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NOTICE

The study reported herein was undertaken under the aegis of the National Research Council with the express approval of the Governing Board of the NRC. Such approval indicated that the Board considered that the problem is of national significance; that elucidation or solution of the problem required scientific or technical competence and that the resources of NRC were particularly suitable to the conduct of the project. The institutional responsibilities of the NRC were then discharged in the following manner:

The members of the study committee were selected for their individual scholarly competence and judgment with due consideration for the balance and breadth of disciplines. Responsibility for all aspects of this report rests with the study committee, to whom we express our sincere appreciation.

Although the reports of our study committees are not submitted for approval to the Academy membership or to the Council, each report is reviewed by a second group of appropriately qualified individuals according to procedures established and monitored by the Academy's Report Review Committee. Such reviews are intended to determine, inter alia, whether the major questions and relevant points of view have been addressed and whether the reported findings, conclusions, and recommendations arose from the available data and information. Distribution of the report is approved, by the President, only after satisfactory completion of this review process.

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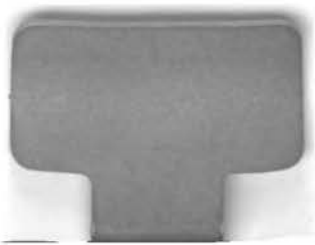

THE CANE AS A MOBILITY AID FOR THE BLIND

A REPORT OF A CONFERENCE

Washington, D.C.
September 10--11, 1971

Subcommittee on Sensory Aids
Committee on Prosthetics Research and Development
Division of Medical Sciences, National Research Council
2101 Constitution Avenue, N.W. Washington, D.C. 20418

1972

SECTION I

THE LONG CANE AND THE CONFERENCE

A PREFACE

The so-called "Long Cane" as a guidance device for the blind has in principle been available since very early times. Long shepherds' crooks have in fact been used occasionally by rare individuals for many centuries.

The systematic use of a relatively light cane, however, and especially the association of the use of this device with orderly psychological counseling and systematic training of mobility under a wide variety of circumstances, dates primarily from the work of Richard E. Hoover at the U. S. Army General Hospital, Valley Forge, Pennsylvania, during World War II. Dr. Hoover's early work has been described in several places. A source of anecdotes, though with relatively few details on canes, is "The Valley Forge Story," by Richard E. Hoover, in *Blindness 1968*, an annual published by the American Association of Workers for the Blind, Washington, D.C.

Much of the work at Valley Forge was directed toward developing a systematic and orderly method for using lengthened canes, first wooden and then with long slender metal tubular shafts, to permit independent and confident mobility by newly blinded servicemen.

After World War II work on rehabilitation of the blinded veterans was concentrated at Hines VA Hospital, just west of Chicago. This center emphasized mobility but provided a wide variety of other therapies and training during an individually selected period averaging some 14 weeks. The Chief, Russell Williams, had been a patient and staff member at Valley Forge. In addition, Miss Kathern Gruber and Mr. C. W. Bledsoe were

active at both Valley Forge and Hines. Richard Hoover, though then a medical student, visited Hines as a consultant as often as feasible. Thus the Valley Forge philosophy was perpetuated at Hines. Various aspects of the work at Hines were described in the *Blindness Annual*, by Williams 1965, Bledsoe 1969, and Malamazian 1970, with the last emphasizing mobility.

In the early 1950s Father Thomas J. Carroll, director of the Catholic Guild for the Blind of Boston, and repeatedly elected National Chaplain of the Blinded Veterans Association, determined to organize a civilian rehabilitation center for blind adults modeled in large part upon the program at Hines. One aspect of his planning was a conference at Gloucester, Massachusetts, over a period of three days in November 1953, bringing together (and resolving misunderstandings between) a variety of professionals concerned with rehabilitation of the blind and some outstanding blind people.

At the Gloucester conference, for example, a well-known advocate of the "White Cane Laws," who was a relatively short person, met for the first time Mr. Russell Williams the blinded veteran who then headed the Hines Mobility Center, and was struck by the discovery that Mr. Williams was well over six feet tall. For the first time he realized why Mr. Williams advocated such a <u>long</u> "long cane," though he already realized that a "long cane" held diagonally vertically and downward in front of the body would necessarily be longer than the white orthopedic-style cane to which he was accustomed. The "White Cane" was held vertically but was not used to probe very far in advance of the body. The Gloucester conference, in this and in a number of other examples, was quite successful in promoting group dynamics to bring into the open differences of opinions, to resolve them, to increase mutual respect,

and to encourage a consistent approach to the field of rehabilitation of the blind.

Based partially upon his experience with blinded veterans and partially upon his subsequent operation of the St. Paul's Rehabilitation Center for newly blinded adults, Father Carroll became increasingly persistent in advocating the systematic training of newcomers to professional work for the blind. In 1960, largely as a result of Father Carroll's efforts, Boston College started a training program under a grant from the then Office of Vocational Rehabilitation, now the Social and Rehabilitation Service of the Department of Health, Education, and Welfare. The plan was to set up a graduate-level mobility therapy program to train individuals whom Father Carroll described as "peripatologists," or experts in the science and art of travel. The Boston College program, the first of its kind, required an initial summer, a complete school year, and a second summer to obtain a master's degree.

While there was heavy emphasis upon practicum in teaching mobility with the aid of the long cane, and a shorter exposure to the program with dog guides at Seeing Eye, the students also received extensive training in a variety of other matters related to the blind. In addition, of course, certain courses automatically were required by the College as a basis for a master's degree in special education. This program, with some modifications, still continues.

Soon other, and somewhat modified, training programs for mobility instructors were developed at Western Michigan University at Kalamazoo, Michigan, at California State College at Los Angeles, and elsewhere. A program aimed primarily at teachers of young blind students was developed, with somewhat

modified emphases, at San Francisco State College. Many of these programs have provided practical training not only at Hines VA Hospital but, in later years, at Palo Alto VA Hospital, and at other well-known centers for blind mobility training. Some experts feel that the original techniques have provided a basis for further improvements.

The broadening influence of mobility instruction is illustrated by the growth of Section 9, Mobility, of the American Association of Workers for the Blind. A certification program has been developed for this field. A substantial number of people have received master's degrees from an increasing number of curricula recognized as competent in this highly specialized field.

Numerous rehabilitation centers throughout this country now offer systematic training in mobility and in total adjustment to blindness. Increasingly, both therapeutic and research programs are being conducted in other countries as well. The program also has already spread to education for blind children. One well-known residential school, for example, has four full-time mobility instructors. Some public or parochial school systems which offer education for blind children integrated with sighted children likewise have started mobility programs. There is a rapidly growing literature on both research aspects and clinical applications.

The so-called long cane is only one tool used in the overall rehabilitation of blind individuals. There is much emphasis on auditory training, geographical orientation, etc. Training in the graceful use of this device to detect objects and to provide protection is an important phase, however, in the rehabilitation process leading to safe, effective, smooth mobility by the totally blind and by very severely visually handicapped individuals.

With this background, it seemed appropriate to bring together a conference to review the traditional axioms, to assess the demonstrable improvements in detailed techniques, and to outline the challenges for further research as well as for wider dissemination of known techniques. In an effort to accelerate these desirable trends, it was the purpose of this conference to recodify some of the concepts of the design and optimum use of the long cane. In addition to reiterating basic principles, the conference compiled experiences over the past quarter century of broadening use of this apparently simple device. While improvements in design and in usage are desirable, it is essential that apparently valuable changes should not "improve out" some of the best features of the original concepts.

At its sixth meeting, the Subcommittee on Sensory Aids of the Committee on Prosthetics Research and Development, NRC, decided to sponsor a conference to:

1. Reconsider and revise, if necessary, present standards and specifications for the long cane.

2. Develop for publication a set of acceptable techniques for use of the long cane under a variety of conditions.

This conference was held September 10-11, 1971, at the National Academy of Sciences. A list of participants is given in Appendix A. Dr. George C. Mallinson was chairman and the report that forms the main body of this document was prepared by him and Professor Stanley Suterko.

The program is included here as Appendix B. After addresses by Dr. Hoover, Warren Bledsoe, and Russell Williams, five groups (Appendix C) were formed to consider the problems

concerned with specifications. A consolidation of the reports of these five groups is set forth in Section II.

After a report by the specifications groups and a presentation by Professor Suterko, each group was reassembled to consider the problems associated with mobility training with the long cane. A consolidation of the reports of these groups is set forth in Section III.

A list of Orientation and Mobility Terms is included as Appendix D.

Eugene F. Murphy

SECTION II

PHYSICAL AND FUNCTIONAL CHARACTERISTICS OF THE CANE

The cane consists of four sections or parts: the crook, the grip, the shaft, and the tip.

The Crook is that portion of the upper end of the cane which has been bent or curved to form an arc or "hook."*

The Grip is that portion of the cane which has been adapted for grasping by covering with leather, plastic, rubber, or other suitable material.*

The Shaft is the main portion or "body" of the cane, and extends from the base of the crook to the tip end of the cane.*

The Tip is the element located at the lower end of the cane and is that portion which normally contacts the floor or ground.*

The diameter of the crook, shaft, and tip should not exceed .5 inches.

A cane 56 inches in length should weigh no more than 7 ounces. The proper length is considered to be a distance from a point 1½ inches above the xiphoid process (bottom of the breast bone) to a point on the lateral side of the foot that is in the forward position.

THE CROOK

1. Should aid in hanging of the cane--may be a crook or some hanging device.
2. Contributes to cane balance.
3. Prevents cane from rolling when dropped.
4. Provides some protection in specific travel environments.

* From "Specifications for the Long Cane (Typhlocane)," U.S. Veterans Administration, February 1965.

THE GRIP

1. Shape

   a. Allows a secure grasp without undue fatigue or hindrance of technique.

   b. Allows the user to grasp the cane so that it is in balance when the cane is held in the prescribed position.

   c. Is comfortable.

   d. Should have a flat surface for orienting the cane to the hand.

2. Dimensions

   a. Maximum length is 8½ inches.

   b. Maximum diameter (width) is one inch.

3. Physical Characteristics

   a. Transmits vibrations from the tip and shaft without significant damping so as to provide a satisfactory tactile stimulus

   b. Must not conduct significant amounts of thermal or electrical energy.

   c. Has a high coefficient of friction.

   d. Is weatherproof.

   e. Is extremely durable.

   f. May be cleaned easily.

   g. Should be free of irritants to human skin, sometimes in the presence of perspiration.

THE SHAFT

1. Shape

   a. Vertical axis of the shaft must be straight.

   b. The shaft should taper slightly from the grip to the tip.

2. Dimensions

   a. Should be available in various lengths to fit the individual users.
      {Should be long enough to extend 1½ inches above xiphoid process (bottom of breast bone) and extend to ground at side of foot that is in forward position.}

3. Physical Characteristics

   a. Should weigh 6-7 ounces for a 56-inch cane.

   b. Must not conduct significant amounts of thermal or electrical energy.

   c. Should transmit vibrations from the tip to the grip so as to provide the optimal tactile and aural stimulus.

   d. Should have a low wind resistance.

   e. Should be rigid; namely, not whip, but maintain its original shape under stress.

   f. Should not shatter or pose other hazards or dangers if it breaks.

   g. Must be visible to motorists or pedestrians.

   h. Must produce minimal noise level when used without artificial dampening devices.

THE TIP

1. Shape

   a. Should be compatible with cane shaft.

   b. Should have a chamfer at lower end.

2. Dimensions

   a. Should have same diameter as lower end of cane.

   b. Portion extending from distal end of cane should not be greater than 2 inches.

3. Physical Characteristics

   a. Must not conduct significant amounts of thermal or electrical energy.

   b. Should transmit vibrations so as to provide optimum tactile stimulus at the grip and optimum aural stimulus.

   c. Should resist expansion and contraction with changes in temperature and humidity.

   d. Should wear smoothly and not become sharp or dangerous to pedestrians.

   e. Should have a coefficient of friction and should be shaped so as to move easily over all surfaces, yet be able to transmit sense of surface.

   f. Should be durable.

4. Other Characteristics

   a. Should be replaced easily without special tools.

   b. Does not weaken shaft of cane when inserted.

TIP FITTINGS

May be any of the following provided the functional characteristics of the tip are maintained:

1. Screw in nylon, or other suitable material.

2. Slip over nylon tip, or other suitable material.

3. Eccentric cam locking.

4. Glide ferrule.

SECTION III

THE TOUCH TECHNIQUE--FUNCTIONAL USE

The touch technique, a systematic method of using a long cane, was devised by Dr. Richard E. Hoover to provide a safe and efficient method of travel for the blind. When executed properly the touch technique provides protection from objects lying in the path of the traveler; conveys textural qualities of the surfaces in contact with the tip by conducting vibrations to the index finger, the hand, and the ears; and alerts the user to vertical surface changes as declines, drops, inclines, etc. Any omissions or deviations from the prescribed execution of the touch technique lessen the effectiveness of the technique and endanger the safety of the individual.

USING THE TOUCH TECHNIQUE

When the touch technique is used in unfamiliar areas, the cane should be held in the dominant hand which is brought to the midline of the body through flexion of the shoulder and adduction of the upper arm. In this position, the hand is about six to eight inches in front of the body and just below the lateral plane of the belt. The upper arm rests confortably against the rib cage with the elbow in a fully extended position.

With the hand simulating a "hand-shaking position" the cane is grasped so the grip rests under the thenar eminence with the upper limit of the grip protruding slightly to the rear of the hand. The middle finger is flexed under the cane, supporting and balancing it. The extended index finger is on the lateral side of the grip and pointing to the tip of the cane. The flexed thumb is curved over the top of the grip and

supports the cane on the medial side. The remaining fingers are flexed into a comfortable position that allows them to rest lightly on the medial aspect of the grip.

When the arm is in the proper position and the cane tip is on the contralateral side, a straight line should be the configuration from the shoulder to the tip of the cane. Optimally, there should be a slight radial deviation of the wrist to prevent the cane from sticking to the surface over which it is moving. With the forearm and upper arm remaining stationary, the wrist is flexed, hyperextended and returned, pivoting the cane so the tip describes an arc in front of the user, and touches the ground lightly on each side. The cane tip is moved in a rhythmic motion across the body, in concert with the feet, always touching in front of the foot that is in the rear (or the one that is about to be brought forward), thus assuring that this foot will have a safe and unobstructed spot for placement when it is brought forward. The tip, as it describes the arc, should just clear the ground so that low protruding objects may be detected. If the cane has a crook, the crook should be turned down.

The Touch-and-Slide Technique: A Modification

A modification of the basic touch technique is employed to enhance the detection of downcurbs, level sidewalks blended into slopes or driveways, and identification of surface textures. With this technique the basic arm, hand, and wrist positions of the touch technique are employed. The differences are in the control and movement of the tip. In the Touch-and-Slide technique, the cane tip, as it touches the ground at the spot at which the ball of the foot will touch the ground, maintains a light contact while being moved laterally. The forward motion of the body will cause the cane to move forward and the result of these two forces will cause the tip to describe a

line 8 to 10 inches long at a 35-degree angle to the line of travel. The initial contact point of the tip on the ground will be where the ball of the foot next will touch and will describe a line at a 35-degree angle that will terminate laterally at the sagittal plane of the shoulder. The basic arc and rhythm of the cane can and must be maintained with the gait. This takes much practice to attain.

The Touch-and-Drag Technique: A Modification

Another modification of the basic touch technique is the Touch-and-Drag technique that is employed to follow "shorelines" and ridgelines when these lines are parallel to the travel path. An example is the ridgeline across a gas station or a sidewalk that has a drop on one side. With this technique it is essential that the hand and arm position and the rhythm of the touch technique be employed. The difference lies in what is accomplished with the cane tip. Essentially, after the tip is moved to its most lateral position, it remains in contact with the ground and is brought back toward the center line of the body. Thus the tip describes a line that is roughly perpendicular to the travel line. In describing this perpendicular line the tip will identify and indicate the direction of a ridgeline or sidewalk edge. In moving the tip from the lateral edge to the center line of the body it may be done from left to right or right to left, depending upon the side on which the ridgeline is located.

ASCENDING UNFAMILIAR STAIRWAYS

As the first step of a stairway is located with the cane tip, the shaft of the cane is brought to a vertical position while the traveler moves forward to position his toes alongside the cane tip. Contacting the riser with the toes is not necessary (nor is it possible with stairways lacking risers).

The tip of the cane is then moved laterally to the left and to the right along the edge of the first step to insure safety, and to provide alignment and position information. The height of the step and width of the tread are measured as the cane tip is raised and moved forward to the second riser. (For very tall individuals having long arms, it is more comfortable to have the cane tip on the third riser.) The tip of the cane is then raised to about one inch below the edge of the second step, and laterally in line with the opposite shoulder. The hand and arm are held straight with the elbow locked with the cane in a diagonal position. With the weight properly balanced over the balls of the feet the ascent is begun and, if the cane-and-hand-arm position is not altered, the tip of the cane will lightly touch the edge of each succeeding step. Failure of the cane tip to touch a step is an indication of the landing and one more step is necessary. As this last step is taken the cane tip sweeps the floor and immediately the touch technique is resumed.

It may be noted that in ascending familiar stairways the experienced and proficient traveler will expedite his ascent by omitting the checking of the width and depth of the stairs. One needs only to verify the precise position of the first step and then move directly into the diagonal cane position.

DESCENDING UNFAMILIAR STAIRWAYS

As the stairway is approached, the tip of the cane will indicate the presence of a drop or step down. While the user maintains cane contact with the edge, he brings his toes forward to the cane as he moves it to a vertical position. Determining one's position on the stairway, as well as the margin of safety on either side in order that stepping off the side may be avoided, is accomplished by a sweeping motion

along the edge of the step for twelve to eighteen inches on either side of the body. The depth of the stair is then determined by putting the tip on the first stair tread. Next, the width of the tread is determined by moving the tip forward until the edge of the stair is located. With the cane tip extended two inches below the tread, two or three inches in front of it, and laterally in line with the opposite shoulder, the traveler is ready to descend. When the traveler is properly balanced with weight toward the heels, the hand that holds the cane should be in a natural position at his side and there should be no relative movement of the hand or the cane as he descends.

When this method of descending is used, the tip will just miss each stair and contact the landing a minimum of one stair ahead of the feet. As this contact is made, the tip will slide along the landing while descending the last stair. The sliding of the tip along the landing should be converted into a sweeping motion for clearance before the touch technique is resumed.

With familiar stairways, namely, those the traveler negotiates daily, a proficient traveler can add sophistication to his descent by omitting the checks for width, depth, and height of the stairs. He need only maintain contact with his cane on the edge of the first stair until one foot is brought up to the cane. At this moment his cane is moved forward into position for the descent, and with his body properly balanced his next step with the opposite foot will be on the first stair below the landing. Again this procedure takes practice and should be used only by proficient travelers.

CONCLUSION

Two sections in this report are entitled "Physical and Functional Characteristics of the Cane" and "The Touch Technique--Functional Use." The elements of the report are based on the experiences of many persons who have been associated for a number of years with orientation and mobility problems of the blind.

This report represents the consensus of individuals with a great deal of experience in mobility training, but one should not assume that the specifications for the long cane or the touch technique have been developed to the optimal extent, and the contents should not be considered as final.

However, this report should be useful to those now engaged in orientation and mobility training. Much research is needed to determine how the cane can be improved and how its use can be enhanced.

APPENDIX A

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Committee on Prosthetics Research and Development

National Academy of Sciences
Washington, D.C.

September 10-11, 1971

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APPENDIX B

PROGRAM

CONFERENCE ON THE LONG CANE

SUBCOMMITTEE ON SENSORY AIDS
COMMITTEE ON PROSTHETICS RESEARCH AND DEVELOPMENT
DIVISION OF ENGINEERING-NATIONAL RESEARCH COUNCIL

National Academy of Sciences
Washington, D.C.

Lecture Room
September 10-11, 1971

George G. Mallinson, Chairman

September 10, 1971 - 9:00 a.m.

I.	OPENING REMARKS	Richard E. Hoover Subcommittee on Sensory Aids, CPRD
		George G. Mallinson
II.	SPECIFICATIONS AND STANDARDS FOR LONG CANES	Russell Williams
III.	WORKING GROUPS ON SPECIFICATIONS AND STANDARDS	
IV.	SUMMARY ON SPECIFICATIONS AND STANDARDS	Russell Williams

September 11, 1971 - 9:00 a.m.

V.	GUIDELINES FOR EVALUATION OF CANE TECHNIQUES	Stanley Suterko
VI.	WORKING GROUPS ON ACCEPTABLE TECHNIQUES FOR USE OF THE LONG CANE	
VII.	SUMMARY ON CANE TECHNIQUES	
VIII.	GENERAL SESSION	

APPENDIX C

FIVE GROUPS FORMED

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ORIENTATION AND MOBILITY TERMS

1. *Orientation* The process of utilizing the remaining senses in establishing one's position and relationship to all other significant objects in one's environment.

2. *Mobility* The term used to denote the ability to navigate safely from one's present fixed position to one's desired position in another part of the environment.

3. *Sighted Guide* Sighted person who accompanies a blind person in the recommended manner.

4. *Forearm Technique* The act of protecting the upper part of the body during travel.

5. *Trailing* The act of using the back of the fingers or fingernails to follow lightly over a straight surface (e.g., wall, lockers, desks, tables, etc.) for one or all of the following reasons:

   a. to determine one's place in space;
   b. to locate specific objectives;
   c. to get a parallel line of travel.

6. *Squaring Off* Placing one's body against an object in order to determine his positional relationship to other parts of the environment.

7. *Direction Taking* The act of getting a line or course from a fixed object or a sound to better facilitate traveling in a straight line toward an objective.

8. *Line of Travel* Desired straight route.

9. *Guideline* A line formed by the meeting of two surfaces, in either plane or texture. The line gives the traveler direction and/or location. (For example, grass and sidewalk edge, blacktop and cement of parking area of gas station, etc.)

10. *Landmark* Any familiar object, sound, odor, temperature, or tactual clue that can be easily recognized and that has a known and exact location in the environment.

11. *Point of Information* A familiar object, sound, odor, temperature, or tactual clue, whose exact location in the environment is known but is more difficult to recognize or perceive and may not always be present.

    Clue - information necessary to solve a problem.
    Cue - stimulus which results in a response.

12. *Dominant Clue* Of the maze of cues that are present, the one that most adequately fulfills all of the informational needs at that moment.

13. *Familiarization* Techniques used by the blind person to explore his environment or introduction of a blind person to an area through description or assisted examination by a sighted person.

14. *Protective Stooping* The act of protecting head and face when stooping.

15. *Search Pattern* A method of recovering dropped object.

16. *Sound Sources* Objects in environment which produce sounds of their own.

17. *Sound Shadow* An object in the environment which is between the sound source and the traveler.

18. *Sound Echo* Sound which is reflected from an object in the environment, such as a building or wall.

19. *Localization* To determine the direction of a source of a sound.

20. *Pinpoint* To identify the exact location of a sound source.

21. *Proprioceptive Sense* Ability of the mind to perceive the location or relationship of parts of the body in stationary positions without need of checking through any other sense.

22. *Kinesthetic Sense* Ability of the mind to perceive the location of relationship of parts of the body as they are moving, without checking through any other sense.