

CACHE NEWS

News About Computers
In Chemical Engineering
Education.

No. 4

November, 1975



PURPOSE OF CACHE

CACHE was established to accelerate and coordinate the introduction of digital computation in chemical engineering education.

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COMMUNICATION WITH CACHE

CACHE actively solicits the participation by interested individuals in the work of on-going projects. Anyone who wishes to learn more about current CACHE activities may contact any member or write to CACHE, Room 12-188, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139.

The *CACHE News* is published one or two times a year to report news of CACHE activities and other noteworthy developments of interest to chemical engineering educators. Persons who wish to be placed on the mailing list should notify CACHE at the address listed above.

Material for publication in *CACHE News* is solicited from all sources. Submissions should be directed to CACHE at the above address or to the editor, Cecil L. Smith, Department of Chemical Engineering, Louisiana State University, Baton Rouge, Louisiana 70803.

The work of CACHE is supported in part by the National Science Foundation under Contract C310, T.O.196.

THE CACHE CORPORATION

In order to continue and expand the work of the CACHE Committee after termination of the project by the National Academy of Engineering (scheduled for December 31, 1975), the CACHE Corporation was formed. Although the purposes of the CACHE Corporation are similar to those of the CACHE Committee and the same individuals are involved, the CACHE Corporation is legally and operationally independent and distinct from the CACHE Committee.

Legally incorporated as a non-profit corporation in the Commonwealth of Massachusetts on February 26, 1975, the Corporation's purpose is to promote cooperation among educational institutions, industries and governmental institutions and agencies with respect to the development, production, and distribution of computer-related and/or technology-based educational aids for the engineering profession.

The Trustees of the CACHE Corporation are the same individuals as the members of the CACHE Committee. Members normally are elected to three year terms (see call for nominations in a subsequent section of this issue).

Like the CACHE Committee, the work of the Corporation is carried out by task forces which are organized to accomplish specific objectives. The chairman of each task force is a trustee of the CACHE Corporation, but the members may include other engineering educators and representatives from industry. The Trustees of the CACHE Corporation meet twice yearly to coordinate task force activities.

A local representative to CACHE has been designated at each chemical engineering department across the country. These representatives serve as a focal point for communication with CACHE; they receive communications from CACHE and provide feedback to the Corporation.

The first major activity of the CACHE Corporation has been to make the FLOWTRAN computer program developed by Monsanto Company available to chemical engineering departments at universities in the United States for use in education. This is a proprietary computer program developed by Monsanto at a cost of several million dollars and previously restricted to in-house use by Monsanto or licensed to other companies at a cost of over \$100,000. The fact that students at universities now have access to the system is a significant advance in engineering education.

The computer program is installed on a central computer network operated by United Computing Systems in Kansas City, Missouri. It is accessed by users from remote terminals connected over a telecommunication network. Professors who wish to use FLOWTRAN should contact the CACHE Corporation at the headquarters office in Cambridge, Massachusetts. They must sign a three-party agreement between themselves, the CACHE Corporation, and Monsanto Company agreeing not to use FLOWTRAN for private financial gain.

The CACHE Corporation submitted a proposal to the National Science Foundation in August, 1974 requesting a grant of \$144,000 for the production, testing, evaluation, and distribution of approximately 500 self-study instructional modules covering the basic chemical engineering curriculum. Funded on June 1,

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1975, this project will require the coordination of work by university professors across the country in a cooperative effort.

CACHE SOLICITATION WAS SUCCESSFUL

One measure of the effectiveness of any program is: are people willing to support it. The CACHE Trustees late last spring put into effect a program to solicit funds from university departments of Chemical Engineering. These funds were to be used to help CACHE get started and provide support in areas which could not otherwise be supported by contract or other funds.

All of the Departments of Chemical Engineering in the United States and Canada were contacted by letter. Each department was asked to contribute \$200 to CACHE. A number of different services and publications are provided by CACHE, and it was felt that if the departments found the services of CACHE to be worthwhile, contributions should not be too difficult to obtain. Such, indeed, was the case. Over 52 departments in the United States and 4 in Canada so far have contributed to the CACHE funding drive. More are expected to contribute during the remainder of 1975. The Development Committee of CACHE wishes to thank all of the contributing departments who in these difficult economic times have been of material assistance.

NEW OFFICERS ELECTED

At the meeting of the CACHE Corporation in Boston this past August, the following officers were elected:

President: Ernest J. Henley, University of Houston

Vice-President: Robert E. C. Weaver, Tulane University

Secretary: Duncan A. Mellichamp, University of California, Santa Barbara

Treasurer: Lawrence B. Evans, Massachusetts Institute of Technology

Officers for the previous year were: Brice Carnahan (President), Ernest J. Henley (Vice-President), Robert E. C. Weaver (Secretary), and Lawrence B. Evans (Treasurer).

ELECTION OF NEW TRUSTEES

At the end of this year, the terms of six trustees of the CACHE Corporation will expire. Nominations of individuals for trustees may be made by anyone, and should be sent to CACHE, Room 12-188, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139.

Nominations should include a resume of the nominee along with a cover letter from the individual making the nomination, stating how the nominee could contribute to the promotion of the development, production, and distribution of computer-related and/or technology-based educational aids for the engineering profession.

The election of trustees will be held at the CACHE meeting to be held in conjunction with the forthcoming Los Angeles AIChE meeting. In order to be considered, nominations must be received by November 14, 1975.

LARGE-SCALE SYSTEMS TASK FORCE ACTIVITIES

Since the last CACHE newsletter, the LLS Task Force has concentrated its efforts on making FLOWTRAN available to all chemical engineering departments in the United States and Canada via a national computing network. FLOWTRAN is a generalized computer program for design and simulation of steady-state chemical processes. It computes material and energy balances, equipment sizes and costs, and profitability analyses. On December 10, 1973, Monsanto announced approval of the use of their FLOWTRAN program in this manner, including assistance in implementation of the system by providing a grant and loaning a specialist from its Corporate Engineering Department. Since then, the LSS Task Force has:

(a) Prepared a 370-page textbook on FLOWTRAN in 1974 for students and other users. The text is entitled "FLOWTRAN Simulation—An Introduction." The authors are J. D. Seader (Utah), W. D. Seider (Penn.), and A. C. Pauls (Monsanto). In addition, R. R. Hughes (Wisconsin) wrote a chapter on a comprehensive example making use of most of the features of FLOWTRAN. The text can be purchased from Ulrich's Bookstore (attention M. E. Bundy, 549 East University Avenue, Ann Arbor, Michigan 48104) for \$9.95 plus \$0.75 for mailing and handling. Approximately 800 copies have been sold.

(b) Installed the FLOWTRAN program on the United Computing Systems, Inc. national network in mid-1974. This network allows FLOWTRAN to be accessed by either (1) remote batch using in-WATS lines or (2) remote job entry (typewriter terminal) with local phone numbers in more than 80 cities across the United States.

(c) Prepared a 56-page guide to the use of FLOWTRAN on the UCS system. The title is "CACHE Use of FLOWTRAN in UCS," written in early 1975 by R. R. Hughes. Copies are available for \$1.00 from the CACHE office in Cambridge, Mass.

(d) Presented three workshops on FLOWTRAN to both potential academic and industrial users. The first workshop was held at Northwestern University on August 13-16, 1974 and was attended by 38 chemical engineering department faculty representing 35 schools in the United States and Canada. The second workshop was an AIChE Continuing Education course. Held on March 19-22, 1975 at Houston, Texas, it was attended by 18 chemical engineering faculty and 10 chemical engineers in industry. On September 11-14, 1975, six chemical engineering faculty members and three chemical engineers from industry attended a third workshop under the auspices of AIChE Continuing Education at Boston, Massachusetts.

(e) Set up a business office at Cambridge, Massachusetts, in late 1974 to handle FLOWTRAN usage. By

June 30, 1975, 25 schools were using FLOWTRAN in teaching and research.

(f) Established a FLOWTRAN Users Group under J. T. Sommerfeld (Georgia Tech) and J. P. Clark (V.P.I.). They have issued three newsletters, have prepared an article on FLOWTRAN for a future issue of Chemical Engineering Education, and are collecting interesting FLOWTRAN class problems for the preparation of a problem booklet. Meetings of the FLOWTRAN users group are held at most AIChE national meetings.

FLOWTRAN can be used to strengthen chemical engineering courses in material and energy balances, thermodynamics, equilibrium-stage operations, process design, etc. In addition, it is useful in research. Professors desiring more information on FLOWTRAN, including interest in attending a future workshop, should contact:

Professor J. D. Seader
Chemical Engineering Department
Merrill Engineering Building
University of Utah
Salt Lake City, UT 84112
Telephone: (801) 581-6915

An excellent article on FLOWTRAN and other simulation programs appeared in the May 1975 issue of the AIChE Journal on pages 417-436.

The task force is currently investigating the addition of other large-scale computer programs to the UCS or other networks.

PROGRAM DISTRIBUTION TASK FORCE EXPLORES COMPUTER NETWORKS

Monsanto's decision to provide FLOWTRAN for use at universities added significance to the Program Distribution Task Force's search for a computer network. In Spring, 1974, after evaluation of four networks, the United Computing Systems Network was selected. Other networks offer similar arrangements for communication with typewriter terminals, but UCS was judged to be accessible to more schools for the cost of a local phone call. In addition, UCS provides an 800 exchange (WATS-line service) for communication by higher speed terminals (card readers and line printers) from anywhere in the U.S. The latter mode of usage has been predominant among the schools using FLOWTRAN on UCS.

Experience has shown that UCS costs are low enough for use of FLOWTRAN in coursework. However, it is the objective of the Program Distribution Task Force to lower costs and provide a more student-proof accounting system than offered by UCS. The Task Force is working cooperatively with EDUCOM (The Interuniversity Communications Council), which is developing a network of lower cost university computers. The EDUCOM Planning Council for Computer Networks is planning a network that will initially benefit the 20 schools that comprise the Planning Council. CACHE together with user groups in business, law, medicine, library sciences, etc., will help EDUCOM select

appropriate university computers, programs, and data bases. In the near future, we expect FLOWTRAN to be installed on this university computer network.

The Program Distribution Task Force is exploring methods for maintaining and distributing programs developed at universities. Many programs are written by research students and require refinement before they can be widely used by students across the country. We are exploring methods of setting-up a "National Center for Chemical Engineering Computing" that would provide this service as well as make programs available to the chemical industry. In this regard, there is a session planned for the Los Angeles AIChE meeting entitled "Pros and Cons of a National Center for Chemical Engineering Calculations."

THE CHEMI PROJECT

The CACHE Corporation has embarked on a new venture in education by and for the chemical engineering community with its CHEMI (Chemical Engineering Modular Instruction) Project. In July of this year, CACHE received a \$150,000 grant over the next three years from the NSF to produce and distribute self-study, single concept, text (print) modules in chemical engineering. These modules will cover the entire chemical engineering undergraduate curriculum. From 50 to 100 modules are planned in each of seven curriculum areas; control, transport, stagewise processes, design, stoichiometry, kinetics, and thermodynamics.

Each module will be roughly from 7 to 15 pages in length, single spaced, with an educational content equivalent to about a one hour lecture. The modules can be used as lecture and textbook supplements for students self-study, student evaluation, and for concept demonstrations in the case of those modules which embody simulation type of computer programs.

The entire chemical engineering community is invited to participate in this new project by writing modules in the area of their interest. Each module will receive wide distribution to the chemical engineering community. The availability of the author's module will be announced in the CACHE Newsletter and also in periodic news releases to various journals. An honorarium of \$50 will be paid to each author for each module. Every module will be reviewed and tested. The review process is designed to enhance the professional recognition of the author's work and to make it comparable to that of research articles. About 50% of the modules have already been commissioned. Anyone interested in writing modules should contact the appropriate editor listed below.

The project is directed by Ernest Henley (University of Houston) and his assistant director is William Heenan (University of Puerto Rico). The editors in charge of the 7 curriculum areas are: Kinetics—Billy Crynes (Oklahoma State University) and Scott Fogler (University of Michigan), Thermodynamics—Bernie Goodwin (Northeastern University), Control—Tom Edgar (University of Texas), Transport—Ron Gordon (University of Florida), Stagewise Processes—Ernest Henley (University of Houston), Design—Bob Jelinek (State

University of New York, Syracuse) and Bob Weaver (Tulane University), Stoichiometry—Dave Himmelblau (University of Texas).

The entire project is under the oversight of a distinguished steering committee: Lawrence Evans (M.I.T.), Gary Powers (Carnegie-Mellon University), Ernest Henley (University of Houston), David Himmelblau (University of Texas), Duncan Mellichamp (University of California), and Robert Weaver (Tulane University).

MATERIALS ON REAL TIME SYSTEMS

The Real Time Task Force is writing a set of materials covering the basic areas of the real-time field. To be available in about a year, the table of contents is as follows:

- I. An Introduction to Real Time Systems
 1. Real Time System Structures
 2. Introduction to Real Time Computer Programming
- II. Processes, Measurements, and Signal Processing
 3. Characterization of Processes
 4. Physical Measurements and Signal Processing
- III. Digital Systems
 5. Representation of Information in the Digital Computer
 6. Digital Computer Hardware
 7. Communications and Peripheral Equipment
 8. Digital Computer/Process Interfacing
- IV. Real Time Systems Software
 9. Assembly Language Programming
 10. Utility of Systems Software
 11. Multi-task Programming and Operating Systems
 12. Real Time Basic
 13. Real Time Fortran
 14. Control Oriented ("Fill-in-the-Blank") Languages
- V. Real Time Computing Laboratory Management
 15. New System Justification, Planning, and Installation
 16. System Operations Management and Program Documentation

LIST OF CACHE COMMITTEE PUBLICATIONS

Origins and Organization of the CACHE Committee—A Report, 22 pages, January 1, 1972, CACHE Committee
Computer-Aided Chemical Process Synthesis—A CACHE Sponsored Symposium, 5 pages, February 20-23, 1972, Seader, Elzy
Standards for CACHE FORTRAN Computer Programs, 35 pages, May 1972, Standards Subcommittee—P. T. Shannon, Chairman; Grens, Hughes, Klaus
Real Time Digital Computer Systems in Undergraduate Education—St. Louis AIChE Meeting, CACHE Symposium,

May 24, 1972, 24 pages, May 1972, Elzy, Evans, Weaver, Westerberg

CACHE Physical Properties Data Book, 35 pages, August 1972, Physical Properties Subcommittee, R. Motard, Chairman; Samuels, Hall, O'Connell, Seider, Wilson

CACHE Guidelines for Large Scale Computer Programs, 16 pages, February 1973, Large Scale Systems Task Force, J. D. Seader, Chairman; Evans, Hughes, Seider and Shannon

Real Time Task Force Report, 52 pages, October 1973, Real Time Task Force, Elzy, Chairman; Evans, Gallier, Mellichamp, Moore, Schmitz, Seborg, Smith, Weaver, Westerberg, Williams, Wright

CACHE Guidelines for Computer Networks, 25 pages, June 1974, Program Distribution Task Force, Seider, Chairman; Hughes, Mah, Phillips, Seader, Shannon, and Westerberg
Computer Programs for Chemical Engineering Education:

Editors

<i>Stoichiometry</i>	241 pages	Sept. 1972	E. J. Henley
<i>Kinetics</i>	388 pages	Sept. 1972	M. Reilly
<i>Control</i>	240 pages	Sept. 1972	A. Westerberg
<i>Transport</i>	418 pages	Sept. 1972	R. Gordon
<i>Thermodynamics</i>	400 pages	Sept. 1972	R. Jelinek
<i>Design</i>	400 pages	Sept. 1972	R. Jelinek
<i>Stagewise Computations</i>	500 pages	Sept. 1972	J. Christensen
<i>CACHE Use of FLOWTRAN on UCS</i>			
Richard R. Hughes			