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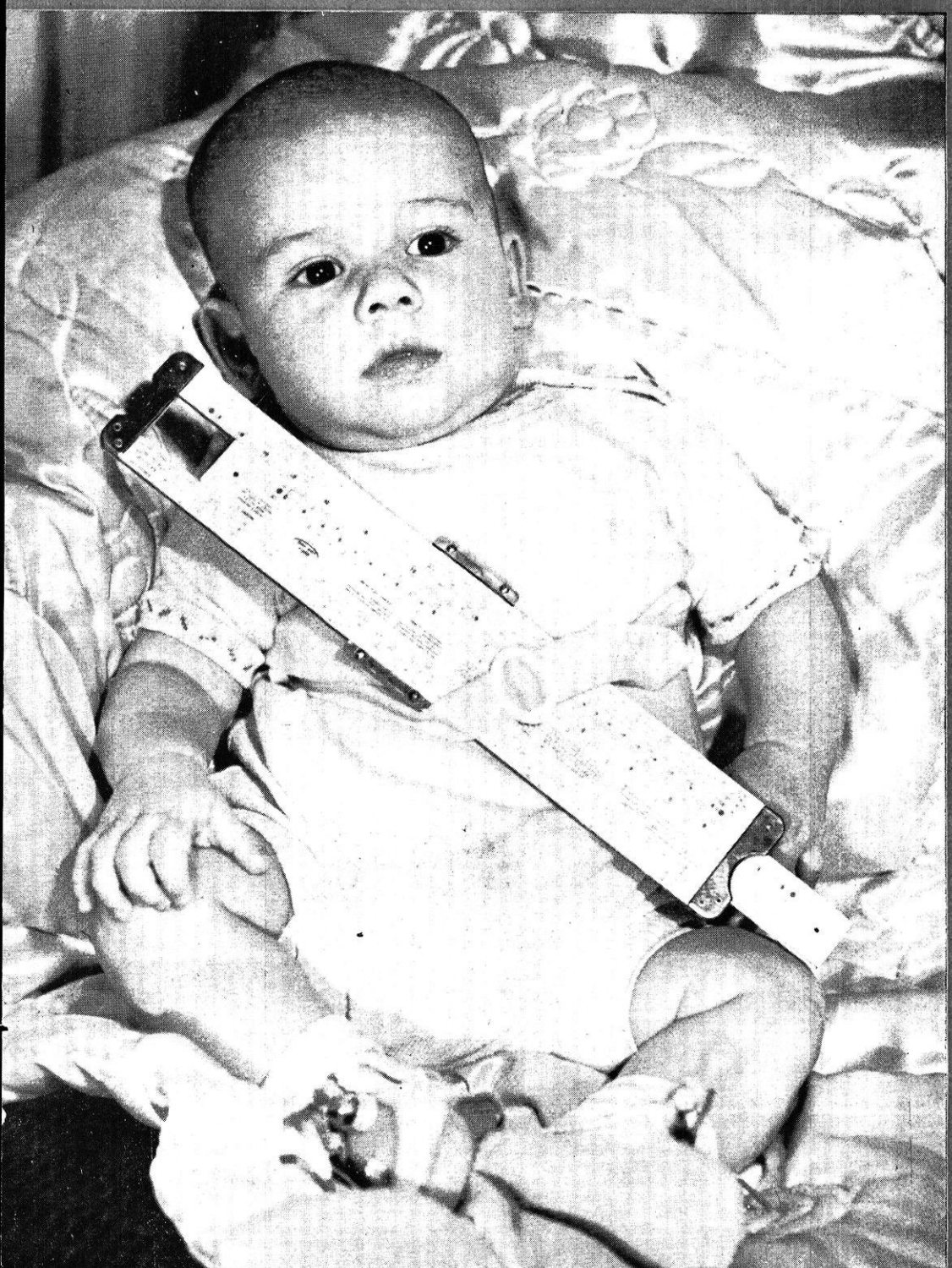
The Wisconsin

engineer



October, 1948

In This Issue:

Michael Mikyska m'70

15¢

Machines in RCA's Lancaster Tube Plant are designed for mass production of Kinescopes—television picture tubes—at lowest possible cost.

Behind the magic of a Television Tube

Every morning, 14 tons of glass "bulbs" go down to the production lines at the RCA Tube Plant in Lancaster, Pa.

By evening, the bulbs are television picture tubes, their luminescent faces ready to glow —in television homes everywhere—with news, sports, entertainment, education, and major political events.

Born of glass, metals, and chemicals, the picture tube comes to life through flame and intense heat. Its face is coated with fluorescent material—forming a screen on which an electron gun "paints" moving images.

Each step is so delicately handled that, although RCA craftsmen are working with fragile glass, breakage is less than 1%.

Water, twice-distilled, is used to float the fluorescent material into place on the face of the tube, where it clings by molecular attraction—as an absolutely uniform and perfect coating.

Every phase of manufacture conforms to scientific specifications established by RCA Laboratories. Result: Television tubes of highest perfection—assuring sharp, clear pictures on the screens of RCA Victor home television receivers.

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- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and reproducing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

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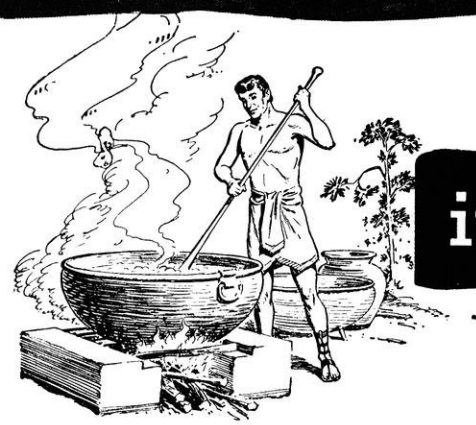


it's out of the kettle!

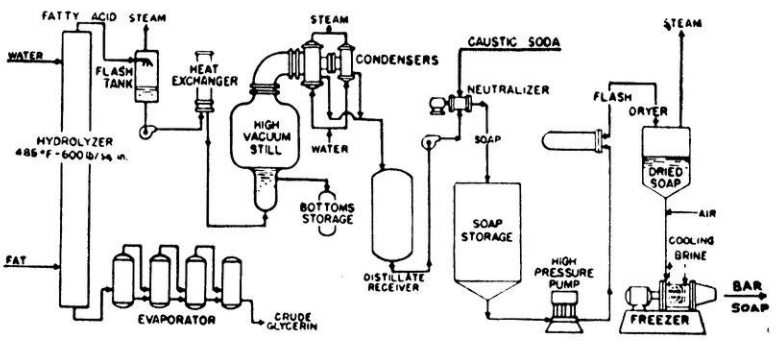
Since ancient times, ever since the discovery of soap, the making of this product has been strictly a "batch" affair. Even today, most factories still make soap in huge kettles.

Recently, however, technical men at Procter & Gamble have developed a revolutionary new *continuous* process for making soap. It starts in a hydrolyzer like the one pictured right.

The entire process, diagramed below, takes only a few hours, instead of the many days required by the old method. In addition to obvious savings, it also means improved products. To develop it, P AND G chemists had to pioneer uncharted fields—to solve many problems in the fundamental reactions of fats and oils; engineers had to design high-pressure equipment, high vacuum distillation and "flash" drying units, and lay out and construct new equipment, and entire new plants.

Now the process is in operation in many P AND G plants, with additional chemists and engineers supervising operation and personnel.

This is just one example of P AND G technical teamwork in action; similar developments progressing in other fields call for additional men with technical training. That's why P AND G representatives periodically visit the country's top technical schools to interview students. If you would like to talk to a P AND G representative, ask your faculty adviser or placement bureau to arrange a meeting.



PROCTER & GAMBLE CINCINNATI 1, OHIO

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He's a Square D Field Engineer. There are others like him in Square D branches in more than 50 principal cities of the United States, Canada and Mexico. These men are liaison between Square D and industrial America. Their full-time job is contacting industries of every type and size. It is through them that we are able to do our job effectively. That job is three-fold: To design and build electrical distribution and control equipment in pace with present needs—to provide sound counsel in the selection of the right equipment for any given application—to anticipate trends and new methods and speed their development.

If you have a problem in electrical distribution or control, call in the nearby Square D Field Engineer. He makes a lot of sense in finding **"a better way to do it."**

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In This Issue . . .

COVER:

Michael is starting engineering a bit early for a member of the class of '70, but it's a good start nevertheless. He is the son of Edward J. (m'49) and Marie Mikyska, 318 E. Johnson St.

Features

Departments

Why water gets better all the time

Most people take purified water for granted today. But water now gets other scientific "treatments" as well . . . to do highly specialized jobs.

New chemicals, for example, make hard water *soft* . . . for a quicker, cleaner job of washing and laundering. And, important to industry, are other chemicals that war on corrosion . . . and lower the freezing point of water.

There is *wetter-water*, too . . . water chemically treated so that it penetrates more quickly, spreads more evenly. It helps do a better dyeing job on the clothes we wear. In fire-fighting, *wetter-water* soaks in faster, quenches stubborn blazes swiftly . . . and cuts fire and water damage.

To get the full benefits of water, we need today's engineering advances and *better materials*. New plastics now used in our tough, long-lasting, lightweight garden hose. Also, improved alloy steels in today's pumps, pipelines, tanks . . . that bring water from reservoir to your home or factory, where it's always on tap.

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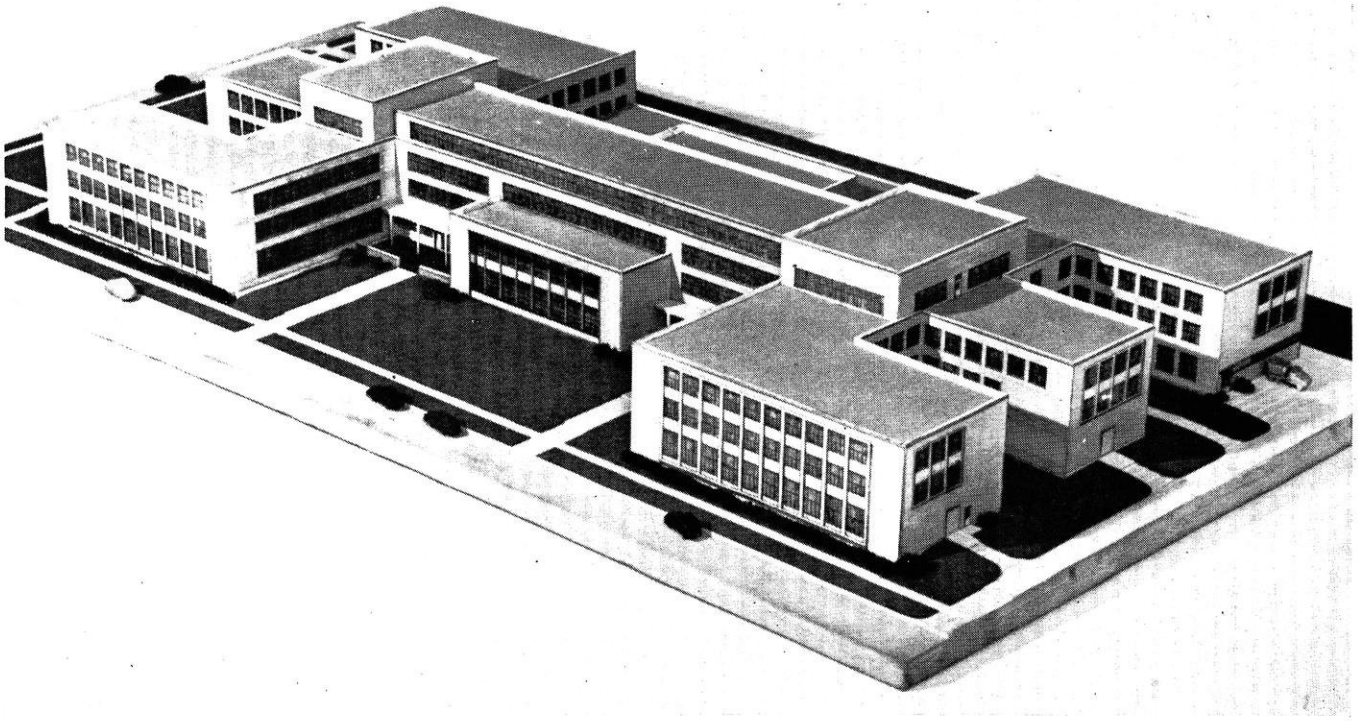


Photo by Lefebvre-Luebke

This view of the architect's model of the proposed Engineering Building shows the structure as it will be when fully completed. Present plans as submitted to the Board of Regents call for immediate construction of only one of the 'E' shaped wings. Completion of the entire building is contemplated within ten years.

More Elbow Room for Engineers

The New Building

by Robert Johnson e'50

AFTER several decades of planning, working, and hoping, the College of Engineering is about to obtain its badly needed new building for the accommodation of its various departments. This building represents the plans and hopes of the engineering faculty, alumni, and students of the last 36 years. Immediate construction of the west one-third of the entire building is planned for this fall, but the building committee, faculty, and students hope to see the rest of the building completed in the near future.

With the Regents' approval of the working plans and specifications expected in the latter part of September, Professor Kurt F. Wendt, associate director of the engineering experiment station and secretary of the building committee, explained that bidding may be opened immediately thereafter. It is hoped construction of the west third will begin this fall before winter sets it.

The new building is to be located in the section of Randall Park shown in the aerial view of the western part of the campus. The building will lie southwest of the Wisconsin highway commission laboratory and would face Johnson street if the street were extended into Randall Park. The completed structure will be situated between "extended" Johnson and Dayton streets.

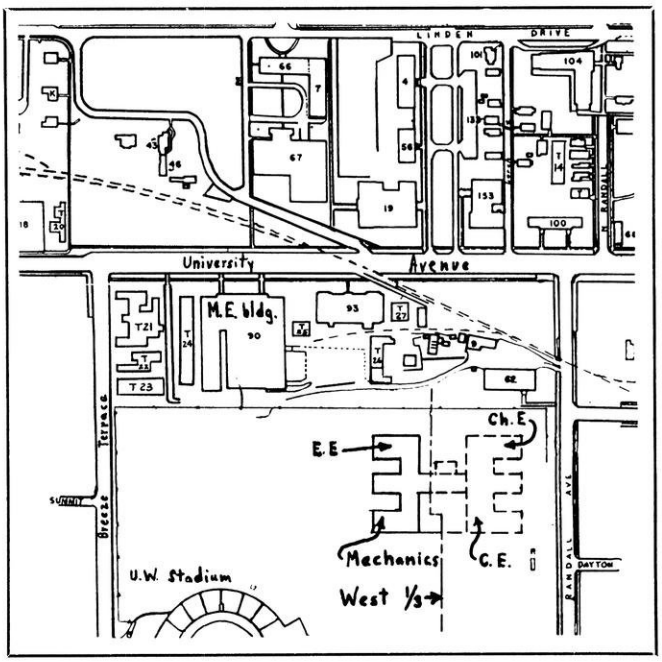
When construction commences, about 34 of the trailers in the University trailer camp will have to be moved to provide the required space for the building.

According to Professor Wendt, the ultimate development of this western part of the campus will include a mall running between Agricultural Hall and the new building. Hoard Mall would form the north portion of the future mall. It is hoped that this will help create what might be called a West Campus where eventually will be concentrated the entire engineering school.

Previous Building Attempts

In 1912 the first plans were formulated to move the Engineering College from the shores of Lake Mendota to the Camp Randall-University avenue area now being expanded. At that time, eight engineering buildings were planned; one for each department. This plan was embodied in a general program called the Peabody Plan in honor of the then state architect, Arthur Peabody. The completion of the Mechanical Engineering building in 1931 represented the first step of the general plan. In 1935 plans were drawn up for the then urgently needed Electrical Engineering building. The site: the tennis courts just west of the M.E. building, an area better known as the Breese Terrace Cafeteria. The drawings were made and approved, but the state legislature failed to appropriate the necessary funds.

About 1938 the growing enrollment in engineering revived the movement for a new building. A set of plans was drawn up for the Committee on Building Plans, then under the chairmanship of Professor Edward Bennett, head of the electrical engineering department. The idea at that time was two U-shaped building intended to house the entire engineering college. These two buildings were to be placed in the Camp Randall area on the land between Johnson and Dayton streets, extended; the site of the presently planned building.



This drawing shows the relation of the position of the proposed building to the rest of the campus.

These plans did not materialize, and in 1941 the third set of preliminary building proposals was submitted for approval. These plans called for one large continuous building to be connected directly with the Mechanical Engineering building. It was to face University avenue and lie between the M.E. building and the Mining and Metallurgy building. Due to the war and to a disagreement on the advisability of a single building, the building plan was left for further study until after the war.

Need Urgent

The immediate need for a new engineering building is very pressing. The temporary buildings have partially eased the strain due to the very heavy post-war enrollment, but there is a desperate need to modernize and expand the facilities in nearly all of the engineering departments. Even before the war there was a dire shortage of space for work on undergraduate theses, graduate study and research, and staff and industrial cooperative studies.

The electrical and chemical engineering schools are those most critically in need of increased facilities. The present electrical engineering building was built before 1900. It is probably in the worst shape of any of the buildings and has been serving the largest number of engineering students. The chemical engineering building is of equivalent age and was not designed in the first place for the fire and chemical dangers inherent in that profession.

The building facilities and equipment of the other engineering departments are in almost as bad condition. The situation has deteriorated even more rapidly in the past few years, and the need for increased accommodations has become far more critical.

The Completed Building

The building plans now under close scrutiny call for a large building in the form of two E's, back to back, and connected by a single rectangular structure. The wings, or E sections, will be three stories high, and the center section will be four stories. The building is to be a reinforced concrete frame structure, veneered with brick, and trimmed with stone. When complete, the new building with 361,000 square feet of floor space will be more than 3½ times as large as the present mechanical engineering building with its 101,000 square feet. The entire structure will be 512 feet long on extended Johnson street and 260 feet wide when finally completed.

The costs of constructing the first wing of the building this fall are hoped to be considerably less than $2,000,000.

The completed building will house the departments of electrical, chemical, and civil engineering except for the hydraulic research department. It will also include the drawing and mechanics departments. Although the choice was difficult, the initial wing of the new building will accommodate the electrical engineering department and the mechanics and materials laboratories.

—Photo by Wahlin

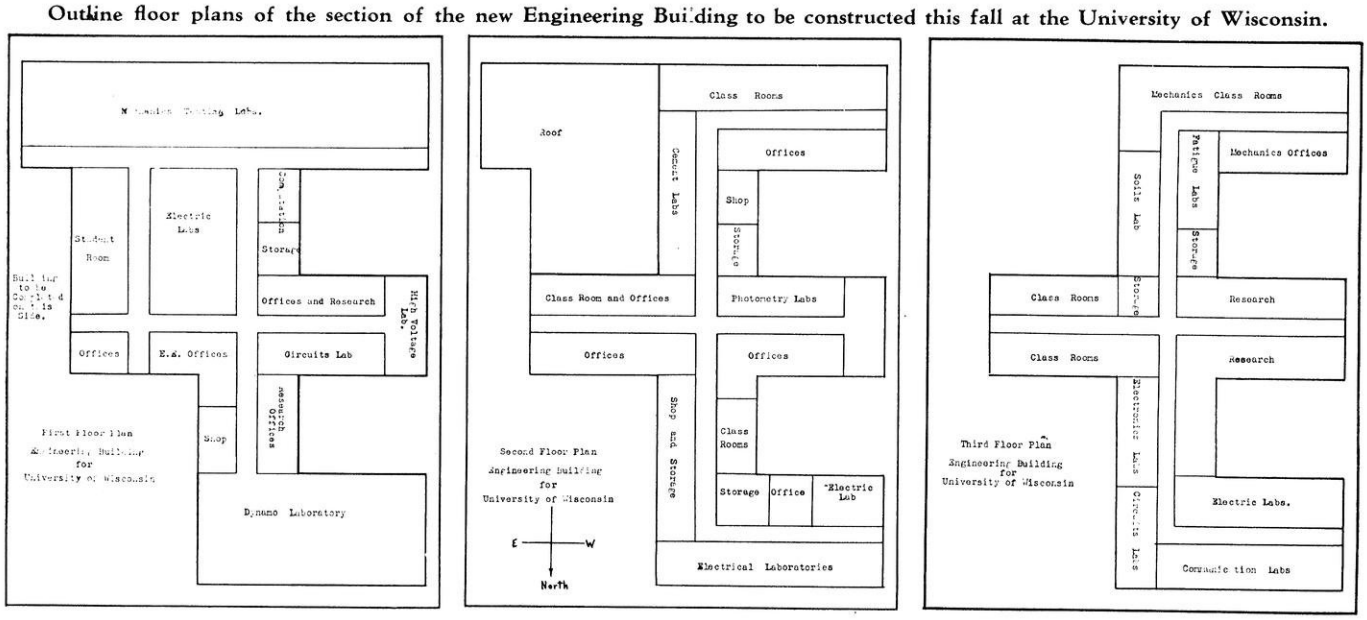
Taking a soil sample for the new building's footings. As a result of the test data, the usual ground support pressure of 5000 pounds per square foot of bearing area was reduced to 3500 pounds per square foot.

When finished, the new building will also include an auditorium, the engineering library now located in the Mechanical Engineering building, the revived and expanded engineering experiment station, and the requisite administrative office space.

During the past year and a half, the building committee has visited most of the principal new industrial and engineering buildings in the East and Midwest to see the latest designs, learn of the difficulties and problems encountered in building by other schools and industries, and to in-

(*please turn to page* 42)

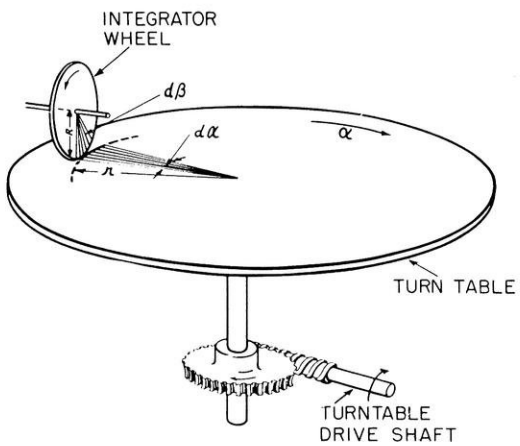
Outline floor plans of the section of the new Engineering Building to be constructed this fall at the University of Wisconsin.



LARGE - SCALE
COMPUTING DEVICES

by Leon Kirchmayer & Lindon Saline

During the past decade the art of automatic computation has advanced rapidly as a result of the increased demand for rapid and accurate calculations. Modern calculating devices have a heritage several thousand years old. The abacus, one of the oldest computing devices, consists simply of beads mounted on a wire frame and represents man's first attempt to economize time and eliminate human error in performing arithmetic operations.



$$R\,d\beta = r\,d\alpha$$

$$\alpha\beta = \frac{1}{R} r\,d\alpha$$

$$\beta = \frac{1}{R}\int r\,d\alpha$$

Fundamental Principles of the Kelvin wheel and disc type of mechanical integrator.

For thousands of years following the invention of the abacus, history records no significant advancements in the development of computing devices. In 1642, after the invention of gears, Blaise Pascal built the forerunner of the modern cash register and accounting machine. Samuel Morland and Gottfried Leibnitz followed a short time later and invented, independently, machines for multiplying numbers.

Early in the nineteenth century Charles Babbage, a philosopher, conceived the idea of a difference engine to "perform the whole operation — (the computation and printing of tables of functions)—without any mental attention when once the given numbers have been placed in the machine." Babbage built a model difference engine and then undertook a more complicated task, namely, that of building an analytical engine which could perform a whole series of arithmetical operations without intervention from the operator. He proposed the use of Jacquard (punched) cards to control the sequence of operations. If the machine could compute tables and then print them for immediate use or punch the numerical results in cards for future use, Babbage conjectured that the analytical engine would be entirely free from error. Fundamentally, modern large-scale digital computers are highly developed analytical "engines."

In 1876 Sir William Thomson proposed a mechanical system for the solution of differential equations. This system is now known as the Kelvin disc integrator and is employed in modern differential analyzers. Further advancements in the field of analogue computation were made shortly after the turn of the century with the invention of the d-c and a-c network analyzers.

Hollerith first applied punched cards to modern scientific methods when he invented a punched card sorter for the 1880 census. The International Business Machines Corporation (IBM) pioneered in research relative to the use of punched cards in accounting, statistical, and scientific problems. Punched card machines now include a variety of ingenious devices ranging from simple sorting and tabulating machines to the complex automatic sequence controlled calculator (Mark I) which was completed in 1944. Since that time, the successful development of electronic digital calculators has given promise of a new era in the field of numerical analysis.

DIGITAL COMPUTERS

Digital computers are devices in which numbers are represented in digital form and which give a solution for discrete points only. They may be divided into two types:

(a) Mechanical.
  (1) Counter-wheel.
  (2) Relay.
(b) Electronic.

The accuracy of a digital computer can be made independent within certain limits of the accuracy of its component parts, the overall accuracy being limited by the amount of equipment employed.

In general, a digital computer has five basic components:

(1) Input unit.
(2) Output unit.
(3) Arithmetic unit.
(4) Memory unit.
(5) Program unit.

The input unit introduces to the machines numerical data which is necessary in the solution of the problem. Recording of the calculated results is the function of the output unit. In the arithmetic unit the machine performs the

LINDON E. SALINE

Having an educational background much like his good friend Leon K. ("Stator") Kirchmayer, Lindon E. ("Rotor") Saline, 24, comes from Minneapolis, Minnesota. He too received his B. of EE at Marquette, his MS(EE) and also needs only to complete his thesis to get his PhD at the University of Wisconsin. He has been a graduate assistant here and last year was a University Fellow, Department of Electrical Engineering. After two years in V-12 at Marquette, he was commissioned and spent some time on an LCI(L) in the South Pacific. He gained experience for his present job working as an experimental research engineer at Cutler Hammer, Inc. He is now working in the Analytical Division for General Electric Company. Weekends he might be found golfing, swimming, bowling, or playing tennis. His favorite pastime, he says, is beating "Stator" Kirchmayer at table tennis. He is affiliated professionally with AIEE, IRE, ASME, ESM, and honorarily with Tau Beta Pi, Eta Kappa Nu, and Pi Mu Epsilon.

fundamental operations of addition, subtraction, multiplication and division and, in certain machines, the automatic calculation of the transcendental function. The memory unit provides storage capacity for original data and intermediately calculated data. Programming directs the operation of the machine in the solution of a given problem.

Punched Card Machines

A punched card machine is a device which interprets numerical or operational data according to the position of a hole or series of holes punched in cards and which performs arithmetical, arranging, or recording operations on the interpreted data. The keypunch transcribes written information into punched holes in cards and operates similarly to a typewriter. Various reproducing machines repunch information into new cards on a mass production basis. The interpreter reads punched holes and prints the literal information on the card. Sorting approximately 24,000 cards per hour, the sorter selects cards according to information punched in a column. The collator performs filing, merging, and counting operations on 16,000 cards per hour. The tabulator adds (or subtracts by complements) 9,000 eight-digit numbers per hour. The multiplying punch forms the product of 2 numbers punched in a card and punches the result in the same card. Addition, subtraction, multiplication, and division may be performed in various sequences on the calculating punch.

The versatility of punched card machines lies in the electrical plugboard connections. Although these machines can solve any problem which can be reduced to the fundamental arithmetical operations, they are neither as automatic nor as fast in operation as the large-scale computers which will be discussed in the succeeding sections.

Mark I

Mark I (automatic sequence controlled calculator) was designed and constructed by IBM in cooperation with the Computation Laboratory of Harvard University. This machine, which was formally presented to Harvard in 1944, is 51 feet long and 8 feet high. It is of the counter-wheel type.

Numerical data may be introduced into the machine in three ways:

(1) Mechanical interpolators.
(2) Constant registers.
(3) Card feeds.

The three mechanical interpolators introduce functions defined by tabular data on continuous, punched tapes. The 60 constant registers hold constants that are needed at some point in the calculation of a given problem. The third method of introducing data into the calculator is through the card feeds which read data from holes punched in standard tabulating cards. The output unit consists of electrically operated typewriters and a card punch.

To perform the arithmetic operations, Mark I employs a combination of counter-wheels and relay circuits. The electromechanical tables provide the following elementary transcendental functions: Common logarithms, 10 to an arbitrary power, and sin x. The memory of Mark I consists of constant registers, adding-storage registers, and standard tabulating cards.

The sequence control (program unit) operates according to holes punched in a paper tape. The 24 punching positions in each line of the tape are divided into 3 groups of 8 holes each. Group A tells the machine where to obtain a number; group B tells the machine where to deliver the number; and group C tells the machine what operation to perform on the number in unit A in connection with the number in unit B. Each register, counter, and operation is assigned a code number which corresponds to the holes punched in the perforated, sequence-control tape.

During normal operation the automatic sequence controlled calculator computes with 23 significant figures and performs at the following maximum operating times:

Operation	Seconds
Addition or Subtraction	0.3
Multiplication	6.0
Division	11.4
Sin x	60.0

Mark II

Mark II (the Dahlgren computer), an all-relay calculator employing the binary system of numbers, was designed and built at Harvard University for the United States Navy. This machine, which cost $500,000 requires approximately 3,000 square feet of floor space.

In general, Mark II is merely an improvement over Mark I. The improved programming, faster operating relay circuits, and teletype recording techniques permit Mark II to operate 12 times faster than Mark I.

Bell Relay Computer

The Bell relay computer (located at the Ballistics Research Laboratory, Aberdeen, Maryland) employs standard teletype equipment and requires 1,000 square feet of

LEON K. KIRCHMAYER

One of this month's highlighters is Leon K. Kirchmayer, 24, of Milwaukee, B. of E.E., MS(EE), received at Marquette University in Milwaukee and the University of Wisconsin, respectively. His Master's Degree was obtained with the aid of a Tau Beta Pi Fellowship, and he has only to finish his thesis for a PhD from the University of Wisconsin. Mr. Kirchmayer has had an active academic life, being a research assistant to Dr. Douglas of Marquette, and an instructor both at Marquette and Wisconsin. He was an experimental research engineer at Cutler Hammer, Inc., and has been Associate Editor of "Milwaukee Engineering". At present he is employed in the General Electric Company's Analytical Division, his chief attention being directed toward the GE differential analyzer. While not actively engaged in analyzing differentially at GE, he clears his head with bowling, swimming, tennis, or pure relaxation with classical music. He is associated professionally and honorarily with the same societies as Mr. Saline.

floor space for the 27 panels of relay rack equipment and the 6 tape units. Carrying 7 significant figures, this machine employs the bi-quinary system of numbers and multiplies, divides, and extracts square roots by successive additions or subtractions.

Data is supplied to the computer in the form of teletype tapes:

(1) Problem tape—carries numerical data to be substituted into a given formula.
(2) Table tape—carries tables of functions to which computer must refer in solving problems.
(3) Routine tape—carries formula to guide the solution of the problem.

Memory is provided in constant registers (relay circuits) and teletype tapes. Automatic checking operations throughout the calculation insure accuracy of the final results which are recorded on teletype tape or on a teletype page printer.

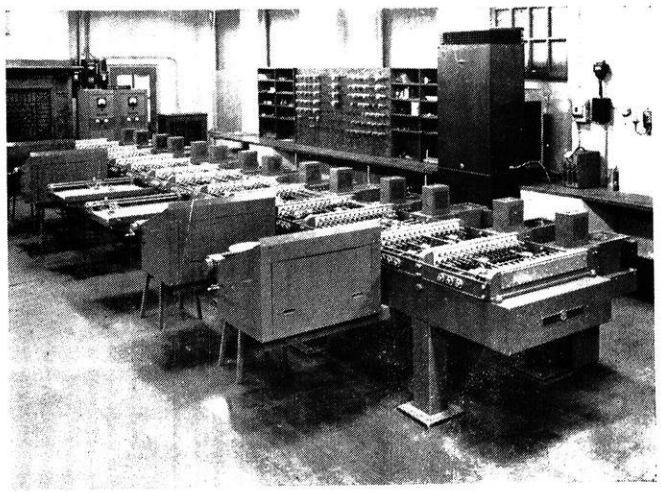
ENIAC

The ENIAC (electronic numerical integrator and computer), the first electronic discrete variable computer, was dedicated in February, 1946, and is now at the Aberdeen Proving Grounds where it is used largely for the solution of ballistics problems. This unit weighs 30 tons and contains approximately 18,000 tubes, 70,000 resistors, 10,000 capacitors, and 6,000 switches.

In this computer the numbers are represented in radix-ten or decimal form by groups of pulses which are equal in number to the value of the digit. Connections for carrying the pulse groups between various units are made by digit trunk lines. Data on punched cards is introduced at the rate of 960 ten-digit numbers per minute by means of a constant transmitter controlled by an IBM card interpreter. A record of the solution is punched into cards at the rate of 300 ten-digit numbers per minute.

The arithmetic operations are performed by 20 accumulators, the high-speed multiplier, and the combination divider and square-rooter. Each accumulator contains a ten-stage ring counter and a sign circuit and is designed to perform the following functions:

(1) Store a ten-digit number.
(2) Receive a ten-digit number (in the form of pulses coming over a digit trunk) and add the received number to its contents.
(3) Transmit in pulse form either the number or its complement. Since the accumulator cycles in only one direction, subtraction is performed by addition of complementary functions. Addition of two ten-digit numbers requires 0.2 milliseconds; multiplication, 2.6 milliseconds; division, 25.0 milliseconds.



The differential analyzer applies to all problems that can be expressed by ordinary differential equations.

Numerical memory is provided in the following manner:

(1) Internal.
  a. Accumulators—operating time = 0.2 milliseconds.
  b. Function tables—operating time = 1.0 milliseconds.
(2) External.
  a. Punched cards—operating time = 83.3 milliseconds.

The operation of the various components of the ENIAC is synchronized by means of a standard set of timed signals emitted by the cycling device at the rate of 100,000 cycles per second. In addition to the circuits for handling digits, each unit contains local programming circuits which control the operation of their respective units.

These programming circuits are connected together by program trunk lines. Each program control has associated with it several selector switches. When a program control is stimulated by a program pulse, it directs its unit to operate in accordance with the setting of the switches. An overall control of the sequence of operation may be obtained through the use of the master programmer. This unit transfers the program pulse from one program line

(please turn to page 24)

ON the Campus

by John Ashenbrucker e'49

ASME

An organizational meeting was held in the Mechanical Engineering Building by the student chapter of ASME on Tuesday evening, September 28.

FIELD TRIP

On their annual tour of industry last spring, 100 Electrical Engineering seniors visited the General Electric X-Ray Corporation in Milwaukee.

These annual field trips to the various industrial plants throughout the Midwest are made by the senior engineering students and are intended to acquaint the embryo engineers with the various manufacturing and engineering techniques used in modern industrial practice.

This year the senior electricals contemplate a three day trip to Chicago. They expect to visit a number of the important industries in that vicinity.

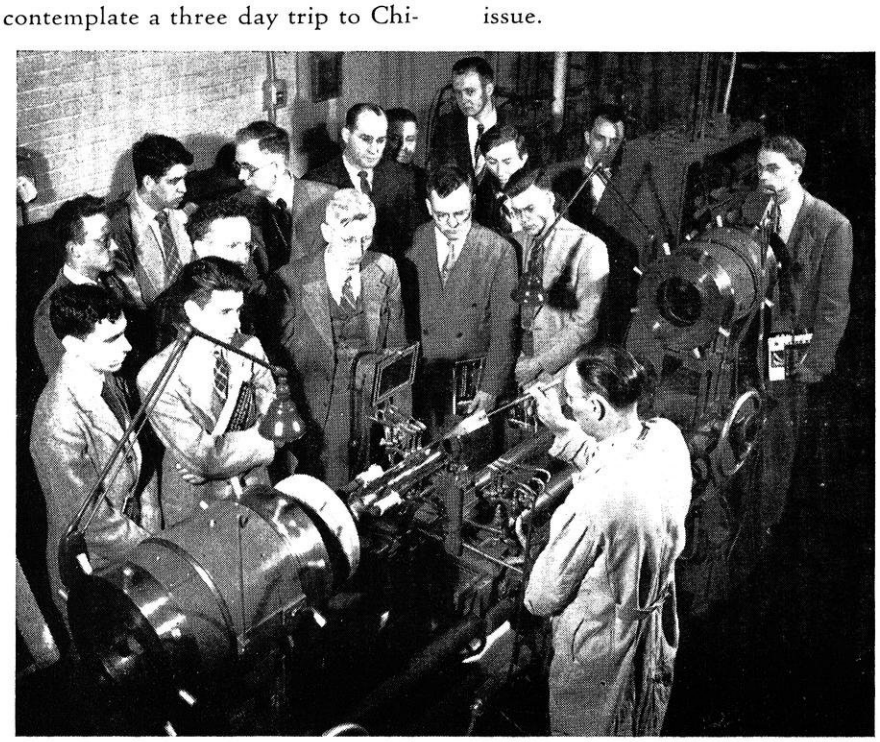
TRIANGLE FRATERNITY

The Wisconsin Chapter of Triangle was host to the fraternity's National Convention held September 2-5 at the Loraine Hotel in Madison.

A touch of the old college days was brought back to the alumni who attended the Triangle party after the Illinois game, October 2. Mr. and Mrs. George Westmont were chaperons.

NO SCOOP

Granted that a lot of you got married this summer, but Hugh Wahlin is on the Engineer Staff so he gets the Ball and Chain award for this issue.



—Photo courtesy MILWAUKEE JOURNAL

E.E. field trip with Prof. Glen Koehler at G. E. X-ray Corp. in Milwaukee watching a glass lathe operation.

ENGINEERING TEACHERS MEET

More than 200 members of the American Society for Engineering Education and their families attended the summer school for teachers of Chemical Engineering on the campus of the University of Wisconsin.

The school was held August 30-September 4. Nearly 60 experts and leaders in the field of engineering and engineering education were on the program.

THETA TAU

Theta Tau celebrated its founding with a banquet on Friday evening, October 15, in the Hoffman House. .

PROFESSOR MYERS

"Should the Fundamental Features of All Majors (Options) Be Required of All Mechanical Engineers?" was the subject of a paper that Professor Myers presented to the North-Midwest section of the American Society of Engineering Educators. It was delivered at the annual ASEE meeting held this year at Houghton, Mich.

KAPPA ETA KAPPA

Taking advantage of fall weather, Kappa Eta Kappa fraternity picnicked at Burroughs Park on Saturday, September 25. Picnics are conventional fall social events, but reports have it that this one wasn't quite so conventional.

(please turn to page 26)

REMOTE CONTROL
FLASH SYNCHRONIZER

by Willis B. Foote e'48 & John C. Wade che'48

For the amateur or professional photographer who specializes in multi-flash pictures, especially pictures of large groups or areas, the remote flash synchronizer is an indispensable boon. Besides minimizing the drain on flash gun batteries, it does away with the necessity of laying long lengths of extension cord from camera to additional reflectors and the hazards involved when these cords cross the path of milling crowds.

This photograph of the 770 Club was taken with the aid of Remote Control Flash Synchronizers. Notice the detail and background that would otherwise be missing.

The remote control flash is completely self contained. It sets off side lighting flash bulbs in synchronization with the master flash on the camera. The circuit is quite simple. Its basis can be found in any elementary book on electronics and certainly only a meager knowledge of electricity is needed for its construction. The cost of all the materials required is less than fifteen dollars. The result is an amazingly compact box measuring 4x5x6 inches which will pick up reflected or direct light from the flash on the camera, and convert this light into enough energy to flash one or more of the largest flash bulbs, in synchronization with the camera shutter. Tests of the first unit built under the specifications listed here show that the apparatus can be used effectively at shutter speeds exceeding 1/200th second. This same unit was tested by the Rentual Camera Repair Co., Milwaukee, Wis., and found to react faster than a similar model produced by a noted research company.

The above photograph illustrates the results which can be obtained using these units. Four flash bulbs were used in obtaining the photograph of the large dance hall shown. The room itself was illuminated by ceiling molding lights, entirely insufficient for any type of photograph. Two of the remote synchronization units were placed on top of curtain rods, less than a foot from the ceiling, along the right hand side of the room. The third was located to the left, near the ceiling and behind the camera. This unit was connected to a flash set in a pre-focused spotlight in order to illuminate the bandstand at the far end of the room. All were touched off by the master flash which was synchronized to the shutter of a 4x5 Speed Graphic camera. The shutter speed used was 1/100th second.

Although this setup is a normal one as far as light balance is concerned, it would have been impossible without the aid of the remote synchronization units. To attempt the use of extension cords would have been unsatisfactory in the large crowd.

The Circuit

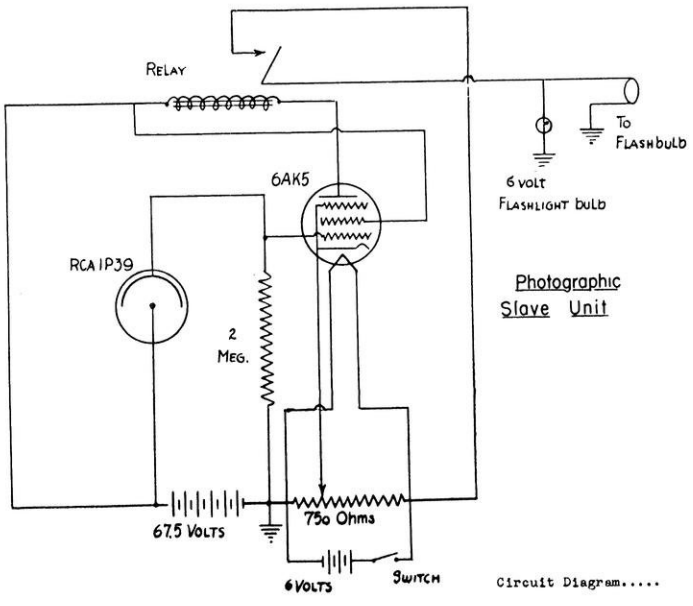
An examination of the circuit will make it clear why this unit can and does synchronize with the camera, although there is no direct connection of any sort between the two.

The ultimate object is to make enough current flow through the 6AK5 tube to energize the small relay which is in series with it. When this happens, 6 volts is applied to the flash bulb.

When light strikes the phototube, current will flow (usually just a few millionths of an ampere). This current sets up a voltage drop across the 2 megohm resistor, and the voltage drop is applied to the control grid of the 6AK5.

By means of the potentiometer, it is possible to adjust the "operating point" of the 6AK5 so that it is passing current through the relay, but not quite enough for it to

(please turn to page 38)



Circuit Diagram.....

Alumni Notes

by Walter Mueller m'49

—ME—

Lorin G. Miller, national authority in the field of heating and ventilation engineering, will start his first school term in September as dean of engineering of Michigan State College at East Lansing. He succeeds Dean Henry B. Dirks, retired.

Lorin G. Miller

Miller received his bachelor of science and bachelor of science electrical engineering degrees from Des Moines University and conducted advanced study at the Massachusetts Institute of Technology. He was employed three years by Western Electric Company, and taught on the engineering faculties of the University of Wisconsin and Des Moines University. Miller came to Michigan State College as professor of mechanical engineering in 1929, and has served as head of that department from 1935 until his recent appointment as dean.

A member of the American Society of Heating and Ventilating Engineers, Miller is a member of the governing council and the executive committee of the research board, which operates the ASHVE laboratory in Cleveland. He has served as president of the Western Michigan chapter of the society, and for two years held the office of president in the Michigan chapter of the American Society for Engineering Education. He is also a governing committeeman of the Boiler and Radiator Manufacturing Institute, and teaches each year at the special short course sponsored by the Institute at the Navy Pier in Chicago.

The new engineering dean is credited with founding the annual Forced Warm Air short course conference at Michigan State College, which each year draws a large group of industry leaders to the campus. He is the author of numerous journal and magazine articles, and is nationally known as a speaker on engineering topics.

—CE—

Dr. Nephi Albert Christensen, who received his bachelor's degree from the University of Wisconsin in 1928, has been appointed director of the School of Civil Engineering at Cornell University and will enter upon his new duties in September. He has been dean of engineering at Colorado State College of Agriculture and Mechanic Arts at Fort Collins.

Dr. Christensen, who began working as a handy-man on a cattle ranch during his high school days, was an expert carpenter by the time he received his first bachelor's degree from Brigham Young University in 1925. During the following school year, he taught mathematics and mechanic arts in Iron County High School.

He was a student in civil engineering at Wisconsin from 1926 to 1928. During the summers of 1927 and 1928, he worked for the Wisconsin Highway Commission on location surveys. From 1928 to 1933 he was professor of exact science at Ricks College, Rexburg, Idaho, and taught a wide range of subjects. In 1934 he received a master's degree from California Institute of Technology, and in 1938 he received his Ph.D. degree from the same institution.

From 1942 to 1945, while on leave of absence from the Colorado State College, he served as chief engineer of the Rocket Branch of the Ballistics Research Laboratory and chief of the research branch, Rocket Research Division at Aberdeen Proving Ground.

Kenneth A. Schroeder (ME) has joined the Eastman Kodak Co., Rochester, N. Y., and is with the Kodak Park Works division as an engineer in the engineering and maintenance department.

He is a graduate of South Division High School, Milwaukee, and received his B.S. degree from Wisconsin in 1942. After serving with the Navy from 1944 to 1946, he attended Purdue University and was granted the M.S. degree this spring in machine design. He was also an instructor at Purdue during the past two years.

Recent news of Badgers in industry, particularly, the '48 grads are as follows:

R. J. Mitchell (ME), editor of the "Engineer" last year is in Toledo, Ohio, with the Plaskon Division of the Libbey Owens Ford Glass Company.

Dan Orlando (EE) is very well satisfied to be with the Johnson Service Co., Milwaukee.

Bill Wolfenberg (ChE) is carving out a toe hold in the field at Globe Union, Inc., Milwaukee.

Richard Wilson (ME) is with the Wright Aeronautical Corp., New Jersey.

Leon K. Kirchmayer and **Lindon E. Saline** are at Schenectady, N. Y., with the General Electric Co.

W. J. Peterson (ME) is doing Methods and Time Study at the

(*please turn to page* 32)

Arresting Stream Pollution

by Raymond D. Kolasinski ch'48

Photos courtesy State Sanitary Engineer

THE pulp and paper industry has given increasing attention to the problems occasioned by its wastes which, in general, can be handled either by utilization or by disposal. In the utilization procedures, the great difficulty is finding a sufficient market demand for the products produced. Since disposal methods add to operational expense, only those methods which show low cost of operation are applicable. Critical food and fuel shortages at present may prove to be a boon to utilization methods.

The problem of industrial wastes and their disposal has become increasingly important and complex to both industrialists and to society. In general, wastes may be solids, liquids, gases, or combinations of them. The liquid wastes present the biggest problem; the gaseous wastes can be vented to the atmosphere; and the solids can be carted away to be buried or burned. The simplest method of disposing of liquid wastes is to dump them into nearby bodies of surface waters. These waters must be of sufficient volume and turbulence to permit nature to rectify any temporary damage incurred. In the early days of industry in this country this method proved quite satisfactory, for the volume of wastes was negligible. However, as the industries grew, the volume of wastes increased proportionately. The effect of this large volume was multiplied many-fold when more than one industry located on the same water course. As each industry dumped its contaminated waste liquid into the receiving waters, the dissolved oxygen content would be reduced to a very low concentration. As a consequence, many harmful effects resulted, such as: water rendered unfit for recreation, fish life destroyed, reduction of natural content of oxygen in the surface water supplies which sometimes went to the point of exhaustion and created odor nuisances, waters may be rendered turbid, sludge or floation scum may be deposited on waters, and rivers may be rendered unfit as a source of domestic water supply unless given adequate treatment. The task of liquid waste disposal could be diminished considerably if the municipal sewage system could be used, but this would only be practical in the case of small industries. The principal industries contributing to the large volume of liquid wastes in this country are, in order: the food and beverage industry; the paper and pulp industry; and the chemical and metal industry.

That the question of waste disposal definitely poses a problem is shown in the fact that practically every state has passed legislation exercising control over disposal of industrial wastes. The first state to enact such legislation was Vermont in the year 1890, which gives some indication as to how early this problem was recognized. Since the receiving waters can possibly be used by two or more states, it can be seen that inter-state legislation must be necessary. This has been done in several instances, such as formation of the Interstate Sanitary Commission for New York, New Jersey, and Connecticut, which governs pollution of New York Harbor; or the commission from New York, New Jersey, Delaware, and Pennsylvania for control of pollution of the Delaware River; and other similar agreements concerning the Potomac, Ohio, and Red Rivers. Enactment of legislation alone, however, does not solve the problem, for there is still much to be done in the way of standardization and cooperation. This standardization and cooperation will not come about until the problem of pollution by municipal sewage is overcome.

Waste Liquors Detrimental

Among the industrial wastes, that from the sulfite pulp process is perhaps of first importance. The problem of treating waste sulfite liquors is one of great difficulty. The belief that waste sulfite liquor is the most detrimental type of industrial waste is erroneous, for this type of liquor alone would not result in stream pollution, but would be one of the contributing factors. However, to attack this problem properly, all contributing factors must be considered separately.

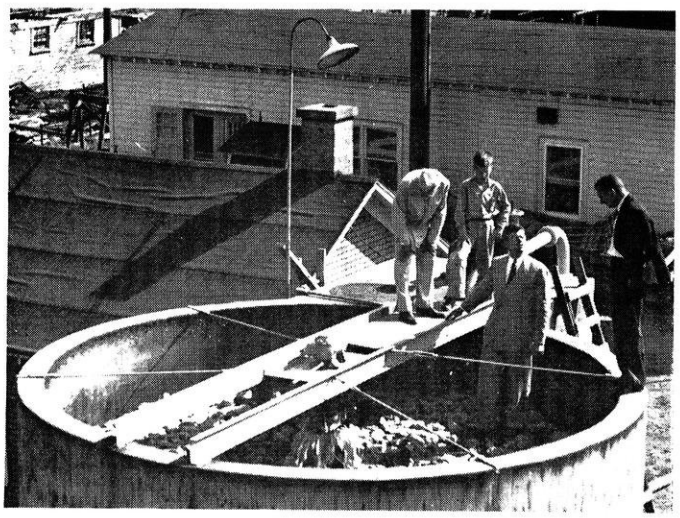
In the sulfite pulp process, chipped wood is cooked in a liquor which dissolves the constituents which bind the cellulose fibers together, thus freeing the fibers or pulp. The liquor used in the process is an aqueous solution of sulfurous acid and calcium bisulfite. The cooking is done in autoclaves for 8-10 hours at a maximum temperature of 135° C., and a pressure of 80-100 psi. The calcium bisulfite reacts with the lignin in the wood to form soluble calcium lignosulfonate. Wood gums are hydrolyzed in the acid

An important factor in the control of stream pollution is the oxygen content. These men are finding the oxygen content at Rhinelander, Wisconsin.

cooking liquor at high temperatures. The soluble material present in the spent liquor is drained away from the fibers at the end of the cook, and the liquid effluent is known as sulfite waste liquor. Soluble products of digestion in the waste liquor comprise about 50% of the weight of the wood. For every ton of sulfite pulp made, about a ton of soluble material is discharged to streams in about 2,500 gallons of waste liquor. The liquor normally contains 10% solids, mostly lignin and carbohydrates, the quantities varying with the type of wood used, and the method of cook. The carbohydrates are present as sugars in 2 to 3% concentration of which about 1.8% are fermentable. The total production of sulfite pulp in North America is approximately 14,500 tons per day, which means that somewhat more than 14,500 tons per day of soluble waste are also produced.

For a long time, these sulfite liquors were dumped into surface waters to be carried away, and so any usable material in these liquors was lost. Eventually, as the effects of dumping wastes into receiving waters became acute, steps were taken to solve this problem.

In the sulfite pulp and paper industry it was apparent that the treatment of waste liquors could be handled under two general plans, namely, "disposal" and "utilization."



Experimental Trickling Filter Installation at the Consolidated Water Power and Paper Company plant in Appleton, Wis. The large tank shown in the picture is the 15 foot diameter filter pilot plant used in the filtering treatment.

Disposal has as its object the reduction of the "biological oxygen demand" (35,000-45,000 ppm.) of the waste, so that relatively little decrease of oxygen content will occur upon discharging the waste into receiving waters. Utilization may involve two procedures, 1. converting the organic materials into useful chemical compounds, and 2. extraction of the lignin and carbohydrates by precipitation in such manner that they will find commercial outlets.

The industry has indicated its willingness to cooperate in solving this problem of waste sulfite liquor disposal by forming The National Council for Stream Improvement. The membership of the organization comprises 80% of the pulp, paper, and paperboard manufacturers of the United States. That council has undertaken two projects in connection with disposal of waste liquors: the trickling filter and the river re-aeration process.

In the trickling filter process, the waste liquor is treated, and the biochemical oxygen demand is satisfied before the waste liquor passes into the receiving waters. This project had progressed from the laboratory stage to a 15-foot diameter filter pilot plant at the Consolidated Water Power and Paper Company mill at Appleton, Wis. After several months of operation, however, the project has been abandoned. From the standpoint of reducing stream pollution, the project was successful, but the objectionable feature was that the size and cost for a full scale filter was too great to be feasible for industry.

In river re-aeration, the deficiency in dissolved oxygen in the stream is satisfied by diffusing large amounts of air into the water of the river below the point of discharge of the waste. The diffused air appears to reduce rapidly the biological oxygen demand of the receiving waters, as well as add a considerable amount of the dissolved oxygen. Efficient application of this method is limited to streams where the oxygen content falls below 4 ppm. with flows of 1,000 cu. ft. per second. Under these conditions, it was found possible to add as much as one and one-half tons of oxygen daily. As far as is known, this process was tried for the first time on commercial scale in 1943 in the Flambeau River near Park Falls, Wis. Several "baskets" of the plate-type diffusion media were placed at the bottom of the river, and compressed air was pumped in at 5-15 psi, thus introducing the oxygen from the air into the water. The apparatus is required only during the warmer summer months, for during the winter months the dissolved oxygen content is higher and the microbiological activity is considerably reduced. Of the several methods of disposal, re-aeration his the advantage of lower cost of installation and operation than that for the trickling filter process.

The problem of utilization, at present, is not what to do or how to do it, but rather the case of finding a large enough market for the by-products produced.

As far back as 1878, A. Mitscherlisch, a pioneer in the sulfite cooking process, recognized the possibility of producing alcohol from the waste sulfite liquors; 30 years later the first plant was built in Sweden.

In North America, several such plants were constructed between 1942 and 1945 because ethyl alcohol was a vital raw material in the manufacture of synthetic rubber and explosives. In 1944, the Puget Sound Pulp and Timber Co. entered into agreement with the Defense Plant Corporation to produce 1,800,000 gallons of ethyl alcohol annually from waste sulfite liquors. This was the first plant in the West, and the only one in the United States using waste sulfite liquor as a raw material to make ethyl alcohol.

The process was comprised of the following steps:

1. Separation of waste sulfite liquor, its collection, and storage.
2. Conditioning of waste liquor for fermentation.
3. Addition of yeast and fermentation.

4. Separation of yeast from fermented liquor for re-use.
5. Separation, concentration, and purification of alcohol by distillation.
6. Warehouse and shipping.

This fermentation process is called the "re-use" of yeast process which was developed by Les Usines de Melle. It is based on the fact that yeast functions more efficiently in a medium to which it has been accustomed. Thus, after a batch has been fermented, the yeast is removed by a centrifugal separator, and then re-used. The more times the yeast is re-used, the greater the production of alcohol.

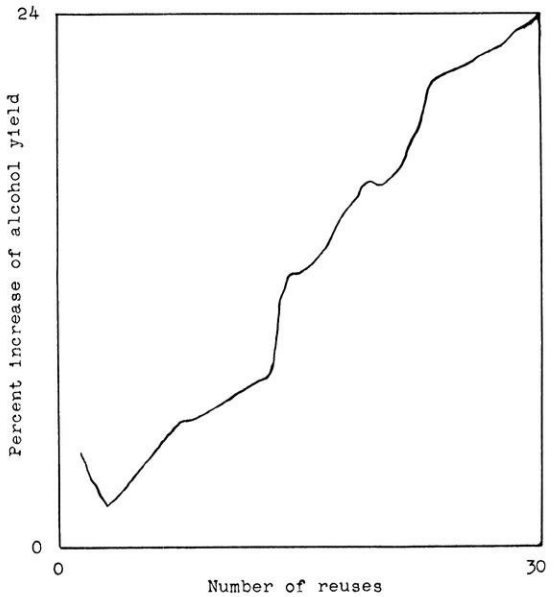
At the Puget Sound plant the production rate is 28 gallons of ethyl alcohol per ton of pulp, or about 6,500 gallons per day. This production equals the pre-war production and consumption of alcohol on the west coast. It must be remembered that the production rate is controlled by the rate of pulp production.

Another plant producing industrial alcohol from waste sulfite liquor is the Ontario Paper Co., at Thorold, Canada. This plant, like the Puget Sound plant previously mentioned, was developed during the war years, and is continuing production under improved methods. Here the process has been so simplified that only four men per shift are required for operation, with a trained chemist being used during the day to run routine analyses on the product. Following are some statistics on production at this plant:

1. Waste sulfite from storage to alcohol plant ..... 198,000 Imp. gal.
2. Fermentable sugars ..... 1.34 gm/100 cc.
3. Fermentable sugars ..... 26,000 lbs.
4. Average fermentation time ..... 15.2 hrs.
5. Fermentable sugars in last test ..... 0.05 gm/100 cc.
6. Ethyl alcohol production ..... 1,336 Imp. gal.
7. Strength of alcohol ..... 96.3% by vol.
8. Methyl alcohol production ..... 72.7 Imp. gal.
9. Ethyl spirit in per cent of total alcohol produced 94.8%
10. Sulfur content of ethyl alcohol ..... 1.4-2.1 ppm.

By this method alcohol can be produced at a cost of 10-20 cents per gallon, and in large plants for as low as eight cents per gallon. The current price of ethyl alcohol is 18 cents per gallon. At present, about 30 plants in Sweden are economically producing alcohol from waste sulfite liquors, because of the high price it demands on the market.

Another usable commodity from waste sulfite liquors is an edible yeast. Such yeast has a mild flavor, light color, and almost is indistinguishable from that grown from molasses. During the war (1942-1945) the Germans utilized this method to make a fodder for cattle as a supplement to their food supply. This wood yeast contains 1.6% more digestible protein than any other concentrates now used for cattle rations; it is also good for poultry and hogs. The process involves the use of "torula utilis," a yeast culture which utilizes pentoses, hexoses, and acetic acid. It is somewhat similar to the process for producing alcohol, except conditions are made more favorable for the growth of the yeast, rather than alcohol formation. Yields of 120 pounds of yeast per tons of pulp were predicted, or 277 pounds of 93% yeast per hour from 730 pounds of sugar. Total production available per year equals 150,000,000 pounds. During the war this "torula yeast" was produced in Germany at the rate of 7,300 tons per year. In this country, torula yeast can be produced for four to five cents per pound. This compares favorably with the present cost of yeast at 8-12 cents per pound. Evidence that this method of yeast production is out of the experimental stage is the fact that The Lake States Yeast Corporation will build a $500,000 plant to produce yeast from paper mill wastes at Rhinelander, Wis. The process to be used at this plant will probably be similar to the production of "torula yeast," but actual facts and data on the process are not yet available. It is expected that actual production will begin some time in the summer of 1949.



This sketch shows the relation of the per cent increase in alcohol yield to the number of times the yeast is re-used.

The "Howard process" is another method devised for utilization of the waste liquors from a Wisconsin paper mill. In this process chemicals and lignin are recovered which in turn are used for production of vanillin and plastics. Waste sulfite liquor is treated with lime; calcium sulfite is recovered in the first step, and calcium lignin sulfonate in the second step. From the latter pure vanillin, tanning agents, surface active agents, and carbon black have been produced. The spent liquor is used to "cook" more wood chips, yielding a plastic which may be pressed in sheets, or ground into molding powder. The ligno-sulfonate can be used in that form as a dispersant for solids in water and to retard settling of particles, to reduce viscosity of the dispersion at a given solids content, and to maintain low viscosity, but increase solids concentration. An instance of the use of dispersants is in the operation of combining carbon black with rubber latex. Without the dispersant, the concentration of carbon black in rubber latex is limited to about 6%; whereas with the dispersant, a concentration of 30% carbon black can be attained. The dispersant can also be used in agricultural sprays to dis-

(*please turn to page* 30)

Science Highlights

by Robert Johnson e'50

"OPINION METER"

A new device for measuring opinion, taking averages, and generally testing the sentiment of small groups anonymously has been developed by the General Electric Company. The device was developed primarily to be used in meetings of boards of directors, but it may eventually be adapted to taking straw votes and similar tests of public sentiment.

Consisting of a thyratron tube, a wheatstone bridge, a small motor, and a face of about 24 by 30 inches, the entire gadget may be packed in a suitcase. The individuals expressing their opinion hold small dials in their hands. These dials, when set at the desired opinion, control the voltage on the wheatstone bridge which in turn causes the motor to stop at the point at which the aggregate opinion is expressed. Only the individual voter knows how he has voted.

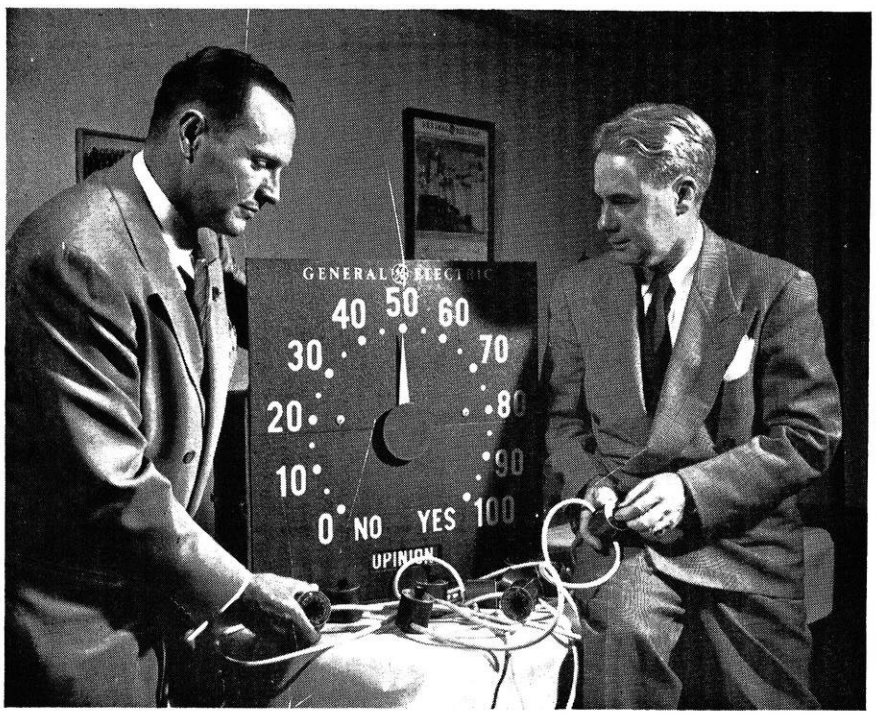
One string of small hand dials is generally included as standard equipment with the opinion meter. However, it is possible to use as many as 10 strings of 12 dials each with each meter. This means that as many as 120 persons could express their opinions anonymously at one time. The machine also discloses the number not voting and the number who are undecided.

NEW CRYSTALS FOR INFRARED SPECTROMETRY

For the past two years, scientists of the National Bureau of Standards have been engaged in a study of thallium halide crystals to determine the feasibility of developing prisms of these substances for use in long-wavelength infra-red spectrometry. These materials possess optical properties of considerable value for measurements in the infra-red region, but crystals of sufficient size have never been produced. During the last war, however, mixed crystals of thallium bromide-iodide were grown at Jena, Germany, and lenses were made from them for use in field instruments. The Bureau of Standards began a program of growing crystals of the thallium halides in 1946, and a single mixed crystal of high purity was successfully grown.

Prisms of other materials, such as potassium bromide, are available for measurements to 24 microns, but the new thallium bromide-iodide prism allows observations to be made with a prism spectrometer all the way out to 40 microns. Studies are now being made of a great variety of materials to find substances having transmission characteristics that would make them suitable window materials for use in cells and in other applications of the 24- to 40-micron band.

The data obtained in these investigations promises to be of great assistance in designing lens systems and in determining optimum prism angles for use in the different regions of the infra-red spectrum. As additional crystals are being produced, other applications of measurements in this portion of the spectrum are being developed.



—Photo courtesy of MILWAUKEE JOURNAL

W. A. Mann (left) and E. L. Nicolson of the Milwaukee office demonstrate the newly invented "opinion meter" developed by the General Elecrtic Company.

"MAGNETIC SUSPENSION" BEARINGS IN NEW METERS

A new type of watthour meter employing a radically new principle has been developed by the General Electric Company. A rotating disk actually floats in air and is suspended in space by the interaction of two very small "cunico" magnets. This suspension eliminates the need for sapphire jewel bearings which have always been used in such meters, and which have been the major item in meter maintenance.

The new magnetic suspension is made possible by the high coercive force of cunico, the copper-nickel-cobalt permanent magnet alloy developed by G.E. Cunico is supplied in the form of rod, strip, or wire instead of the cast or sintered form of the better known "alnico" series of alloys. The two cunico magnets

(*please turn to page* 40)

Opportunities for Engineers

Civil Service

by John Misey e'49

THE post-war era is undergoing one of the greatest expansions in our economic life. The tremendous amount of energy exerted during the war years has produced a vast supply of applications which are now being converted to peacetime uses. This conversion requires not only many man hours of labor but also a huge supply of technical experience to carry it through to a successful completion. The question in every student engineer's mind should therefore be how to prepare oneself to take a place in the whole scheme. The best way is to observe what technical experience suits each student's taste, find what educational experience is required, and then direct all efforts toward that goal.

When graduation approaches a host of interviewers descends upon the engineering campuses of the country with the sole purpose of attracting the best talent into their organizations. There is, however, one interviewer who generally makes his presence known only by posting announcements on the bulletin boards. This person is seeking men for public service under auspices of the Civil Service Commission, whether it be local, state, or federal. Of these the federal government has set the pattern of offering the best opportunities to engineers who graduated or will be graduating shortly.

Very few people realize that the federal government is the greatest employer in the country. In its monthly report for May, 1948, the Federal Civil Service Commission listed 2,061,342 employees on its payroll. It is therefore important that future engineers should consider civil service as carefully, if not more so, than private employment. Despite the fact that many rumors have been circulated to the effect that most of the engineering opportunities would disappear by 1949, the government is begging for technical help, especially in engineering. At this moment there are over 12 assignments of examinations listed covering all phases of engineering and having no closing date. Besides the need in all the general branches of Chemical, Civil, Electrical, Mechanical, Mining, and Metallurgical Engineering opportunities are plentiful in specialized fields as Aeronautics, Communications, Navy Architecture, Electronics, Structure, Materials, Sanitation, Hydraulics, Highways, Soils, and others. With such an abundance of opportunities, the engineer can practically apply for the type of work he desires to specialize in. The only preliminary effort is to make a trip to the local post office or the placement bureau on the campus for an announcement.

The announcements for the position of engineer are classified by grades. These are numerical and are superseded by the letter "P" which indicates professional status. The lowest grade is P-1 and goes up to P-8 as professional maturity of a person increases. With every grade there is a minimum and maximum basic salary obtainable which varies from $2,974.80 a year for the minimum wage of a P-1 rating to $10,305.00 a year for the maximum wage of a P-8 rating. The accompanying chart gives the basic salary for every grade, and includes periodic raises as well as maximum salary obtainable for every grade. When cost of living bonus and other benefits are included with the basic salary these salaries agree favorably with those given by private employers.

TABLE OF SALARY CHANGES IN ACCORDANCE WITH THE FEDERAL EMPLOYEES SALARY ACT OF 1948

Grade of Position	Old Basic Salary	New Basic Salary	Periodic Increase	New Maximum Basic Salary
P-1	$2,644.80	$2,974.80	$125.40	$ 3,727.20
P-2	3,397.20	3,727.20	125.40	4,479.60
P-3	4,149.60	4,479.60	125.40	5,232.00
P-4	4,902.00	5,232.00	250.80	6,235.20
P-5	5,905.20	6,235.20	239.40	7,192.80
P-6	7,102.20	7,432.20	239.40	8,389.80
P-7	8,179.50	8,509.50	299.25	9,706.50
P-8	9,975.00	10,305.00	.....	10,330.00

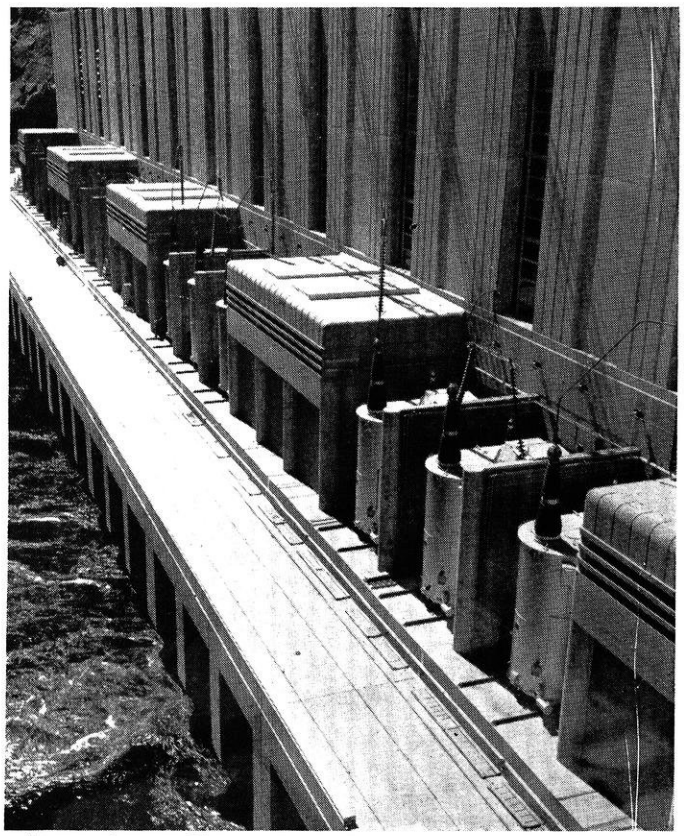
Requirements

Every grade of engineer has certain qualifications which are clearly printed in each announcement. The general requirements are listed below:

1) Citizenship—Applicants must be citizens or owe allegiance to the United States.
2) Age—Applicants must have reached their 18th birthday at the closing date for acceptance of the application. The upper age limit is determined by the grade of engineer sought after, but these age limits do not apply to persons entitled to veterans' preferance.
3) Physical Ability — Applicants must be physically capable of performing the duties of the position and be free of such defects or diseases as may constitute employment hazards to themselves or other federal employees. Physical abilities vary with some posi-

tions and therefore persons with physical handicaps which will not hinder them in the satisfactory performance of duties of the position are invited to apply.

4) Education — Applicants must complete a standard professional engineering curriculum leading to a bachelor's degree in a college or university of recognized standing. Substitution for educational requirements may be made by showing successful and progressive technical engineering experience of such a nature as to enable them to perform successfully at the professional level. This substitution consists of one year of experience for one year of education.



Power plant at Hoover Dam. The Bureau of Reclamation built this dam; now directs its operation.

5) Experience—There is no additional experience required for the grade of P-1. For positions in higher grades applicants must show additional professional engineering experience in one of the general fields. Some of this experience must include at least one year of important and responsible work in one of the fields. Graduate study may be substituted for experience up to a maximum of two years. Completion of all scholastic requirements for the master's degree will be accepted for eligibility in the P-2 grade.

6) Basis of Rating—For the grade of P-1 a written test is required. This test of general abilities includes paragraph reading, vocabulary, English usage, graph and table interpretations, arithmetic reasoning, abstract reasoning, and spatial perceptions. For the higher grades no written test is required unless definitely specified. Applicant's qualification will be judged from a review of their experience, education, and training, and on corroborative and supplementary information which may be obtained. In both cases competition will be rated on the basis of 100 and from this a register is prepared.

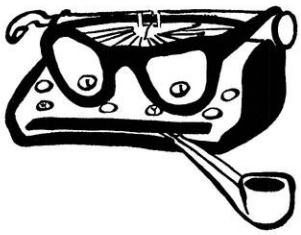
7) Preference—Veterans who have served honorably in the armed forces of the United States during any war or in any creditable campaign or expedition is entitled to preference which consists of having five points added to the earned rating. Ten points are added to the earned rating of applicants who establish a claim as:
   a) a disabled veteran
   b) the wife of a disabled veteran who is disqualified for appointment because of his service connected disability, or
   c) the widow (who has not remarried) of a deceased ex-service man who could have claimed veteran's preference.

Many of the grades are beyond the reach of the average graduating engineer. Realizing this the Federal Civil Service Commission conducts an examination for a "Junior Professional Assistant" with a grade of P-1. Students attending a college or university of recognized standing who expect to complete all courses leading to a bachelor's degree by June 30 of the following year are accepted for this examination. It is given every year, usually during the months of November and December. Another examination of interest to graduating engineers is that of "engineer" with the Bureau of Reclamation at Denver, Colo. Here again applications will be accepted from senior students who can qualify in the options of Civil, Electrical, Irrigation, and Mechanical Engineering. Unlike the latter examination this one has no closing date. The only requirements for qualification are age, citizenship, physical ability, and a written examination.

An opportunity for engineers in the subprofessional level is in the Bureau of Reclamation at the SP-4 and SP-5 levels. These are summer jobs for students who have completed their sophomore and junior years respectively. At the end of the summer they are given leaves of absence to continue their schooling. Upon graduation, they are eligible for the P-1 rating.

One of the advantages of Civil Service is that positions can be filled in practically any locality. For those who prefer to stay in the Midwest the Seventh Regional Office announces an examination for engineers with grades from P-2 through P-7 to serve in various Federal Agencies in the states of Illinois, Michigan, and Wisconsin. The options are aeronautical, communication (wire), electrical, fire protection, gas, industrial, materials, mechanical, metallurgical, petroleum, plumbing, radio and electronics, safety, sanitary, and welding. If the West is calling, the Bureau of Reclamation at Denver is seeking engineers for all grades to assist in its big projects throughout the western states. If the far West is more desirable, the National

(*please turn to page* 34)



The Way We See It

S.N.A.F.U.

WE HAD the questionable honor of visiting the office of the Rottendorf **Incubator** during our summer vacation, and frankly, after viewing the premises we wonder to what state the noble profession of engineering has degenerated.

The first item that caught our roving eyes was the complete absence of empty beer bottles. Apparently the **Incubator** staff was addicted to drinking a nauseous fluid called Coca Cola, which proved upon investigation to be composed largely of water. Any competent engineer knows that water is fit only for boilers, and that the rightful fuel for mankind is spiritus frumenti.

As further evidence of the lack of sensibility of the local denizens, we noted three copies of the **Wisconsin Engineer** unopened in a stack of mail. Apparently the word has not gotten to Rottendorf yet that our magazine is good reading. (That such is true can be proven by a casual count of the number of publications which copy from us, some of them having the audacity to publish versions of our stories before we do!).

Additional indication of moral turpitude on the part of the Rottendorfers was the fact that while their office is only one half as large as ours, they had only one small pile of honest-to-gosh trash, whereas we have managed to fill our office to the ceiling. Gentlemen of the **Incubator,** it takes real talent to run a magazine for an entire year without cleaning out the office!

At this point horror overcame us and, grinding our cigarette out morosely on the floor (we can't even **see** our floor any more), we stalked away, taking with us the impression that the **Incubator** staff were probably a bunch of sissies who shaved once a week and went out with girls.

Out here at Wisconsin we never shave. We don't like wimmin, and the only cleaning we do is to empty the cuspidors once a month. Furthermore, **our** football team can lick **your** football team, drunk or sober. Nyaaah!

H.W.

INFORMATION, PLEASE

WITH THE rapid developments in the field of engineering it is necessary for the student of this profession to consult sources outside of the classroom in order to keep abreast of these changes.

One of the best of these sources is the journals published by the various publishing houses. The articles to be found in them are of utmost importance, but they are by no means the only source of information within the covers.

The student can find more, if he would care to look. The advertisements in these publications are an excellent supplement to the information of the classroom. New developments are often presented in advertising copy even before an adequate discussion is presented by means of an article. Advertisements offer the essentials of a new method or technique for the minimum of reading. A student can learn what standard materials are available. Many an ad invites the reader to write in for further information; information that is up-to-date.

A further benefit to be derived from the advertising pages of your technical magazine is the familiarity with the names, products, and policies of various manufacturers. Several of the advertisements in this magazine are intended to serve the latter purpose. Through these ads, the company is not trying to sell its product to the consumer, but rather is trying to sell itself to its prospective employees—you, the engineering students. These advertisements employ pictures, graphs, and drawings to depict the work of engineers in producing the products.

The engineer must be familiar with all types of products and where they can be had. This fact cannot be questioned. Advertising offers a most ready source of information needed by the practicing engineer.

R.W.H. & W.H.

S-T-A-T-I-C

by Chuck Strasse e'50

The phrase of the day of course is similar to that famous one used by General MacArthur—"We have returned."

A glance from one of the Madison Bus Company's vehicles shows that outwardly the campus is about the same. Music hall clock is still slow; Abe Lincoln remains seated; the temporary buildings look just as crummy; and Diogenes (Officer Hammersley) is still around with his little flashlight.

A friendly politician I know suggested that a metal owl be installed in a tree outside the Law building so that the unsuspecting would be scared away before they get caught in a writ of habeas corpus or some other shyster web of iniquity.

Surely you all want to get to the meat of this column, so here are the jokes (apologies to N. Webster). If anyone has any better ones kindly print them on a sheet of **soft** paper, fold three times, write "Static" on the front and drop in the Wisconsin Engineer box in the lobby of the M. E. building.

Drawing I

Co-eds say:
Necking is a form of divansport.

* * *

As the woman said to her husband who was looking at the display in a dentist's window, "John, don't pick your teeth in public."

* * *

"Your fraternity brother is always so well dressed."
"Yes, we call him railroad track."
"Why?"
"Because he has so many ties."

* * *

Women wear girdles from instinct—the desire to be squeezed.

* * *

An ashtray is the place where you put your butts when the room you're in doesn't have a floor.

* * *

There was a young fellow named Krause
Who got on a terrible sauss;
He had the right key
In the keyhole, you see,
But the keyhole was in the wrong house.

* * *

The working girl had an evening appointment with her dentist for an extraction. Arriving home at two in the morning, her mother asked why she was late. "He ran out of gas," was the answer.

* * *

Two bachelors were reminiscing.
"Why I still get letters from ladies all over the country," one boasted. "Yes," countered the other, "landladies."

* * *

To be a bride is a hit or miss proposition. If a girl isn't a hit she remains a miss.

* * *

Math. Prof.: "What is the definition of straight?"
Student: "Without soda."

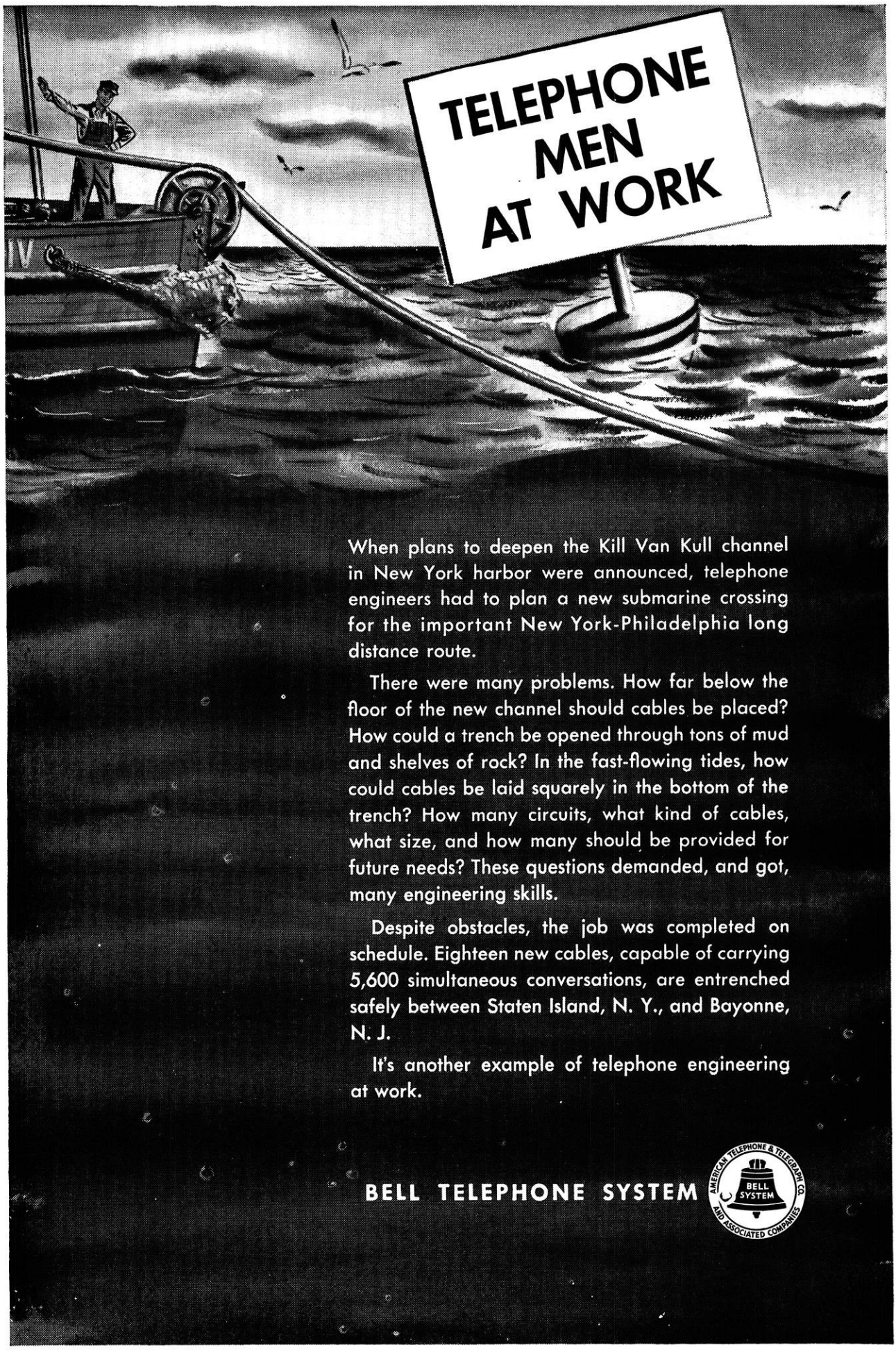
* * *

Slogan in the Y gym:
"Chest development or bust."

* * *

What did the Frenchman say after his fifth beer?
"Oui, oui—"

(*please turn to page* 28)



When plans to deepen the Kill Van Kull channel in New York harbor were announced, telephone engineers had to plan a new submarine crossing for the important New York-Philadelphia long distance route.

There were many problems. How far below the floor of the new channel should cables be placed? How could a trench be opened through tons of mud and shelves of rock? In the fast-flowing tides, how could cables be laid squarely in the bottom of the trench? How many circuits, what kind of cables, what size, and how many should be provided for future needs? These questions demanded, and got, many engineering skills.

Despite obstacles, the job was completed on schedule. Eighteen new cables, capable of carrying 5,600 simultaneous conversations, are entrenched safely between Staten Island, N. Y., and Bayonne, N. J.

It's another example of telephone engineering at work.

BELL TELEPHONE SYSTEM

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

COMPUTING DEVICES . . . (*continued from page* 11)

to another either after a predetermined number of calculations or in accordance with some criterion such as a change in the sign of some variable.

The limitations in the applications of the ENIAC are the following:

(1) Slow input and output.
(2) Limited internal memory.
(3) Large amounts of time required to manually set up control circuits.

EDVAC

The EDVAC (electronic discrete variable computer) as well as the ENIAC was designed by the University of Pennsylvania under the direction of J. W. Mauchly and J. P. Eckert. Because of the following design features, the EDVAC required only 3,000 tubes as compared to 18,000 tubes for the ENIAC:

(1) The use of the radix-two instead of the radix-ten number system.
(2) The use of series rather than parallel operation.
(3) The storage of numbers by acoustic delay tubes instead of ring counters.

The EDVAC is a faster computer than the ENIAC first, because the pulse rate has been increased from 10^5 pulses per second to 10^6 pulses per second and second, because the slow input and output devices have been replaced by magnetic tapes. Multiplication of two 10-digit numbers requires only 1 millisecond.

UNIVAC

The UNIVAC (universal computing machine), which was also designed by J. W. Mauchly and J. P. Eckert, is similar to the EDVAC requiring, however, only 800 tubes. the performance characteristics proposed by the Bureau of Census are the following:

Addition of two 10-digit numbers	0.1 milliseconds
Multiplication	2.00 milliseconds
Internal Memory	50,000 digits

IBM Electronic Calculator

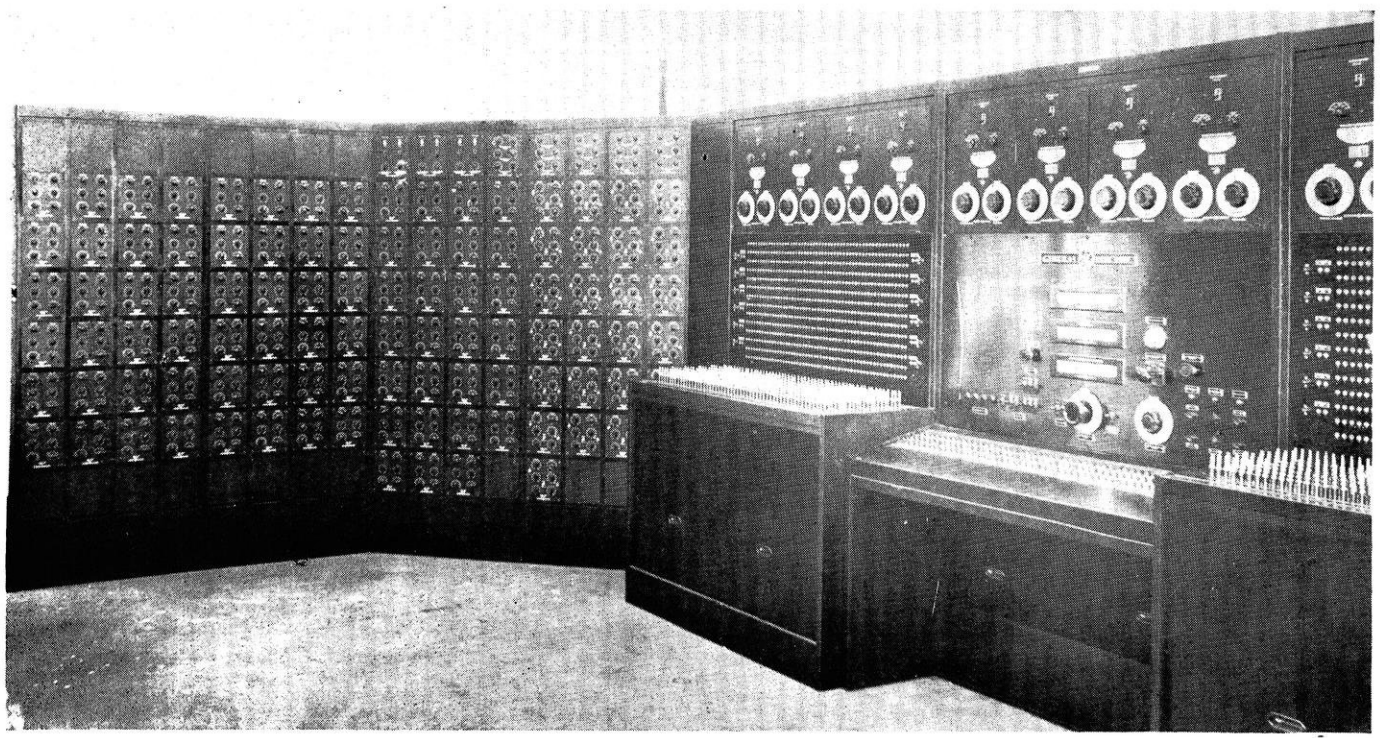
One of the latest developments in digital computers is the IBM selective sequence electronic calculator which is located in New York City. This device combines electronic tubes, relays, and punched tape to provide a memory capacity of 400,000 digits which may be supplemented by a virtually unlimited slow memory in punched cards. Addition or subtraction of 19-digit numbers is performed in 0.286 milliseconds; multiplication of 14-digit numbers, 20 milliseconds; and division of 14-digit numbers, 50 milliseconds. The productive capacity of the new machine which contains 12,500 tubes and 21,400 relays is 250 times that of the Mark I at Harvard University.

MIT Computer

MIT has initiated development work on an electronic digital computer. The memory unit is a dielectric insulating plate which stores positive and negative charges, the positive and negative charges representing the 2 digits of the binary system. These numbers appear as spots of light on the face of a cathode-ray tube, and a record of these spots may be obtained photographically. These quantities may be introduced into the machine by passing the film through an optical system which projects the recorded data on photoelectric tubes. These tubes in turn supply electrical signals corresponding to the numbers on the film.

Increased speed of calculation is obtained by using par-

(*please turn to page* 44)



The AC network analyzer is applicable to a wide range of power system design and operating problems.

DU PONT Digest

For Students of Science and Engineering

From tire cords to football pants

Do you know about nylon's other lives?

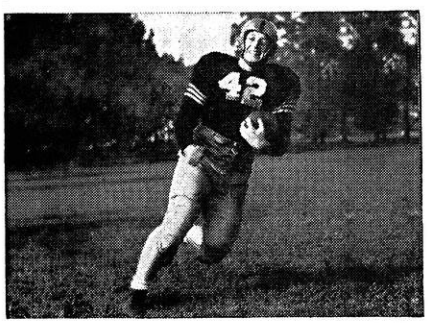
Here's a surprise for those who think of nylon mainly in terms of stockings and lingerie.

Nowadays, nylon fibers — twice as strong and half as heavy as the same size aluminum wire—are doing a variety of jobs, better than any previously known fiber. Off Labrador, men are harpooning whales with nylon lines. In a New England textile mill, abrasion-resistant nylon ropes now drive big "mule spinners" for periods ten times as long as other commercial materials, without a breakdown. Nylon fabrics are being used in everything from rugged automobile seat covers to delicately woven filter cloths.

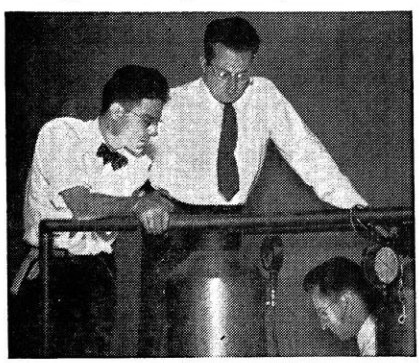
In its plastic form, nylon is used to make everything from unbreakable dishes to hypodermic needles. As a monofilament, it goes into a variety of products from brush bristles to surgical sutures.

Nylon cords *give giant truck and airplane tires the strength and elasticity to absorb tremendous impact shock without bruising.*

Water won't hurt the nylon strings *of this racquet. They resist breakage over an extended period of time. No tiny strands to fray.*



Nylon football uniforms, *as worn by Bobby Jack Stuart, Army back, are not only tough wearing, but much lighter and quicker drying.*



Nylon research: *O. C. Wetmore, Ph. D. Phys: Ch., New York U. '44; D. A. Smith, B. S. Mech. Eng., Purdue '40; C. O. King, Sc. D.-Ch. E., Mich. '43, charging experimental condensation polymers to a spinning machine.*

Nylon owes its origin to a Du Pont fundamental research project begun in 1928. A group of scientists set out to find out how and why the molecules of certain substances polymerized to form giant chainlike molecules. Hope of obtaining a new commercial fiber was first aroused when, two years later, a polymer was developed which could be drawn out into a thin strand, like taffy candy. The complex problems which followed called for the services of over 200 Du Pont men and women, among whom were some of America's most competent scientists and engineers.

Research—a Major Du Pont Activity

Nylon is an excellent example of modern research at work at Du Pont. Young scientists joining the organization now may share in other discoveries of outstanding importance. They may find opportunities in such challenging fields as finishes, coated fabrics and various fibers; synthetic organic chemicals, including fine chemicals; synthetic rubber; electro and agricultural chemicals; plastics; pigments and photographic film; and high pressure synthesis.

Each of ten manufacturing departments of Du Pont has its own staff and is operated much like a separate company. Within each, research men work in groups small enough to bring quick recognition of individual talent and capabilities.

Year after year, young, inquiring minds come from leading U.S. schools of science and engineering to Du Pont —where individual ambition is matched with opportunity, cooperation and the type of friendly support that brings out the best in each person.

You'll want to read this free booklet

"Du Pont Company and the College Graduate" is just off the press in a completely revised edition. Fully illustrated—describes opportunities in research, production, sales, and many other fields. Explains the plan of organization whereby individual ability is recognized and rewarded. Write for your copy today. Address: 2521 Nemours Building, Wilmington 98, Del.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

More facts about Du Pont — Listen to "Cavalcade of America" Monday Nights, NBC Coast to Coast

Campus . . . (*continued from page* 12)

HI PROF!

Hey, have you seen the new Prof? The College of Engineering has added several new professors to its teaching staff.

Professor T. J. Higgins comes to the Electrical Engineering Department from the Illinois Institute of Tech-

Higgins

nology. Doctor Higgins is interested in teaching and research and will teach Operation Methods and Electrical Circuit Theory.

Associate Professor John Baird was Assistant Professor of Electrical Engineering at the University of Rochester

Baird

Crandall

and had formerly taught at Cornell University. Previously he had been working for the U. S. Bureau of Reclamation in the Technical Studies Division. Doctor Baird will teach machinery and power engineering.

The Civil Engineers see the return of a Wisconsin graduate as Associate Professor Lee W. Crandall joins

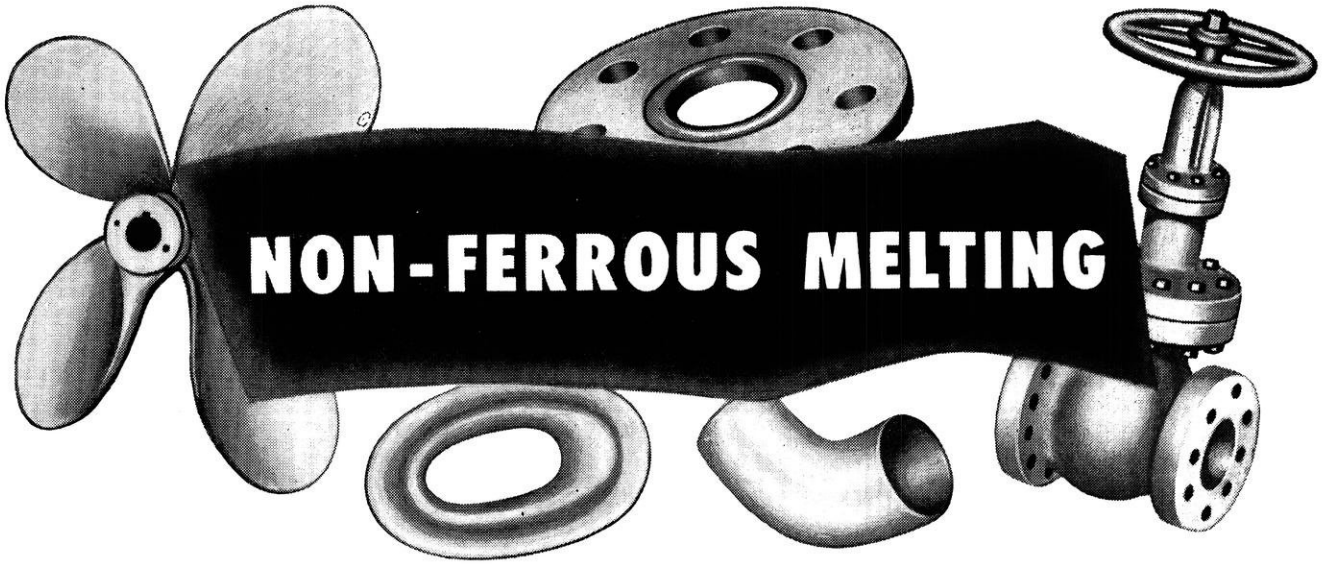
Leutwiler

Heine

the staff after teaching at the University of Denver.

The University of California gave up R. C. Leutwiler who will be Assistant Professor of Mechanical Engineering. He will be teaching machine design for the engineering students. Prior to the California post, Mr. Leutwiler taught at Purdue, Iowa State, and Tulane Universities.

Richard Heine was advanced to Assistant Professor in the Mining and Metallurgy Department.



Production of Marine Hardware at ELCHINGER FOUNDRY, NEW ORLEANS, Demonstrates Efficiency of *GAS*

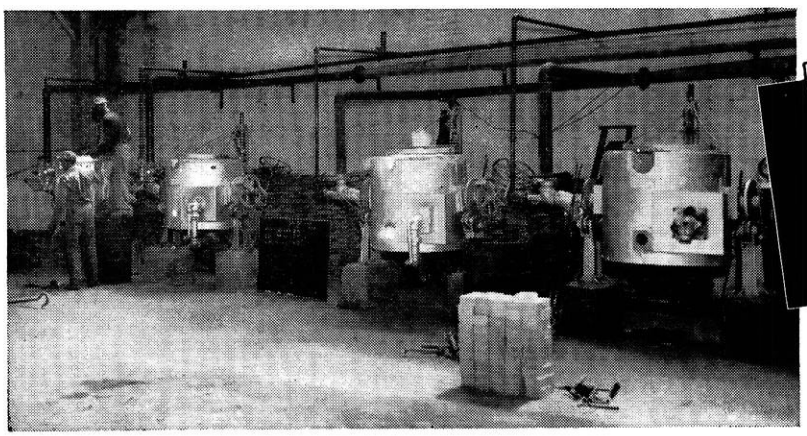
TEMPERATURE CONTROL is one of the most important factors in melting brass and bronze. And the strict control of each heat is especially important in the production of marine hardware which is subjected to extreme service conditions.

At the Charles F. Elchinger foundry in New Orleans, metallurgical supervision is facilitated by the use of four Gas-fired crucible furnaces which are so precisely regulated that any desired temperature can be maintained. This accurate control is necessary because various alloys require temperatures varying from 1850° F. to 2300° F.

But controllability is just one of the features which makes GAS the most desirable fuel for non-ferrous foundries. The four Gas-fired furnaces in the Elchinger foundry can be brought to heat in 2½ hours from a cold start or 1½ hours in succeeding heats—a simple demonstration of the speed of GAS.

The flexibility of GAS is important, whether it is used in a small foundry specializing in certain alloys, or in a large plant melting many types of non-ferrous metals. That flexibility is emphasized in the production control made possible in the Elchinger foundry by the use of four small furnaces capable of economical heating and reheating, at high speed, with GAS. In addition, cores are baked in Gas-fired ovens.

In every non-ferrous foundry operation requiring heat—for core-baking, melting, ladle heating—there's a job for GAS and modern Gas Equipment worth investigating.



MORE AND MORE... THE TREND IS TO GAS FOR ALL INDUSTRIAL HEATING

Employees prepare one of the four crucible furnaces for charging. These Gas-fired tilting furnaces are rated at 600 pounds each.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE NEW YORK 17, N. Y.

S-T-A-T-I-C . . .

(*continued from page 22*)

It has been proved that two can live as cheaply as one—a horse and a sparrow.

* * *

Tourist: "Do you have any outstanding sights here?"
Hotel Clerk: "Why, yes, we have the only helium plant in the world."
Tourist: "Oh! When does it bloom?"

* * *

He (in a phone booth): "I want a box for two."
Voice at the other end: "We don't have any boxes for two."
He: "Aren't you the theater box office?"
Voice: "No, we are the undertakers."

* * *

A tree is a thing that stands and grows in the same place for years and then jumps in front of a woman driver.

* * *

Pat: "My wife just had quadruplets."
Mike: "Well four crying out louds."

* * *

"I just came from a wooden wedding."
"No!"
"Yes, two Poles were married."

* * *

Some girls are easy to look at—others pull down the shade.

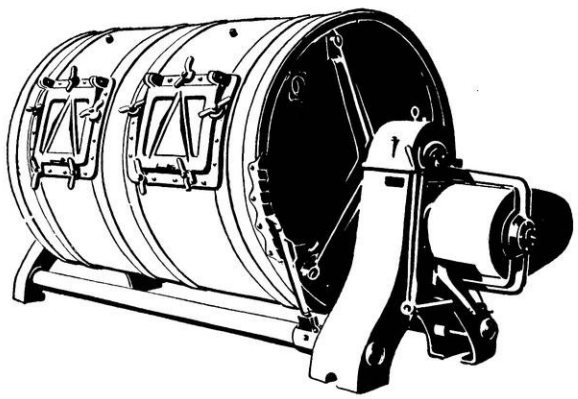
* * *

How many magazines does it take to fill a baby buggy?
A COUNTRY GENTLEMAN
A MADEMOISELLE
A LOOK
A few LIBERTY'S
And a little TIME.

* * *

Some girls think that smelling salts are sailors with B. O.

Another page for **YOUR BEARING NOTEBOOK**



How to turn a churn of butter better

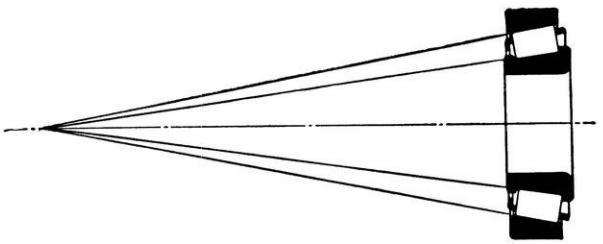
Engineers who design creamery equipment have found that a sure way to keep a churn turning smoothly, quietly and steadily is to equip all journals and countershafts with Timken tapered roller bearings.

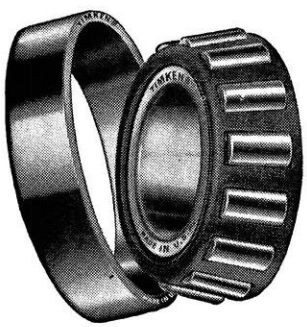
Because Timken bearings have true rolling motion and take both radial and thrust loads in any combination, the churn drive operates with less power, less wear, less maintenance. And with Timken bearings, more effective closures are possible, keeping lubricant *in* and dirt *out.*

Why Timken bearings have true rolling motion

The rollers in Timken bearings really *roll.* That's because rollers and races are precisely tapered so that all lines coincident with their tapered surfaces always meet at a common point on the axis of the bearing.

This means friction-free operation, minimum wear, greater precision. It's another reason why 9 out of 10 bearing applications can be handled more efficiently with Timken bearings.





TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Would you like to know more about bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'd be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◎ AND THRUST →◎← LOADS OR ANY COMBINATION ✳

Stream Pollution

(*continued from page 17*)

perse sulfur in water. Other products stemming from the Howard process are "a lignin-enriched filler," and a product called "Resin 26." The latter is a partially desulfonated lignin compound primarily used as an extender for varnishes, molding resins, and adhesives.

Another possible use for waste sulfite liquors is their addition in a concentrated form to the soil. The lignin and carbohydrates in the liquors may prove beneficial as agents for improving structural properties of soil through bacterial action. This would add to the humus supply through formation of bacterial protein-lignin complexes. The waste liquors must first be chemically treated and concentrated to about 50% solids.

As yet, no process has been found to separate the sugars in a pure state from the waste liquor. Were this possible, excellent results in reduction of pollution could be realized for the sugars are the chief offenders in waste liquors.

In conclusion, due to the ever increasing pressure of governing bodies plus rapidly expanding industries, it can be seen that the engineer must take into account the problem of waste disposal before he can consider his plant design complete. If the wastes are to be merely treated and disposed of, this will be an item of added operation expense. However, if the waste liquors are to be utilized for what marketable products they may yield, it is possible the project may help reduce operating expenses.

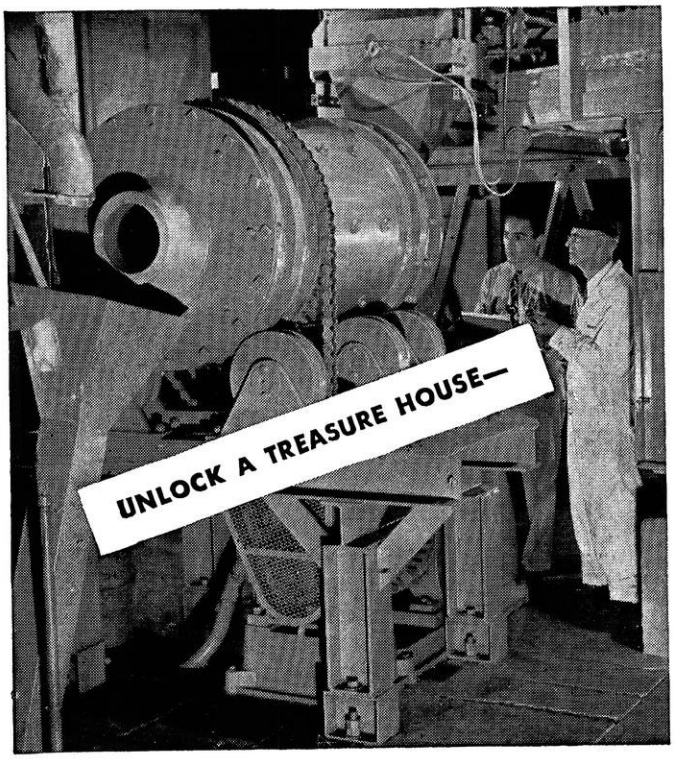
The biggest problem in utilization is finding a large enough market for the products. Normally, this country produces enough alcohol from molasses and grain to meet demand. However, in view of the present food shortage, it would seem that waste sulfite liquors could be used as a substitute raw material for alcohol manufacture. Each gallon of alcohol from waste sulfite liquors makes available a half bushel of grain, or 2½ gallons of molasses. Another market could possibly be found by combining ethyl alcohol with gasoline to be used as a motor fuel, in view of impending shortages. This has been done in Europe for many years.

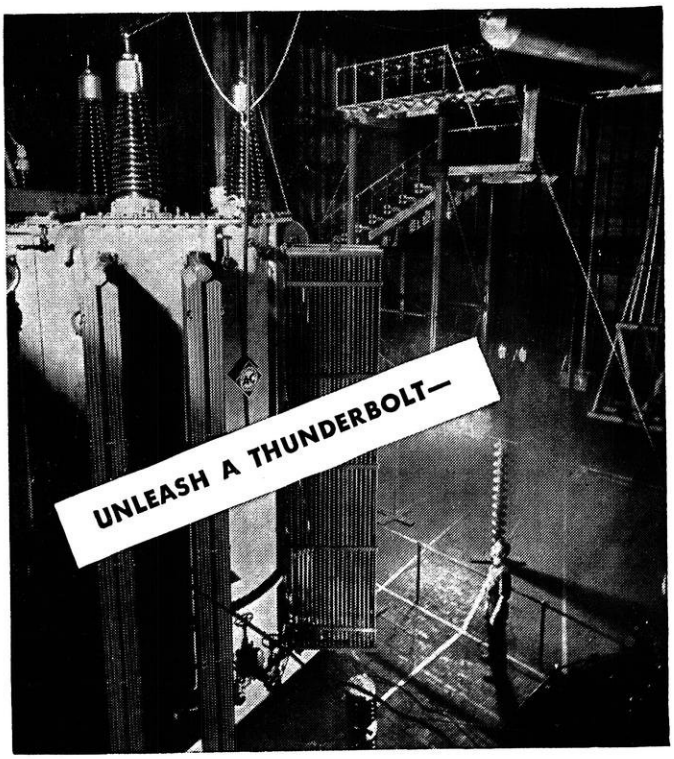
As for yeast production from waste sulfite liquor, the industry could turn out 150,000,000 pounds of dry "torula yeast" per year at a price lower than that now produced from molasses, but the difficulty is, that there is not a sufficiently large market to absorb this production.

Since the plastics industry has yet to get out of the "gadget stage," production of ligno-sulfonates for plastics also faces the difficulty of insufficient market demand.

In considering all the aforementioned processes, the primary objective must not be lost sight of, namely, reduction of stream pollution. Production of alcohol reduces the effluent effect by 43%; yeast production by 60 to 70;% and ligno-sulfonate production by 40%. There are other processes showing comparable results, but the cost involved renders them useless.

OPEN: New Fields to Explore!





AN Allis-Chalmers scientist seeks new, better ways to reduce low-grade ores . . .

. . . another hurls lightning at giant transformers to test abnormal stresses . . .

. . . another catches "wolf whistles" from the sun for clues to better power transmission!

The whole history of A-C is one of far-flung research and pioneering . . . of revolutionary advancements in almost every field of science and industry!

Whatever your chosen field—electric power, hydraulics, processing, machine design or production—you'll find unequaled opportunities in Allis-Chalmers' broad range of operation!

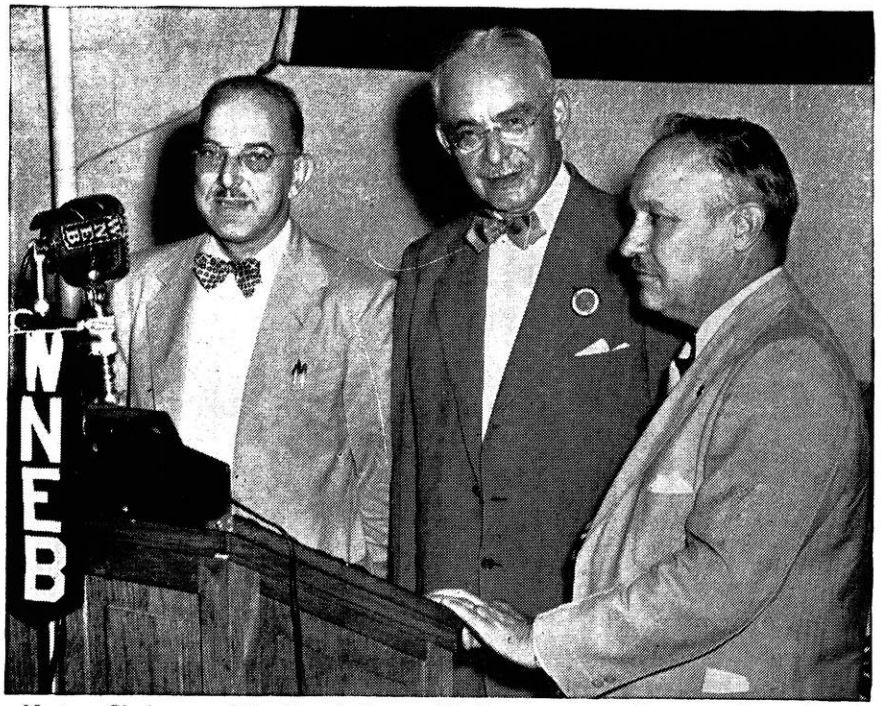
INVESTIGATE

ALLIS-CHALMERS

ONE OF THE BIG 3 IN ELECTRIC POWER EQUIPMENT—
BIGGEST OF ALL IN RANGE OF INDUSTRIAL PRODUCTS!

Write for Book No. 6085, outlining A-C's Graduate Training Course.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wisconsin



Norton Chairman of the Board George N. Jeppson pays tribute to the work of development engineers Wallace L. Howe (left) and Edward Van der Pyl (right) for their work in solving countless problems in building and equipping the world's largest grinding wheel plant

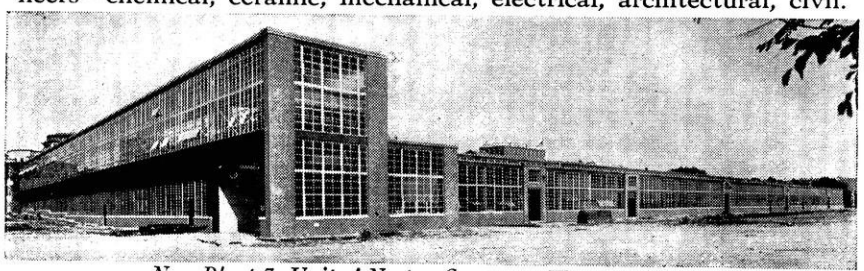
New Era in Grinding Wheel Manufacture

A revolutionary new process in the manufacture of grinding wheels is being carried out in the recently dedicated Norton Plant 7, the largest of the eighty-six buildings that stretch for a distance of one and one-half miles in the Greendale section of Worcester.

In this new Norton plant, with floor space of approximately five acres, grinding wheels are being made at a speed and with a uniformity never before known in the abrasive world.

Abrasive grain and bond, brought in one end of this six hundred and two foot building by a modern conveyor system, moves down the line for various processes, through continuous electric kilns, to finally emerge at the shipping end ready for service in the industrial world.

The new process envisioned through the more than half century experience of George N. Jeppson and the mammoth new building to house it have become realities by the co-operation of Norton engineers—chemical, ceramic, mechanical, electrical, architectural, civil.



New Plant 7, Unit of Norton Company, Worcester, Mass.

NORTON

ABRASIVES — GRINDING WHEELS — GRINDING AND LAPPING MACHINES
REFRACTORIES — POROUS MEDIUMS — NON-SLIP FLOORS — NORBIDE PRODUCTS
LABELING MACHINES (BEHR-MANNING DIVISION: COATED ABRASIVES AND SHARPENING STONES)

Alumni . . .

(*continued from page* 14)

Beloit Iron Works, Beloit, Wis.

These men are employed in the Graduate Student Course at Westinghouse: **William K. Creelman** (EE), **Delmar R. Dhein** (ME), **David F. Doeller** (EE), **Joseph H. Gifford** (MS in EE), **James J. Kunes** (EE, former editor of this column), **Henry J. Oakes** (EE), and **John J. Westland** (ME). Also **James W. Gorton** (ME'47) was transferred to the Buffalo (N. Y.) Works, Engineering Dept., on June 1, 1948. **Loren F. Weiss** (ME'47) was transferred to Lima (Ohio) Works on July 1, 1948.

George G. Pinney (ChE) is a pilot plant engineer at the Ansul Chemical Company, Marinette.

James F. Piotrowski (ME) is doing production work at the National Pressure Cooker Company, Eau Claire, Wis.

Robert L. Porth (ChE) is in New York with Carbide & Carbon Chemicals Corporation.

Edward F. Posch, Jr. (ChE) is an engineer with Thompson Aircraft Products, Cleveland, Ohio.

James R. Price, Jr. (EE) is a sales engineer at the Square D Company, Milwaukee.

James R. Randall (ChE) is Superintendent of Training, Cargill, Inc., Minneapolis, Minn.

E. R. Reichmann (ME) is a Physical Science Aide at the Naval Research Laboratory, Washington, D. C.

Charles D. Reiter (Met) is in the training program at the J. I. Case Company, Racine.

David H. Rice (EE) is in the design department, Louis Allis Co., Milwaukee.

Gene W. Richards (ME) is in the production department of Clark Equipment Co., Buchanan, Mich.

Frank Rizzo (CE) is Material Timekeeper for the Siesel Construction Co., Milwaukee.

John Norris (ME) announces the birth of Timothy McMillan Norris. John is with Babcock and Wilcox, Green Bay.

There's something here no photograph could show

Pictures could convey a clear idea of the buildings of Standard Oil's new research laboratory at Whiting, Indiana. We could also photograph the many new types of equipment for up-to-date petroleum research that are housed in the laboratory, one of the largest projects of its kind in the world.

Or we could photograph the men who work here, many of whom have outstanding reputations in their fields. For many years, Standard Oil has looked for and has welcomed researchers and engineers of high professional competence. We have created an intellectual climate which stimulates these men to do their finest work.

But no photograph could show the basic idea that motivates Standard Oil research. It is simply this: our responsibility to the public and to ourselves makes it imperative that we keep moving steadily forward. The new Whiting laboratory is but one evidence of Standard Oil's intention to remain in the front rank of industrial research.

Standard Oil Company

(INDIANA)

910 S. MICHIGAN AVENUE, CHICAGO, ILLINOIS

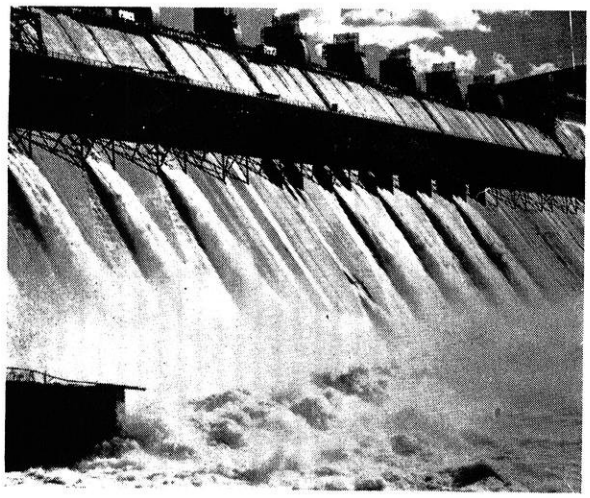
STANDARD

STANDARD SERVICE

CIVIL SERVICE . . .

(*continued from page* 20)

Advisory Committee for Aeronautics is looking for engineers who are interested in research. This will include aerodynamics, mechanics of statistics or moving bodies and structures, thermodynamics (theoretical and experimental), electronics, optics, combustion processes, physical or chemical metallurgy, lubrication, flight research, and applied mathematics. The U. S. Air Force has openings for engineers in development work at Wright and Patterson Felds in Dayton, Ohio, and also at Cleveland, Ohio. However, the majority of positions for engineers to be filled are located in the Potomac region. Civil, electrical, and mechanical engineers can work at Veterans' Administration establishments in the states of Maryland, North Carolina, Virginia, and West Virginia as well as the field service in the District of Columbia. The R. E. A. is interested in electrical engineers with options in design, construction, generation, transmission, farm electrification, and wiring to fill positions throughout the United States. The First Civil Service Region announces research opportunities for electronic engineers to work at the Naval Research Laboratory Field Station in Boston, Mass., and at the Navy Underwater Sound Laboratory in New London, Conn. These are but a few of the many localities where engineers can be employed.

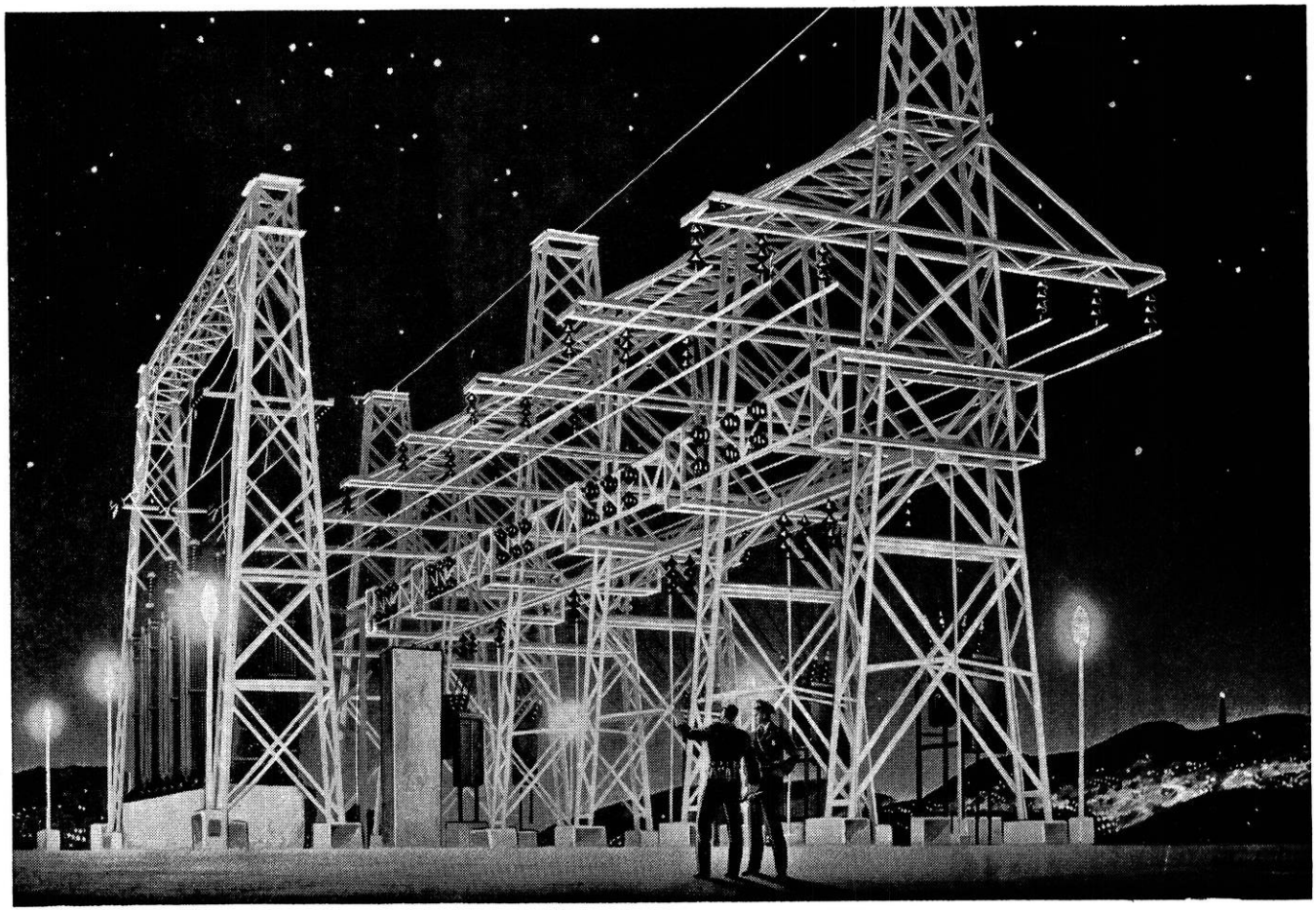


Grand Coulee Dam, another Reclamation project.

For further information and necessary card forms, the applicants can write to their respective regional office or the main Civil Service office. The correct mailing addresses are given below:

Main Office:
U. S. Civil Service Commission
Washington 25, D. C.

Seventh Region: Wisconsin, Michigan, Illinois
U. S. Civil Service Commission
New Post Office Bldg.
Chicago 7, Ill.



The skeleton where Volts are Housebroken

. . . with the help of Alcoa Aluminum Structural Shapes

Electricity is transmitted in raging, sizzling, high-tension currents that couldn't be allowed to enter a home or factory. To "housebreak" this hot stuff—step it down toward a useful 110 or 220-volt distribution stature—is the job of substations.

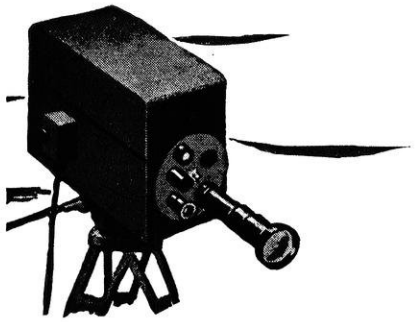
The "skeleton" of each substation—the framework of beams and girders that support the transformers and equipment—is prey to weather, corrosive atmosphere, clinging dirt. Good maintenance has always called for frequent painting, and that called for shutdowns of electricity . . . until substation builders heard about Alcoa Aluminum Structural Shapes! Now the skeleton of a substation can be built, and routine maintenance painting forgotten. Among the standard shapes made by Alcoa, engineers find sections exactly suited to their needs.

It gives a whole new concept to structures—this building with Alcoa Aluminum Shapes. When they are used for bridges, railroad enginehouses, industrial equipment and similar structures, damaging red rust will never be a menace, painters will be freed from their frequent rounds! That's something to remember when you start putting your degree to work and are designing structures for industry instead of for grades. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM 1888 1948 60 YEARS OF SERVICE

60 years ago aluminum was a novelty metal, used only for trinkets such as combs, watch fobs and napkin rings. Then along came a little company with two ideas firmly in mind—making aluminum *cheaper* and *better* so it could be more useful. That was the start of Alcoa, the start toward making aluminum so strong that it can often replace structural steel. Alcoa's 60 years of research and engineering development have swelled the uses of aluminum from a handful of trinkets to 4,000 different applications in industry, in homes, and on farms.



Plastics where plastics belong

Synthane where Synthane belongs

HERE'S Synthane at work in a channel selector turret . . . the nerve-center of any television receiver.
Synthane is employed for a number of the intricate parts to insure extreme electrical and mechanical precision and rugged operation. It's an appropriate job for useful, hard-working Synthane . . . a timely example of plastics where plastics belong.

In addition, Synthane is moisture and corrosion resistant, hard, dense, easy to machine, and has unusual electrical insulating qualities. Synthane is also structurally strong, light in weight and stable over wide variations in temperature.

These and many other properties—combined—make Synthane adaptable to countless chemical, electrical and mechanical applications. Synthane Corporation, 14 River Road, Oaks, Pa.

SYNTHANE

SYNTHANE TECHNICAL PLASTICS • DESIGN • MATERIALS • FABRICATION • SHEETS • RODS • TUBES • FABRICATED PARTS • MOLDED-MACERATED • MOLDED-LAMINATED

FLASH SYNCHRONIZER . . . (continued from page 13)

energize. Now the voltage due to current flow in the phototube appears on the grid of the tube, and since the tube has a very high gain, current flow increases greatly and the relay energizes, setting off the flash bulb.

This happens in an extremely short length of time. The following would be the sequence of events:

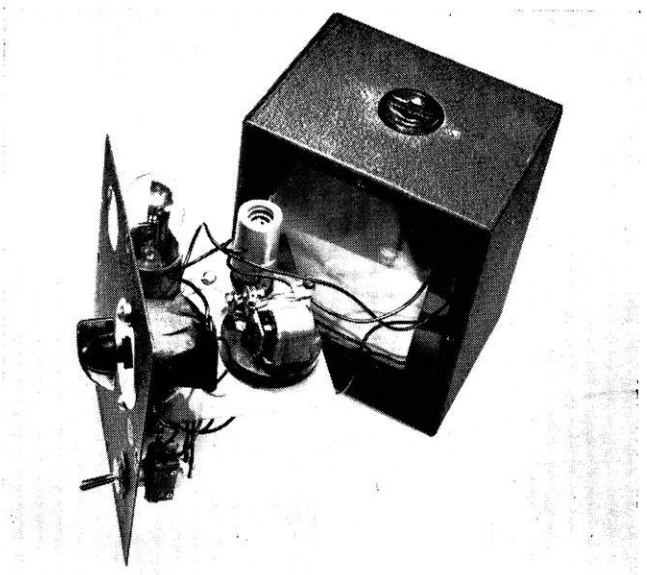
Set up the remote synchronization unit in the spot it is going to occupy when the picture is taken; this may be around a corner, back of a post, or almost anywhere, just so that the opening in the box where light reaches the phototube is facing in a direction where it will pick up either direct light from the flash bulb on the camea, or reflected light from a wall or ceiling.

Turn on the switch so the tube will heat up.

Adjust the potentiometer so that the relay just energizes, as shown by the flashlight bulb lighting up; this is also in the flash bulb circuit. Then turn back the potentiometer until the flashlight bulb just goes out; now the unit is on the verge of tripping; plug in the auxiliary reflector and insert the flash bulb.

When the camera is fired, the flash bulb on the camera begins to fire; the remote unit picks up this light even before the first bulb reaches its peak, and the second bulb goes off. As mentioned before, this unit synchronizes at 1/200th second with some time to spare.

Construction details are mainly up to the builder. The



A view of the Remote Control Flash Synchronizer with the component parts brought to view.

cabinet used here was made by the Budd Co. and their type number is CU-729. A small shelf may then be bolted to the front panel, to mount the two tubes and the relay. This can be made or bought. The 67½ volt battery is a Ray-O-Vac #4367; the 6 volts is made up by soldering standard #2 flashlight cells in series.

There is some leeway in the size of the potentiometer; any value between 500 and 1000 ohms will work satisfactorily. The resistance in the phototube circuit could be smaller, but sensitivity is lowered if the value of 2 megohms is reduced materially. A better way to reduce sensitivity for some specific occasion would be the use of neutral density filters over the phototube. As the circuit stands, striking a match five feet away will set it off.

There are many phototubes on the market which could be used equally well in this circuit. But, since they are made with specific response characteristics, i.e., to infrared light, etc., one should be used which is most sensitive in the center portion of the light spectrum, that is, white light, if best results are to be obtained for all-around usage. The actual size of the tube must be considered also, since it is in a fairly small box. In one of the units built, an RCA 1P39 tube was used, and in another, an RCA 1P37.

The relay used here is a 5000 ohm plate circuit type, type G, made by the Allied Control Co. It will energize with 4 milliamperes of current flowing. At the present time, the Allied Co. recommends substitution of their type BG relay for the type G. Almost any fast acting plate circuit relay could be used, if it energizes with from 2 to 7 milliamperes of current. It should have adjustable contacts. The setting of the contact spacing will help reduce any inherent delay. The flashlight bulb, mounted in a jewel socket, which indicates that the relay has energized, should be covered so that no light from it will reach the photoelectric tube (from inside the box itself).

THE SALESMAN WHO CARRIED A GLASS PIPE!

"LOOK AT THIS, Mr. Irvin!" said Joe the salesman as he whisked a short length of glass pipe out of his briefcase.

"This is one reason why our food products are pure and clean. Right up to final inspection, they flow through Pyrex glass piping. We can see them all the time!

"We can keep the pipes clean easily without taking them down. And when they're clean, we can see they're clean. And what's more, food and fruit acids don't attack glass, so there's no danger of spoiling the taste!"

Glass pipe to guard the purity and quality of your product is only one of 37,000 things we make at Corning Glass Works.

We make the glass bowls for five best-selling coffee makers. We know the answers to a lot of questions about television because Corning has been making the glass parts for television from the start. And if you sold housewares, we could help you attract new customers with our Pyrex Flameware Double Boiler, made of the first glass ever specially developed to stand the extra shock of top-of-stove cooking.

In nearly a hundred years we've found ways to make 50,000 different kinds of glass. Some of them may someday help you improve production or cut costs. Others may suggest ways to make your product more desirable or useful to the people who buy it. Remember us when that day comes. Corning Glass Works, Corning, N. Y.

IN PYREX WARE AND OTHER CONSUMER, TECHNICAL AND ELECTRICAL PRODUCTS ▶

CORNING
means
Research in Glass

Science . . .

(*continued from page 18*)

are placed concentrically with the outer one attached to the meter frame and the inner one to the disk shaft. Stainless steel guide pins keep the disk shaft in vertical alignment.

To provide a damping system minimizing side thrust, noise, and vibration, two small alnico V magnets are die-cast into the frame of the G.E. "I-50" meter. "Cunife," a third member of the G.E. family of permanent magnet materials, is employed for two magnets attached to the first cylinder shaft and bearing plate of the cyclometer register. As the cylinder revolves, the magnets alternately repel and attract each other; the coercive force of cunife being adequate to snap the cylinders into position when the moving magnet goes over dead magnetic center.

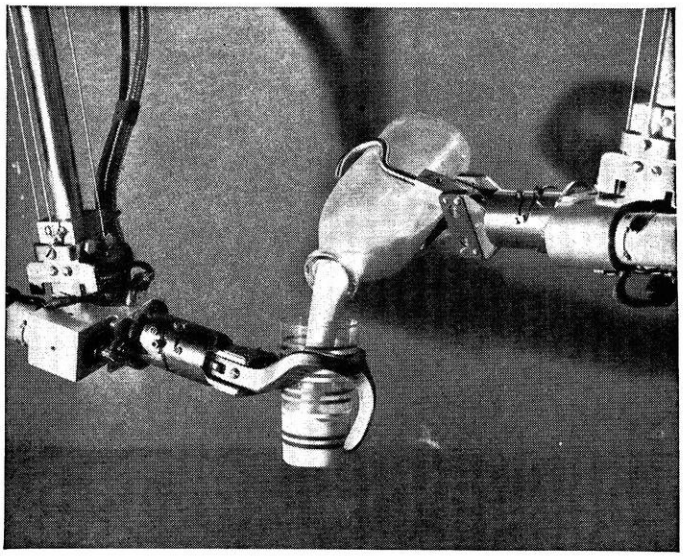
MECHANICAL HANDS

Mechanical "hands" which in dangerous radioactive regions can operate machines and perform delicate chemical experiments were recently demonstrated by scientists of the General Electric Company.

In use, the "hands" extended over an eight foot protective wall into a radioactive area where they performed many interesting and useful feats. Operated by remote control from a room outside the danger area, the hands were capable of performing such feats as pouring bottles from one to another, writing one's name, and operating a drill press. In this case, the hands can pick the correct drill from the rack, insert it in the chuck, place the work in position, turn on the switch and feed the drill.

The actual hands resemble the double hooks used by amputees. They are at the lower ends of two arms which descend vertically from two horizontal shafts eight feet high across the top of the wall. Vertical arms come down from these at the other ends, and carry at the bottoms the handles with which the operator controls the device. He views his mechanical hands with the aid of binoculars and a four mirror periscope, and controls the grasping action of the hands with foot pedals.

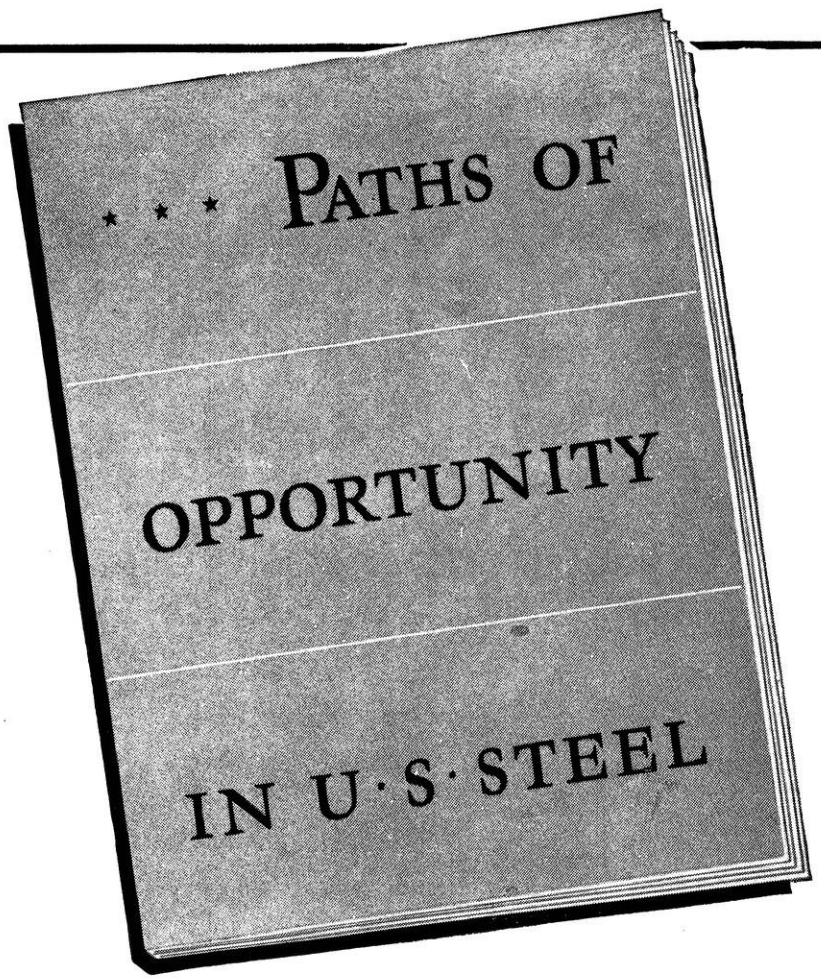
The general motion of the hooks follows that of the operator's handles. As the handles are moved up or down, forward or back, side to side, the hands follow suit. By wrist movement the handles can be turned around three axes, and this causes the hooks to do likewise. Most of the connections between the handles and hooks are mechanical, but the wrists are twisted electrically. This means that the mechanical wrists can be twisted around completely any number of times, which is particularly useful in unscrewing nuts and screws.



Just as milk is poured from bottle into glass here, mechanical "hands" or remote control manipulator can mix chemicals in experiments that have to be performed in "no man's land" radioactve areas.

—Cut courtesy of General Electric

To Engineering Students



"PATHS of Opportunity in U.S. Steel" explains the opportunities for the college graduate with United States Steel Corporation.

It describes the operations of the five major divisions of the Corporation. Explains the training program — shows how it provides a sound foundation for future progress.

U. S. Steel's promotion policy is explained. And interesting examples of the technical progress of the various subsidiaries are given.

Whether your field is mechanical, electrical, metallurgical, civil, chemical, industrial, mining, combustion, welding, lubrication, instrument, safety or transportation engineering, you will want to read this interesting book about the opportunities offered you by United States Steel.

You can secure a copy through your Placement Officer.

AMERICAN BRIDGE COMPANY · AMERICAN STEEL & WIRE COMPANY · CARNEGIE-ILLINOIS STEEL CORPORATION · COLUMBIA STEEL COMPANY
H. C. FRICK COKE AND ASSOCIATED COMPANIES · GENEVA STEEL COMPANY · GERRARD STEEL STRAPPING COMPANY
MICHIGAN LIMESTONE & CHEMICAL COMPANY · NATIONAL TUBE COMPANY · OIL WELL SUPPLY COMPANY · OLIVER IRON MINING COMPANY
PITTSBURGH LIMESTONE CORPORATION · PITTSBURGH STEAMSHIP COMPANY · TENNESSEE COAL, IRON & RAILROAD COMPANY
UNITED STATES STEEL EXPORT COMPANY · UNITED STATES STEEL PRODUCTS COMPANY · UNITED STATES STEEL SUPPLY COMPANY
UNIVERSAL ATLAS CEMENT COMPANY · VIRGINIA BRIDGE COMPANY

USS

UNITED STATES STEEL

Building . . .

(continued from page 8)

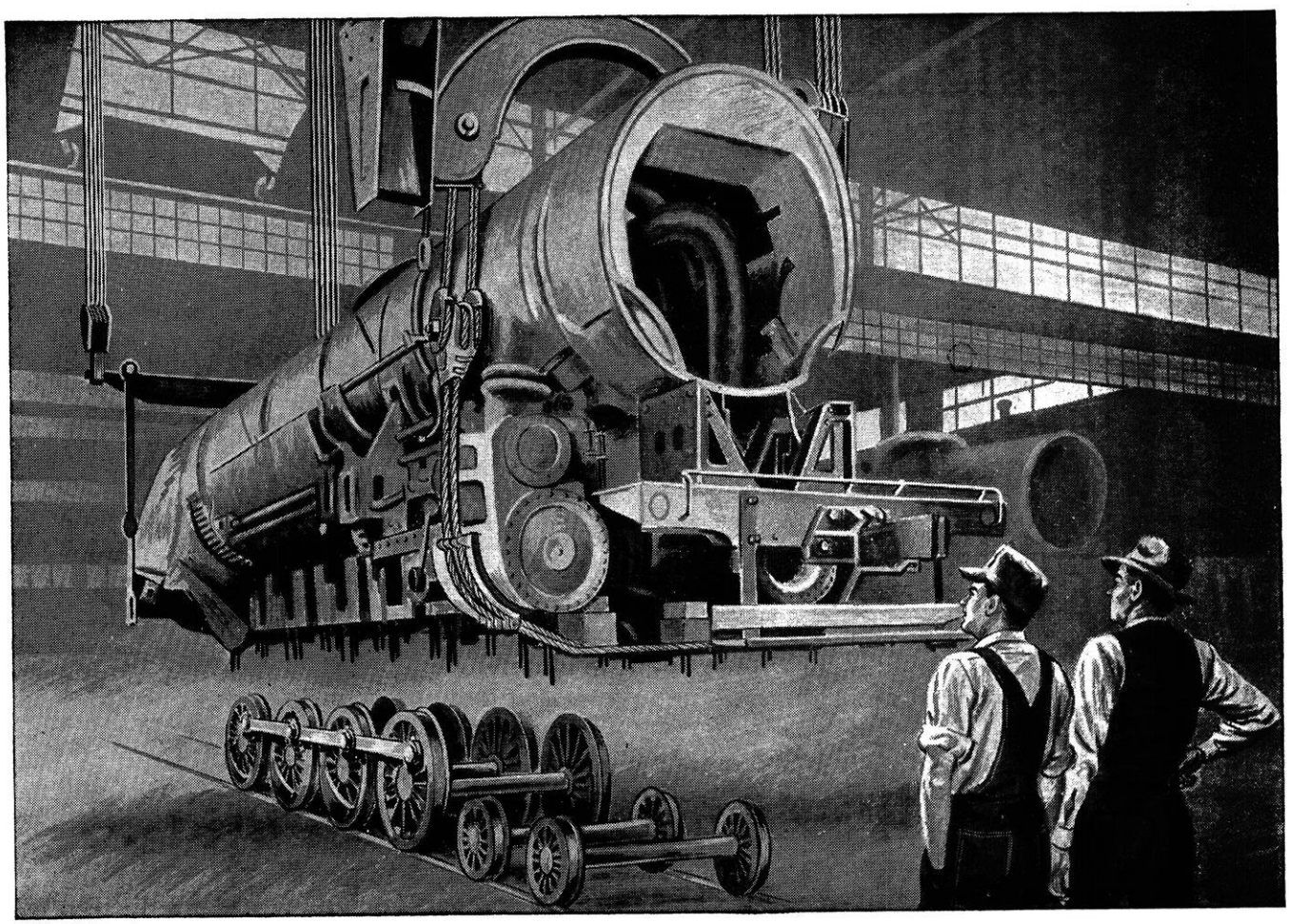
corporate the latest improvements and designs in the building to be constructed here at the University. Greatly improved classroom and laboratory lighting is but one of the many modern designs being included in the new engineering building.

Problems Not Solved

According to Professor Wendt, the construction of the west thrid of the building will be an excellent step in the right direction, but it will not meet all the requirements of the engineering school. The temporary buildings will still be required for classroom and laboratory space, the chemical engineering building will remain in desperate straits, the engineering library will still need more space, the civil engineering department will continue badly cramped, and the mechanical engineering building will remain almost as badly overcrowded due to the continued presence of the remaining engineering departments.

The new wing will, however, be of immense help in relieving the congested conditions and will enable the engineering school to begin its expanded research program. Completion of the new building will also enable the engineering school to relinquish the various "Hill" accommodations that are now so badly needed by other University departments.

These live lines are cheaper than headlines



Guy de Maupassant's classic about the Frenchman whose mania for saving string brought ruin upon him, is an object lesson for wire rope users.

Courting trouble through a misguided sense of economy applies to wire rope, too.

The prevention of waste is a commendable effort but, it should be exercised before, not after the rope has outlived its usefulness. It should be exercised in the selection of the right rope for the job, its proper installation and care.

The man who roots through a scrap pile for a short length of rope that is "good enough" to serve as a sling, should remember that a wire rope, too, is only as strong as its weakest link.

Our free enterprise system has created markets that demand the output of millions of workers. Roebling slings were developed to increase the efficiency of these workers, and to insure their safety.

Scientifically designed for a widespread variety of requirements, Roebling slings have won the confidence of management and worker alike . . . throughout the world.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON 2, NEW JERSEY
Branches and Warehouses in Principal Cities

A CENTURY OF CONFIDENCE **ROEBLING**

COMPUTING DEVICES . . . (continued from page 24)

allel operation instead of serial operation, the multiplication of two 10-digit numbers requiring only 50 microseconds.

MANIAC

The MANIAC (mechanical and numerical integrator and computer), a development of the RCA Laboratories and the Princeton Institute for Advanced Study, also employs an electrostatic storage device. This storage device, called the selectron, is a tube in which two orthogonal sets of equally-spaced parallel bars are placed between the electron source and the insulating surface. By properly selecting combinations of bars, 32 sealed leads can control 4096 memory elements by forming windows which either pass or block the stream of electrons. The given information can be placed into the tube by opening one window at a time and applying the proper voltage to the tube. Reading is performed in a similar manner by opening one window at a time and determining the potential of the corresponding memory element.

Mark III

The Navy Department is sponsoring an all-electronic discrete variable computer called the Mark III. The Harvard computation laboratory is executing the design which is still in the preliminary stages.

ANALOGUE COMPUTERS

Analogue computers are devices in which numbers are represented by physical quantities and which give a continuous solution. The accuracy of an analogue computer depends upon the accuracy of its component parts and upon the accuracy with which the variables under consideration (shaft rotation, volts and amperes, quantity of light, etc.) can be measured.

A.C. Network Analyzer

The more important analogue computers are the a.c. network analyzer, the differential analyzer, and the Westinghouse analogue computer. An a.c. network analyzer consists essentially of the following:

(1) Variable - impedance units of inductance, capacitance, and resistance.
(2) Single-phase a.c. generating units whose voltages are adjustable in magnitude and phase.
(3) 3 master instruments for direct measurement of magnitudes, phase angles, and vector components of voltage and current as well as real and reactive power in any branch of a network.

The network analyzer is employed in the solution of network problems and certain field problems.

The Differential Analyzer

The differential analyzer is used for the solution of differential equations. It is particularly adapted to the solution of equations involving non-linearities and discontinuities and also to the approximate solution of certain partial differential equations. Many of these equations, if solvable by longhand methods, would require tedious labor involving successive approximations, graphical methods, or the evaluation of the terms of a series.

In the mechanical differential analyzer, the variables under consideration are represented by shaft rotations. The various mathematical operations are performed in the following manner:

(1) Addition and subtraction — Differential gears.
(2) Integration — Kelvin-disc integrator.
(3) Multiplication or division by constants—spur-gears.
(4) Multiplication of two variables — Integration as
(5) Division of two variables — Usually it is necessary to form the reciprocal and then repeat (4).

The functions to be considered are introduced on mechanical input tables; the results are recorded on mechanical output tables.

Literature indicates that there are nine large-scale differential analyzers in existence. The number of integrators in the various analyzers varies from six in the unit in Leningrad, USSR, to 18 in the MIT device. An idea of the magnanimity of these devices is given by a consideration of the MIT analyzer. This unit weighs 100 tons and uses 2,000 tubes, several thousand relays, and 200 miles of wire.

The Westinghouse Analogue Computer

In the Westinghouse analogue computer, the system parameters are represented by electrical quantities. Functions to be considered are introduced by means of magnetic tapes, phonograph records, or cathode-ray-tube function-generators. The range of application of this device has been extended through the use of d.c. amplifiers and electronic multiplying units. A repetitive solution which may be observed with a cathode-ray tube is obtained by means of a system of mechanical synchronous switches. Recording on magnetic tapes or photographing results on the cathode-ray tube provides a permanent record of the solution.

CONCLUSION

Analogue devices are most useful in problems requiring limited accuracy and are somewhat restricted in their application. Digital computers are more versatile and may be used to solve problems which can be reduced to the fundamental arithmetic operations and which require greater accuracy. However, digital computers usually require complex coding even for relatively simple problems.

Most analogue computers are owned by educational institutions and private industry; most digital machines (excluding punched card machines) are financed by government agencies. In general, modern calculators (analogue or digital) range in cost from $100,000 to $500,000.

The development of large-scale calculators has made possible the solution of many problems involving large quantities of numerical data which could not previously be manipulated efficiently. These modern computers offer new challenges and responsibilities to engineers, scientists, statisticians, and economists in the solution of tomorrow's problems.

You can see split-second action

. . . with photography

ZIP! *Fifty-two cards cascade from hand to hand.* Yet fast as they flash by, photography is faster still—giving you this picture of what happens in half a tick of time.

It's having speed like this—and speed to spare—that enables photography to accomplish the near-incredible for industry and business.

Ultra-speed photography, in the realm of industrial research, can show you the behavior of a plane's wingtip, for example, at supersonic speed. Or picture the action of a spark or shock wave at the rate of 10-million times a second!

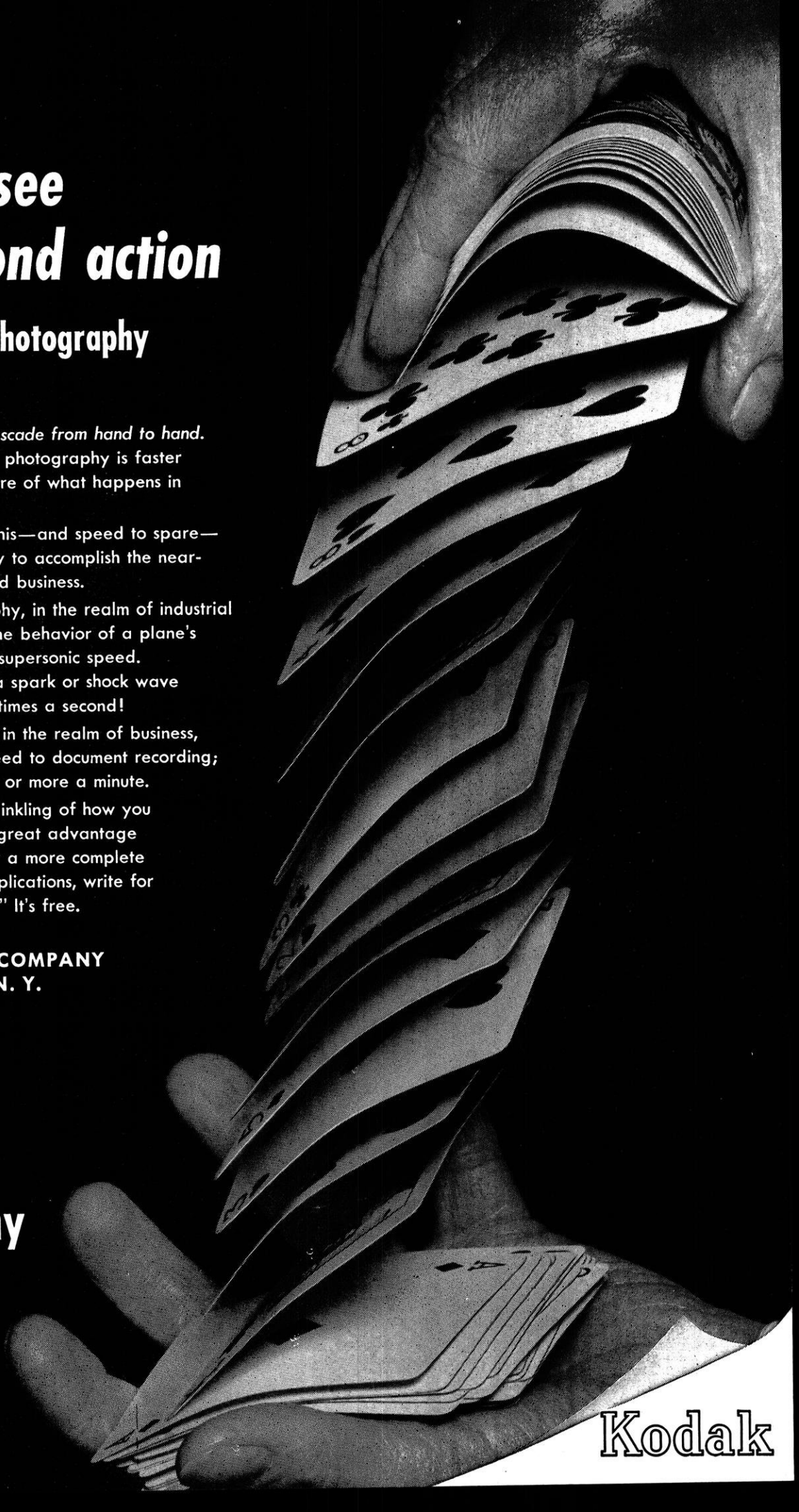
Recordak microfilming, in the realm of business, can bring unheard-of-speed to document recording; photographing 60 letters or more a minute.

And this gives only an inkling of how you can use photography to great advantage because of its speed. For a more complete idea of its workaday applications, write for "Functional Photography." It's free.

EASTMAN KODAK COMPANY
Rochester 4, N. Y.

Advancing business and industrial technics . . .

Functional Photography



Kodak

. . . a great name in research with a big future in **CHEMISTRY**

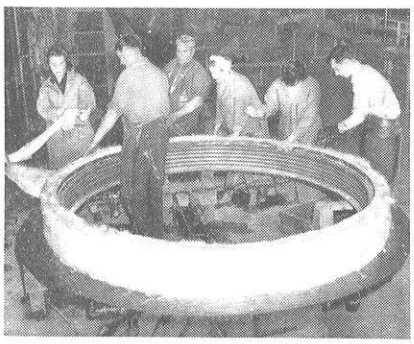
PLASTICS—INFANT INDUSTRY THAT GREW UP FAST

Ten years ago the infant plastics industry was teething. It has since rushed through a precocious childhood and grown to a vigorous and impressive maturity. Today the plastics industry is a multimillion-dollar business. Two-thirds of all American factories use plastics materials in their manufacturing operations.

Of course, plastics were not new ten years ago. In fact, back in 1894 General Electric was making lamp carbons out of an early plastic—lampblack-impregnated potter's clay.

New Materials Encourage Growth

But the rapid growth of the plastics industry came in the late 1930's when new materials and improved molding techniques encouraged its expansion. Then, with World War II, plastics manufacturing accelerated tremendously.



Synchrotron ring, molded by G. E. for Univ. of California's new betatron atom-smasher.

General Electric's position in the plastics field is unique in that G. E. is the world's largest manufacturer of finished plastics products and also a manufacturer of molding powders.

General Electric offers a complete plastics service. It has facilities for developing special compounds and for designing, engineering, and molding plastics products to meet individual customers' requirements.

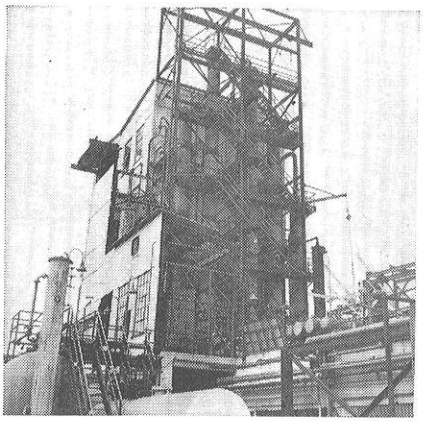
The variety of parts and products turned out by General Electric's Plastics Division is startling—and it illustrates the diversity of applications that are being found for plastics in the postwar world.

For Rowboats and Radios

Take, for example, the plastics dinghy. This is a four-passenger boat molded of laminated plastics by General Electric for a New England boat manufacturer. Then there is the synchrotron ring for the University of California's new betatron atom-smasher. It's the largest single part ever molded by G. E. Less spectacular, perhaps, but still important, are the hundreds of more familiar plastics products like clock cases, compacts, radio cabinets, camera cases, packages of all sorts, Textolite surfacing material, plastics parts for automobiles, refrigerators, and other appliances—even plastics cups for milking machines.

This plastics dinghy was molded by General Electric for the Beetle Boat Company.

Since 1920, General Electric has manufactured molding powders for its own use. Recently, a synthetic phenol plant was completed in Pittsfield. As a result of this increased production capacity, G. E. can now provide high quality phenolic compounds to other molders.



New G-E Phenol plant at Pittsfield, Mass., showing fractionating towers on distillation building.

General Electric's plastics activities are just one phase of the operations of the Chemical Department, where research is opening new doors to progress. In the fascinating new field of silicone chemistry, in resins, in insulating varnishes, in permanent magnets, General Electric is making contributions to chemical knowledge. For more information on any of these activities, write *Chemical Department, General Electric Company, Pittsfield, Massachusetts.*

A message to students of chemistry from

DR. J. J. PYLE

Director, General Electric Plastics Laboratory

The field of plastics is surely a stimulating one—and one that offers many opportunities and the utmost in challenge to graduate chemists and chemical engineers. At General Electric, plastics research is presenting new possibilities in this fascinating field that should prove exceptionally interesting to young technical men.

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