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VOLUME XXXII NUMBER VIII

THE ENGINEERING BUILDING

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of the UNIVERSITY OF WISCONSIN

May, 1928

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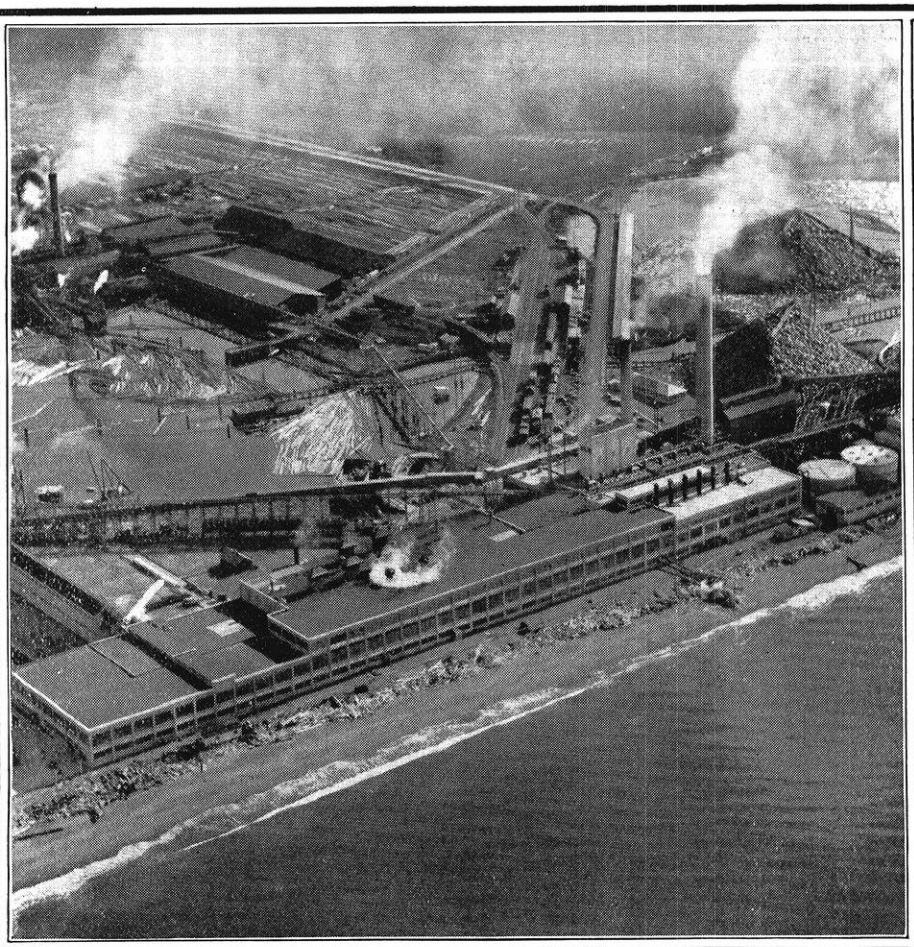

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

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VOL. XXXII, NO. 8 MADISON, WIS. MAY, 1928

GIBSON DAM

SUN RIVER IRRIGATION PROJECT, AUGUSTA, MONTANA

By JAMES W. ARNOLD, c'29

MY connection with the construction of Gibson Dam has not, as yet been very technical, as my principal occupation since my arrival here on September 2, 1927 has been that of 'Jackhamer' skinner. Riding a jackhamer, by the way, with the throttle wide open and ninety-five pounds of air on the line is not conducive to very clear thinking or clear vision, but it does allow plenty of *time* for both, so I have been able to absorb quite a lot of knowledge about the work while on the job. My chief source of information, however, has been from the resident office of the United States Bureau of Reclamation, and to the office force there I give much of the credit.

The Gibson Dam, besides being rather remotely situated, which tends to make interesting problems for the contractors, contains several unique features of design and construction which were introduced by the U. S. B. R. for experimental and research purposes. The job should, therefore, furnish abundant material which would be of interest to readers of the Wisconsin Engineer. In this article I will only attempt to give a short history of irrigation in the Sun River Valley and a description of Gibson Dam.

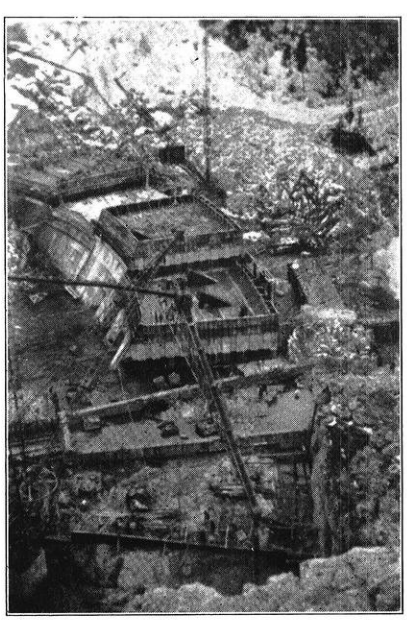

FIG. 1: *A view of the construction from the top of the spillway.*

Irrigation in Sun River Valley

The Sun River, on which is located a short mountain stream about one hundred miles in length, rising near the Continental Divide west of Great Falls, Montana, and flowing south eastward into the Missouri River at a point a few miles south of Great Falls. The Sun River crosses the north and south ranges of the Rocky Mountains at approximately right angles and passes from the last range of mountains into the rolling prairie, at a point about seventy miles west of Great Falls and twenty miles west of Augusta. From this point to its mouth, about sixty-five miles, the river flows through prairie land which at one time was fit only for grazing and prairie dogs, due to lack of moisture. An irrigation ditch was finally built leading water direct from the river for the irrigation of about 15,000 acres on the south side of the river. The north side of the acres, however, could not be irrigated in this manner, so the U. S. B. R. took over the problem. In 1912, 1913, and 1914 an irrigation dam was built under the supervision of the U. S. B. R. at the point where the river crosses the last mountain range before passing into the prairie. This dam was of the circular arch, massive concrete type, and developed a reservoir of approximately 10,000 acre feet. The size of this reservoir, however, was not of importance, as the purpose of the dam was simply to raise the water to an elevation from which irrigation ditches could be built to reach the 38,000 acres of irrigable land on the north side of the river. A reservoir was constructed on the slope canal several miles from the diversion dam, which made a more even flow of irrigation water possible.

Since construction of the diversion dam, all the irrigated land has been cultivated, and valuable crops of alfalfa, small grains, and sugar beets have been raised. The canal reservoir, however, was not large enough to satisfactorily irrigate the 38,000 acres then under irrigation, and as there were 90,000 irrigable acres in all, the need of more reservoir was imperative. The U. S. B. R. coped with the situation by financing and supervising the construction of Gibson Dam, to form

an ample reservoir for Diversion Dam. These dams have both been financed by the U. S. B. R. appropriations, but their cost will ultimately be paid by the farmers in the form of water tax, at a stipulated amount per acre foot. Another form of tax may be

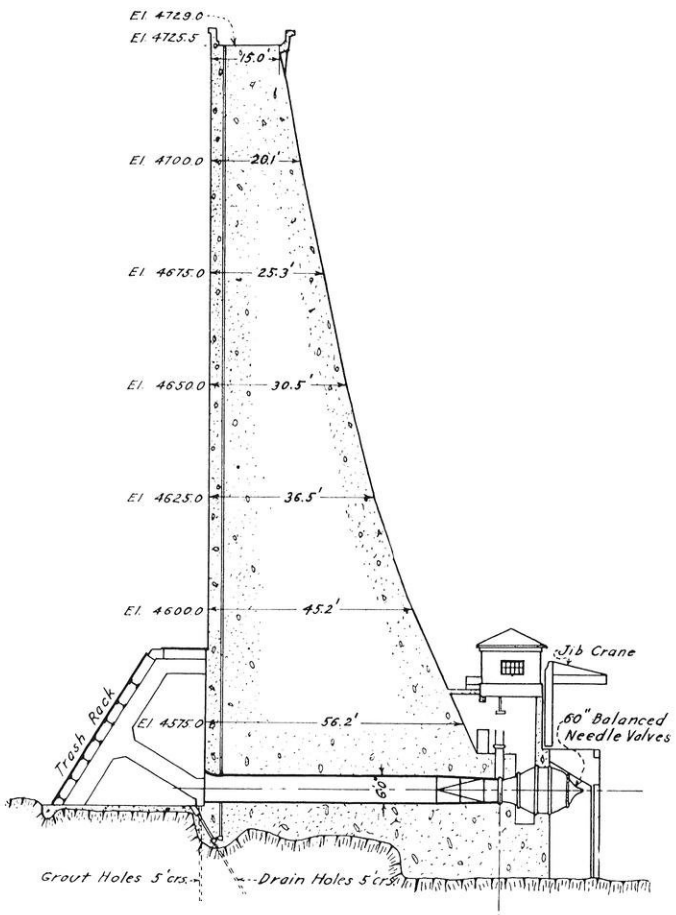

FIG. 2: *Profile of the dam showing details.*

devised however, whereby payment will be in proportion to the value of the crops raised over a period of years.

General Features of Gibson Dam and Its Location

The plans and specifications for Gibson Dam were completed in 1926, and on September 13, 1926 the contract was let to the Utah Construction Company of Ogden City, Utah, for $1,566,240, cement being furnished by the government. The job is to be completed on or before June 30, 1929.

The Gibson Dam is located about three miles upstream from the Diversion Dam, in the cut through the fourth mountain range west of the prairie. It will raise the water approximately 188 feet, forming a reservoir of 90,000 acre feet, with a surface elevation of 4,711.5 feet U. S. G. S. The area flooded is about 1,250 acres of valueless maintain land, the only private property distributed being a dude ranch owned by Ralph Allan. (This region is a noted big game and trout country. Elk, deer, and Big Horn Sheep can be seen almost daily, during cold weather from the dam site.)

The Sun River, being a mountain stream, shows very great fluctuations in flow. Hydrographs taken from 1905 to 1925 inclusive, show an average discharge between August and March of approximately 350 second feet, while between March and August the discharge reaches an average maximum of 7,830 second feet, with the highest discharge coming around the last of May. The maximum discharge recorded was 32,300 second feet in 1916, and the lowest was in October 1917 when there was no flow.

Dam Details and Specifications

The dam is of the massive concrete, constant radius arch type, with a radius to the upstream face of 405 feet, and a length measured along the arc at the top, of about 920 feet. Its total height, from the lowest point in the original stream-bed, is approximately 198 feet. The width of the dam at its crest is 15 feet, and the maximum width at the base is about 90 feet. The dam is of all concrete construction resting on a solid limestone foundation with no reenforcing or foundation ties. The dam proper will contain about 165,000 yards of concrete.

The Spillway is to be through a 29'6" diameter shaft and tunnel driven in the mountain at the north end of the dam. The verticle shaft, which is located back of the north wing of the dam, is about 161 feet deep to the bottom of the connecting tunnel. From there, the tunnel runs on a level grade to the discharge opening below the dam, a distance of approximately 290 feet. The shaft and tunnel are to be lined wih eighteen inches of concrete, leaving 29'6" in the clear. The lining in the shaft is to be reinforced with three-fourths inch round steel, placed 18 inches center to center both ways. The tunnel lining will not be reenforced. This spillway is designed to safely handle a discharge of 50,000 second feet discharge.

Two sixty-inch Gates will be installed near the base of the dam to regulate the water flow for irrigation.

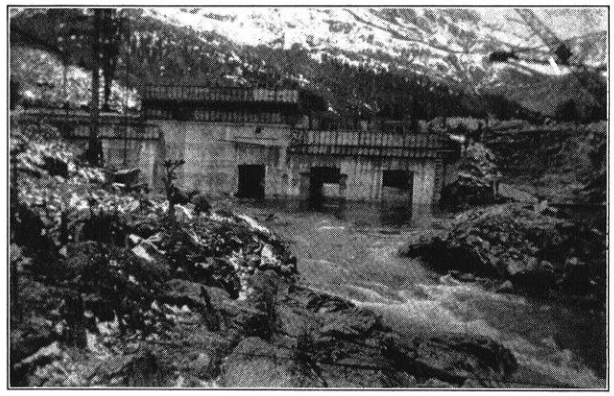

FIG. 3: *The downstream face of the dam showing present state of construction. Note diversion openings.*

The Gate openings are to be lined with semi-steel conduit lining, and are to be equipped with sixty-inch needle valves, and high pressure emergency valves. The valves will be operated from a valve house built over the gate openings on the downstream face of the dam.

The foundation is excavated to a solid limestone base,

and as far as is practicable, especially at the ends, is formed of a series of horizontal and vertical planes. A cutoff trench about five to eight feet deep is excavated along the upstream face of the dam to act both as a keyway, and a hindrance to water seepage under the concrete. All foundation surfaces are carefully cleaned and scrubbed with wire brooms, aided by washing with a jet of water under pressure. Before mass concrete is poured,, all horizontal foundation surfaces are covered with a layer of 1:2 mortar an inch thick, into which the mass concrete is placed. When pouring is suspended for over eight hours, all horizontal surfaces must be corrugated by parallel ridges ten feet center to center and one foot high. These corrugations are, of course, run perpendicularly to the radii of the dam.

All mass concrete is to be a mixture of cement, sand, pea gravel, and cobble in such proportions that the compressive strength, at 28 days shall exceed two thousand pounds per square inch. As a result of experiments carried on by the U. S. B. R. in their laboratory here at the dam, the following mix was decided upon as the most satisfactory:

Constituent	Cement	*Sand	Pea Gravel	Coarse Gravel	Cobble
§Part by Volume	1	2.2	1.8	2.4	3
Fineness Modulus		3.03-3.7	5.5-6.0	7.7-8.1	9(2½"-8")

* Due to shortage of natural sand about 37% manufactured sand is being used.

§ Loose dry volume taken as standard. Sand and Pea gravel are corrected for moisture bulking.

This mixture has been giving actual results of from 2,400 to 2,800 pounds per square inch compressive strength at twenty-eight days on 8" x 16" cylinders. After reducing for cobbles, however, the actual strength lies between 2,100 and 2,300 pounds per square inch.

The concrete in the tunnel lining will not contain cobbles. The mix to be used will be determined from the results of future experiments carried out in the laboratory.

The dangers resulting from possible upward pressures on the bottom of the dam are to be reduced to a minimum, by grouting the foundation, and also providing relief for any pressure developed.

Grout holes are drilled evey five feet in the cutoff trench at the upstream face of the dam, to a depth varying from forty feet along the central portion, to ten feet near the ends. These holes must be at least one inch in diameter at the bottoms. Before any concrete is poured on the foundation, these holes are each fitted with a length of two-inch pipe, sufficiently long to project above the concrete, which is to fill the trench and project out from the upstream face of the dam. After the base of the dam has been poured, the grout holes are to be flushed with water and then grouted under ninety-five pounds pressure. The pressure relief system consists of a row of relief holes drilled every five feet along the upsteam face of the dam, and connected with steel pipes which lead through the concrete to the downstream face of the dam. The relief holes are staggered with the grout holes, but are drilled at an angle, so they extend somewhat under the dam. These holes vary in depth from fifty feet to ten feet as the grout holes, and must be not smaller than two inches in diameter at the bottoms.

To allow for contraction, vertical joints are installed along radii of the dam at intervals of sixty feet below

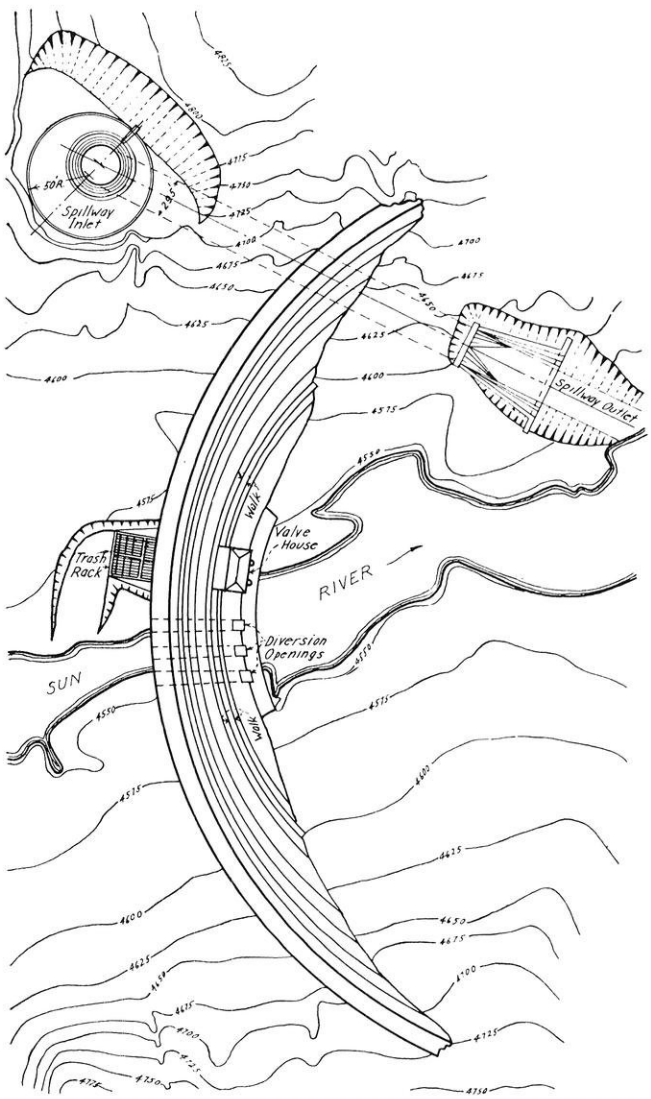

FIG. 4: *Plan view of the project showing topography and general layout.*

elevation 4,650 and every thirty feet above that elevation; elevation 4,650 being seventy-five feet below the top of the dam. The joints are formed of alternate vertical ridges and depressions. The joints are made by pouring the dam in sections, with the contraction joints as dividing lines. Before each section is poured, the face of the existing section, against which concrete is to be poured, is thoroughly painted with creosote. Each joint is sealed off from water seepage by copper expansion strips placed at both the upstream and downstream ends. These also serve to prevent loss of grout when the joints are grouted.

Due to shrinkage of the concrete, it becomes almost

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CHROMIUM PLATING—A NEW TOOL IN INDUSTRY

By Oliver P. Watts,
Professor of Chemical Engineering

CHROMIUM plating is the greatest sensation that ever occurred in the electroplating industry. Wherever there is a gathering of platers, chromium plating is sure to be the foremost, if not the sole, topic of discussion. Go where you will among the plating plants of the country, whether the business be nickel, copper or silver, you will find chromium plating in either the experimental or the productive stage. Company after company has been organized for doing commercial chromium plating, and these have been merged and re-merged, until the largest is backed by millions of capital,—and all this development has taken place in two and a half years.

However, interest in chromium plating is not confined to the electroplating industry. It has already extended to many companies engaged in making light machinery and articles of sheet metal, ranging from aluminum ware and flash-light cells to clocks. Scores of firms that previously had no interest in plating have installed chromium plating as a time and money saver in their processes of manufacture; hundreds of others will do so as soon as they learn the value of this new aid to metal maunfacturers.

To the general public chromium plating is beginning to be known through its substitution for nickel on automobile radiators and plumbing fixtures. At present the virtues of chromium plate are little known outside the small circle of those who are producing it; but when one finds the nickel plate on the new car looking dull and old, in spite of frequent cleaning, while the bright metal on the older car of a neighbor still looks as if it were just out of the factory, it is certain that another car will not be bought unless its bright finish is chromium plate. Once the public is educated to the superiority of chromium plate, it will be difficult to sell cars with nickel plated parts.

The properties of chromium plate which make it the sensation of the electroplating world are:

(a) Freedom from tarnish on exposure out of doors.

(b) Extreme hardness, which resists wear and scratching, so that a polish on chromium plate is more lasting than on any other metal surface so far produced.

(c) Resistance to attack by certain chemicals.

(d) A skin effect on its external surface which prevents adhesion of metals and other substances.

Because of its resistance to tarnish and to scratching, chromium plate is vastly superior to nickel for plumbing fixtures, and is already extensively used for that purpose. The fact that the polish is permanent will soon cause it to be used exclusively in high-grade hotels and apartments.

Manufacturers of silver-plated ware, percolators, etc., are substituting chromium plate for silver and nickel on these articles, with the advantage of a handsomer appearance, entire freedom from tarnish, and much longer use without defacement by nicks and scratches. Chromium-plated forks and spoons will be especially valuable in hotels and restaurants in place of the usual silver-plated variety.

Although its reflective power is only about seventy per cent that of silver, chromium plate is being successfully applied to flood-light reflectors in place of the latter. Its substitution for silver on automobile headlight reflectors, although not yet practiced, would seem to have distinct advantages. Instead of the too-dazzling brightness of the newly silvered mirror, which is soon followed by a continuous loss of illuminating power as the reflector becomes tarnished and scratched, the chromium-plated reflector will never dazzle, and should retain its original reflecting power for years.

Chromium plate resembles platinum very closely and keeps its original surface finish far better than that extremely expensive metal, so that manufacturers of jewelry are already plating many articles made of base metals with chromium. It is to be hoped that this practice will spread to such an extent that platinum will become unfashionable for jewelry, and so release

(Continued on page 284)

Because of its remarkable resistance to wear, heat, and corrosion, chromium as an electro-plating material is engaging the attention of engineers and industrial executives. So completely has it established its value that its use is common practice in a wide variety of diversified fields. Its adoption has enabled manufacturers and platers to employ quickly, economically, and successfully a satisfactory plating material to meet their own particular requirements.

Professor Watts has done considerable research work on the development of chromium plating. The peculiar action of chromium when being deposited electrolytically necessitated much experimentation before successful commercial application was possible.

—THE EDITOR.

PROFESSOR CHARLES IVES CORP

HEAD OF DEPARTMENT OF HYDRAULIC ENGINEERING SUCCUMBS TO PERNICIOUS ANEMIA AFTER THREE MONTHS' ILLNESS

PROFESSOR Charles Ives Corp, for seventeen years a member of the faculty of the department of hydraulic and sanitary engineering of the College of Engineering, died Saturday, April 28, from pernicious anemia after being ill since January. He had been under the care of Dr. R. Van Valzah, professor of clinical medicine, and Dr. E. R. Schmidt, professor of surgery at the Wisconsin General hospital. A trip to Florida in February had seemed to aggrevate his condition, so he was brought back to Madison. He remained perfectly alert until the time of his death, although his condition was gradually becoming worse. He was buried in Forest Hill cemetery, Madison. He was 49 years old.

Prof. C. I. Corp
1879 - 1928

Because of his activities in the Engineering Society of Wisconsin, the Technical Club of Madison, the Reserve Officers' club, several national engineering societies, and many campus committees, Professor Corp was widely known.

He first came to Madison in 1910 as a graduate student and assistant in hydraulic engineering, while on leave of absence from Kansas University. After receiving the degree of master of science here in 1911, he returned to Kansas for one year. In 1912 he came back to Wisconsin as assistant professor. He was promoted to associate professor in 1915, and in 1920 to full professor. In 1923, he received the degree of Mechanical Engineer.

After graduating from Kansas with the B. S. degree in 1903, he spent a year in a machine shop in Hutchinson, Kansas, and then became assistant professor of mechanical engineering. He was promoted to associate professor and was on the Kansas faculty continuously until 1912 except for the year 1910-1911 at Wisconsin.

Professor Corp was born in Nickerson, Kansas, Dec. 12, 1879, received his early education in the schools of that city and was graduated from Nickerson Normal School in 1899. His parents, Freeman and Helen Stuart Corp, were of English descent and had moved to Hutchinson from Ohio. His father is an engineer engaged in operating railroad mechanical shops.

In 1905, Professor Corp married Miss Georgia Elizabeth Metzger, of Stafford, Kansas. They are the parents of Ruth Elizabeth and Paul Metzger Corp. Their home is at 2114 West Lawn Avenue, Madison.

During the World War, Professor Corp served as captain in the Sanitary corps and later major of engineers in the Officers' Reserve Corps. He was sent to Camp Kearney, near San Diego, Calif., as camp engineer and was later inspector in the surgeon general's department of the Pacific Coast.

Since the war, Major Corp had been active in the Officers' Reserve Corps. He was a member of a small committee of middle western reserve officers who have been called to Washington frequently to consult with the War department on the affairs of the R. O. T. C.

He was active in the First Congregational church, and was president of the University club. He was president of the Wisconsin chapter of Sigma Xi. He was also a member of Tau Beta Pi, Chi Epsilon, Pi Tau Sigma, and Theta Xi. He was active in the university post of the American Legion. For a number of years, he was a member of the public functions committee of the university as well as the war credits committee, Regent-faculty conference, and other important committees.

He held various offices, including the presidency of the Technical Club of Madison. He has been secretary and president of the Engineering Society of Wisconsin. He was also active in the American Society of Mechanical Engineers, the Society for Promotion of Engineering education, and the American Water Works Association.

Professor Corp contributed numerous articles to technical publications, and has written several bulletins of the Engineering Experimental Station of the University. In 1922 he was co-author of an important bulletin (Vol. IX, No. 1 of the Engineering Experimental Station) on losses of head in valves and pipes from one-half to twelve inches in diameter. Last year, with H. T. Hartwell, he wrote Bulletin No. 66 of Engineering Experimental Station on experiments on loss of heads in U, S, and twisted S pipe bends. In conjunction with his work in the Sanitary Laboratory, he has written bulletins on milk and pea cannery wastes for the State Board of Health.

ERIN GO BRAGH! SPIRIT OF ST. PAT MARCHES THROUGH MADISON

By O. C. SCHMEDEMAN, min'30

ESCORTED by two motorcycle policemen and led by a gay band, the spirit of the engineers marched through the city on April 21, in joyous celebration of a time honored custom, the annual St. Pat's parade. No one was to deny them their pleasures. All along the line of march large crowds gathered to watch the parade and waited expectantly for a brawl; however, the "shysters" stayed well hidden and offered no resistance.

It is new features in an old tradition that keeps the tradition alive, and hence Polygon is to be complemented on the innovations this year. The green "billies," ostensibly for the "huskies," will make fine souvenirs, and the addition of the flags and color guard helped a good deal to brighten up the parade.

Dick Reinke alias St. Pat., proved to be an able representative of the patron saint — except for his "Milwaukee brogue." It is rumored that Dick has asked "What Price Glory" in reference to a strained neck contracted from bowing continuously to the crowds. He rode in a closed car, again following the custom set last year, but many complained that they were unable to see him.

The sacred Blarney Stone of vintage 1446 took its yearly airing, of course, escorted by four husky "Irishmen" in the persons of Zeihlsdorf, Yonker, Kashin and Fell. The band of twenty or so engineers added a lot of pep and looked mighty fine in the green and white uniforms and led by Drum Major Zander.

After the parade had broken up on the lower campus St. Pat. initiated over two hundred into the ranks of the Loyal Guard of St. Pat. Many are said to have felt like new men after the experience of kissing the Blarney stone.

* * * *

Satire characterized the majority of the floats, and all the campus questions of the year came in for a share of it.

The Cardinal portrayed by mud slingers and a buxom "Sis" was cleverly satirized in a float entered by Lamba Chi Alpha who won first in the Fraternity prizes.

Kappa Eta Kappa saw free speech as hot air and the press as effective as a wash wringer.

Triangle tried all during the parade to get a frog like lawyer to hop through a hoop but it could not be prevailed upon.

Alpha Chi Rho asked why go to Reno in their float on companionate marriage.

* * * *

Bob Poss and Glaesner substituted for "Glennie" Frank and Dora Russell who were unable to attend. Bob, with red nose and nifty spats was quite the gentleman to escort charming Dora who was clad in a simple yet chic evening dress.

* * * *

McLeod and Wicksburg dressed in "what have you got" carried a banner portraying the left-handed publicity Wisconsin has gotten of late by the Dora, Davy, etc. episodes.

* * * *

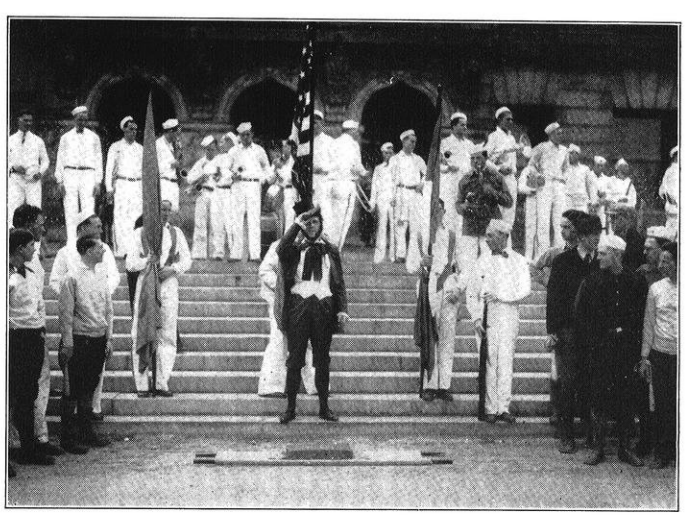
A. S. C. E. won the engineering society class with a satire on the "America" poem. Some of the printable parts were bulletined; and Zona Gale, Gordon, and others were seated reading them.

* * * *

John Sargent rose to the heights of comedy in the difficult contortions of a pie-eyed shyster with St. Vitus' dance dragging behind the A. I. E. E. chariot of progress.

* * * *

A. S. M. E. clearly portrayed obvious conditions in the library. One of their signs read "Get Your Dates Here."



SHALL THE ENGINEERING PROFESSION BE REGULATED?

By L. F. VANHAGAN, *Professor of Railway Engineering*

A SPECIAL committee of the *Engineering Society of Wisconsin* is studying the question of whether or not the engineers of the state ought to work toward securing state regulation of their profession. As a preliminary step, the committee collected all of the arguments that could be discovered on both sides of the question. These arguments, as presented herewith, were laid before the society at its annual meeting in February without any discussion or attempt to pass upon their merits. It is believed that our readers will find them of interest, for the question of regulation is one of the most important that now faces the profession.

The following statement of arguments pro and con, although brief, is intended to be complete.

ARGUMENTS FOR REGULATION

A. Based on Benefit to the Public

1. Regulation will "safeguard life, health, and property." There are men posing as engineers who are grossly incompetent. The public is entitled to protection from the activities of such men, and regulation is the only thing that will provide such protection. Altho it will not eliminate incompetency entirely, any more than it has done so in law and medicine, still it will afford protection to an extent that will justify itself.
2. Regulation will establish a body whose duty it will be to examine and pass upon the qualifications of those who wish to practice. As population increases and our social organization becomes more complex, "it is inevitable that we should substitute place of personal investigation of the qualifications of those with whom we deal publicly, some public guarantee of their integrity and ability." "Setting a standard for a given class of performance, which is what the license law aims to do is of decisive value in determining the standard and credence of that field of performance, just as a commercial or manufacturing standard has a definite effect upon the market."

B. Based on Benefit to the Profession

3. Regulation will protect the competent engineer from the cut-throat competition of the bold and impudent fellow who is unwilling or unable to get the proper training. Today, the man who has gone to school for four years or more and then gone through an appreciceship of practical work and study finds himself confronted with a man who has sacrificed neither time nor money in preparing himself. Before the courts and in competition for employment, the trained man finds that he is on a level with the untrained man. A profession cannot hope to make real progress unless those from whom progress can come—the students and scientists—are encouraged to devote themselves to the profession and be protected from the activities of the incompetent.
4. Registration will protect the term "Engineer" from careless and misleading use and establish it in the mind of the public as the designation of a profession that requires exacting training and that contributes greatly to the public welfare.
5. Registration would give the qualified engineer the distinction of state recognition, a distinction that in time would come to be highly valued.
6. "The legal status which the law would give the profession would help materially in the development of professional consciousness."
7. Because surrounding states have license laws, Wisconsin also should have one, so that (1) the state will not become a dumping ground for the incompetents who cannot practice in license states, and (2)

(Continued on page 280)

THE LICENSE SAVES THE DAY

THESIS WORK IN HYDRAULIC AND SANITARY ENGINEERING DEPARTMENT

By R. T. Homewood, c'27
Instructor in Hydraulic and Sanitary Engineering

THESIS work in the Hydraulic Laboratory continues to be popular. One of the thesis that has brought out some results that will undoubtedly be of wide interest is that of Mr. Glen Cox. For the past two years Mr. Cox has been studying the peculiarities of flow over submerged weirs, and contrary to the general opinion of submerged weirs, he finds them to be very satisfactory for measurement and accurate to within two and one-half per cent Up to the present

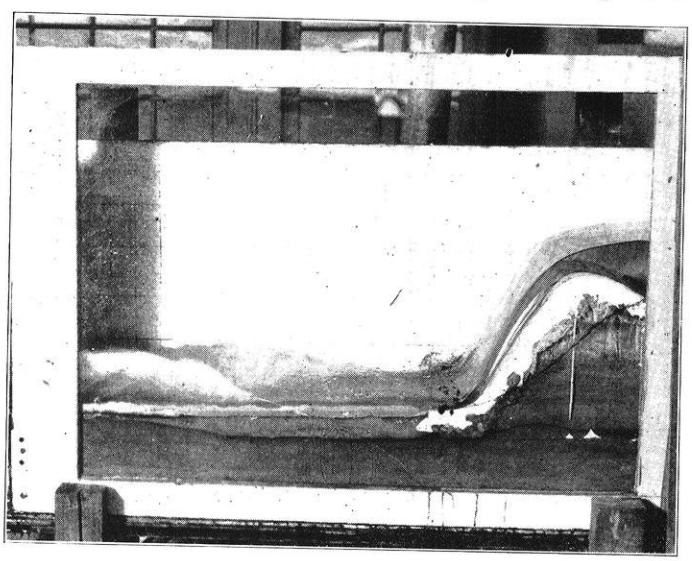


Fig. 1: *Typical hydraulic jump on present type of Ogee dam.*

time submerged weirs have not been held in very high regard, it being assumed that they were not at all trustworthy.

In Mr. Cox' studies he has ascertained the proper place for measurement of the up-stream and down-stream heads (this latter has always been a question), and he has developed a formula which seems to be very satisfactory. Submerged weirs can be used to advantage in drainage and irrigation work, for example, where only a small loss of head thru the measuring device is allowable. Mr. Cox is submitting his work for his doctor's degree, and he has been assisted by William Lidicker and Dave Harker who are submitting their work for their Master's and Batchelor's degrees respectively. Professor B. W. Pegues of the Univesity of Louisiana completed his Master's thesis in February on a portion of the same study.

An attempt to try a new scheme for dissipating the energy of the water as it flows over an Ogee dam has been made by Julius Alperovitz and John Smallshaw. Professor Daniel W. Mead has long been interested in the solution of special hydraulic problems by the study of actions of models. Many studies have been made on the Hydraulic Jump or standing wave which causes erosion below dams to an alarming extent. (See Fig. 1.) Alperovitz and Smallshaw are using a model in the laboratory; water is not only being discharged over the dam, but is actually being carried thru the dam by an orifice or slot which expends the energy in the water by impinging into the stream the water plunging down the Ogee. It has been possible, by directing this water discharging thru the orifice into the stream, to cause the hydraulic jump to form at a very advantageous point on the apron, and using only eight per cent of the total discharge as that part which passes thru the orifice. (Fig. 2.) In fact the smaller percentage is proving to be better than when the size of the orifice used is increased and a larger percentage of water discharged thru the orifice. By using only a small amount of water, it is quite possible that the dam can be designed to be structurally stable. Much saving can be made in the cost of dam construction if this scheme allows the apron to be shortened materially.

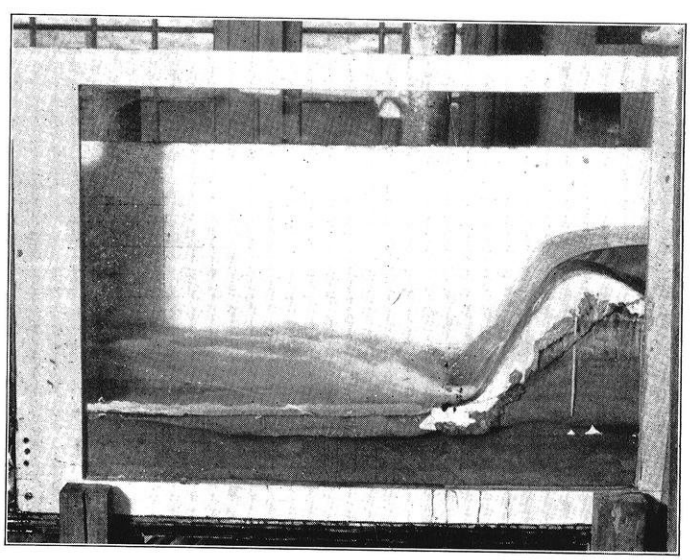


Fig. 2: *Hydraulic jump on improved experimental model of Ogee dam.*

A study of the coefficients of large orifices under high heads has been made by Robert Brigham. Fig. 3 shows the jet from a two inch orifice under a head of fifty feet.

The losses in pipe bends has been investigated by Lawrence J. Beck. His findings indicate that the losses from several bends placed close together is considerably

(Continued on page 278)

NORMAL AND ABNORMAL CARBURIZING STEEL

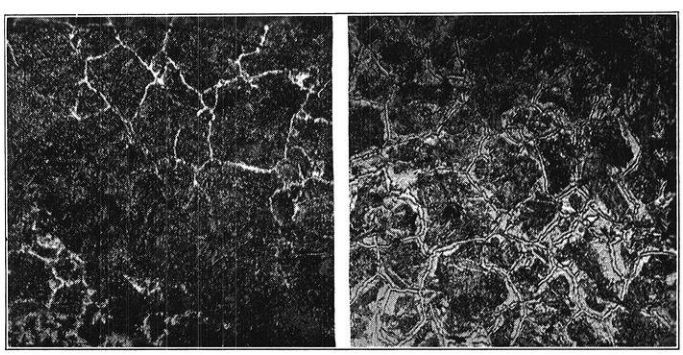
By R. R. Smith, m'27

THE terms normal and abnormal steel are the result of recent investigation and research in the case hardening process of steel. Case hardening or carburizing failures were first thought to be the result of carelessness in the process of carburizing by improper use of the carburizing material or not strict attention to the process of carburizing. The case hardening failures became of too great commercial importance to pass unnoticed and so the matter was carefully studied by Messrs. A. W. McQuaid and E. W. Ehn of the metallurgy department of the Timken Roller Bearing Co. After a short time they were convinced that carelessness was not the cause but that the trouble lie within the steel itself. Their results show that certain steels though fulfilling specifications of analysis and physical properties are entirely unsuitable for carburizing, which is not only interesting but is of commercial importance. This refuted the opinion that all steels of certain chemical specifications would carburize.

Steels which on hardening in water after carburizing acquire uniformly hard martensitic case are normal, steels giving soft spots on case hardening are abnormal. Normal steels show pearlite and free cementitie with large sharp cornered grains — abnormal steels show pearlite, cementite, and free ferrite, with small poorly defined crystals. Normal steel will respond readily to heat treatment and in hardening will form martensite and become uniformly hard, while abnormal steel will not respond readily and will not under any circumstances harden without soft spots. The soft spots are irregular in shape, size, and distribution. Scleroscope on spots is 45 to 60 against 75 to 90 on normal steel. High carbon tool steels as well as low carbon steels are normal and abnormal. Normal and abnormal are not superior and inferior but indicate suitability for case hardening only and for other purposes the abnormal steel will show up as well as the normal.

As a remedy against using abnormal steel for carburizing the McQuaid-Ehn test came to be used. Their idea was to carburize a sample from each lot of steel and subject it to a microscopial analysis which would show whether the sample was normal or abnormal. If the sample did not show the proper carburizing qualities the lot could be rejected. The test was said to be practical as a large outlay in laboratory equipment was not necessary, it could be performed in a few hours, and the results were satisfactory in determining whether or not the steel would be acceptable.

McQuaid and Ehn attacked the problem in an effort to find the causes for these conditions. The normal was found to have coarse grains, large pearlite crystals, and clean cut cementite areas in the hyper-eutectoid zone. The abnormal consisted of curly cementite, disentegration of pearlite in the hyper-eutectoid zone, fine grain size with rounded pearlite areas in the gradation zone, and with thin case and soft troositic spots on hardening. After many tests it was decided that the cause of the unstable pearlite of the hyper-eutectoid zone after carburizing existed previous to the ingot or in steel furnace practice. Electric furnace output seemed better than open hearth steel in general, though abnormal pieces have come from the electric furnace and excellent specimens have been found in open hearth products.



Normal **Abnormal**

These photomicrographs were from the collection of Waldemar Naujocks, m '26, and prepared, etched and photographed by the author.

The normal specimen shows the hyper-eutectoid zone in the upper right corner consisting of white lines of cementite surrounding sharp cornered grains of pearlite and just below it the eutectoid or graduation zone of dark pearlite. In the lower left is the hypo-eutectoid zone of dark pearlite and white ferrite.

The abnormal specimen shows the hyper-eutectoid zone of dark, rounded pearlite grains, the white network of cementite with white areas of ferrite in between.

Ehn, in an article in the Journal of Iron and Steel Institute, Vol. CV. No. 1, 1922, p. 157, states that the properties of carburized steel are due to some inherent character of the steel itself. He says, "The most characteristic property is more or less disintegration of pearlite in the hyper-eutectoid zone. Thus to divorce pearlite a reagent must affect the solubility and equilibrium of carbon in iron when passing through the critical range." His reason is that the different carburizing properties are caused by oxides uniformly distributed through the steel. He says that the ultimate reason is improper deoxidation of the steel when made and no later treatment can change these properties. He offers proofs from his own experiments. He examined a part of an oxy-acetylene flame weld and found very abnormal properties though the steel previous to welding was entirely normal. He says, "apparently the steel from the rod when melted under the torch absorbed

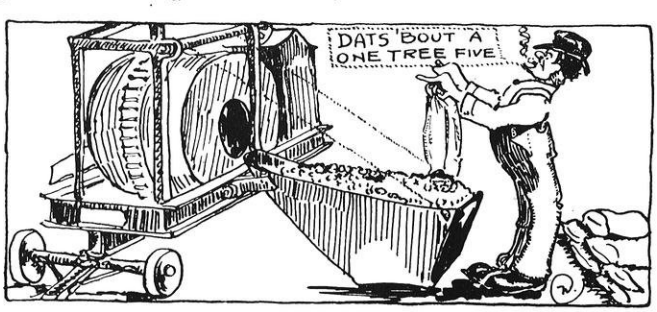
(Continued on page 276)

Campus Notes

COURSE IN DESIGN AND CONTROL OF CONCRETE MIXTURES HELD AT UNIVERSITY

A short course in the design and control of concrete mixtures under the auspices of the Portland Cement association in cooperation with the department of mechanics was given in the Engineering Auditorium, April 10, 11, and 12. The meetings were held in the evening.

The first session covered the following items: requirements of good concrete, fundamental water-cement



ratio law, elements of the design of concrete mixtures, water-cement ratio specifications, trial method of designing mixture, and bulking of aggregate.

The second meeting covered design of mixtures by the calculation method, inter-relation of mix, grading, workability, and strength, and control of concrete in the field.

At the final gathering, there was discussed control of concrete in the field, effect of factors other than proportioning on quality of concrete in structures, and high early strength concrete. A display of available publications on concrete was shown.

ENGINEERS WIN FELLOWSHIPS

Allan P. Colburn of Wauwautosa, Walter H. Fuldner of Milwaukee, and Hua Fuh Woo of Shanghai were appointed to one-year, graduate, research fellowships in the College of Engineering of the state university at the meeting of the faculty of the college on March 26. The fellowships carry a stipend of $600 and freedom from the non-resident fees in the case of out-of-state students. The new men will enter upon their appointments next September, at which time they will undertake some research problem and, in addition, will be assigned duties equivalent to one hour of teaching daily.

Mr. Colburn has held a fellowship during the current year. He is a graduate of the college, having received has bachelor's degree in chemical engineering in 1926 and his master's degree in 1927. He is working on a study of the transmission of heat in gas condensers.

Mr. Fuldner will receive his bachelor's degree in electrical engineering this June at the University of Wisconsin. He is president of Tau Beta Pi, the honorary engineering fraternity.

Mr. Woo, who is the first Chinese to receive a fellowship in the college, received his bachelor's degree from Fuh Tan University at Shanghai in 1925. He has been engaged upon reinforced concrete construction in Shanghai and designed and erected a number of important buildings for Yenching University at Peking. He is specializing in structural engineering.

TAU BETA PI ANNOUNCES INITIATION

Tau Beta Pi announces the initiation on April 25 of Professor A. V. Millar, assistant dean of the College of Engineering as honorary member, and the initiation of the following juniors as active members: chemical engineer, E. C. Ragatz; civil engineers, W. W. Behm, Marvin Hersh, and G. C. Ward; electrical engineers, F. R. Collbohm, G. W. Curran, R. G. Garlock, F. A. Maxfield, A. L. Sweet, and E. A. Wegner; mechanical engineers, R. V. Brown and M. H. Rutherford; and mining engineer, R. G. Stephenson.

Professor Van Hagan presided at the banquet following the initiation. The speakers were W. H. Fuldner, G. C. Ward, Professor Millar, and Mr. M. W. Torkelson.

ENGINEERING RESEARCH HELPS WISCONSIN INDUSTRIES

The establishing of a new indusry in Wisconsin that would make electrolitic zinc from Wisconsin ores and result in saving $700,000 worth of zinc each year which is lost under present methods, awaits simply cheaper power, Professor George Baker of the mining department told members of the faculty of the College of Engineering and engineers from the city at a meeting of the Research Committee of the college held in the Mining Laboratory last month Other speakers on the program were Dean Turneaure, E. R. Maurer, R. J. Roark, J. B. Kommers, H. L. Turrittin, K. F. Wendt, D. H. Pletta, and M. O. Withey for the department of mechanics; G. L. Larson, D. W. Nelson, and W. M. Richtmann for the department of steam and gas engineering; and E. R. Shorey, G. J. Barker, J. F. Oesterle, and S. Mackay for the department of mining and metallurgy.

The electrolitic process for recovering zinc, which has been worked out by Prof. Barker, gives not only greater recovery, but also produces a purer product. Professor Barker believes that, with cheap power, a five million dollar industry could be created for the state.

An unusual piece of research, which is in charge of P. J. Norton and C. L. Neumeister, and which was described by Prof. E. R. Maurer, is being done on a model of a reinforced concrete chimney that has been erected in the Mining Laboratory. The differences of temperature between the inside and the outside of such a chimney, Prof. Maurer said, are so great as to cause cracks. The object of the study is to learn something about chimney temperatures and how to design such chimneys against cracking.

Prof. R. J. Roark described research problems that had been presented to him by the paper industry of the state. One of them involved the question of the safety of a steel digester tank whose walls had become thin from years of usage and which could not be immediately replaced.

NEW EQUIPMENT FOR ELECTRICAL ENGINEERING DEPARTMENT

The Electrical Engineering Department has recently received a Silsbee Current Transformer Testing Set which was manufactured by the Leeds and Northrup Company of Philadelphia according to the specifications of Dr. F. B. Silsbee of the Bureau of Standards. This set will be used as part of the Electrical Standards Laboratory Equipment for testing current transformers, and will also be used in connection with the course in electrical metering. With this set it will be possible to obtain as much data on a current transformer in fifteen minutes as could be obtained by previous methods in two hours or more.

The Electrical Engineering Department is also securing a demonstration Relay Panel manufactured by the General Electric Company. This panel is equipped to demonstrate the operation of the following types of relays: (a) Time Over-current, (b) Directional with Time Over-current, (c) Differential or Balanced Current, and (d) Balanced Power with Time Over-current. There is an increasing demand on the part of the electric power companies for instruction in the theory and use of protective relays. Consequently it is expected that these relays will prove useful both in the short course for electrical metermen and in some of the regular electrical engineering courses.

MINING CLUB HEARS DEAN TURNEAURE

The Mining Club closed its sessions for the year on May 8 with an address by Dean Turneaure on his South American experiences. It has been the custom of the club to schedule speakers whose subjects were outside of the mining field, in the hopes of acquainting the members with what other professions do and think. A feature peculiar to the Mining Club is that at every meeting a very pleasing dinner is prepared by the miners with the assistance of Professor Barker.

The last meeting was turned into a business session. R. G. Stephenson was elected president, Dan Krause, secretary, and Carl Schmedeman representative to Polygon.

THE JUNIOR CIVILS GO ON INSPECTION TRIP

The annual junior civil engineering trip was held April 2, 3, and 4, Chicago, Buffington, and Gary being the places visited. The trip covered construction work in Chicago as well as visits to several manufacturing plants near by.

After "rendezvousing" at the Chicago and Northwestern depot, Monday morning, April 2, the gang proceeded to the Madison Street bridge where they took

At the Fire Underwriters' Laboratory.

boats for the inspection of the new four-mile crib in Lake Michigan and new bridge construction on the Chicago River. In the afternoon the new intake tunnel was given the once over and pronounced satisfactory.

Tuesday morning was spent in inspecting the foundation work of buildings under construction after which the Fire Underwriters' Laboratories was visited. The afternoon was taken over with going through the Buffington plant of the Universal Portland Cement Company.

The much heralded trip to Gary to see the works of the Indiana Steel Company was the program for the last day of the trip. The only disagreeable thing was getting up at six in the morning to be dressed in time to catch the train for Gary. A luncheon in honor of the fellows was given at the city Y. M. C. A.

GOOD LUCK, GORDON!

Gordon A. Beebe, instructor in topographic engineering has resigned his instructorship to accept a position in the United States Engineer's office, Milwaukee district. Mr. Beebe, who is a Wisconsin graduate of the class of 1912, will leave the university on May 21 to take up his new duties. His address will be 406 Federal Building, Milwaukee, Wisconsin.

OF INTEREST TO MINING ENGINEERS

The following story has been brought to our attention as having happened in one of the graded schools in the state:

"Today, children," said the young teacher of one of

(Continued on page 274)

Alumni Notes

RECOGNITION PIN FOR WISCONSIN ENGINEERS

ALUMNI MAY PURCHASE THE PIN FROM POLYGON WHO IS SPONSORING ITS SALE

THE Wisconsin Engineering Recognition pin was adopted last year as a mark of identification of graduates of the College of Engineering, who are in professional engineering circles by Polygon, the central engineering society of the College of Engineering. The design, which is the work of David C. Nowack, e'28, was selected as a result of a competitive contest held a year ago and incorporates a miniature slide rule across the face of a cardinal "W". The accompanying cut shows the pin enlarged to about double size. The pin is designed to be worn as a lapel button and has been made in a size which is pleasingly inconspicuous, yet unmistakably distinctive and attractive to those students and alumni who are aware of its significance.

Polygon has been lead to make this announcement largely as a result of the initiative of Mr. A. F. Gramm, e'25, of the Consumers Power Co., of Jackson, Michigan. Mr. Gramm secured a pin for himself and then on his own initiative "rounded up" eight other Wisconsin alumni in and about his office and took charge of a bulk order for their supply. Included in this group are: W. C. Schmidt, e'24; I. R. Dohr, e'23; W. R. Carlyon, e'24; F. J. VacLavik, e'24; F. M. Baxandall, e'24; C. P. Lindner, c'25; H. G. Holmes, e'25, and C. E. Johnson, e'26.

In order that other alumni groups or individuals may secure the pins, the following definite information concerning the Wisconsin Engineering Recognition Pin, is announced: Polygon will deliver to engineering alumni postpaid any orders received at the following prices: 10k. pin with bolt clasp, $1.25; 10k. pin and safety pin clasp, $1.50. Orders should be addressed to Polygon, Engineering Bldg., University of Wisconsin, Madison, Wisconsin.

The class of '27 left the College last June with almost every one of its members wearing this pin and the class of '28 will do the same this year. Watch for the man with the "W" and the slide rule — he's a Wisconsin Engineer!

ELECTRICALS

Kartak, Frank A., e'09, EE'11, has been appointed Dean of the college of engineering of the University of Marquette, and will take over the supervision of the engineering department at the close of the present semester.

After his graduation, Mr. Kartak taught here for two years as instructor and assistant in electrical engineering, and was director of the standards laboratory. He was a member of the staff of state engineers from 1913 to 1919, and during that time wrote the electrical section of Marks' Handbook for Mechanical Engineers, and contributed largely to technical magazines. Before going to Marquette as head of the department of electrical engineering, he was associated with the Milwaukee School of Engineering.

Lynn, Delmur C., e'24, has been made foreman for the Great Lakes Dredge & Dock Company at Staten Island, N. Y. Mr. Lynn lives at 1213 Fairmount Ave.

Matthias, Lynn H., e'26, is now working in the research laboratories of the Allen-Bradley Co. of Milwaukee, where he is developing special tests for the inspection of radio equipment. His address is Waverly Club, Milwaukee.

Nolte, Frederick, e'23, who has been connected with the Wisconsin Valley Electric Company at Antigo, was recently appointed manager of that division.

Lilja, Edgar J., e'24, former editor of the Wisconsin Engineer, announces the birth of a daughter, Ruth Alice, on March 28. Mr. Lilja's address is 915 19th Street, Rockford, Ill.

Rusch, Hugo L., e'23, former manager of the Wisconsin Engineer, and at present district manager for the A. C. Nielson Company at 4450 Ravenswood Avenue, Chicago, was chairman of the committee that arranged an unusually interesting program for a meeting of the New York Alumni Association of Tau Beta Pi on March 29. The topic for the evening was Some Interesting Steps in Transportation, and the speakers included Mr. Daniel Willard, president of the B. & Q. RR.; Major John F. O'Ryan, president of the Colonial Air Transport Co.; Mr. Edward Hungerford, director of the B. & O. Centenary; and Lt.-Commander Charles E. Rosendahl, U. S. N., commanding officer of the Airship Los Angeles.

Semrad, Charles A., e'08, who was vice-president of the Public Service Co. of Colorado, has recently been appointed general manager of the St. Joseph Mission property of that company.

CHEMICALS

Bennett, B. Floyd, ch'10, is now with the American Sheet and Tin Co. His address is 61 N. 3rd Street, Martins Ferry, Ohio.

Bogumill, Thomas R., ch'23, is in the purchasing department of the Peoples Gas, Light & Coke Co. He is living at 9442 Laflin Street, Chicago, Ill.

Houghland, Glen S., ch'17, is with the E. I. du Pont, de Nemours & Co., Chicago. He is living at 1139 Maple Ave., Evanston, Ill.

Ross, George H., ch'27, is in charge of the erection of a high tension line in southern Illinois for the Illinois Power & Light Co. Mr. Ross lives in La Salle, Ill.

Lohr, F. D., ch'17, visited the College of Engineering recently in search for chemical engineers for the Seaboard By-Prdouct Coke Co., Jersey City, N. J.

Walker, W. S., ch'26, is now in the New York office of the Linde Air Products Co. and accompanied the staff engineer on his visit to Wisconsin to interview seniors.

W. R. Kellett, ch'22, is superintendent of the Neenah, Wis., Experimental Paper Mill for the Kimberly-Clark Co.

Kuke, D. B., ch'24, is in the Bay Mill Department of the Continental Paper and Bag Mills Corporation, Rumford Falls, Maine.

Boenner, E. C., ch'19, is now Engineer of Manufacture for the Milwaukee Gas Light Company.

Damon, G. H., ch'26, is teaching qualitative analysis in the Michigan College of Mines, Houghton, Mich. Mr. Damon visited friends on the campus the last week of April.

MINERS

Nelson, Floyd Arthur, min'24, is now with W. C. McBride, Inc., 704 Shell Building, St. Louis, Mo. Mr. Nelson was a member of Tau Beta Pi, and the Mining Club while in school.

MECHANICALS

The question of what happens to Wisconsin Engineer editors after they are graduated is answered, in part at least, in Professor Church's new book on "Steam Turbines", in which we read, on page 204, "If the turbine is of the reaction type, by the Brown and Drewry rule, the average internal efficiency in the super-heated region would be 10 per cent higher than in the wet region. If an impulse turbine, follow Blowney and Warren's rule." Drewry, Blowney, and Warren are all Wisconsin grads. Glenn B. Warren, m'19, was editor of the Wisconsin Engineer during 1918-19. Blowney, e'20, was elected to succeed him, but left to join navy. Later, upon his return to school, he was made associate editor. M. K. Drewry, m'22, was editor during 1921-22. All three of the men were Tau Beta Pi men. Apparently editors of the Wisconsin Engineer, who are Tau Beta Pi men became experts on steam turbines.

Hanzel, J. W., m'26, reports a change of address from River Forest, Illinois, to 1818 Wesley Ave., Berwyn, Ill.

Stewart, Frederick C., m'25, who is in the Experimental Department of the Georgia School of Technology, has completed a series of tests on the heat transfer in the condensor and brine cooler of a refrigeration system, and is preparing to present his results before the American Society of Refrigeration Engineers in their spring meeting in Detroit.

Rasmussen, Adolph, m'26, is now sales manager for the Electric Service Company, Cincinnatti. Mr. Rasmussen entered Wisconsin in 1924, after graduating from the United States Military Academy at West Point. While here he was elected into Tau Beta Pi and Pi Tau Sigma.

CIVILS

Bennett, Arthur E., c'10, is city engineer of Aberdeen, South Dakota. His address is 207 Kline St., N., Aberdeen.

Betts, Clifford A., c'13, was recently entertained at a party given in his honor by the Wisconsin Alumni Club of Denver. Mr. Betts has been secretary of the club for several years. His work as Engineer of the Moffat Tunnel Commission has been very commendable.

Bishop, Paul W., c'26, who for a time after graduation was with his uncle, Frank Charlesworth, city engineer of Kaukauna, is now county engineer for Winnebago County with headquarters at Oshkosh.

Brennan, William M., c'94, died at Poughkeepsie, New York, last December, at the age of 68 years.

Buetow, Walter C., c'08, has resigned as bridge engineer for the Stern Construction Company of Milwaukee, to accept the position of state highway engineer.

After graduating from the University, Mr. Buetow worked for a while with the Geological Survey and later with the Chicago, Milwaukee & St. Paul Railway Company. He soon left this work and secured a position with the state highway commission, where he worked until 1923, when he resigned to become bridge engineer for the Stern Construction Co. of Milwaukee. While in the employ of this company, Mr. Buetow has managed some very large projects, the largest of which is the Palatka, Florida bridge. This project is especially interesting in view of the fact that it is built on a coral foundation. He has also managed the building of a large bridge at Indianapolis.

Mr. Buetow will take charge of the state work immediately. He is regarded being an exceptionally good man for the position, because of his former experience with the commission and also because of his wide and varied experiences in bridge construction.

Hedges, Warren B., c'26, has been promoted and is now superintendent of the Hedges-Weeks Construction Co. of Aliceville, Florida. His home is at 940 N. Jefferson St., Springfield, Mo.

Isabella, N. M., c'14, who has been a member of the staff of the State Highway Department since 1915, has resigned to accept a position with the Morris Martin Construction Company of Berlin, Wisconsin. Mr. Isabella was Division Engineer of the Wisconsin Rapids division when he resigned.

Janda, H. F., c'16, has been appointed professor of highway engineering and city planning to take the place of Prof. L. S. Smith who is leaving the university.

Kuelling, J. H., c'08, has resigned his position as State Highway Engineer to become Consulting Engineer for the Wisconsin Highway Paving Contractors' Association. He is succeeded by **Mr. Walter C. Buetow,** c'08, a member of his class.

Lathers, Victor, c'26, is with the Johnson Service Co. of Milwaukee. He is doing heating and ventilating work in the Philadelphia branch of that Company, and lives in the Chatham Court Apartments Sec. J, Apt. B-2, 49th and Locust Streets, Philadelphia, Pa.

(Continued on page 272)

ST. FRANCIS DAM AS A LESSON At a recent investigation to determine the causes for the failure of the Saint Francis dam, William Mulholland, chief engineer of the construction, stated that he envied those who had died, and it is easy to see why he feels so keenly over his part in the disaster. Mulholland is an old man and has built many dams before, which have earned him an enviable reputation, and now his remaining years will be filled with the bitter thoughts of his failure. This failure is an illustration of the well known and oft repeated responsibility placed in the hands of an engineer.

The consensus of opinion brought out by the various investigations of the cause of the disaster indicates that the dam had been anchored in badly weathered and insecure rock at the ends. Perhaps the engineers did not think of the possibility of rock failure or else they poorly judged its strength, either one a consequence of little knowledge of the fundamentals of geology.

If this failure has shown anything it is that concrete dams are safe in themselves but that a thorough knowledge of the geological conditions is of high importance to their stability. May we all as engineers realize this and take full account of all conditions before giving our final approval of the design of a structure.

THE NEW AMERICAN TEMPO The new American tempo is manifesting itself in the public's disconcerting willingness to turn its back on established institutions, products, methods, and ideas. Witness the public's promptness, amounting almost to aggressiveness, in accepting new products, new methods, new institutions and ideas, the radio, balloon tires, the tabloid pictorial newspapers, the movie, Duco finish, electric refrigeration, pale ginger ale, four-wheel brakes, stepped-back skyscrapers, cooperative apartments, symphony concerts by radio, installment buying and Air Mail. These new developments lose their novelty so fast, and are accepted with such utter matter-of-factness, as to take away the breath of the older generation of business men.

Stable and experienced business men are today secretly or openly worried for fear something will happen suddenly — another invention like radio, another craze like bobbed hair, another development like the auto bus, another national upheaval like prohibition — that will wipe out or seriously cripple their business, make costly machinery useless, or destroy the monopoly of some pet patent, without giving them time to turn around.

On the other hand, a new crop of business geniuses has sprung up — men who, with nothing much to lose and everything to gain, have caught the new tempo and jumped in at the right time to capitalize the movie, the swing to Florida, the radio, the six-cylinder complex, the lure in literature.

There is no telling in what direction invention will lead next. But there is now no excuses for the man who ignores an invention which threatens his business. If he makes refrigerators, he may at least make them so that they will readily accommodate an electric or gas refrigerating unit. If he is in the steel or the aluminum business, he may at least start his research department working on new alloys, or he may anticipate that such a metal may be developed and lay plans to protect his business in case it is.

"Step on it" is more than motor slang; it is expressive of a new American attitude: have what you want, do what you want to, be where you want to be — and without waiting.

THE MODERN MACHINE AGE Machinery industry is the living background of every modern enterprise, and the man who is today trying to conduct a business must know the character and tendency of machine civilization, if his work is to be effective.

President Glenn Frank of the University has said:

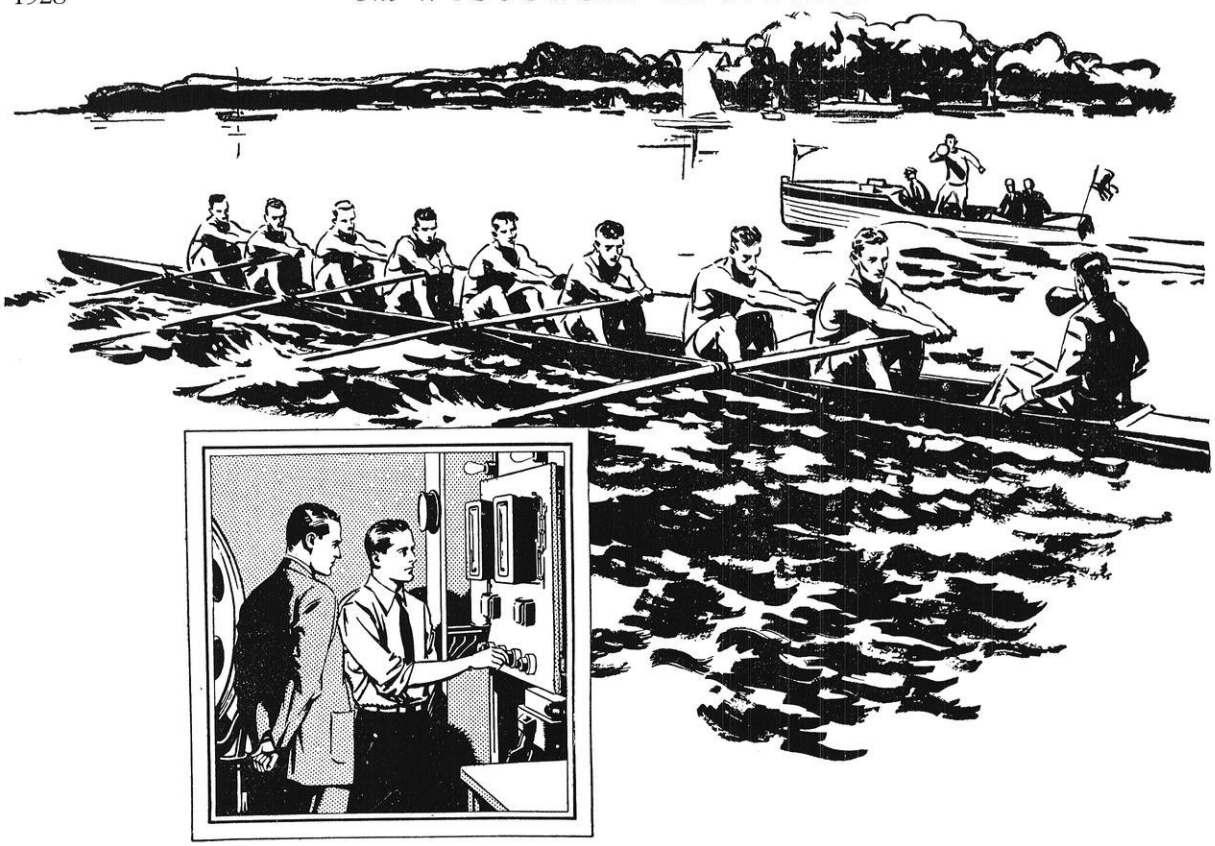
"The American business man is at one and the same time profit-maker and civilization-maker. In both capacities he must, if he is to be effective, undergo the intolerable fatigue of unraveling and understanding this machine civilization. If he does not, he runs the risk of becoming a contributor to a bad business and a bad civilization.

"Here, then are two compelling reasons why the American business man should ask and seek an answer to the question: *Where is this machine civilization of ours going?*

"First, it will make him a better business man, because the character and tendency of American civilization in general will affect profoundly the future of American business in particular."

"Second, it will make him a better citizen, because the character and tendency of American business in particular will affect profoundly the future of American civilization in general."

America leads the world in the sciences of astronomy, geology, biology, and its allied palentology.



Where "good enough" isn't—

WAS there ever a "good enough" stroke? Was there ever a winning crew—or, in the business world, a progressive industry—perfectly satisfied with its own coordination?

This self-criticising viewpoint at Western Electric has brought together chemist and mechanical engineer to improve ceramic making methods; mechanical engineer and metallurgist to create new wire-drawing processes; production engineer and personnel manager to create new records for stabilized employment.

There is no resting on the oars in this work of building the nation's telephone equipment. The pace itself sets continually new standards for men with vision, the ability to co-ordinate, and the will to achieve.

BELL SYSTEM — AMERICAN TELEPHONE & TELEGRAPH CO AND ASSOCIATED COMPANIES

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

THE SANITARY LABORATORY

By R. T. Homewood, c'27
Instructor in Hydraulic and Sanitary Engineering

"Hydraulic and Sanitary Engineering" at the University of Wisconsin has meant chiefly hydraulic engineering until the past few years. With the advent of a small sanitary laboratory the sanitary part of the department has been developed more rapidly.

Cooperation has been the keynote in the development of the sanitary laboratory. Under Professor Corp's stimulation the space above the lecture room in the Hydraulic Laboratory building gradually changed in appearance from an attic to something live, and finally into a laboratory.

From the very first, every attempt was made to carry into the field whatever work was taken up in the laboratory. Realizing that in this way the department would develop most rapidly, Professor Corp conferred with C. M. Baker, then State Sanitary Engineer, and it was decided that a study of the treatment of pea-cannery wastes would be beneficial to both the state and the department. Students were offered theses along this line, and much was learned regarding the treatment and disposal of the wastes.

This past year an effort has been made to learn something of the possibilities of treating creamery wastes by the activated sludge method. Small-scale laboratory apparatus has been set up and the treatment carried on in the laboratory. In addition to this work, the department is cooperating again with the state sanitary engineer, and a thesis is being run on this type of treatment as a small dairy in a town a short distance from Madison.

The laboratory is equipped to take care of the usual tests in sewage and trade waste analysis. Part of the special equipment is a Kjeldahl apparatus, a delicate chain balance, an incubator for B.O.D. tests and a microscope with the necessary equipment for light and dark field work in bacteriological study.

A course in laboratory practice in water, sewage and trade waste analysis will be offered next year in addition to the thesis work in the laboratory.

Altho the sanitary laboratory is one of the most recent additions to the engineering college, it is felt that it will serve a definite need in assisting in the solution of problems in the rapidly growing field of sanitary engineering. It is expected and hoped that the laboratory will continue to grow even more rapidly than in the past, and that the sanitary department will soon share the reputation that hydraulics at Wisconsin now enjoys.

Engineering Review

GOOD ROADS HELPFUL IN RURAL SCHOOL DEVELOPMENT

The widespread improvement of rural roads of all classes has aided in developing certain types of rural schools, notably the junior high school, according to Emery N. Ferris, Professor of Rural Education at Cornell University.

In his recent report, issued by the U. S. Bureau of Education, he notes that reliable means of transportation have greatly extended — in fact doubled — the distance from which schools can be reached by the pupils. This has made it possible to develop three or four-year high schools, older pupils going daily to adjoining communities having high schools which serve several small communities.

There are now 1,174 centers of population under 2,500 having junior high schools.

As a direct result of our modern road program, a million children in farm homes have more regular attendance, longer school years, and one, two, or even three more years of advanced public schooling than was within their reach a few years ago. Good highways have no influence more profound than this.

—Badger Highways.

AUTOMATIC TRAIN CONTROL SYSTEM SUCCESSFUL ON CHICAGO AND NORTHWESTERN RAILWAY

The last stretch of Chicago & Northwestern's main line automatic train control installation, extending from Chicago to Omaha, is scheduled to be complete and in service during the month of May, according to an announcement of President Fred W. Sargent.

This outstanding factor of safety and railroad efficiency between these two cities, such as has been in operation on the Clinton-Omaha Division since July 1st, now marks, what is said to be, one of the longest stretches of continuous automatic train control in the country.

With the completion of this vast improvement, representing an outlay of three million dollars, all Chicago & Norhwestern passenger and freight trains on the main line will pass under an invisible master control that is absolutely automatic. It holds the speed of all trains within proper limits independently of the engineer or train men at all times. Under any and all conditions of the weather, day or night, it safeguards the movements of all trains and provides engineers with a constant check as to speed, and the condition of the right of way ahead entirely independent of block system signals which are often obscured by fog and thereby sacrificing speed for safety.

The new system allows an engineer to operate his passenger train as usual but at a speed within range of safety, if the track is clear, not greater than seventy miles an hour. The maximum speed for freight trains by this system of control is fifty miles per hour, if the track is clear, but no faster. Should an engineer approach too closely to a train or other unexpected restricted condition ahead, the invisible master control causes a warning light in the cab to change from green to yellow, at the same time sounding a chime or shrill warning whistle which demands acknowledgement.

This double automatic warning of light and sound must be immediately acknowledged by the engineer in charge of the train. The speed of his train must forthwith be reduced to below twenty miles an hour, to prove his complete mastery of conditions, otherwise the brakes will be automatically applied, the control taken from his hands and the train stopped. As soon as the track ahead is clear, the master control signal informs the engineer of the fact, whereupon he can again proceed at full speed ahead, up to within the required safety margin of seventy miles per hour as before.

The Chicago & Northwestern was the first railroad to install continuous automatic train control on so large a scale and at so great an outlay. Over 350 locomotives and 1050 miles of track had to be equipped with the control apparatus.

The Clinton-to-Omaha installation was completed and in operation July 1, 1927. Engineers in charge of equipping the main line report that this installation into Chicago will be complete and ready for service May 1st of this year.

IMPROVEMENT MADE IN AUTOMATIC COAL BURNING MACHINE

The insistent demand for an automatic coal burning device which would burn efficiently the cheaper grades of coal, both for heating and power purposes, and eliminate smoke, has resulted in the development of a new accomplishment of automatic stoker operation, in the form of a device to be known as the "Combustioneer."

It is so designed and constructed that when it feeds coal auomatically to the fire bed, by the underfeed principle, the fuel is evenly distributed over the entire bed, an improvement which has been immediately recognized by fuel experts as the outstanding improvement of the

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ALUMNI NOTES

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JAMES F. CASE HEADS PARIS OFFICE OF AMERICAN CONCERN

Stone & Webster, Inc., are sending out announcements of the establishment of an office at 2 Rue des Italiens, Paris, and the appointment of Major James F. Chase, c'90, as representative in charge.

Major Case is unusually well qualified to take this position because of his long and varied experience in analytical and report work, as financial and consulting representative for American interests on projects in all parts of the world, and his wide acquaintance among American and foreign engineers, bankers and government officials.

He graduated as a civil engineer from the University of Wisconsin and his early experience was in the construction and operation of railroads, street railways and water works. Following the Spanish-American War in which he received recognition for conspicuous service and gallantry, he became connected with the important public works which were carried out in the Philippines in the early years of American control. He was appointed Assistant United States Engineer in charge of the design and construction of Manila Harbor which included a breakwater, dredging, reclamation, dock construction and bridge design. As chief engineer of the Water and Sewer department he designed and constructed a new water supply and sewer system and as city engineer he directed city planning and carried out sundry municipal improvements. Later, as Director of Public Works in the Philippine Islands, he was in general charge of all such activities as improvement of rivers, irrigation, drainage, roads, buildings, water supply, and sewers.

In the past few years, as Consulting Engineer to Ulen & Co. and to various American Banking Houses, he has examined, appraised and reported on projects of all kinds in South America, England, France, Spain, Italy, Greece, Serbia, Bulgaria, Turkey and Roumania.

He acted as Chairman of the Delegation of American Engineers to the French International Engineering Congress in Paris in 1918-19, which studied and reported upon plans for restoration of devastated districts, on electric development of the Rhone River, and an electric distribution throughout France.

He was appointed by the League of Nations as a member of a committee which studied and reported on transportation in Poland, completing its work in 1926.

—Stone & Webster Journal.

Lindner, Clement P., c'25, is with the Consumer's Power Co., Jackson, Mich. His address is 535 Wildwood Ave., Jackson, Mich.

Smith, Leathem, D., c'08, has been named as the vice-president of the newly created Maritime Engineering Corporation, Inc., 608 South Dearborn Street, Chicago, organized for the purpose of studying waterway and terminal problems for cities, states, and industrial organizations.

Since his graduation from the University, Mr. Smith has been engaged in breakwater construction, marine salvage, and crushed stone business at Sturgeon Bay, Wisconsin. In 1917 he organized a shipyard, and during the war period completed nine seagoing tugs for the shipping board. His work was always connected with transportation, and he has applied his engineering skill to the solution of his transportation problems so efficiently that his unloading device has been patented and has proved to be a real advance over the old systems. This device has already been used in nine of the large lake-going vessels, and is very well recommended by shippers.

Stock, Harry, c'06, made a visit to Florida during the month of February in regard to an engineering project in which he is interested. He has been living in Minneapolis during the past year.

Thwaits, Edmond H., c'25, m'26, is now consulting engineer with Douglas and Thwaits, Inc., of Denver. His firm deals in municipal and coal engineering.

Mr. Thwaits lives at 669 Lafayette Street, Denver, Colo.

Titus, William J., c'13, has been made Chief Engineer of the Indiana Highway commission. He has recently made out a report of the plans of the commission for the development of their highway system. One of the most important points in the program outlined by Mr. Titus, is that all surfaced highways are to be kept open throughout the whole year. Mr. Titus has been working with the Indiana commission for several years and is well acquainted with their special highway needs.

Tschudy, Lionel C., c'23, has moved to 2018 Washington Blvd., Chicago, Ill.

Wisner, John C., Jr., c'26, who has been working with the Wisconsin Highway Commission since graduation, resigned, effective April 21, to take a position with Ray Mann, contractor for bridges at Rockford, Ill. Wisner's address will be 4203 Broadway, Rockford, Ill.

ENGINEERING REVIEW

(Continued from page 268)

year in combustion engineering. By this uniform distribution of fuel, air holes in the fire are eliminated, insuring uniform combustion, and preventing blasts of air from impinging on the boiler.

The design and construction of the "Combustioneer" embodies several additional new features. The gearless final drive is practically silent in operation. A bronze worm gear eliminates friction. The final drive is through an all-steel overrunning clutch, operated through bronze connecting rod and over-sized eccentric. Every part is easily accessible. The coal feeding worm is semi-steel, connected to drive by universal coupling, protected against damage by safety shearing pin.

BOOK STACKS FOR YALE'S NEW LIBRARY TO BE ARC WELDED

Fifteen miles of steel columns will be electrically welded together to form the book stacks of the

$7,000,000 Sterling Memorial Library being built by Yale University at New Haven, according to G. D. Fish, consulting engineer on welding for the book-stack contractor. The book tower of this library will be the tallest structure of its kind in the world when completed, consisting of eighteen stories. It will be 130 feet high and will provide space for four million books.

Arc welding, instead of riveting, will be employed to join these columns together because double the stiffness can be secured. The channel-shaped beams carrying the book shelves and the passages are 5 inches deep; if rivets were used, only two, spaced 3 inches apart, could be employed for each joint, whereas with the electric process the entire depth of 5 inches can be firmly welded to the adjoining member. Arc welding these sacks will make unnecessary the use of a hundred thousand rivets, and will also eliminate the noise of driving them, which will be a decided advantage due to the structure being located adjacent to many of the University Buildings.

—*Westinghouse Bulletin.*

CAMPUS NOTES

(Continued from page 263)

the primary grades, "you must make up a story for me right out of your own heads. You must not put anything into the story which you have seen. It must be something which you have only imagined."

She then explained to them what imagination meant.

The next day the children brought her their essays. Here is one of them:

"Right after they were married, the bridegroom said to the bride, 'I must leave you now, for I have no money, and I must go out and dig for gold way across the ocean or we must starve.'

'Go, my bridegroom,' said the bride, 'and I will wait for thee.'

"Seven years passed, and one day the bridegroom came running to where his bride was seated in the parlor of their home, and he took from his grip great bags of gold, which he dropped at her feet, and on them he placed smaller bags which he had taken from his coat and pants pockets.

'There, my bride, is the gold I promised you.'

"The bride's face lighted with a smile, and she said: 'Neither have I been idle, my bridegroom,' and she opened a door which led to another room, and in tripped seventeen children."

HIGHER MATHEMATICS

How to Avoid Studying

ITEM	TIME (per week)
Regular school classes	29 hours
Studying (regular rate of two hours per credit)	38 hours
Sleeping, dressing, toilet, etc.	63 hours
Eating	11 hours
Transportation	12 hours
Working	16 hours
Physical recreation	5 hours
Dates and at athletic contests	4 hours
Auditing "liberal" or "cultural" courses	4 hours
Reading periodical magazines and daily newspapers	8 hours
Outside activities (of innumerable varieties)	12 hours
Church (which with preperation and transportation requires most of Sunday morning)	4 hours
	206 hours

Since there are only one hundred sixty-eight hours in most weeks, it is obvious that some item must be eliminated After applying the proper mathematics, one arrives at the conclusion that there are 37.998 extra hours (by ye trusty slip stick) in the poor engineers' week. The simplest and only procedure that can follow is to cancel the 38 hour study item, because no other combination of items total 38.

CAST IRON RESEARCH BY MECHANICS DEPARTMENT

One of the pieces of research work that has been going on in the Mechanics Department since last summer is some work on cast iron carried on by Professor J. B. Kommers. This work has been done in co-operation with Committee A-3 on Cast Iron of the American Society for Tesing Materials, and the various manufacturers who furnished cast iron bars for the tests. The manufacturers who cooperated included, among others, the Buffalo Foundry and Machine Company of the east, the American Cast Iron Pipe Company of Alabama in the south, and General Motors, Bucyrus-Erie, and Allis-Chalmers in the middle west.

The tests included tension, compression, hardness, cross-bending, impact, and fatigue tests, in an attempt to determine the static and fatigue properties of various cast irons, and the correlation between these various properties. One of the matters kept in mind in making the tests was the production of high strength cast irons.

The results on ten different cast irons will be reported in a paper to be presented at the annual convention of the American Society for Testing Materials, held at Atlantic City in June.

ELEVEN ENGINEERS RECEIVE SCHOLARSHIPS

At the recent meeting of the Board of Regents, scholarship awards to eleven engineers were authenticated. Legislative and Wisconsin scholarships were granted.

Legislative scholarships entitle the receiver to exemption from the non-resident tuition fee and are granted only to out-of-state students. Wisconsin scholarships are given only to freshmen and carry with them a stipend of $100. Both are granted by the State of Wisconsin.

The men receiving Legislative scholarshops are:

Ronald E. Copeland, c'28; and Howard L. Canfield, e'31. Those receiving Wisconsin scholarships are: Alexander Cowie, m'31; Jack Essock, e'31; Gordon Fredendall, e'31; G. Willard Gibson, m'31; Walter Karsten, m'31; Leo Kosak, ch'31; Frank Ladwig, c'31; Eugene Peterson, c'31; and Norbert Steckler, m'31.

PI TAU SIGMA ELECTS HONORARY MEMBER

At the meeting of Pi Tau Sigma, Honorary Mechanical Engineering Fraternity, held on Tuesday, May 8, Prof. L. A. Wilson of the Steam and Gas Department was initiated as an honorary member.

After the ceremony had been concluded, the members banqueted at the Park Hotel. There they were entertained by incidents and experiences as related by Chester Braatz, W. M. Richtmann, Prof. P. H. Hyland, and Prof. G. L. Larson.

NORMAL AND ABNORMAL CARBURIZING STEEL

(Continued from page 261)

oxygen from the flame." He found that burnt steel will show abnormal qualities after carburizing and that exceptionally abnormal carburizing qualities are obtained in steel exposed to oxygen while in the molten condition. He says, "It can be safely stated that oxygen in order to influence the carburizing qualities, must be combined with one or more of the constitutents in the steel, probably as oxides of the lowest valency." That the oxides are evenly distributed through the steel is beyond doubt, but the condition is difficult to decide as in solution, suspension, etc. The cause is an improper deoxidation of the heats when made, though just how oxygen influences is a matter of speculation.

Ehn makes the following additional statements and recommendations in the Transactions of American Society for Steel Treating, Vol 2, p. 1177 (1922). Structures of both abnormal and normal vary with carburizing temperature and rate of cooling. For carburizing purposes straight low carbon steel (SAE 1020) is satisfactory. For general carburizing purposes 0.3 to 0.5% Chromium, as Chrome steel is usually normal. Extreme types of abnormal steel cannot be hardened under any condition.

S. Epstein and H. Rawdon (Bureau of Standards, Washington, D. C.) became interested and carried on an investigation and presented a paper before the American Society for Steel Treating. They support the McQuaid-Ehn results but do not agree in the theory. Their experiments with quenching added more facts to the problem. Quenching the case hardened piece in tap water showed more soft spots than pure water, probably because of air disolved in the tap water. A minimum of soft spots was found by using boiled water and then when oxygen was put through the boiled water the soft spots reappeared. When carbon dioxide was put into the cooling water the entire surface of the specimens was soft. Their theory is that gas is evolved upon heating during quenching and bubbles of vapor cling to the specimen and prevent heat abstraction from

the piece. Soft spots were prevented by quenching in sodium chloride or sodium hydroxide solutions.

Their results show that previous conditions as rolling, annealing, etc., has little effect on the carburizing properties, and variation in mechanical and heat treatments have no effect on normality, therefore the origin is in the steel making. Their theory is that the cause is the size of the oxide particles rather than the amount of the oxides.

The following additional statements were also taken from their paper. The coarse grain of normal steel is more brittle than the abnormal and the finer grained abnormal is better for some work if the soft spots give no difficulties. Drastic quenching prevents soft spots, and the presence of dissolved gas in quenching water is an important factor. Determinations of gas contents of steels have revealed nothing conclusive as the real nature of abnormality. Abnormality is associated with aluminum content, but aluminum is not a sure indication of abnormality. Both effervescing and ladle killed steel normal when finished were made abnormal by addition of aluminum or ferrovanadium in the mold. They say that the probable explanation is "obstruction to grain growth process" though there is no conclusive evidence of it yet.

Further work was done independently by John D. Gat and additions of his efforts will now be given. His experiments revealed that there is no relation between grain size and abnormality and grain size does not effect the dimensions of case. There is no pronounced variation in carburizing properties recorded for various stages of reduction of the specimen and the time of annealing does not effect the hyper-eutectoid zone. Soft spots sometimes came from non-mettalic films on the surface of the piece at quenching, interfering with proper heat transfer. As far as is known there is no difference depending upon the kind of carburizing used.

All the men who have worked with this problem admit the normal and abnormal conditions set forth by McQuaid and Ehn though the individual theories for the causes differ in many respects. As Epstein and Rawdon have stated, the subject is still in its early stages and some questions still remain unanswered.

As this is a new problem and is not completely solved no definite conclusions can be drawn as yet, but this paper has exhausted all available material now on the subject.

THESIS WORK IN HYDRAULICS

(Continued from page 260)

less than the product of the loss due to one bend times the number of bends. This indicates that the grouping of bends is desirable wherever possible.

Paul Fell has been making an analytical study on the loss in head due to flow in pipes from one-fourth inches thru eight inches in diameter, and assisting in developing the University of Wisconsin equation for flow in pipes. A. J. Anderson has completed his thesis along the same line as Mr. Fell.

Two theses are being written in the sanitary laboratory on the disposal of creamery wastes. Harold Ruf and Richard Reinke have set up a small activated sludge plant in the laboratory and are attempting to check or disprove the results that were obtained by a similar thesis last year. The equipment used this year

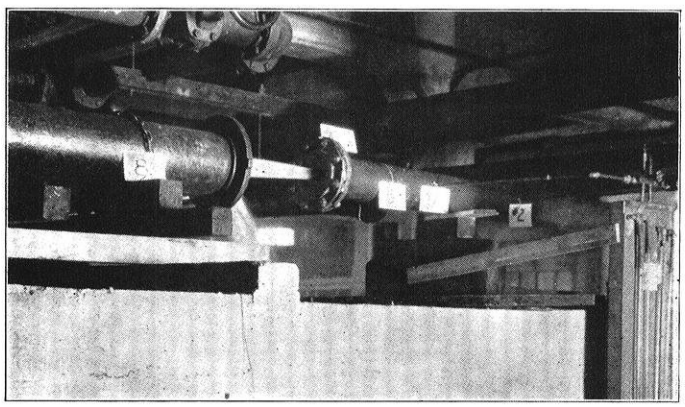

FIG. 3: *Jet from 2 inch orifice under a 50 foot head.*

is much more complete than that which was available last year, and it is thought that the results of this thesis coupled with those of last year's thesis should throw interesting light on the possibility of the activated sludge treatment of such wastes.

Spencer Merz and Herbert Brown are writing on the same subject but are using a plant set up in cooperation with the State Sanitary Engineering department at a small creamery at DeForest, Wisconsin.

REGULATING ENGINEERING PROFESSION

(Continued from page 259)

Wisconsin engineers will be able, through reciprocal licensing, to move about freely in other states.

C. Based on General Considerations

8. Regulation has been in force in other states for many years and the engineers of those states are satisfied with it.
9. Regulation will come eventually; therefore, engineers should frame the bills now rather than have legislators do it for them later.
10. Engineers will not lose dignity by submitting to regulation, for over 240 occupations are subject to regulation, and among them are the most respected professions of all, law and medicine.

ARGUMENTS AGAINST REGULATION

1. Regulation will constitute a nuisance in the following respects: (a) It will add to the financial burdens of the individual engineer; (b) It will restrict movement from state to state; (c) It will involve the necessity of passing a written examination of a highly theoretical type that will be an impassable barrier to the engineer who has been long out of school.
2. Regulation is "more likely to become a cloak for dishonest, unprofessional work than to be a protection for the public against incompetence." "I never

knew a license of any kind that was not taken advantage of by a rascal. It is a dangerous thing to put the stamp of approval on a man by means of a license." "The unscrupulous and indolent will develop the greatest energy of their lives in getting a license and then depend upon official recognition in selling their services. Attempts to keep such men out are futile. Examinations avail little, diplomas are of no benefit, 'responsible charge of work' can be given to an incompetent young man by a rich uncle or father. Influence—social, political, or financial—secures endorsement with little trouble."

3. Regulation will "tend to elevate the inferior man to the level of the experienced man because both would be just licensed." "It helps only the incompetent and lowers professional standards. It is advocated by young men who have not been successful, in the hope of getting a standing to which they are not entitled." "The license idea is usually evolved and supported by near-engineers who think in that way to raise themselves to the level of real engineers."
4. Regulation "would give rise to a false sense of security and investors would suffer."
5. Regulation would hamper the development of engineering practice. "The progress of the United States has been due largely to freedom from governmental restrictions. The law of the survival of the fittest brings out the best man in any line." "The creative mind is not academic, and such men would be lost to the profession." (This argument seems to be based upon the idea that the genius who can originate something now is not likely to submit to a course of training that he would have to undergo before he could qualify.)
6. It would "bar from service those men who are highly developed in but one branch, as specialists, and who could well serve in their limited field." This probably refers to so-called practical men who have not studied the fundamentals but have learned some of the procedure of engineering.
7. The moment a bill is passed for licensing, the door is opened for further regulation of the profession. The original purpose may be defeated by provisions directly opposed to the interests of the profession. (This danger has been realized in Florida.)
8. Licensing is a step toward unionizing engineers.
9. Regulation would handicap the young engineer. (Apparently, the idea is that he might have trouble in passing examination.)
10. Regulation will entail the maintenance of additional state machinery.
11. Licensing would permit any licensed engineer to perform any kind of engineering work regardless of his qualifications. The law would not permit a civil engineer from practicing mining or electrical engineering, and, therefore, would mislead the public
12. Licensing is class legislation.

13. Licensing is unnecessary for the following reasons: (a) The engineer does not work for individual clients as do the doctor and the lawyer, and for that reason the profession does not offer them the same opportunities for the quack as is offered by medicine and law. Most engineers work for corporations under the direction of men who are competent to pass upon their qualifications and who do not need the recommendation of a registration board. (b) The state and federal government already have a system for selecting technically trained men for public employment that is better than any licensing system. (c) Ordinarily, the design of structures involving public safety is required to be approved by the proper authorities before construction can be begun. It does not seem necessary to have a licensed engineer design the structure, if his design is subsequently passed upon by others concerning whose competence no doubt exists. Where engineering practice affects life, health, and property, it can be controlled most effectively thru codes and public supervision.
14. "The work of the engineer is not of such importance to the human life, and limb as to make an engineer's work improtant."
15. Licensing will not eliminate incompetent men and, therefore, will not protect the public nor improve the status of the profession. It cannot be shown that license laws for doctors, lawyers, plumbers, realtors and other "professions" have resulted in any public good. License boards are incompetent to pass upon a man's qualifications; "they cannot examine the only points worth examining,—honesty and reliability." "Where licensing is in vogue, it protects many educated quacks."
16. The law would be evaded by unlicensed persons paying licensees a fee for use of name. Much engineering work would be done by men who did not use the title "engineer" and therefore avoided the license fee.
17. No satisfactory definition of "engineer" has yet been found.

CHROMIUM PLATING

(Continued from page 256)

the limited supply of this valuable metal for other purposes.

The uses of chromium plate thus far enumerated depend mainly on its resistance to tarnishing. Its hardness has led to its use on parts of machines and tools subject to severe wear, and to many valuable applications in factories engaged in the working of metals. Printing plates and electrotypes have their useful life increased four or five fold by chromium plating, and when the coat of chromium shows wear it can be dissolved without injury to the printing plate and a new deposit of chromium put on.

Although made of hardened steel, fine gages used in the automobile industry soon wear to an extent that renders them unfit for use. It has been found that chromium plate lasts several times as long as the steel, and when the gage is no longer accurate the plate can be dissolved and a new coat applied. Where extreme accuracy of dimensions is required invar gages are used and given indefinite life by chromium-plating. Another important application of chromium plate is on dies for stamping and drawing metals. Depending on their form and the material worked, a chromium plate .0005 to .001″ thick increases the life of the die five to twenty fold.

One of the instruments on automobiles contained a small shaft made of a special steel and case-hardened. Twenty per cent of these were rejected due to warping in case-hardening. The substitution of chromium plate for the case-hardening not only saves the rejections due to warping, but lessens the cost of machining by another twenty per cent because it permits the use of a different steel. Several tiny steel shafts are chromium-plated with a saving in manufacturing cost and a betterment in the product. A manufacturer of automobile fans has installed chromium plating for the fan shaft, and tests show that there will be no serious injury to either shaft or bearing if the car owner forgets to oil the fan for a week or two.

Not only does chromium plate provide a surface which has a low coefficient of friction and to which other metals do not stick, but it resists heat and oxidation remarkably. The chromium plating of molds for die-castings and for glass not only increases the life of the mold but gives a better surface to the product. Similar results have been obtained with molds for vulcanized rubbed goods. Because of its resistance to attack by sulphur at high temperatures chromium plating of equipment in oil-cracking stills promises large savings.

Chromium plating is not a cure for all ills, but where hardness, resistance to wear, a low coefficient of friction or the prevention of the adhesion of another metal is needed, its use will save much money by imparting longer life to equipment. These applications and many others have been made in less than two years. When all manufacturers become acquainted with such uses of chromium plating and employ it, the saving is likely to amount to millions of dollars annually.

GIBSON DAM

(Continued from page 255)

necessary to provide some means of replacing the volume lost by shrinkage with concrete, in some manner. On dams built in the past, as I understand it, when replacing the shrinkage volume was attempted at all, it was accomplished by leaving narrow sections, say four or five feet wide, open when pouring; such openings to be filled after the dam had been given ample time to shrink. On this dam, however, a new system was devised whereby all joints are to be grouted after complete shrinkage has taken place. To do this a system of grout pipes are installed for each joint with grouting points spaced every three feet horizontally and eight feet vertically, with one-inch leader pipes opening on the downstream face of the dam to which the grout machines are connected. It is hoped that this method will be a great improvement over the old method, and will prevent delays and trouble in case of flood water.

To provide a means of diverting the water while the gates are constructed in the present diverting flume, three temporary diversion openings are to be built through the dam in the old river channel, as shown in Fig. 4. These openings are each to be 10′ x 14′ in cross-section, and each is provided with two sloping shafts 4′ x 4′3″ in cross-section, leading upward to the downstream face of the dam. These shafts are to be used in filling the diversion openings with concrete after the permanent gates have been installed.

Experimental and Research Installations

A number of devices are to be installed by the U. S. B. R. for experimental and research purposes. This equipment consists of the following:

Uplift Pressure Pipes. To determine how effective the drain holes are in preventing upward pressure on the base of the dam, twelve uplift pressure pipes are to be installed. These are three-inch vertical pipes, connecting holes, drilled eighteen inches deep at various points in the foundation, with the inspection gallery back of the sidewalk. To determine the uplift pressure at each point it is only necessary to note the height that the water rises in the respective uplift pipes.

Telemeters. To determine internal stresses in the dam, twenty telemeters are installed at nine different points in the concrete. Two or three telemeters are placed at each point in different positions so that stresses will be shown in various directions. These telemeters are connected electrically with indicators in the inspection gallary.

Inspection Shafts. Three vertical inspection shafts 2′ x 3′ in cross-section, and 175 feet deep are to be built into the dam in the three central sections. These shafts contain ladders and equipment for measuring strains and deflections of the dam, the equipment consisting of clinometers, Barry strain Gauges, and deflection targets.

Thermometers. A large number of pressure theromometers are to be imbedded in the concrete at various points, and connected electrically with the inspection gallery.

Progress

At present the excavation for the foundation has been practically completed and about ten thousand yards of concrete have been poured on the south end. The spillway tunnel has been driven, and a center heading completed for the shaft. Due to winter weather, concreting has been discontinued, and at present most of the labor is being concentrated on completing the spillway shaft.