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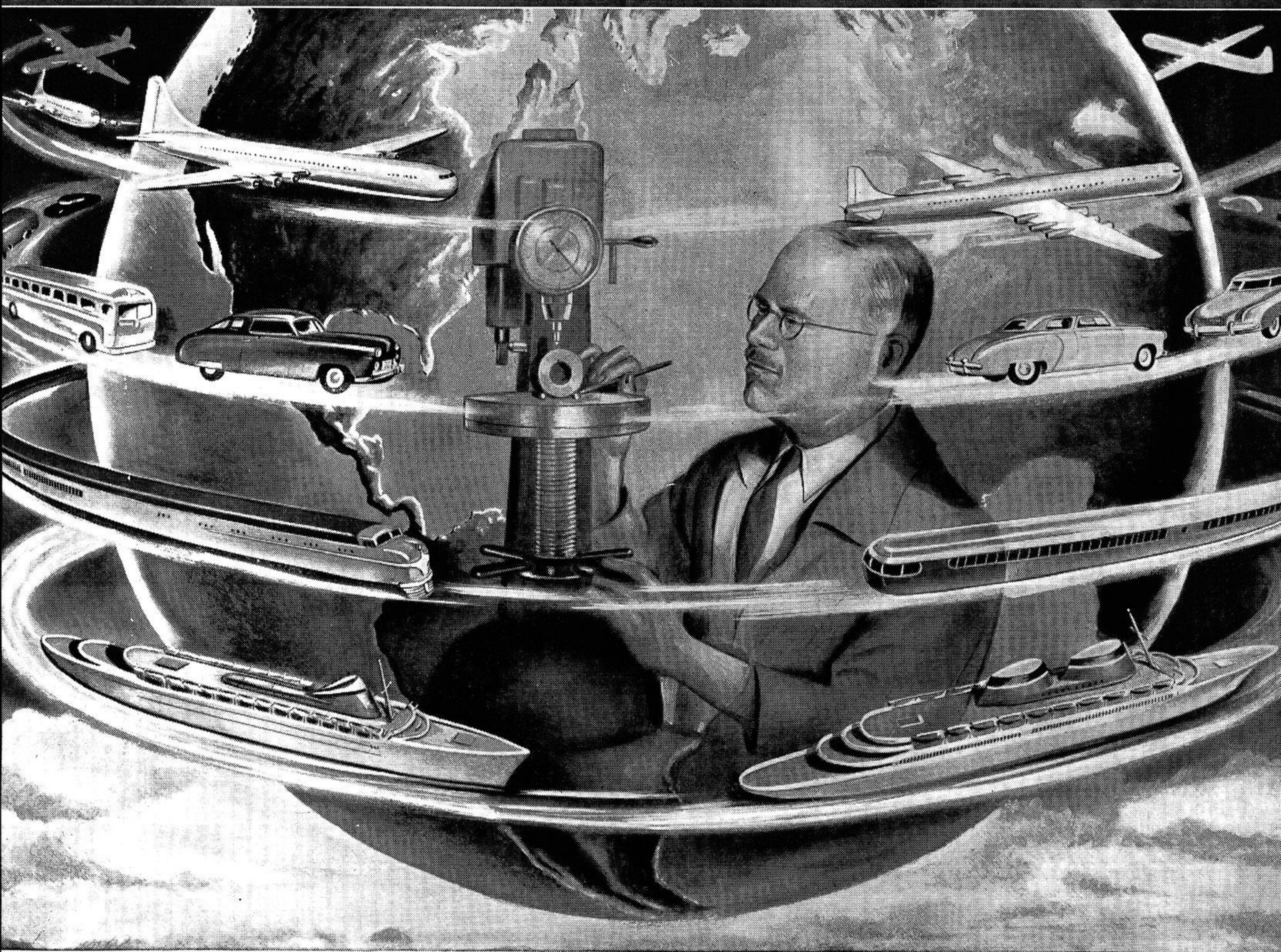
December, 1947

the WISCONSIN ENGINEER

"—Many shall run to and fro, and knowledge will be increased" —DANIEL XII, 4.



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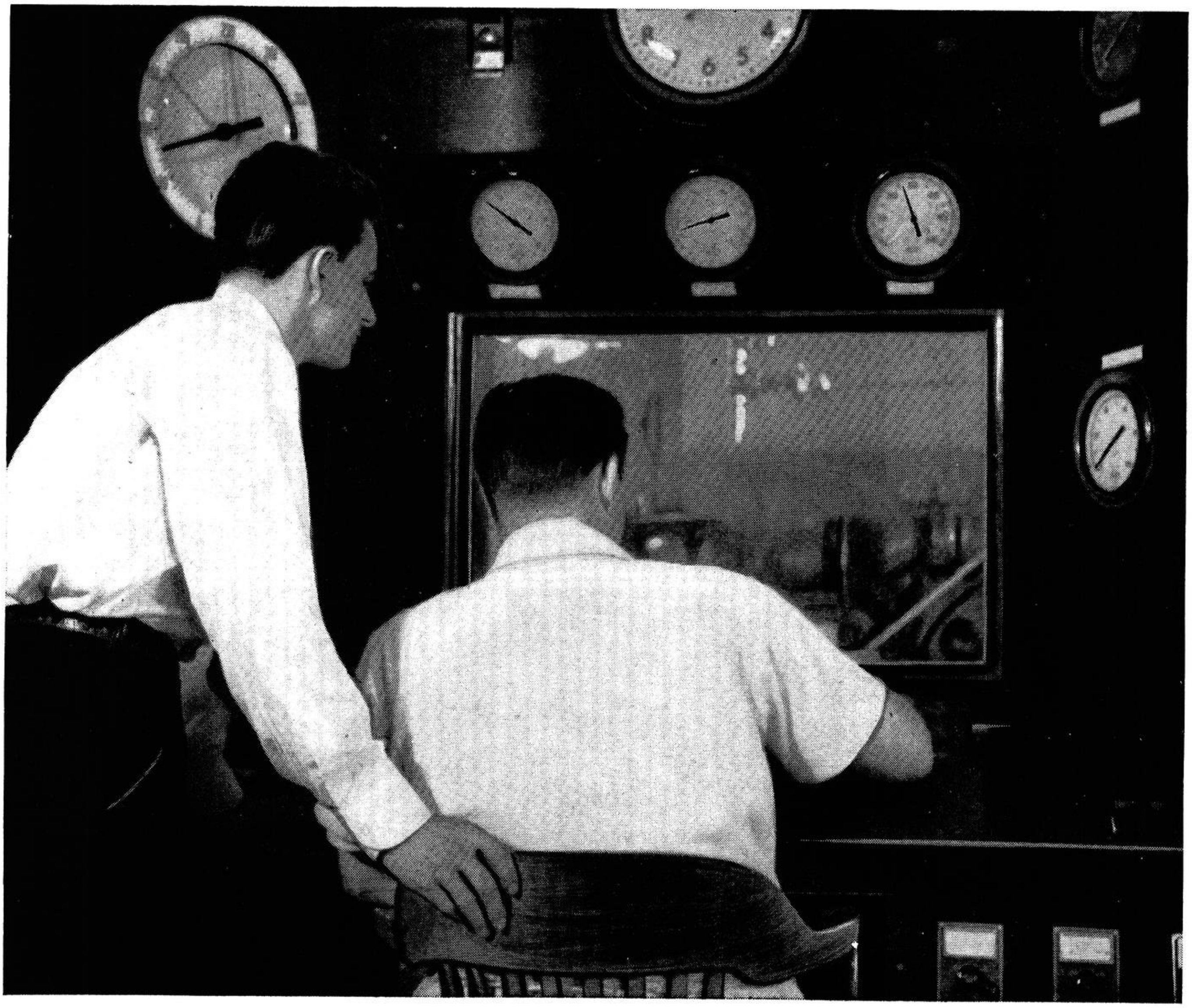

WISCONSIN ENGINEER

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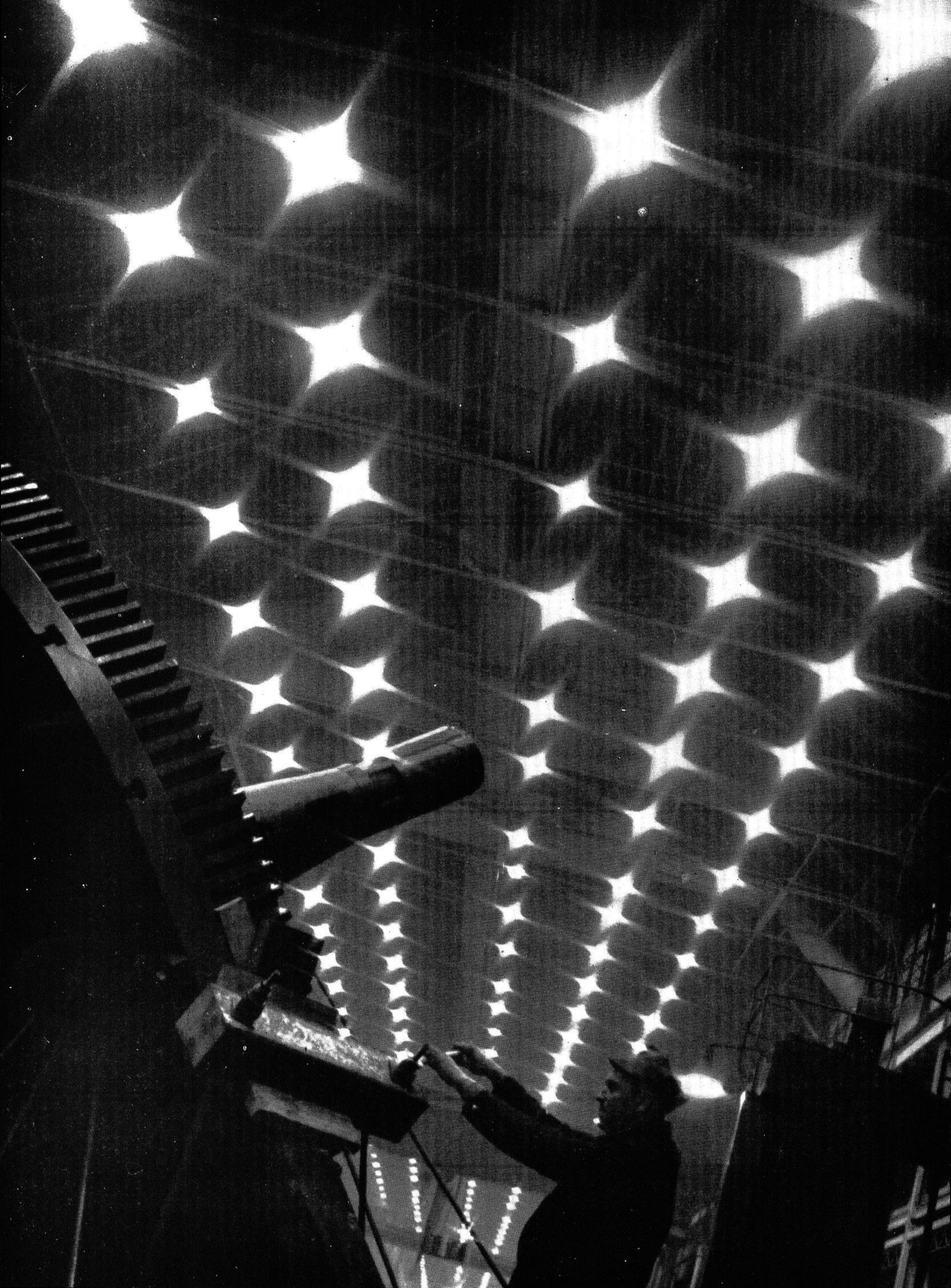
In This Issue . . .

COVER:

Model dam in operation. Built in connection with the Petenwell Dam project at the University of Wisconsin.

FRONTIS:

Experimental 1,000 watt mercury lamps give 45 foot-candles at working levels. This canopy of 1 kw lamps is 20% more efficient than 400 watt lamps. Picture was taken through a fine screen held close to the lens to make possible the all-but-impossible shot of lighting installations.
—*Courtesy Westinghouse*



Classroom Lighting

by Charles N. Clarke e'48

Photograph by J. Kroot e'48

EDITOR'S NOTE: *The design of lighting for the lower campus reading room and the data submitted for this article are by the University Standards Laboratory.*

THE problem of adequate lighting for classrooms, libraries, laboratories and offices in the University is one of concern not only to the people who plan the lighting, but also to the students and faculty who make use of it. In the early days of artificial lighting, a sufficient condition for "good lighting" was that there be light, no matter how much or how distributed so long as one could see by it.

Today, illumination engineers, with the support of doctors, psychologists, and educators tell us what has long been known, but little accepted by people in general—that adequate illumination depends not only upon the amount of light supplied to the working area, but also upon presence or absence of glare, the type of work, the time factor, and the amount of contrast between the work area and the surrounding area. Glare may be caused by the presence of an excessively bright unshielded light source in the field of vision, by reflections of a concentrated source from the work or a nearby object, or by improper placing of the light with respect to the work. For close fine work, such as sewing or mechanical drawing, a high level of illumination is necessary. For reading, perhaps not quite so much is needed, 40-60 foot-candles being a commonly recommended range, while for jobs such as running machinery, loading trucks, etc., a much lower level of illumination is necessary. Since the eye must adjust itself to changes in the amount of light entering it, and these changes occur when one shifts his sight from his work to its surroundings, continual adjustment takes place and may cause fatigue if the amount of adjustment for intensity is great each time the eyes are shifted from the work. A ratio of ten to one of the brightness of the work area to the darkest part of the surrounding area is generally accepted as the maximum contrast beyond which ocular fatigue becomes noticeable.

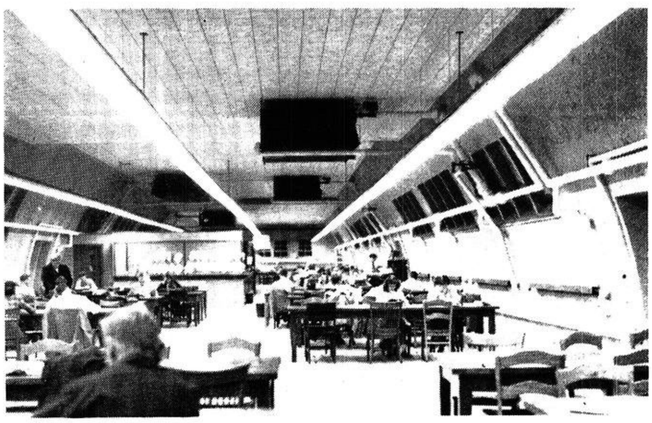
Obviously the greater the illumination, the quicker may objects be discerned and details observed. The time factor is important in accident prevention and production efficiency, particularly as it concerns seeing objects in motion. However, a person reading, for instance, can control the time it takes, so that time is not a critical factor.

The best type of lighting is, of course, natural lighting such as is found out of doors in the shade on a clear day where the illumination is high and there is no glare or great contrast, since the light is perfectly diffused, coming from all directions.

It follows that the best type of artificial lighting is the indirect system wherein no light comes directly from the source to the area to be illuminated, and all light is reflected from the ceiling or walls with resultant diffusion and absence of glare. However, where the ceiling is high or dark, the indirect system is in general less economical than the so-called semi-direct system, since much of the by absorption to the ceiling and walls.

The semi-direct system is the one in most use on the campus. A typical semi-indirect luminescence consists of light bulb enclosed in a globe, the bottom half of which is opal glass, while the top surface is transparent. The opal bottom diffuses the light passing through it, reduces the apparent brightness, and reflects some of the light through the clear top. The light reflected through the top, together with some direct rays from the source, serves to illuminate the ceiling to reduce ceiling contrast and provide even more diffused light below.

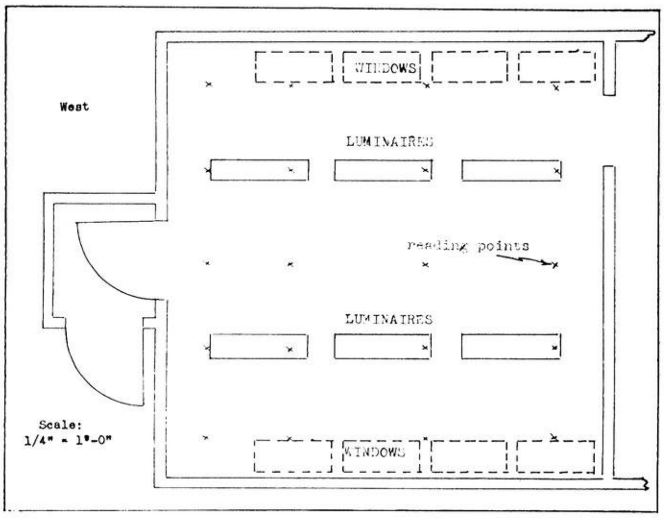
A brief outline of the fundamental units used in the measurement of light may be in order here. All units are based on the "new candle," recently adopted by the International Committee of Weights and Measures as the primary standard of luminous intensity, to take effect January, 1948. The new candle is of such magnitude that the brightness of a full radiator (black body) at the temperature of solidification of platinum is 60 candles per square



Louvered fluorescent luminaires in the lower campus reading room.

centimeter. A "new lumen" is the luminous flux radiated within one unit solid angle by a uniform source having a luminous intensity of one new candle. The unit of illumination is one new lumen per square foot, or one "new foot-candle." The units of brightness are one new candle per square inch, or one new foot-lambert (ft.-L.), which is the brightness of a perfectly diffusing surface of 100% reflection factor when its illumination is one new foot-candle. The reflection factor of a surface is the ratio of the total light reflected from it to the light incident upon it, and is usually a constant for a given surface. These new units differ by only a fraction of a per cent from the old ones.

A point source of one candle emits 4 lumens. The amount of flux crossing an area of one square foot at a uniform distance of one foot from a point source of one candle is one lumen, and the illumination on that area is one lumen per square foot, or one foot-candle (ft.-c.). If the square foot of area were at a uniform distance of 2 feet from the one candle point source, the illumination on it would be $\frac{1}{2^2}$ or ¼ ft.-c., since light obeys the inverse square law.



Floor plan of quonset classroom, showing luminaires, windows, and points of data collection.

The brightness of an illuminated surface depends upon the illumination, the reflection factor, and the direction from which the surface is observed. An ordinary 60 W. inside frosted lamp has a light output of about 830 lumens initially, and a brightness of about 60 c./in^2 (candles per square inch) or 60 X $144\pi = 27{,}200$ ft.-L. To avoid annoyance from direct glare, it has been recommended that the brightness in the center of the field of vision should not exceed 2 - 3 c./in^2 (500-1300 ft.-L.) of apparent area for casual observation and ½ c./in^2 (225 ft.-L.) of apparent area when viewed continuously in a room with low (10 to 1 or less) brightness contrast.

When the temporary buildings on the campus were being planned, the designers saw an opportunity to study the more modern forms of lighting, especially library illumination. Accordingly, a fluorescent system was installed in the lower campus reading room, comprising three continuous rows of 27 fluorescent luminaries with six 40 W. white tubes in two reflectors per fixture, hung on messenger cables at a distance of 9 feet from the floor. On the basis of manufacturer's design data, the system was designed to produce between 30 and 40 ft.-c. at table-top level. The specifications for the installation also called for louvers, or "egg-crates," which are honeycombed metallic shields fitting on and beneath the reflectors, serving to diffuse the light and cut down brightness by shielding the tubes from direct vision. Immediately after the building was opened, and before the installation of louvers, a survey was made of the illumination using a Weston photronic cell foot-candle meter, consisting essentially of a light-sensitive cell in series with a low resistance galvanometer. The current delivered by the cell is a function of the amount of light falling on it, and thus the meter scale can be calibrated in any units of illumination; in this case, foot-candles.

With the photronic cell in the horizontal plane of the table-tops, readings were taken at some 25 strategic spots throughout the building of the illumination in foot-candles. The average of these readings was 48 ft.-c., a fair approximation of the average illumination. Readings taken 4 months later on June 25, 1947, in the same spots with the louvers installed showed an average decrease of 25%. The average intensity was now 36 ft.-c., within the range (30-40 ft.-c.) specified in the design. However, the decrease of 25% could not possibly be attributed entirely to the addition of louvers. Owing to the lack of exact data on the lamp replacements, it was impossible to know the average age of the tubes. Some time later, it was discovered that a great many of the tubes were of the "warm white" 40 W. type, having an initial lumen output of 2100 louvers per tube as compared with 2300 lumens per tube for 40 W. "white." Thus the decrease in illumination was attributed to addition of louvers, replacement of white tubes with warm white (pink-white) tubes, and normal depreciation (dust on tubes, tube blackening, wall blackening, etc.).

In order to determine the effect of louvers, dust, and aging of tubes on the light output of fluorescent luminaries, a more comprehensive test was devised and carried out in the west end of the second Quonset from Langdon Street in the lower campus group on the night of July 25, 1947. All the chairs were removed, and the photronic cell was set up horizontally on a movable tripod 35 inches from the floor. The lighting system comprises six industrial type fluorescent luminaries, each containing three 40 W. white tubes, and equipped with louvers. The luminaries were hung eight feet above the floor and spaced as shown in the accompanying diagram. Four "runs" were made, each consisting of 20 readings of ft.-c. at the spots indicated by X in the diagram, 35 inches from the floor. (1) "as found," tubes dirty, louvers in place; average illumination, 24.0 ft.-c. (2) Louvers removed; average

(continued on page 30)

Professor
Ben G. Elliot

by R. L. Smith m'48

"MY WIFE claims that there is not anything I'm not interested in," says Professor Ben G. Elliott, newly appointed chairman of the Mechanical Engineering Department. The trueness of the quote is brought out in his diverse past and present activities which vary from membership on the Panel of Conciliators and Arbitrators set up by the Wisconsin Employment Relations Board, to an intensive study of the life of Buffalo Bill.

The latter interest is greatly due to Mr. Elliott's birthplace, the roaring railroad frontier town of North Platte, Nebraska, also being the home of the illustrious buffalo-hunter of the West.

Early experiences in the power plant of the Union Pacific at North Platte combined with an apparent mechanical aptitude, caused the young westerner to desire a technical education. Therefore upon graduation from high school in 1906, he entered Rose Polytechnical Institute in Terre Haute, Indiana. The present curriculum seems lighter, as Professor Elliott recalls the twenty-one credit minimum per semester, seven o'clock classes (morning, that is), and six full class days per week.

Summer vacations were spent as a machinist apprentice with the Union Pacific, Allis-Chalmers, and the McKeen Motor Car Company.

Upon graduation in 1910, he returned to the latter company in the capacity of a journeyman machinist and field engineer. It was during this period that Professor Elliott became particularly interested in the internal combustion engine. The company, recognizing the need for a power unit for branch line service, had encouraged its development. This type of internal combustion unit was the forerunner of the modern diesel locomotive.

Gas Turbine Research

At about the same time Carl C. Thomas was conducting research on gas turbines at the University of Wisconsin. Realizing the possibilities of the gas turbine, Professor Elliott became Thomas' understudy and assistant in the winter of 1912.

In 1913 he accepted a position with the University of Wisconsin Extension Division. His position called for effecting an increase in the efficiencies of state power installations. This he accomplished by personal instruction of the operating personnel at their places of work. It was on one of these many trips that he met Miss Georgia Mae Buchanan, a co-ed of Lawrence College, who was later to become Mrs. Ben Elliott.

Professorship at Nebraska

In 1915 Mr. Elliott was offered a professorship at the University of Nebraska. After about two years of teaching, coupled with additional work for the McKeen Motor Car Company, he was appointed Chairman of the Mechanical Engineering Department at Nebraska. An offer to return to Wisconsin brought him back to his previous position with the University of Wisconsin Extension Division.

During the first World War he was with the United States Shipping Board. He was stationed at the great Hog Island shipyards for the early part of the war period. His duty was to train welders, machinists, shipfitters, etc. Later in the war he was stationed at the shipyards in the Great Lakes area. After the war was over he returned to Madison and was put in charge of developing the day school program at the Milwaukee Center of the Extension Division.

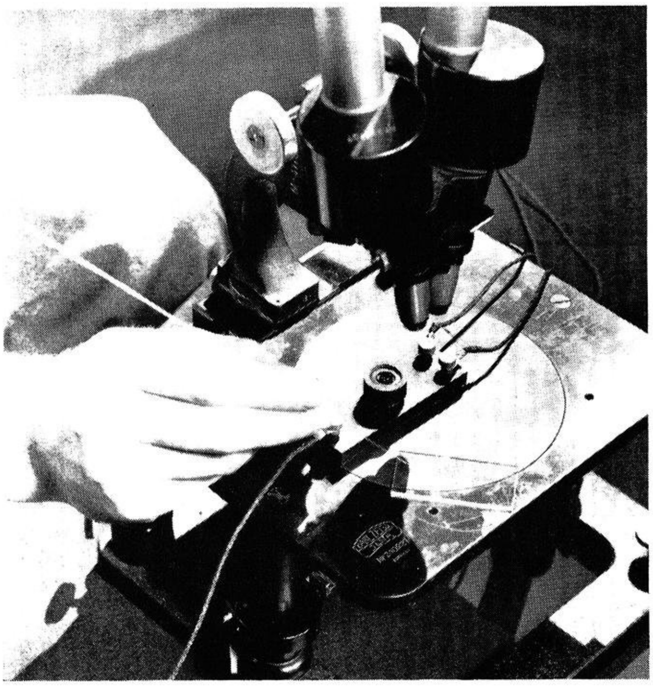
Working on the new Extension Division branch, the first day classes were held in Milwaukee by the fall of 1919. The following seven years were spent in the development of technical instruction in the vocational schools throughout the state.

About 1927 he accepted the dual role of a part time instructor and Public Relations man for the Engineering College. It was during his period of Public Relations Director that the great possibilities of contact and co-operation with the state industries were fully developed. These positions were relinquished eight years ago in favor of full time teaching in the Mechanical Engineering Department.

Professor Elliott has written five or six books and is now working on "An Operating Engineer's Handbook." Although the greater part of his work has concerned steam power, his book "The Gasoline Automobile," now in its fifth edition, is one of the larger selling books on that subject.

Research Engineer

ENGINEERING work may be classified according to function into the fields of research, development, manufacturing, sales and education. In industry this type of classification is often more important than the "vertical" division into chemical, civil, electrical, mechanical, and mining engineering, found in most college curricula. The engineering student, when he reaches his sophomore year must usually decide to take engineering training



A research engineer making micro-chemical analysis of corrosion on relay contacts with the aid of a binocular microscope.
Photograph courtesy Bell Telephone Laboratories

mainly in one department. It is obviously important that he also choose, as early as possible, that functional field which he likes best and is best fitted for in order that he may properly prepare himself. Engineering research, in particular, calls for special preparation in the undergraduate years, and usually requires one or more years of graduate work. To understand what this preparation should include we must first decide just what engineering research involves, and examine some typical examples of research work.

It is not easy to define the term research in such a way that will satisfy everyone unless we use the simple dictionary definition, "a diligent search for truth." This is certainly so broad that nearly everyone can claim to be, at times, a research worker. Yet many engineers, designated research engineers by their employers, are hesitant to claim that their work is really research. Here, then, is an anomaly which should be cleared up in the beginning.

Scientific research in general is often classed as "pure" or fundamental research on the one hand, and applied research on the other. Thus the physicist, while investigating the basic facts of atomic fission, is engaged in pure research. When he supervises the construction of an atomic pile he is engaged in applied research. The fundamental research worker uses scientific observations as bases for new explanations and interpretations. The applied research worker applies known explanations or theory to new situations in the laboratory or the field.

Now the work of the research engineer usually has some useful application as its goal. Thus, not only is his work applied research, but design and development follow his work so closely that it is hard for him to know just when he has shifted from one field to another. To cite an example in the field of radio engineering consider the Bell Telephone Laboratories' MUSA (Multiple Unit Steerable Antenna)—a highly directional antenna with a steerable beam, used to separate individual reflections of short-wave signals from the Heaviside Layer. The research work first involved the building of the antenna. Then this antenna was used to find just where the signals came from, and just what improvement in signal-to-noise ratio was possible with this device. At the conclusion of the research work the antenna stood as a pilot model. Thus because the research work was successful it included development work. Had it been less successful, the whole cost would have been written off as research. (It is interesting to note that the MUSA type of antenna was not a commercial success until some years later, when it was applied to microwave radar.)

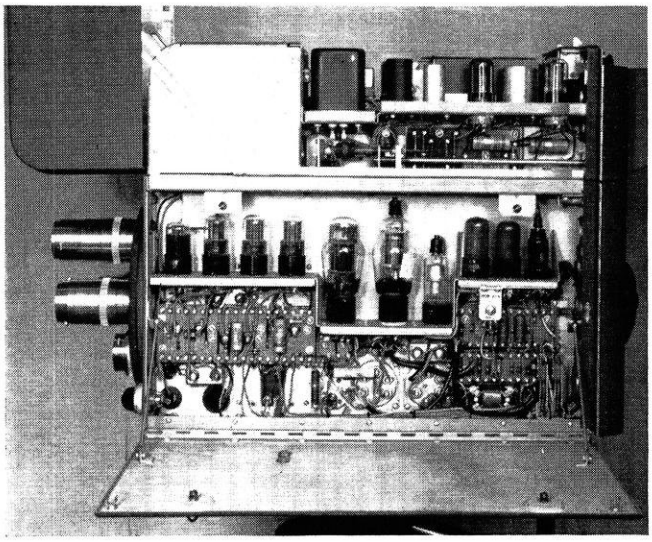
It must not be thought that engineers never engage in pure research. Most industrial concerns today, realizing that applications depend on the continuous building up of theory by pure research, retain physicists and chemists on their staffs to keep such forward-looking work in progress. Graduate engineers engaged in such work should ing

by V. C. Rideout,
Asst. Prof., E.E.

perhaps be classed as physicists or chemists. Other engineers normally engaged in applied research may find that their work slips into the class of pure research when some void appears in the theoretical background needed in their everyday work.

An example of this last case is found in Mr. Karl G. Jansky's work on star noise. This work was also done at Bell Telephone Laboratories in conjunction with the MUSA movement. Measurements were made of the strength and direction of arrival of atmospheric noise in the short-wave radio band. Close examination of the measured results showed that some noise was coming in from an unknown source outside the atmosphere. Another year of work revealed that this noise came chiefly from a region in the Milky Way. This was certainly fundamental research, since this work and other such investigations now form the basis for some new theories of conditions in the far reaches of our galaxy. On the other hand, we now find that engineers who discuss radar range are familiar with the limitations due to star noise.

Then, too, pure research may merge into applied research. An example of this is found in the work of the



This shows a few of the parts and connections in a modern television camera, typical of growing complexity.
—Photograph courtesy RCA

V. C. Rideout, Assistant Professor in Electrical Engineering, came to Wisconsin in 1946, after seven years with a radio research group in the Bell Telephone Laboratories. While there he was engaged in radar and television relay research and development work. He received a B.Sc. degree in Engineering Physics from the University of Alberta in 1938, and an M.S. degree in Electrical Engineering from California Institute of Technology in 1940.

Varian brothers and Dr. W. W. Hansen at Stanford in the late thirties. Their fundamental work on the early klystrons led directly to applied research on vacuum tube oscillators, operating on the same principles and bearing the same name, but designed for industrial and war-time applications.

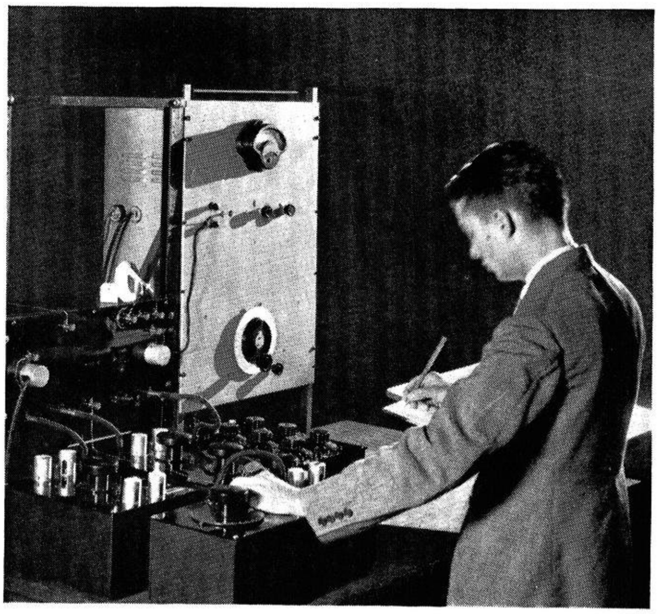
The engineering student who contemplates entering the research field often subjects himself to a good deal of soul-searching. Will he be able to close the gap between what he knows about practical engineering devices and what he knows of theory? Will he be able to summon the kind of originality necessary to compete with highly trained research men in the field? Such questions are not easy to answer until he actually engages in research, either in industry or in the graduate school. Some ideas can be outlined with regard to the importance of various phases of his undergraduate preparation.

The writer, before leaving industrial research to enter the teaching profession, asked half-a-dozen successful research engineers of fifteen to twenty years' standing what they considered to be the most important thing an engineering teacher should keep in mind. They all answered without hesitation, "Stress the fundamentals." This, of course, is just what engineering teachers tell their students, ad nauseam. Nevertheless, the matter may not be fully appreciated by the student until some time after he graduates; there is a small but indispensable group of fundamental concepts which must come to him as naturally as the act of chewing his food.

The study of mathematics is important in this regard. Some excellent research engineers get along with very little mathematical training, or even mathematical ability of a formal kind. They are the exception, for in general the research worker continually strives to express his results in mathematical "shorthand." Courses in mathematics are not enough—they are a sort of dry land swimming practice. The student will benefit by consciously trying to apply such knowledge as he may have of the calculus in his laboratory work and problems whenever he can, not only when he is asked to do so.

Now fundamentals are fundamentals, whether in mathematics, physics, chemistry or psychology. But nature is no respecter of the departmentalization of engineering knowledge, and a man who graduates in one field finds that he must know the basic facts in several others as soon as he begins serious research work. Consider for a moment the simple electromagnetic relay. Current flows in a coil, and the magnetic field set up results in forces which move an iron armature against a restraining spring to close an electrical contact. So far this sounds like electrical engineering. But the design of the wire, the iron and the insulation are more in the field of the mechanical engineer. The spring deflection is a problem for the specialist in mechanics, and the problem of corrosion at the contacts is a chemical problem—microchemistry at that. Thus the engineer who works on relay problems cannot succeed unless he knows the fundamentals in these various branches of engineering. He may ask specialists for their help, but he must at least know enough to pick the right man, and to ask the right kind of question. These considerations will explain why students are not encouraged to specialize too much, in their course work, particularly in the undergraduate years.

The research problems mentioned so far are closely allied to physical experiment. Some research may consist of paper work only—mathematical research for example. The engineer should always remember that in his field one experiment may upset reams of theory, and he should never hesitate to get up from his desk and go to the laboratory. Engineering students, though of research calibre, often spend too much time "searching the literature" and doing a lot of paper work, when a short but well chosen experiment would carry their knowledge beyond anything they could read.



Making an analysis of transmission circuits.
—*Photograph courtesy Bell Telephone Laboratories*

One important difference between applied and fundamental research lies in the amount of organized group effort possible. Fundamental research cannot be planned or organized to a great extent for the simple reason that the research worker may not even know what he is looking for. Applied research, on the other hand, can be organized so that the advantages of group effort are obtained. Since about 1900, more and more applied research has been done in larger and larger laboratories. One has but to look at a piece of television equipment, bristling with vacuum tubes, to realize that many engineering developments today are altogether too complex for anything but this group effort. This cooperative type of research proved particularly successful during the war—so much so that our stock of fundamental research results is nearly used up.

The present day emphasis on cooperative effort has some important implications for the student. Employers, naturally, are anxious to employ men who will fit into their complex organizations with the least friction. Interviewers first try to find out whether or not a man is capable of cooperative effort—they then look at his grade-point average.

In order to cooperate, the research work must follow the wishes of his supervisor to some extent. This may not be too much fun for the research worker who is always a bit of a prima donna, and it actually may be true that he can carry cooperation too far for his own good. Some top men got their start by doing something — successfully — that

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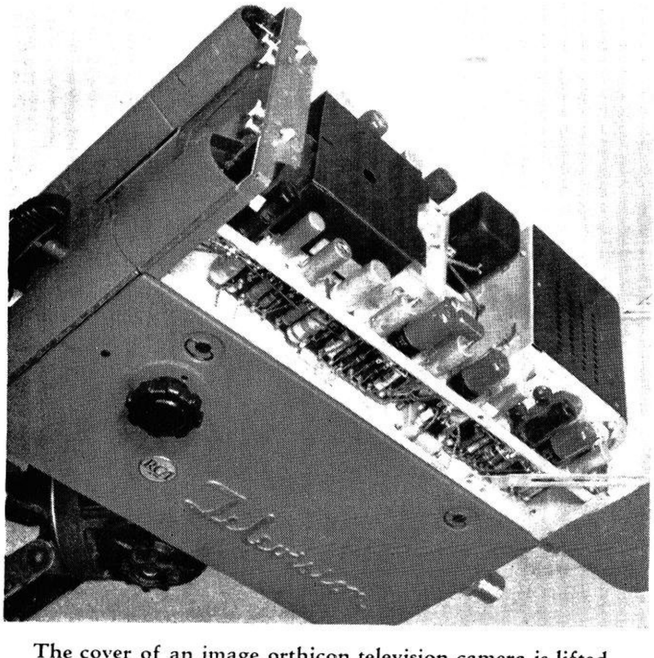

The cover of an image orthicon television camera is lifted to show the electronic viewfinder. This device is necessary because this camera works at very low levels.
—*Photograph courtesy RCA*

Peaceful location of the dam.

Wisconsin's Projected Petenwell Dam

by W. M. Haas c'49

Photographs by A. Rezin c'49

WHEN the construction of Petenwell Dam was started this summer, another step was taken towards complete utilization of the water power possibilities of the Wisconsin River. The river has a total fall of 1,050 feet, of which 600 has already been used for water power purposes. Dams have been built along the Wisconsin from the lowest at Prairie du Sac to the uppermost near the Michigan border.

Petenwell Rock is located about halfway between Wisconsin Dells and Wisconsin Rapids. The river is somewhat constricted at this point, forming a natural location for a dam and reservoir. The site was recommended in 1926 after an exploration trip by canoe. Surveys followed, and in 1938 the site was investigated for its flood control possibilities.

This $8,000,000 project will create a lake about two miles wide and fifteen miles long, lying in Adams and Juneau counties. The head of the lake will be only three and one-half miles below Nekoosa. It is primarily an earth fill dam, 45 feet high, 240 feet wide at the base, 15 feet wide at the top, and 7,800 feet long. Two million, five hundred thousand cubic yards of earth fill will be required to build this embankment. The spillway section will consist of 16 flood gates, each 30 feet wide and 18 feet deep. Their combined flood capacity will be 160,000 cubic feet per second, compared against the record flood of 80,000 cubic feet per second at that point on the river.

The power house will be 154 feet long, 200 feet wide at the base, will extend 35 feet below present water level, and 61 feet above. Four turbines operating under a 42 foot head will drive four 5,000 kilowatt generators, capable of producing an annual output of 115,000,000 kilowatt hours. Transmission lines will be built from Petenwell to Wisconsin Rapids, Stevens Point, and Portage.

Due to foundation conditions at the site, extreme care had to be exercised to prevent erosion of the sandy base and the resulting failure of the dam structure. When

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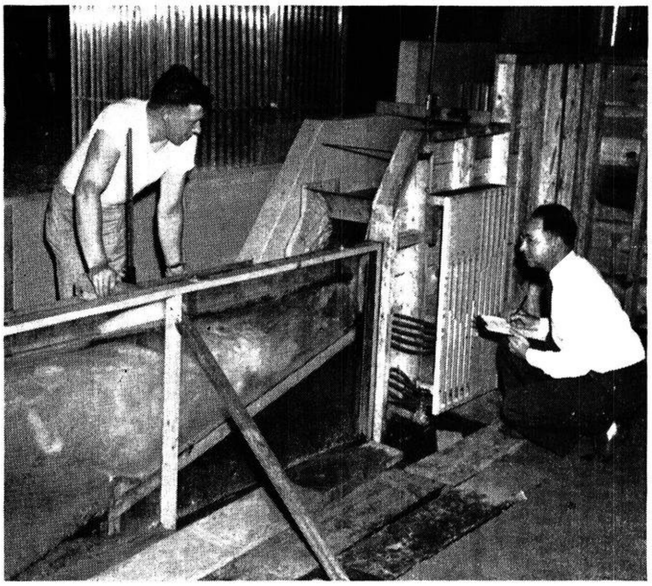


Determining water action from model flume. Professor A. T. Lenz in the foreground.

National Electronics Conference

by Gerald Estrin e'48

Photographs courtesy National Electronics Convention

TWENTY-FIVE hundred engineers, physicists, manufacturers, and students assembled at the Edgewater Beach Hotel in Chicago from November 3rd through 5th.

The above titles are just a sampling of the diversified interests present among the men and women who attended, but the thread which tied those interests together was the controlled flow of electrons in an evacuated chamber.

The National Electronics Conference is a non-profit organization established to serve "as a national forum for the presentation of authoritative technical papers on electronic research, development and application."

Some 80 papers were presented, running the gamut of television, frequency modulation, industrial applications of electronics, nucleonics, vacuum tube circuit analysis, instrumentation, and electronic computers in addition to reports on methods for increasing the efficiency of research and development organization. These papers were presented by engineers from industrial, government and university laboratories.

One of the highlights of the exhibit hall was the Lear, Inc., "Dynatrope." This device combines an A.M. and F.M. receiver, a magnetic pickup phonograph player, and a magnetic tape recorder and playback unit. Each of these units contains up-to-date methods of scratch and distortion reduction. The Dynatrope even goes to the extreme of including a time clock which can be set to record a radio program while you are away from home!

An outstanding development of the conference's second day was a paper on "Microwave Spectroscopy," presented by Dr. Donald K. Coles of the Westinghouse Research Laboratories. Dr. Coles disclosed that ultra-short radar waves, beamed through a gas, unlock vital information about the nature and structure of the gaseous molecules.

"Each type of molecule has a set of distinctive motions," he explained. "When the frequency, or vibration, of the radar wave is exactly 'in tune' with the rotation of the molecule, some waves will be absorbed by it. By seeing which wave vibrations are absorbed, we can tell what molecules are present and how the atoms within the molecules are arranged."

In this same field of development, Dr. John W. Coltman of Westinghouse announced a new "atomic ray detector." This instrument can count radiating particles at the rate of 100,000 per second, 50 times faster than the famed Geiger counter.

"When atomic radiation strikes the specially coated screen, it releases a flood of light rays or photons," Dr. Coltman said. "These are collected by the mirror and focused on a light sensitive surface in the phototube, shaking loose hundreds of electrons from that surface. These freed electrons collide with another sensitive plate in the phototube, knocking loose still more electrons. This procedure is repeated nine times until the flow of electrons is amplified one million times."

The session on "Electronic Computers" head J. W. Mauchly of the Electronic Control Co. describe the improvements incorporated in the newest large scale digital computers. Electronic and mechanical computers have long been the dream of engineers and scientists, who have time and again encountered mathematical computations, too laborious to permit solution. Mr. Mauchly described extensive simplification of the device, through the use of mercury pool "memory circuits." This achieved a decrease in the number of vacuum tubes required by a factor of ten.

Mrs. Edith B. Fehr's paper on Color Measurement of Television Tubes was the only paper submitted by a woman at the Electronics Convention.

However, with all the improvements, these devices still remain beyond the use of any but the largest scale organizations and are at present almost exclusively operated by the military forces.

Numerous other new concepts were brought forth during the conference. For those students who attended, the conference established a closer link between the necessarily restricted outlook of the text book and classroom and the problems of present day electronics.

It is impossible to leave the subject of the conference without remarking on the youth of those who delivered papers. A rough estimate would place the average age in the very early thirties.

Those interested in the details of the technical papers may order a copy of the "Proceedings of the National Electronics Conference—1947" by writing to R. E. Beam, Secretary, National Electronics Conference, c/o EE Dept., Northwestern University, Evanston, Ill.

Mechanical and Electrical Honoraries

Pi Tau Sigma

Mechanical Engineers of the University of Wisconsin should have a special interest in Pi Tau Sigma, the Honorary Mechanical Engineering Fraternity, because it is one of the two Alpha chapters. That there should be two Alpha chapters is probably not apparent to all, but a brief review of the organization of the fraternity will certainly clear up the matter. Back in 1915 each of two groups of mechanical engineering students, one at the University of Illinois and the other at the University of Wisconsin, formed fraternities. Each of these were formed without any knowledge of the other and were for the same purpose, namely, to increase the interest of students in their work and to promote the efficiency of the department by securing more effective cooperation from the students it served. A letter from the Illinois fraternity to Wisconsin brought to light the existence of the similar organizations. The two organizations corresponded with each other and after plans were made they coalesced into one fraternity under the name of the Illinois fraternity, Pi Tau Sigma.

Pi Tau Sigma now has many chapters and about 7,000 members. Active membership is limited strictly to men, but as in Tau Beta Pi women are permitted to receive a pin and a membership certificate.

Professor G. L. Larson of the Mechanical Engineering department has been one of the active Wisconsinites of the organization since its first years. He has served as National Secretary - Treasurer 1920-22, Vice-President 1923-25, and President 1926-28, and at present he is Pi Tau Sigma Faculty Adviser.

The local chapter holds a number of meetings each semester, one of which is for the election of new officers. There is an initiation each semester for new members. Members are elected on the basis of scholarship and character. Students must have reached their junior year before they are considered for membership. Also requirements for selection are higher in the junior year than in the senior year. In the senior year the grade-point average required is in the neighborhood of 2.25 while in the junior year it is generally above 2.75. To stimulate interest in the organization, a Marks' Mechanical Engineer's Handbook is given each year to the sophomore mechanical engineer who was top rank as a freshman. This year the award went to Hugh Wahlin.

At the first meeting held this year, the following were elected to office: D. W. Retzinger, President; C. Goldbeck, First Vice-President; W. Michelsen, Second Vice-President; A. Ebi, Recording Secretary; D. MacDonald; C. Verlo, Treasurer.

Scheduled events for the semester include the formal initiation December 4th and a dance on January 9th.

Eta Kappa Nu

Eta Kappa Nu is the national honorary society for electrical engineers. It was founded in 1904 at the University of Illinois, and has grown to a present membership of 40 active chapters. Eta Kappa Nu is a member of the Association of College Honor Societies and must conform to very high standards.

HKN stresses scholarship as a basic requirement, but puts character as another requisite for membership. Members are recruited from the upper third of their class, and have the privilege of better acquaintance with those who will be the leaders in electrical engineering.

In addition to recognition of outstanding work, HKN provides scholarships for graduate electrical engineers, and aids alumni through the twelve alumni chapters in various cities of the United States, including Milwaukee and Chicago. HKN works closely with AIEE in promotion of the electrical engineering profession. Every year some outstanding electrical engineer who is not more than ten years out of college receives a recognition award.

The Theta chapter of HKN was activated at Wisconsin in 1910 and has been active ever since. Like the chapters in most other colleges, it makes an annual award to the highest ranking electrical engineering freshman. The recipient of this year's prize, a Standard Handbook, was Robert Royce Johnson, of Rockford, Illinois, who had a perfect average for his freshman year.

The officers of HKN this semester are Bob Keeler, President; Jerry Estrin, Vice-President; Gene Fordham, Recording Secretary; Mel Griem, Corresponding Secretary; and Joe Gifford, Treasurer. They are ably backed by the many HKN men who are professors or instructors in the engineering department here at the University.

Electromechanical Power

SHORTLY before the war, the General Electric Co. developed commercially, under the trade name **amplidyne,** a "two stage" electromechanical power amplifier which has recently received wide acclaim.

The amplidyne may be thought of as being roughly equivalent to two separately-excited d-c generators connected as shown in Fig. 1 below.

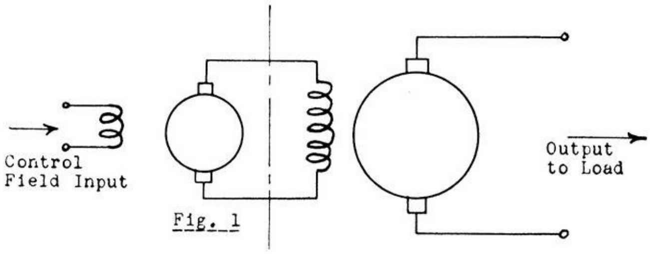


Fig. 1

The amplidyne, however, incorporates both stages of amplification into a single armature by deliberately producing high armature reaction by means of a controlled short-circuit. To illustrate how the above is accomplished, consider first the magnetic fields set up in a conventional d-c generator supplying a normal load (Fig. 2).

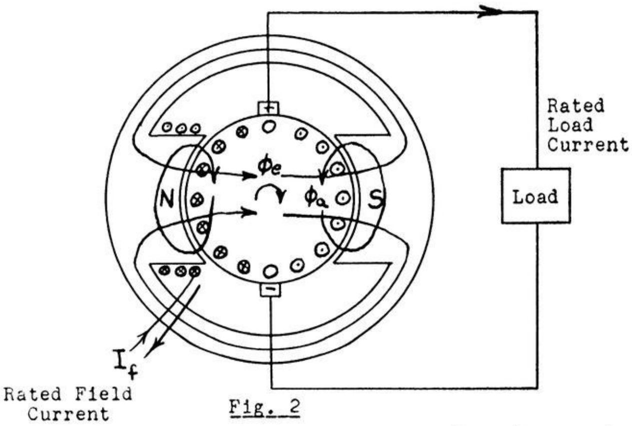


Fig. 2

Equivalent circuit of above cross-section of generator:

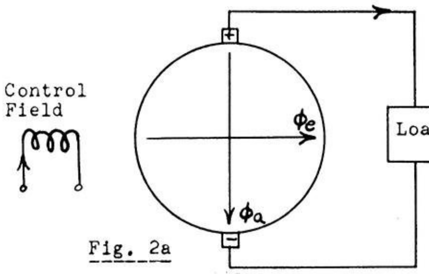


Fig. 2a

The necessary excitation flux, θ_e, is established by the flow of normal current in the field coil. Since the load current flows through the armature conductors, another magnetic field is set up, producing what is termed armature reaction flux, θ_a. With the direction of the current in the armature conductors as indicated, it is seen that the armature reaction flux is in space quadrature with the excitation flux.

If the external load were then removed and the brushes short-circuited, only a very small voltage need be induced in the armature to maintain the same value of armature current as before, due to the very low resistance now existing in the armature circuit. Hence the excitation or control field current must necessarily be drastically reduced to, perhaps, one per cent of its former value. The magnetic fields set up in a short-circuited d-c generator are shown in Fig. 3. The control or excitation flux is now very small but the magnitude and direction of the armature reaction flux remain unchanged since the armature current is as before.

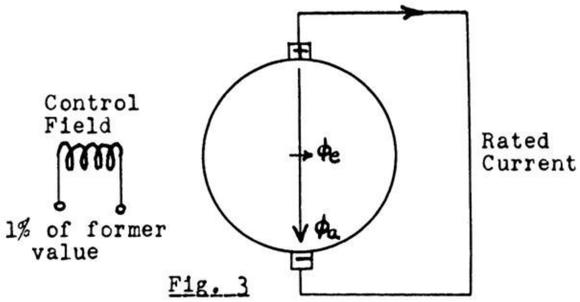


Fig. 3

Since the armature conductors are uniformly distributed about the armature, it is evident that some of these conductors will cut across the reaction flux at the same rate as others cut across the excitation flux.

Because of the direction of the two magnetic fields, the maximum voltage caused by the cutting of the reaction flux appears across the armature normal to the voltage developed by the excitation flux. If then a second set of

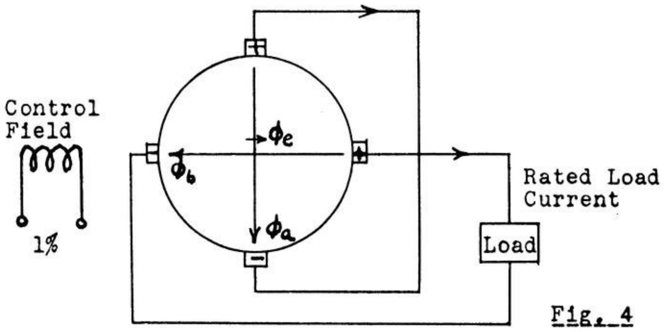


Fig. 4

Amplifier

by Joseph Gifford e'47

brushes is added at right angles to the original shorted brushes (Fig. 4), sufficient voltage becomes available to supply rated load current to an external load, in addition to the rated current flowing through the short-circuited path.

The direction of the load current, however, is such that it produces another armature reaction flux, θ_b, which is normal to the short-circuit armature reaction flux, θ_a, and in direct opposition to the original control flux, θ_e. Since the load armature reaction flux will be much greater than the control flux, the control field would be prevented from controlling the output. It is essential, though, that the small control flux be unaffected by armature reaction if it is to retain control over the output. Therefore a series compensating winding is wound around the control-field poles. The number of turns in this winding is usually adjusted so that the compensating flux, θ_c, exactly cancels the load armature reaction flux for all values of load current within the operating range (Fig. 6).

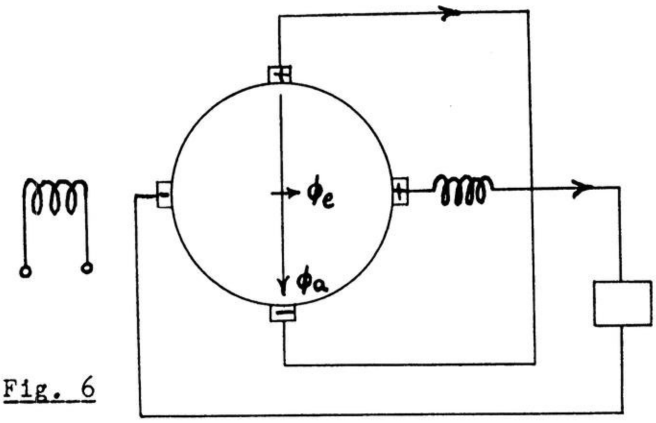


Fig. 6

The resulting effective magnetic fields.

If the compensating flux is slightly less than that required for complete neutralization, the machine has reduced power gain and acts as a degenerative amplifier, resulting in perhaps more stable operation. Overcompensation, on the other hand, simulates regenerative amplification, but which may easily result in unstable operation.

Thus it is seen that the amplidyne may be considered to consist of: a stage of essentially current amplification; a stage of primarily voltage amplification; and a feedback circuit. The power gain of an amplidyne may range from 3,000 to 10,000, roughly a hundred times the gain of an ordinary generator.

A basic amplidyne drive is suggested in Fig. 7.

The amplidyne generator is ordinarily driven by an a-c motor. The control field is shown as a split winding, because the fields are commonly supplied by a control amplifier having separate outputs for each polarity of the applied signal.

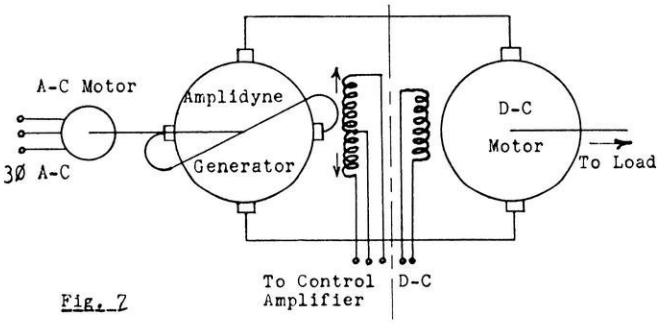


Fig. 7

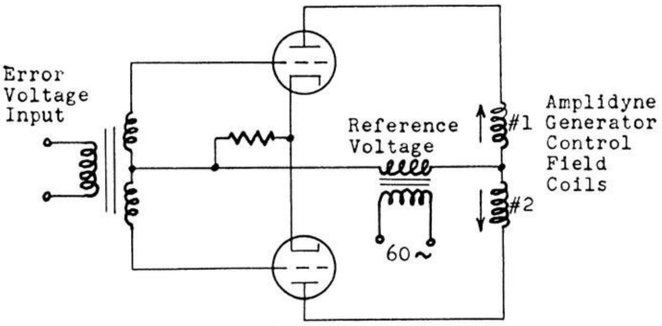


Fig. 8

A control amplifier, basically as shown in Fig. 8, is frequently employed to supply the amplidyne control field.

Such an amplifier is controlled by comparing an a-c error voltage from a selsyn control transformer with an a-c reference voltage furnished by the a-c supply line. The output is a half-wave rectified voltage supplying either coil 1 or 2 as the case may be. Thus the magnitude of the amplidyne output is directly controlled by the magnitude of the a-c error voltage, and the polarity by the phase of the error voltage.

Actually the amplidyne may have several control fields (usually four) incorporated in its field structure, permitting the amplidyne output to be controlled by a number of independent signals, since the amplidyne responds to their resultant action.

The above characteristics plus the additional advantage of very rapid response make the amplidyne a valuable contribution to control and allied applications.

Campus Highlights

by John Ashenbrucker e'48
Russ Pavlat e'48

As the generators start generating, the evaporators start evaporating, and as the pistons start—working, we see that the various organizations on Campus are well into the school year and carrying out their various programs with enthusiastic endeavor.

AIEE

Mr. H. B. Hull, chief engineer of the Southwest Bell Telephone Company and National President of AIEE, was guest speaker at a meeting of the local chapter of AIEE at Kennedy Manor on Friday evening, November 7th. Mr. Hull gave a talk on the "Organization of the American Engineering Association."

• • •

AI M&ME

Mr. E. C. Koerper, in charge of special engineering at the A. O. Smith Corporation in Milwaukee, talked to the Mining Club at their monthly meeting in November on the "Use of Engineering Principles in Industrial Design." Plans were also discussed for a Christmas Party, and movies of the Yale-Wisconsin game were shown. Leading the Mining Club for this year are: Robert Dustrude, President; Arthur Henschen, Vice-President; Joseph Vinette, Secretary - Treasurer; and Arnold Arnaut, Polygon Board Representative.

Engineer Lectures

Mr. J. W. Owens, engineer for Fairbanks Morse Co., spoke to a joint meeting of the SAE and ASME on Nov. 5th at the Mechanical Engineering building. His topic was "The Evolution of Diesel Engine Weldment Design and Fabrication."

The progressive fabrication of a Diesel motor block was illustrated with slides. Mr. Owens emphasized the importance of detecting cracks that may be induced by the welding process. Although cracks may be invisible to the eye, the stresses produced under operating conditions will usually produce premature failure. The device used for detecting the cracks is known as a "Magneflux." When an electrical current is passed through the block, magnetic powder sprinkled on the surface leaves a tell-tale pattern in the vicinity of a crack, due to interruption of the lines of force.

The engineer also emphasized the care which must go into the design of a welded product, adding that it is less costly to have the engineering staff work out all the details than to have the workers experiment in the shop.

• • •

KHK

Eight members of Kappa Eta Kappa, Electrical Engineering Fraternity, donned red caps and took off for the northern part of the state for a few days of deer hunting in middle November. The State Conservation Department as yet has made no statement regarding next year's season.

The University Alumni groups are buzzing with plans for early building and expansion of the University. Keep your fingers crossed for that new Engineering Building. It has been promised that when the new building goes up the Mechanicals will have the ME building to themselves.

SAE & ASME

The Society of Automotive Engineers and the American Society of Mechanical Engineers held separate meetings and membership drives on Wednesday, November 5th. Following the meetings the two groups combined to listen to a talk by Mr. James W. Owens of Fairbanks Morse and Company. Pictures for the Badger were taken of both groups after the lecture, and refreshments were then served.

Officers of the SAE student branch are: Toru Iura, chairman; Keith Rhodes, vice-chairman; Harold Miller, secretary; Bill Searles, treasurer. Other leaders include Bernard Kloehn, field editor; Alfred Yard and George Heberer, program committee; Howard Traeder and George Piper, membership committee; George Montemayor and George Dick, publicity; and Carl Leyse, Polygon representative.

(continued on page 32)

The Way We See It . . .

A Christmas Story

Plink - plink - plink - plink - plink - plink - plink - plink - plink ———

Once upon a time there was a little harp. It had the finest E-string in all harpdom. But that was the only string it had. And in spite of its fine string, it was a very unhappy little harp. You see, it could not play a tune. All it could do was play, "Plink - plink - plink." It was a sterling note, the finest "Plink" in all harpdom. But it just was not enough to keep the little harp happy.

Then one Christmas it happened!! A benevolent old gentleman climbed down the chimney with the doggonedest bunch of strings you ever saw. He saw that the unhappy little harp was asleep, so he put all the new strings carefully in place. Back up the chimney he went, and away into the night.

The next morning, the little harp awoke, stretched, and—to its surprise—played "Claire de Lune." The little harp was astounded. It launched into a rendition of "My Wild Irish Rose." The results of this venture were not too good, but better than a mere "Plink." And so the little harp went through life, happily playing through its new repertoire—a little discordantly, at times, but immeasurably better than "Plink" all the time.

A lot of us are like a "harp with one string." Engineers have a way of going through life playing the only tune they can play because of a desperate need for more strings. In our case, the need can be met with a broader education. If not formally, then in odd moments in our rooms with a good book. It is possible, this "self-education." There are many good books to make it easier. Try Emerson's Essays, Thoreau's "Walden," "The Education of Henry Adams," Gibran's "The Prophet"—I cannot name them all. Buy them for your own Christmas present this year. A few of them, anyway.

These books will not make you a versatile da Vinci, but they will increase interest in life considerably. You cannot expect perfect tonal results from such small investments in these "strings," but occasionally discords are still better than "Plink" all the time.

—RJM

Instructor Rating

With the six weeks' exams well over everyone is very much aware of the fact that students are subject to examinations periodically. They are given with the idea of having the students indicate how much they have gleaned from the instruction. Results of the tests also show the students how effective their studying has been.

These same test results could be used by the instructors as a means for measuring the effectiveness of their classroom efforts. A much more positive method to accomplish the latter was used at the College of Engineering at the University of Missouri. The local chapter of Tau Beta Pi initiated an "Instructors' Rating Poll." All the instructors that were rated taught junior and senior classes, and were representative of all departments. Voluntary participation by the instructors was encouraged by the use of a code system known only by each participant and the chairman of the rating committee, which was a very responsible position.

Attributes that were rated were interest in the course, knowledge of the subject, teaching ability, preparation, and cooperation.

The results of the poll were returned to the participants in coded form so that they could check their rating relative to the other instructors. The Missouri Poll showed very little evidence of "getting even" and any remarks included by the students were sincere and constructive.

Here is an opportunity for an organization on the campus to institute a constructive project which would help to create a better understanding between faculty and students at Wisconsin.

—EK

ROSES TO THE CAFETERIA

Those of us who have classes in the Mechanical Engineering Building want to pass along some compliments heard about the new cafeteria. Condensed, they are: Neat, clean, handy, good food, and good coffee. The idea of between-meal snacks and coffee-sessions in a well lighted room with tables for studying is good.

Alumni Notes

by J. J. Kunes e'48
L. Hunholz e'47

Charles W. Newing (CE'31) is living in Detroit, Mich.—he is a Civil Engineer with the U. S. Engineer's Office.

Edward K. Neroda (CE'35), a Contractor Engineer at Carmel, Calif., announces the arrival at his home of a new (potential) engineer.

Jack H. Maxfield (CE'38) is with Crawford, Murphy, & Tilly, Consulting Engineers of Springfield, Illinois. He had been with the Illinois Division of Waterways for the past six years.

Charles J. Naeser (CE'46) is with Consoer, Townsend & Associates of Chicago, as an inspector.

William L. Olson (CE'47) writes: "I spent the summer at a Boy Scout Camp up in Northern Wisconsin, as a waterfront director. After that I married a girl from there that I met at school in Madison; I started this job (with Merritt, Chapman & Scott Corp. of New York) two weeks ago. We are building the Franklin D. Roosevelt Hospital for the Veterans Administration here at Peekskill, N. Y. I am instrumentman with one of the field parties. When completed, the project will amount to about $17,500,000. There will be thirty-four buildings."

—Photograph courtesy Carnegie-Illinois Steel Corp.

Among the Wisconsin Engineers now working at the Carnegie-Illinois Steel Corp. South Works, Chicago, Ill. (left to right): John A. Roeber, Combustion Engineer (Power Division), Class of May 1947; Jack H. Eisaman, Superintendent, Electric Furnaces, Class of June 1933; George E. Steudel, Superintendent, Blast Furnace Division, Class of June 1911; Donald E. Strom, Draftsman (Engineering Dept.), Class of May 1947.

Gordon E. Harman, former boxing star, has been made resident engineer in charge of construction of the General Electric Co. turbine plant in Schenectady, N. Y. He left Madison in 1947 to become chief field engineer for Stone and Webster Co., engineering firm in charge of the project.

Albert L. Schluter (CE'38) is engineer with Holland, Ackerman & Holland, of Chicago, located at Little Chute, Wis., on a hydro plant for the City of Kaukauna.

Paul W. Bishop (CE'26) is reported to have been seriously injured in an auto crack-up in October. He has been on the staff of the McMahon Engineering Co., at Menasha.

ChE

Raymond J. Meisekothen (ChE '47) is doing pilot-plant work on a process for the solvent-extraction of cottonseed-oil at the Swift & Co. Oil Mill, Memphis, Tenn.

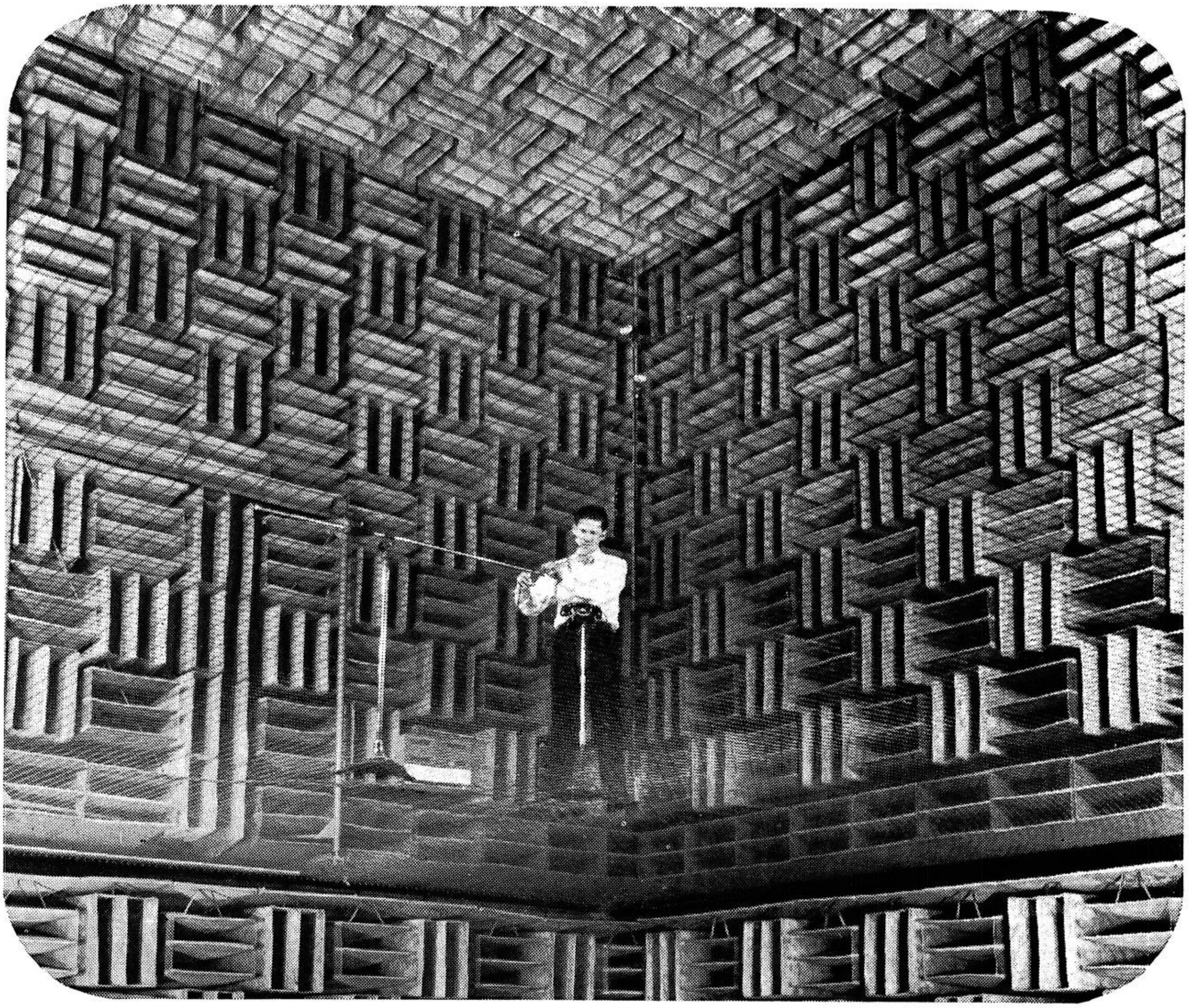
Robert R. Mazer (ChE'47) has been employed by the Soya Products Division of the Glidden Co., Chicago, Ill.

Francis C. Zevnik (ChE'43, MS '47) is a Chemical Supervisor in the Grasselli Chemicals Department of E. I. DuPont de Nemours & Co.

Gilbert W. Stockwell (ChE'47) is the restless type; he is now in training at Lawrenceville, Illinois, for foreign service with the Arabian-American Oil Co.

Robert A. Carlson (ChE'47) is employed in the craft mill of Crown Zellerbach at Port Townsend, Wash.

(continued on page 28)



SHHHHHHHHH!

Quiet.

Walk into this new acoustic test room at Bell Telephone Laboratories and all you'll hear is silence.

It's about the quietest place on earth.

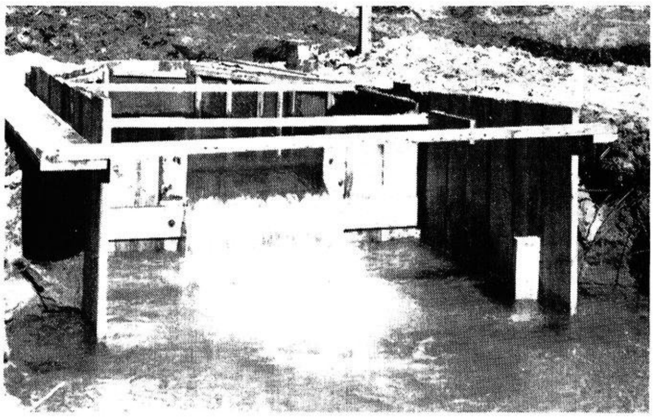
This non-reverberant chamber was ingeniously designed by telephone engineers so that acoustic development and research could be carried on under the best possible conditions. It's another aid in a continuing program to improve communications.

This is telephone engineering at work.

BELL TELEPHONE SYSTEM

Petenwell Dam

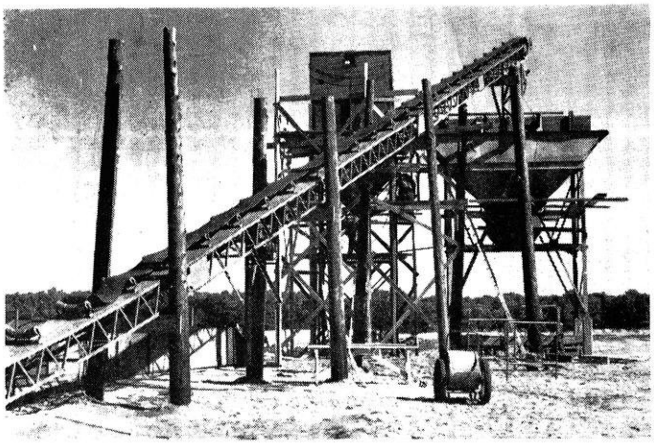
(continued from page 13)



A rough measure of the water pumped from the sand is given by the rectangular weir.

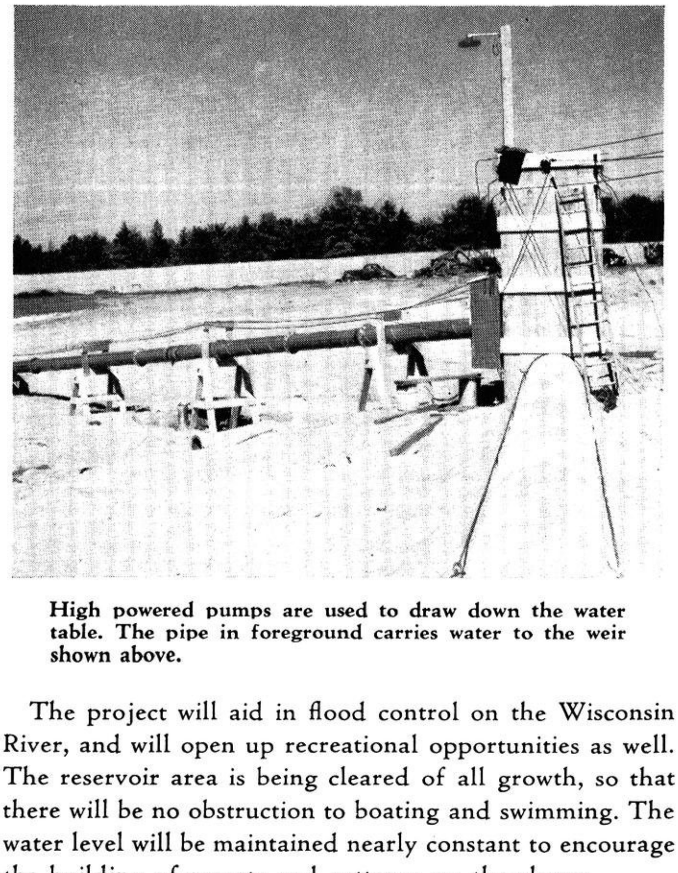
water flows over a spillway, it possesses considerable energy. Upon reaching the bottom, this is characterized by the relatively high velocities and turbulence for some distance downstream. This energy must be taken from the water, or it will erode the stream bed and cause damage to the structure.

The dam at Petenwell is to be constructed on sand foundations confined by steel sheet piling. Therefore, suitable spillways and aprons had to be developed so that the sand would not be eroded. To determine the design of the best spillway section, scale models were built and tested at the Hydraulic Laboratory, University of Wisconsin. Under the direction of Professor A. T. Lenz, several senior civil engineers performed the experiments and wrote theses concerning the various aspects of this problem. As a result of this work, a spillway and apron section was developed that will prevent dangerous erosion of stream bed sand.



The conveyor carries aggregate from storage bins to the concrete mixing tower. Pumps will force concrete through pipes to the forms.

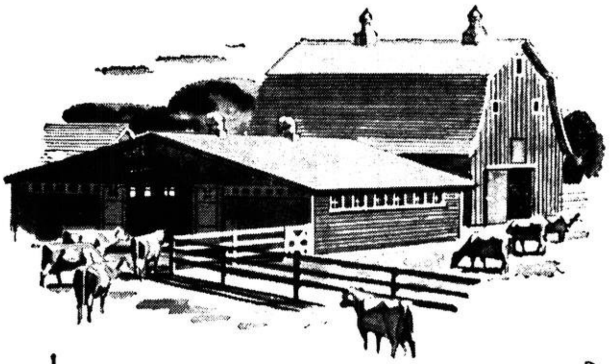
These tests were made in a flume with Plexi-glass sides, so that the water action could be seen and photographed. Sand was placed in the channel to simulate actual river conditions as they are now. Then, by taking a profile of the sand after a test was run, it could be compared with the original, and the effect of the water determined. Naturally the section producing the least change in this sand profile is the most desirable. These tests have resulted in some radical changes in the design from the conceptions of 1938.



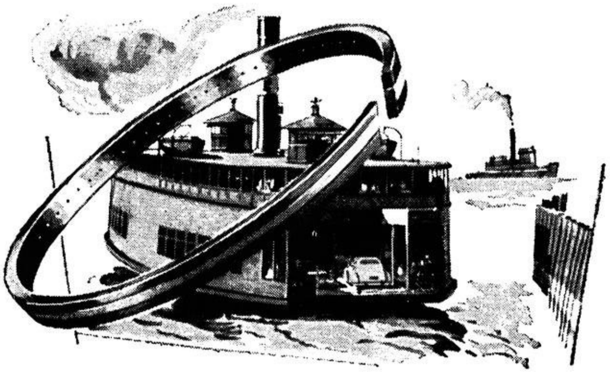
High powered pumps are used to draw down the water table. The pipe in foreground carries water to the weir shown above.

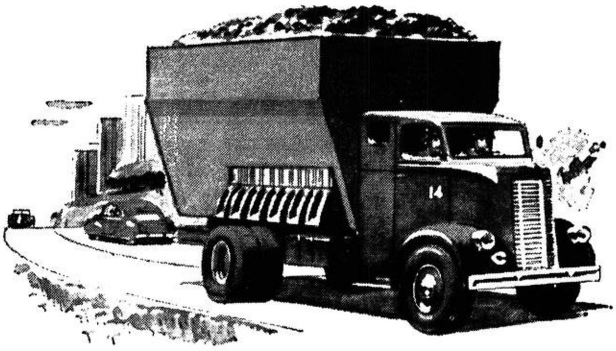
The project will aid in flood control on the Wisconsin River, and will open up recreational opportunities as well. The reservoir area is being cleared of all growth, so that there will be no obstruction to boating and swimming. The water level will be maintained nearly constant to encourage the building of resorts and cottages on the shores.

The Wisconsin River is very well suited to the production of water power. When the Petenwell Dam is completed in 1949, with a generating capacity second to the plant at Prairie du Sac, the Wisconsin will be one of the most highly developed rivers in the United States.

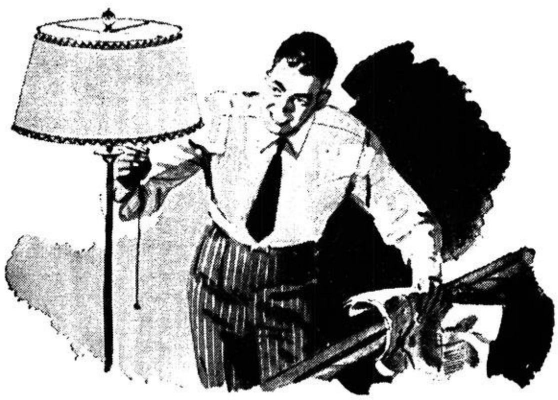


When you admire a beauty[1] . . . or visit a farm[2] . . .





ride on a ferry[3] . . . . or order some coke[4] . . .



swallow an aspirin[5] . . . . or turn on the light[6] . . .

the chances are, you are coming in contact with Koppers engineering or chemical skills.

1. Koppers chemicals for use in cosmetics. **2.** Farm structures made of lumber pressure-treated by Koppers for long life. **3.** Koppers American Hammered Piston Rings for marine engines. **4.** Coke from Koppers-built ovens. **5.** Koppers chemicals for use in medicines. **6.** Koppers Fast's self-aligning couplings, widely used in power plants. All these are Koppers products . . . as well as scores of others that help to increase our comfort, guard our health, enrich our lives. All bear the Koppers trade-mark, the symbol of a many-sided service . . . and of high quality. Koppers Company, Inc., Pittsburgh 19, Pa.

K
KOPPERS

S-T-A-T-I-C

by Chuck Strasse e'47

"Doesn't this steak have a queer taste?"

New bride: "I can't understand why, I rubbed vaseline on it as soon as it burned."

* * *

Bob went off to college. The second weekend he was back at the old homestead with his grip in his hand.

"Homesick?" his mother asked.

"No, just no-home sick," he replied.

* * *

I like girls with golden hair.
I like girls with gold.
I like girls.

* * *

"I had a strange dream last night, dear. I saw you running off with another man."

"Did you stop him?"

"No, I asked him why he was running."

* * *

THE CRAFTY DRAFTSMAN

The designer sat at his drafting board
A wealth of knowledge in his head was stored
Like "what can be done on a radial drill
Or a turret-lathe or a vertical mill?"
But above all things, a knack he had
Of driving gentle machinists mad.
So he mused as he thoughtfully scratched his bean
"Just how can I make this thing hard to machine?
If I make this body perfectly straight
The job had ought to come out first-rate
But 'twould be so easy to turn out and bore
That it would never make a machinist sore.
So I'll put a compound taper there
And a couple of angles to make 'em swear
And brass work for this little gear
But it's too darned easy to work, I fear.
So just to make the machinist squeal
I'll make him mill it from tungsten steel!
And I'll put those holes that hold the cap
Down underneath where they can't be tapped.
Now if they can make this it'll just be luck
'Cause it can't be held by a dog or a chuck
And it can't be planed and it can't be ground
So I feel my design is unusually sound!"
And he shouted in glee: "Success at last!
"This #*&§$ #!$*& thing can't even be cast!"

Engineer "A": "She's a nicely reared girl, isn't she?"

Engineer "B": "Not too bad from the front either."

* * *

"I sent my little boy for two pounds of plums and you only sent me a pound and a half."

"My scales are all right, Madam. Have you weighed your little boy?"

* * *

"Is your boy friend an engineer?"

"No, a veteran. He learned to swear like that in the Army."

* * *

John: "Hi, care for some peanuts."

Jean: "Sure, thanks."

John: "Care to neck?"

Jean: "No, thanks."

John: "Give me back my peanuts."

* * *

Did you hear about the three Chinese girls who aren't married:

Tu-Yung-Tu
Tu-Dumb-Tu
No-Yen-Tu

* * *

A man with a black eye and one or two other injuries was checking out of a big hospital. The desk attendant began to fill out the regular form.

"Married?" he asked.

"No," was the answer. "Automobile accident."

* * *

The lawyer had just given his wife a beautiful skunk coat for Christmas.

"I don't see," she mused, "how such a nice coat can come from such a foul smelling beast."

"Well," was the reply. "I don't ask for thanks, dear, but I do demand a little respect."

* * *

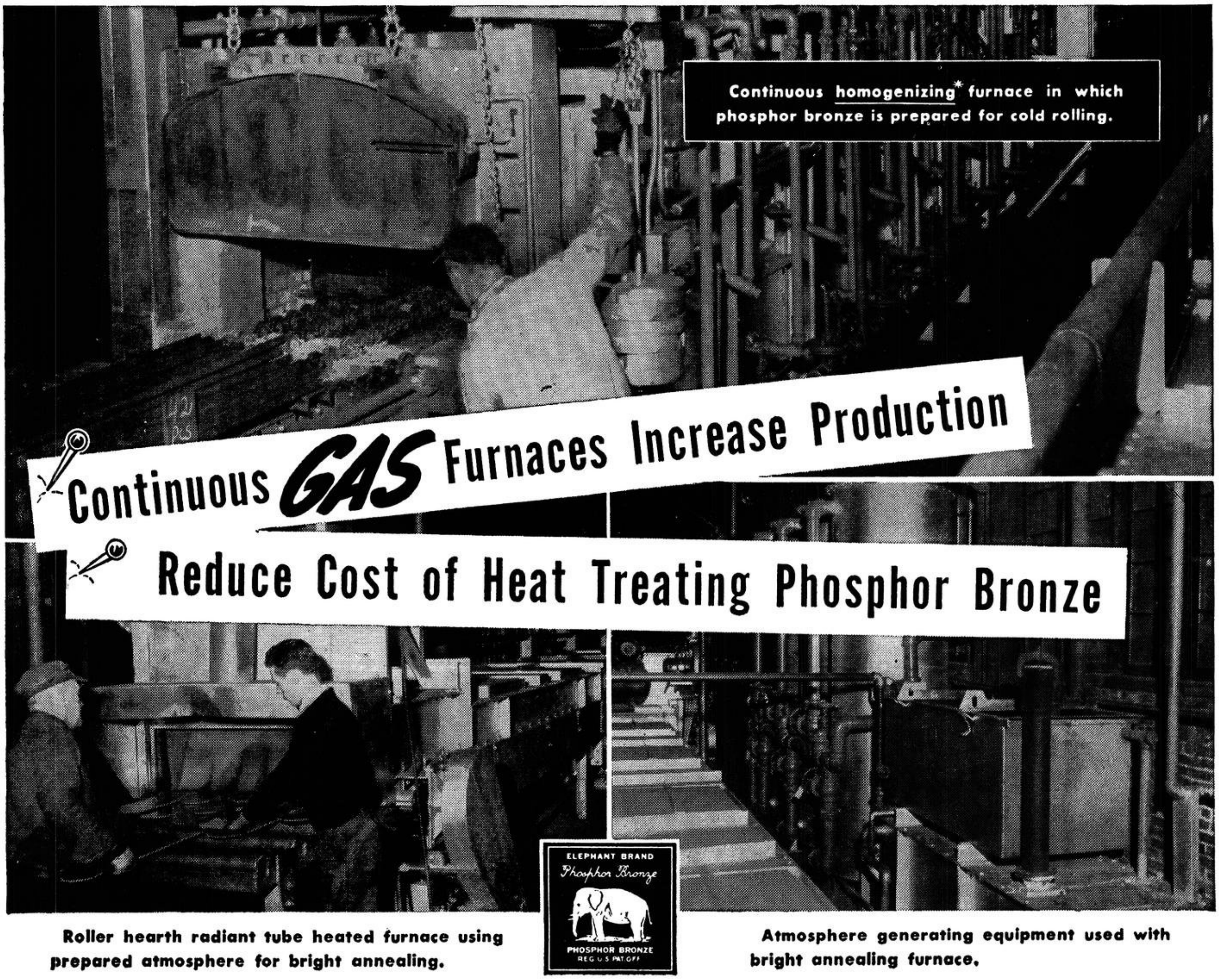
"Hey Joe, that's a bad burn. Where'd you get it, welding class?"

"No, Liz' Waters."

* * *

Curious old lady: "Why you've lost your leg, haven't you?"

Cripple: "Well, darned if I didn't."



Continuous homogenizing* furnace in which phosphor bronze is prepared for cold rolling.

Roller hearth radiant tube heated furnace using prepared atmosphere for bright annealing.

Atmosphere generating equipment used with bright annealing furnace.

Customers of Phosphor Bronze Smelting Company, 2200 Washington Ave., Philadelphia, started the whole thing—they demanded more Elephant Brand Phosphor Bronze products than the company could produce by former methods of heat treating.

So company production engineers, already familiar with GAS and Gas Equipment, specified the modern method of heat treating—with continuous, automatically-controlled, Gas Furnaces, with integral prepared atmospheres.

Here are the processes...

Process—*Homogenizing—a method of heat treating to develop uniform grain structure in phosphor bronze billets prior to rolling, while relieving casting strains.
Temperature—1200° F.
Cycle—6 hours
Furnace Capacity—2000 lbs. per hour

Process—Annealing of bars and sheets in a prepared-atmosphere furnace to retain brightness while relieving stresses set up during rolling or drawing operations.
Temperature—1200° F.
Cycle—40 minutes to 3 hours, varying with stock size
Furnace Capacity—5000 lbs. per hour

Here are the results....

1. Pickling process eliminated
2. Production increased 80%
3. Uniformity of heat treatment assured by automatic control
4. Annealing and homogenizing costs reduced over 50%
5. Working conditions improved

Throughout industry modern Gas Equipment has established cost-cutting and time-saving records wherever GAS heat treating methods and machinery have been integrated in production-line processes.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

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

Exploration of ocean depths is made possible by RCA Image Orthicon television camera.

Alumni Notes

(continued from page 20)

Delmar D. Dettner (ChE'33) is a Chemical Engineer with the Universal Oil Products Co. of Chicago.

Daryal Arnold Myse (ChE'33, LLB'37) has combined his slide rule and legal talents and opened lawyer and engineering offices in Washington, D. C.

Ralph N. Schaper (ChE'35), formerly plant superintendent of Westlake Castings, Inc., Los Angeles, has accepted a position as plant superintendent of the Marion Malleable Iron Works, Marion, Ind.

John F. Wright (ChE'36) is a Chemical Engineer and executive assistant for the Standard Oil Company at Baton Rouge, La.

ME

Karl E. Sager (ME'38) has been appointed head of the Patent Department of the Kimberly-Clark Corporation, and manager of the Paper Patents Company.

Joseph G. Green (ME'33) recently joined the staff of Fairbanks Morse & Co. of Chicago as Research Engineer.

Eugene S. Skinner (ME'35) is now Purchasing engineer for the Beloit Iron Works, Beloit, Wis.

Harlo W. Scott (ME'42) is a Safety Engineer for the Sinclair Refining Company, in East Chicago, Indiana.

Raymond L. Zobel (ME'46) is with the Bucyrus-Erie Company of South Milwaukee, Wis.

Richard V. Rhode (ME'25), with his wife and four children, is living in Hampton, Va. He is doing aeronautical research; is Chief of the Aircraft Loads Research Division of the National Advisory Committee for Aeronautics.

Robert Gray Griswold (ME'04) began as a Cadet Engineer doing research on gas plant operations and distribution for the Denver Gas & Electric Company, and is now president and director of Gas Advisers, Inc.

(continued on page 36)

Campus Lighting

(continued from page 8)

illumination, 27.9 ft.-c. (3) Tubes removed, cleaned with damp cloth, reflectors cleaned and tubes replaced, no louvers; average illumination, 31.0 ft.-c. (4) New 40 W. white tubes were installed, no louvers; average illumination, 49.5 ft.-c.

The effects of the various factors under consideration were computed as follows:

Per cent decrease due to adding louvers $= \frac{27.9-24.0}{27.9} \times 100 = 14\%$. (This percentage may be a bit high due to the fact that there were three readings made to one side of the luminaries where the direct rays from the tubes were cut off by the louvers to every two readings made directly underneath the fixtures where the louvers have little effect.)

Per cent decrease due to aging of tubes $= \frac{49.5-31.0}{49.5} \times 100 = 37.4\%$. (Most of the tube ends were considerably blackened. The University Chief Electrician stated that the tubes were ready for replacement.)

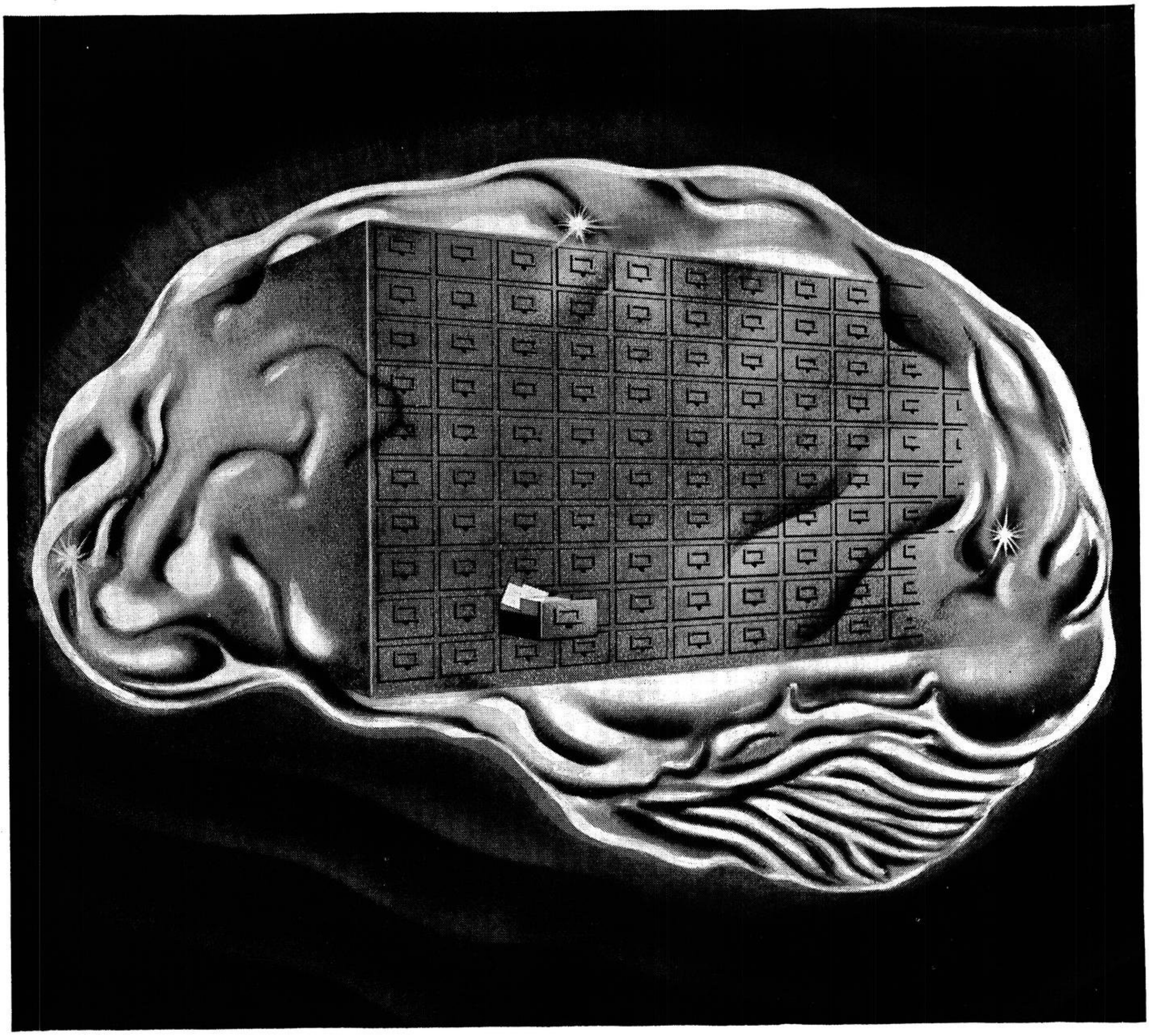
Per cent decrease due to an estimated four month accumulation of dust on tubes and reflectors $= \frac{31.0-27.9}{31.0} \times 100 = 10\%$.

Owing to the fact that the reflectors do not collect much dust on their under surfaces, which do the actual reflection, the only place where dust can collect on these fluorescent fixtures is on the tops of the tubes and the louvers. Thus the maintenance factor is quite a lot higher in general than that of the usual semi-direct or indirect incandescent fixtures, where dust collects readily on the upper surface of the reflector or globe, just where it does the most harm.

Aging and blackening of the tubes accounts for a great part of the decrease in efficiency of a fluorescent system, just as it does in an incandescent system. The effect depends, of course, upon whether tubes or bulbs are replaced before excessive blackening takes place, or are allowed to remain in place until they fail.

It may be of interest to compare the fluorescent lighting system installed in the lower campus reading room with an incandescent semi-indirect system yielding an equivalent reading table illumination. Choosing a semi-direct fixture of the type alluded to above (bottom of globe opal, top transparent) the manufacturer's table states that for 35 ft.-c. with 14 foot ceiling height, 500 W. units should

(continued on page 38)



ALUMINUM BRAINS FOR THE ASKING

Some day you are going to want to know something that you won't have learned in college. And won't find in books.

You are going to consider using aluminum for some purpose where the engineering isn't all spelled out for you. You'll want facts about aluminum that you can apply to your problem; and guidance in using them.

When that happens, remember to call on the brains that have stored up more knowledge of aluminum than you can find anywhere else. For 59 years this brain has been gathering facts and experience in making aluminum useful in thousands of ways.

We are talking about the cumulative corporate brain of ALCOA . . . Aluminum Company of America. When it goes to work on your problem, the particular kind of knowledge needed is sure to be found in one or more of this brain's many parts . . . in the minds of the scientists, engineers, plant men and salesmen who make up this corporate brain of ours.

Their metallurgical experience, their counsel on design, their intimate knowledge of aluminum fabrication and finishes . . . all yours for the asking. ALUMINUM COMPANY OF AMERICA, Gulf Bldg., Pittsburgh 19, Pa.

MORE people want MORE aluminum for MORE uses than ever

ALCOA FIRST IN **ALUMINUM**

ALCOA
A C O A
ALUMINUM

Campus Highlights

(continued from page 18)

AIChE

The first meeting of the year was held Thursday, November 13th, in the Chemical Engineering Building. A short talk and slides on "Gold Mining in Alaska" was given by Mr. J. Hennig. Refreshments were served.

• • •

Eta Kappa Nu

Eta Kappa Nu, national honorary Electrical Engineering Fraternity, held a social meeting in the Beefeaters' Room of the Union on Wednesday evening, November 19th. Pictures were taken for the Badger.

• • •

Pi Tau Sigma

Pi Tau Sigma, honorary Mechanical Engineering Fraternity, at its semi-annual informal initiation on Nov. 13th, elected the following members to the organization:

Donald H. Bennett, William O. Clark, George R. Creedle, Robert E. Doyle, Richard H. France, David Goodman Harrison, John W. Mann, Lester M. Maresh, George H. Montemayor, Allen B. Pagel, Russell H. Pipkorn, Ernest R. Reichmann, Alvin C. Roecher, Stephen P. Sanders, Thomas V. Severson, Reno J. Testolin, Morris H. Thorson, Hugh R. Wahlin, Carl Zickert, and Lawrence A. Zuchowski.

• • •

Triangle Fraternity

Triangle Fraternity initiated the following men on Sunday, November 16th: Hans L. Preu, ME 2; Walter Griskavich, M&ME 2; Duane E. Glaubitz, EE3; Clarence E. Fordham, EE 3; and Donald A. Dowling, EE 3. Henry Preu was toastmaster at the banquet held at 1:00 P.M. in the Colonial Room of the Loraine Hotel.

Year after year, the Square D Company emphasizes to industrial executives, the importance of their electrical men.

***Advertisements such as this one** appear regularly in leading business magazines. We believe they perform a three-way job. They give top management a worthwhile idea. They enhance the standing of today's and tomorrow's electrical men. They build acceptance for Square D Field Engineers, practically all of whom come to us from leading engineering schools such as yours.*

Don't turn around, Jim • • • we want to talk behind your back • • • and to your Boss, too

WE WANT TO TELL HIM how valuable his head electrical man can be in any huddles that have to do with cost reduction.

We want to point out the sharp increase in power required for automatic machinery during recent years. Most electrical systems have been operating under abnormal stress—are overloaded, unreliable, poorly located or inflexible in the light of present machine locations. Excessive "down time" and high production costs are certainties.

We want to suggest that he check these possibilities with you. And we'd like to remind you that your nearest SQUARE D Field Engineer will be glad to work with you in analyzing any electrical problem and selecting corrective power distribution and electric motor control equipment. Field Engineering Counsel is available through SQUARE D offices in 50 principal U. S., Canadian and Mexican cities. There is no obligation.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D CANADA, LTD., TORONTO, ONTARIO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

Science Highlights

by E. Robinson m'49
E. Zimmerman e'49

SYNCHRONOUS MOTOR CALCULATOR

Westinghouse Electric Co. has come out with a synchronous motor calculating board which does on a limited scale for the synchronous motor what the transient network analyzer does for the whole power system. While motor running conditions are well standardized, motor starting conditions vary considerably. Calculating a dozen variations of starting windings for some special condition to make sure that the best possible arrangement has been achieved would be expensive and time consuming. With the aid of this calculator, all that is necessary is to determine several sets of winding constants for the motor, insert each into the calculating board, and the torque, line current, and field current of the proposed motor can be read on the built-in meters for each instant from starting to full synchronous speed.

HIGH-TEMPERATURE, HIGH-STRENGTH METAL ANNOUNCED

Kennametal, Inc., has announced development of a new metal that retains its strength and resistance to corrosion at temperatures as high as 2,100° F. The company said that the metal withstands temperatures that rapidly destroy conventional carbides and the best cast alloys, resists thermal shock better than ceramics, and has a specific gravity about one-third that of tungsten carbide and about two-thirds that of steel. The actual yield points of the metal were not given.

WEATHER TINKERING

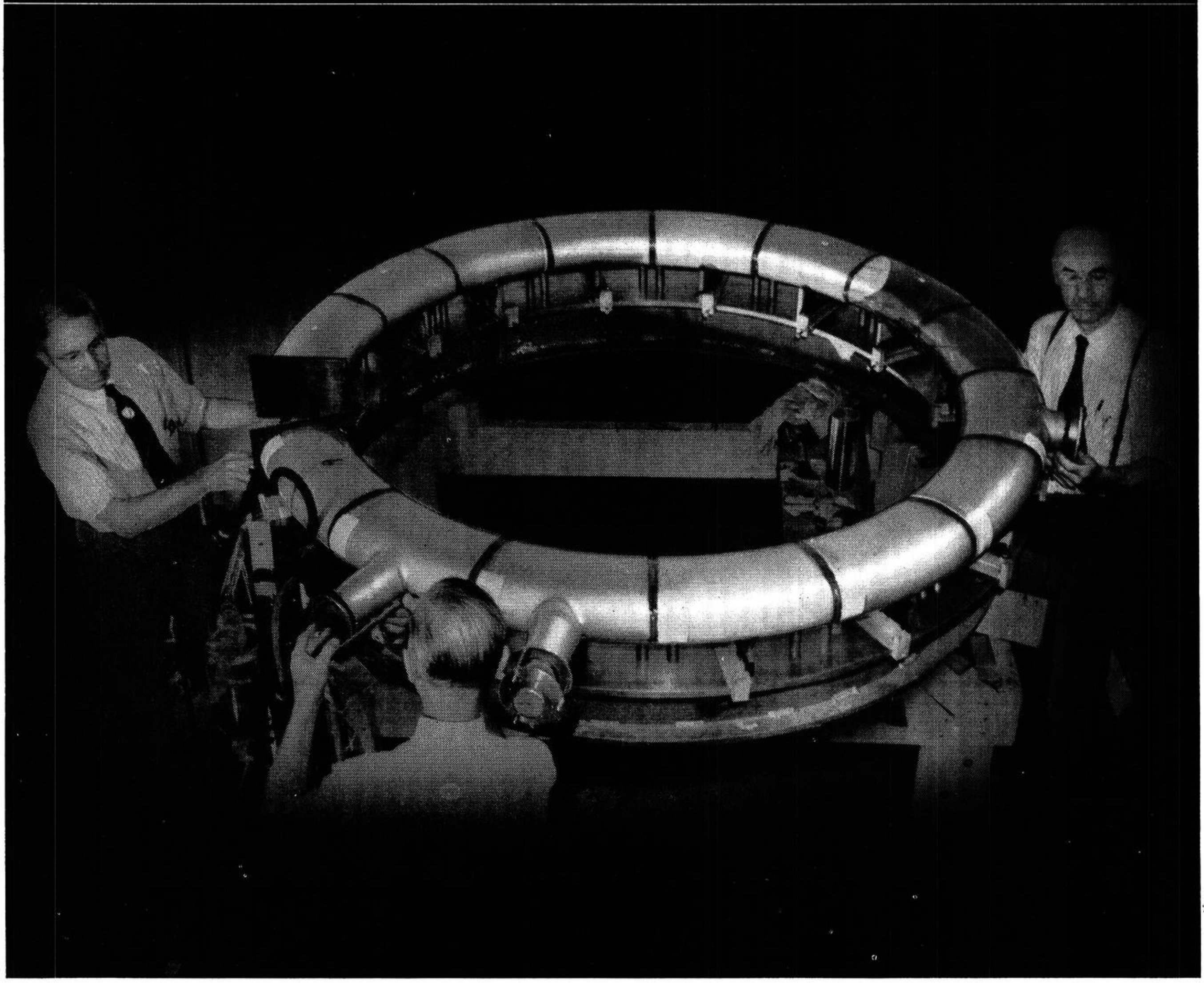
The old saying that everyone talks about the weather, but that no one does anything about it, is no longer true. Scientists who have been studying weather have devised several means of "doing something about it."

Under certain atmospheric conditions, the droplets of water in a cloud (fog) remain liquid even though the temperature is below freezing. Such a condition is called supercooling. It has been shown experimentally that ice nuclei form spontaneously only at as low a temperature as minus 31 degrees Fahrenheit (31 below zero) or lower. Therefore if a small segment of such a supercooled cloud can be cooled below —31 degrees F., ice nuclei will form and "seed" the rest of the cloud. The result is snow. One method of lowering the temperature is to drop dry ice into such a cloud.

Another method involves the fundamental principle that sudden expansion of air will cause a severe drop in the temperature of the air expanded. This can be accomplished by bursting a tiny balloon smaller than a pea. The sudden expansion takes about one-thousandth of a second and lowers the temperature sufficiently to produce about 1,000,000,000 ice nuclei "seeds." The same effect may be produced by opening a bottle of pop, shooting a popgun, or by any device that allows sudden expansion of air into the supercooled cloud.

A third method of causing snow (rain) is to "seed" the cloud with foreign-nuclei, which, though of different chemical composition than snow, resemble snow in crystalline structure. The supercooled water is "fooled" into forming snow crystals about the foreign particle nuclei and falls as snow.

The glass doughnut that made headlines...



ON January 26, 1946, newspapers carried front page stories about the new and amazing 100 million volt "betatron". The heart of this instrument that enables scientists to peer more deeply into steel castings to discover flaws, is a giant hollow glass "doughnut." With the betatron, men in the field of nuclear research have already made startling discoveries in the investigation of atomic energy.

The making of this giant glass tube called for glass research knowledge and glassmaking skill of the highest degree. And Corning was ready with the right combination of both. Each of those "doughnut" sections you see in the picture had to be built to the most exacting dimensional tolerances.

Science and industry have learned to expect Corning to come through with the answer to any glass problem. For instance, Corning produced the world's largest piece of cast glass... the 200″ telescope mirror for famed Mt. Palomar. And when all other materials failed to do the job of handling hot corrosive acids, Corning made glass pipe and glass pumps that work without a hitch or replacement for years. Thermometer tubing ... miles and miles of it ... with a bore only 1/8 the diameter of a human hair is just an everyday job at Corning.

With more than 50,000 different glass formulae to draw on, Corning scientists and glass workers have adapted glass to thousands of different jobs ... some simple, some as complicated as the betatron. But in every instance glass is used because it does the job best. And you'll find after graduation, that a knowledge of glass may help you do a better job. So why not keep Corning in mind. We'll be ready to help you all we can. Corning Glass Works, Corning, N. Y.

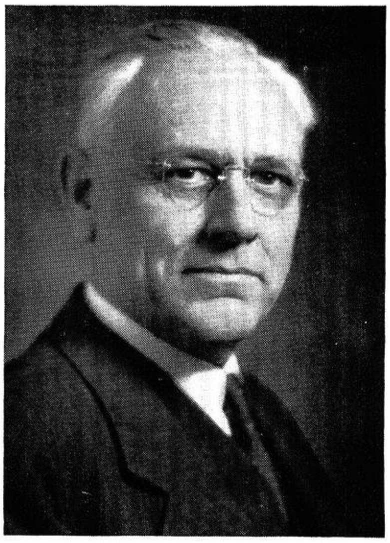
CORNING
means
Research in Glass

MAKERS OF PYREX OVENWARE AND FLAMEWARE AND 37,000 OTHER GLASS PRODUCTS

Alumni Notes

(continued on page 28)

From 1906, the year following his Cadetship, to 1913, Mr. Griswold served as gas engineer designing concrete gas purifiers, gas distribution systems, and a district steam heating distribution system as well as constructing the rates for central station district heating. During this same period he also took charge of the Training School for Cadet Engineers. In 1913 he became engineer attached to the New York office, and in 1915, chief technologist, in charge of special engineering problems concerning oil and gas transportation, rates and special meters for gas service. He assumed his present position in 1938. He is, in addition, director of the Doniphan County Light and Power Company.



Robert G. Griswold
—Photograph courtesy Cities Service

Frederic D. Utter (EE'37) is a Motor Sales Engineer specializing in shaded-pole motor application engineering with the Barber-Colman Company of Rockford, Ill. Other Wisconsin men with the company are: **Clark Bullen** (EE'32), **Herb Kieckhefer** (EE'33), **Oscar Welker** (EE'36), **Everett Davies** (EE'39), and **Roger Schuette** (EE'39).

THE MARCH OF SCIENCE

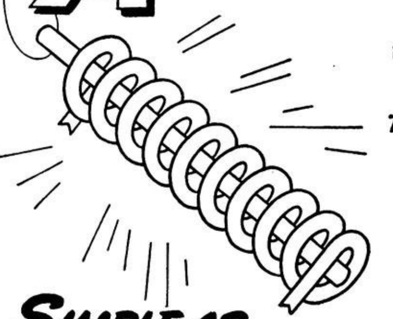
MIRACLE HEAT—
without fire or furnace!

HEATING A PIECE OF METAL BY OPEN FLAME, BLOW-TORCH OR FURNACE IS RELATIVELY SLOW—APT TO LEAVE SCALE... IT'S HARD TO HEAT ONE SPECIFIC AREA WITHOUT HEATING THE WHOLE PIECE.

PRODUCTION MEN REALIZED HEAT-TREATING OPERATIONS SUCH AS FORGING, PRECISION BRAZING AND SURFACE HARDENING COULD BE STEPPED WAY UP IF A FASTER METHOD OF HEATING COULD BE FOUND... ONE WHICH WOULD CONCENTRATE THE HEAT AT PRE-SELECTED AREAS!

HEAT BY INDUCTION SEEMED LIKE THE ANSWER. SCIENCE HAD ALREADY DISCOVERED THAT METALS HEAT RAPIDLY WHEN INTRODUCED INTO A HIGH FREQUENCY, HIGH DENSITY MAGNETIC FIELD!

A NEW ELECTRONIC HEATER DESIGNED BY ALLIS-CHALMERS SCIENTISTS—



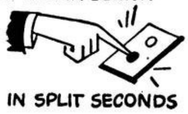
AMAZING PRODUCTION TOOL RECTIFIES ORDINARY 60-CYCLE CURRENT THEN STEPS IT UP TO 450,000 CYCLES. A MAGNETIC FIELD OF HIGH DENSITY IS SET UP IN WORK COIL AND WHEN METAL IS INTRODUCED INTO THIS FIELD, PASSAGE OF CURRENT CAUSES POWER LOSSES WHICH PRODUCE HEAT WITHIN THE METAL WITH INCREDIBLE SWIFTNESS.

BIG BENEFITS: COMPLETE, SELECTIVE CONTROL OF HEAT PENETRATION... EXACT UNIFORMITY... GREATLY INCREASED PRODUCTION!

SIMPLE AS

A PLACE METAL IN WORK COIL...

B PUSH BUTTON



C METAL IS HOT IN SPLIT SECONDS

ALLIS-CHALMERS MANUFACTURING CO. MILWAUKEE 1, WIS.

ELECTRONIC HEATER IS ONE MORE EXAMPLE OF HOW ALLIS-CHALMERS RESEARCH AND EXPERIENCE GO TO WORK FINDING BETTER, FASTER, MORE EFFICIENT WAYS OF HANDLING PRODUCTION PROBLEMS—ANOTHER GOOD REASON WHY A-C EQUIPMENT IS IN DEMAND IN EVERY MAJOR INDUSTRY...

ALLIS-CHALMERS

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

Campus Lighting

(continued from page 30)

be hung 10 feet, six inches from floor and recommends one unit for each 70 square feet of floor area. The building is 40′ X 240′ so the number of fixtures should be $\frac{40 \times 240}{70} = 137$. Five luminaries across and 28 lengthwise per row make a total of $5 \times 28 = 140$ fixtures.

Unit cost (based on list price):

hanger	$ 5.00
globe	19.80
bulb	1.00
labor to hang luminaire	1.70
	$27.50

Total initial cost (incandescent):

$$140 \times 27.50 = \$3{,}850$$

Unit cost, fluorescent installation (list price for type installed):

reflector, starter, ballast	$70.00
4 cable clamps and misc.	2.00
6 tubes (40 W.)	6.00
labor	5.00
	$83.00

Total initial cost (fluorescent):

$$77 \times 3 \times 27 = \$6{,}800$$

Energy consumed:

Incandescent: $500 \times 140 = 70$ KW.

$$\frac{70{,}000}{40 \times 240} = 7.3 \text{ W/ft.}^2$$

Fluorescent: 6×40 (tubes) plus 2×23 (ballast) $= 286$ W/unit

Total $= 3 \times 27 \times 286 = 23.2$ KW.

$$\frac{23{,}200}{40 \times 240} = 2.4 \text{ W/ft.}^2$$

Thus it can be seen that while a fluorescent system, in this case, costs about twice as much as an equivalent incandescent system initially, the load, load density, and hence the energy cost are only about one-third as great for fluorescent as for incandescent. After a certain period of operation, depending upon prevailing power rates, the overall cost (initial, total energy) would be less for the fluorescent system than for the incandescent due to the much greater efficiency of fluorescent lighting.

A room dotted with lamp globes is not nearly so pleasing in appearance as one such as is shown in the illustration, with its "streamlined, modern-design" appearance.

DU PONT Digest

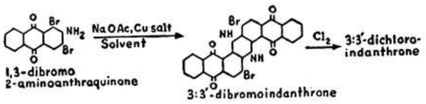
For Students of Science and Engineering

Development of dyes requires both physical and organic chemistry

The synthesis of a new dye in the laboratory or even the development of a manufacturing process from that synthesis may still be a long way from the realization of the full potentialities of the new compound as a coloring material. This is illustrated by the commercial history of the exceedingly fast bright blue dye indanthrone and its halogen derivatives.

Indanthrone was the first known anthraquinone vat dye and has led tonnage sales of vat dyes in the U.S. since its introduction, despite the commercial use of well over 200 types. In 1901, Bohn first synthesized indanthrone by KOH fusion of 2-aminoanthraquinone, but the yields obtained were in the range of only 25-30 per cent. Because of the industrial importance of indanthrone, and the low commercial yields obtained by the original fusion procedure, a great deal of research time has been spent in its study.

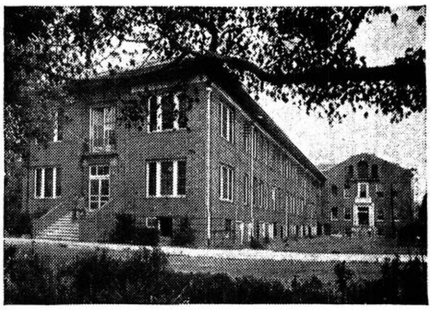
Several U.S. patents record the fact that Du Pont organic chemists have made outstanding contributions in this field, particularly by developing the intercondensation of 2 moles of 1,3-dibromo-2-aminoanthraquinone and replacing the bromine by chlorination to give 3:3′-dichloroindanthrone ("Ponsol" Blue).



This fixes the chlorine in the desired positions to give a product with greater bleach-fastness than indanthrone and minimizes extraneous substitution that always accompanies direct chlorination of indanthrone. The commercial yields of 3:3′-dichloroindanthrone now being obtained by Du Pont are markedly greater than those obtained by Bohn and his workers.

It is just as important, however, that a water-soluble dye be made in a physical form that gives optimum shade and working qualities, such as perfect dispersion, freedom from specks, rapid reproducibility and storage stability. A significant Du Pont contribution to the production of vat dyes in optimum physical form is called "turbulent flow drowning." In this procedure, the color is dissolved in strong H_2SO_4 and then diluted by a large volume of water in a constricted tube. High turbulence is maintained during dilution and produces uniform dye particles.

In this development the work of physical chemists and physicists, aided by electron microscopy, ultra-centrifuging, infrared and ultra-violet spectrometry and other modern techniques, was of major importance.



One of the three wings of the Jackson Laboratory, where a large portion of the basic research on dyes is carried on. The new $1,000,000 addition on the right is nearing completion.

The conversion of laboratory findings to a plant operation often presents unique and difficult problems that require unusual ingenuity on the part of chemists, chemical, mechanical and electrical engineers. The work on the indanthrones was no exception. The outstanding commercial success of "Ponsol" vat colors, typified by "Ponsol" Blue is one example of the results achieved through cooperation of Du Pont scientists.

★ ★ ★

Questions College Men ask about working with Du Pont

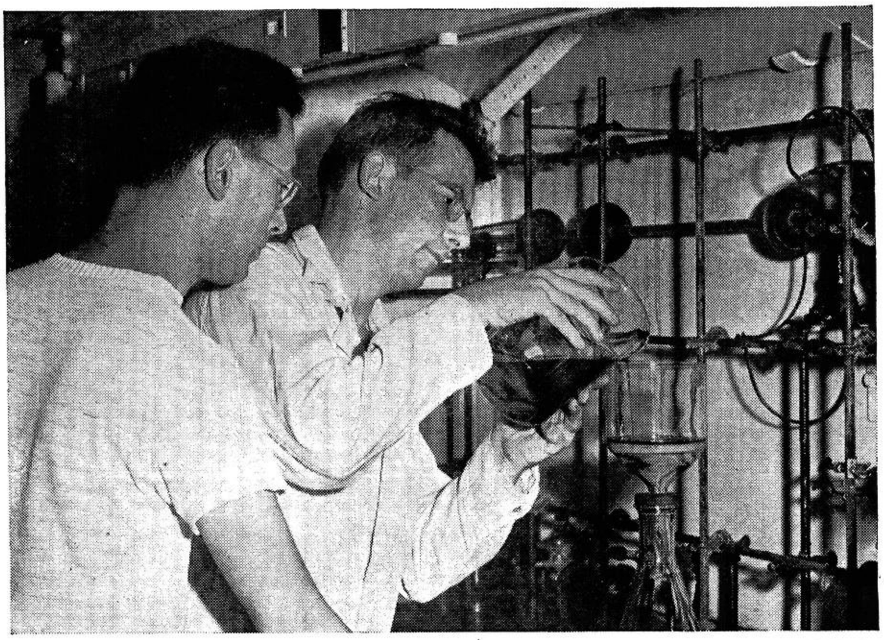
WILL I GET LOST IN A BIG COMPANY?

The organization of Du Pont is unique in that each of its ten manufacturing departments and two technical staff departments is responsible for its own operation. Furthermore, new chemists and engineers work in small groups under experienced supervisors. Du Pont's group system assures men of interesting and friendly working conditions plus the broad avenues of promotion that go with size. Write for the new booklet, "The Du Pont Company and the College Graduate," 2521 Nemours Building, Wilmington 98, Delaware.

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
... THROUGH CHEMISTRY



W. R. Remington, Ph.D., University of Chicago, 1944, and S. N. Boyd, Ph.D., University of Illinois, 1945, working on a dye research problem.

Research Engineering

(continued from page 12)

Using high-speed motion picture camera to study simple relay operation.
—Photograph courtesy Bell Telephone Laboratories

their supervisors told them could not be done. In fact, some supervisors have been suspected of egging men on by expressing doubts regarding the feasibility of some scheme. It must be emphasized however, that only unqualified success will justify much unilateral action.

The student should not think, however, that there is anything tedious or uninteresting about research work. It is doubtful whether any kind of engineering work can offer as much freedom—freedom from undue pressure to meet deadlines, and freedom to follow one's inclinations. Furthermore, the opportunities in research are unusually good because all employers are increasingly aware of the value of applied research, and many employers now realize that they cannot afford to neglect fundamental research.

One more important phase of engineering education must be stressed. No one is too comfortable about the present state of world affairs. Certain groups of scientific men have been scared right out of their ivory towers by the realization that by no means all of the factors governing human welfare are on a completely rational basis. The research engineer should at the very least dispossess himself of completely false notions in history and economics, and cast out prejudice and dogmatism. At best he should contribute thought and action to the field of the social sciences at something approaching the intellectual level of his work in his own field.