, and since modifications in the computer software (i.e., dictionaries) were made throughout the laboratory phase, primary emphasis in this analysis is on the results of courtroom performance.

Two versions of transcripts are produced as output from the computer translation program. An initial translation is printed as a "first run" transcript; this includes

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*The element of cost, which must be considered in any thorough examination, was not operationally tested, but is discussed in Volume I.

stenotype elements which could not be translated (shown between asterisks), as well as any fingering errors, incorrect resolutions of homographs, and word boundary anomalies which had not been noted by the reporter prior to translation.* Subsequent proofreading, error correction entry, and reprinting provide a second "edited run" transcript. If a transcript is to be processed through the editing procedures, the first run copy is printed in a special "edit mode" format (see Figure III-7). Because of the additional cost incurred in the editing process, only the last four days' transcripts from the courtroom phase were edited.

It should be noted again that the limited scope of the study (in particular, the small number of reporters participating) and the singular features of the experimental situation preclude generalizations to other situations. The numbers presented here reliably represent what, in fact, did occur, but they do not necessarily reflect normal or average performance in transcript preparation. Within the test situation they clearly reflect excellent performance by top-flight reporters, and as such are a valid basis for evaluating the feasibility and potential of the computer-aided system. They should not, however, be used as a basis of comparison of individual reporting performance in other, non-test situations.

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*See pages 74-76 and Appendices B and F for further discussion of "errors."

## 2. Measures of System Performance

### 2.1 Time

One of the major components of court backlog is said to be the time required to obtain transcripts of the court proceedings. Consequently a major element in appraising any system of transcript production must be the time required for the hard-copy transcript to be prepared.

For both phases of the study, production time for the transcripts produced by the several conventional techniques, whether from machine shorthand or other techniques, was measured to the nearest half minute for each transcript. Since transcripts differed somewhat in the actual number of words, these production times were reduced to the number of words per minute in order to secure a uniform measure.* Rough estimates of equivalent pages per hour were calculated, in order that results given here could be examined more meaningfully in the light of published transcript production data, and so that the findings could be placed in perspective by court reporters and administrators.

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*In any one set of transcripts, the numbers of words recorded by the reporters may differ by as much as 10%, but are usually quite similar. Much of the variation in word counts of the transcripts is directly attributable to the experimental situation, or, perhaps to a lesser degree, to the differences in reporting practices in different jurisdictions. Reporting style (whether to record false starts, for example), format variations (especially the method of indicating non-verbal court activity e.g., "side bar held" vs. "Whereupon a side bar conference was held."), and in some cases differing ability to hear the speakers because of seat location all contributed. Since the sources of difference cannot be separated in the data, no investigation of the word count issue in this study would be meaningful.

The time required for the computer system to produce a transcript is somewhat more difficult to measure directly. For the purposes of comparing computer system transcript preparation time to that consumed by the reporters using their conventional techniques, computer "turn-around time" was considered to be the time to read the input, process the material, and print the output. Time records are calculated directly from the computer records, as the difference between the start and stop times, to the nearest second, recorded for each computer run. (Material being printed was also transferred to a computer output tape for storage for future use. The time required to accomplish this transfer could not consistently be separated from printing time and is estimated, on the basis of timing one or two separate transfer procedures, to add approximately one minute to the turn-around time.)

Peripheral operating times may differ substantially under different operating conditions. The time required for the computer personnel to start and stop runs, physically transfer tapes, and other purely operational activities was measured during one computer run session. It is, however, reported only incidentally, since to a great extent it applies to experimental conditions and would not necessarily represent the time required to operate the system under full-scale production effort.

Time measurements were made for all procedures required to complete the editing and printing of a final copy for the last four days' transcripts in the courtroom phase. The editing procedures which were used were unusual and artificial in that the contractor's personnel did the editing: the reporters would have been more likely candidates for this task, but were disqualified by virtue of their earlier experience in transcript preparation from the paper tape notes.

Each of several steps in the editing process was separately timed for the four sets of transcripts. Each transcript was proofread and "errors" were noted by inspection (or by reference to one of the other corrected transcripts), but without prior exposure to the court proceedings and without reference either to the reporters' notes or to the audio recording.

Each change was keypunched on a separate card, along with the appropriate "edit mode" coordinates, and was verified to detect possible errors in the keypunch operation. These cards were read directly into the computer, and the text reprinted without the requirement for retranslation.

## 2.2 Transcript Quality

Reporters are required to provide a verbatim record of court proceedings. Reporters are not infallible in

this task, but the verbatim nature of the record is not an issue in this study. That there was variation in numbers of words in some transcripts of the same material, as well as evidence of a small number of potentially meaningful errors, suggests that the notion and significance of "verbatim recording" should be examined systematically and objectively. However, for the purpose of evaluating the acceptability of the computer transcript, the conventional record produced by the reporter from his or her own notes was the standard of comparison for the computer transcript.

When stenotype notes are processed conventionally, the reporter (or note reader) adds punctuation, corrects shadow stroke "errors" and resolves anomalies from context. In record-taking for the computer, recording errors made by the reporter and recognized at the time of keying may be signalled to the computer by using the asterisk (*) key on the stenotype machine. One asterisk stroke signifies deleting the previous stroke, and three asterisk strokes causes deletion of all strokes back to the last period or question mark. Errors not cued by asterisk at the time they are made (including shadow strokes) may be listed to be directly entered into the computer (thus becoming, in a sense, special dictionary entries) prior to submission of material for translation. Errors which are

not noted, or are not corrected, must be corrected later either by hand or during editing procedures. For the most part reporters in this study did not attempt corrections prior to the computer run.

The complex nature of the English language does not encourage a simple counting of differences between transcripts as a useful measure. Nonetheless, an estimate of the number of times the transcripts differ in words or phrases (punctuation differences are counted only on those rare occasions where the meaning of the sentence is substantially changed) does offer a rough measure of the "accuracy" of the computer system. The number of differences was calculated for one transcript for each reporter in each phase of the study. In each case, one "error" was generally attributed for each word in the reporter's original transcript which did not appear identically in the computer transcript. In some cases, a word in the standard transcript might correspond in the computer transcript to several words, or might be combined with an adjacent word form to appear as a single, different word. In either case, only one "error" was counted, representing the word in the original transcript which did not appear correctly in the computer transcript.

Of considerably more concern than the simple number of times the transcripts were different is the substance and origin of the differences which occurred. This computer program acts in a completely predictable fashion, but is limited entirely by the scope of its program information (in this case, the size and structure of the dictionaries) and by the accuracy of the input it receives (i.e., the stenotype symbols). The errors which arise in the initial computer transcript may stem from limitations in either of these dimensions, or perhaps both. (A more extensive discussion of sources of errors, with examples, may be found in Appendices B and F.)

A fairly large number of errors which occurred in the current study would probably be avoided in an operational situation. With only limited training the reporters did not acquire the skills with special codes required to signal to the computer format changes, proper names, and character-by-character spelling. In addition, the dictionary contains some spelling errors, which in time could be easily corrected.

Unfortunately, not all of the errors in the computer transcripts can be definitely categorized by source without extensive examination of the reporter's original shorthand notes. An attempt was made by the contractor to categorize the errors in the transcripts for the first three days of courtroom activity; these distributions

are reported, but should be taken as only rough estimates of the true distributions.

## 3. Phase I - Laboratory Study

### 3.1 Time

Three different types of material were presented during the laboratory phase of the study: NSRA dictation tape selections, tape recorded speeches, and portions of a filmed trial. Average transcript preparation rate by type of material (words per minute) is shown in Figure IV-1. Estimate of the corresponding rates in pages per hour are also shown.

Preparation rates for the two stenotype reporters (A and B) who dictated their notes for typists have been calculated by adding the times taken for dictation and typing. These tasks are normally performed sequentially, and the combination of the two (although the court reporter is directly involved only in the former) yields total transcript preparation time. If rush copy is required, typing can begin within minutes after dictation is started, and transcript preparation is substantially faster. Dictation and typing were overlapped for some transcripts in this study;the preparation rate for those transcripts was increased by nearly 20% (compare Figure IV-2).

Figure IV-1

Average Transcript Preparation Rates, Laboratory Phase

| | Type of Presentation | | | | | |
|---|---|---|---|---|---|---|
| | NSRA Dictation Tapes | | Taped Speeches | | Film | |
| | Words/ Minute | Pages/ Hour | Words/ Minute | Pages/ Hour | Words/ Minute | Pages/ Hour |
| Stenotype Reporter | | | | | | |
| A | 46 | 13 | 33 | 7 | 44 | 11 |
| B | 45 | 13 | 37 | 8 | 44 | 11 |
| C | 51 | 14 | 40 | 9 | 53 | 13 |
| D | 56 | 16 | 44 | 9 | 55 | 14 |
| Audio Transcriber | 42 | 12 | 29 | 6 | 32 | 8 |
| Manual Shorthand | 39 | 11 | 28 | 6 | 36 | 9 |
| Approximate No. Words | 29,400 | | 9,800 | | 38,300 | |
| Average Words/page | 208 | | 284 | | 236 | |
| Approximate No. pages | 145 | | 35 | | 162 | |

The stenotype reporters' transcript preparation rates for the NSRA dictation tape material and the film were substantially faster than the previous estimates of transcript preparation rates under day-to-day working conditions (8 to 12 pages per hour). Transcripts for the taped speeches took a more "normal" amount of time (7-9 pages per hour) but the difficulties in distinguishing words in many instances would probably have slowed down a transcriber to perhaps 5-6 pages per hour under ordinary working conditions.* On the other hand, the time required by the manual shorthand writer and the audio recording transcriber to prepare the transcripts was within the range of estimates made under normal working conditions, except for the dictation tape transcripts, which were prepared somewhat faster. However, the recording and transcribing conditions were better than average. In general, then, it appears that the stenotype reporters were transcribing close to their top rates for this experiment, while the other reporters transcribed at more "normal" rates for their techniques. This finding is not unexpected in the light of the perceived pressures, which encouraged the stenotype reporters to "beat" the other systems. (See pages 52-53.)

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*If only the court reporter's dictation time is considered, the "preparation rate" is approximately three times that for dictation plus typing. The two reporters dictated approximately 47, 24, and 37 pages per hour, respectively, of transcript for NSRA dictation material, taped speeches, and the film record.

Figure IV-2

Average Transcript Preparation Rates:
Dictation and Typing Overlapped

| | Type of Presentation | | | |
|---|---|---|---|---|
| | NSRA Tapes | | Taped Speeches | |
| Stenotype Reporter | Words per minute | Pages per hour | Words per minute | Pages per hour |
| A | 55 | 14 | 38 | 8 |
| B | 55 | 14 | 44 | 9 |

A comparison of the times required for the reporters to prepare their conventional transcripts with those required by the computer to translate the same stenotype notes for first run transcript is shown in Figure IV-3. Conventional transcripts are grouped for comparative purposes corresponding to the "batches" in the separate computer runs.* Computer time as indicated in Figure IV-3 includes time required to read in the stenotype record tape, and to translate and print out the transcript. Tape transfers and loading times are not included.

Computer processing of first run transcripts was accomplished from seven to seventeen times as fast as the reporters' preparation of the related conventional transcripts, the faster processing times occurring whenever more material was processed in a single batch. The total time** for computer processing is obviously

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* See page 47. Presentations 2-4 are omitted since neither conventional nor computer transcripts were prepared for these presentations.

**Peripheral processing times for each batch of transcripts varied from 10 to 20 minutes. The contractor's software is a batch system written under OS 360. The hardware used for processing normally operates under DOS. The switch from DOS to OS operation requires about five minutes in addition to the five minutes necessary to load the translation program into the system. In addition to the time required to prepare the computer system to begin processing, the information on the computer-compatible tape had to be copied to a second (larger) tape, and transferred to a third tape in the specific format required for input to the computer translation program. This reproduction time adds only from a half minute to three minutes to the translation time for each batch of several test transcripts for one reporter, and is in part an artifact of the particular processing arrangements used.

Figure IV-3
Average Transcript Preparation Times;
Conventional Transcripts and
Computer First Run Transcripts, Laboratory Phase

| | Reporters | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | |
| | Conventional (minutes) | Computer* (minutes: seconds) | Conventional (minutes) | Computer (minutes: seconds) | Conventional (minutes) | Computer (minutes: seconds) | Conventional (minutes) | Computer (minutes seconds) |
| Presentations (approximate # of words) | | | | | | | | |
| 5 - 8 (12,900) | 315 | 19:27 | 315 | 20:05 | 284 | 19:24 | 265 | 18:54 |
| 9 - 14 (18,800) | 457 | 28:24 | 433 | 25:26 | 373 | -** | 330 | 25:18 |
| 15 - 17 19 - 20 (11,400) | 235 | 18:23 | 347 | 18:22 | 202 | 18:48 | 191 | 17:13 |
| 18, 21 - 26 (17,200) | 384 | 24:23 | 353 | 22:02 | | | 300 | 22:13 |
| 18,21,22,25,26 (11,685) | | | | | 215 | 18:37 | | |
| 27 - 28 (4226) | | | | | | | 68 | 10:34 |
| 27 - 30 (8220) | 149 | 17:14 | 167 | 18:41 | 135 | 16:48 | | |

* Includes input, processing, and output times. Does not include peripheral set-up or tape transfer times.

**Operator/Program error: time not available.

very much less than for the conventional transcript process. The computer times shown in Figure IV-3 correspond to preparation rates of approximately 3 pages of transcript per minute, or 180 pages per hour.

3.2 Transcript Quality

One of the considerations underlying the design of the study's laboratory phase was the desire to examine the capability of the computer system in a variety of record-taking situations, ranging from simple dictation to simulated courtroom activity. While the presentations did vary in this respect, meaningful evaluations of the effects of this variation on the quality of the computer transcripts could not be made because of the inability to complete necessary developmental modifications to the computer system during the training period. Throughout the laboratory phase, additional entries to the dictionaries were necessary and transcript quality reflected the incomplete development of the total system for courtroom vocabulary and conditions. Consequently, only a limited analysis of computer transcript quality was made for the laboratory phase.

For each of the stenotype reporters, the computer transcript was compared, word for word, with the conventional transcript for the record of the NSRA dictation tape presentation on the 14th day of testing (Presentation 27); this appeared to be representative of transcript available from

the computer system at that time. In addition, analysis of a record made under the best recording conditions would minimize ambiguities caused by lack of clarity in the presentation material.

The percent differences between conventional and computer transcripts, by reporter, are shown in Figure IV-4. In general, one "error" is counted for each word in the conventional transcript which does not occur identically in the computer transcript. The percentages of transliterations (i.e., no-match elements appearing in the computer transcripts printed between asterisks compared to the total number of words in that transcript) are also shown. The number of times the computer "noted" an "error" is only 1/9 to 1/5 the number of actual transcript differences. This discrepancy is discussed in more detail in connection with the courtroom phase results.

Figure IV-4

Analysis of Differences:
Presentation 27, Laboratory Phase

| Reporter | Total % Differences, Conventional vs. Computer Transcripts* | % Transliterations |
|---|---|---|
| A | 9.3 | 1.4 |
| B | 10.6 | 1.2 |
| C | 15.4 | 2.9 |
| D | 14.1 | 2.2 |

*No. differences between transcripts divided by no. words in conventional transcript.

## 4. Phase II - Courtroom Study

The laboratory phase of the study was, in a sense, a continuation of the training phase since modifications continued both in the dictionary and in the program logic. Even at the conclusion of the laboratory phase, the contractor's personnel felt that additional experience in a courtroom would be necessary to achieve an adequate level of court-oriented entries in the dictionary. In order to allow final modifications to be made, yet probe the computer system in a stabilized condition over a significant period of time, changes in the dictionaries were permitted through the first three days spent in the courtroom. The tapes made on those days were processed and transcripts examined for final dictionary entries. Subsequent tapes were held until the close of the courtroom phase, then processed.

### 4.1 Time

Stenotype reporters prepared transcripts for a portion of court record as specified each day for study purposes. Average transcript preparation rates for a total of approximately 270 pages of transcript are shown in Figure IV-5, along with estimates of the corresponding number of pages per hour. As in the laboratory phase, the rates shown appear to be close to the upper limits of skill. (It may also be noted again that the "rush

Figure IV-5

Average Transcript Preparation Rates,
Courtroom Phase

| | Preparation Rates | |
|---|---|---|
| | Words/Minute | Pages/Hour* |
| Reporter | | |
| A | 47 | 16 |
| B | 48 | 17 |
| C | 55 | 20 |
| D | 54 | 19 |
| Audio Recording Transcriber | 27 | 9 |
| Dictation and Typing Overlapped | | |
| Reporter | | |
| A | 57 | 20 |
| B | 56 | 19 |

*Approximate; based on 172 words/page (sampled average length of page in this experiment).

copy" technique of overlapping dictation and typing resulted in an improvement in preparation rate of approximately 20% for the two reporters who worked with typists.)

The audio recording reporter also prepared transcripts during this phase at approximately the same rate as for the more difficult presentation material (the taped speeches and the film) in the earlier phase.

Transcript preparation rates for individual days of the courtroom study are shown in Figure IV-6, showing separate typing and dictation rates for Reporters A and B. The range in the number of words per minute in total preparation rates corresponds to a range of 14 to 20 pages per hour. There was no evidence, however, that daily variation was related to difficulty in taking the record.

Computer translation times for first run copy are compared to reporter transcript preparation times in Figure IV-7. As in Figure IV-3, computer times represent input, translation and printing times, but do not include peripheral tape transfer times. Computer first run transcript preparation was 8 to 14 times faster than conventional methods. In terms translatable to the size of current court backlogs, the demonstrated rate of computer translation is equivalent

Figure IV-6

Transcript Preparation Rates by Day, Courtroom Phase
(Words per Minute)

| Day | Approx. No. Words | Reporter A | | | Reporter B | | | Reporter C (Typed from Notes) | Reporter D |
|---|---|---|---|---|---|---|---|---|---|
| | | Dictate | Type | Comb.* | Dictate | Type | Comb.* | | |
| 1 | 5000 | 159 | 59 | 42 | 164 | 75 | 51 | 64 | 51 |
| 2 | 4000 | 155 | 66 | 46 | 151 | 57 | 41 | 53 | 56 |
| 3 | 4200 | 147 | 57 | 41 | 148 | 68 | 47 | 53 | 51 |
| 4 | 3600 | 168 | 74 | 51 | 159 | 61 | 44 | 55 | 56 |
| 5 | 4200 | 159 | 60 | 44 | 165 | 54 | 49 | 52 | 47 |
| 6 | 4800 | 185 | 77 | 55 | 188 | 67 | 49 | 59 | 58 |
| 7 | 6500 | 178 | 67 | 49 | 163 | 68 | 48 | 62 | 59 |
| 8 | 4400 | 179 | 70 | 50 | 175 | 66 | 47 | 54 | 559 |
| 9 | 10000 | 162 | 63 | 46 | 167 | 72 | 50 | 49 | 51 |
| Average | | 165 | 65 | 47 | 165 | 66 | 48 | 55 | 54 |

*"Comb." - Dictation and Typing combined serially.

Figure IV-7

Average Transcript Preparation Times

Conventional Transcripts (in minutes) and Computer First Run Transcripts (in minutes:seconds), Courtroom Phase

| Days | Approx. # pgs. | Reporter A | | Reporter B | | Reporter C | | Reporter D | |
|---|---|---|---|---|---|---|---|---|---|
| | | Conventional | Computer* | Conventional | Computer* | Conventional | Computer* | Conventional | Computer* |
| 1-3 | 76 | 317 | 23:13 | 290 | 22:58 | 220 | 22:22 | 242 | 19:37 |
| 4-5 | 47 | 171 | 17:01 | 172 | 20:30 | 141 | 17:55 | 148 | 12:22 |
| 6-9* | 143 | 539 | 38:20 | 523 | 36:54 | 447 | 38:07 | 265 | 23:45** |

* Computer transcript printed in edit print format.

** Days 8 and 9 only; records for Days 6 and 7 missing due to incremental recorder malfunction.

to the processing of several months of transcript in little more than a week.

Full utilization of this high transcript preparation rate presupposes that first run transcript is suitable for court record purposes; however, that is not necessarily the case, as discussed in the following section. The computer system has provision for a separate editing function, which allows acceptance of error corrections directly into the master text and permits reprinting without further translation. The last four days' transcripts (Days 6-9) were subjected to these procedures in order to determine the feasibility of using edited, instead of first run, copy.

It must be emphasized again that the editing procedures were adopted only for this experiment, but would probably not ordinarily be employed. The limited set of stenotype reporters prepared conventional transcripts of all their notes to provide a basis for comparison. If after that they had also served as editors for the computer version, the results would surely be biased. Of course, only a single transcript is prepared in the "real world." Moreover, the use of contractor personnel to perform the editing procedures introduced a different form of bias: for ambiguities which could not be resolved from context within the transcript, reference was made to the computer transcripts for the other reporters. No reference was make to the stenotype

notes or the audio recordings of the court sessions, both of which were available. This tended to save time, but it introduced a new type of "error" into the edited transcripts (see page 98).

The time required for the editing process was much greater than had been expected.* Figure IV-8 shows the time used to accomplish the various steps in the process, in minutes, and the total time to produce the final edited version (in hours and minutes). For reporters A and B, editing required more than 6 minutes per page, on the average. (The transcripts for C and D required more time, but they manifested an unusually high number of errors, due in part to the inability of C and D to hear much of what was said in the courtroom; see page 59.) The combined time for computer processing and editing was almost twice as long as the preparation time for conventional transcript.

It is not possible to estimate the time which would be required for editing if proofreading and noting of errors on first run computer transcript were performed by the

---

*As a result of this experience, the contractor is considering undertaking the development of a more rapid error correction system than the keypunch cards currently in use. Although reporters better trained in this system would be expected to make fewer errors, particularly in the format area, the current system is conceded to be inherently inefficient.

Figure IV-8

Number of Minutes required for Edit Process:

Courtroom Phase, Days 6 - 9*

| | Reporter | | | |
|---|---|---|---|---|
| | A | B | C | D** |
| Correction | 742 | 718 | 1253 | 512 |
| Keypunching (# cards) | 163 (1590) | 149 (1570) | 234 (2880) | 126 (1200) |
| Verification*** | 25 | 30 | 30 | 30 |
| Computer print (nearest minute) | 7 | 7 | 7 | 3 |
| Total | 937 | 904 | 1524 | 672 |
| Hours: Minutes | 15:37 | 15:04 | 25:24 | 11:12 |

* Approximately 145 pages.

** Days 8-9 only.

*** Approximate; includes computer input, error detection and search, keypunch correction and reverification.

reporter: his recollections and access to his own (paper tape) stenotype notes should eliminate many ambiguities and provide considerable savings in time over that required for the editing actually performed. It may be observed that a reduction of editing time to one-fifth of that taken experimentally would yield a computer system transcript production time about half that required by conventional methods.

## 4.2 Transcript Quality

At the time that the initial computer transcripts were examined for the first three days of the courtroom phase, in preparation for the final modifications to the dictionaries, a preliminary count was made by the contractor of the number of errors in those transcripts by apparent source of the error. These distributions (in percentages) are presented in Figure IV-9. Although the source of error cannot always be clearly identified, these distributions give some indication of the relative rate of occurrence of various types of errors.* As the dictionary was further developed, the occurrence of dictionary errors would be expected to decrease.

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*For example, word boundary errors and homograph errors frequently overlap. The stenotype stroke sequence in which a word boundary (in English context) is missed may be a legitimate shorthand form for some other English word or phrase, hence a homograph. (For example, the shorthand forms for "summaried writing" and "some red writing" are identical.) (See Appendix F.

Figure IV-9

Distribution of Errors by Type:*
Courtroom Phase, Days 1-3

| | Error Distribution(%) | | | | | | No. Errors | % of Total Words in Error |
|---|---|---|---|---|---|---|---|---|
| Reporter | F | M | D | B | H | W | | |
| A | 50 | 0 | 34 | 2 | 3 | 11 | 1001 | 8 |
| B | 20 | 0 | 45 | 3 | 3 | 29 | 858 | 6 |
| C | 65 | 0 | 14 | 2 | 3 | 16 | 1776 | 14 |
| D | 31 | 23 | 27 | 2 | 9 | 8 | 913 | 7 |

Definition of errors:

F - Fingering error

M - Hardware malfunction

D - Dictionary error or entry not present in dictionary

B - Word boundary error

H - Homograph which is a homonym

W - Homograph which is not a homonym

* As classified by contractor personnel (see text; also see Appendix F for further description of error types).

The overall percentages of errors decreased somewhat from the level of error in the laboratory phase, although the basis for these figures is somewhat different (resulting in smaller percentages) from the techniques used to count errors for Presentation 27. (The percentage figures in Figure IV-9 refer to the approximate number of cards punched for an editing procedure, rather than the number of words differing from the conventional transcript.)

Figure IV-10 shows the percentages of numbers of words of transcript resulting in transliterations (no-match elements) printed in the first run courtroom transcripts (grouped by days run as "batches."). Figures given for Days 1 - 3 in this table represent transliteration rates in the second translation of that tape, following dictionary entry of elements based on analysis of the first translation of those days' records.

Despite further dictionary entries, no-match situations occurred at approximately the same rate as during the last week of the laboratory phase. Reporter C's rate continued to be higher than the others, in part due to the unusual sensitivity of that reporter's stenotype machine (see page 49 and Appendix D) and the reporter's tendency toward shadow strokes. Reporter B's consistently low transliteration rate corroborates an unusually clear and consistent stenotype writing style

Figure IV-10

Transliteration Rate (%):
Courtroom Phase

| Reporter | Transcript Days 1-3 | 4-5 | 6-9 |
|---|---|---|---|
| A | 1.9 | 2.0 | 1.4 |
| B | 1.4 | 1.3 | 0.8 |
| C | 4.2 | 4.4 | 3.1 |
| D | 1.5 | 2.5 | 1.8 |

previously observed in the laboratory phase. Since transliteration occurred quite often in conjunction with the use of proper names, it would be expected that further training in the use of special codes would reduce these figures somewhat for all of the reporters.

These figures represent the number of "obvious" errors, i.e., those noted by the system. The actual error rate in the computer transcripts is considerably higher. The quality of the computer transcript under fairly typical courtroom conditions was therefore examined more closely for Day 8 of the courtroom phase. On that day a prosecution witness, whose voice could be heard easily, provided testimony which was nearly all short answers to short questions.

The total number of errors in the computer transcripts for Day 8 are shown (by reporter) in Figure IV-11 along with transliteration rates. It is estimated that 50% of the errors might be eliminated by further training in special codes for proper names, format, and other procedural issues. Consequently, error rates after full training would probably range from 2.5% to 8%. These lower rates represent perhaps 4 to 14 errors per page of ordinary courtroom transcript, a rate which under some conditions

Figure IV-11

Error Rate: First Run Computer

Transcripts: Courtroom Phase, Day 8*

| Reporter | First-run "errors" | % "errors" | % Trans-literation** |
|---|---|---|---|
| A | 337 | 7.5 | 1.4 |
| B | 229 | 5.0 | 0.8 |
| C | 669 | 16.4 | 3.1 |
| D | 668 | 15.5 | 1.8 |

* Approximate number of words: 4400

** Estimate; based on data for days 6-9.

could be tolerated for official record purposes (see Chapter V).

Naturally, edited computer transcripts are considerably improved as compared with first run copy. However, the editing procedures used for this study unfortunately introduced errors into the second run copy, as well as overlooking (and so not correcting) errors in the first run computer transcripts. For example, Reporters C and D were so situated in the courtroom that it was difficult for them to hear part of the proceedings. They prepared conventional transcripts which indicated that particular passages were inaudible. However, the contractor's procedure for editing included comparison with other transcripts, hence inaudible portions were frequently filled in although the computer tape itself contained no evidence on which to reconstruct the passages. Thus "error counts" of edited copy are not always meaningful. It may also be noted that such errors could not occur in an operational situation, especially if the reporter reviewed computer transcripts and made corrections based on his own notes.

Sample pages from first computer run and reporter transcript for Day 8 records are shown in Figures IV-12 through IV-15. The original computer transcript pages show approximate error rates from 5% (Figure IV-12) to 14% (Figure IV-13). Edited computer copy for these pages is shown in Figures IV-16 and IV-17. Lines on which error

Figure IV-12

Sample Computer First Run Transcript Page with Low Error Rate

84.1 Q And -- let me go back now a minute. After Kennedy
1 2 3 4 5 6 7 8 9 10 11 12

84.2 came back in to the car who was the next person that came in to
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

84.3 the car?
1 2

84.4 A Trap, he was coming around Columbia after.
1 2 3 4 5 6 7 8

84.5 Q He came from Columbia after, he did not go throug
1 2 3 4 5 6 7 8 9 10 11

84.6 the alley?
1 2

84.7 A No.
1 2

84.8 Q All right. Now when all four back, all four of
1 2 3 4 5 6 7 8 9 10 11

84.9 them came back in the car with you what conversation -- excuse
1 2 3 4 5 6 7 8 9 10 11 12

84.10 me amino-what conversation if any did the four or five of you
1 2 3 4 5 6 7 8 9 10 11 12

84.11 have?
1

84.12 A Well when everybody was in the car told me to pull
1 2 3 4 5 6 7 8 9 10 11 12

84.13 off.
1

84.14 Q Who told you to pull off?
1 2 3 4 5 6 7

84.15 A When the person there was in the back.
1 2 3 4 5 6 7 8 9

84.16 Q One of 3 in the back?
1 2 3 4 5 6 7

84.17 A Yes.
1 2

84.18 Q When you say someone of the 3 in the back who wer
1 2 3 4 5 6 7 8 9 10 11 12 13

84.19 the 3 who were in the back at that time?
1 2 3 4 5 6 7 8 9 10

84.20 A Trap, Kennedy, Kadar.
1 2 3 4

84.21 Q And besides telling you to pull off what else were
1 2 3 5 6 7 8 9 10 11

Figure IV-13
Sample Computer First Run Transcript Page with High Error Rate.

20.1 I told him I could then the gc nc place because the light was
1 2 3 4 5 6 7 8 9 10 11 12 13 14

20.2 red, the cars with stcpped, blccking the street. They tcld m
1 2 3 4 5 6 7 8 9 10 11

20.3 to go around, I said nc. So then we started arguing, and then
1 2 3 4 5 6 7 8 9 10 11 12 13

20.4 the light changed and I pulled off and turned right on Columbi
1 2 3 4 5 6 7 8 9 10 11 12

20.5 and went down 27 is the.
1 2 3 4 5 6

20.6 Q Down 27 to where?
1 2 3 4 5

20.7 A To Montgomery. Turned left.
1 2 3 4 5

20.8 Q When you got on Montgomery Avenue, what happened?
1 2 3 4 5 6 7 8 9

20.9 A We started going west, I think, it's, toward 33
1 2 3 4 5 6 7 8 9 10

20.10 street. Up Montgomery, and we got to 29 street, my car *staul
1 2 3 4 5 6 7 8 9 10 11 12

20.11 on me.
1 2

20.12 Q Take your hand off your mouths, please?
1 2 3 4 5 6 7 8

20.13 A My car *stauld* on me.
1 2 3 4 5 6

20.14 Q What happened when you're car stalled on you?
1 2 3 4 5 6 7 8 9

20.15 A I cut my lights off and stamped race go the motor
1 2 3 4 5 6 7 8 9 10 11 12

20.16 of the then I pulled off, and then started going over the brid
1 2 3 4 5 6 7 8 9 10 11 12 13

20.17 and there is abridge right there between 29 and *3078*, was go-
1 2 3 4 5 6 7 8 9 10 11 12

20.18 -ing over the *blij*, saw applies dare, and the had is lights --
1 2 3 4 5 6 7 8 9 10 11 12

20.19 red light -- making a *u* turn to go towards 26 street, and t
1 2 3 4 5 6 7 8 9 10 11 12 13 14

20.20 the confusion started in the car.
1 2 3 4 5 6

20.21 Q What kind of confusioned started in your car?
1 2 3 4 5 6 7 8 9

Figure IV-14

Sample Conventional Transcript Page Prepared by a Reporter. (Compare Figure IV-12.)

Q. And -- let me go back a minute. After Kennedy came back into the car who was the next person that came into the car?

A. Trapp, he was coming around Columbia Avenue.

Q. He came from Columbia Avenue, he did not go through the alley?

A. No.

Q. All right. Now when all four back, all four of them came back in the car with you what conversations--excuse me a minute--what conversation, if any, did the four or five of you have?

A. Well, when everybody was in the car told me to pull off.

Q. Who told you to pull off?

A. When the person there in the back.

Q. One of the three in the back?

A. Yes.

Q. When you say someone of the three in the back who were the three who were in the back at that time?

A. Trapp, Kennedy, Kadar.

Q. And besides telling you to pull off what else were

Figure IV-15

Sample Conventional Transcript Page Prepared by a Reporter. (Compare Figure IV-13.)

I told him I couldn't go no place because the light was red, the cars were stopped, blocking the street. They told me to go around, I said no. So then we started arguing, and then the light changed and I pulled off and turned right on Columbia and went down 27th Street.

Q. Down 27th to where?

A. To Montgomery. Turned left.

Q. When you got on Montgomery Avenue, what happened?

A. We started going west, I think it is, towards 33rd Street, up Montgomery, and we got to 29th Street, my car stalled on me.

Q. What happened when you car stalled on you?

A. I cut my lights off and started racing the motor. Then I pulled off, and then started going over the bridge, and there is a bridge there between 29th and 30th, was going over the bridge, saw a police car, and it had his lights red light -- making a U turn to go towards 26th Street, and then the confusion started in the car.

Q. What kind of confusion started in your car?

Figure IV-16

Sample Page from Edited Computer Copy
(Compare Figures IV-12 and IV-14.)

Q And -- let me go back now a minute. After you all came back into the car who was the next person that came in to the car?

** A Trap, he was coming around Columbia Avenue.

** Q He came from Columbia Avenue, he did not go through the alley?

A No.

Q All right. Now when all four back, all four of them came back in the car with you what conversation -- excuse me a

** minute -- conversation if any did the four or five of you have?

A Well when everybody was in the car told me to pull off.

Q Who told you to pull off?

A When the person there was in the back.

Q One of 3 in the back?

A Yes.

Q When you say someone of the 3 in the back who is the 3 who were in the back at that time?

A Trapp, Kennedy, Kadar.

Q And besides telling you to pull off what else if

**Line in which errors from the first computer-run copy were corrected.

———Elements which were omitted from edited copy or were not corrected from the first computer-run copy.

Figure IV-17

Sample Page from Edited Computer Copy
(Compare Figures IV-13 and IV-15.)

** A Well, you know, Kadar, he told me to pull on off. I told him I couldn't go no place because the light was red, the cars were stopped, blocking the street. They told me to go around, I said no. So then we started arguing, and then the light changed and I pulled off and turned right on Columbia and went down 27 Street.

Q Down 27 to where?

A To Montgomery. Turned left.

Q When you got on Montgomery Avenue, what happened?

A We started going west, I think, it's, toward 29 street. Up Montgomery, and we got to 29 street, my car stall on me.

** Q Take your hand off your mouth, please?

** A My car stalled on me.

** Q What happened when your car stalled on you?

** A I cut my lights off and started racing the motor, then I pulled off, and then started going over the bridge, and there is a bridge right there between 29 and 31, was going over the bridge saw a police car, and it had his lights -- red light -- making a U turn to go towards 26 street, and then the confusion started in the car.

** Q What kind of confusion had started in your car?

**Line in which errors from the first computer-run copy were corrected.

_____Elements which were omitted from edited copy or were not corrected from the first computer-run copy.

corrections were made are noted, along with elements which were not corrected in the edited copy.

The same first run computer page as shown in Figure IV-12 is shown again in Figures IV-18 and IV-19, with corrections this time made by hand and with a typewriter. Although these hand corrections do not result in a "clean" transcript copy, the readability of the transcript is hardly affected when there are only a few such corrections per page. It should be noted that the line and word numbers of the "edit print" format would not appear on first run copy produced for hand correction and unlined paper could be used.

Present standards for court transcript require an immaculate typewritten copy, presumably free of error, at a substantial cost in time. (One factor leading to comparatively fast transcript production in this study was the decision that appearance was not to be considered.) The cost (in time and money) of achieving "clean" copy in computer transcript is also (currently) very high. If efficient use of a computer transcription system is desired, some adjustment in the "neatness" criterion will probably be required.* Further discussion of this issue may be found in Volume I of this report series.

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*Several judges have expressed a willingness to adjust the "neatness" criterion in the interest of reducing transcript backlog. Technical details of insuring that no illegitimate alterations are made in the transcript after certification can be satisfied through the use of appropriate document reproduction processes.

Figure IV-18
Handwritten Corrections of Computer First Run Transcript.

84.1 Q And -- let me go back now a minute. After [illegible]
1 2 3 4 5 6 7 8 9 10 11 12

84.2 came back in to the car who was the next person that came ~~in to~~ into
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

84.3 the car?
1 2

84.4 A ~~Trapp~~ Trapp, he was coming around Columbia ~~after.~~ Avenue.
1 2 3 4 5 6 7 8

84.5 Q He came from Columbia ~~after,~~ Avenue, he did not go through
1 2 3 4 5 6 7 8 9 10 11

84.6 the alley?
1 2

84.7 A No.
1 2

84.8 Q All right. Now when all four back, all four of
1 2 3 4 5 6 7 8 9 10 11

84.9 them came back in the car with you what conversation[s] -- excuse
1 2 3 4 5 6 7 8 9 10 11 12

84.10 me ~~amino~~ a minute - what conversation if any did the four or five of you
1 2 3 4 5 6 7 8 9 10 11 12

84.11 have?
1

84.12 A Well when everybody was in the car told me to pull
1 2 3 4 5 6 7 8 9 10 11 12

84.13 off.
1

84.14 Q Who told you to pull off?
1 2 3 4 5 6 7

84.15 A When the person there was in the back.
1 2 3 4 5 6 7 8 9

84.16 Q One of[the] 3 in the back?
1 2 3 4 5 6 7

84.17 A Yes.
1 2

84.18 Q When you say someone of the 3 in the back who were
1 2 3 4 5 6 7 8 9 10 11 12 13

84.19 the 3 who were in the back at that time?
1 2 3 4 5 6 7 8 9 10

84.20 A ~~Trapp,~~ Trapp, Kennedy, Kadar.
1 2 3 4

84.21 Q And besides telling you to pull off what else were
1 2 3 4 5 6 7 8 9 10 11

Figure IV-19
Typewritten Corrections of Computer First Run Transcript.

84.1 Q And -- let me go back now a minute. After Kennedy
1 2 3 4 5 6 7 8 9 10 11 12

84.2 came back in to the car who was the next person that came ~~in to~~ into
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

84.3 the car?
1 2

Trapp, Avenue.
84.4 A ~~Trap,~~ he was coming around Columbia ~~after~~.
1 2 3 4 5 6 7 8

Avenue,
84.5 Q He came from Columbia ~~after~~, he did not go through
1 2 3 4 5 6 7 8 9 10 11

84.6 the alley?
1 2

84.7 A No.
1 2

84.8 Q All right. Now when all four back, all four of
1 2 3 4 5 6 7 8 9 10 11

84.9 them came back in the car with you what conversation^s -- excuse
1 2 3 4 5 6 7 8 9 10 11 12

a minute -
84.10 me ~~amino~~ what conversation if any did the four or five of you
1 2 3 4 5 6 7 8 9 10 11 12

84.11 have?
1

84.12 A Well when everybody was in the car told me to pull
1 2 3 4 5 6 7 8 9 10 11 12

84.13 off.
1

84.14 Q Who told you to pull off?
1 2 3 4 5 6 7

84.15 A When the person there was in the back.
1 2 3 4 5 6 7 8 9

the
84.16 Q One of^3 in the back?
1 2 3 4 5 6 7

84.17 A Yes.
1 2

84.18 Q When you say someone of the 3 in the back who were
1 2 3 4 5 6 7 8 9 10 11 12 13

84.19 the 3 who were in the back at that time?
1 2 3 4 5 6 7 8 9 10

Trapp,
84.20 A ~~Trap,~~ Kennedy, Kadar.
1 2 3 4

84.21 Q And besides telling you to pull off what else were
1 2 3 4 5 6 7 8 9 10 11

# V. CONCLUSIONS AND RECOMMENDATIONS

## 1. General Conclusions

The experience gained during the course of this study, both in the laboratory and in the courtroom, has provided a substantive basis for evaluation of the computer-aided transcription system for stenotype reporting. The following general conclusions can be drawn:

- The feasibility of computer translation and transcription has been demonstrated.
- The computer system tested is currently subject to a number of deficiencies and some inefficiency. For example, first-run copy must undergo extensive proof-reading and a costly, time-consuming correction procedure.
- Computer translation offers the potential of a significantly large saving of time in high volume transcript production provided that some compromise in appearance (but not accuracy) of the record is acceptable.
- The system may not readily accept the writing styles of all reporters, necessitating a screening program for compatability, followed by a training program for specialized techniques and for developing individual dictionaries.
- The demonstrated capabilities of the present system and the prospects for its potential suggest that support should be given to further developmental efforts, particularly

to improve editing techniques, to effect program modifications to resolve translation problems, and to ameliorate problems at the reporter/translator interface.

2. Specific Conclusions

In support of the general conclusions cited, the following specific conclusions may be drawn from the results of the laboratory and courtroom phases of the experiment:

1. The time required to produce first run computer transcript is about one-tenth that taken by conventional procedures. The turn-around time includes peripheral operation times as well as actual computer processing, and is an order of magnitude less than that required for conventional transcription of the same stenotype notes.

2. First-run computer transcription, as now produced, is not satisfactory to serve as an official, certifiable court record. The first-run copy generally contains a small, but significant, number of errors, incorrectly resolved ambiguities, and nontranslatable symbols which must be corrected.

3. The current computer transcription program is capable of producing readable court transcript, but a number of features are not efficient. Inefficiency has a profound

impact on the time and cost of transcript production: the substantial time-saving already demonstrated can likely be increased by improved program logic and peripheral operations. For example, ambiguities of symbology are now resolved according to a set of rules in a search procedure, then printed in the same fashion as clearly unambiguous text. Resultant incorrect translations thus now resemble correct word forms, thereby complicating the task of proofreading and correction.

4. The main dictionary of the current computer system is adequate for most courtroom situations, but can be expected to grow with additional commonly-used forms. Computer transcription has in the past been employed in economic, business, and general legal spheres. Specialized terminology was incorporated in the course of the laboratory and early courtroom phases; further experience should yield enough court-oriented entries to serve in a fully operational environment.

5. The editing procedures applied during the study program were cumbersome and time-consuming, and were inadequate to insure error-free test in a second run. Proofreading by personnel unfamiliar with the court proceedings and manual processing procedures increased the total time required to obtain a transcript by a factor

close to fifteen over that required to produce the initial computer transcript (including peripheral operating times). Furthermore, additional errors were at times introduced. Alternative approaches are available, including review of first-run copy by the stenotype reporter (or notereader) and use of on-line editing techniques.

6. Writing styles of individual stenotype reporters differ greatly from one another and not all styles are readily adaptable to computer-aided transcription. Some keying techniques may have no effect on a reporter's ability to transcribe his own notes, but may create frequent ambiguities for the computer, due to shadow strokes or idiosyncratic abbreviations, which usually cannot be resolved in a first run transcript. The number of corrections to be made in first run copy may well be unacceptable, even in an environment where absolutely clean copy is not required.

7. At present, a substantial amount of stenotype record must be computer processed before a decision can be made about the compatibility of a given reporter and the computer system. Very high or very low adaptability can likely be detected readily, but most reporters will probably need extensive system tryout to determine the suitability of the match-up, hence a relatively high cost for screening.

8. Further development of training procedures is necessary. The contractor estimates that about 20 hours of training are required by each reporter,* but that this will vary with individual adaptability to modifying practices and to learning new techniques. A separate examination of the effectiveness of training procedures is warranted. Ideally, training to work with the computer system should take place during initial schooling in stenotypy since some retraining is now necessary. Substantial evidence is available in psychological learning theory to suggest that retraining is considerably more difficult and less effective than proper initial training.**

9. The stenotype machines and attached incremental recorders performed adequately during the tests, but equipment design is such that a malfunction might go unnoticed. A small meter atop the stenotype machine indicates electrical contact with the incremental recorder. However, experienced reporters rarely watch the machine,

*The contractor requested four weeks to "train" the reporters and "tune" them to the computer system. Very little training had actually been accomplished after those four weeks of effort. Further "tuning" took place over three weeks in the laboratory, but even after this additional time, it was felt that substantial additions to the dictionaries would still be required to make the system really workable. In reality, no substantial progress was ever made during this study in teaching the reporters the special codes and distinctions necessary to utilize the computer system fully.

**See, for example, discussion of negative transfer in Robert S. Woodworth and Harold Schlosberg, Experimental Psychology, New York, Holt, 1954, pp.748ff; or Charles E. Osgood, Method and Theory in Experimental Psychology, New York, Oxford Univ. Press, 1962, pp.526ff.

hence the only signal of malfunction might be the absence of the slight noise usually made by the recorder. (See #10.) During the study a large part of a record-taking session elapsed before a machine failure was detected. Although the stenotype notes could provide for conventional transcription of information not captured by the recorder, an equipment problem might not be discovered until the electronic record was processed, possibly causing delay and inconvenience.

10. Unlike the silent stenotype machine itself, the tested combination of stenotype and incremental recorder produces some noise when operating. The noise, which originates from the mechanical advance of the cartridge tape, is muted, but is loud enough to be heard by other courtroom participants in the same general area. At least one judge and several of the reporters considered the noise to be disconcerting, especially initially. Redesign to reduce or eliminate this source of distraction would be desirable.

3. Recommendations

1. Further research and development efforts should be supported to remedy deficiencies in the current computer transcription system and to enhance its suitability for preparing court transcripts. Specifically, additional

effort should be directed toward:

a. Software

- expanding the main dictionary
- improving word search techniques to reduce translation errors
- improving techniques for reporter cues as an aid in ambiguity resolution
- exploring the use of grammatical context to aid in ambiguity resolution
- improving software processing efficiency to reduce time and cost of computer operation

b. Reporters

- standardizing screening techniques for reporters to detect those who are compatible with the current computer system
- developing and standardizing training techniques

c. Hardware

- improving equipment design to reduce likelihood of shadow strokes
- redesigning to improve malfunction detection
- reducing equipment cost
- reducing recorder noise

d. Editing

- reducing time and cost now required for editing
- using reporters or notereaders to review and correct first run copy
- exploring on-line editing techniques.

2. Consideration should be given to using the present computer system as an interim measure to relieve excessive transcript backlogs. Such usage would entail

- availability of suitable computer hardware
- selection and training of reporters for assignment to high-volume generation of stenotype records
- adequate funding, especially for initial equipment investment
- judicial acceptance of hand-corrected transcript for subsequent certification, including a reduction in neatness, but no loss in readability or accuracy. The certification might be made on photographic or xerographic copy of computer text on which corrections have already been entered by hand or typewriter, thus precluding further changes.

APPENDIX A

Participating Court Reporters
(in alphabetical order)

| | Years Experience | Current Position |
|---|---|---|
| Sylvia Colebreuner<br>5431 Connecticut Avenue<br>Washington, D.C. | 10 | Official Reporter<br>Juvenile Court<br>District of Columbia<br>(since 1961) |
| Isabelle Cormier<br>4434 68th Place<br>Hyattsville, Maryland | 8 | Official Reporter<br>Superior Court<br>of the District of<br>Columbia<br>(since 1970) |
| Bernard Goldstein<br>3234 Chelsea Place<br>Philadelphia, Pennsylvania | 11 | Official Reporter<br>Philadelphia Court<br>of Common Pleas<br>(since 1965) |
| Allen Kaplan<br>2213 Hoffnagle Street<br>Philadelphia, Pennsylvania | 24 | Official Reporter<br>Philadelphia Court<br>of Common Pleas<br>(since 1958) |
| James R. Mann<br>40670 Leah Court<br>Sterling Heights, Michigan | 14 | Official Reporter<br>Recorders Court<br>Detroit, Michigan<br>(since 1957) |
| Sarah R. Walker<br>1240 W. 87th Street<br>Chicago, Illinois | 5 | Reporter Supervisor<br>Divorce Division<br>(since 1970) and<br>Official Reporter<br>Circuit Court of<br>Cook Co., Ill.<br>(since 1968) |

Court Record Typists

| | | |
|---|---|---|
| Helen DiPietro<br>1142 Shilmere Street<br>Philadelphia, Pennsylvania | 10 | Free-lance typist<br>Philadelphia<br>Court System |
| Vincent P. Murphy<br>1046 Central Avenue<br>Ocean City, New Jersey | 10 | Free-lance typist<br>Philadelphia<br>Court System |

APPENDIX B

## Special Codes Currently Required for Reporter Use of Computer-Aided Transcription System

### 1. Proper Names

Develop a unique symbol for name (e.g., first syllable struck twice), and list for addition to subdictionary prior to computer translation.

### 2. Punctuation

Punctuation is automatic in question and answer format. A question will end in "?"; an answer will end in "." Any additional or different punctuation must be keyed by reporters.

Colloquy punctuation must be keyed by the reporter. Opening and closing punctuation (quotation marks, parentheses) must be keyed: one stroke indicates open, two indicates close.

### 3. Spelling

Current practice to indicate character-by-character spelling: precede first letter by keying "stel"; indicate close of spelling by striking "klel."

Alternately: key asterisk in each stroke with letter.

4. Current resolutions of common homographs.

| Stroke | English | Stroke | English |
|---|---|---|---|
| -T | THE | IT | IT |
| T- | IT | S- | HIS |
| -S | IS | W- | WITH |
| WER | WERE | WAOER | WE ARE |
| WAOER/AOE | WE'RE | WR- | WHERE |
| THR- | THERE | THAIR | THEIR |
| -B | BE | B-N | BEEN |
| BE | BE(PREFIX) | A | A |
| AN | AN | AND | AND |
| UR | YOU ARE | YUR | YOUR |
| YAOR | YOUR | AOUR | YOU'RE |
| YAOUR | YOU'RE | ITS | ITS |
| ITS/AOE | IT'S | T-S | IT IS |
| IT/SE | ITSELF | -G | GO |
| GON | GONE | H- | HAD |
| -D | (PAST TENSE) | WAS | WAS |
| WA | WHAT | WHAS | WHAT IS |
| WHATS | WHAT'S | T-F | TESTIFY |
| T-M | TESTIMONY | DA | DAY |
| DAI | DAY | H-M | HIM |
| -M | MANY | NO | NO |
| NOE | KNOW | EFR | EVER |
| -FR | EVERY | V- | HAVE |
| V- | HAVE | -FB | VERY |

| STROKE | English | Stroke | English |
|---|---|---|---|
| SO | SO | SM- | SOME |
| SOM | SOME | SUM | SUM |
| F-R | FOR | FR- | FROM |
| FOR | FOR(PREFIX) | FOUR | FOUR |
| NU | NEW | NAOU | KNEW |
| OFR | OFFER | OEFR | OVER |
| DIF | DIFFERENT | DIFS | DIFFERENCE |
| BI | BY | BAOEU | BUY |
| WIN | WIN | W-N | WITHIN |
| WEL | WELL | WAOEL | WE WILL |
| WAOEL/AOE | WE'LL | WI | WHICH |
| WH- | WHETHER | WEGT/ER | WEATHER |
| AF | AFTER | AFB | AVENUE |
| HOM | HOME | WHOM | WHOM |

APPENDIX C

## Phase I: Laboratory Phase
## Materials Used in Presentations

First Week

Day 1

1.* "Due Process on Campus"
Georgetown University Radio Forum

2. "Summations"
Trial Lawyers Tape of the Month
Trial Lawyers Service Company
Washington, D.C.

Day 2

3.* Selection from Courts on Trial by Jerome Frank;
Tape from Library of Congress, Division for the Blind and Physically Handicapped.

4. "Preparation of Plaintiff for Deposition"
Trial Lawyers Tape of the Month

Day 3

5. National Shorthand Reporters Association
Dictation Practice Tape #210-1, Side 1,
Takes 2-4.
-Two Voice Testimony (210 wpm)
-Judge's Charge (185 wpm)
-Two Voice Testimony (210 wpm)

6. National Educational Television
Film: "Trial -- The City and County of Denver vs. Lauren R. Watson," produced by Robert Fresco. Part I, Reel 1.
-Voir dire.

Day 4

7. NSRA Tape 210-1, Side 1, Takes 6-8
-Two Voice Testimony (165 wpm)
-Opening Statement (180 wpm)
-Two Voice Testimony (200 wpm)

8. NET Film: "Trial", Part I, Reel 2
-Voir dire.

Day 5

9. NSRA Tape 210-1, Side 1, Takes 9-10
-Legal Opinion (165 wpm)
-Two Voice Testimony (210 wpm)

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*Transcripts not prepared. Numbers 1 through 30 are Presentation Numbers.

10. NET Film: "Trial", Part I, Reel 3.
-Motion in chambers
-Conclusion of voir dire.

Second Week

Day 6 11. NSRA Tape 210-1, Side 2, Takes 1-3.
-Two Voice Testimony (180 wpm)
-Judge's Charge (165 wpm)
-Two Voice Testimony (210 wpm)

12. NET Film: "Trial", Part II, Reel 1.
-Defense statement for the record
-Testimony of Witness I.

Day 7 13. NSRA Tape 210-1, Side 2, Takes 5-7
-Two Voice Testimony (210 wpm)
-Opening Statement (165 wpm)
-Two Voice Testimony (170 wpm)

14. NET Film: "Trial", Part II, Reel 2.
-Testimony of Witness I, continued.

Day 8 15. NSRA Tape 210-1, Side 2, Takes 8-9
-Legal Opinion (165 wpm)
-Two Voice Testimony (210 wpm)

16. NET Film: "Trial", Part II, Reel 3.
-Testimony of Witness I, continued.
-Testimony of Witness II, completed.

Day 9 17. NSRA Tape 200-1, Side 2, Takes 2-3
-Judge's Charge (180 wpm)
-Two Voice Testimony (200 wpm)

18. NET Film: "Trial", Part III, Reel 1
-Testimony of Witness III

Day 10 19. NSRA Tape 200-1, Side 2, Takes 5-6
-Judge's Charge (180 wpm)
-Two Voice Testimony (200 wpm).

20. NET Film: "Trial", Part III, Reel 2 (1st half)
-Testimony of Witness III, concluded.

Third Week

Day 11 21. NSRA Tape 200-1, Side 2, Takes 8-9
-Judge's Charge (180 wpm)
-Two Voice Testimony (200 wpm)

22. NET Film; "Trial", Part III, Reel2(2nd half)
-Testimony of Witness IV, completed
-Testimony of Defendant

Day 12 23. NSRA Tape 200-1, Side 1, Takes 1-3
-Literary (160 wpm)
-Judge's Charge (180 wpm)
-Two Voice Testimony (200 wpm)

24. NET Film: "Trial", Part III, Reel 3.
-Testimony of Defendant, concluded.
-Further testimony of Witness I, completed.

Day 13 25. Chief Judge Harold H. Greene, D.C. Superior Court. "Receipt of Seal and Remarks for the Superior Court." Recorded at the Joint Opening Session of the District of Columbia Court of Appeals and the Superior Court of the District of Columbia.

26. NET Film: "Trial", Part IV, Reel 1.
-Testimony of Witness V, completed.
-Further Testimony of Witness I.
-Motions on insturctions in chambers.

Day 14 (I) 27. NSRA Tape 200-1, Side 1, Takes 4-5.
-Opening Statement (160 wpm)
-Judge's Charge (180)

28. NET Film: "Trial", Part IV, Reel 2.
-Judge's Charge
-Closing Statement: Prosecution

Day 14 (II) 29. NSRA Tape 200-1, Side 1, Takes 8-9.
-Judge's Charge (180 wpm)
-Two Voice Testimony (200 wpm)

30. NET Film: "Trial", Part IV, Reel 3.
-Closing Statement: Defense
-Rebuttal Statement: Prosecution

APPENDIX D

Stenographic Machines, Inc.
Mechanical Inspection Report On
Stenotype Machines and Incremental Recorders Used in NBS Study

The following machines were used by reporters in the National Bureau of Standards computer transcription evaluation program and are the subject of this report:

Computer Model Stenograph: 7000778, 7000777, 7000770, 7000781, 7000772, 7000764, 7000775

Incremental Recorder: 124, 108, 112, 104, 114, 125, 102

Machines were inspected by Richard Michals.

The inspection consisted of operating the Stenograph machines with the Incremental Recorders in pairs by actuating each key, two at a time in sequence across the keyboard, to determine that it closed the contacts and operated with no malfunction. Each key was operated a minimum of twenty strokes. In addition, the entire keyboard was operated simultaneously a minimum of twenty strokes for each machine. All strokings were recorded on Incremental Recorder magnetic tape and then played back and viewed at regular and slow speeds on an oscilloscope.

No malfunction of any Computer Model Stenograph was detected.

Before the Computer Model Stenographs were shipped from this office, each key was tested to determine at what point in relation to the actual ink imprint on the paper tape the electrical contact was closed. It was determined that the setting or adjustment would be at a point when some semblance of an inked letter or number appeared on the paper tape, even though it might not be distinct. When the equipment was returned, this same test was again applied. It was determined that machines 7000777, 7000775, and 7000764 retained approximately that same adjustment. Machines 7000772, 7000778, 7000781, and 7000770 apparently did not maintain the original adjustment. A recording on the magnetic tape could be made on all of these last four machines [without] the appearance of the inked impression on the paper tape.

All Incremental Recorders except one functioned perfectly.

Incremental Recorder #125 functioned intermittently. It was determined that the fault lay in the battery that supplied the power. The battery was new, and there are ten elements connected by metal straps and encased into one unit. One end of one of the metal straps was not welded to the adjoining battery element, causing the intermittent malfunction. If the battery was in such a position at any given time so that contact pressure forced the metal strap against the battery, the Incremental Recorder operated correctly; if the pressure was insufficient to hold the strap against the battery, it would not operate.

The noise level of the incrementing tape on Recorders 108, 112, 114, and 102 was higher than on 124, 104, and 125 (when operating). This was not esthetically pleasing, but it in no way affected performance of the equipment.

APPENDIX E

## Phase II - Courtroom Phase
## Summary of Cases and Testimony Recorded for Study Purposes

Day 1 - Monday, July 12

-Commonwealth vs. Edward Bey
Possession of stolen property.

Testimony:
Officer Tyrone Spiller, for the Commonwealth
(direct and cross examination)

-Commonwealth vs. William Murray
Possession and sale of narcotics.

Testimony:
Officer William Smith, for the Commonwealth
(direct examination)

Day 2 - Tuesday, July 13

-Commonwealth vs. Elmer Beatty
Possession of narcotics.

Testimony:
Officer Robert Morris, for the Commonwealth
(direct and cross examination)
Officer Alan Senise, for the Commonwealth
(direct and cross examination)

Day 3 - Wednesday, July 14

-Commonwealth vs. Ronald Welsh
Receiving stolen property and conspiracy

Testimony and Argument:
Boyce Bauman, for the Commonwealth
(direct examination)
Norman Metcoff, for the Commonwealth
(direct and cross examination)

Ronald LaSalvia, for the Commonwealth
(direct examination)
Closing Argument for the Defense
Court verdict and statement

Day 4 - Thursday, July 15

-Commonwealth vs. Clinton Duval
Possession of narcotics.

Testimony and Argument
Officer John Flaherty for the Commonwealth
(direct, cross, and redirect examination)
Clinton Duval for the Defense
(direct and cross examination)
Closing statement for the Defense
Closing statement for the Commonwealth
Court verdict and statement

-Commonwealth vs. Kenneth Jones
Aggravated robbery.

Testimony:
Officer John Weiss for the Commonwealth
(direct and cross examination)

Day 5 - Friday, July 16

-Commonwealth vs. Reginald Johnson
Possession of unlicensed weapon.

Testimony and Argument:
Officer David Reid for the Commonwealth
(direct and cross examination)
Reginald Johnson, for the Defense
(direct and cross examination).
Officer Reid recalled by the Defense
(direct and cross examination)
Closing argument for the Defense
Court verdict

-Commonwealth vs. Vallone
Possession of narcotics.

Testimony:
Officer Eugene Dooley, for the Commonwealth
(direct and cross examination)
Argument on demurer for the Defense

Day 6 - Monday, July 19

-Commonwealth vs. Howard Kennedy
First degree murder.

Voir dire (examination for selection of jury).
Hattie Peed, prospective Juror

Testimony:
Andrew Stephenson, for the Commonwealth
(direct examination, part)

Day 7 - Tuesday, July 20

-Commonwealth vs. Howard Kennedy, continued

Testimony:
William Levin, for the Commonwealth
(direct examination, and cross examination, part)

Day 8 - Wednesday, July 21

-Commonwealth vs. Howard Kennedy, continued

Testimony:
William Scott, Jr. for the Commonwealth
(direct examination)

Day 9 - Thursday, July 22

-Commonwealth vs. Howard Kennedy, continued

Testimony:

Offer of Proof: Edward Guy, M. D., for the Defense
(direct and cross examination)

Officer Donald Patterson for the Commonwealth
(cross examination continued, and redirect examination)

Suchila James for the Commonwealth
(direct examination)

Officer Edgar Gaskin for the Commonwealth
(direct and cross examination)

Edward Guy, M.D. for the Defense
(direct examination)

# APPENDIX F

## COMPUTER TRANSCRIPT "ERRORS"

In the present version of the computer-aided transcription system there are occasional "errors", or failures to translate the stenotype notes in the correct fashion. The purpose of this appendix is to catalogue typical "errors" and to discuss the extent of difficulties caused by their occurrence. Additional discussion of these may be found in Volume I.

### 1. No-Match

The simplest form of error occurs whenever a legitimate shorthand argument has not yet been incorporated into the main dictionary or the reporter's subdictionary, or when a fingering error (q.v.) causes the shorthand input to be altered to a nonexistent dictionary form. If no match can be made with a legitimate English form, the shorthand notation is printed out (in transliterated form) and delimited by asterisks (e.g., *koun*). Such abbreviations are readily detectible and, since the phonetic indicators are given, the correct form can usually be determined quickly.

### 2. Fingering Error

Fingering errors stem from accidentally striking the wrong keys or extra keys (possibly as shadow strokes), usually resulting in failure to match, as discussed above. A more serious error occurs when the unintended stroke corresponds to a legitimate symbol other than that intended, causing an

incorrect English word to be printed. For example, the shorthand symbol "SHOT" represents "shot" but "SHROT" is translated as "slot" (since "HR" is equivalent to "L"). Thus inadvertent keying of "R" here would result in the substitution of "slot" for "shot." (See Table F-1 for other examples.) This kind of error might be difficult to detect if the incorrect word is sufficiently similar to the intended form. However, careful review of the text, especially by a skilled reader, should lead to the discovery and correction of these errors.

It may also be noted that compound no-match and mismatch incidents may derive from fingering errors. For example, an error in the first syllable of "microphone" might result in "*pliK* row phone" since the computer program starts afresh after transliterating a no-match.

3. Proper nouns and formats

Stenotype reporters must invent special codes for proper nouns and formats (such as change in speaker, short forms for commonly-used phraseology, etc; see Appendix B). Unless these forms are subsumed into the reporter's subdictionary, he must compile and supply for the computer a special glossary for each court proceeding; incompleteness of the glossary leads to fairly frequent occurrence of transliterations and peculiar word forms, as illustrated in Table F-2. Special codes may also be used to signal the computer of the use of a proper name, or the fact that something is to be spelled

TABLE F-1

Shadow Stroke Errors,
Miskeying Errors

| Correct Word | Computer Print-out |
|---|---|
| nickname | flickname |
| Next to | flexion |
| down | *dwoun* |
| through | *flu* |

TABLE F-2

Proper Names/Format Errors**

| English Word(s) | Computer Print-out |
|---|---|
| Guy | guy |
| Cavanaugh | calf gnaw |
| McAllister | mechanical center |
| L E V I T | will he have I the |
| G.T. | good the |
| (whereupon a conference was held.) | (whereupon a conference was held.( |

**See Appendix B for explanation of special codes for formatting.

out-character-by-character. Familiarity with and regular use of these codes should eliminate most such errors.

4. Homographs

Basic stenotype theory encourages the use of short-form codes for connectives and common words which occur frequently. Unfortunately, a valid shorthand argument may be used to represent two or more English words. For example, the single-stroke consonant "T" may be keyed on either the left or right side of the stenotype keyboard and each form may be used for either "it" or "the." Ambiguity also occurs if English homonyms are represented indistinguishably by a single homograph. Thus, stenotypy "SE" may mean see or sea. Some common homographs are shown in Table F-3 as a sampling of the much larger number extant.

It may be observed that many courtroom phrases are homographic to standard stenotype symbols without necessarily sounding similar. These may derive from common usage or personal idosyncrasies, equally confusing to a machine translator. As an example, "FUL" may be intended to mean "if you will" or "full."

The resolution of homographic ambiguities is a difficult problem for computer programming. Reporters can be encouraged to modify their writing styles to avoid using homographs: for example, restricting the left-hand

TABLE F-3

Common Homographs

| English Words | Homograph |
|---|---|
| there,their | THER |
| know, no | NO |
| root, route | ROUT |
| red, read | RED |
| your, you are | UR |
| yours, yourself | URS |
| of, have, ever | F |
| dog, doing | DOG |

"T" to "the" and the right-hand "T" to "it" could eliminate one particular source of confusion. In other cases, entering elements of context in the dictionary can also aid in distinguishing forms. Thus, "SAOEN" might be limited to the word "scene" while a double-stroke "...S"/"SAOEN" could be included in the dictionary as the entry for "is seen." (Note: the present system provides a particular one of the alternative possible translations without indication of ambiguity. Techniques used now for resolving commonly occurring homographs are shown in Appendix B.)

5. Word Boundary.

Unlike typing (for example), spaces between words are not indicated between words in stenotypy, leading to a troublesome problem for computer translation, namely identification of proper word boundaries. In simplest terms, the program logic may fail to recognize the true end of a word, this occurring most frequently when multiple stenotype strokes are required for a single word.

The computer program uses a "longest match" rule, whereby a match is first made for the first stroke of a word (as assumed); a search is then made to match that first stroke in combination with its successor. This cumulative search process is continued until no match can be made after adding the last stroke to the combination.

The previous match is then printed as the English equivalent to the symbology. The last stroke considered, but not used, then becomes the first stroke for the next word.

The nature of the word boundary problem can be illustrated with the sentence: "They stayed there about five minutes." After (correctly) identifying the match for "there," the program would further match the following strokes to produce the single word "thereabout" for the combination.

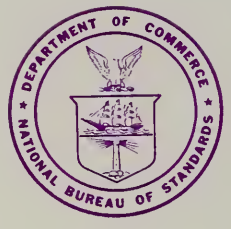
Boundary errors may also be encountered in translating phrases with internal syllables which can be shifted sensibly, such as "gunnery loaded" instead of "gun reloaded." Other examples of boundary errors are shown in Table F-4.

As with homographs and those fingering errors which produce legitimate word forms, boundary errors may be discernible on careful review of first-run transcript. Correction from context may be possible; "editors" with a knowledge of stenotypy and access to the paper tape notes (e.g., professional notereaders) should be able to develop facility in resolving incongruities, albeit at the expense of time devoted to the process. These errors can also be reduced by continued expansion of the dictionary, with concomitant increase in storage requirements and processing time.

TABLE F-4

Word boundary Errors

| English Word (Phrase) | Computer Print-out |
|---|---|
| there about | thereabout |
| did you | duty |
| gotten | opt on |
| importance | important answer |


DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS