Edited In Retrospect

service by association

• In the middle of January Georgia Tech was host for the first time at a meeting of the Inter-Service Committee on Technical Facilities, Southeastern, USA. This is a cooperative association, primarily of military research organizations, intended to avoid costly duplication of research facilities, such as electronic computers, hydraulics and electronics laboratories, etc. The committee encourages the sharing of such facilities and the exchange of technical information of mutual interest.

The January conference was devoted to developments in the applications of computers, including an accounting of the various computers available in the committee membership. The visitors were given tours of the Rich Electronic Computer Center, the Analog Computer Laboratory and other research laboratories at Georgia Tech. The Engineering Experiment Station is honored to serve as the only non-federal member of the eight-member committee, which includes agencies of the Army, Navy, Air Force and the Tennessee Valley Authority.

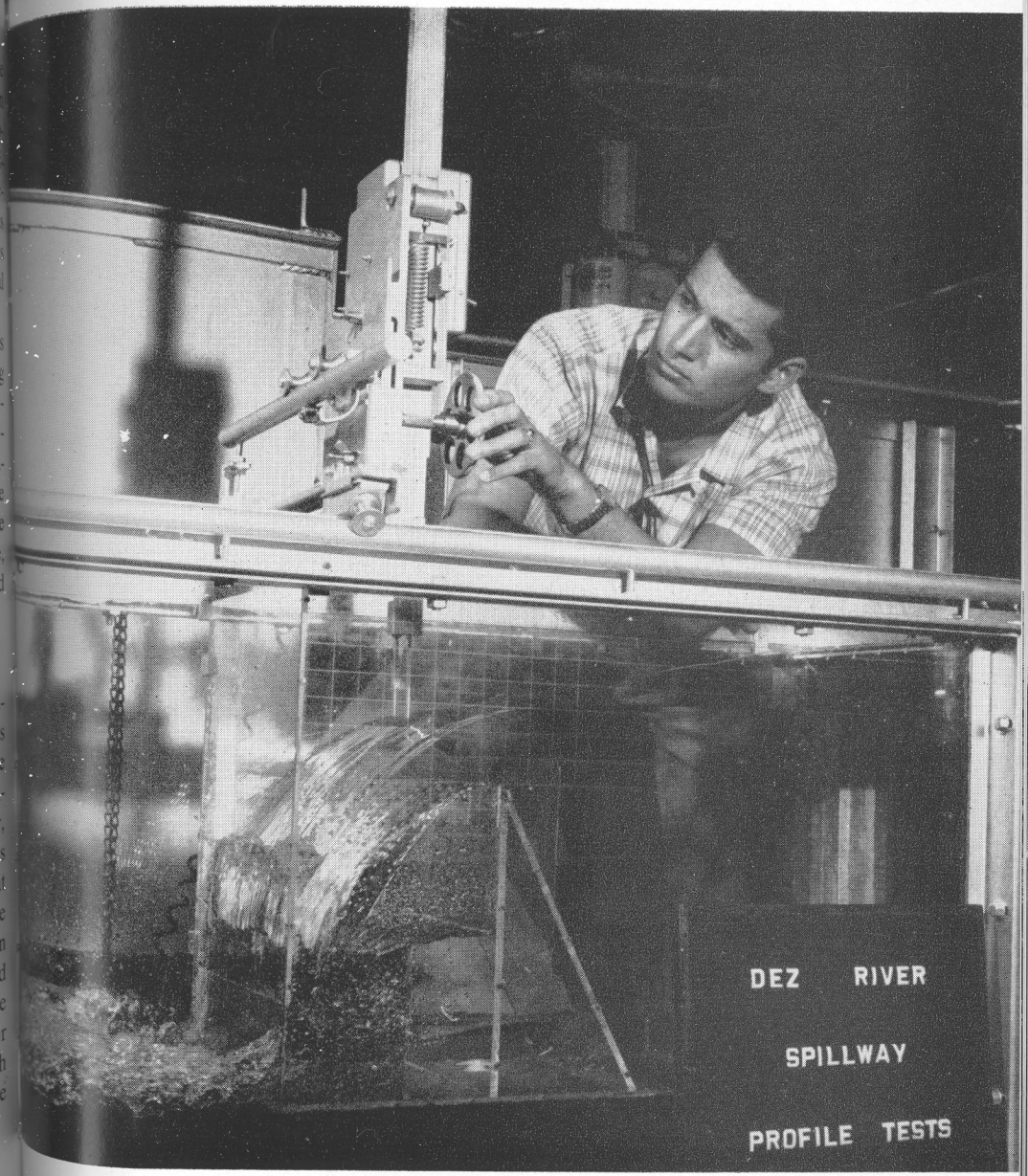
think or swim

• It isn't often that we hear of someone spending his vacation playing games with electronic computers, much less carrying on such an engagement by proxy. But it has come to our attention that one of Georgia Tech's resident experts on games of chance and strategy, Dean Ralph Hefner, not only played tic-tac-toe with Tech's IBM 650 from his mountain hideaway, but he won. It seems that someone at the University of Florida wrote a 650 program for the game and challenged anyone to beat it. Last summer Dean Hefner accepted the challenge, made one move, noted the machine's rapid return move, then retired to the shade of his cabin porch at Lake Rlue Ridge, Georgia, to ponder his strategy. After a few exchanges of post cards with Computer Center operators who refereed the contest, the dean was pronounced winner and still champion.

APRIL, 1959

The Research Engineer

Published by the Georgia Tech Engineering Experiment Station



HYDRAULICS RESEARCH FOR IRAN

Psychology Program - page 12

The Research Engineer

VOLUME 14, NO. 2 APRIL, 1959

Published five times a year by the Engineering Experiment Station
Georgia Institute of Technology, Atlanta, Georgia

the station

the staff

contents

the cover

Graduate civil engineering student Charles Siffri watches the indicator lights on an instrument that accurately measures the height of the water at various points on the crest of a model spillway inlet. This experiment helped determine the shape, or profile, of the inlet structure, which will be cut into the solid rock of the canyon walls above the Dez River in Iran. More details of the Dez River spillway project are presented in an article beginning on page 4 of this issue. Student Siffri is from the Middle East himself—he came to Tech from his native Lebanon on a Rotary International Fellowship.

Cover and Hydraulics Laboratory photographs by Bill Diehl

THE RESEARCH ENGINEER is published five times a year in February, April, June, October and December by the Engineering Experiment Station, Georgia Institute of Technology. Second-class postage paid at Atlanta, Georgia.

LIKE MOST STATE-SUPPORTED INSTITUTIONS OF HIGHER LEARNING, Georgia Tech is often approached by an individual or a group concerning the establishment of a new bachelor's degree program. Many of these proposals have merit with regard to the objectives and responsibilities of the institution. However, under closer scrutiny most of these suggested programs turn out to be but specializations of Tech's current basic undergraduate curricula.

It has long been our conviction that higher education must take just the opposite course from specialization and place more and more emphasis on fundamentals, especially at the undergraduate level. Thus it is a special occasion when a new degree program receives the enthusiastic support of the administration and the official approval of the Board of Regents. Two bachelor's programs (engineering mechanics and applied psychology) have received such acclaim during the past two months.

Engineering Mechanics is almost as fundamental as its parent science. Future Tech graduates of the School of Engineering Mechanics will be well prepared for work in a number of engineering fields: their knowledge being as valuable to highway engineering as to missile and space technology. The program's emphasis on fundamental theory also provides an excellent background for graduate work in other branches of engineering as well as mechanics.

The applied psychology major likewise will be in a position to serve in a wide variety of industrial capacities, ranging from personnel and training activities to research on the human factors in equipment and instrument design. Again the curriculum stresses fundamentals, requiring broad training in mathematics, chemistry, physics, and a number of basic engineering, management and humanities subjects. This background will equip the student ideally for advanced study and research in psychology.

Both the engineering mechanics and applied psychology programs have been in the thinking and planning stages for over ten years. In the future, Georgia Tech graduates should prove the value of this careful planning.

E. D. Harrison

President

SPILLWAYS FOR IRAN

Tech research on a complex hydraulics problem aids a vital water development program in the Middle East

by M. R. Carstens
Professor, Civil Engineering

A HYDRAULIC MODEL STUDY of the spillways of an Iranian dam has just been completed in the Georgia Tech Hydraulics Laboratory for the Development and Resources Corporation of New York.

The Development and Resources Corporation is the parent organization of the "Khuzestan Development Service,' which is inventorying the resources, planning development, and supervising the construction of development projects in the Khuzestan region for the Iranian government. (Iran, formerly called Persia, is bounded on the north by the U.S.S.R. and the Caspian Sea; on the east by Afghanistan and Pakistan; on the south by the Persian Gulf and the Gulf of Oman; and on the west by Iraq and Turkey. The Khuzestan region is in southwestern Iran at the same latitude as South Georgia.)

The resource-development plans are primarily based upon integrated schemes for utilizing natural gas and for greater utilization of the rivers. The natural gas of the Iranian oil fields, presently wasted, will be put to work as a source of heat, electrical energy, and chemical products. The region's five rivers will be controlled through a series of large storage reservoirs designed to provide maximum benefits of water storage for irrigation, flood control, electric-power generation, and navigation.

The first project undertaken in river development will be the building of a 630-foot high dam in the gorge of the Dez River. The canyon bottom is about 160 m in elevation. The walls rise steeply at about 2 (vertical) to 1 (horizontal) to a plateau which is in excess of 600 m in elevation. An arch dam is to be placed near the upstream end of the canyon to form a reservoir storing 3.4 (10^9) m^3 of water. By comparison it would take about 82,000,000 railroad tank cars to store the same volume of water. Figure 1 is an aerial photograph looking upstream and down into the canyon at the dam site.

The storage reservoir is to be used for the multiple purposes of power generation, irrigation, flood control, and downstream navigation. The water in the storage reservoir possesses tremendous potential energy that can be converted to electrical energy by allowing the water to pass around the dam through tunnels (penstocks) in the canyon walls and thence through hydraulic turbines which discharge into the riverbed downstream from the dam. Because of the limited space within the canyon, the hydraulic turbines and electric generators are to be placed in an underground powerhouse, which is to be in the canyon wall shown on the left side of Figure 1. The high flows of the river occur during the months of February, March, April, and May from the melting snows in the mountains. This water is to be stored and released later in the year in order to provide water for irrigation in the fertile plains downstream from the canyon. In the same manner, the storage of water during periods of high flow for release during periods of low flow are to be employed to increase the stages in the navigation channels in the downstream portion of the river during the periods of low natural flow. Downstream navigation is also aided by reducing the flood flows which, in turn, are presently responsible for much of the riverbed scour and sand-bar build-up in the existing navigation channels.

With this multiple-purpose method of operating the storage reservoir, the water that is released for irrigation and navigation can also be passed through the turbines for the generation of power. However, since the demands may not exactly coincide for each of these uses, greater flexibility in operation is to be achieved by construction of an additional low dam, which will create a reregulating reservoir just downstream from the lower end of the canyon.

Because of the tremendous volume of water stored behind the dam, complete failure of the high dam must be precluded without a possibility of a doubt. The stampede of 82,000,000 railroad tank cars of water would trample downstream cities and would be a major disaster. One possible way for such a failure to occur is for the storage reservoir to be filled at the time of a great flood. If there were no way to pass this flood safely beyond the dam, then the water would overtop the dam. Conceivably the water flowing over the dam could result in damage to the foundations to the extent that failure could occur.

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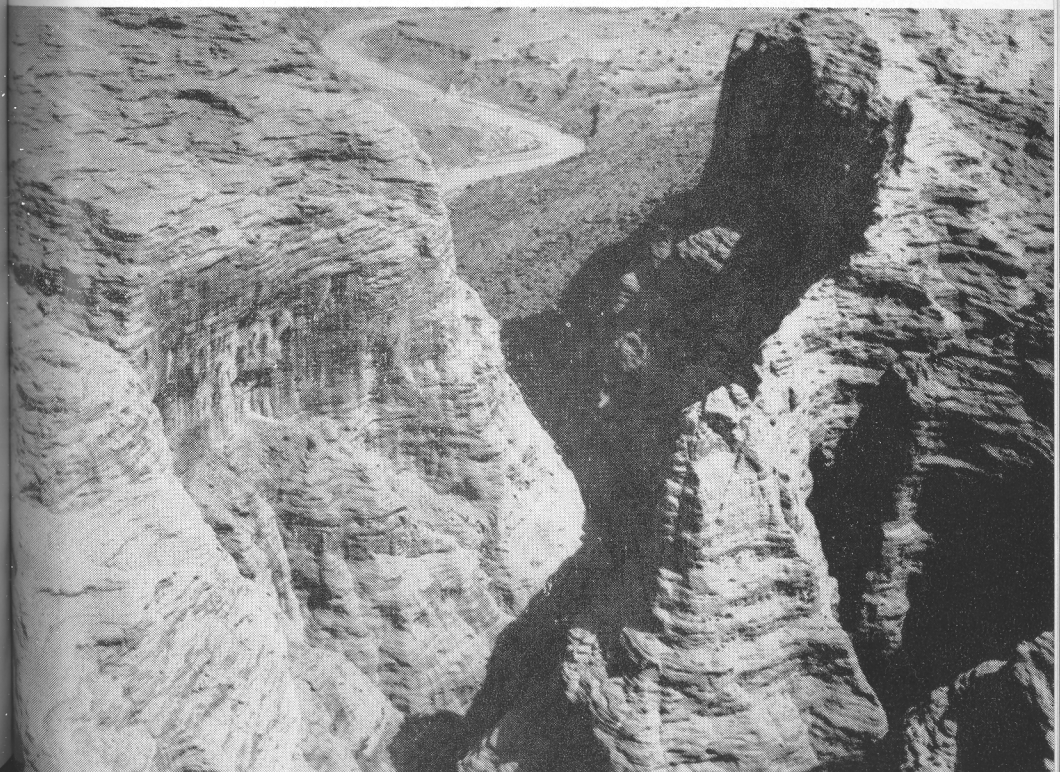
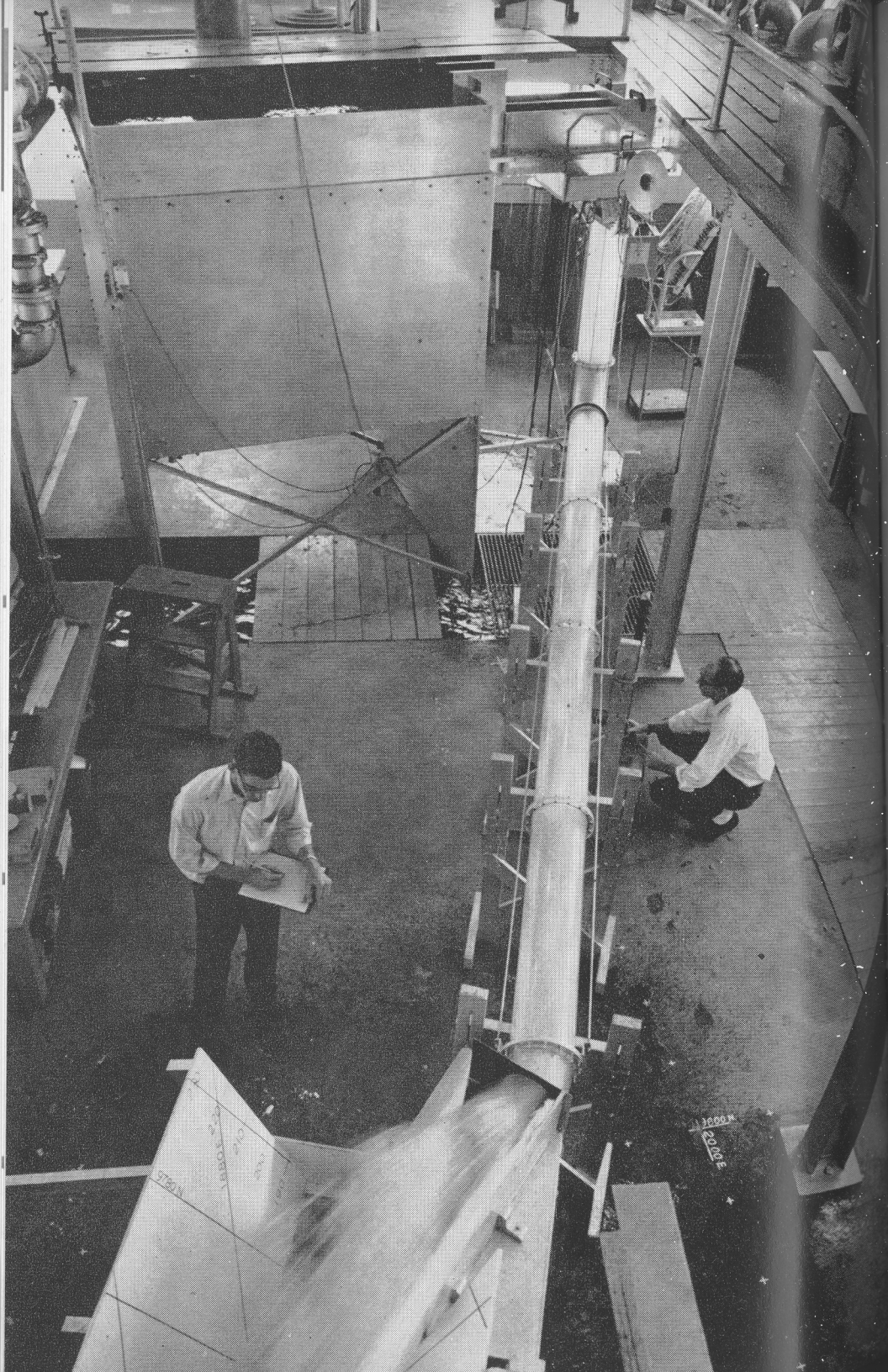


Figure 1. Aerial photo of Dez River dam site, looking upstream. Dam will rise 630 ft. in the 1450-ft. gorge at the river bend (center), with spillways on the right side.



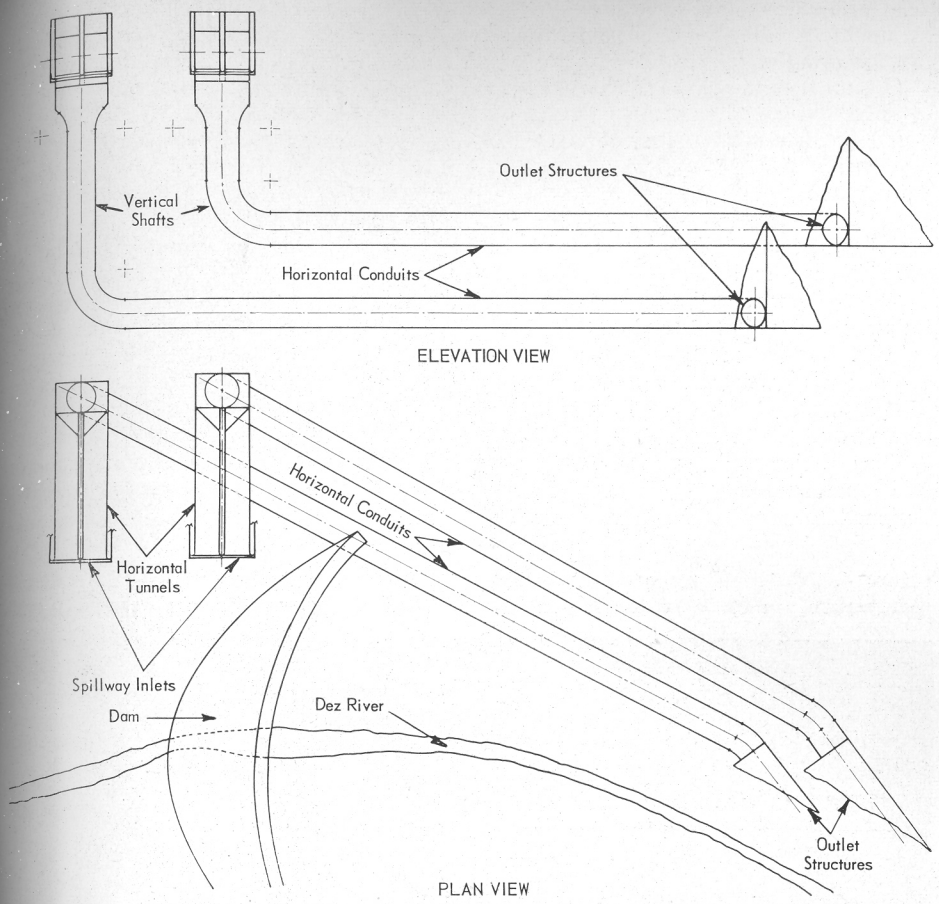


FIGURE 2. GENERAL DESIGN AND LOCATION OF THE TWO SPILLWAYS.

Obviously, structures must be included in the project to safely bypass high flows past the dam. The structures designed to pass these high flows are called spillways. Because of the potential dangers of overtopping the dam, extreme conditions are assumed in the design of the spillways. At the time the storage reservoir is completely filled, the maximum possible flood is assumed to occur in the river. Thus the spillways are designed to pass safely the maximum possible flood which is, of course, much larger than any recorded flood flow of the river. As a result of hydrologic studies, the maximum possible flood flow of the Dez River was deemed to be 6,000 cubic meters per second or 212,000 cubic feet per second. By comparison, the maximum recorded flood discharge of the Chattahoochee River at Norcross, Georgia, is 55,000 cubic feet per second during the 50-year period of record.

Hydraulic-model studies for the spillways of the high dam of the Dez River Project were begun in June 1958 and were completed in January 1959 in the Georgia Tech Hydraulics Laboratory.

←

Figure 3. View in Hydraulics Laboratory as Dr. Carstens (right) and student Bill Emmett run maximum-discharge test of lower spillway. Reservoir at top represents dam.

The hydraulic-model studies were used to aid in the design of the spillways in the following ways:

(1) to determine the shape and to calibrate the gated spillway inlets;

(2) to determine the air-demand requirements for the design of the air-vent system;

(3) to determine the requisite size and form of the various components of the spillways; and

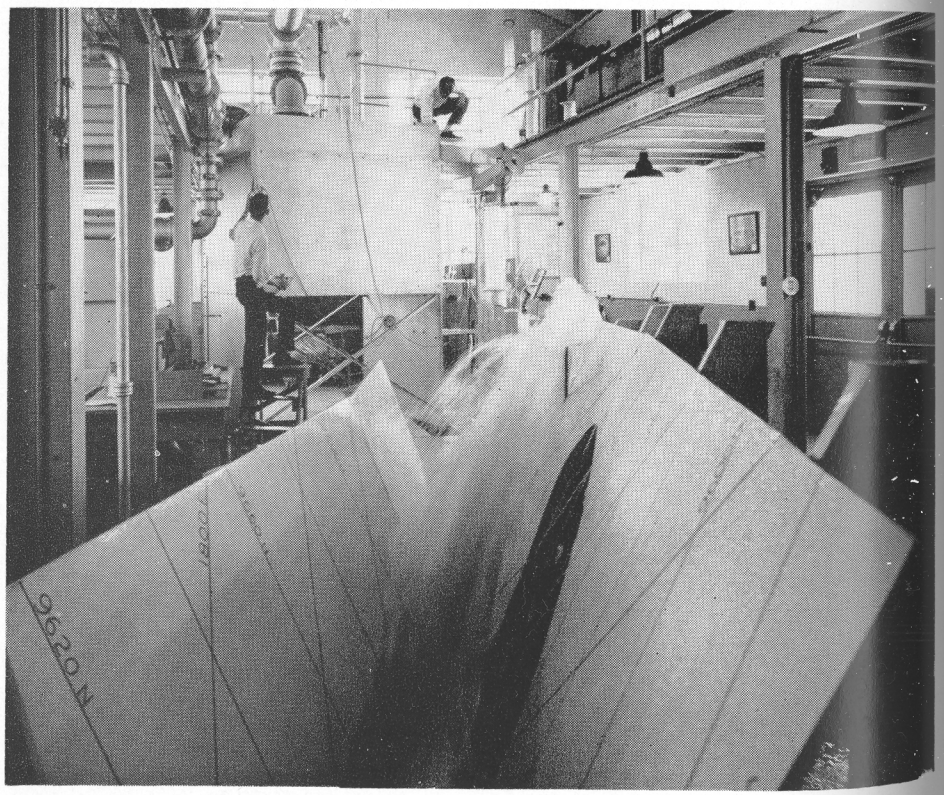
(4) to determine the form of the outlet structures required to direct the high velocity outflow safely into the canyon downstream from the dam.

The principal features of the final design of the spillways are shown in Figure 2. The design discharge is carried by two separate spillways. Each spillway is designed to carry one-half the spillway design discharge, or 3,000 cubic meters per second. The water enters the spillways from the reservoir and passes over a crest. The crest at the spillway inlet is a control section, that is, the flow upstream from the crest is subcritical (low-velocity) flow and the flow downstream from the crest is supercritical (high-velocity).

In order to pass around the dam, the water is guided by horizontal tunnels into the canyon for about 70 meters. At the end of the horizontal tunnels the water is turned into a vertical shaft. At the bottom of the vertical shaft the water turns into the horizontal direction and flows as supercritical open-channel flow by the dam in the horizontal conduits which are buried in the canyon wall. The

continued on page

Figure 4. Model of gorge shows jet impact pattern (in black) made in previous tests of upper spillway outlet. In real spillways the water speed may reach 110 mph.



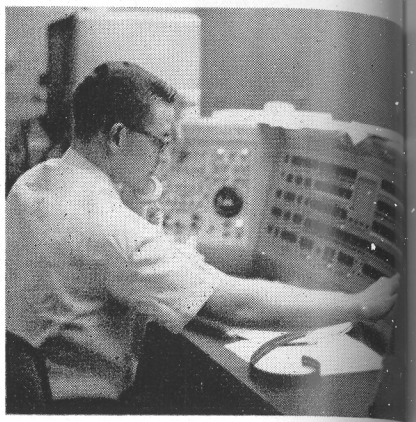
THE ANXIOUS YOUNG MAN ABOVE is Norman G. Heller, one of the Georgia Tech students who designed a unique registration system for the District Conference of the American Institute of Electrical Engineers held in Atlanta, April 8-10. The system employed one of the E.E.'s most phenomenal products, the electronic computer, in an arrangement that enabled detailed data on the conference registration to be made available on demand.

The computer was connected by telephone lines to input-output electric typewriters at the Dinkler-Plaza Hotel in downtown Atlanta. When the above photograph was made, Heller was at the information desk of the hotel, talking to technicians at Georgia Tech's Rich Electronic Computer Center, where the UNIVAC SCIENTIFIC (ERA 1101) computer was beginning to answer the first questions posed by conventioners. The early replies from the machine were not always the complete English sentences they should have been, a situation reflected in Heller's brow. But the bugs were soon eliminated from the program, which involved a moderately complex encoding and decoding arrangement for rapid communication between conventioner and UNIVAC. The telephone lines were furnished by Southern Bell.

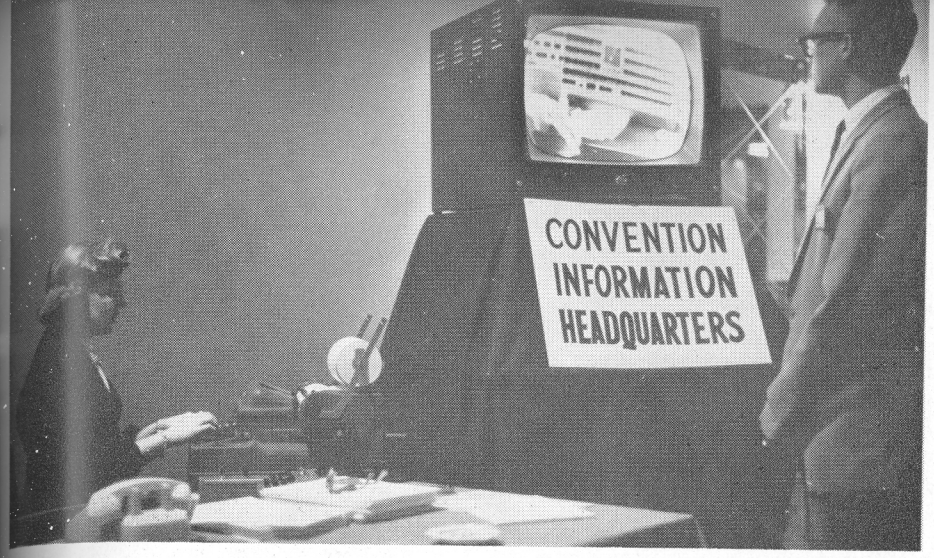
On the following pages are more pictures and information on the successful student project, a story we might call . . .

BINARY SPOKEN HERE

Photographs by Van To



Heller (above) reads output typewriter at the hotel and Pat Flautt (right) controls Univac at the Computer Center as the two check system in first hours of operation.



Conventioners saw Univac process data typed on input machine by Computer Center technician Kathryn Myers. Questions involved banquet lists, tour groups, etc.

Student engineers taught Univac to memorize all registration da rapidly process conventioners' inquiries, and return answers to hotel.

Computer Center engineer Jim Collins aids student Flautt as closed-circuit TV camera is brought up. Heller, Flautt and Rob Eason designed system as Sr. E. E. proje

Engineers Collins (left) and Ed Manseau (below) noted smooth operation of the system throughout the three-day conference. Dr. W. J. McKune directed the project.

THE NEW PSYCHOLOGY PROGRAM

Led by a diverse staff of research-minded Ph. D.'s, the curriculum takes advantage of its presence in a technological institution, stresses study in basic sciences

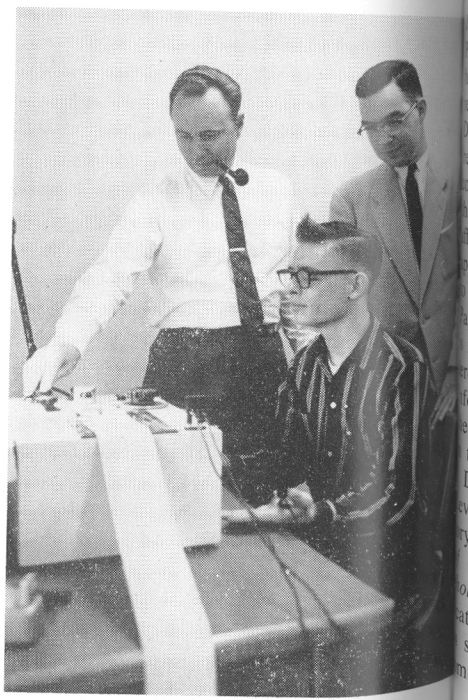
THE YEARS SINCE WORLD WAR II have seen many changes in American industry, not the least of which has been greatly increased utilization of psychological techniques for the solution of personnel, production, and design problems. Psychological testing for the selection of new personnel is no longer a novelty. The psychologist's knowledge of the learning process is now frequently applied in industrial training and employee counseling. The experiences of the armed services and defense industries clearly demonstrated the usefulness of psychology, the science of behavior, not only in the personnel office and the shop, but in the engineering departments. Knowledge of human perceptual, motor, and intellectual processes is now being used in the design of products ranging from telephones to airplanes. Research on the "human factors" involved in product design is rapidly becoming accepted industrial practice.

One consequence of the increased use of psychological techniques has been increased demand for persons with training in psychology. To meet this demand, Georgia Tech was recently authorized to offer a curriculum leading to the degree, Bachelor of Science in Applied Psychology. Graduates of the newly established School of Psychology at Georgia Tech will be equipped to fill positions in personnel and training departments, and to work with psychologists and engineers in human factors research.

The new curriculum leading to the degree, Bachelor of Science in Applied Psychology, was approved early this year by the Tech faculty and the Board of Regents of the University System of Georgia. It is unique in the Southeast. Similar programs of study are offered by only a few technological institutions in the country. The School of Psychology will continue its service function by offering a broad selection of courses which will permit students majoring in architecture, engineering, industrial management and the natural sciences to gain training in the science of behavior.

Like their colleagues in other science departments, the staff of the School of Psychology is engaged in a variety of research projects. The diversity of research is as great as that to be found in many larger psychology departments, and reflects the diversity in training of the staff members. Dr. Joseph E. Moore has worked primarily in educational and industrial psychology. Dr. Edward H. Loveland's work is in the areas of industrial psychology and psychometrics. Dr. M. Carr Payne's research reflects his specialized training in the psychology of sensation and perception, while Dr. Richard P. Moll carries out studies dealing with the learning process and clinical psychology. The department hopes to add a social psychologist to the staff during the coming academic year.

Dr. Loveland (left) and Dr. Payne set up experiment to study response of student volunteer under given conditions. Instrument measures perspiration in palms.



In December, 1958, the *American Journal of Psychology* published Dr. Payne's article, "Apparent weight as a function of Color." This article was the result of several experiments in which Dr. Payne investigated the relationship between color and apparent weight of colored blocks of equal size. He found that changes in the size of blocks did not affect the relationship between color and apparent weight (red and blue appeared to be "heavier" than other colors). Dr. Payne also found that apparent weight is not related to the viewers' color preferences. In addition to providing basic information about perceptual processes, these studies suggest possible applications in the advertising and marketing fields.

Dr. Moll's article, "Effect of Drive Level on Acquisition of the Consummatory Response," is in press for the *Journal of Comparative and Physiological Psychology*. The work reported in this publication was conducted with albino rats as subjects. It is Dr. Moll's hope that sometime in the future an animal colony will be available for other studies of behavior. In the area of clinical psychology, he is planning a long-range study of figure-drawings as a means for the evaluation of personality.

Psychometrics, the discipline which deals with the measurement of psychological traits, is a branch of psychology which overlaps many other branches of the field. Dr. Loveland is presently conducting research on the measurement of aptitudes, interests, and other characteristics of applicants for admission to Georgia Tech. These research efforts are directed toward the formulation of a more efficient method of selecting students who will succeed scholastically. The basic psychological and statistical techniques involved in these studies are directly analagous to those which would be used in industrial personnel selection research, and hence can be used as illustrations for the teaching of industrial personnel selection methods. Thus, the research serves two purposes; it provides information useful to admissions officers, and at the same time augments the supply of material available for the training of psychology students. Dr. Loveland has, for the past six years, been collecting data on the relative contributions of various sources of random error of measurement to the unreliability of psychological measuring devices (such as aptitude tests, opinion surveys, personality tests, etc.).

The foregoing account gives only a partial summary of psychology at Georgia Tech. It does, however, reflect the vitality of the young science and the broad scope of educational and research capability in Tech's new School of Psychology.

SPILLWAYS FOR IRAN

continued from page 8

water reaches the ground surface at the outlet structures. The water jets from the outlet structures fall into the bottom of the canyon.

The size of the structures is impressive. The diameters of the vertical shafts and horizontal conduits are 46 ft. and 41 ft. for the upper and lower spillways, respectively. By comparison the Queens-Midtown vehicular tunnels under the East River in New York City consists of two tunnels, each 31 ft. in diameter. The spillway crests, which are at the same level on each spillway, are 246 and 362 ft. higher in elevation than the outlet structures of the upper and lower spillways, respectively.

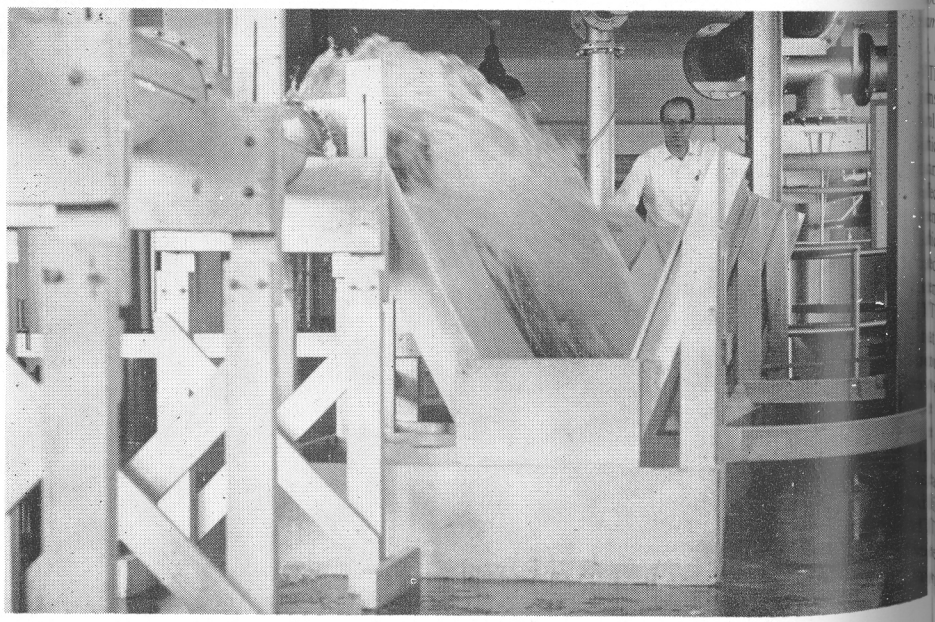
The scale ratio of the prototype-to-model is 62-to-1. In other words, one foot on the model represents sixty-two feet on the actual spillway. The flow passages in the model were geometrically similar to the prototype (actual structure). The model was operated under dynamically similar conditions to t prototype. In other words, the model operated such that the forces acting the fluid particles are similar in bo model and prototype. From the con tions of dynamic (force) similarity, t ratios of the magnitudes of the flo variables can be determined. In the fo lowing table, the ratios of prototpye-t model flow variables are listed for th 62-to-1 model.

L_r	(length)	62
V_r	(velocity)	7.81
Q_r	(discharge)	30,267
$\triangle P_r$	(pressure differences)	62

Thus, measurements can be made o the model and scaled to the prototype For example, the design discharge o 3,000 cubic meters per second corre sponds to a discharge of slightly less the 0.1 cubic meter per second in the mode

The model study was performed unde the direction of Regents Professor Kind vater and the author. Mssrs. Emmett Falvey, Mehrhoff, and Siffri are civi engineering students who worked on the study.

DR. CARSTENS USES "HYDRAULIC MARKSMANSHIP" TO DESIGN OUTLETS.



publications

esham, W. A., Jr., C. E. Collum and R. J. le, "Bibliography on the Technology of anut Production, 1896-1956." 1957. Spe- l Report No. 32. Gratis.

The literature of peanut technology is list- in four subject divisions—planting and tivation, harvesting and curing, storing d shelling, and marketing. An additional tion of miscellaneous references is also en. These references include general arti- s and those related to the four main sub- ts but not readily classified in any one them. The bibliography is intended prin- ally for the use of peanut research rkers.

The references were compiled from ex- ng bibliographies in English and foreign nguages, from reviews of indexing jour- s, and from correspondence with peanut earchers throughout the world. Abstracts the majority of the most outstanding ref- nces are given. All foreign titles have en translated to English, and each section the compilation is indexed in detail. A al of 2573 references is listed.

▲

oore, Jerrold A., "Planning for Flood mage Prevention." Special Report No. One dollar.

The principal contributions this study s to make are: (1) the identification and luation of flood and land-use factors ch should be considered, so that pro- ms of flood-damage prevention can be ctively utilized; and (2) the establish- nt of a procedural framework within ch flood and land-use data can be anal- d and the inter-relationships between m can be studied.

he methods of analysis presented show planning for flood-damage prevention uld be pointed towards assisting local erning bodies reach three decisions: (1) delineation of flood-hazard areas; (2) selection of land uses to be permitted ese areas; and (3) the selection of the ns of flood-damage prevention to be zed.

he delineation of flood-hazard areas is d upon an analysis of flood records and m studies. This analysis can be used as the basis for the selection of a flood magnitude which can reasonably be expected to occur in a particular locality. The magnitude of this flood can then be used to delineate a floodway which should be kept as free as possible from encroachments and the temporary water-storage areas within which certain uses of land can be permitted that are not susceptible to extensive flood damage.

A comprehensive land-use plan summarizes the future requirements for land in a community and acts as a guide for development.

Finally, the selection of the means of flood-damage prevention to be undertaken depends upon the nature and magnitude of a local flood problem. Each method has a specific role to play in reducing flood damage. Certain of these methods should be combined to form a program for flood-damage prevention which is designed to fit specific situations. A summary of measures to reduce flood damage is outlined for developmental, preservation and redevelopmental programs.

▲

Fetner, R. H. and R. S. Ingols, "A Comparison of the Bactericidal Activity of Ozone and Chlorine against Escherichia coli at 1°." Reprinted from The Journal of General Microbiology, October, 1956. Reprint 121. Gratis.

The bactericidal effects of ozone solutions were tested against *Escherichia coli* suspensions at 1°, and the lethal concentration was found to be that quantity of ozone necessary to produce a detectable residue in the suspension; under the conditions of our experiments this was 0.4–0.5 mg./1. A comparison of the bactericidal activity of chlorine under similar conditions emphasized the different modes of action of the two agents.

These and other technical publications may be obtained, and the complete publications list requested, by writing Publications Services, Engineering Experiment Station, Georgia Institute of Technology, Atlanta 13, Georgia.

Edited In Retrospec

big month

• Just as the presses began rolling on the last (Februar issue of *The Research Engineer,* which carried an arti on Tech's $17,000,000 building program, word reach us from President Harrison that the National Scien Foundation had made a grant of $750,000 to Georg Tech's research reactor project. The grant was an impo tant step toward the realization of the reactor proje initiated in August of 1957 when former Governor Ma vin Griffin allocated the first $2,500,000 toward the desi and construction of a nuclear facility that would be "mor than just a teaching aid . . . but also big enough for com mercial and industrial research of a high order."

Only seven days later the NSF advised President Har rison of another grant, this one a $150,000 sum for "sup port of the Rich Electronic Computer Center and basi research requiring digital computation." Dr. William Atchi son, whose description of the history and aims of the Com puter Center was also featured in the February issue, wil direct the use of the funds over a period of three years.

in foreign waters

• Dr. Marion Carstens, author of this issue's article on the spillways for the Dez River dam in Iran, isn't the only Tech researcher exporting some of his talent. One of his colleagues in civil engineering, Professor George Sowers, is presently winding up a four-month assignment in India. A line from one of his letters to Tech friends reveals his interests: "India is fascinating . . . Through Roorkee flows the Ganga (Ganges) Canal, carrying 10,000 cfs to the flat central plain of India . . ."

Professor Sowers is one of two Americans on a United Nations technical team at the University of Roorkee, India's oldest engineering college. He is assigned to the college's Water Resources Development Training Center, which trains engineers from Southeast Asia and Africa. His work includes teaching special courses on dams and foundations to graduate students, consulting on actual engineering problems of the Center's trainees and the Indian Government, and aiding in the development of the University's soil mechanics laboratory.

JUNE, 1959

The Research Engineer

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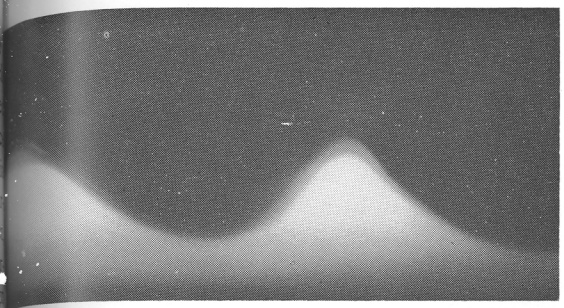

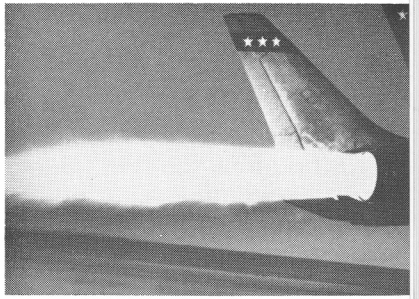

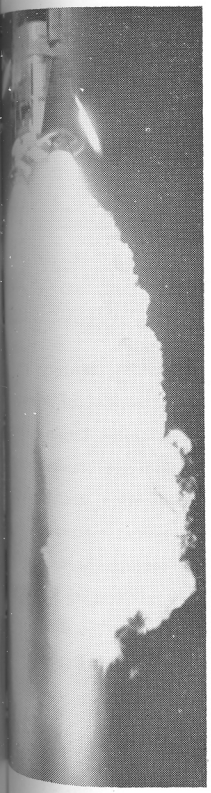

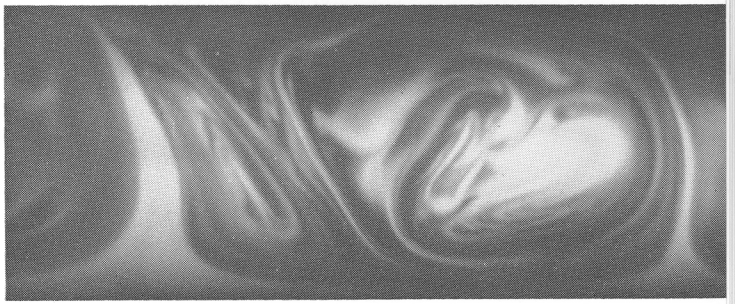

HEAT,
SCREECH,
AND
NUCLEAR POWER

Industrial Isotopes - page 10