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AUTHOR Lyman, Elisabeth R.
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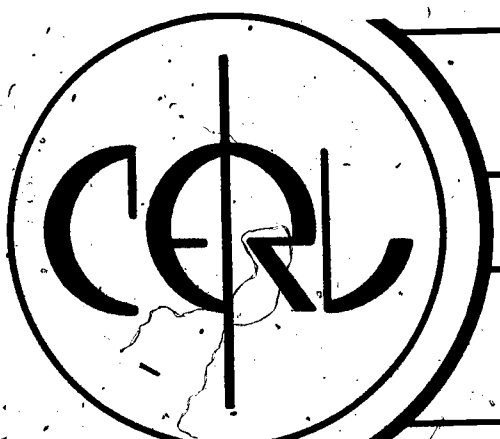
ABSTRACT

This document describes the development of the PLATO system, and six figures illustrate the chronological development of PLATO terminals, lesson programing languages, instructional material, and system usage. A list of financial supporters of PLATO and the Computer-based Educational Research Laboratory is followed by a chronological listing of highlights in PLATO's history. The last section of this document is a chronological bibliography of 262 PLATO publications written between 1961 and 1975. (CH)

PLATO HIGHLIGHTS

ELISABETH R. LYMAN



Computer-based Education Research Laboratory

University of Illinois Urbana Illinois

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Grateful acknowledgement is expressed to the many supporters of the PLATO project who are listed on page 10 of this report.

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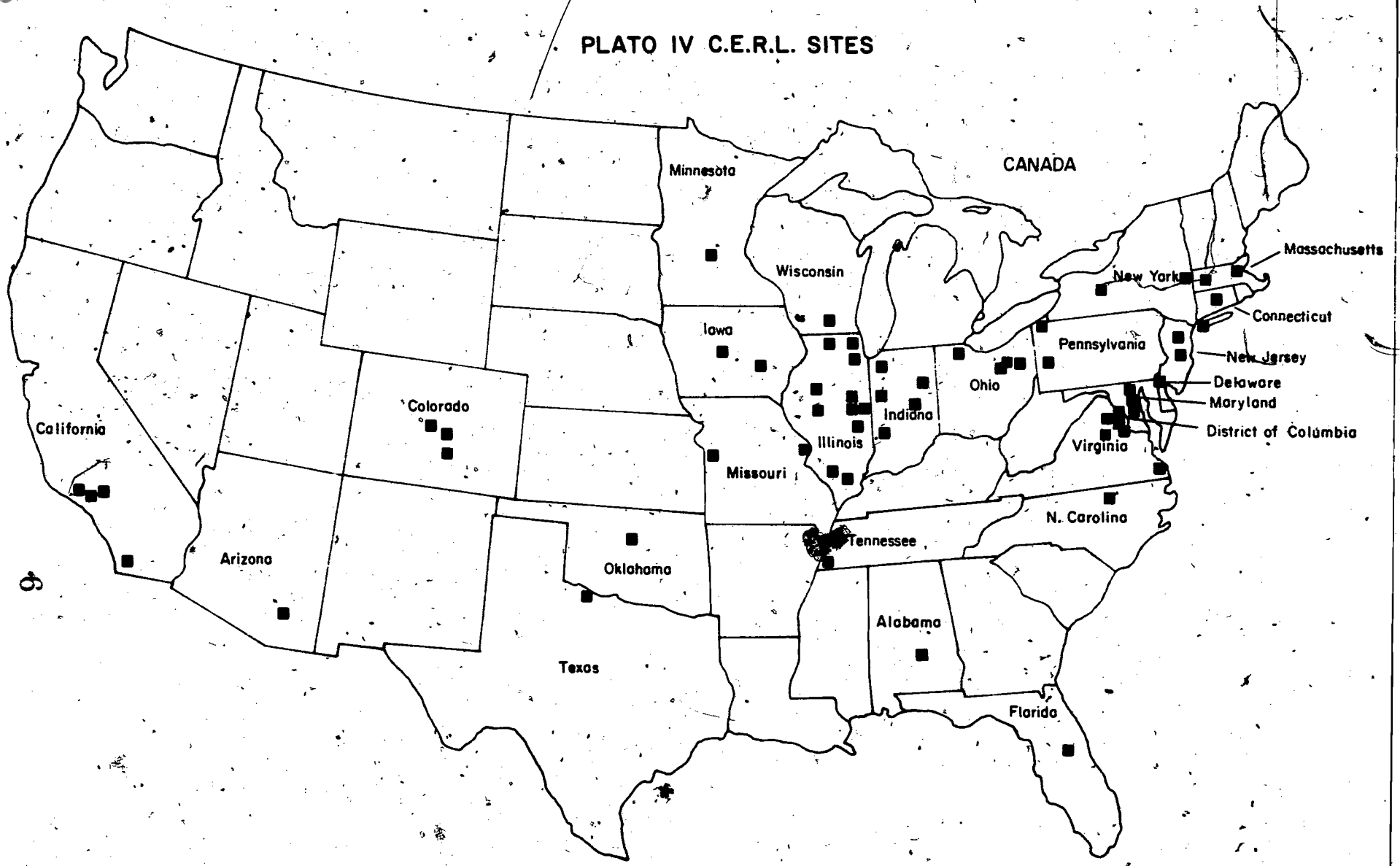

PLATO IV C.E.R.L. SITES
CANADA
Minnesota
Wisconsin
Iowa
Illinois
Missouri
Indiana
Ohio
Pennsylvania
New York
Massachusetts
Connecticut
New Jersey
Delaware
Maryland
District of Columbia
Virginia
N. Carolina
Tennessee
Colorado
California
Arizona
Oklahoma
Texas
Alabama
Florida

Figure 1

Development of the PLATO System

As a result of conversations in 1959 among engineers, physicists, psychologists and educators, research was started in 1960 in the Coordinated Science Laboratory at the University of Illinois to explore the possibilities of automation in individual instruction. A teaching system called PLATO (Programmed Logic for Automatic Teaching Operation) was invented and developed initially in the Coordinated Science Laboratory under the direction of Dr. Donald Bitzer. The PLATO system utilized a high speed digital computer as the central control element for teaching a number of students simultaneously.

In the course of the first seven years of PLATO's existence, the system grew from one terminal to seventy-one (twenty of which were operable simultaneously) (Figure 2), utilized three different computers (Figure 3) and employed four languages (Figure 4). During this period about 300 programs, of which 180 were lessons, were written for the system to illustrate or demonstrate its flexibility for teaching as well as for educational and other research (Figure 5).

In January 1967, the University of Illinois organized the Computer-based Education Research Laboratory and moved the PLATO project from the Coordinated Science Laboratory into the new laboratory. Dr. Bitzer continued the direction of the PLATO development. The purpose of the new laboratory was to continue the research and operation of the PLATO system. Work in the laboratory concentrated on the educational aspects of the PLATO III teaching system with particular emphasis on the most efficient use of PLATO III (the twenty terminal system) and on the development of the hardware (equipment), software (computer programs), and courseware (educational materials) for an economical large-scale computer-based educational system (PLATO IV).

From 1967 through 1972 the use of the PLATO III system reached peak capacity with approximately sixty hours assigned to student class time per week (Figure 6) and authors relegated to writing their lessons on the system from late evening until the early hours of the morning, while system programmers had to experiment on and correct the basic program problems during the rest of the night. The storage medium for PLATO lesson material was changed from magnetic tape to disk storage and the interactive interpretive program for the TUTOR language improved to allow time-sharing of the system.

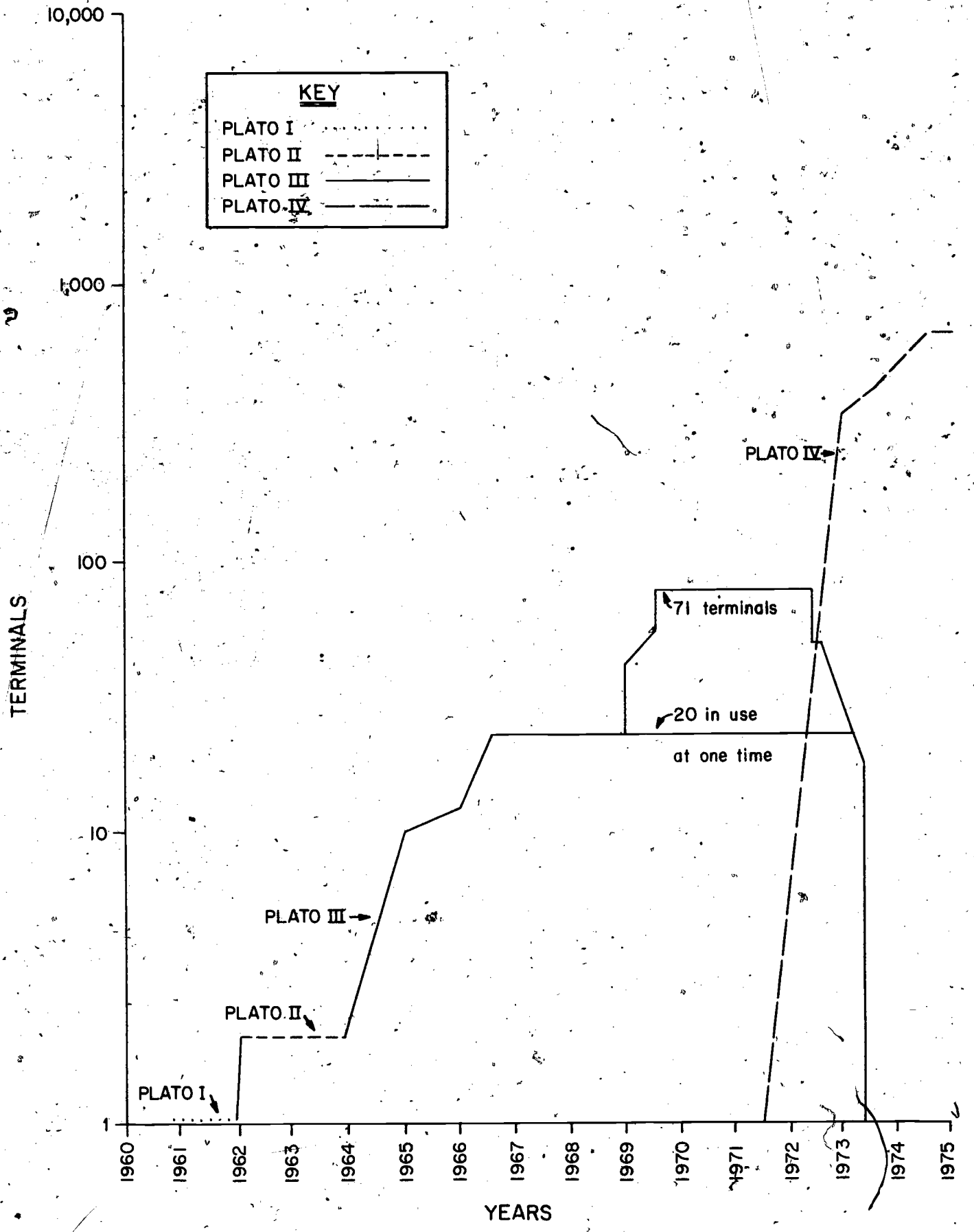


Figure 2 PLATO TERMINALS

by students and authors simultaneously as well as to add new features to the language. The computer and the available terminals were then being used as efficiently as possible. Lesson material proliferated rapidly (Figure 5) and work in many new subject areas was tried.

The actual testing of the large scale computer-based educational system, PLATO IV, began with the arrival of many commercially manufactured PLATO IV terminals during the summer of 1972. These terminals utilized plasma display panels as the visual display rather than storage cathode ray and television tube presentation. Extensive development of the TUTOR language for PLATO IV enabled PLATO authors to convert their PLATO III lessons to the PLATO IV system and to develop new PLATO material. Classes taught using PLATO IV terminals officially began in February 1973 and the teaching with PLATO III was phased out in June of that year.

Concurrent development of improvements to the computer system, of the design and construction of auxiliary equipment, of the scope of the TUTOR language and of curricular materials has been the PLATO project pattern since 1973. Every phase of the system has either been improved or expanded. In February 1973, a new CDC computer, CYBER 73, replaced the CDC 6000 series machine (Figure 3). Extended core storage (ECS) was increased in February 1974 by 500,000 words to a total of 1 million words and in December 1974 to a total of two million words. A larger disk storage system was provided (one in early 1973 and an even larger one in March 1974). A touch panel attachment and a random access audio facility have been developed for the terminal, and new memory storage systems are being investigated. In addition, a second generation version of the PLATO terminal has been built. Meanwhile, as terminals have been received from the manufacturer, they have been installed in many locations. The PLATO network now includes about 146 locations, twenty-six on the campus of the University of Illinois and the others in locations ranging from San Diego, California, to Boston, Massachusetts, and Orlando, Florida, to upper New York state, as well as one terminal at the University of Stockholm in Sweden (Figure 1). The present network has been terminated at approximately 950 terminals. Two other PLATO systems are now in operation, one by Control Data Corporation in Arden Hills, Minnesota, and one at Florida State University in Tallahassee, Florida. As predicted technological developments improve computer and communications systems, plans call for possible expansion of the CERL PLATO network and the addition of other PLATO

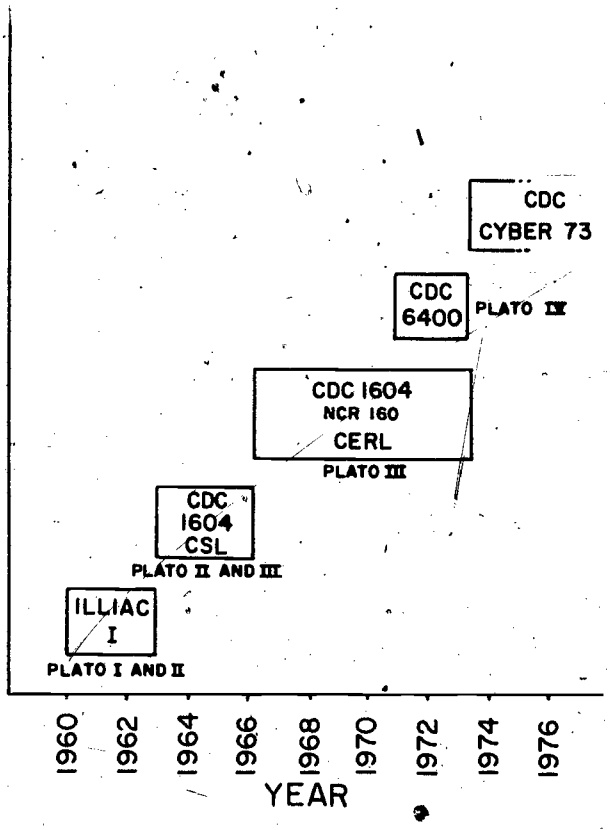
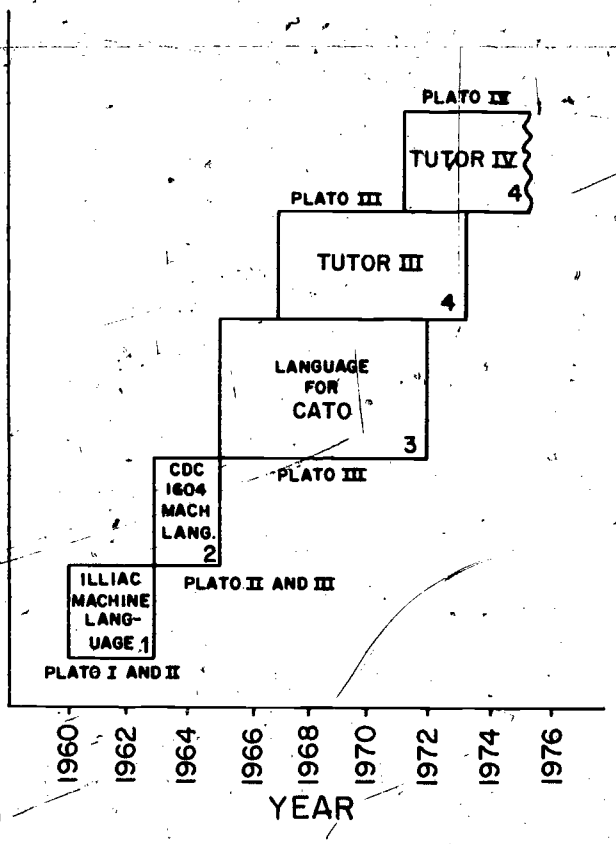


Figure 3 · COMPUTERS



KEY

1. Tutorial Logic until 1962
2. Tutorial & Inquiry Logic 1962-1965
3. 3 or 4 Logics 1965+1972
4. Individualized logics possible for every lesson

Figure 4 . LESSON PROGRAMMING LANGUAGES

AA-036-1

networks in the foreseeable future so as to provide many, many thousand users with high-quality computer-based education at a low cost.

Along with the hardware development, the software for the system has also been immeasurably improved. Many of the sophisticated refinements and extensions of the TUTOR language have been a result of suggestions from the many users on the system, suggestions arising as the users experimented with and developed curricular materials. The language is now highly flexible and offers capabilities from complex calculations for dazzling graphics to powerful judging routines.

Curricular material development for the PLATO IV system has obviously had a major emphasis during the last two years (Figure 5). Particular attention has been paid, at the request of those supporting the laboratory, to materials for the community college level and for elementary reading and mathematics. However, teaching materials for many other areas have also been written. Tested materials are available for about 3500 instructional hours in about seventy subject areas with many more hours of material in preparation. Details on the available PLATO curricular materials are to be found in CERL Report X-41, nos. 2, 3.

The increase in student contact hours on the PLATO system from 1960 to 1964, is plotted in Figure 6. Accurate data available on the usage of the system is shown in Figure 7. One million terminal hours use was recorded between January 1, 1975, and November 19, 1975.

An independent external evaluation of teaching using PLATO was begun in September 1974 in community college courses in accountancy, biology, chemistry, English and mathematics, and in elementary school curricula in beginning reading and intermediate mathematics. This external evaluation is being carried on by the Educational Testing Service of Princeton, New Jersey, at the Chicago City Colleges, and Parkland College in Champaign, Illinois, and in several elementary schools in Urbana and Champaign, terminating in the spring of 1976.

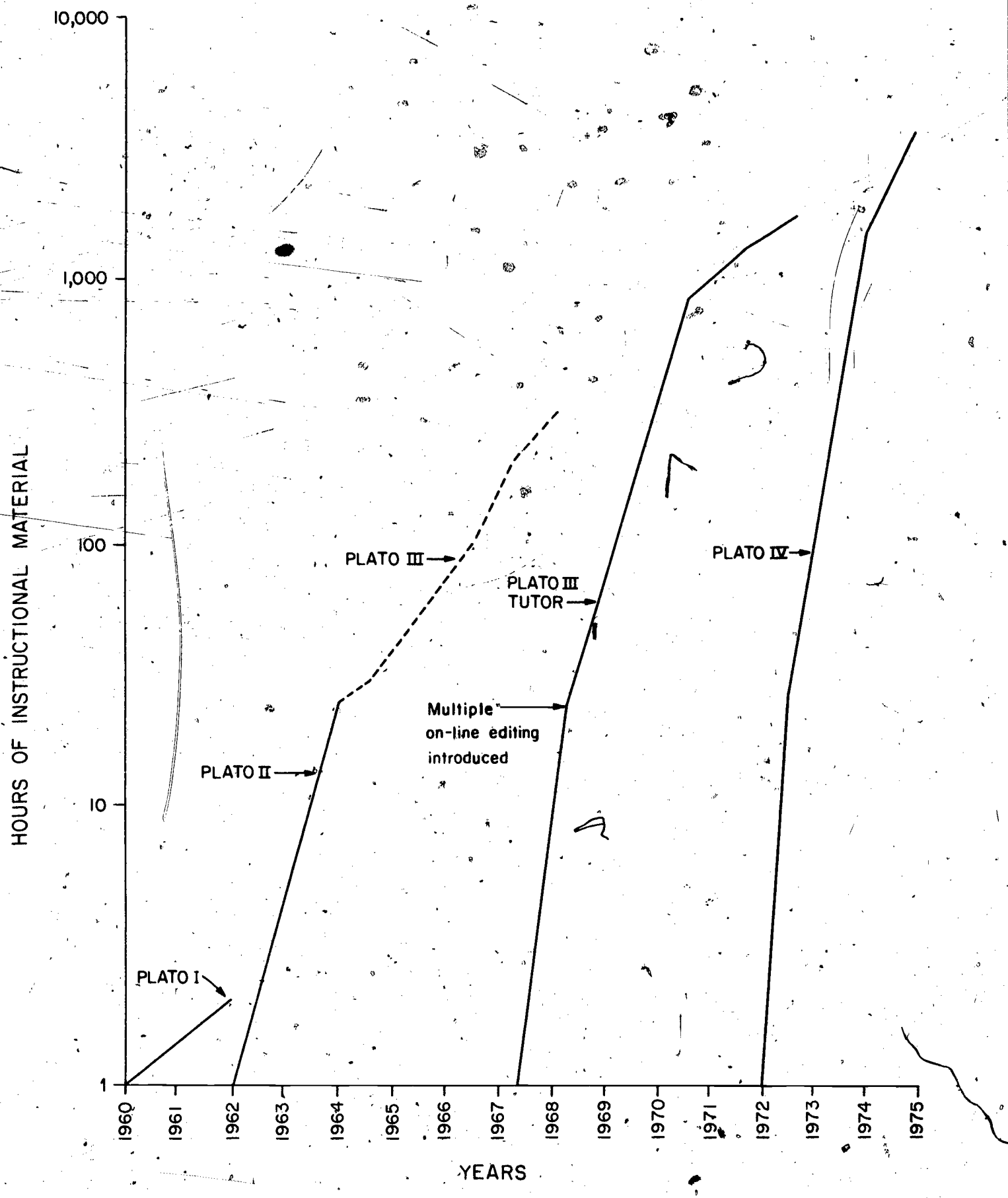


Figure 5 INSTRUCTIONAL MATERIAL

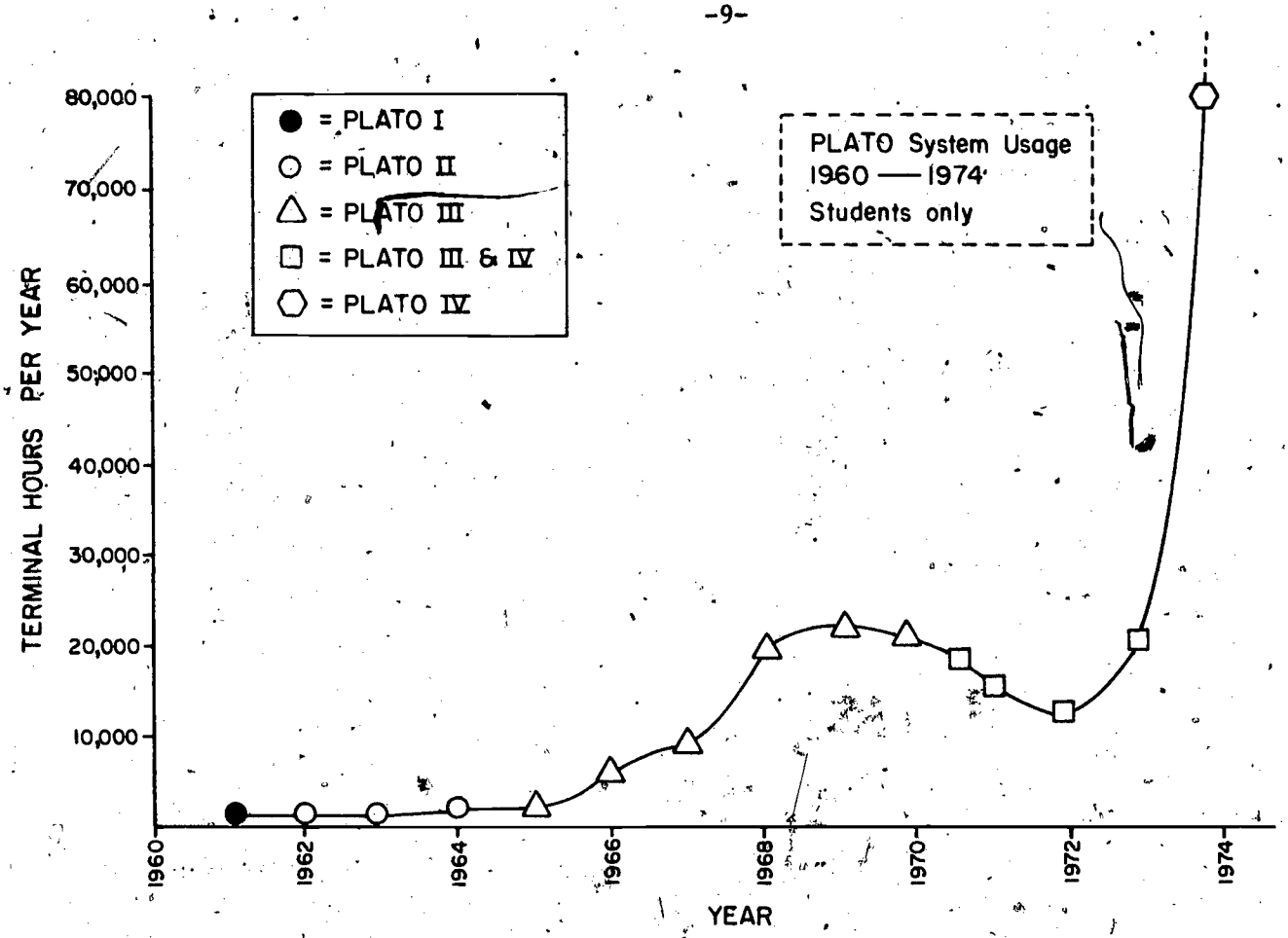


Figure 6

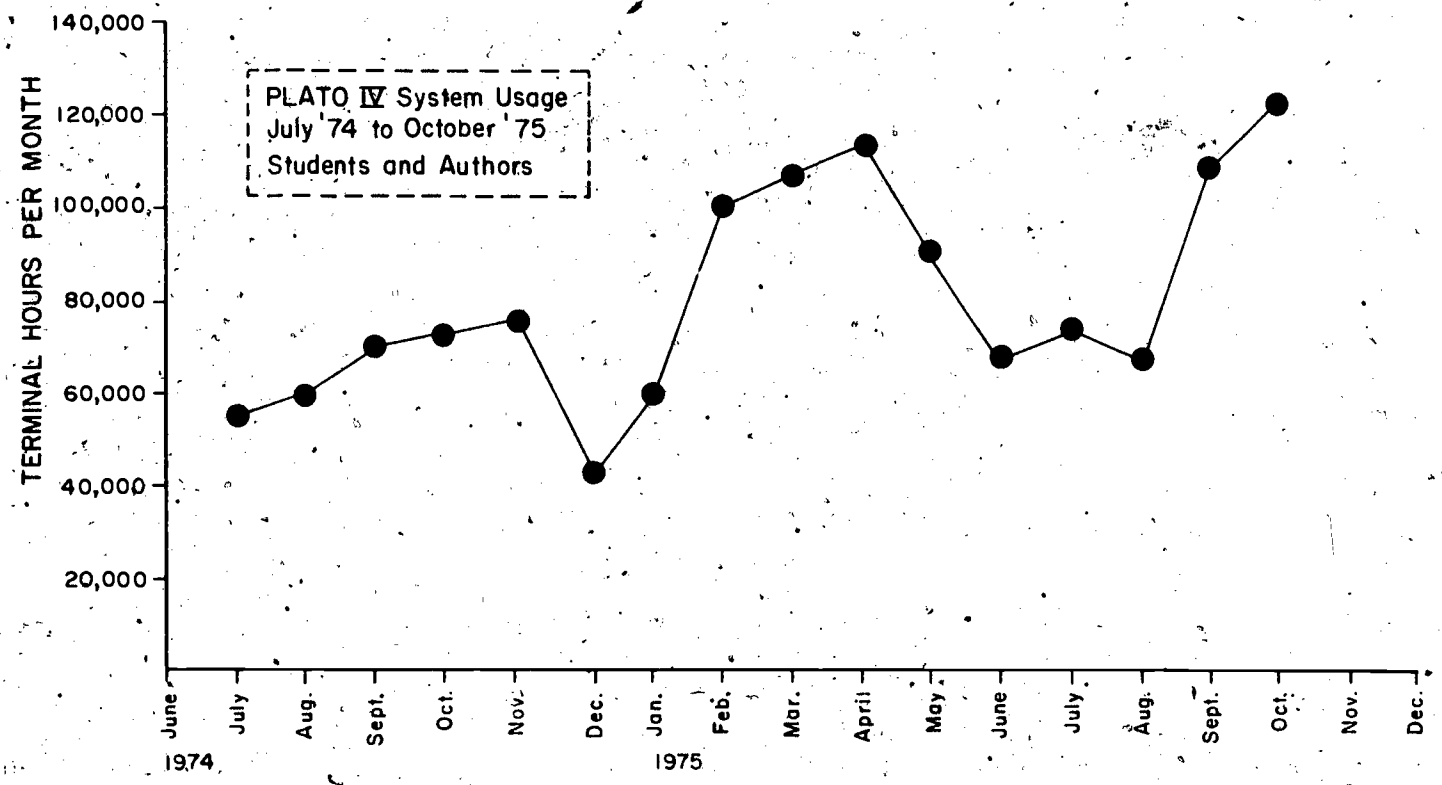


Figure 7

Financial Supporters of the PLATO Project

PLATO in the Coordinated Science Laboratory

1960-1962	Support extended to the Coordinated Science Laboratory of the University of Illinois jointly by the Department of the Army (Signal Corps), Department of the Navy (Office of Naval Research), and the Department of the Air Force (Office of Scientific Research) under Signal Corps Contract DA-36-039-SC-85122
1962-1964	Support extended to the Coordinated Science Laboratory of the University of Illinois jointly by the Department of the Army, Department of the Navy (Office of Naval Research), and the Department of the Air Force (Office of Scientific Research) under Department of Army Contract DA-36-039- TR US AMC 02208 (E)
1964-1966	Support extended to the Coordinated Science Laboratory of the University of Illinois under the Joint Services Electronics Program by the Department of the Army, Department of the Navy (Office of Naval Research) and the Department of the Air Force (Office of Scientific Research) and by the Advanced Research Projects Agency under Department of Army Contract DA-28-043-AMC-0073 (E)
1966-1967	Same as 1964-1966 except under Contract DAAB07-67-C-0199
1964-1967	Advanced Research Projects Agency through Office of Naval Research under Contract Nonr-3985 (08)
1966-1968	United States Office of Education under Contract OE-6-10-184
1966-1967	Control Data Corporation

PLATO in the Computer-based Education Research Laboratory

1967-1970	Subcontract from Mercy Hospital School of Nursing through contract under Nurse Training Act of 1964 from Public Health Service, Division of Nursing United States Department of Health, Education and Welfare under Contract NPG-188-01
1967-present	State of Illinois
1967-present	Control Data Corporation
1967-present	Owens-Illinois, Inc.
1968-1976	National Science Foundation under Contracts NSF GJ81, NSF GJ 974, NSF 65 29981, NSF C-723
1969-present	Metropolitan Museum of Art
1971-1973	United States Air Force Contract F-30602-72-C-0141 United States Air Force Contract F-30602-73-RADC
1971-1973	Ford Foundation under Contract 710-0293
1971-1973	United States Agency for International Development Contract CSD-2937
1972-1973	United States Department of Health, Education and Welfare through Illinois Regional Medical Program
1972-1974	United States Air Force Contract F-41609-72-C-0050
1973-1976	Advanced Research Projects Agency through United States Army Contract DAAC-15-73-C-0077

Highlights in PLATO's History

PLATO in the Coordinated Science Laboratory

June 1960	First design for PLATO complete (single station consisting of keyset and CRT with provision for simultaneous display of computer-generated characters and photographic slide).
Fall 1960	PLATO goes into regular research operation (2 hours per day using ILLIAC I computer) as project of Coordinated Science Laboratory.
November 1960	First formal demonstration of PLATO in operation.
January 1961	PLATO II goes into operation (two stations operating simultaneously).
March 1961	First use of remote terminal with PLATO (30 miles from computer).
Spring 1961	PLATO first used with instructional material (high school math and French grammar).
Fall 1961	College level material first used on PLATO (Network Synthesis lessons).
Spring 1962	PLATO first used to provide part of accredited college course (Math 195, University of Illinois).
Summer 1962	Inquiry type logic developed for PLATO.
November 1962	PLATO first used to collect and process physiological information (heart rate) as part of student response data.
January 1963	PLATO shifts from ILLIAC I to CDC 1604 computer.
Spring 1963	PLATO first used to provide part of accredited professional course (Nursing).
Fall 1963	PLATO III first used (capability for expansion to 32 stations).
June 1964	Two different lessons simultaneously available to class using PLATO.
October 1964	Provision for inter-terminal communication between PLATO terminals completed.
Fall 1964	PLATO used for control of real experiments in physical sciences (all stations able to observe outcome and perform analysis of results).
December 1964	On-line editing of PLATO lesson possible while students use lesson.

January 1965	CATO (Compiler for Automatic Teaching Operations) completed.
Spring 1965	PLATO first used for extensive portion of accredited college course (EE 322).
Fall 1965	First college course (Library Science 195) given completely by PLATO.
March 1966	Expansion of PLATO III to 20 terminals completed.
May 1966	PLATO operating on own CDC 1604 computer.
Summer 1966	Multiple on-line author editing program first used (MONSTER tape editor).

PLATO in the Computer-based Education Research Laboratory

January 1967	Computer-based Education Research Laboratory (CERL) formed for continued operation of and research on PLATO.
Summer 1967	TUTOR author language first used on PLATO (specifically designed for authors with no background in computer use).
March 1968	NSF grant awarded for first steps of development of PLATO IV (ultimately to consist of more than 1000 student terminals requiring only telephone line communication with a large central computer). Terminals use the plasma display panel developed at the University of Illinois instead of the more costly CRT presentation.
June 1968	Disk storage added giving on-line editing capability to authors while students are operating (any combination of up to 20 authors or students simultaneously operating).
June 1968	Delivery of first commercially produced 4" plasma panel (Owens-Illinois).
December 1968	14 station remote PLATO demonstration center in operation at Mercy Hospital (3 other centers operating by February, 1969).
June 1969	Multiple disk storage in operation. Up to 150 lessons available to students (for use) or authors (for editing) during a class session.
November 1969	1 remote station operating at Springfield High School, Springfield, Illinois, ninety miles from Urbana.
Summer 1970	720 hours of instructional material developed; 100,000 student contact hours of use by this date.

January 1971	On-line remote demonstration for NSF in Washington, D.C.
May 1971	Delivery of first 512 x 512 Digivue display memory device from Owens-Illinois.
June 1971	Delivery of first PLATO IV terminal from Magnavox Company.
Summer 1971	1100 hours of instructional material developed; 130,000 student contact hours of use by this date.
January 1972	Four PLATO IV terminals in operation.
June 1972	20 PLATO IV terminals in operation. On-line PLATO IV demonstrations between January 1972 and June 1972 in many locations from California to Massachusetts, Canada to Texas.
Summer 1972	On-line PLATO IV demonstrations in Italy, Germany, and Switzerland.
August 1972	1600 hours of PLATO III instructional material developed, 154,000 student contact hours of use of the PLATO system to date. Instructional sequences available in about 70 courses.
August 1972	40 PLATO IV terminals in operation.
Fall 1972	Intensive PLATO IV lesson development.
Winter 1972	250 PLATO IV terminals in operation at approximately 40 locations (15 on the University of Illinois campus and about 25 off campus).
February 1973	CDC CYBER 73 computer installed.
June 1973	Phasing out of the use of the PLATO III system for teaching.
June 1973	PLATO on-line demonstration in Mexico.
September 1973	PLATO on-line demonstration in Sweden.
Fall 1973	300 PLATO IV terminals in operation at 50 sites.
November 1973	PLATO on-line demonstration in the Soviet Union - 5 terminals, Russian keysets.
Winter 1973-1974	Second PLATO system started by Control Data Corporation in Minnesota.
January 1974	500,000 words of extended core storage (ECS) added.

February 1974	1500 hours of available PLATO IV instructional material. 1500 hours of instructional material in preparation. Over 90 college courses using PLATO.
March 1974	450 terminals operable. New disk system operational (CDC 844).
April 1974	Second PLATO system operational at Control Data Corporation, Minneapolis, Minnesota.
July 1974	700 terminals operable. 2500 hours available curricular materials.
Summer 1974	PLATO on-line demonstration in Budapest, Hungary.
September 1974	Formal external PLATO evaluation started by Educational Testing Service.
Fall 1974	PLATO terminals located at approximately 100 sites: 23 sites on the campus at the University of Illinois, 9 in elementary schools, 1 in a high school, as well as terminals at about 40 colleges and universities, 17 government projects and 12 miscellaneous sites.
Fall 1974	Third PLATO system in operation at Florida State University, Tallahassee, Florida.
December 1974	Addition of 1 million words of extended core storage.
Spring 1975	Many lessons written in other CAI languages (particularly medical lessons) being translated to TUTOR for use on the PLATO system.
Summer 1975	PLATO IV terminals (CERL network) located at 146 sites: 26 sites on the University of Illinois campus, 10 elementary schools, 3 high schools, 6 community colleges, 22 government-supported institutions, 31 medical sites (17 situated at colleges or universities), 32 colleges and universities, 16 miscellaneous.
November 1975	One million terminal hours of usage by students and authors logged in the period between January 1, 1975, and November 19, 1975. Approximately 1500 authors on the system using 11,000 lesson spaces of which over 4500 are considered tested "finished lessons" varying in student completion time from a few minutes for some to several hours for others.

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