

PAP 231

UNITED STATES GOVERNMENT

Memorandum

HYDRAULICS BRANCH
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Denver, Colorado
DATE: July 27, 1967
BUREAU OF RECLAMATION
HYDRAULIC LABORATORY
**OFFICE
FILE COPY**
WHEN BORROWED RETURN PROMPTLY

TO : Memorandum
Chief, Personnel Branch

THROUGH: Chief, Hydraulics Branch
Chief Research Scientist
Business Manager

FROM : E. J. Carlson, Hydraulic Engineer

SUBJECT : Training Evaluation Report--Two-week summer session at Massachusetts Institute of Technology, Cambridge, Massachusetts, "Ground Water Hydrology and Flow Through Porous Media"

I attended the special summer session "Ground Water Hydrology and Flow Through Porous Media" offered by Massachusetts Institute of Technology during June 19 to 30, 1967. I am engaged in hydraulic research with special emphasis on laboratory and field studies of flow of water in aquifers, drainage, and seepage. This special summer course taught the most recent advances in the theoretical, experimental, and practical phases of ground water hydrology and dynamics of fluids in porous media. The objective of my attending this course was to acquire additional knowledge that could be applied directly to the Bureau's research to assure that the Bureau derives maximum benefit from this research. The excellent quality of instruction given made it possible to achieve this goal. In addition to the professors on the staff of MIT, outstanding men from other universities, Government agencies, and private industry working in various specialties under the general subject of ground water hydrology were invited to give lectures in their special fields. The instruction was excellent by the resident and visiting professors and excellent to very good by the guest lecturers invited to participate in the sessions.

The core of the course consisted mainly of lectures and study from a book "Dynamics of Flow Through Porous Media," by Jacob Bear who, during the 1966-67 school year, has been a visiting professor from Technion University in Israel to MIT. He has been teaching this course to enrolled graduate students at MIT during the past year. A preliminary edition of the book was given to each enrollee.

Donald R. F. Harleman, Professor of Civil Engineering in the Hydrodynamics Laboratory at MIT, taught specific subjects on flow through porous media, including the continuum approach to porous media, continuity equations and boundary conditions, and flow nets in ground water problems. A good set of notes was provided for those subjects taught by Professor Harleman that were not included in Professor Bear's book.

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Professor U. Shamir, also a visiting instructor, from Israel, taught the subject, "Use of Computers in Groundwater Hydrology." He furnished the enrollees with a complete set of notes on this subject. A practical ground water problem was worked on the computer time-sharing system in which a console connected by telephone line to an IBM 7094 in another building was used. A problem was also worked using an IBM 1130 in the room with the batch processing method. The four specialists in ground water and flow through porous media outside of MIT gave lectures on the following subjects:

"Flow of Water in Unsaturated Soils," by Professor A. Klute, Professor of Soil Physics, University of Illinois, Visiting Professor, 1966-67 to Department of Agricultural Engineering, Colorado State University

"An Outline of Criteria for Pumping - Test Design, Observation, and Data Analysis," by Robert W. Stallman, U.S. Geological Survey, Denver, Colorado

"Artificial Recharge," by Leonard Schiff, Consulting Soil-Water Hydrologist, Fresno, California, formerly with Agricultural Research Service

"Regional Studies and Ground Water Balances," by William C. Walton, Director, Water Resources Research Center, University of Minnesota

The information gained and notes obtained during the course are largely unpublished at the present time.

Problem sessions were conducted each day under the supervision of Professors Gelhar and Cross of the MIT staff, during which time the enrollees solved practical problems prepared by Professor Bear. Professors Gelhar and Cross also assisted Professor Harleman and Bear in supervising laboratory experiments conducted by the enrollees for 3 hours during each of 4 evenings. Laboratory sessions were conducted for the purpose of teaching the use of equipment in the laboratory for solving the following problems:

Dispersion due to flow through porous media

Determination of phreatic surface in an earth dam and the formation of a fresh water-salt water interface in a coastal aquifer using the Hele-Shaw Analog

Operation of the electrolytic tank and the R-C Network electric analogs

Use of an IBM 1130 computer with peripheral equipment and use of a time-sharing system having remote consoles with the IBM 7094 facility

The information I gained is directly related to my duties in the Hydraulics Branch in on-going research and planned future studies in flow through porous media. The lectures, studies, and practical work sessions furnished knowledge that assured awareness of and capability in advanced techniques in research in this field of flow through porous media and ground water studies.

This special summer session was unique in that it had not been taught before and probably will not be taught as a special summer course in the future. The subject material was especially fitted for the phase of hydraulics research in which I am engaged and it was taught by the best available teachers. The facilities for the laboratory experiments were excellent. Library facilities with the most complete set of books and pamphlets on hydraulics I have ever seen in two reserve reading libraries and in the main library made studying a pleasure.

The 2-week period chosen for the course was long enough for me to become acquainted with a large amount of material. I plan to continue to study the notes that were given me during the course and that I personally kept and use the notes and reference material in our future studies. I recommend that the technical library purchase a copy of the book, "Dynamics of Fluids in Porous Media," by Jacob Bear in about 6 months, at which time it will be published by John Wiley and Sons, Incorporated. I believe the value received from the course was every bit worth the time and money spent.

In the future, when specialized courses are offered by MIT that would enhance the work of research and design specialists of the Bureau of Reclamation, I recommend that advantage be taken of the very excellent training which I feel has not been surpassed.

E. J. Carlson

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This is to certify that

Erno Carlson
has completed a *Special Summer Program in*
Advanced Groundwater Hydrology
1967



Jacob Bear
Professors in charge
Donald R. Harleman

James M. Austin
Director of Summer Session

Memorandum

Denver, Colorado
DATE: June 29, 1967

TO : E. J. Carlson

THROUGH:

FROM : Personnel Branch, Code 500

SUBJECT: Training under Government Employees Training Act

SECTION A

We note that you (are, were) scheduled to complete training authorized under the subject act as follows: Course Ground Water Hydrology & Flow Through Porous Media at MIT Massachusetts; dates 6-19 to 6-30-67. To complete the record, it is necessary that we have the following information regarding your participation. (Please complete Section B, have the Library complete Section C, if applicable, and return the form to me.)

E. J. Carlson

SECTION B

I (did/~~did not~~) satisfactorily complete the above course. Grade received (if any) _____. I desire reimbursement as follows: Tuition (attach receipt) \$ 7; Textbook(s) \$ _____. ~~I did not purchase any textbooks for this course.~~ Tuition was paid by USBR Check. No textbooks were purchased.

No grades were given.

Copy of certificate of completion of the course is attached.

Signature of employee *E. J. Carlson*

Noted: _____

Signature: Branch, Office or Division Chief

List below in Section C, the textbook(s) for which you are requesting reimbursement. Take (it, them) to the Library for recording, and obtain signature of Librarian.

*Submit copy of official notification of grade or attach copy of certificate.

SECTION C

The above textbook(s) (has, have) been recorded as Bureau property and (has, have) been charged out to this employee on an indefinite basis.

(Name and Title)
Library Branch, Office of Engineering Reference

SECTION D

NOTE: This section is to be filled out by the Personnel Branch

TO : Accounting Branch

FROM : Personnel Branch

SUBJECT: Completion of Training--

Course _____

The above named employee has furnished proper evidence that he has satisfactorily completed the course listed above. This employee may now be reimbursed for the following costs:

TUITION TEXTBOOK(s) OTHER _____

TOTAL _____