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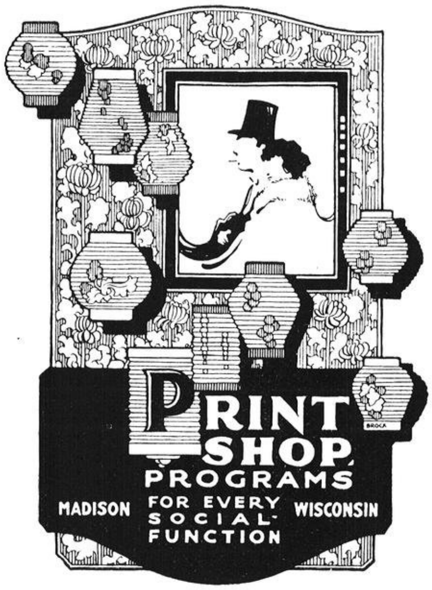

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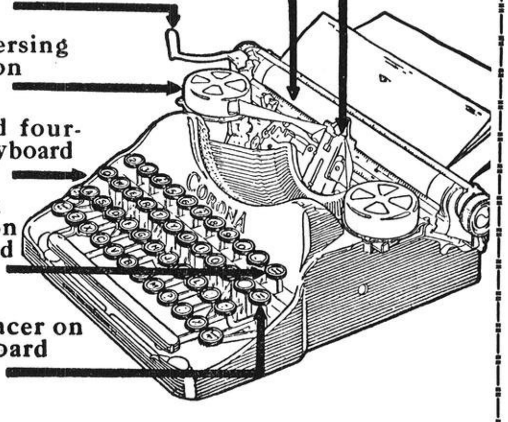

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The

WISCONSIN ENGINEER

UNIVERSITY OF WISCONSIN

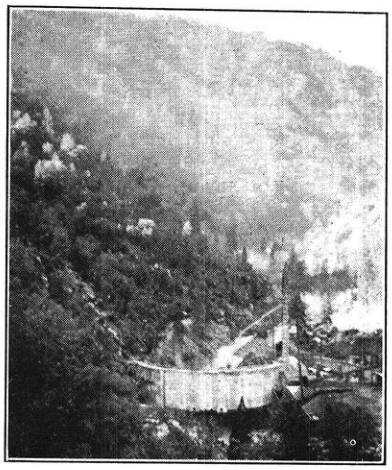
VOL. XXIX No. 6 MADISON, WIS. MARCH, 1925

THE HETCH HETCHY WATER SUPPLY OF SAN FRANCISCO

By LIONEL C. TSCHUDY, c '23

THE Hetch Hetchy Water Supply Project is financed and operated by the city and county of San Francisco, California. In size it is comparable with the Los Angeles Supply, the Metropolitan of Boston, and the Catskill development of New York City. In 1910, the city voted on and passed a bond issue of $45,000,000. M. M. O'Shaughnessy, city engineer, started work in 1912. He is an experienced and reputable engineer, and through his guidance the project has progressed rapidly. The 1910 estimates were found to be low due to the increase in costs of present day labor and material. On October 4, 1924, the voters passed on an additional bond issue of $10,000,000. This amount will complete the tunnels in the lower Sierras, the work in the upper Sierra being practically completed. When these funds are used, the people will vote on another bond issue to complete the project. The present construction headquarters are at Groveland, California, but will be moved nearer to the city as the work progresses. Groveland is famous for being the home of Tennessee's Partner, one of Bret Harte's famous characters, and many people will travel miles to visit this historical place.

The water is collected from the high floods of the Tuolumne River in the Sierra Nevada Mountains and stored in the Hetch Hetchy Reservoir. The water is of the purest type of surface waters and is cool and clear during the hot summer days. The dam, or reservoir, is 168 miles from San Francisco, and at an elevation of 3726 feet above sea level. The water passes from the dam (called O'Shaughnessy Dam) down the Tuolumne River to Early Intake where a diversion dam has been built to divert the water into the first of the Hetch Hetchy tunnels. The tunnel, driven through granite for a distance of 18.8 miles, comes out at Priest. Here a large earth and rock filled dam has been built to maintain a constant flow of water to the Moccasin Power tunnel. The water enters the penstock and drops 1300 feet to the Moccasin Power House. Here there will be from 60,000 to 80,000 Horse Power developed. The water flows from the power house and enters an 18 mile tunnel which comes out at Oakdale. Then it is carried by pipe line across the San Toaquin Valley and thence through the coast range by tunnel. Pipe lines and a syphon across the bay bring the water near the city limits, and from there it passes through a tunnel to the city reservoir. The project calls for the construction of 69 miles of tunnels, arch roof with a height of 10 feet 3 inches and a width of the same amount, and 87 miles of steel pipe line. The city is building a project that will actually develop 200,000 Horse Power and provide for a daily flow of 400,000,000 gallons. The major part of the work in the future will be to complete the water supply,—the power developments being more nearly completed.



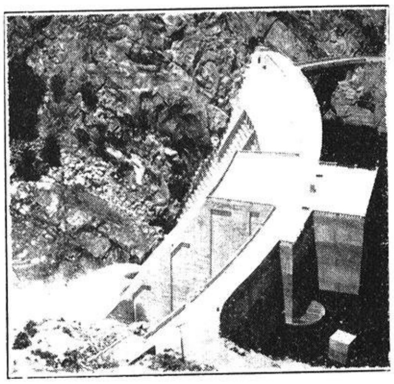
LOOKING DOWNSTREAM.—*Early intake diversion dam—arch type, 50 ft. radius, 50 ft. high, 254 ft. long, and 8 ft. wide.*

In order to develop the work economically, it was necessary to construct the Hetch Hetchy Railroad. The railroad starts at Hetch Hetchy Junction, leading from the Sierra Railroad. Winding in and out — it appears as if the locating engineer was afraid to look a tangent in the face — the road gradually rises to an elevation of 3700 feet at O'Shaughnessy Dam, or Hetch Hetchy Reservoir, through a distance of 68 miles. Thus the city had transportation available to get supplies to the construction camps. Locomotives of the Mikado type are found quite necessary on the four per cent grade.

Where water can be harnessed for power production, due to the large available heads in mountainous regions, it was found profitable to build a power house at Early Intake. The city built the multiple arch dam at Lake Eleanor. The water passes from the lake down Cherry Creek to a point about four and one-half miles from

Intake where it is diverted by a weir into a tunnel. Passing through channels, tunnels, and penstock, the water passes to the power house. The power is developed from 200 second feet under a head of 345 feet. Three Pelton-Francis water wheels running under full capacity develop 6000 Horse Power. Many miles of transmission lines reach from Early Intake to all the construction camps. With this power available, an abundance of electricity can be used for crushers, mixers, motors, compressors, mucking machines, and lights.

On all construction work, accidents cannot be prevented, even though precautions are taken to avoid carelessness. For this reason, the city has built and maintains the Groveland Hospital. It has been provided with all modern medical equipment. A competent surgeon and three registered nurses are in attendance. An ambulance is at hand, and when emergencies arise, the injured are given prompt attention.



O'SHAUGHESSY DAM AND HETCH HETCHY RESERVOIR.—*(Gravity Type).*

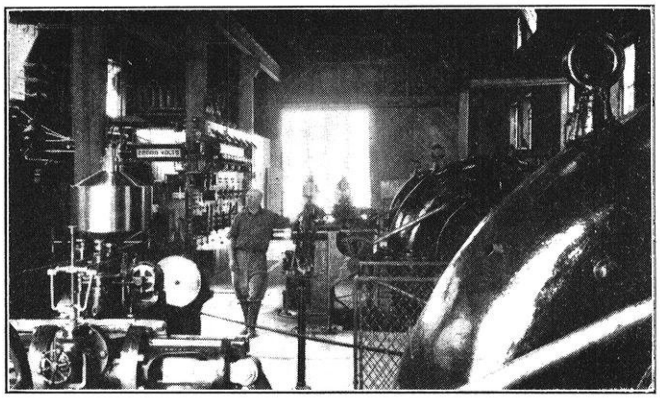
When one sees vertical cliffs practically 1000 feet high that have stood the weathering for thousands of years without any deterioration, one can comprehend that not much soft rock will be encountered when excavating for dam foundations. This makes the excavation for dams comparatively easy, and the dams constructed on such foundations are likewise more secure from failures. The tunnel driving is also through hard rock. In the tunnel from Early Intake to Priest, the upper half consists principally of hard granite. This does not require a concrete lining except in a few bad sections of from 25 to 100 feet in length. The lower half of this 18 mile tunnel consists of a poorer grade of rock that has been classified as schist. It was so poor that the city lined the entire length of nine miles with concrete.

The Eleanor Dam is of the multiple arch type, from 50 to 75 feet high, and approximately 750 feet in width. It has been designed so that at some later period, it can be extended several feet higher in elevation thereby increasing the storage capacity of Lake Eleanor. At the time this dam is increased in height, a tunnel will be constructed leading from Eleanor dam to the Tuolumne river coming out about one-half mile above the Early Intake Diversion works. Here there will be another large power house. The water which serves to develop the power will pass on down the river to the aqueduct tunnel and will be used as part of the city water supply. This development of the project may not come to pass for several years; but in all probability, it will be some of the last work to be completed on the project.

The O'Shaughnessy Dam is of the gravity type, contains about 360,000 cubic yards of concrete, and was completed in 1923. It is set in a canyon below Hetch Hetchy Valley, an ideal place for a dam. The dam is 260 feet high and 500 feet in width. The reservoir of San Francisco's main water supply is seven miles in length and approximately 1500 feet in width. The reservoir and O'Shaughnessy Dam together present a most beautiful piece of scenery that is often called "Little Yosemite."

The tunnel driving from Intake to Priest has been completed, but it will take a month or two to complete the tunnel lining. The sides have been poured separate from the floor or invert. Now they are pouring the invert. In order to work efficiently the work is accomplished by two shifts, the "clean up" crew and the "concrete crew." The "clean up" shift working at night gets the floor clean, places the mixer, and in short arranges the work so that the "concrete shift" can start the next morning without any unnecessary delay. The "concrete shift" pours as much as they can in their time, usually ten hours. It is nothing unusual to pour 450 to 500 feet in one day. The city has an inspector for each shift and also an inspector for the grading of the rock and sand before it enters the tunnel.

The surge chamber and penstock to the Moccasin Power House will not be completed before April 1, 1925. The power house also will be completed by April 1st. It is the plan of the engineer to get power to the city at that time.



INTERIOR OF INTAKE POWER HOUSE. —*Showing Three Units*

The project is over half completed, but several years of work remain. The 18 mile tunnel from Moccasin Power House through the lower Sierras is to be started in several months. The tunnel will be worked from several points by adits and shafts. There will be eight tunnel camps, three adits, and five shafts. These shafts will be from 50 to 250 feet deep. The shafts at Big Creek and Second Garotte between Intake and Priest of the upper Sierra tunnel, are from 600 to 800 feet deep.

(Concluded on page 109)

EXPERIMENTS ON RUSTING OF REINFORCING STEEL IN CONCRETE

By E. C. SCHUMAN

Instructor in Mechanics

SINCE there was very little available information on the rusting of reinforcing steel in concrete, the tests herein described were begun in the Laboratory for Testing Materials at the University of Wisconsin in February, 1911, under the direction of Professor M. O. Withey. Although the tests are neither extensive nor elaborate, and were not carried out as had been planned originally, they are sufficient to permit the drawing of some valuable conclusions. These tests were conducted over a period of about 12 years, which period, in view of the accelerated action, was sufficient to reveal the results which might be expected to obtain under ordinary conditions over longer periods. During this time the effects of such variables as alternate wetting and drying, salt in the mixing water, salt in the water bath, richness of mix, and thickness of covering on the rods were studied.

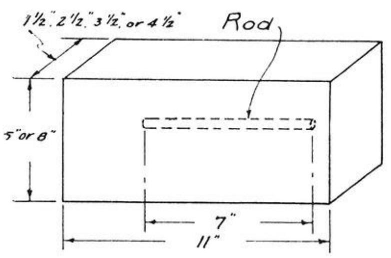


FIG. 1. SKETCH OF SPECIMEN BEFORE TEST.

Specimens.— The specimens consisted of small rectangular concrete blocks, all of which were 11 inches long, either 5 or 8 inches wide, and either 1, 2½, 3½, or 4½ inches thick. A one-half inch round structural steel rod 7 inches long was centered in the axis of each block. The specimens were made with the long dimension horizontal as is shown in the sketch of Fig. 1. By this procedure small air pockets formed at the bottom of the rods. This condition, however, probably occurred to a lesser degree than would obtain when rods are similarly bedded in practice.

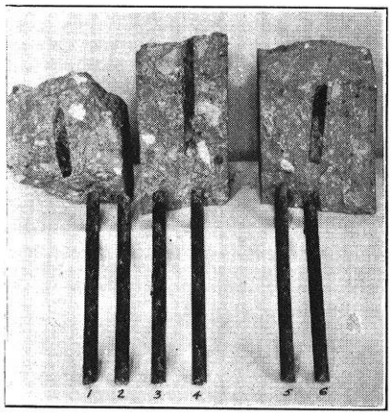


FIG. 2. VIEWS OF RODS AFTER 12-YEAR TEST.—*Specimens 4 to 1 made with salt in mixing water; others without salt. Thickness of concrete: No. 1 and 2, 3½ in.; No. 3 and 5, 2½in.; No. 4, 4½ in.; No. 6, 1½ in.*

All specimens were prepared from batches of about 200 pounds which were thoroughly mixed by hand. Proportions were 1:1:2, 1:2:4, and 1:3:5 by volume. The materials were a mixed Portland cement, Madison crushed limestone, and Janesville sand, having specific weights of 100, 85, and 105 pounds per cubic foot, respectively.

One half of the specimens were mixed with Madison city water, and the other half were mixed with the same water containing seven per cent of common salt by weight.

Curing.—All of the specimens were placed ends up in a water bath one day after making and kept there until March 18, 1911. The mixing of the various batches was carried on over a period of three weeks, so that by the above procedure the last batch was left in the water two weeks. The specimens were removed from the bath on the date mentioned and placed on end with an air space between them. On march 25, one week later, they were immersed in the same respective tanks. Fresh water had been added as needed, and it was noted that in the tanks in which the salt water specimens had been immersed the water had become salty due to leaching. This process of immersion and drying, alternating each week, was continued until November 4, 1911, when the specimens 1½ inches thick were broken with a hammer. One of each of the other sizes of the salt water speciments was also broken at this time.

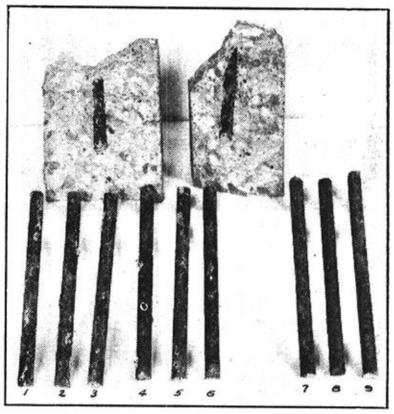


FIG. 3. VIEWS OF RODS AFTER 12-YEAR TEST.—*Specimens 1 to 6 made with salt in mixing water; others without salt. Thickness of concrete: No. 1 and 7, 1½ in.; No. 2 and 4, 4½ in.; No. 3, 6 and 8, 3½ in.; No. 5 and 9, 2½ in.*

On January 9, 1918, specimens 1½ x 5, 2½ x 5, and 4½ x 5 inches in cross section of each mix were broken. They had been subjected to alternate wetting and drying in accordance with the previously mentioned program since making, except that they had dried in air about 1½ years just prior to 1918 because of leakage in the wooden tanks. Water in the tanks had been replenished as needed but no salt had been added in any case.

On January 30, 1918, a solution equivalent to sea water was made as follows: chloride of sodium (Na

Cl, 3%, sulfate of magnesia crystallized (MgO SO_3 $7H_2O$) 0.5%, chloride of magnesium crystallized (MgCl $6H_2O$) 0.6%, sulfate of lime (hydrated) (CaO SO_3 $2H_2O$) 0.15%, bicarbonate of potassium (KOH_2O $2CO_2$) 0.02%, distilled water 100%. The remaining salt water specimens and one half of the remaining fresh water specimens were immersed in the above solution. All specimens were allowed to soak in their respective baths (normal or sea water) for two days, and were then set in air, well separated, for twelve days to dry. This two week cycle was continued about four months. All specimens were then put out doors until September 17, 1923, when they were broken and examined. Through oversight no provision had been made for distinguishing the fresh water specimens and the salt water specimens.

RESULTS OF TEST

Tests on November 4, 1911. Age 8 months.

Mix	Cross Section (in.)	Results
1:1:2 N	1½ x 5	No rust.
1:1:2 S	1½ x 5	About ⅝ sq. in. of rust on lower side of rod; very slight spot 0.01 sq. in. on upper side of rod at one end—concrete not perfect at that spot.
1:2:4 N	1½ x 5	No rust.
1:2:4 S	1½ x 5	5 spots of light rust on lower side of rod (specimens as molded), area about ½ sq. in.
1:3:5 N	1½ x 5	No rust.
1:3:5 S	1½ x 5	3 light rust spots, area ½ sq. in. All spots on sides of rod farthest from surface of concrete.
1:3:5 S	1½ x 8	One rust spot on bottom side of rod
1:3:5 S	1½ x 8	3 light rust spots ⅜ sq. in. on bottom side of rod (as molded).

The under side of all the above 1:3:5 specimens showed some air pockets; top sides perfect in practically all cases with no air pockets; concrete was damp in all cases.

Mix	Cross Section (in.)	Results
1:1:2 S	2½ x 5	Showed a very bad corrosion near one end of rod ½ sq. in. on bottom side of rod.
	3½ x 5	Showed considerable corrosion, ½ sq. in. or more.
	4½ x 5	Few rust spots both top and bottom of rod.
1:2:4 S	2½ x 5	Showed ¼ sq. in. of pits at one end on bottom of rod.
	3½ x 5	Showed considerable corrosion ¼ sq. in. or more on bottom of rod.
	4½ x 5	Only a few rust spots—scattered.
1:3:5 S	2½ x 5	Very small pits of light rust on bottom of rod.
	3½ x 5	Rod only 1¼" from side. Slight rust on near side of specimen.
	4½ x 5	½ sq. in. of rust on lower side of rod.

Tests on January 9, 1918 Age 6 yr. 10 mo.

Mix	Cross Section (in.)	Results
1:1:2 N	1½, 2½, 4½ x 5	No rust.
1:2:4 N	1½, 2½, 4½ x 5	No rust on any rods except in 2 spots aggregating ¼ sq. in. in specimens 4½" thick.
1:3:5 N	1½, 2½, 4½ x 5	Very small rust spots less than ⅛ sq. in., total area on rods 2½" and 4½" thick. Only a couple spots per rod. Other rods in this concrete were all right.
1:1:2 S	1½, 2½, 4½ x 5	All rods corroded; specimens 1½ and 4½ badly rusted.
1:1:4 S	1½, 2½, 4½ x 5	All rods corroded; specimens 2½ and 4½ badly rusted.
1:3:5 S	2½, 4½ x 5	All rods corroded; specimen 4½ was pitted.

RESULTS OF TESTS OF 1923

Tests on September 17, 1923 Age 12 yr. 7 mo.

Mix	Cross Section (in.)	Results
1:1:2 N	1½ x 5	No rust.
1:1:2 N	1½ x 5	No rust.
1:1:2 S	1½ x 5	Cracked before tested. Corroded over one half of surface.
1:2:4 N	1½ x 5	No rust.
1:2:4 N	1½ x 8	No rust.
1:3:5 N	1½ x 8	About 0.1 of surface of rod was rusted, mostly on under side.
1:3:5 S	1½ x 8	About ¼ of surface of rod was rusted 5 pits formed; one about 0.01" dia.
1:1:2 N	2½ x 5	No rust.
1:2:4 N	2½ x 5	No rust.
1:1:2 S	2½ x 5	Corroded.
1:1:2 N	2½ x 8	No rust.
1:1:2 S	2½ x 8	Corroded.
1:1:4 N	2½ x 5	No rust.
1:2:4 S	2½ x 5	Rusted on bottom of rod.
1:2:4 N	2½ x 8	No rust.
1:2:4 S	2½ x 8	Rusted badly on top and bottom of rod.
1:3:5 N	2½ x 5	A rust spot about ½" sq. at one end.
1:3:5 N	2½ x 5	Rusted on bottom in 4 or 5 patches near on end; no pitting. Rust patches almost one sq. in. in area.
1:3:5 N	2½ x 8	No rust.
1:3:5 S	2½ x 8	Rusted.
1:1:2 N	3½ x 5	Practically clean; a few spots under 1/16 inch sq.
1:1:2 S	3½ x 5	Rusted; and pitted slightly in 4 places.
1:1:2 N	3½ x 8	No rust.
1:1:2 S	3½ x 8	Rusted over about 1/5 of surface.
1:2:4 N	3½ x 5	Practically clear of rust.
1:2:4 S	3½ x 5	Rusted slightly over about ¼ sq. in., no pits.
1:2:4 N	3½ x 8	No rust.
1:2:4 S	3½ x 8	Rusted over 2/3 of surface, mostly on bottom.

Tests on September 18, 1923 Age 12 yr. 7 mo.

Mix	Cross Section (in.)	Results
1:3:5 N	3½ x 5	Rusted over ⅛ of area at one end.
1:3:5 N	3½ x 5	Clean.
1:3:5 S	3½ x 5	Rusted over 2/3 area, 3 pits.
1:3:5 S	3½ x 5	Rusted over 2/3 area, 3 pits.
1:3:5 N	3½ x 8	Clean.
1:3:5 S	3½ x 8	Rusted over ½ of area, several pits.
1:1:2 N	4½ x 5	No rust.
1:1:2 N	4½ x 5	No rust.
1:1:2 S	4½ x 5	Rusted over 1/3 or area; pitted in three places.
1:1:2 S	4½ x 5	Rusted over ½ of area; specimen cracked along rod.
1:1:2 N	4½ x 8	No rust.
1:2:4 N	4½ x 5	No rust.

(Concluded on page 112)

THE EVOLUTION OF SUPERPOWER SYSTEMS

By JOHN S. STRONG

Instructor in Electrical Engineering

PART II

(B) Characteristics of the Superpower System

A DISTINCTIVE feature of the development of the electric light and power industry prior to the World War was the isolation and independence of electrical systems. As long as the operations of an electric utility were confined to a single community, its generating and distributing system functioned necessarily as an independent unit; and as the utility built transmission lines and extended its operations to other communities, after the manner pointed out in the preceding paragraphs, it was perhaps natural that its system should continue to operate independently. The service afforded its customers was only as reliable and as cheap as the design, economies, and operating contingencies of the system would permit.

Origin of the "Superpower" Idea

During the war period when manufacturing industries were trying to turn out supplies at top speed, a serious power shortage greatly handicapped at times operations in some regions of the country. The situation became most acute in the eastern section. A large number of the manufacturing establishments were dependent in whole or in part upon the power resources of the particular utility in whose territory they were located. Furthermore, it oftentimes happened that at periods of peak demand on the system of one company there might be generator capacity standing idle in the stations of companies serving contiguous territory. Since but a few interconnections between adjacent systems existed at that time, little cooperative effort in the way of interchange of energy because of diversity of load conditions was possible. In such cases where interconnections did exist, the mutual advantage of one company being able to draw upon the generating resources of another company became at once apparent.

Out of these war-time experiences there grew the realization among engineers that greater economies of operation and improved reliability of service could be secured if the individual transmission networks of the utilities operating in a given section of the country were tied together and the major portion of the load placed upon the larger and more efficient generating stations feeding the interconnected network. The smaller and less efficient stations might then be utilized to carry the peak-load portions of the load of the entire system. Such a scheme enlisted the sympathetic attention of the Federal Government, and as a result there was begun in 1920 a comprehensive study of the power resources and energy requirements of that section of the country lying between Boston and Washington and extending inland from the coast about 150 miles. The investigation was carried on as an activity of the United States Geological Survey of the Department of the Interior, the actual work being done by an engineering staff under the direction of W. S. Murray, a consulting engineer of New York. The results of the study were published in 1921 in a report entitled, "A Superpower System for the Region between Boston and Washington." Thus the word "superpower" came into our vocabulary. Since that time, however, various interpretations of the term have been given. Its implication of a colossal super-structure reared over existing electrical systems has made a striking appeal to the popular imagination; the press has bandied the word about with characteristic sensationalism; and politicians, ever watchful for a new issue, have seen in the idea the machinations of a giant power monopoly octopus.

> **Every time we cheapen power and centralize its production, we create new uses and increase the production; we decrease the burden of physical effort upon men; and we increase the standards of living and comfort of all our people.**
>
> **—HERBERT HOOVER.**
>
> **We are at the threshold of an age greater in significance to humanity than even the hundred years through which we have just passed. We have only begun the use of electricity.**
>
> **—CHARLES P. STEINMETZ.**

The Ultimate or Ideal Superpower System

The superpower system contemplated in the Murray Superpower Report embodies the principles of electrical power production and distribution which are pretty generally regarded today by superpower advocates as being fundamental. While differences of opinion exist as to the steps which must be taken in carrying out the ultimate superpower plan, such considerations need not enter into our picture at this point. Beginning at the top of the structure and working our way downward to the local consumer for whom the entire system is designed to serve more efficiently, we will find first a number of "base-load" generating stations at various points of the particular section of the country which is to be encompassed in the superpower system. Eventually a single superpower network may cover the entire nation, but for the present it is better to be more conservative and to limit the discussion to a single section consisting of a number of states which geographically and commercially form a natural power group. The base-load generating stations will be the large, modern, and highly efficient plants located at economically strategic points. For the greater part, these stations must be steam-electric plants (except perhaps in the far West section where water power is abundant) of several hundred thousand kilowatts capacity and located in many instances in or near the large centers of population and industry, and in other cases at the mouths of coal mines. In addition, such large capacity stations must be situated on lakes or on rivers with sufficient year-around flow to supply quantities of necessary condensing water. For every pound of coal burned, there will be required from 500 to 800 pounds of condensing water. This represents an enormous quantity of water for a large station. The City of Chicago, for example, pumps on an average of 800,000,000 gallons of water per day for all purposes, while the generating stations in that city require 900,000,000 gallons on an average day. Hydro-electric plants located on nearly constant-flow streams, as at Niagara Falls and the proposed St. Lawrence development, will function also as base-load plants. Since the base-load generating stations are to be designed to carry that portion of the system load which is nearly continuous, they will operate therefore at high capacity factors.

Operating at the highest feasible voltage, which, from present indications, would be 220,000 volts, a system of trunk transmission lines will interconnect all the base-load generating stations. The primary function of this transmission network will be to bring the energy generated in the distant base-load stations, such as the mouth-of-mine and the hydro-electric plants, to the large cities or load centers in the superpower area. Secondly, these trunk lines will permit interchange of energy between stations, that is, the shifting of a portion of the system load from one station to another as operating conditions may dictate. Tapping this primary or trunk-line transmission system at the load centers and at the generating centers, there will be a comprehensive secondary transmission system. The lines of this system will be designed to connect with the smaller steam-electric and hydro-electric stations (of which there will be a considerable number), and also to supply energy to large sub-stations at industrial centers and secondary centers of population. This transmission network will operate at lower voltages. Some of the lines may operate at 132,000, others at 110,000, and some perhaps at 66,000 volts.

The secondary transmission system will be tapped at many points by a third transmission network covering the entire region. This latter interconnected network should be regarded more properly as a distribution rather than a transmission system, because its main purpose will be to distribute electrical energy to the smaller cities, villages, and hamlets. It will also make available to the system the energy which can be generated in some still smaller and scattered steam-electric plants and in hydro-electric plants on the smaller variable-flow streams. Some of these water power stations will have automatic control, and others remote control. In this way the development and utilization of many small water powers will become economically possible, which otherwise could never be undertaken. This primary distribution network, as we shall call it, will of course operate at various voltages below those of the secondary transmission lines. Finally, connected through sub-stations to the primary distribution lines, there will be found the local or secondary distribution systems of the smaller cities and villages, and the rural lines which will radiate from the latter.

Requirements of a Power Supply System in an Electrical Age

Such is the picture which the superpower enthusiast paints of the ultimate system for the generation of electrical energy and its transmission to every factory, store, home, farm, and railway. In other words, he visualizes an electrical age characterized by the universal supply of electrical energy to a completely motorized industry, to electrified railroads, to homes fully equipped with electrical appliances, and eventually to an electrified agriculture. If we are to attain to a substantial realization of such an era, two essential requirements must be fulfilled by the electricity supply system. One is a continuous and never-failing supply of electrical energy for every demand, and the other is that this energy shall be available to every consumer at the lowest possible cost. Of all the means so far devised by man, the superpower system is best adapted to meet these requirements. By virtue of its ability to coordinate the utilization of practically all the water power resources of the region with the generation of energy in large and efficient base-load steam plants, and to transmit this energy through a comprehensive and interconnected network to the consumer, the superpower system can afford the maximum reliability of service at a minimum production cost.

Advantages of the Superpower System

The question may be raised as to the grounds for believing that the superpower system can meet the requirements of continuity of service and low cost better than the isolated and uncoordinated systems, each serving limited areas from small generating stations. The reasons are best expressed by considering some of the advantages of the former over the latter. These advantages are so interrelated that any adequate treatment of one must necessarily include some discussion of the others. However, for our purposes here a few brief statements concerning each must suffice.

(a) Lower operating costs of generating stations will decrease the unit production cost of energy. The base load, or that portion of the system load which is nearly continuous, will be carried by the large and efficient steam plants operating at high capacity factors and by such of the hydro-electric plants which have sufficient water over a given period to enable them to run continuously. The smaller and less efficient steam-electric stations and the remaining hydro-electric plants will operate ordinarily only during peak-load periods. Since each kilo-

(Continued on page 107)

BANK PROTECTION ON THE MISSISSIPPI

By C. W. FAUQUHER

THE following article and pictures will give the reader only a general idea of the big task that confronts the Mississippi River Commission and the Levee Boards of the states bordering on the Mississippi in protecting the people and their property from the floods that often occur in the spring. It is surprising, especially to the younger engineers, to learn of the amount of money spent every year by our government through the Mississippi River Commission and the Levee Boards on the "Father of Waters."

Rich, fertile lowlands reach for miles back on both sides of the Mississippi River. This land would not be safe for farming purposes if the Mississippi were allowed to overflow its banks. It was considered a great engineering accomplishment when the levees were completed along both of sides of the river almost continuously from Cape Girardeau (above Cairo, Illinois) to the Gulf.

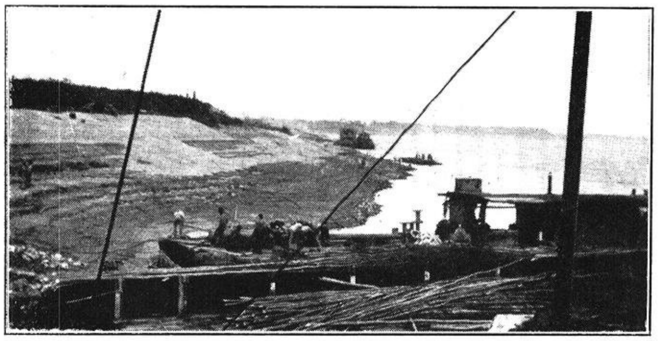


FIG 1. THE "MAT PLANT"

At first the levees were built far back from the river bank, but the Mississippi, flowing mostly through a sandy and loamy soil, has meandered from its original course. Consequently, the bends of the river have been pushed back, and during a flood the river has broken through the levees before anything could be done. But such accidents are few and far between, because of the efficient work of the revetment parties which are put into the field equipped to make suitable bank protection to stop the river temporarily, if not permanently. The pictures are of the work of such a party located in the bend at Knowlton, Arkansas. The work along the Mississippi has proved to be the downfall for many engineers and it requires the continuous efforts of the government, working through the Mississippi River Commission, to hold it within its banks.

A deep channel may be cut into the bank by the changing of the current. This enables the current to either undermine the bank and cause caving, or saturate the soil to such an extent that it will not support the weight of the soil above it and thus cause a settlement. To prevent this erosion and settlement, large channel mats are built on the surface of the river and sunk to the bottom by being loaded with stone. These mats average about 256 feet in width, which ordinarily is wide enough to reach from the water's edge to the middle of the channel. The width is determined in the field by soundings which are plotted to show cross-sections of the river bottom. Where it is not possible to lay the mat close to the bank, small connection mats are constructed between the bank and the large channel mat.

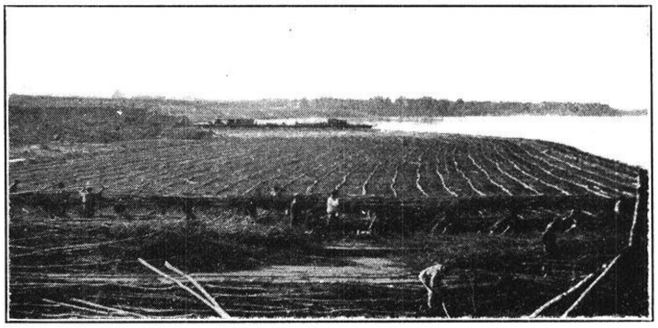


FIG. 2. POLE CRIBS BUILT ON TOP OF MAT TO HOLD STONES IN PLACE

The banks are graded to a three to one slope by two streams of water under high pressure. The water is furnished by a special barge equipped with pumps which deliver water under a pressure of 235 pounds per square inch.

When the first levee was built here years ago, the river was about one and a half miles east of its present location. Since then it has forced the building of three new levee loops, the third having been completed recently. The work that the levee outfits are doing is a large task in itself.

The revetment is strictly a floating organization. The men live, eat, and sleep on three quarter boats, while their work is largely on the mat plant. This "mat plant" consists of a "mooring barge" to which the head of the mat is fastened; a "fascine barge" on which the fascines are built and bound to the mat; and the "crane barge" on which is located a revolving crane to remove brush from the "brush barges" to the fascine barge. This entire mat plant is shown in Fig. 1.

The head of the mat is usually built by binding small poles to a total diameter of about three feet. To this are bound the sewing strands which are strands of wire used to hold the fascines together. The fascines are

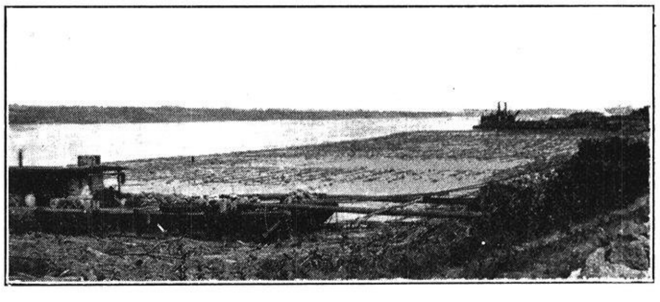


FIG. 3. SINKING THE MAT

made in a rack at the top of the ways and consist of willow poles. Each fascine is allowed to gradually slide down the "ways" by the lengthening of the sewing strands. When the ways are filled, the fascine barge floats from under the mat. In this manner a mat can be built safely to a length of about 1200 feet. However, special precautions must be taken when greater lengths are needed.

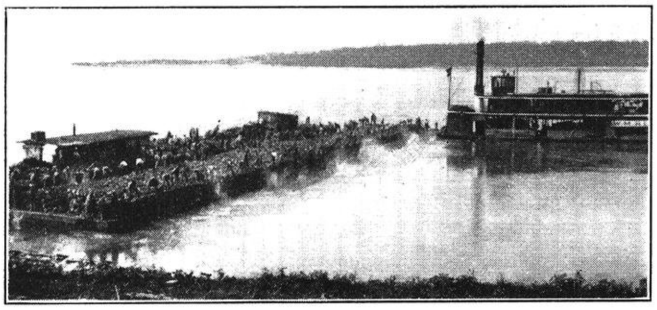


Fig. 4. "Heave That Rack, You ? ! - G.-" — *That's about what you hear all the time.*

After the ways have been filled, the plant is made ready to "swing out" to a position 90° with the bank by pivoting about the lower corner of the mooring barge. The current exerts such a great force on the mat and plant that it is necessary to use eighteen — 1⅛ inch cables to hold them in place.

After the completion of the mat enough stones are placed on it to ballast and sink it as shown in Fig. 3. A crib of poles is built on the top of the mat, as shown in Fig. 2, to hold the stone in place while the mat is being sunk. Stones are thrown onto the head of the mat from the mooring barge until the head is sunk to the bottom of the river. It is then necessary to float two stone barges over the mat. The barges drift downstream and force the mat to the bottom as they go.

I have given you only a general idea of the work. The details are simple enough, but strange to say, it takes an experienced river man to make and sink one of these mats without losing it. This one branch of construction is proving valuable to the people directly affected by it and of indirect value to all of us. The pictures shown were taken during the 1924-1925 season which is about completed.

On March 5, an open meeting of the A. S. C. E. was held in order to give the freshman civils an opportunity to hear Prof. Louis Kahlenberg speak on *The Romance in Civil Engineering*, and also to enable them to get acquainted with the work of the society. Through his narration of inimitable incidents in the lives of great engineers and inventors, reinforced at intervals with keen bits of humor and philosophy, Professor Kahlenberg certainly succeeded in making a positive impression on his listeners.

When Professor Kahlenberg had finished, a short business meeting was held to consider plans for a society float in St. Pat's Parade, and a committee was appointed by the president to create a representative float for the club.

THE RICARDO HEAD

By Bernard Weideman

Senior Mechanical

THE present tendency in the design of the internal combustion engine is toward increased efficiency and economy. To increase the efficiency, it is necessary to obtain more work from a given amount of heat. To increase the economy, it is necessary to reduce the cost of producing a given amount of power. Most economy devices that have been invented are improvements in carburetion, that is, better carburetors and improved pre-heating manifolds. Such devices have done a great deal toward improving the economy of the engine by vaporizing the fuel more completely, but the real solution of increased efficiency is in the combustion chamber, where the heat obtained from the fuel is converted to useful mechanical energy. Only recently an improvement has been made in the design of the combustion chamber which has done a great deal toward increasing not only the efficiency, but also the economy and performance of gasoline engines.

The invention of the Ricardo combustion chamber for L-head engines is credited to Mr. Harry Ricardo of Shoreham, England. The development in this country has been made by the Waukesha Motor Company of Waukesha, Wisconsin, which controls the patent rights in the United States. Its engineers have co-operated with Mr. Ricardo in the experiments which extended over a period of years, and which have led to the final design of the combustion chamber.

The principle underlying the design of the Ricardo head is that the gases will be in a state of increased turbulence prior to and at the moment of firing. In the improved head (see Figure 1.) the agitation is produced during the compression stroke of the piston by forcing the gases into the clearance chamber, the shape of which is such that it causes a swirling or rapid movement of the charge. When ignition occurs within the cylinder, the flame of combustion reaches the farthest end of the effective chamber in an extremely short time, due to the agitation and compactness of the charge, and the favorable location of the spark plug. If a charge is compressed in a cylinder and allowed to come to rest before igniting, it takes about six one-thousandths of a second for the gases to burn and reach the maximum pressure after the spark has passed. In a test on an ordinary engine with a plain L-head, running at 1000 r. p. m., it took actually 0.0051 of a second. With the Ricardo head fitted on the same engine and running at 1000 r. p. m., it took only 0.0038 of a second after the spark had passed, and in this case the charge reached a greater pressure than it did with the plain head. The piston displacement was the same in both tests—398 cubic inches. The clearance volume in the plain head was 39.4 cubic inches, and with the other only 33.3 cubic inches. The compression ratio, therefore, had been increased from 3.53:1 to 4.0:1, and the compression pressure at full throttle from 58 to 70 pounds per square inch. The maximum explosion pressure was approximately 230 pounds per square inch with the plain head, and 280 pounds per square inch with the Ricardo head. From these data, it can be seen that, although the charge per cylinder had been decreased due to the lesser clearance space in the Ricardo head, the explosion pressure had been increased by 50 pounds per square inch, which means that more work was being obtained from less fuel, or in other words, that combustion was more complete.

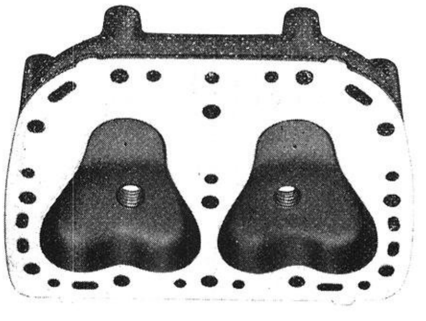


FIG. 2. DETAIL VIEW OF RICARDO CYLINDER HEAD.

Ordinarily with as high a compression pressure as is used with the Ricardo head, pre-ignition of the charge would occur, especially in an engine burning low test gasoline. Pre-ignition is the result of excessive heat in the combustion chamber during the compression stroke. This heat may be localized in some portion of the chamber, or distributed throughout the whole mass of the mixture. If the compression is too great, the temperature will be raised above the flash point of the fuel and ignition will occur. This is usually the fault of incorrect design of the combustion chamber. More often pre-ignition is caused by overheating of one portion of the charge. For instance, a poorly located spark plug may become overheated, and if the mixture is in a quiet state, that portion of the charge in the immediate vicinity of the plug will be heated to a temperature in excess of the flash point. The flame will then spread to the rest of the mixture, and the whole will be ignited before the spark had passed. If the mixture is in a state of turbulence, as is with a Ricardo head, no one portion of the charge can become overheated; instead, the heat is distributed throughout the mixture and ignition will not occur until the proper time. The state of agitation that the mixture is in while being compressed, therefore, has the effect of allowing higher pressures before ignition, even at full throttle.

To operate an engine of the ordinary type efficiently, a wide variation of the spark is necessary. The Ricardo head engine, due to the more rapid burning of the fuel, can operate more efficiently with less variation, as is shown by the test data which follow:

Plain head:		Ricardo head:	
r. p. m	**Degs. adv. of spark**	**r. p.m.**	**Degs. adv.**
600	15	600	10
800	21	800	15
1000	23	1000	17
1200	26	1200	18

The more rapid combustion of the fuel, the decreased danger of pre-ignition, and a smaller spark variation, have resulted in a noticeable increase in acceleration and a much smoother operation of the engine.

The overhead valve type engine has always been considered as the most efficient, because of the favorable location of the valves, and the compactness of the combustion chamber. The L-head engine, however, equipped with a Ricardo head surpasses the efficiencies previously credited to the overhead type. The following table gives a comparison between the two types of heads:

COMPARATIVE EFFICIENCIES OF OVERHEAD AND RICARDO L-HEAD—

	b. h. p.	i. h. p.	Lb. fuel per b. h. p. hr.	Lb. fuel per i. h. p. hr.	Thermal eff. Brake	Ind.
Economy setting (1000 r. p. m.)						
Overhead	47.9	54	.634	.561	.223	.252
Ricardo L-head	45.8	54.5	.545	.457	.260	.310
Power setting (1000 r. p. m.)						
Overhead	48.4	54.5	.651	.577	.218	.246
Ricardo L-head	50.6	59.4	.625	.534	.226	.266

A well designed Ricardo head will increase the power and efficiency of an engine. To obtain this increased efficiency, more heat must be changed to useful work and less lost through radiation. With the increased compression, it is apparent that the maximum temperature attained during combustion will be higher than with an ordinary head. Nevertheless, it has been found that the exhaust gas temperature has decreased. In the $4\frac{1}{2} \times 6\frac{1}{4}$ engine that was tested, running at 1000 r. p. m., the final exhaust temperature with the plain head was 1460° and with the Ricardo head only 1370°, or a decrease of 90° F. This difference does not mean that more heat has been lost by radiation, because in an ordinary L-head motor, the amount of heat expelled through the cooling water is 100 b. t. u. per minute per horse power while with the improved head this amount has been decreased to 85 b. t. u. per minute per horse power. These differences show, therefore, that more work is being obtained from a given amount of fuel, or that the thermal efficiency has been increased.

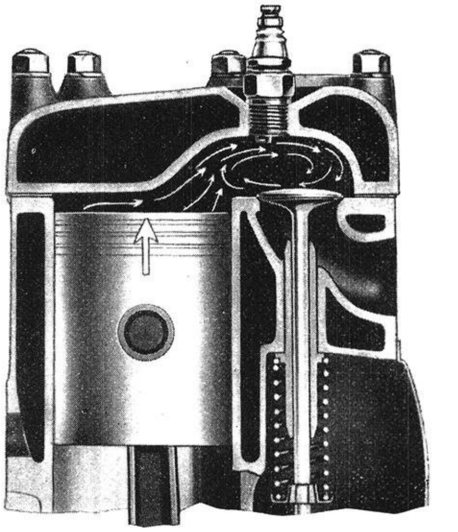


FIG. 1. RICARDO HEAD IN PLACE.—*View shows relative positions of spark plug, valve, and piston. Note circulation of gases as shown by arrows.—Courtesy of Waukesha Motor Company.*

(Concluded on page 109)

THE ARTIFICIAL SILK INDUSTRY

By Milton J. Shoemaker, ch '21

Engineer, Du Pont Fibersilk Company

Among our younger chemical industries the manufacture of artificial silk has rapidly become of tremendous importance. Developed originally in Europe, the established methods have not been fundamentally changed by American producers who have, however, with typical energy entered upon mass production. Today the United States has the largest artificial silk plant in the world and produces about 40% of the silk made. Nevertheless the United States still imports artificial silk.

Commercial production started in this country in 1910 at Marcus Hook, Pa. The industry has been remarkably prosperous, and artificial silk is now being manufactured in thirteen factories, at the rate of approximately 45,000,000 pounds per year. Nearly all these plants are enlarging, three new plants are under construction, and at least four new companies contemplate entrance into the field.

An idea of the rapid growth in the United States can be gained from the following data:

Year	Production in pounds
1910	?
1911	320,000
1912	?
1913	1,566,000
1914	2,445,000
1915	4,111,000
1916	4,744,000
1917	6,687,000
1918	5,828,000
1919	8,000,000
1920	9,000,000
1921	18,000,000
1922	26,000,000
1923	35,490,000
1924	41,600,000

This growth is due to the great demand for silk and the cheapness of artificial silk. While it is chiefly used in satins, underwear, hosiery, braid, etc., new uses are constantly being discovered. Compared to other fibres it is not artificial but a fibre with distinct and original properties. For this reason the name "Rayon" has recently been coined for artificial silk. True, its strength is inferior to that of real silk, but its lustre far surpasses that of any other product. Novel effects are to be obtained by mixing artificial silk and wool. In hosiery extreme lustre is undesirable so that some manufacturers are now selling silk with very little lustre.

Artificial silk readily takes direct dyes, and considerable skill is required to get an even shade throughout piece goods of mixed fibres; ie., silk and cotton, etc. It has the undesirable property, however, of becoming temporarily weaker while wet.

Artificial silk is made by four processes: viscose, nitrocellulose, acetate, and cuprammonium. The first process is by far the most important one. Viscose is an aqueous solution of sodium cellulose xanthate, discovered by Cross and Bevan in England in 1892. A year later the inventors endeavored in vain to sell the American patent rights for $50,000. During the early part of the century various attempts to make artificial silk were made by such men as Waite, Chorley, and Ernst who later were destined to play the leading role in the development of the American artificial silk industry. Several companies were formed, but none were successful; meanwhile in Europe rapid progress was being made. Where formerly silk was spun upon rotating bobbins, and subsequently twisted, Topham adapted the centrifugal spinning machine, formerly used to twist asbestos twine, to the production of viscose silk. Stearn evolved suitable coagulating baths at Kero Gardens, England. These two men developed the metallic nozzle usually made of an alloy of gold and platinum. Clayton contributed a two cylinder piston pump with positive delivery very accurately controlled to force the viscose through the nozzles or spinnerets into the coagulating bath. Prior to this time gear pumps had been used with resulting uneven weight of threads. Napper discovered the valuable use of zinc sulphate in the coagulating bath, although Margosches in his "*Die Viskose*" had described the properties of zinc xanthate, which is probably formed in the spinning process, many years previous to Napper's patent of 1912.

With this wealth of European knowledge an English concern started production on a commercial scale in this country in 1910 as explained above. Since then many minor improvements have been made by Americans.

While the exact process used in the manufacture of viscose silk has not been disclosed due to the fact that a shroud of secrecy is carefully maintained by silk producers it is possible to give a brief outline of the viscose process.

Viscose is usually prepared from bleached sulphate spruce pulp and sometimes from cotton linters. Sheets of these materials are steeped in caustic soda solution of proper strength and temperature for a definite time. The batch of pulp is then squeezed to the desired weight, shredded, and ripened for several days. The alkali-cellulose, as it is now known, is then xanthated by treating with carbon disulfide in a closed container. Following this the mass of xanthated alkali-cellulose is dissolved, filtered, ripened, and spun by either the bobbin or the bucket process. In either case the silk must be subsequently washed and dried. It is usually put on the market in the form of skeins.

Little more exact information is to be gained from the literature since most of this is written by people

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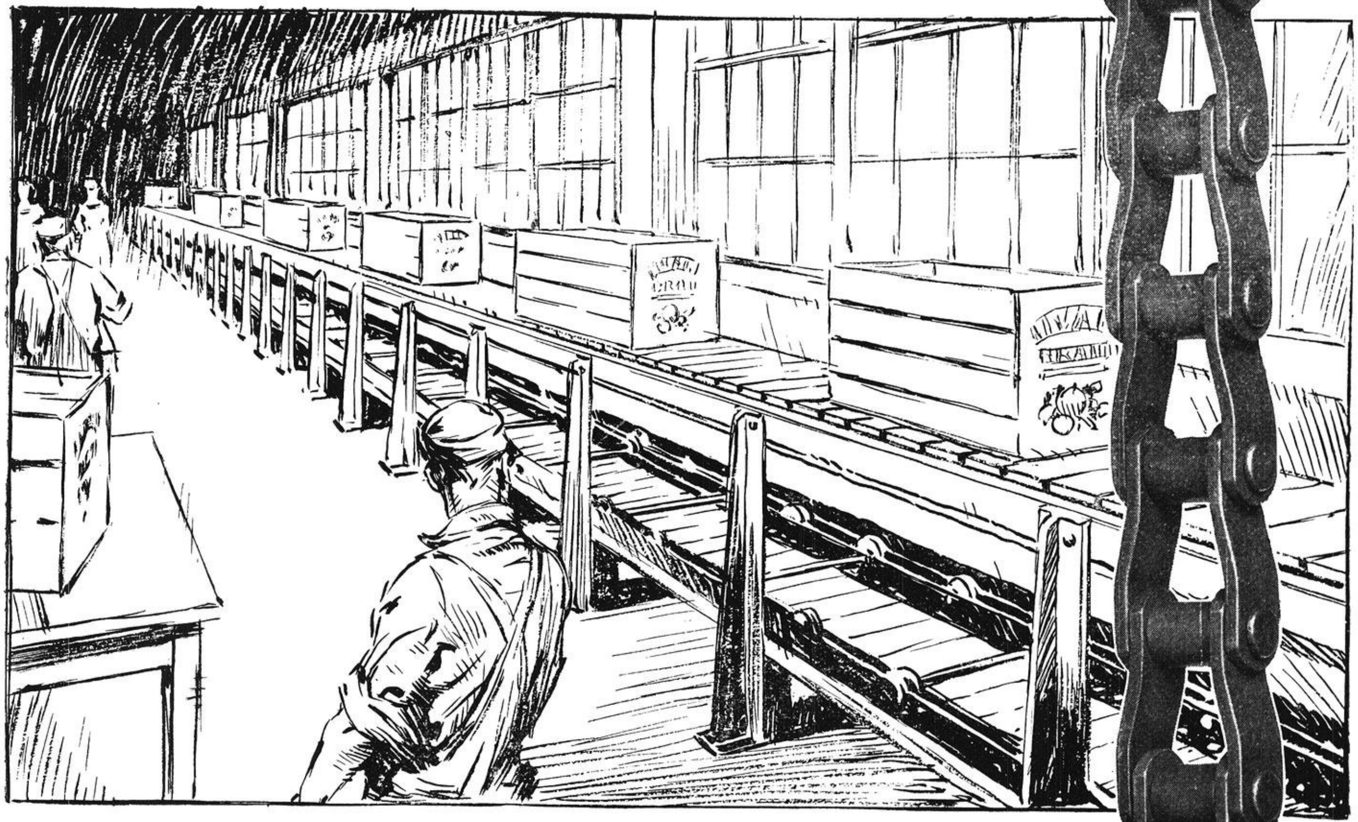
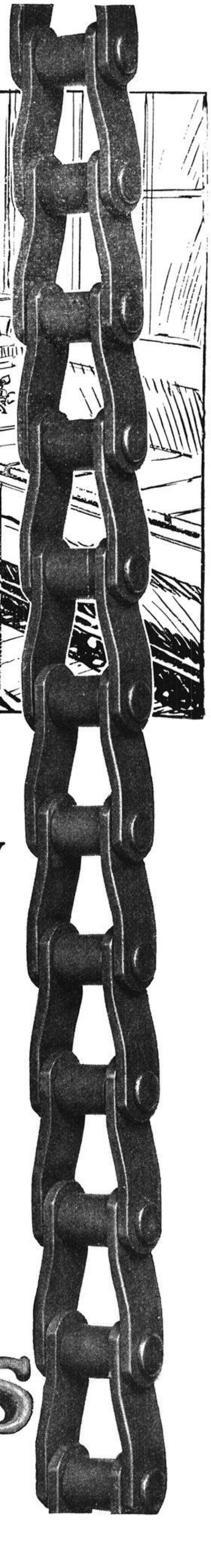




At the Forefront of an Expanding Industry

THE outstanding development of American Industry during the past decade has been the progress of mechanical handling of materials.

Necessitated first by the demands of quantity production and the rising cost of labor, it was given additional impetus by war conditions and the later curtailment of immigration.

Great as the progress of mechanical handling has already been, it is still in its infancy. The possibilities of its expansion seem to be unlimited, as there is scarcely an industry today that does not realize the advantages of dependable, always-on-the-job conveying machinery.

The Chain Belt Company was a pioneer in the mechanical handling field. Many of the outstanding improvements in material handling equipment have been designed, engineered and built by it.

Rex Chain, Rex Transmission Machinery, Rex Concrete Mixers and Pavers, Rex Water Screens

REX CONVEYORS

CHAIN BELT COMPANY

EVOLUTION OF SUPERPOWER SYSTEMS

(Continued from page 102)

watt-hour of energy generated by water power will conserve between 1 and 2 pounds of coal, it is evident that as much of the load as possible will usually be shifted to the hydro-electric plants. Hence the operating portion of the production cost of their energy will be comparatively small. Furthermore, since the base-load steam generating stations will operate at high capacity factors, under which condition they give the highest efficiency, the operating cost of their energy will be somewhat less than if this same energy were generated in smaller and less carefully designed plants operating at low capacity factors. Thus the superpower system, by virtue of its ability to coordinate the power resources of its territory, can furnish energy at lower operating costs.

(b) A much improved daily as well as yearly load factor results from the wide diversification of consumption over a large area. There will be diversity in demand between industries of different kinds, between industries and traction systems, and between communities east and west due to differences in time. The yearly load factors of utilities serving large cities, or many small towns over a limited area, generally lie now between 40 and 50 per cent. In other words, their generating capacity is standing idle more than 50 per cent of the time. A better load factor will keep the investment in generating equipment and transmission lines working a larger percentage of the time. Consequently, through the lowering of fixed charges per unit output, the production cost should decrease.

(c) A smaller reserve of generating equipment is required to meet the peak demand of the system and to provide for emergencies. This advantage is a direct result of the conditions leading to an improved load factor. The total investment in generating equipment for the superpower system is by no means the sum of the investments which independently operated utilities, serving the same area, would be required to make. As a rough estimate, it can be said that in present systems one-third of the generating capacity furnishes ten per cent or less of the total kilowatt-hour output.

(d) The fullest practicable utilization of the water powers of variable-flow streams becomes possible. At times when there is plenty of water, a portion of the load carried by the steam stations would be shifted to the hydro-electric plants on these streams. At low water periods, the latter plants would operate only at those times of the day when the system load becomes heavy, using if necessary water which had been stored in reservoirs during the remainder of the day. By these same means, it becomes possible to utilize more fully the streams of different watersheds having a diversity of run-off conditions.

(e) A greater reliability and security of service will result from a large interconnected transmission system with generating stations located at various points. Through the coordination of mouth-of-mine steam plants, plants located in centers of population, and hydro-electric plants, the possibility of interruptions in service from coal strikes, transportation difficulties, plant breakdowns, and transmission line failures is materially reduced.

How Superpower Systems are to Become a Reality

The superpower system which has just been described should be regarded as the goal toward which past and present developments in the electric light and power industry are the stepping stones. Probably no person would be extreme enough to recommend that during the next five years, for instance, that most of the present generating stations, their equipment, and the transmission lines be relegated to the scrap heap, and in their places be built large and modern stations and high voltage transmission lines according to the ultimate superpower plan. If for no other reason, such a procedure would be an economic impossibility. Some people, however, do suggest that the State embark upon a program of building base-load generating stations, particularly hydro-electric plants, and trunk transmission lines to carry the energy to the existing utilities, which would function then principally as distributing agencies. Or differently stated, it is proposed that the State control what might be termed the superstructure of the superpower system.

But the most natural method, it would seem, of attaining the ultimate snuperpower plan is by the orderly and regular processes of evolution. In the preceding section of this discussion on developments within the electric light and power industry, the intention has been to bring out and emphasize the fact that the present state of the industry has been reached by the evolutionary process. It has been a step-by-step advancement. Superpower must be realized by this same process of evolution.

Present Superpower Construction

It may be a matter of interest to note here a few of the steps now being taken by the electrical industry to develop the superpower plan. In our Middle West region many base-load steam-electric plants of the superpower type are being built, and others are planned. The following generating stations are of that type: Trenton Channel on the Detroit River near Detroit; Miami Fort on the Ohio River near Cincinnati; Dresser, a mouth-of-mine plant on the Wabash River near Terre Haute; Cahokia on the Mississippi River across from St. Louis; Peoria on the Illinois River at Peoria; Crawford Avenue on the Drainage Canal at Chicago; Waukegan on Lake Michigan at Waukegan; and Lakeside on Lake Michigan at Milwaukee.

In the same region there are several transmission lines, either already built or under construction, which must be regarded as eventually becoming a part of the superpower system in the Middle West. Some of these may perhaps function as trunk lines of the primary transmission system, others perhaps as parts of the secondary transmission system. The following might be mentioned in this connection: the 132-Kv. lines north

(Concluded on page 109)

EDITORIALS

S. G. Sargis

HELP YOUR UNIVERSITY. An opportunity has come to the students such as may never occur again to help the university during its most serious crisis. Anyone who has read the articles by the President of the Board of Regents will realize the predicament that the university will be in if the proposals before the legislature are enacted into law. These proposals, in so far as they pertain to funds for operating the university, would mean the shutting down of departments and curtailing otherwise the activities of the university, to say nothing of preventing any expansion in the near future. In so far as the building situation is concerned the proposals would mean that during the next biennium the university would have funds merely for an addition to Bascom Hall; and the other building needs which have been piling up, particularly since the late war, would go unrecognized for at least two years more. These possibilities should arouse every loyal student to immediate action. Let us not stand by and await the outcome, but let us join our alumni and try to effect the outcome by bringing home to the people of Wisconsin the real state of affairs. Few people realize that the University *earns* over 46% of its total receipts, and that of the total amount spent, over 33% is spent in direct public service to the state and *not* for campus needs. Few people know that the number of students enrolled has increased nearly 200% more than class room space since 1901. These and other facts as well as other valuable achievements of the university should be advertised and in some measure discount the wild and untruthful rumors which have recently been circulated, degrading the good name of our university and creating a false impression. The students' part in this campaign is clear. Any efforts in this connection will result in a beneficial return which can be shared directly by them. In a comparatively large measure the prestige and regard which others hold for us is measured by the prestige and regard with which our university is held. To let that prestige drop at a time when we can avoid it is overlooking our duty just as much as if we failed to take the proper precaution to insure ourselves against any of the usual tasks of life. The Board of Regents, the President, and the Business Manager, cannot alone cope with the present situation. They must have the backing of the alumni and students and other friends of the university. The alumni have responded nobly to the call for help without much urging. The students should likewise respond since the matter affects them more seriously than any other class.

In what way can we help? We can do it in either of the following ways: Secure the Alumni handbook and mail it to interested people in your home community; become familiar with the facts and acquaint your home folks with them. Write your representative in the legislature and indicate your stand. To those who can afford it send contributions, (of at least one dollar), to the Alumni Loyalty Fund, F. H. Elwell, Treasurer, 828 State Street, to aid in the sending out of the Alumni Handbook, which sets forth in detail the facts concerning the university, to the people of the state. There should be little hesitancy on the part of the students to help. The problem is theirs, and consequently it is a duty to be fulfilled to act at once and aid in maintaining the prestige and fame of Wisconsin.

Rogues differ little. Each began first as a disobedient son. —*Chinese Proverb.*

OVERCOMING PREJUDICE The world is full of argument. Much of it could be avoided through a sympathetic understanding of the experiences of others. No one can argue successfully until he has considered the interests of others. Every person or group is influenced by some tradition or interests. These interests are desires, many of which are selfish, but many of them are due to force of circumstances. We should take cognizance of all facts and by means of persuasion pierce the bias of each group in an argument by showing a knowledge of their point of view. Fairness, generosity, and practicability should be exercised. We cannot always have our own way. Most decisions after all are results of compromises on the part of those concerned, but those persons derive the greatest good from them who have pushed their ideas vigorously in the knowledge of their opponents point of view. They are not given to unsound arguments or to false proportions, neither do they stand out for trifles. A world free from prejudice is of course impossible, but our own individual happiness may be made more secure by eliminating bias as much as possible in our dealings with others no matter what field we pursue.

There are three perons who should never deceive: your physician, your confessor, and your lawyer.
—*Walpole.*

The first and simplest emotion which we discover in the human mind is curiosity. —*Burke.*

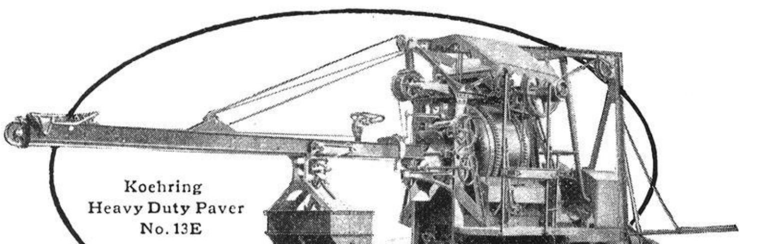
Stamina and Dependability

A concrete mixer receives about as hard usage as any machinery designed—and a great deal harder than most.

The record of the Koehring Paver shown above may, therefore, appear unusual. This mixer, purchased in 1913, has been in continuous use for 12 years and today is ready to begin another full season's work. The total repair bill to date is $300.00.

Koehring Pavers and Mixers are the accepted equipment wherever concrete roads are built and construction work carried on.

"Koehring Heavy Duty" is a phrase the significance of which is understood and appreciated wherever construction equipment is used. It is synonymous with equipment of the highest grade of manufacture, built to deliver maximum operating service over a period of years.


Koehring Heavy Duty Paver No. 13E

KOEHRING COMPANY
MILWAUKEE WISCONSIN
Manufacturers of
PAVERS, MIXERS—GASOLINE CRANES
DRAGLINES, SHOVELS

EVOLUTION OF SUPERPOWER SYSTEMS

(Concluded from page 107)

from Milwaukee to Plymouth, and south to Racine; the 132-Kv. line from Waukegan to Evanston, which in the near future will become a part of the high-voltage ring around Chicago and south to Joliet, and thence east to Gary; the 132-Kv. line from Dresser, near Terre Haute, to Indianapolis; the extensive 132-Kv. lines in Ohio; the 120-Kv. ring around Detroit; the 110-Kv. lines from hydro-electric plants on rivers in northwestern Wisconsin to St. Paul and Minneapolis; and the 110-Kv. loop around the latter two cities.

The present transmission network, such as was shown on the transmission line map of Wisconsin, will function in connection with the superpower plan principally as the primary distribution system. A few of these lines will doubtlessly serve as part of the secondary transmission system, but the greater portion of them, with many more to be built, will make up the great interconnected network which is to make available to every village and hamlet the entire power resources of the region. To function properly, this network must be well interconnected. This interconnection is now going on very rapidly all over the country. Large interconnected networks already incorporate into one system the individual systems of many companies. In the southeastern section of the country, seven independent companies are interconnected into a single system over 600 miles long, which covers the larger parts of the states of Tennessee, Alabama, Georgia, and the Carolinas. On the Pacific Coast there is, with the exception of two gaps of a few miles length, an electrical highway from the Canadian to the Mexican borders. In the Middle West it is now possible to trace through an unbroken chain of transmission lines across an entire state, and in some instances across two states. Of course a large number of these interconnections are as yet limited to the interchange of relatively small amounts of energy, but larger capacity interconnections are following as rapidly as required for use.

The advantages of interconnections between present systems of different utilities are to a large degree those previously mentioned for the superpower system. In fact it would seem that in practice superpower is more a matter of degree than a final goal to be reached ultimately. The construction of large capacity, highly-efficient, steam-electric stations, the erection of high voltage transmission lines, and the interconnection and extension of existing transmission networks are the steps that are beginning to make the superpower system a reality today.

Necessity of Expansion According to a Definite Plan

Since many different and independent utilities operate properties within a given region, and since their systems are rapidly expanding and new stations and transmission lines are continuously building to meet the demands of growth in energy consumption, it is necessary that this expansion of systems and the new construction be carried on along the lines of a comprehensive and coordinated plan. The working out of the more general features of such a plan, to say nothing of the details, requires considerable study of the present industrial and economic trends in the region and the prediction of its future load distribution. Such studies are being carried out in various sections of the country. In our Middle West section, the Great Lakes Division of the National Electric Light Association, through its Power Survey Committee, is now engaged in such a study. The results of this investigation are expected to form the basis for a program of expansion which will best coordinate the power resources of the area with its future energy requirements.

HETCH HETCHY WATER SUPPLY

(Concluded from page 98)

Such is the history of the Hetch Hetchy Project up to the present time, January 20, 1925. The project including all of its dams, power houses, tunnels, etc., is of no little magnitude; and hence no definite answer can be given as to its time of completion. In order to finish the project as originally planned, more money will be necessary. The people of San Francisco are very anxious to own their own water supply and power. The people voiced a "twenty against one" vote for the last bond issue ,and there appears to be little doubt but that the project will be completed.

THE RICARDO HEAD

(Concluded from page 105)

The form of the Ricardo combustion chamber now being used has been worked out experimentally to produce exactly the right amount of turbulence and compression to give the rate of combustion which develops the greatest power with the least amount of fuel consumption without causing any roughness in the engine. The discovery of the methods of producing added turbulence in the combustion chamber is important because of the better performance and higher efficiencies made possible. Up to recent years, so far as intentional design for the purpose was concerned, turbulence was neglected by all, yet as a matter of fact it is the thing that makes modern engines at all possible. Turbulence and combustion chamber design are the first factors of importance in all engine designs.

A Central Student Employment Office has been established in the Administration Building by the Regents of the University. The bureau is maintained at no charge to students or to employers; students desiring work, part time or odd jobs, are asked to communicate with Miss Alice V. King, who is in charge of the office.

E. B. Roberts of the Westinghouse Electric Company spoke to a combined gathering of the A. S. C. E., A. S. M. E., A. I. E. E., and A. S. Ch. E. in the auditorium of the Engineering Building, March 6, on the topic *Choosing Your Job.*

ENGINEERING REVIEW

J. P. Smith

POWER SURVEY OF SNAKE RIVER, IDAHO, REVEALS OVER A MILLION HORSEPOWER AVAILABLE

The west will not suffer for want of water power as long as streams such as the Snake river continue to flow. A recent survey made by the engineers of the Department of the Interior and published by the Geological Survey shows that over a million horse power is awaiting development.

The work includes a survey of the banks and bed of the Snake river and the adjacent country from Lewiston, Idaho, to Huntington, Oregon, a distance of 187 miles, along with a detailed survey of five dam sites. In this distance the river falls 1,321 feet. In connection with this survey a study of the possible dam sites was made by W. G. Hoyt who found fifteen undeveloped power sites at which, with the present flow, 1,430,000 horsepower can be developed for 50 per cent of the time and 861,000 horsepower for 90 per cent of the time. With regulated flow and complete irrigation development 1,080,000 horsepower can be developed for 50 per cent of the time and 750,000 horsepower for 90 per cent of the time.

The development of the available power sites on this river would require some of the greatest dams in the world. Power would be carried by high voltage power lines westward to the Pacific coast and eastward to the Mississippi valley. The complete report of the survey and investigation can be obtained from the publications of the United States Geological Survey. The only thing needed now is a good market for this power.

ARCTIC POWER

Thirty miles above the Arctic circle on the Glomfjord there is a $5,600,000 Norwegian state hydro-electric plant. This plant is equipped with unusually large generating sets and has several features which the ordinary plant does not have.

The power house is on the sea coast. At a height of 1,542 feet above it, a collecting bay delivers the water to two penstocks leading to the plant. Instead of the usual one or two valves, there are three at the upper end of each penstock, insuring the safety of the station in case of pipe failure. Room is provided within the power house for four turbines.

The power house contains three Peilton double runner type turbines, the largest of which is rated at 27,500 horsepower. In contrast with the usual high speed turbines operating at high heads these are built to operate at 330 r. p. m. The diameter of the runners on the largest turbine is 11 feet, and each runner carries 20 buckets of two feet width. The complete rotor weighs 35 tons. A ten inch jet issues from each of the nozzles. The highest efficiency that has been obtained with the turbine is 88.2 per cent.

The turbines are coupled direct to 15,000 volt, 25 cycle generators. The generators are rated at 20,000 K. W. at 80 per cent power factor. They are completely enclosed and are fan ventilated. The largest generator is 22 feet overall, and weighs 225 tons. The stator rests on rollers in the generator pit which makes it possible to revolve the machine and replace burned out coils.

The power is sent out over two three-phase transmission lines at 15,000 volts. The lines are carried on steel towers to Naesne where it is used for municipal purposes.

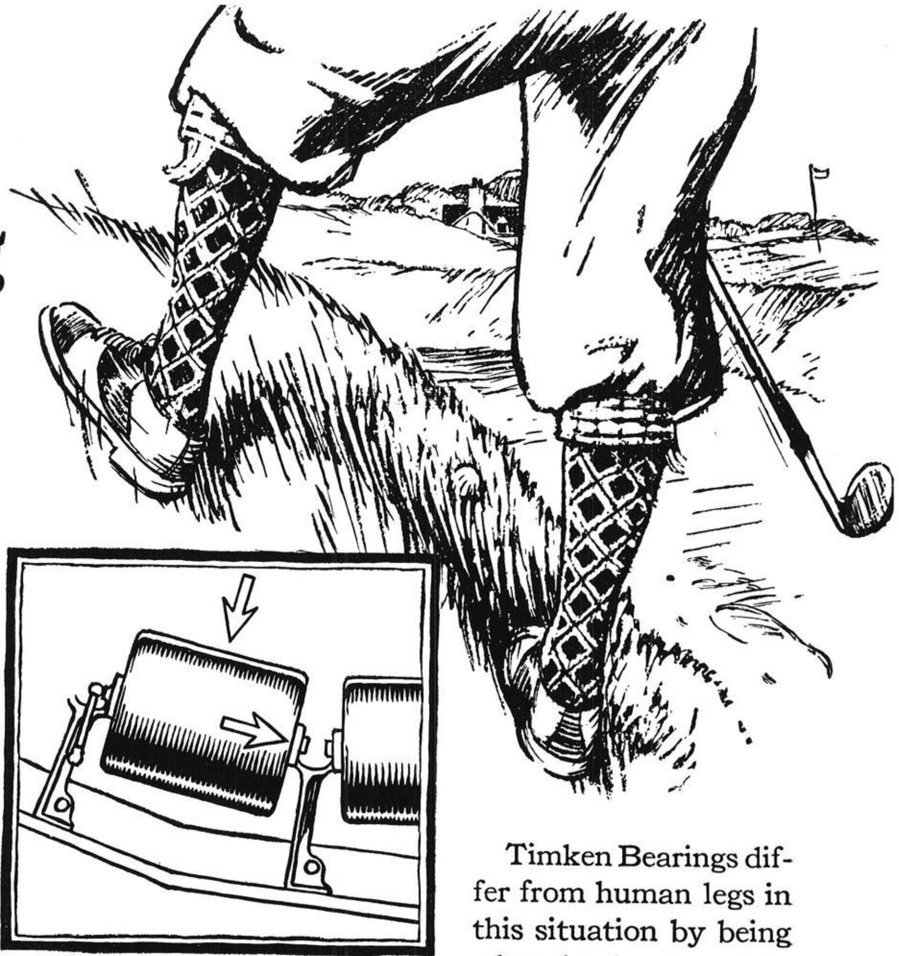
GOVERNMENT CONTROL OF RAILROADS COSTS $1,674,500,000.

In a final report of adjustment of the claims of all railroads whose property was taken over and actually operated by the government during the world war period of government control, James C. Davis, Director General of Railroads, says that the total cost to the government was $1,674,500,000. Of this amount, the loss sustained by the Government during the period of Federal control between December 31, 1917, and February 29, 1920, was $1,123,500,000. The expenses of the six months guaranty period as promised by the government were $536,000,000. The amount required to reimburse small deficit roads (short lines) under the provisions of Section 204 of the Transportation Act, is estimated to be $15,000,000. These amounts are determined by the Interstate Commerce Commission. All losses and settlements were paid without litigation.

Truth is the foundation of all knowledge and the cement of all societies. —Dryden.

Good manners are a part of good morals; and it is as much our duty as our interest to practice both.
—Hunter.

Which Leg Gets the Weight?



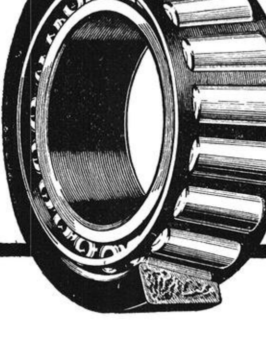
In time, Nature would answer this question. Make a habit of standing in this posture, and your right hip would become larger, due to the added muscular development.

There are conditions in industry when wheels and pulleys must operate under conditions similar to those of the body in this position. One example is found in the pulleys of a troughing conveyer—particularly those pulleys which run at an angle. In addition to the straight up and down load resting on the bearings, there is a definite *thrust* load that also must be carried.

Timken Bearings differ from human legs in this situation by being *already developed* to carry continuously such loads. They are designed for intermittent thrust loads and for permanent thrust loads. The Timken tapered principle is the explanation.

From whatever angle the load comes—whether straight up and down, or from a side—it is evenly distributed over the entire length of the rollers. Hence the long wear. Hence, too, the wide use of Timken Bearings in every field of industry.

The Timken Roller Bearing Company
CANTON, OHIO



TIMKEN
Tapered
ROLLER BEARINGS

ALUMNI NOTES

R. T. HOMEWOOD

The sixth edition of Gebhardt's "Steam Power Plant Engineering", well known as one of the best authorities in its field, was written in part by G. B. Warren, m '19, W. E. Blowney, e '20, and M. K. Drewry, m '22. It is interesting to note that all of these men graduated less than six years ago. All of them are former editors of the Wisconsin Engineer.

The Engineering Society of Wisconsin held its seventeenth annual convention here February 19, 20, and 21. Among the men who were here for the sessions were:

A. H. Gladden, c '19, with the Wisconsin Vilrolithic Service Co., Milwaukee, Wis. His home address is 222 E. North St., Appleton, Wisconsin.

D. S. Fowler, c '17, consulting engineer at Watertown, Wis. His home address: 500 Western Ave.

H. J. Kuelling c '08, design engineer, Madison, Wis.

Henry Traxler, c '10, City Manager, Janesville. Home address 429 Prospect.

A. H. Withington, c '13, Assistant City Engineer, Janesville. Residence 1513 Corrington St.

Robert M. Connelly, c '16, city engineer, Appleton, Wis. Residence 62 Bellaire Ct.

E. E. Parker, c '07, City Engineer, Madison.

W. G. Caldwell, c '10, Consulting Engineer, Waukesha, Wisconsin.

A. L. Hambrecht, c '10, Division Engineer, Wisconsin Highway Commission. Residence 2248 Rowley Avenue, Madison.

W. P. Hirschberg, c '01, Designing Engineer, Milwaukee. Residence 397 Summit Ave.

F. W. Ullins, Jr., c '11, Engineer of Sewers, Milwaukee. Residence 1305 Cramer St.

L. J. Marquardt, C.E. '12, Engineer Forest Products Laboratory. Residence 12 Lathrop St., Madison.

G. W. Trayer, c '12, Forest Products Laboratory. Residence 631 Langdon St., Madison.

Robert M. Smith, c '13, City Engineer, Kenosha, Wis.

Karl L. Zander, c '23, Assistant City Engineer, Kenosha, Wisconsin.

CHEMICALS

Rolland Soll, ch '24, is metallurgist in charge of electric furnace and laboratory for Oklahoma Steel Casting Co., Tulsa, Okla. His address is 317A W. Third St., Tulsa, Okla.

CIVILS

Harry Breimeister, c '24, is with the City of Milwaukee, engaged in some preliminary work on an addition to the North Point pumping station. He announces the birth of a son last summer. His address is 829 Sixteenth St.

Louis Burns, c '05, is a member of the firm Burns & Haley, Inc., Watertown, N. Y. The firm is at present completing their fourth Hydro-Electric Power development.

D. P. Dale, C.E. '17, has moved to 1717 Rollins, S. E., Minneapolis, Minn.

Jerry Donohue, c '07, has been elected president of Sheboygan Association of Commerce for 1925. He has a consulting engineer's office in that city.

Edward K. Smith, C.E. '14, will be associated with the highway bureau of the Portland Cement Association with headquarters at Chicago after February 15. He has resigned as assistant city engineer of Beloit.

Lawrence L. Stebbins, c '24, recently changed from New York Telephone Co. to the Ferber Construction Co., building contractors in Hackensack, N. J. His work will consist of estimating, buying, and some designing and drafting. His address is 136 Weaver Ave., Bloomfield, N. J.

Lionel C. Tschudy, c '23, is doing concrete inspecting work for tunnel lining at Groveland, Calif. His address is Big Bear Camp, Groveland.

K. E. Wagner, c '10, has changed his address to Builder's Exchange, Rose Bldg., Cleveland, Ohio.

Omar White, ex.c '25, was married at high noon on February 3, to Miss Florence Palmer '25, at the home of the bride's parents in Madison. The bridal pair spent a most enjoyable honeymoon at Bungalowen, Professor Owen's cottage on the far side of Lake Monona; there they remained stranded until Sunday noon, when the blissful two were brought to Madison by Professor Owen.

ELECTRICALS

R. W. Brewer, e '21, is power engineer with the Pennsylvania Power & Light Co., Williamsport, Pa. His address is 860 Park Ave., Williamsport.

H. H. Fuller, e '15, is assistant engineer for the United Electric Light & Power Co., 56 Cooper Sq., N. Y. City. He lives at 235 E. Twenty-sixth St., Brooklyn, N. Y.

Charles Goldammer, e '17, writes that he has just purchased the Schwartz Hotel at Elkhart Lake, Wis., one of the largest summer resorts in the state. He is going to run it himself. Goldammer was business manager of the Engineer back in '17.

Elmer Goldsmith, e '15, of Engineer's Officers Reserve Corps is with Lockwood and Lockwood patent lawyers of Indianapolis and Los Angeles. He has been assigned as officer in charge of the Patent Unit in the Administrative Branch of the Procurement Section, Supply Division, in the office of the Chief of Engineer.

Hendrick J. Gregg, e '24, has moved from 1475 Race St., to 1464 Marion, Denver, Colo.

MECHANICALS

Walter Alexander, m '97, M.E. '98, was elected vice-president of the Milwaukee Kiwanis Club for the present year.

F. A. Buese, m '22, is assistant to industrial engineer for Burson Knitting Co., Rockford, Ill. His residence address is 212 N. 4th St.

R. O. Commer, m '08, is with the General Chemical Co., New York. His adress is 10135 Lefferts Ave., Richmond Hill, Long Island, N. Y.

Rufus S. Phillips, m '23, announces his engagement to Dorothy L. Johnson '24, Omaha, Neb. Mr. Phillips is instructing at the University.

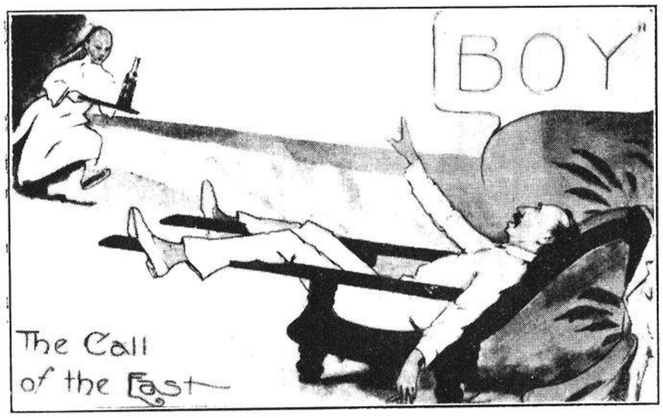
H. Dana Taylor, m '21, gives his address as 314 N. Dean St., Schenectady, N. Y.

Richard Trotter, m '24, has enrolled in the shop management section of the Graduate Student Course offered by Westinghouse Electric Co., at East Pittsburgh, Pa.

MINERS

C. C. Gladson, min '24, has resigned his position as instructor in the New Mexican Military Institute, and is now in the sales department of the Ladish Drop Forge Co., Milwaukee.

Everet W. Jones, min '23, has left the Western Electric Company where he was doing metallurigical research, and has entered the employ of the John A. Manning Paper Co., Ithica, N. Y.



R. G. Marquez Giving "The Call of the East"

R. G. Marquez, min '23, is at Malaujas, Philippine Islands.

A. T. Newell, min '15, is superintendent of kilns and acid plant of United Zinc Smelting Corp. His address is P. O. Box 40, Moundsville, W. Va.

Otto L. Sickert, min '22, has been made sales manager for the Ladish Drop Forge Company, Milwaukee.

RUSTING OF REINFORCING STEEL

(Concluded from page 100)

1:2:4 N	4½ x 5	No rust.
1:2:4 N	4½ x 5	No rust.
1:2:4 N	4½ x 5	No rust.
1:2:4 S	4½ x 5	Badly rusted and pitted.
1:2:4 S	4½ x 8	Rusted over 2/3 of area and badly pitted.
1:3:5 N	4½ x 5	Rusted on ¼ of area at one end.
1:3:5 S	4½ x 5	Rusted badly and pitted deeply.
1:3:5 N	4½ x 8	Clean.
1:3:5 S	4½ x 8	Rusted and pitted badly.

Conclusions.— It is well known that oxygen and moisture are the factors which promote rusting. These tests show that rusting of bars imbedded in concrete will occur to some extent where these two factors are present, but only after a long period of time and in the mixes lean in cement. No rusting of any kind was noted in the fresh water specimens until the seven year tests, and this occurred on specimens of the 1:2:4 and 1:3:5 mixes. The porosity of the rich mixes is considerably less than that of the leaner mixes; therefore, in a given time the amount of oxygen and moisture that can reach rods imbedded in a rich mix is less than can penetrate to rods similarly imbedded in a lean mix. Usually rusting occurred at the air pockets underneath the rods. Where chemicals such as salts came in contact with the rods the rusting action was greatly increased, and, in accordance with the above conclusion, the greatest increase was noted in the lean mixes. As was expected, rusting occurred first in the specimens 1½ inches thick because oxygen and moisture could reach the rods in these specimens most easily.

Since there was no marked rusting of any of the fresh water specimens, whether they had been soaked in sea water or not, it is probable that the effect of the short time treatment in the sea water was negligible.

The cycle of immersion and drying which was carried on over the first five years of the test was probably more severe than would be encountered in practice, but this accelerated action was probably of no greater extent than that which would occur under actual weathering conditions extending over a much greater period of time. During the drying it is probable that the forces exerted on the particles of cement and aggregate by the crystallization of the salt broke down the minute cell walls and thus increased the porosity of the concrete. This increase in porosity permitted a freer access of oxygen and moisture, which, as stated above, subsequently caused greater corrosion of the rods.

However, as Figs. 2 and 3 show, in no case was the corrosion so deep or the deterioration so complete that the capacity of the rods to carry static loads was materially decreased. On the other hand it is probable that the resistance of the rods to impact or repeated loads was materially lessened because of the concentration of stresses which would occur at the bottom of the pits under such loadings. After longer exposure to such action even the static capacity of the rods might be decreased.

These tests show conclusively that salts, and chemicals having like action on steel, should be avoided in the mixing water for reinforced concrete. Where permanency is important in the structure, any deteriorating chemicals used to lower the freezing point of the mixing water are to be rejected.

THE ARTIFICIAL SILK INDUSTRY

(Concluded from page 106)

unfamiliar with actual manufacturing conditions. Most patents on the subject are without value, and those that are valuable are generally so worded as to be misleading to the average person, and often to one skilled in the art.

The future for artificial silk is very bright. The industry is founded on a sound economic basis. Pulp is used for a raw material costing about five cents a pound, and the silk is sold for approximately $2.00 to $3.00 per pound according to quality and weight of thread. In the manufacture of viscose silk in this country last year, 8.7% of all the caustic soda made was consumed, and this year it will be more. As Lord Rothermere has said, in England the possibility of artificial silk competing with cotton may soon be realized. At any rate the chemical engineer is making a truly great contribution to his fellow man by converting trees into artificial silk.

ATHLETICS

G. H. ABENDROTH

BASKETBALL

Wisconsin can thank its lucky stars that Iowa is in the Big Ten race. With defeats from Illinois, Purdue, Michigan, and Minnesota, Wisconsin simply had to find someone to beat, and Iowa was the victim. The Cornhuskers had the appearance of a good team, but Wisconsin, with a zero in the victory column to its credit, met them on the home floor and won its first game. To prove that the victory was a real one and not a fluke, the Badgers travelled to the state "where the tall corn grows" and administered the second drubbing to the Iowans .

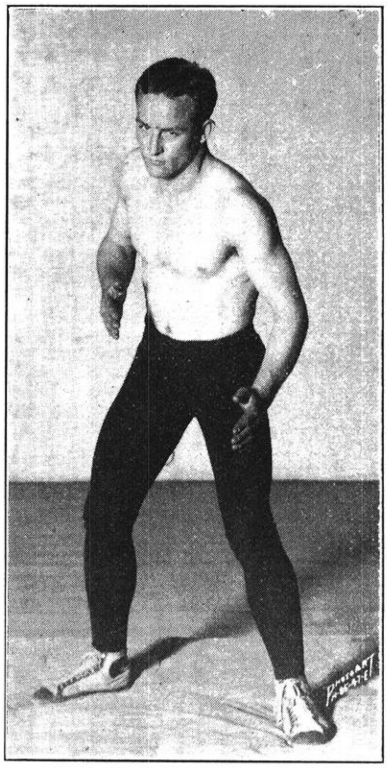
Our glory in basketball is over after we have mentioned our two victories over Iowa. We've got a fighting team but fight isn't the only requisite for a winning basketball squad. A team in order to win games must put the ball through the hoop a few times, and Wisconsin is lacking in this respect. It seems as if the Cardinal-jerseyed men have no luck in making either foul shots or field goals.

Meanwell has had to put several new men on the basketball court due to ineligibility. Three of Doc's forwards, Spooner, Wackmann, and Martel, have been lost either by ineligibility or graduation, and the task of filling their shoes with dependable players has not been altogether successful. Bain, Merkel, and Miller have played good games at the forward positions, but the opposition always seems to play a little better or have a little more luck. Barnum and Brooks look promising at center while at our guard positions we have two old friends, Diebold and Barwig, who can always be depended upon to keep up their end of the game. The combination might win games if the men had played together since last September, but this semester we will have to be satisfied with close defeats rather than victories.

WRESTLING

With four victories and one defeat, the wrestling squad is primed to rank high in the final conference standings. Chicago, Carleton, Minnesota, and Michigan have been defeated, and Ohio State is waiting to take its beating. Coach Hitchcock certainly is producing wrestling teams that command the respect of the other schools in the conference. Although wrestling is not a major sport at Wisconsin, the Cardinal wrestlers have succeeded in making a better record in their sport than has been made in our major sports during the last year.

The wrestling team owes quite a bit of its success to the many engineers who are pinning their opponents to the mat. With an engineering captain, Lisle L. Zodtner, the team cannot help but win. Zodtner, who wrestles in the 145 pound class, is a junior chemical engineer and probably applies his engineering knowledge and science to wrestling. In the four meets which Wisconsin has had thus far, Zodtner has not lost a match. He usually succeeds in not only winning by a decision, but by a fall.



LISLE ZODTNER, OUR FLASHY WRESTLING CAPTAIN

Zodtner, however, is not the only engineer who is playing his part on the squad. Splees, a sophomore electrical, has won all his matches. Against Chicago, Splees wrestled in the 158 pound class, but since that time he has tussled with the 175 pounders. Big or little, he seems to take care of them. Phelps O'Laughlin, and Haas are the other engineering school representatives. Phelps has won his "W" in the sport, but has not been very active during the last year. With a little more conditioning, Phelps should again come to the front. Haas and Phelps both wrestle in the 125 pound class. O'Laughlin took part in the Carleton meet and won his match in the 135 pound class.

The featherweights (115 pounds) are taken care of by Hansen, while Stipek meets the heavyweights. Chada and Whitworth are two other non-engineers on the squad, who, despite this one drawback, are good wrestlers.

The Chicago meet, the first meet of the year, was the closest victory Wisconsin has had. The final score was

(Continued on page 117)

CAMPUS NOTES

J. LEVIN

ENGINEERS MAKE PREPARATIONS FOR ST. PAT'S PARADE

Plans for the annual engineers' parade are rapidly materializing, according to James Verner '26, general chairman of the parade. The date of the parade has been set as Saturday, March 28, and under no conditions will it be changed.

Wenzel Fabera '25, John Kolb '26, and Erwin Summers '25 have been appointed assistant general chairmen. The chairmen of the various committees are as follows:

Engineers' band, F. R. Lhotak '26; prizes, D. T. Thomas '25; cops, J. B. Cassidy '25; floats, V. A. Thiemann '25; finances, J. P. Smith '26; election of St. Pat, N. A. Rick '25; selection of judges, C. P. Lindner '25; publicity, E. R. Summers '25; trucks, W. M. Richtmann '25; individual stunts, W. L. Tietjen '25; and censor, E. S. Peterson '25.

The various engineering societies on the campus are possessed of one feeling: namely, to make this year's St. Pat's Parade the best ever in originality and uniqueness; and the individual societies are each making special efforts to create floats which will surpass those of former years both in conception and effectiveness.

An engineering orchestra is being organized by Chairman Kolb, and all musically-inclined engineers who are true believers in St. Pat should report to Kolb.

History does not say whether our patron saint boasted a Vandyke or not; nevertheless, a prize will be given to that son of St. Pat who displays the most conspicuous beard in the parade.

Madison merchants are co-operating with the parade committee to the extent of furnishing prizes for the various floats and individual stunts.

ENGINEERING SOCIETY OF WISCONSIN HOLDS ANNUAL CONVENTION

The most successful convention in the history of the Engineering Society of Wisconsin was held February 19, 20 and 21.

Officers elected for the following year are A. L. Hillis, city engineer of Marinette, president; C. M. Baker, state sanitary engineer of the board of health, vice-president; L. S. Smith, professor of city planning and highway engineering, secretary-treasurer. The officials of the board of trustees include W. G. Kirchoffer, Consulting engineer of Madison, and G. E. Heebink, city engineer of Beloit. Prof L. S. Smith was re-elected to the office of secretary-treasurer. Mr. W. G. Kirchoffer is the retiring president of the society.

During the final session a resolution was passed urging Congress to appropriate more money to complete the topographical survey of the United States. A second resolution urging the state Board of Health to promote better and more sanitary health conditions was carried. A third resolution thanking the College of Engineering for the hospitality extended during the present convention was carried unanimously.

Approximately 200 members were in attendance at the convention. The total membership was increased to 300 when twenty-five new members were elected. In order to help preserve the unity and forward the aims of the society, it was voted to continue the issue of monthly bulletins to all members of the society.

The meeting this year was characterized not only by the largest attendance on record but also by a great display of enthusiasm. Membership in the society has increased 500% in the last nine years. F. E. Turneaure, dean of the College of Engineering, was the first president of the society when it was founded 17 years ago.

The object of the Engineering Society of Wisconsin is to encourage the professional intercourse between the state, and the advancement of its members in scientific research in the various branches of engineering.

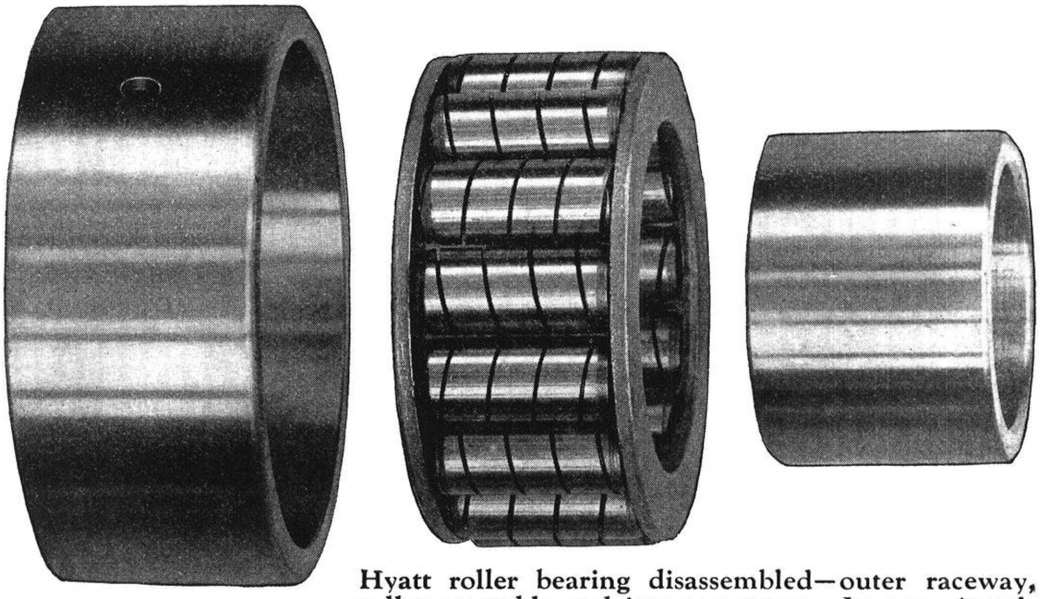
INVENTOR FAILS TO OVERTHOW NATURAL LAW

An inventor, with a pump that would lift water forty feet by simple suction, disturbed the serenity of the hydraulic faculty a few weeks ago. The inventor ambled into the laboratory one day with the pump and his startling claim of a 40-ft. lift. Professors Corp and Ward expressed polite doubt about the claims, but told him to set up the contrivance and give a demonstration. He called them from other duties when he was ready, and, sure enough, he was lifting water forty feet. He didn't get much of a stream to be sure, but he did get some water. No, gentle reader, this story isn't a lie, nor was the inventor a wizard who could change the laws of Nature. A little investigation showed that his suction pipe had some leaky joints so that air entered at each stroke and gave him the benefit of an air-lift. When the joints had been made tight, the pump refused to function further, and another invention was laid regretfully upon the scrap heap.

ONE WAY OF DOING IT

Mr. Wahlin (in Physics 52): "How would you demagnetize a watch?"

Voice from the rear: "Drop it."



Hyatt roller bearing disassembled—outer raceway, roller assembly and inner raceway. In some installations the inner raceway is eliminated, the rollers operating directly upon the shaft.

Anti-Friction Bearings For Modern Mechanical Equipment

THERE was a time when men—even engineers—were satisfied with plain friction bearings for wheels and for other revolving parts of mechanical equipment.

But the day of the plain bearing has passed with that of high collars, pointed shoes and other friction producing devices.

Modern industrial methods require, and enlightened engineers demand that rotating parts be mounted on bearings that will roll instead of rub. The results of using anti-friction bearings are obvious—less fuel and power consumed, less lubrication required and infinitely less bearing wear.

Not only automobiles, but rolling stock, machinery and equipment of all kinds now operate on anti-friction bearings.

Hyatt roller bearings have been pioneers in this field. For over thirty years they have been eliminating friction and showing the way to better and more economical operation of equipment in virtually every line of human endeavor.

HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO

WORCESTER PHILADELPHIA CHARLOTTE
PITTSBURGH CLEVELAND MILWAUKEE

HYATT ROLLER BEARINGS

CAN IT BE, OH ROME, THAT WE, TOO, TOTTER?

According to the super-enthusiastic press agent, preparations for the Pacifists' Ball involved the hiring of thirty-five maids to assist in the boxes, the securing of large hand mirrors, and the ordering of a wholesale supply of powder, hairpins, hairnets, and various other weapons of the weaker sex. We shall waive comment upon the obviously interesting character of the boxes on the night of the momentous event, and pass on to a fore-cast of the logical development of these preparations. Let the Cardinal of 1930 have the floor:

KALSOMINERS TO ASSIST AT PACIFISTS' BALL

Perfumed Baths, Chiropists, Masseurs, and Beauty Experts Will Be at Hand to Relieve Members of Weaker Sex

Thirty-five Kalsominers have been engaged to assist in applying make-up in the boxes at the Pacifists' Ball to be held April 3 in the Cane Flourishers' Hall, according to Whattin L. D'Iker '30, chairman of the committee.

D'IKer '30

"We have secured everything," he stated, "necessary for a complete rejuvenation at the dance. Furthermore, we have provided a goodly number of hash slingers and dumb waiters to supply the life-sustaining corned-beef-and-cabbage which will have to be distributed to the couples before morning."

Large perfumed baths have been installed in the Governor's office, registered chiropodists with the necessary supply of Tiz and Cornocure will be on hand to relieve tired feet, and a goodly supply of silk-hosiery (donated by the Darners' Union) and dancing slippers for both genders will be provided in the boxes gratuitously.

SCHOLARSHIPS IN METALLURGY ESTABLISHED

The Milwaukee Steel Foundry Company has recently established a fellowship in metallurgy, the holder to be a resident graduate student who will make a study of some of the technical problems peculiar to the steel casting industry.

Wisconsin occupies a foremost rank in the number of steel foundries per capita within its boundaries; and co-operation between the University and the industry in the study of its problems is one of the many ways in which the University can render service to the state and help maintain Wisconsin as a leader in the foundry business.

It was through the suggestion of the Works Manager of the Milwaukee Steel Foundry Company, Mr. Arthur T. Baumer, who as a graduate student in the University Extension saw the benefits which would result if a resident student should co-operate in the investigations, that the scholarship was created.

The fellowship will be filled by Mr. Leo Shapiro, who is now completing his second year of graduate study and working for his doctor's degree.

ENGINEERS PREPARE FOR UNIVERSITY EXPOSITION

The engineering exhibits, which constitute part of the program for the quadrennial university exposition to be held from April 16 to 18, will present to the visitors a cross-section of the modern industrial methods taught to the engineering students at the university. The engineering exhibits are planned to be interesting as well as instructive to the visitors at the exposition.

The engineering exhibit will occupy about half of the gymnasium annex, and will consist almost entirely of reduced models of machines used in various industrial processes. The steam and gas department plans to have a model of an industrial ice plant in operation. A model hydro-electric plant, showing the latest and most efficient methods of operation and maintenance, will be the feature of the hydraulics laboratory.

The department of mining will have on exhibition two mine models which it possesses: one is a model of the great Anaconda mine in Montana, which was created by the Anaconda Mining company at a cost of $12,000 for use in a mining claim adjustment, and later presented to the University of Wisconsin; the other model is that of an iron ore mine on the famous Mesabi range in northern Minnesota.

The mechanics department will be represented by a materials testing machine which will be operated continuously during the exposition, and which will demonstrate the general methods used in the testing of various construction materials.

Wenzel Fabera, m'25, is chairman of the engineering exhibits, and with his staff of able assistants he is rapidly carrying the plans through to completion.

Chi Epsilon, national honorary civil engineering fraternity, which has recently been installed at Wisconsin, replaces the local honorary fraternity, Chi Theta Epsilon. A member of the faculty and thirteen civil engineering students were elected to the fraternity on the basis of scholarship and aptitude shown in civil engineering.

W. S. Kinne, professor of structural engineering, is the honorary member and the faculty advisor of the new fraternity.

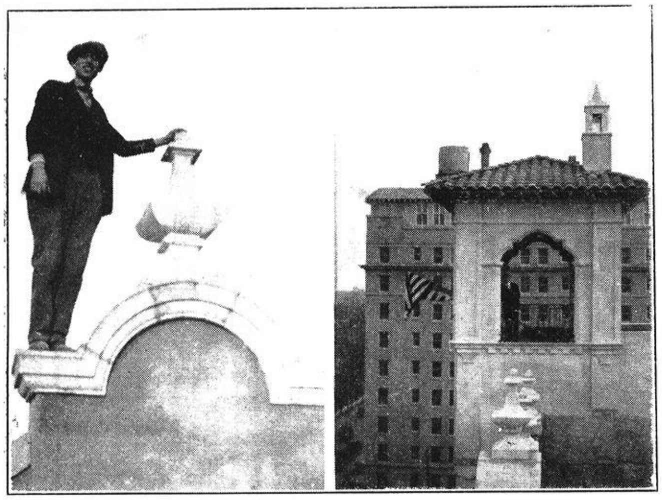
The following men were elected to membership: Clement Lindner '25, Lynn Busby '25, George Abendroth '25, George Field '25, Waldemar Landwehr '25, Norman Rick '25, Eugene Schmidt '25, Millard Smith '25, Ralph Smith '25, Everett Schuman, grad., Larry Sogard '24, Lawrence Stebbins '24, and Robert Webb '25.

Clement P. Lindner is president of the newly installed chapter, which is the sixth chapter of Chi Epsilon.

EXTENSION NOTES

Mr. W. L. Chadwick of Big Creek, California, writes that since he has enrolled with the Extension Division he has been made Division Engineer, in charge of all field work for the Southern California Edison Company on the Florence Lake Division of its San Joaquin — Big Creek Project. During this time his work has been in connection with the construction of the thirteen mile 15 by 15 foot Florence Lake Tunnel and its auxiliary intake and outlet structures, also the construction of a multiple arch dam 3200 feet long, having a maximum height, above its foundation, of 150 feet. He also has had charge of a preliminary survey for the location of a two and a half miles of steel siphon which is eight feet in diameter and designed to deliver 600 second feet of water, (maximum head 800 feet.)

Mr. D. K. French, Directing Chemist for the Dearborn Chemical Company, gave a talk, *Boiler Feed Waters*, before the Steam Engineering classes at the Nekoosa-Edwards Paper Company on February 27.



Mr. Beaupré, Dallas, Texas, *and views of a project on which he is employed.*
—As Seen By R. G. Marquez

Mr. Olin Beaupré, Dallas, Texas, a student in Architectural Drawing, enclosed several snapshots in a recent letter, two of which are shown herewith. The first shows a view of one of the towers of a large stucco apartment building, with Stoneleigh Court apartments, another large project in the background. The second photo shows Mr. Beaupré standing on the center wall of the same structure. The total frontage of the building exceeds three hundred feet. Mr. Beaupré is employed as cost clerk and paymaster by Hickey and Montgomery, the builders.

The engineering students at the Extension Division in Milwaukee have opened their new club room on the fifth floor. This has been made possible through the generosity of Mr. Richards, manager of the building.

The Glee Club of The University of Wisconsin entertained the students of the Extension Division in the assembly room on Monday, February 16.

The Gamma Kappa Phi fraternity has given the Milwaukee Branch of the Extension Division a silver cup and a pin to be awarded annually by the Faculty to that student who excels in scholarship, school loyalty, and fraternal spirit. By unanimous vote, this award was made to Miss Wilma M. Klevay at the assembly February 16th.

On March 1 the Extension Division will occupy quarters on the first, second, and third floors instead of on the third and fourth floors as at present. This move will be consummated with practically no disturbance to the classes.

The Electric Metermen's School announced above is conducted co-operatively by the University Extension Division, the College of Engineering, The Wisconsin Utilities Association, and the Wisconsin Railroad Commission. A special feature of this year's school will be instruction in the installation, adjustment, and maintenance of relays.

NOTES FROM THE FIELD

The new moving picture film on Power, produced by Stone and Webster, was shown before the classes in steam engineering at the Nekoosa-Edwards Paper company on February 10.

A class course on Fuels and Combustion is being conducted for the members of Wisconsin No. 18 N. A. S. E. at Milwaukee. Prof. W. E. Wines has charge of the work.

Mr. H. B. Bryn, Instructor in Mechanical Engineering, has resigned in order to accept a position as Service Engineer with the Globe Electric Company of Milwaukee.

Mr. D. M. Edgar, State Boiler Inspector, spoke before the members of the classes in Steam Engineering at the Nekoosa-Edwards Paper Company on March 3.

GOOD LIGHTING OF INDUSTRIAL PLANTS SECURES SAFETY AND EFFICIENCY.

The Code of Lighting for factories, mills and other work places of the State of New Jersey makes excellent recommendations of daylight for the proper lighting of industrial buildings.

Adequate daylight facilities through large window areas, together with light, cheerful surroundings, are highly desirable and necessary features in every work place, and they should be supplied through the necessary channels, not only from the humane standpoint, but also from the viewpoint of maximum plant efficiency.

Importance of Daylight.

The unusual attention to gas and electric lighting in factories, mills and other work places during the past few years; the perfection of various lamps and auxiliaries, by means of which an improved quality and quantity of lighting effects are obtained; and the care which has been devoted to increasing the efficiency in various industrial apparatus—all go to emphasize the many advantages and economies that result from vital and adequate window space, as a means for daylight in the proper quantities, and in the right direction during those portions of the day when it is available.

Three Considerations.

Three important considerations of any lighting method are sufficiency, continuity and diffusion, with respect to the daylight illumination of interiors. Sufficiency demands adequate window area; continuity requires (a) large enough window area for use on reasonably dark days, (b) means for reducing the illumination when excessive, due to direct sunshine, and supplementing lighting equipment for use on particularly dark days, and especially towards the close of winter days, (c) diffusion demands interior decorations that are as light in color as practicable for ceilings and upper portions of walls, and of a dull or matt finish, in order that the light which enters the windows or that which is produced by lamps may not be absorbed and lost on the first object that it strikes; but that it may be returned by reflection and thus be used over and over again.

Diffusion also requires that the various sources of light, whether windows, skylights or lamps, be well distributed about the space to be lighted. Light colored surroundings as here suggested result in marked economy, but their main object is perhaps not so much economy as to obtain results that will be satisfactory to the human eye.

Requirements for natural lighting:

1. The light should be adequate for each employe.
2. The windows should be so spaced and located that daylight is fairly uniform over the working area.
3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.
4. The windows should provide a quality of daylight which will avoid a glare, due to the sun's rays, and light from the sky shining directly into the eye, or where this does not prove to be the case at all parts of the day, window shades or other means should be available to make this end possible.

As will be noticed in the above recommendations, large windows and proper diffusion of daylight are urged, in order to meet the demands of daylight lighting.

Shades may be eliminated and most efficient lighting obtained by the use of Factrolite Glass.

If interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

St. Louis. New York. Chicago

No. 7.

A darky was being cross-examined on the witness stand by the counsel for the defendant.

Attorney: "Tell us exactly what you saw when the accident occurred."

Darky: "Waal Suh, Ah thinks dat ——."

Attorney: "Now don't tell us what you think. What did you see?"

Darky: "Waal, Ah thinks ——."

Attorney (impatiently): "Keep your thinking to yourself. What did you see?"

Darky: "Suh, Ah thinks befo Ah talks. Ah ain't no gabbin' lawyah."

PITY THE POOR BRICK LAYER

"All brick," writes a junior civil in a specification for laying brick, "must be *socked* before laying."

ATHLETICS

(Continued on page 113)

11-9 in our favor, enough to win, but not enough to satisfy our boys, who since that time have put a little more distance between their own score and that of their opponents.

Iowa, with its championship wrestling team, defeated Wisconsin, but Zodtner and Splees again came through with their usual wins to the surprise of their opponents. Iowa has always turned out a first class wrestling team, and the defeat suffered by our team can not be taken as an indication of their weakness.

THE HOCKEY SEASON

Although the percentage of games won has been small, Wisconsin may well be proud of her hockey team. The fellows have worked hard and fought bravely even though the odds have been against them. Only one experienced man, Captain Gross, was left from last year, and with this material Coach Iverson had to build a team; and then, too, in this as well as in other sports, inelegibility has raised havoc with the squad. The new coach, Kay Iverson, came from Minnesota where he had been director of winter sports. His brother is the present hockey coach of the Gopher team. Every night that the weather would permit Ivy has been giving his pucksters stiff workouts on the rink.

The season started out brightly with a fast game taken from Janesville, and another tied with them, but our luck soon changed. Although we usually lost, most of the games were closely contested matches. In the next to the last game, Michigan defeated us in an extremely rough and hard fought tilt, in which several men received bad bruises and cuts. In the last game, also with Michigan, we held them to a pointless score.

Several days after the Michigan game, Coach Iverson took his men to the fine indoor rink at Portage where in a close exhibition match they demonstrated the fine points of the game.

The College of Engineering, of course, has had its full share in the honors. Gore, a soph mechanical, showed up well in his defense position, and Lidicker, soph civil, played a fast game at wing. Of the others, Captain Gross and Jansky starred in several of the games. Even though we cannot point to a large number of wins, Coach Iverson has established the game on a firm footing at Wisconsin. The squad showed itself equal to its task and behaved like a veteran team. Bright prospects are in store for us next year if Ivy comes back. He hopes, if the athletic authorities deem advisable, to take the team up to Canada for a training trip next winter.

TRACK

After smothering Notre Dame with a number of broken Annex records, and a margin of forty points, Wisconsin tracksters are ready to take a shot at the conference honors. The Badgers should give Illinois, usually the favorites in the race, a close run with the many stars developed by our track coaches.

Wisconsin's first important victory for the year was that over Iowa when the Cardinals, not content with beating the Cornhuskers, broke several of Iowa's records and finished ahead of their Olympic stars. After taking Iowa into camp we were primed to tame the Irish, who last year gave us a good trimming in their own home town. Notre Dame, with one of its four Horseman, was scheduled to give us tough competition, but when the final race was run, the score stood 61 1/3 to 24 2/3. Notre Dame had to be content with two firsts, one in the pole vault and the other in the half mile.

Four annex records were broken in the Notre Dame meet, and McAndrews tied the 40 yard dash record made by Al Tormey in 1912, when he beat Layden, one of the Four Horsemen. The 440 mark was broken by Kennedy who chopped 1/5 of a second off the old record. Bergstresser took the mile and in doing so lowered the record of Arlie Schardt of Olympic fame. Ray Kubly, not to be outdone, bettered George Finkle's mark in the two mile, and to finish up the evening's performance, the mile relay team broke the annex record by a fraction of a second.

Although McGinnis, the star sophomore with the squad, did not break any records he was first in both the high jump and the high hurdles making him high point man on the team. McGinnis came very close to beating Pete Platten's record of 6 feet 4¾ inches when he cleared the bar at 6 feet 4 inches. Wisconsin can almost rely on a first place in the shot-put with Herb Schwarze, the Badger football giant, tossing the shot around. Schwarze, as yet, has not broken the records of Arlie Mucks, who, a few years ago, handled the sixteen pound shot like a marble, but with two more years of competition Schwarze should make some new marks.

The track team should give the West an idea of what Wisconsin can do when it travels to California. California has always had good track teams, but Wisconsin, with its record breaking squad, should be ready to vanquish the boys from the Golden State.