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The Wisconsin Engineer

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VOLUME XXXI NUMBER VII

DETAIL OF MEMORIAL UNION STEEL — TRIPP COMMONS

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VOLUME 31 APRIL, 1927 NO. 7

Saint Pat's Dream

The good saint dreamed,
In fancy dim saw scenes drift by,
Saw lawyers pass until it seemed,
The whole of life had gone awry!

He dreamed--in dreaming planned,
A day of days, a joy indeed,
For all true sons within the land,
Who duty-bound upheld his creed.

Saw the gathering of his forces,
Hurling war cries to the breeze,
Lords of Nature's vast resources,
Masters of the land and seas.

Saw lawyers bowing, lawyers scraping,
Filling all the air with wails,
Heard them pleading and beseeching,
Saw them ride along on rails!

And the P. A. D.'s did grumble,
And the Fiddledephees did groan,
Egg-filled pockets made them tremble,
As they stood before the throne.

"Hail the King!" the plumbers shouted,
And the shysters bowed in fear,
Their downfall plainly flouted,
By old Saint Pat the Engineer!

BY R. DEWITT JORDAN

The Wisconsin Engineer
UNIVERSITY OF WISCONSIN

VOL. XXXI, NO. 7 MADISON, WISCONSIN APRIL, 1927

THE STRUCTURAL DESIGN OF OUR MEMORIAL UNION BUILDING

By C. A. WILLSON, c'21

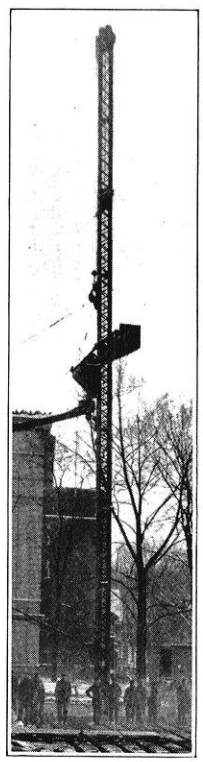
Structural Engineer with State Architect of Wisconsin

OUR FRIEND Bill Kinne will tell you that a plate girder 55 feet long ought to be about 5 feet deep. However, in this job there are four girders of this length which are only 3 feet deep. He will also tell you that roof trusses should not occur over windows, doorways or corridors. And yet here am I, the structural engineer of this building, formerly one of his students and later an instructor in his department, doing these things which he would not recommend. Why? I shall try to tell why in this article. Also I shall try to answer other questions which any observing engineer might ask about certain elements of the design.

At the beginning I might state that the job was complicated from a structural standpoint. However, it excited and held my interest because of its irregularities and will be remembered long after the simple jobs are forgotten.

The Problem

In the first place it should be borne in mind that the final Memorial Union project is composed of three units of which the Memorial Union Building is the central primary feature. The Tripp Commons is the secondary unit on the east and the theater is the secondary unit on the west. The Memorial Union and Tripp Commons units are being built now, while the theater will probably be built later. Since Langdon street slopes downward from west to east, the future theater unit will occupy higher ground than the other two buildings. Therefore, the central unit had to be designed in such a way as to dominate the completed group. It may be some time before the theater unit is built, so a connecting element had to be provided which would look well from Park Street during the period which will elapse before the theater is actually constructed.



Going Up!

You may say that these are architectural considerations and have nothing to do with concrete floor joists or steel girders and roof trusses. But in that you are wrong, for in this case we are dealing with a monumental building and not a boiler factory. To a very large degree the architectural treatment of the exterior governed the interior arrangement and controlled the layout of the structural framing.

Fig. 1 indicates the general outlines of the two buildings in the different stories and also shows some of the main features of the interior. The Alumni Hall on the second floor of the Memorial Union Building constituted one of the main problems of the interior framing. This room was made 48 feet wide and 104 feet long with the requirement that there should be no interior columns. (In this way an excellent dance floor is obtained.) This became a serious problem structurally when rooms were provided over the two ends of the Alumni Hall as indicated in Fig. 1.

The main dining room in the Tripp Commons building was made 55 feet wide and 68 feet long and two stories high. This room became another structural problem when it was decided to provide dormitory rooms overhead and to eliminate all interior columns. To add insult to injury, the architectural treatment of the interior and exterior made it necessary to use extremely shallow girders for the support of the floor above. In addition to this there were several smaller dining rooms in the Tripp Commons Building which were to be without columns.

Among the other major factors influencing the gen-

eral structural design was the requirement for what is commonly termed fireproof construction. Two types of concrete-joist floors are often used in buildings of this class. In one type, rows of hollow clay tiles are used as fillers between concrete joists, while in the other type, plain or corrugated metal tiles are used as fillers between concrete joists. During the long life of a building constructed in this manner it may become

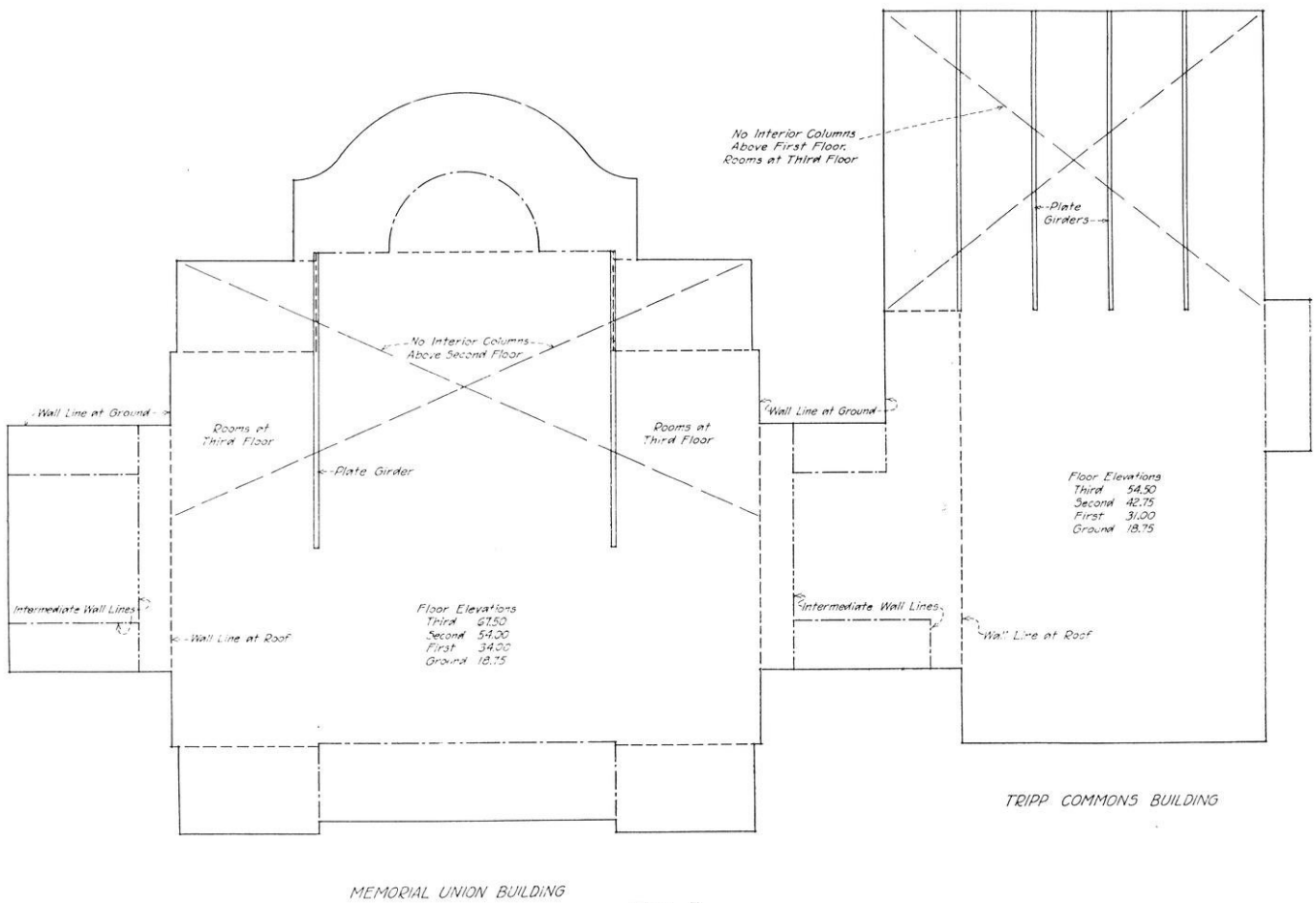


FIG. I

Plan Showing Features of Construction and Shape of Each Floor

desirable to change the size and shape of a number of the smaller rooms to meet varying demands. This means changing partitions and electric light outlets. In the case of a clay tile and concrete-joist floor, the electric conduit is imbedded in the construction, whereas in the other type of concrete-joist floor the conduit is generally hung between the floor and a suspended ceiling composed of metal lath and plaster. The fact that in both buildings, floor joists of different span lengths and different live loads were adjacent to one another also had a bearing on the type of construction that was to be used.

In addition to the requirement for fireproof construction it was felt desirable to have columns which were small in size in certain rooms of the lower stories.

In Fig. 1 you will see that, except for the ground floor, the floors are at different elevations in the two buildings. The differences are so great that the second floor of the Memorial Union Building is only 6 inches below the third floor of the Tripp Commons Building.

The footings under the Tripp Commons Building and under the eastern one-third of the Memorial Union Building were to be carried about 5 feet deeper than those under the western two-thirds of the Memorial Union Building due to the natural slope of the ground.

A few preliminary calculations indicated that there would be some rather heavy column footing loads and so we studied the character of the foundation soil by making a number of test borings well distributed over the ground to be covered by the two buildings. Mr. Ernest F. Bean, State Geologist of Wisconsin, examined the samples of material for us. At his suggestion we used a soil pressure of 4,000 pounds per square foot for the poorest foundation material which was encountered under the front of the Tripp Commons Building. This was increased to 4,500 and 5,000 pounds per square foot, the latter value being used most often. Hence another variable was introduced, — unit soil pressure.

The Solution

That expression, "the solution," might indicate to some people that there was only one solution and that this solution was evident to everyone from the very beginning. However, this was far from being the case. What I call the solution is the one indicated on our plans of the two buildings and is actually only one of

a large number of solutions which were studied and either modified or rejected until the final result was obtained. Floor joists, beams and columns were arranged in several other ways before the final scheme was adopted. The architectural features of the exterior and the interior played a very important part in determining the feasibility of every structural scheme that was considered.

From a study of Fig. 1 it ought to be evident to the most optimistic that an irregular framing of the exterior was unavoidable. The plate girders 55 feet long and 3 feet deep mentioned in the opening paragraph were used over the main dining room in the Tripp Commons Building. Deeper girders would have spoiled the interior treatment of this room. The west end of the front roof truss of the Tripp Commons Building comes directly over the corridor which connects the two buildings. At first thought this seems like poor design, but this position of the roof truss provided the simplest framing of the front part of the roof. A steel beam was placed across the corridor opening so as to carry the load of the truss to nearby columns. Several similar problems were encountered in designing trusses for the Memorial Union Building and the same general type of solution was adopted.

A concrete-joist floor constructed by the use of removable metal forms was adopted for all floors of both buildings. The necessity for long-span, shallow girders, irregular framing, and small column size meant that structural steel beams, girders, and columns, rather than reinforced concrete, should be used over a large portion of both buildings.

Since the ground floor was at the same elevation in both buildings it was chosen as the base above which structural steel beams and columns should be used. The ground-floor beams were of reinforced concrete and were supported on reinforced concrete columns.

As the building progresses it will be noted that almost all of the steel columns (in fact, all but two) are rolled Bethlehem H-sections instead of some form of built-up section. To meet the requirements for load, column height, and small column size, I believe this gives the most economical solution. A few years ago it was possible to obtain only a few weights of Bethlehem H sections, but in this job the plans required a large variety of weights of these columns and no question was raised in regard to any of them. This would seem to indicate a more general use of this type of steel column.

At each floor level several rows of very light steel members may be seen extending east and west across each building. They look rather fragile when compared with the other members which they connect. They are 6-inch channels and are not intended to carry any load, but serve to tie the main rows of steel beams and columns together laterally until the concrete construction is completed. For the lengths used, these members are not capable of resisting any compression, — just tension. To provide a member which could resist compression would mean a much heavier section and this was not thought to be of enough value to justify the greater expense. The roof trusses in both buildings are rather completely sway braced by 1-inch tie rods.

Now let us consider for a moment the detailed design of the concrete floor-joist construction. In a large portion of the Memorial Union Building, 27-foot spans are alternated with 14-foot spans. In other words, each joist is a continuous beam composed of a series of unequal spans. I have met this type of problem so often that I have been compelled to develop short-cut methods which would combine speed and accuracy. (See Proceedings, American Society of Civil Engineers, November, 1926, for a brief description of these methods.) In general, these methods are based on the theorem of three moments, and with their aid the bending moments and shears are obtained at critical sections. In continuous-joist systems the maximum bending moment is almost always negative, occurring over a supporting beam. This means that the top of the joist is in tension and the bottom in compression. This is unfortunate since concrete joists made with metal forms are wider at the top than at the bottom. However, by using a special metal form near the end

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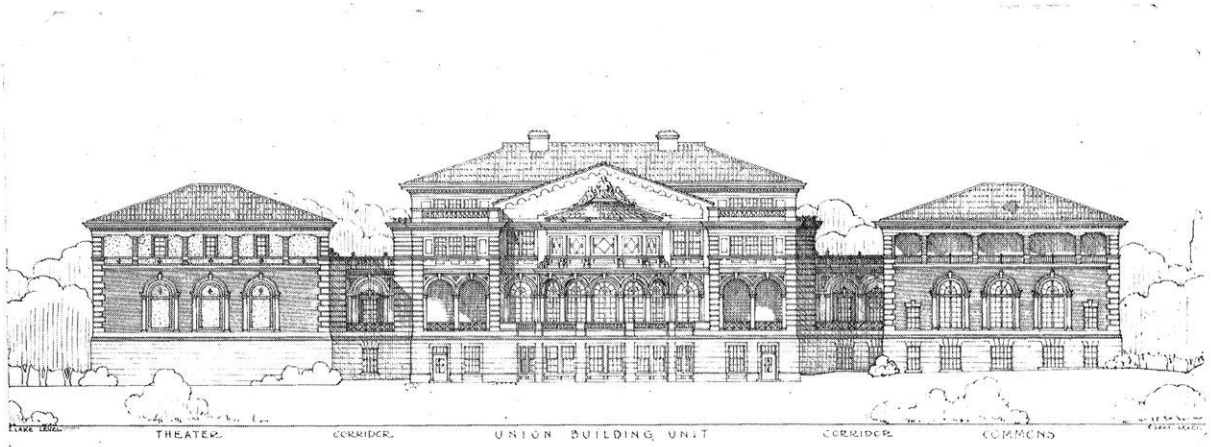


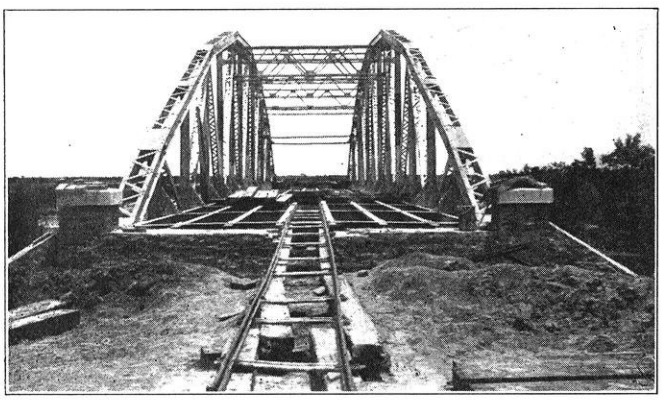
NORTH ELEVATION - FACING LAKE MENDOTA

BRIDGE BUILDING IN THE SOUTHERN HEMISPHERE

By CHARLES H. BELL

THE accompanying photos relate to the construction of a bridge some three hundred miles north of the city of Buenos Aires, the capital of the Argentine Republic, South America.

From Madison it is about seven thousand miles to the bridge site; nearly at the intersection of meridian



Bridge Finished Except Floor and Railing

60° west and parallel 30° south. The climate corresponds more or less to that of New Orleans and the seasons are reversed, the hottest months being from December to March.

The large rivers, the Parana and the Uruguay, enclose between them the two Argentinean provinces of Corrientes and Entre Rios. The dividing line, say 150 miles long, is formed on the east by the river Mocoreta, a Guarani word meaning "earth eater", flowing into the Uruguay; and on the west by the Guayquiraro, a tributary of the Parana. Both have their source in the same almost impassable swamp of water, rushes, sedges, and high grass. The higher land is slightly rolling and covered with woods of thorny trees.

The name Guay-qui-ra-ro was given by a party of Missioneros, people from Missiones, N. E. corner of the Argentine, an old Jesuit stronghold some 200 years ago. They killed a fat ox on the banks, but unfortunately broke the gall bladder and the meat was bitter; hence, the name "Ox fat but bitter" in Guarani.

One small town Sauce (pronounced "sow-si" meaning in Spanish a "willow") is about ten miles north of the bridge in Corrientes, and another, San Jose, is some twelve miles south in Entre Rios. Concordia is the principal port, at the head of navigation on the Uruguay. La Paz, somewhat smaller, is a port on the Parana; the latter is deeper and not subject to such quick changes of level as is the Uruguay.

The principal industries of Corrientes are cattle and sheep raising, also charcoal burning. Agriculture is limited to local demand for maize, mandioca, zepallos, melons, etc. Taxes are high, politics unsettled, and land ownership seems concentrated in comparatively few hands. The official language is Spanish, but most of the people among themselves talk in Guarani, an old South American Indian language, also spoken in Paraguay.

The property holders about Sauce and northwards had difficulty in sending their wool (the highest priced in the Argentine) and skins to Concordia when the Guayquiraro was in flood. The bales and skins were ferried over in canoes, the bullocks swam, and the high two-wheeled carts were drawn across under water by a long cable. This unloading and loading, often in mud and rain, besides the expense, lowered the selling price. Through the provincial government they petitioned the national government in Buenos Aires to make a bridge over the Guayquiraro on the road from Sauce to Concordia.

The national Office of Bridges and Roads had surveys made to find the most suitable site for a bridge. The existing cart pass on the road to Concordia was found too wide and expensive. A place some twelve miles west was fixed upon, where the distance from high water mark to high water mark was least (slightly under three miles) and almost on the straight line joining Sauce and San Jose. The timber and bushes on both sides of the river and the high grass, higher than a man's head, in the swamps (from three to six miles wide) in between, made the surveys both slow and expensive. The axe and machete were needed all the time.

The bridge is near the head waters of the Guayquiraro. More water is carried by the swamps than by the river itself, which is so obstructed by willows that at low water a canoe cannot pass. In the report of the surveys a timber trestle bridge with plenty of culverts, a viaduct if possible, was recommended; but other counsels prevailed, and a single span of sixty meters with embankments and culverts was decided upon.

Even when the narrowest place was found, the river was so crooked that it was difficult to get one straight line across from high water to high water mark, so that the bridge would be square with the stream and the earthworks come on the highest ground. That is why three tangents instead of one long one were fixed for the plan of the road.

Because of the lack of skilled labor, a steel bridge without field rivets was chosen. It was designed and

made in Germany and is of the type adopted by the Dutch (Holland) Government for use in the East Indies. The steel work was well done, so that there was no trouble in fitting. Although most of the paint and the painted numbers were lost by two years storage in the open air in Buenos Aires, the stamped numbers were always legible, and very few pieces were missing.

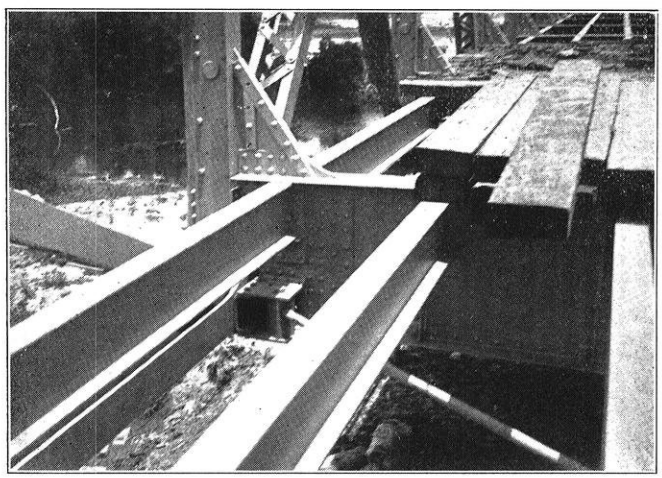
The traffic over the bridge, although not heavy except after shearing, was almost the worst imaginable for an earth road. It consisted largely of two-wheeled ox-carts carrying three tons, about 1½ tons on each wheel, and troops of wild, long-horned cattle, preceded by a horseman who warned all he met to get out of the way and into safety. Droves of cattle seem to keep step and leave a soft road like a honey-comb. After two or three days of heavy, continuous rain, the roads were almost impassable.

Test borings (down to 100 meters maximum) showed several deep soft spots in the bed of the river which would have given trouble with a pile bridge, but underlying all was a stiff red clay, a good foundation if not exposed to water.

No stone or gravel was available at reasonable expense, so brick abutments were decided upon, and well-burned broken brick instead of gravel for the concrete.

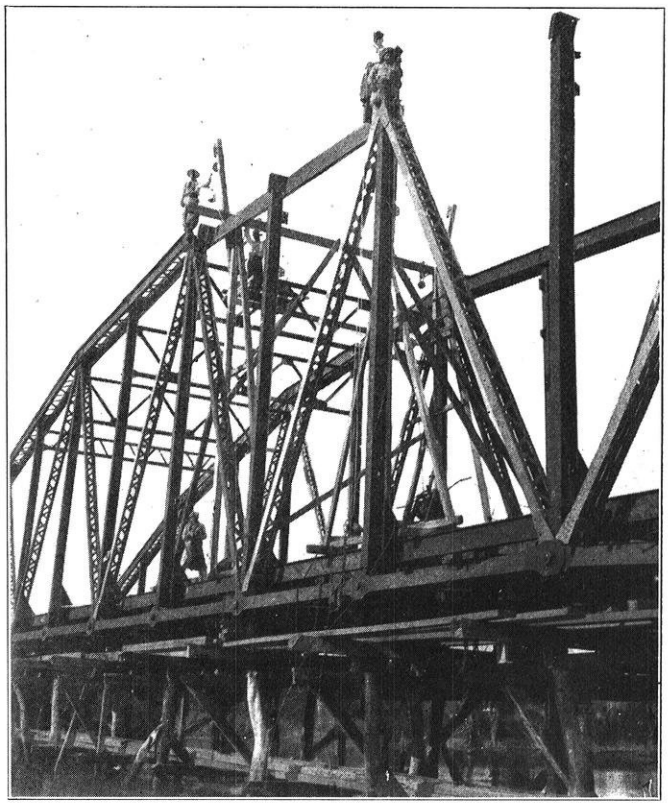
Abutment foundations of "quebracho colorado" piles were first proposed, but finally hollow columns of brick in cement, sunk to a good bearing surface, were employed.

The culverts on the accessible southern or Entre Rios side were of rolled steel beams on brick abutments and piers; while in Corrientes they were of hardwood timber with shorter spans.



Detail of Floor Beams

Of wild life, snakes, ostriches, and carpinchos were most visible. The latter is a kind of water hog with coarse brown hair, and is slightly higher and much wider than a pig. It is not dangerous except when a man stands between it and the water, when it will simply run over him, if necessary, to reach water. Alligators, pumas, and jaguars were there, but seldom seen. The most to be dreaded, after the snakes, were the "palometas", a small carnivorous fish with very sharp teeth, which will bite out a piece of skin and flesh the size of a two cent piece. Sting rays, flat fish, almost the colour of their surroundings, which lie in



Assembling Bridge Without Field Rivets

the sandy shallows sunning themselves, sting with a sharp pointed bone in their long whip like tails. The wound, while not fatal, is very painful. Besides mosquitoes and flies there were the "piques", a species of flea that burrows under the skin and leaves its eggs in a little yellow bag about the size of the top of one's little finger.

Few houses existed in the neighborhood, for cattle and sheep mean a sparse population. Supplies and provisions were brought by cart from San Jose and sometimes during low water from Sauce.

The contract for the earthwork, culverts, and erection of the steel bridge was given to a local firm of two men, one with capital and a knowledge of earth and brickwork, the other with a knowledge of wood and steel and all kinds of mechanical appliances, which he himself invented and made as required. Their knowledge of local people, conditions, and prices was a valuable asset. Wages went up about 50 per cent after the work started, sometimes almost double during shearing. The men were not savers, after they had earned twenty or thirty dollars they drew their pay, and worked no more till their money was gone. One of the contractors remarked that, if the money spent on the bridge had been distributed over the 100 miles of road to the Parana, the result might have been

(Continued on page 250)

1926-27 THESIS STUDIES IN THE HYDRAULIC LABORATORIES

By CHARLES I. CORP

Professor of Hydraulic and Sanitary Engineering

A NUMBER of very interesting experimental investigations have been carried on during the present school year in the Hydraulic and Sanitary Laboratory, as thesis studies by both graduate and undergraduate students.

Glen U. Cox, Research Fellow in Hydraulics, assisted by D. L. Harker and S. E. Kotz, have developed a formula for the discharge over sharp crested submerged

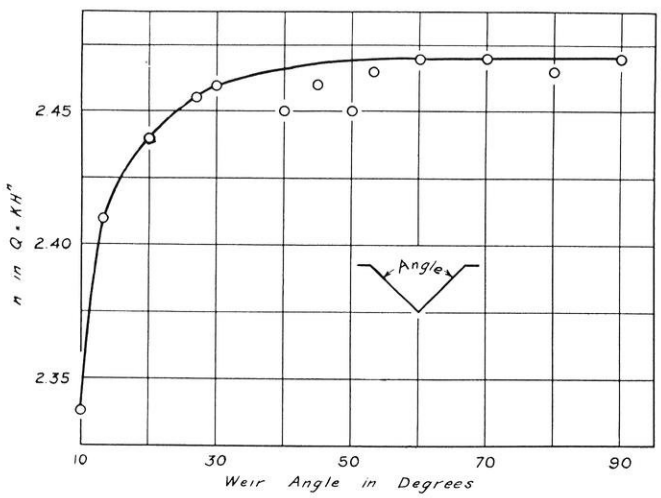


FIGURE 1. *Curve Shows How the Exponent in a General Discharge Formula Varies for Triangular Weirs of Different Angles. For Sharp Angles n Varies Radically. For Angles Above* 50° *the Same n May Be Used.*

weirs. Engineers have been hesitant to use the submerged weir, due to the lack of agreement of experimental work. The Hydraulic Laboratory studies show that this lack of agreement is due largely to the different places selected to measure downstream head, and that the various experiments can be coordinated. The formula now proposed will, it is believed, give discharge measurements that are correct within 2 per cent for weir submergences from minus 5 per cent to plus 96 per cent.

Russell J. Piltz, research assistant in Hydraulics, and Prof. Wm. H. Hall have been conducting a series of experiments on triangular or V-notch weirs. They find that a simple form of expression ($Q=KH^n$) for the discharge over these weirs may be used for all cases. Figure 1 shows how the value of the exponent n varies for different weir notch angles. Mr. Hall is professor of Civil Engineering at Duke University, Chapel Hill, North Carolina. He is on leave while pursuing graduate study at Wisconsin along Hydraulics and Sanitary engineering lines.

Judson P. Smith, fellow in Sanitary engineering, has been investigating industrial waste treatment in Wisconsin, and is operating an experimental plant on creamery wastes at De Forest. This past summer he assisted L. F. Warrick of the state board of health in conducting a series of experiments on pea cannery wastes at Poynette, Wisconsin. A joint bulletin by Mr. Warrick and Mr. Smith was published by the State Board of Health giving the results of their work.

E. H. Abbott, E. P. Chelman, and M. P. La Chappelle have been investigating various means of dissipating energy below spillway dams by means of models in the laboratory. Where dams are constructed on river bottoms which will erode, one of the serious problems is to protect against the undermining of the dam due to the falling water on the downstream side.

B. R. Anderson and N. A. Severson have been studying the accuracy with which the amount of water flowing in a pipe can be determined by injecting salt, and observing electrically the time of its passage through a measured length of pipe.

A. E. Blunt and E. T. Buttles are testing the sewage disposal plant of the Mendota hospital at Farwell's Point for their thesis. This is a small activated sludge plant. Their studies will reveal the amount of compressed air needed in small plants such as this one.

(Continued on page 246)

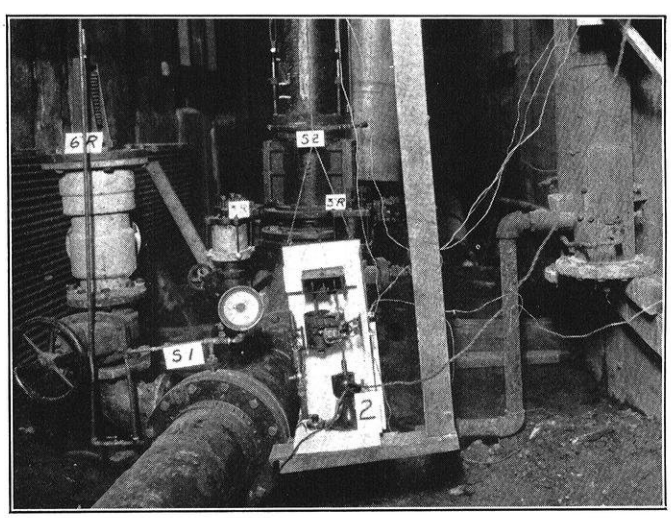


FIGURE 2. *Photograph of Base of Locomotive Water Crane in Hydraulic Laboratory Showing Relief Valves, Gauges, and Water Hammer Recording Apparatus in Place for Testing.*

HIGHWAY CONSTRUCTION IN MEXICO

By P. K. SCHUYLER
Associate Highway Bridge Engineer, U. S. Bureau of Public Roads

THE Mexican Congress passed laws creating a Federal Highway Commission in March 1925, and from that date on work has been carried on in varying amounts depending upon the amount of money that was available. Taxes were placed on the production of petroleum and on the manufacture of tobacco, and it was estimated that these taxes would yield some 400,000 American dollars per month, but due to uncertain economic conditions this yield has not been constant. In September, 1925, the Mexican Government, realizing that there were practically no trained highway engineers in Mexico, engaged a number of such engineers from the United States and the writer was one of these. The idea was that these trained engineers would organize the work and at the same time break in Mexican engineers so that they could take over the construction work. This was done and at the present time all the work is being carried on by Mexicans.

Completed Oil-treated Road

A system of Federal Highways was authorized most of these roads then being entirely impassable to automobile travel. This system consisted of the following roads; Mexico City-Acapulco road 285 miles; Mexico-Puebla road 82 miles; Mexico City-Laredo road 780 miles; Chiapas road 190 miles; making a total mileage of some 1337 miles. During the period of one year that the writer was on this work some 550 miles of road were graded and some 200 miles were surfaced. The standard of the work done was high, as can be seen from the photograph. Reinforced concrete bridges were used largely, these being designed for two 15-ton trucks. The Mexican engineers were entirely inexperienced on bridge work of this type and it was necessary to employ Americans as superintendents, allowing them to gradually train Mexicans. The Mexican peon proved to be a very good workman when properly supervised, and altho slow in his work he is very particular. The bridges and culverts, of which there were a large number constructed, compare rather favorably with the class of concrete work that we see in the States.

The road work consisted of surfacing some existing old cobble-stone roads built many years ago and also in locating entirely new roads. A natural top-soil which is found in the Valley of Mexico proved to be an excellent road material; one of these roads which has been oiled is shown in the photograph. A volcanic ash which was found in the vicinity of the now active volcano Popocatepetl was also used extensively as a road surfacing and this material took oil treatment and made a high class surface. The volcano Popocatepetl which is within sight of the Mexico City-Puebla road for its entire length is becoming more active as time goes on. Some twenty years ago it was possible to mine sulphur down in the crater, but at the present time this is impossible as there is an eruption about every four hours. The road where it crosses the shoulder of this mountain is at an elevation of 11,000 feet and due to this elevation the climate is cold the year around and frost occurs most every night.

Before this road program was undertaken many rivers could be crossed only by fords. These fords served satisfactorily for burro travel but were not good for automobile travel, and also were subject to the disadvantage that after each rain the water would rise and it was necessary to wait for a number of hours for the water to fall. Many of them have been replaced with modern reinforced concrete bridges. There are

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CUBA BUILDS NEW CAPITOL IN HAVANA

By L. T. SOGARD, c'24

A THREE-STORY capitol building, 700 ft. in length, 200 ft. wide and 130 ft. high, with a dome whose top will be at least 300 ft. above street level, is under construction by the Republic of Cuba in the city of Havana. When completed it will vie with the seats of governments throughout the world both in beauty and commodiousness.

The capitol is situated at the south end of the boulevard, El Prado, one of the principal streets of the city and one of the few wide thoroughfares in the downtown section.

Not unlike other republican forms of government, the building of this public edifice has been involved in politics. For fifteen years the various presidents of Cuba have dabbled at capitol building. Each had ideas different from those of his predecessors and no project ever progressed far from its incipient stages due to the lack of definite plans of the builders. However, the present incumbent, President Machado, has set forth with extraordinary zeal to build his capitol and his strenuous efforts bid fair to result in a completed structure during his tenure of office.

This article was received from Larry Sogard immediately following a vacation trip taken by him to Havana. It presents some very interesting aspects of the problems involved in designing buildings for semi-tropical countries, as well as the problems encountered in construction, gotten through first-hand contact.

—THE EDITOR

The original plans of the present building were prepared by European architects, but examination by native architects and engineers revealed faulty ventilation. "They would have sweat us to death," explained one of the construction engineers. Accordingly, the plans were revised by Cuban engineers to adapt the structure to Cuban climate, — which for the most part is simply heat.

Construction was begun in March, 1926. Rather, *destruction* was begun.. The remains of the previous and unsuccessful attempts at capitol building had to be torn down before new work could be initiated. About 10 ft. below street level the soil is a hard, yellow, sandy clay and upon this clay the building has been founded. An endeavor was made to use those parts of the old footings which could be adapted to the new plans, but lack of definite information regarding foundation piles already driven at the proposed base of the dome has necessitated great caution in using old construction. The present plan is to reinforce these existing footings by building additions around them founded on piling.

The building is of thoroughly modern design. Vertical members are columns of reinforced concrete and the transverse construction is structural steel encased in concrete. Wall and floor construction is of reinforced concrete. Facing is to be of cut stones; on the exterior, a 3 ft. course of American granite forms the base course; the remainder of the stone is a hard native limestone, known locally as Guanajay. The blocks of stone are shipped to the site by rail, as quarried, and the dressing is done on the job. The demand for this dressed, hard stone has never been great enough to warrant the installation of stone cutting machinery in Cuban quarries, so American machines and American operators were obtained from the F. R. Patch Manufacturing Co. of Rutland, Vermont, for this job. After the stones have been machined, native stone dressers finish the blocks by hand. Construction methods and equipment employed are similar to those used in American building practice.

The materials incorporated in the structure are, for the most part, obtained within the island of Cuba. Crushed stone for concrete is trucked from quarries not far from Havana, and the sand, taken from the ocean beach, is shipped to Havana in scows and hauled to the site in trucks. This sand is unlike the brownish sand so common in American construction. It is a white sand containing minute shell formations. When damp, it is grayish in color and offhand one would suppose it to be limestone screenings. Portland cement, *Cemento El Morro,* is also made in Cuba. Steel reinforcing bars and structural shapes are imported from the United States. The island of Cuba contains iron deposits, but as yet they have not been developed to the stage of producing commercial building steel.

From 1000 to 1300 men, all native, are being employed in the building. Although the cost of living is quite high in Havana, even the wages in the trades, are surprisingly low. Common laborers work 9 hours a day at 25c per hour; masons and carpenters receive 40c to 50c per hour; and stone workers from 30c to 50c, depending upon their ability. The trades are organized and, at times, simulate their American brethren by striking, — but evidently not for higher wages.

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OIL-ELECTRIC LOCOMOTIVES

By W. V. MERRIHUE, *Eastern Vice-chairman, E. C. M. A.*

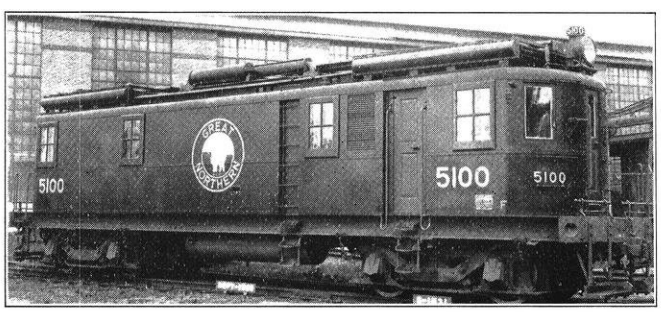
A FEW YEARS ago the first experimental oil-electric locomotive in the United States was constructed. While this locomotive is far from a finished product, it soon proved that there was a future for the oil-electric locomotive. It was used as a demonstrator and was loaned to various railroads in the East for trial.

Tests and practical operating results have shown that the oil-electric can be operated in switching service at about one-fifth the full cost of a steam locomotive doing the same work. It also is available for service a greater number of hours out of every 24, because it does not have to stop work during that period for water, fuel, or cleaning of fires. It can be used in large cities in down-town sections where the noise and smoke from a steam locomotive are objectionable, and where complete electrification is difficult or unjustifiable.

Up to the present time this new form of motive power has been designed for switching service only. Its ease of operation and ability to use its full power at almost a standstill, resulting in rapid acceleration, make it especially desirable for this kind of service. In a number of railroad yards it has demonstrated that it can do the work of a steam locomotive which is considerably heavier than the oil-electric.

There are now two sizes in service. The 60-ton unit derives its designation from its weight, and uses one Ingersoll Rand 300-hp., 600-r. p. m., 6-cylinder, 4-cycle solid-injection engine as the prime mover, directly connected to a 200-kw. generator.

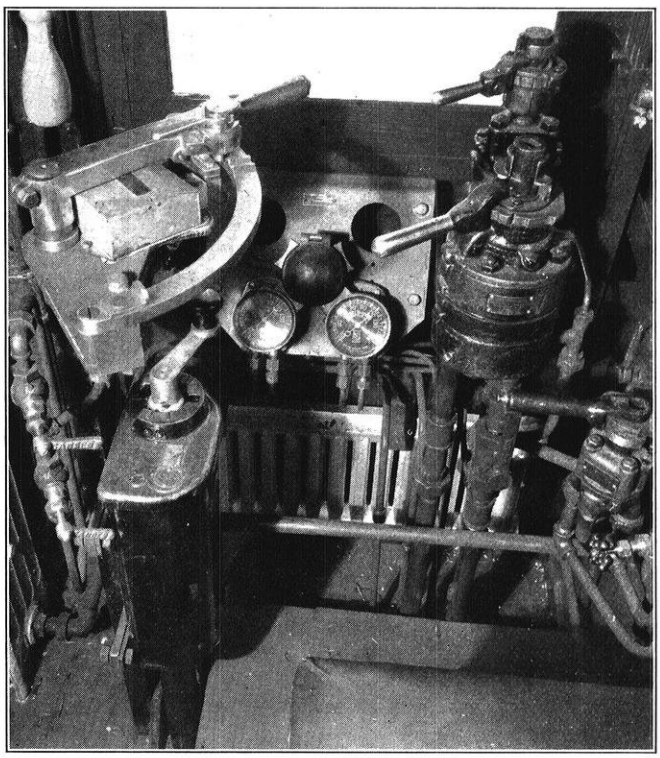
The running gear consists of 2-axle swivel trucks with a single-geared railway motor of the conventional axle and nose suspension type mounted on each axle. The cab is of box type construction, with an apparatus compartment in the middle which houses the generating equipment, control equipment, and compressor. At each



100-ton Locomotive

end is an operator's compartment with the necessary controls for the operation of the locomotive. The radiators for the oil engine are located on the roof.

The simplicity and ease of control are worthy of mention. One of the original problems was to make the control so simple that any steam locomotive engine man could operate the oil-electric after a few minutes of instruction. In order to make him feel at home, a throttle lever was provided similar to the steam loco-



Controls in Cab

motive throttle. This lever is connected to the engine fuel pump and is used to control the power demand from the engine.

The fact, that the engine power is governed by changing the speed, assists in making the control automatic. Overhung from the main generator is an exciter, which receives its excitation from a 32-volt storage battery. The exciter energizes the field of the main generator and charges the battery. In addition the main generator has a differential series field which automatically lowers the voltage under load, to maintain an approximately constant load on the power plant with varying tractive effort demands. When the throttle handle is in the off position, it opens a remotely controlled switch which in turn opens a contactor in the generator field circuit and contactors in the traction motor circuit. When the throttle handle is moved out of the off position, these contactors close before the engine has speeded up. Because the power is thus first applied at low engine speed, it is applied gradually. There are no current

(Continued on page 249)

Campus Notes

THOU SHALT WEEP AND WALK

Beware, all of you who drive your own car. No more will students be permitted to park their cars back of the Engineering Building, says an official report. Hereafter, only those cars bearing a special insignia,

the army engineering castle, attached to the license plate will be permitted to park at the back door. A special space will be left for visitors. The rest of us will have to leave our cars at the foot of the hill and walk.

S. P. E. E. SUMMER SCHOOL COMES TO WISCONSIN

For the past three years, the Society for Promotion of Engineering Education, through its Board of Investigation and Coordination, of which Prof. W. E. Wickenden is director, has been making an intensive study of the problems of engineering education. One of the recommendations contained in the recent preliminary report of the Board is that, "Schools be held in vacation periods for intensive training in the art and science of teaching as applied to engineering subjects."

Word has been received by Dean Turneaure that two summer schools for training in the teaching of engineering mechanics will be held this year. The University of Wisconsin has been selected for the location of the Western S. P. E. E. Summer School, while the Eastern school will be at Cornell University. The school will be under the auspices of the S. P. E. E., but the local authorities are cooperating in every way possible to make the session a success. It is expected that the session will cover a period of three weeks in July, but definite arrangements have not yet been completed. Announcements containing full information will be sent out as soon the plans are perfected.

Madison with its central location, its beautiful lakes and its other facilities for recreation, is an ideal location for this western summer school, and teachers attending the session should find it a pleasant vacation as well as a fine opportunity for professional study.

ENGINEERS IN VARSITY SHELL

It seems as though the sports at Wisconsin can not get along without the help of the engineers. At the present time the first varsity crew has four engineers included in their line-up. They are: Ralph Casselman, ch'29, Homer Kieweg, ch'28, Edwin Kesting, c'29, John Cullinane, c'29.

Little John is coxwain and is quite the boy when it comes to ordering the big men around.

The junior varsity has one engineer in the line-up, George J. Mueller, e'28.

The crew has been quite fortunate this year for Jack Frost let up on his usual ferocious attacks quite early. Now the waters of Lake Mendota are blown by the balmy breezes of Spring, and the old ship of Wisconsin can be seen darting about the lake every afternoon.

A PROBLEM IN MECHANICS

She: "How would you measure a pound of kisses?"
Engineer: "Oh, by compression."

ROUTE OF MARCHING FOR ST. PAT PARADE ANNOUNCED

The St. Pat parade on Saturday, April 23, will start at 1:30 back of the Engineering Building, according to L. J. Beck, general chairman. All society and fraternity floats and those marching should be ready to start off with the first toot of the band. St. Pat, represented by H. C. Weiss, min'28, will lead the parade.

Thirty-five men have turned out for the band, and anyone wishing to join should see L. J. Beck. All big and husky engineers, who wish to be policemen, should get in touch with R. E. Everett, e'27, or Jack Kanalz, c'29.

The route of marching is as follows: Down State St. to the square; around the square to Wisconsin Ave.; up Wisconsin Ave. to Langdon St.; up Langdon St. to the foot of the hill; and then to the front of the Engineering Building where a special ceremony of initiation into the Loyal Order of St. Pat will take place. Only senior engineers will be admitted to the order, and will go through a special ritual of initiation which, even though everybody is watching, only engineers will be able to see. The initiation is being planned by Marvin Hersh, c'29, and Rodney Dexter, e'29.

The final directions for the parade will be mimeographed and distributed to all engineers Friday, April 22, in the lobby of the Engineering Building. Watch for it.

TWENTY-FIVE FROSH RECEIVE HONOR OR HIGH HONOR GRADES

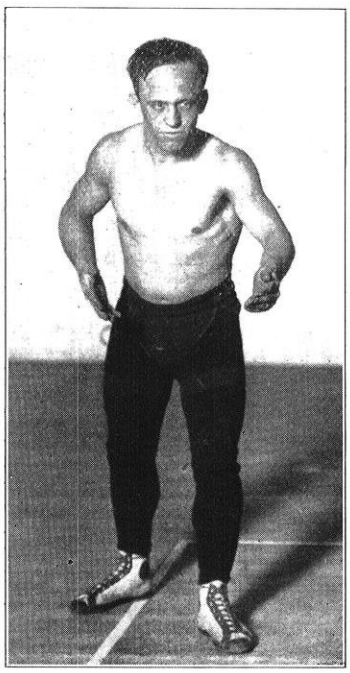
The list of freshmen engineers whose scholastic efforts were at the high honor or honor rate was recently announced by Prof. A. V. Millar, assistant dean of the College of Engineering. To merit a rating of high honors, a student must make at least two and three-quarters grade point per credit; for honors, two and one-quarter grade points per credit.

The men in the order of their ranking are as follows: high honor rate — G. C. Roeming, Martin Joos, and R. J. Kraut; honor rate — E. A. Johnson, E. R. Sonner, F. J. Gruper, S. L. Johnstone, R. S. Plotz, Charles Schwartz, R. W. Kubasta, J. R. Mueller, T. D. Tiemann, J. B. Catlin, D. M. Erikson, R. W. Fairweather, E. V. Antoni, A. H. Benesh, C. A. Silcott, G. S. Watson, N. H. Fritz, Edward Heberlein, F. F. Hornig, G. H. Nickoll, C. G. Niemann, V. G. Van Vlett.

PRIZES TO BE AWARDED SENIORS

Dean Turneaure has received word from the Society of Iron and Steel Fabricators of Milwaukee, through Mr. E. W. Krueger, president of Worden-Allen Company, that the society intends to offer prizes for high scholarship in Civil Engineering. Three prizes, totaling $300, will be offered. The awarding of the prizes is in the hands of a committee composed of faculty members and members of the Society. Announcement of prizes will be made about commencement time. Those eligible are Senior Civil Engineering students. Further details will be given later, and formal announcement will be made on the bulletin boards in a short time.

SOPHOMORE CHEMICAL WINS BIG TEN WRESTLING CHAMPIONSHIP



SMITZ, 29

Louis Smitz, ch'29, won the 115 pound Conference wrestling championship at Chicago, March 12. This is the second time that a Badger matman has brought a Big Ten wrestling title home.

Coming to the conference meet as a dark horse, Smitz surprised everybody and had little trouble beating Shaney of Ohio State in the final bout. Shaney had been favored to win the championship; however the Badger matman was a bit too clever for him and won after fifteen minutes of fast wrestling.

ENGINEERING FACULTY ENJOYS ITSELF AT ANNUAL PARTY

The faculty must dissipate!

The engineering faculty with wifes and sweethearts, gathered itself together, 110 strong, laid down its red pencil and exam papers, and enjoyed itself at the

annual faculty dinner, dance, and card party on March 21, at the Park Hotel.

The dance music was furnished by an orchestra from Tripp Hall. Louis H. Kessler, instructor in hydraulics, led the faculty in singing, while as a special feature, Mr. Pocock, manager of the Park Hotel, sang several songs.

A. S. M. E. HOLDS INITIATION

At the last meeting of the A. S. M. E. which took place on March seventeenth, the following men were initiated into the society: S. Kolton, E. Anderson, R. S. Hartenberg, G. W. Dary, H. L. Kuchlethan, C. F. Dirleth, R. R. Judson, C. H. Clark, L. B. Schuler, P. Farwell, and G. Schilstra.

After the initiation, Professor G. C. Wilson gave a short talk on A. S. M. E. and its benefits for students. After the regular business had been disposed of, coffee and doughnuts were served.

GRADUATE ENGINEERING FELLOWS ELECTED

There were fifteen candidates for the three $600.00 graduate fellowships to be filled for next year. At its March meeting the Engineering Faculty selected the following men for recommendation to the Regents for these fellowships.

Allan P. Colburn, — Fellowship in Chemical Engineering,

Oscar O. Fritsche, — Fellowship in Mining and Metallurgy,

William Z. Lidicker, — Fellowship in Hydraulic Engineering.

Two of these men, Colburn and Fritsche, are holding fellowships in the same subjects at the present time.

BILL SPLEES GOES INTO BUSINESS

His friends in the college of engineering will be interested to know that Bill Splees, former varsity wrestler, has gone into the restaurant business and now operates the Cardinal Restaurant on University Avenue.

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GETTING SETTLED

By G. C. WARD, '29

THERE is a certain type of man in every field of work, and in the engineering profession as well, called the "floater." He is constantly on the move, from job to job, never satisfied with his work, and constantly becoming more shiftless, careless, and inefficient. Employers fight shy of him as they would of the plague, and he keeps going down and down until he eventually finds himself on the human scrap heap, and folks are heard to say, "Jim Jones? Why . . yes, he did come from the same town I did, but I never knew him very well. Went to college and then he went out west — I knew he'd never make good. He's a floater."

Then there is the type that might be called the "stand-patter." He leaves college and goes out and gets a job as somebody's bookkeeper and performs in that capacity for the rest of his days, because he is too timid to venture forth and grab a few plums off the tree of life. He is a good hard worker and is known as a "steady" man and a first-class bookkeeper, but strangely enough his salary hovers around the fifteen-hundred-a-year mark, and his college education is used about as often as the proverbial cat's whiskers. When he finally crumples over his desk and they take him out and lay him away, the local editor scratches the hair off the rear half of his scalp trying to think of something to say about the man and then gives up in disgust and tells what a nice funeral it was.

The foregoing types are extremes, but they point the way to a course which combines the desirable elements of both. When an engineering graduate changes positions too often, his employers lose confidence in him, because they feel that his interest is chiefly in himself and not in the business organization which they have labored many years to build, and as a consequence he is regarded more or less as a temporary aid. On the other hand, the chap who takes a minor position with a large organization, and decides to trust in the Lord and a fast infield for promotion and advances in salary, is apt to subdue himself and his personal qualities in the organization of which he is a part, and he then becomes something of an automaton with a rapidly declining value.

It is possible, however, for the young man of ability to make judicious and well-considered changes and by so doing benefit himself immensely and increase his value to any organization with which he may be connected. And, in this connection, it is interesting to note the experiences of a large number of graduates of engineering colleges throughout the country, from some of the classes of late years.

Professor H. P. Hammond, a member of The Society for the Promotion of Engineering Education, made a study, during the latter part of 1925, of various phases of engineering education, and among them was considered the rapidity with which engineering graduates moved from one position to another during the first few years of their professional life. "These results show not merely different positions held in one firm, but represent essentially the shifting from one firm or type of position to another during the period of adjustment following graduation."

Professor Hammond sent out questionnaires to the members of graduating classes of 1922, 1923, and 1924 — a total of 3933 men were approached, of which only fifty-four failed to answer. The results are as follows:

		CLASS			
		1924	1922	1923	Totals
One position:	Number	542	835	988	2365
	Per cent	43.0	60.5	79.7	61.0
Two positions:	Number	403	365	252	1020
	Per cent	32.0	26.5	20.3	26.3
Three positions:	Number	315	179		494
	Per cent	25.0	13.0		12.7
Total number reporting		1260	1379	1240	3879
Failed to answer					54

Professor Hammond says, "It is found that there is a very considerable shifting about from job to job among the recent graduates. Of the graduates of 1922, 57.0 per cent have held two or more positions since graduation, and 25.0 per cent of these have held three or more positions. Of the class of 1923, 39.5 per cent similarly held two or more positions, and 13.0 per cent three or more. Even in a class graduating as recently as 1924, about 20 per cent have held two or more positions since graduation. The high degree of turnover indicated by these figures shows an unwise choice of first positions in altogether too high a percentage of cases. Of the graduates who do change positions many do not remain long enough in their first job to gain much experience or even obtain a clear conception of its ultimate possibilities. An undue amount of time is wasted by these graduates before they are established in their life's work. This high percentage of turnover among recent graduates could certainly have been reduced, it is believed, by more effective vocational guidance in the colleges. It is one of the encouraging signs of the times that some of our institutions have

(Continued on page 248)

THE FLASH OF GREEN The engineering spirit lives! Despite numerous tricks and subterfuges of the shysters across the way, St. Patrick's Day was duly and truly celebrated by his loyal sons, the engineers. Although the good old saint was unable to be present himself, he sent word through our old friend, Bill Lidicker, that he expects to get around about the twenty-third of April for the annual parade.

An unusually gratifying event of the day was the feather sale. It seemed to us that every engineer in the college was wearing his green feather, thus proudly boasting to the world of his chosen profession, and Larry Beck was hustling around with a happy smile on his face as the dimes came rolling in.

The lawyers got up before breakfast and painted the usual signs over our doorway and on our steps, and between classes all during the morning they gave vent to monkeylike howls from the steps of what is sometimes laughingly referred to as the Law School. A few of our long-distance sharpshooters stepped to the fore, however, and silenced the ambulance chasers with a few well-directed snowballs.

The next event of note on our calender is the Annual Engineers' Parade. Funds from the feather sale and the election of our St. Pat representative are unusually generous this year, and there is every prospect that the parade will be one of the best we've had. Let's keep our spirit at its present high power and show the shysters what a real parade looks like.

And one word to the arm-wavers across the campus: When the engineers start to paint the Law School, it will *stay painted!*

A CHAT WITH EUROPE BY TELEPHONE Telephone connections with Europe now being a reality, the magazine, *Industrial Management,* brings to our notice that in their very first issue, April, 1891, they published a leading article by Herbert Laws Webb, an electrical authority of that day, from which the following are extracts:

"The telephone is barely fifteen years old but for such a youthful addition to the modern galaxy of wonderful discoveries it has made a marvelous record for itself. Scarcely fifteen years ago it was looked upon as a scientific freak, and the majority of those who were priveleged to make the early acquaintance of the newcomer believed that it was doomed to the oblivion of the dusty shelves of museums and workshops. To-day the telephone forms the nucleus of a mighty industry. Within a few years its development has become far-reaching beyond the dreams of its inventor. By its agency speech is transmitted over the valleys and hills that separate great cities, and the capitol of the greatest European republic holds daily and nightly converse with the metropolis of the world on the foggy banks of the Thames. The telephone promises to play an even more important part than the telegraph in knitting the nations of the earth more closely together. Telephony between countries separated by the sea is an accomplished fact. Twenty years ago the prophet who would have ventured such a possibility would have been laughed to scorn.

"Who would venture to assert that fifty years hence telephony between the New World and the Old will not have been accomplished, and that 'a chat with Europe by telephone' will not become an every-day matter for those who shall be able to afford such a luxury?" —*J. H.*

A THOUGHT FOR OUR REGENTS We of Wisconsin are most fortunate in having a beautiful campus, one of the most beautiful of any school in the middle west. Our walks are broad, our trees are tall and stately, our halls are ivy covered, and our lake is blue and glistening. Our architect has adopted a standardized type of architecture for University buildings and all, both new and old, are welded into a harmonious whole.

But at night much of this beauty drops away. Save for a row of lamp-posts on each side of the upper campus, and a few lights on Lincoln Terrace, our buildings are dark and the campus is poorly illuminated. At one end of State Street is our beautiful state capitol, silhouetted against the evening sky with the clearness of a fine-cut cameo, while at the other end is a dim fastness of trees and shrubs with only an occasional light peeping through.

Why not flood-light some of the more important university buildings? Bascom Hall, flood-lighted, would present a beautiful spectacle from the foot of the campus, as well as from the lower part of State Street and the capitol. Flood-lighting Ag Hall would transform Henry Quadrangle into a gem of beauty, and a similar treatment of the Libe would make that stately structure take on a new appearance. Perhaps the Memorial Union, when completed, will be treated in this way from the Lake side, as well as from Langdon Street.

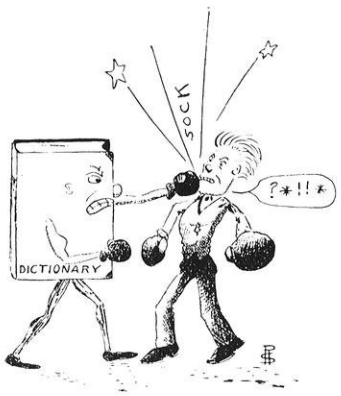
How about it?

CAMPUS NOTES

(Continued from page 231)

SENIORS BATTLE DICTIONARY

Seniors in Engineering English fought another round with Noah Webster recently, and had the old lexicographer groggy at the end of the bout. Here are the senior definitions as vouched for by Prof. Van Hagan:



Precept—seeing before.
Ominous—agreeable.
Lucrative—fluent talker.
Retinue—pit of the eye.
Exotic—gleeful.
Deference—postponement.
Salubrity—a well-known person.
Tenet—Part of a joint in a wooden structure.
Lacustrine—pertaining to the earth's crust.

RAILROADS AND MANUFACTURERS WILL AID IN LOCOMOTIVE WATER CRANE RESEARCHES

L. H. Kessler, instructor in the hydraulics department, attended the convention of the American Railway Engineers Association in Chicago, March 8 to 10, to inform railroad engineers and manufacturers of railroad equipment of the research done by the hydraulics department on the locomotive water crane.

The study of the resistance to flow in the locomotive water crane and the relief from hammer pressure which is built up when the valves are closed are very important problems to the railroads because thousands of dollars are spent every year replacing and repairing water cranes which have become broken or inefficient, due to resistance to flow or hammer pressure. The railroads and manufacturers were very interested in the researches carried on at the university and were willing to co-operate with Mr. Kessler in making tests on water cranes and in furnishing special equipment for further experimentation.

Actual tests will be performed in June on water cranes in various parts of the country, to confirm experimental conclusions and to gather new data. The results of the field trip and the experimental work done at the university, an entire year's effort, will be published as a university bulletin or as part of the procedings of the A. R. E. A.

The problems of resistance to flow and relief from hammer pressure are not only important to the railroads, but to power companies in the penstock lines of hydro-electric turbines.

Prof. and Mrs. C. I. Corp entertained the hydraulics instructors and the senior civils who are doing their thesis work in the hydraulics laboratory at a buffet supper on March 11.

BUNGALOWEN TO BE SCENE OF A. S. C. E. PARTY

Bungalowen, Prof. Ray S. Owen's cottage on the south shore of Lake Monona, will be the rendezvous of the civil engineers and their lady friends at the first annual spring party of the American Society of Civil Engineers.

The party, which is the first of its kind ever proposed by a student technical society on the campus, has been tentatively set for the afternoon and evening of Saturday, May 7. With good fellowship and jollity as its keynote, with outdoor games, dinner, and dancing, the memory of this gathering will long be cherished by those who attend. The committee in charge of the arrangements for this "fussing" party are Jacob Levin '27, Edward Birkenwald '27, and R. T. Homewood '27.

ENGINEERING EFFICIENCY

"Hi!" shouted Kelley to a bricklayer on the scaffold above him, "throw me a brick down."

"Phwat for?" demanded the bricklayer.

"Well," exclaimed Kelley, "don't I need one more to fill this hod I'm bringing up?"

TALK ON AUDIO FREQUENCY AMPLIFICATION FEATURES RADIO CLUB MEETING

"The radio public, through the popular radio magazines, has received the impression that as far as audio frequency amplification is concerned, resistance and impedence coupled amplifiers are superior to those employing transformer coupling," said Mr. Glenn Koehler, instructor in the communications division of the electrical engineering department, in a talk on audio frequency transformers before the Radio club on March 17.

Resistance and impedence coupled amplifiers have much to recommend them, but at the present time the manufacturers of audio frequency transformers have improved their product so much that an amplifier employing good transformers can successfully compete with any other audio amplifier as far as quality is concerned, Mr. Koehler pointed out. Formerly, manufacturers gave little thought to the design of transformers and as a result bad distortion took place. Impedence coupled amplifiers were a great improvement over these early transformer coupled sets, but today the reverse may be said to be true.

AS CHAUCER WOULD PUT IT

"Spring is inne, coming inne,
An egge hath my hamme,
Passeth bus, and splasheth us,
Loud singe,—gosh darn it!"

A. S. C. E. SHOWS FILM ON RAILROADING

A two-reel motion picture on "Modern Railroading" comprised the program of the A. S. C. E., at its bi-monthly meeting, held Thursday evening, March 17, in the Engineering auditorium.

PROF. KOMMERS WRITES BOOK ON FATIGUE OF METALS

Prof. J. B. Kommers of the mechanics department, and Prof. H. F. Moore of the University of Illinois are the authors of a new book on "Fatigue of Metals." It is being published and will be available within the next few months.

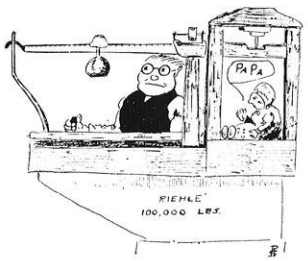
The book is an outgrowth of the investigation of Prof. Kommers and Prof. Moore in 1920 and 1921 at the University of Illinois. The investigation was sponsored by the National Research Council, the Engineering Foundation, the General Electric Company, and the University of Illinois.

"The book is an attempt to collect for the use of engineers the information available at the present time on the subject of fatigue," said Prof. Kommers. "The source material is scattered in a great variety of publications and it would be a very tedious task for the engineer who wanted some information on fatigue of metals to page through a lot of published material to find what he wanted. The book will obviate the necessity for this."

The book will give the latest experimental data and results and will discuss the various theories of fatigue failure which have been presented from time to time. In addition, it will contain several chapters describing work done on wood and concrete.

WATER PUMP ADDED TO PUMPING STATION

A new twin cylinder water pump, made by the Allis-Chalmers Mfg. Co. has been installed in the university pumping station back of the hydraulics laboratory. It is of the fly wheel type, capable of furnishing 2,000,000 gallons every twenty-four hours. The pump was added to take care of the increased use of water on the campus and to furnish a large volume in case of fire.



CONGRATULATIONS, CHRIS!

Mr. and Mrs. C. A. Wiepking announce the birth of a daughter, Georgianna Lucille, on Feb. 27. Mr. Wiepking is an instructor in the mechanics department.

PROF. CORP ATTENDS NATIONAL MEETING OF RESERVE OFFICERS' ASSN.

Prof C. I. Corp, professor of hydraulics, was in Washington, D. C., March 14 and 15 and attended a meeting of the national council of the Reserve Officers' Association. Prof. Corp is a national councilman from the sixth corp area, comprising Wisconsin, Illinois, and Michigan.

The meeting of the national council of the Reserve Officers' Association and a conference with the Secretary of War was called relative to new regulations for the reserve officer unit of the army which are being put into effect.

HE WAS! HE WAS!

The saying, "Music hath its charms," applies to engineers as well as to anybody else. In order to preserve the charms and traditions made famous by engineers in the past, Polygon is trying to collect and publish in a booklet all available songs, music, and verses sung at engineering society meetings, in former St. Pat parades, or on the front steps of the Engineering Building.

Just a few minutes is all the time necessary to write down any ditty, verse, or song that engineers have sung. And how about some new verses for "St. Patrick was an Engineer?"

Let's have any music, song, or verse that is appropriate. Just drop it in the *Wisconsin Engineer* contribution box or at the desk in the engineering library.

Might of the roaring boiler,
Force of the engine's thrust,
Strength of the sweating toiler,
Greatly in these we trust;
But back of them stands the Schemer,
The Thinker who drives things through,
Back of the Job—the Dreamer,
Who's making the dream come true.

From *The Thinker* by Berton Braley.

SENIOR CHEMICALS EXPERIMENT ON WATER VAPOR IN GASES

Senior chemicals, under the direction of Prof. Haugen, are experimenting upon methods of removing the water vapor with which water gas is always contaminated. The problem is a serious one to the manufacturers of water gas due to the fact that it always condenses and clogs up the mains. The men working on this experiment are C. H. Ruhnke, R. E. Zinn, Alfonse Tuppers, Allan Colburn, Lyle Ridgeway, Francis Herreld, and Francis Richardson.

Air laden with steam is pumped into a large condenser, seven feet high. The water vapor is condensed and the free air drawn away. Located in the condenser are forty-two thermocouples, used to carefully measure the cooling of the mixture. In the series of experiments which will last several years it is hoped to determine three things: 1. condenser characteristics for mixtures of gas and water vapor; 2. heat transfer coefficients; 3. mean temperature drop through the condenser. If this data is successfully determined, commercial condensers may be constructed directly from it resulting in a great saving of money.

PROF. OWEN WORKS ON ARMY PLANS IN CHICAGO

Prof. R. S. Owen spent two weeks in Chicago at the sixth corp army headquarters, working on mobilization plans for this corps area. His work consisted in preparing a report for a corps area intelligence school for reserve officers at Camp Douglas in case of mobilization of Wisconsin divisions.

(Continued on page 246)

Engineering Review

BIRTH OF POWER ENGINEERING

The earliest print or drawing of any kind showing the construction of an engine has recently been found in a library of one of the old Oxford Colleges. The print is dated 1717 and the drawing was by Henry Beighton, a man of scientific attainments who could appreciate the several points of the engine. Newcomen's first engine was probably put into action in 1712, and there is a print of this, but it is dated 1719, two years after the Beighton drawing. Newcomen did not invent the boiler, the cylinder, the piston or the idea of condensation, but he was the first to combine all of these in a practical manner, thus giving us what remained the standard form of engine for about a century and a half. Even after Watt had made his improvements in the eighteenth century Newcomen engines continued to be used.

In 1716 the first advertisement regarding Newcomen's engine was printed. It ran: "Whereas the invention of raising water by the impelling force of fire, authorized by Parliament, is lately brought to the greatest perfection, and all sorts of mines, etc., may be thereby drained and water raised to any height with more ease and less charge than with other methods hitherto used, as is sufficiently proved by divers engines of this invention now at work in the several counties of Stafford, Warwick, Cornwall and Flint . . . " This wording may well raise a smile when it is recalled that the engine which had been brought to "the greatest perfection," used about twenty to twenty-five pounds of coal per horsepower per hour. But Newcomen's engine marks the first step on the road which led to the industrial revolution and he it was who blazed the trail which leads directly to the wonderful super-power stations which are sprining up in every part of the world.

—Power Plant Engineering.

HORIZONTAL REFRACTION IN GEODETIC SURVEY WORK

Some interesting instances of horizontal refraction have been encountered by the Geodetic Survey of Canada in its survey work in that country. One outstanding instance of the lateral bending of light rays, was met when locating points along the lower St. Lawrence River. Here it was found that the lines across the river were apparently straight but those along the shore were bowed toward the river. After many tests it was decided that this was caused by the fact that under certain conditions, the air over the water was warmer and therefore of a different density, at night when the observations were made, than that over the land. This difference in density caused the beam to be bowed toward the river and then back to the instrument.

The deviation from the straight line in every case was very slight — from 3 to 20 seconds of arc, — but still sufficient to render useless the calculations based upon the observation. The difficulty was overcome by taking repeated observations on days, or at times of the day, when the layers of air over land and water were as near as possible of the same temperature, and hence more nearly of the same density.

—Engineering and Contracting

SOME TECHNICAL USES OF X-RAYS

The use of X-Ray treatments in the solution of technical problems is comparitively an old process, but few people realize the great importance of them when used in this capacity.

The principle and most important field in which X-Rays are being used is in the testing of materials. Huge castings and other iron and steel equipment are being tested before being assembled, and in that way defective parts are detected before the machinery or building is completely assembled. The X-Ray is able to penetrate the object and detect the slightest flaw in the texture of the material. In addition to disclosing this, the X-Rays can disclose the way in which the atoms are arranged in the ultimate particles of the material, the size of these particles, whether they are arranged in a particular or a random manner, what changes take place in these arrangements when the material is submitted to thermal, mechanical, or chemical treatment, whether two materials which have the same chemical composition, the same appearance under the microscope, or the same reaction to customary tests are really the same in atomic structure.

—Industrial and Engineering Chemistry

REFRACTORY CEMENT USES CHROMITE

A new high temperature cement has been recently placed on the market by the General Refractories Company. The basic component of this cement is chromite. It contains no sodium silicate or other quick-setting elements. The natural atmospheric quick-set has been intentionally retarded sufficiently to permit easy troweling without frequent addition of water. It sets hard and uniformly, and is said to maintain a constant bond through all temperatures. The fusion point is over 3,500 degrees Fahr. and the tensile strength is over 300 pounds.

—Engineering and Mining Journal

Alumni Notes

The following is taken from the "General Electric Monogram" March, 1927.

"In August, 1903, "Jack" Brobst gave an extra coat of varnish to the frame surrounding his brand new diploma certifying that the University of Wisconsin was satisfied to allow him to write "B. S. in E. E." after his name, carefully did up in moth balls the sweater with the varsity letter he had earned in baseball, took a lingering look at his native Wisconsin farm and started for Schenectady. He had no job at the latter — merely hope. Arrived there, he also infused A. L. Rohrer, who at that time had charge of the Testing Department, with hope. Both of them have been vindicated; Mr. Brobst is today Designing Engineer of the Industrial Control Department at Schenectady and Bloomfield.

"JACK" BROBST

It was a steady climb up the ladder. Mr. Brobst spent thirty months in the Testing Department, all but three of them in night work. His final job there was head of the "Floor", nights.

Early in 1906 he transferred to the engineering work on automobile starters and generators, spending one year at the Fort Wayne plant, on this work, together with design on small farm power plants. In 1915 he was transferred to what was then the Power and Mining Department, and two years later to the Industrial Conrol Engineering Department as Assistant to C. D. Knight. In 1920 he was appointed to the position he now holds.

He is greatly interested in the training of engineers coming from the Testing Department and did pioneer work in this field.

As to avocations, golf leaves him unenthusiastic. But bowling—ah, there's the game that is a game! "Jack" can—and does—average 190 on the alley. He is a pinch bowler who is never "rattled" and can be depended on to wreak havoc among the pins. Likewise, he can average 90 per cent with a trap gun; control engineering training, again, maybe. He still likes baseball—but preferably from a grandstand seat. His automobile he regards as a convenience rather than a pleasure, and he finds it very useful to get him to and from camping sites and trout streams in the Adirondacks. He is actively engaged in the Boy Scout cause.

Mr. Brobst is one of those whose list of friends is practically identical with that of his acquaintances, and those who knew him in his Test Department days will tell you that in genial democratic personality, and in kindness and earnestness, time has left him wholly unchanged."

ELECTRICALS

Adhya, G. M., e'26, has resigned his position at the Fairbank Morse Company, at Beloit, to enter into the employ of the Commonwealth Power Corp., at Jackson, Michigan, where he is engaged in designing high tension power transmission lines. His address is % Y. M. C. A., Jackson, Michigan.

Agan, James B., e'29, left school at the end of the first semester to take a position with the power and light company at Green Bay, Wis. He is living at the Y. M. C. A.

Alfery, H. F., e'24, writes Prof. Bennett, "I am still with the Duquesne Light Co., and find working conditions pleasant and the work interesting. I have been teaching a class in the company's night school for employees in elementary mathemetics and thermodynamics, the students being power station employees, such as maintenance men, stoker operators, water tenders, turbine operators, etc. My work in the office is analyzing operating statisics and test records wih a view of reducing the cost of power production in connection with the turbine rooms and, to a lesser extent, with the boiler rooms." He can be reached at 705 Irwin Ave., N. S., Pittsburgh, Penn.

Bacon, V. R., e'14, is with Day and Zimmerman Engineering and Construction Company, of Philadelphia. Mr. Bacon's home address is 85 South Landsdowne Ave., Landsdowne, Pa.

Clark, L. W., e'23, left the employment of the Westinghouse Co., on March 1, and has taken a position with the A. C. Nelson Co., Chicago, Ill.

Cowan, Glen P., e'11, recently purchased the Mulkey Salt Company, of Detroit.

Crosby, M. G., e'26, who completed his course at the University in February, has taken a position with the Radio Corporation of America, in New York City.

Conley, B. L., e'18, MS'20, EE'26, has resigned his position as electrical engineer for the Hoover Co. of Canton, Ohio, and is now chief research engineer with the Emerson Electric and Mfg. Co., of St. Louis. His new address is 5880 Enright Ave., St. Louis, Mo.

Frost, D. K., e'04, who was employed with the General Electric Company at Schenectady, for sixteen years has severed his connection with that company and is now electrical engineer for the Mattison Machinery Works of the Machinery Methods Co., Rockford, Illinois.

Herdegen, R. T., e'05, recently visited the U. W. Club at Detroit, Michigan, and was a guest at one of its noon luncheons.

Johnson, C. E., e'26, who was with the Northern States Power Co., at Eau Claire, Wis., has changed positions and is now working for the Commonwealth Power Corp., at Jackson, Michigan.

Kavanaugh, P. E., e'25, who has been employed in the Testing Department of the General Electric Company since August 5, 1925, has completed his training as a student engineer and has accepted a position with the Commonwealth Power Corporation, Jackson, Michigan. Mr. Kavanaugh's home is in Madison, Wisconsin.

Knott, W. M., e'23, has entered the service of the U. S. Signal Corps and is now stationed at the McCook Field at Dayton, Ohio. The work he is taking up is to be chiefly in connection with the development of aeroplane transmitters and receivers for the use of the Signal Corps.

Moriarity, E. W., e'08, Spalding Bldg., Portland, Oregon, writes, "In the very next office to our real estate office is the firm of Cunningham and Barr, engineers. J. W.

Cunningham is a civil '08, my class, and with him is Teidelhack, of gym fame."

Palmer, Ray, e'01, has just completed a piece of work which is highly commended in the Gas Age-Record for February 12. When the franchise of the Public Service Co., of Colorado expired last May, the voters of the City of Denver rejected a renewal of the contract. The city chose Mr. Palmer to make a thorough investigation and to recommend a solution. The franchise which he offered was adopted by the voters by a two and a half to one majority. There was no recourse to the courts and none of the usual political bickerings, but instead, there were open discussions by all parties concerned to determine what was best for the utility, the customer, and the future of the city of Denver, and, as a result, everyone is satisfied with having received a square deal.

Purucker, Ralph E., e'24, was married to Miss Wilma Elizabeth Kluender, of Edgerton, at Belvidere, Ill., on March 8. Mr. Purucker is connected with the electrical department of the railroad commission. They will be at home in Madison after April 1.

Richmond, L. P., e'23, is with the General Electric Co. at Schenectady, and writes of his varied experiences. "For the first six months I tested receivers in the radio dept. Then for a few months I had maintenance work on the test apparatus. I also put in a month testing carrier current apparatus and small transmitters. After about ten months on test, I was given an opportunity in the radio receiver laboratory, where I was engaged in development work for nearly a year. For the last year and a half, I have been in the super-heterodyne section, specializing in work on that type of receiver. My chief experience there has been in connection with the radio frequency end and the general panel layout. I have also built some of the apparatus used in this laboratory, such as oscillators, tube volt-meters, etc." Mr. Richmond stays at 21 Governor's Lane, Schenectady, N. Y.

Sharratt, C. W., e'25, representative for the Bell Telephone System, was at the university on March 4 and 5, interviewing engineering students relative to future employment.

Theimann, V. A., e'25, who has been doing drafting and design work for the Stone and Webster Co., at Boston, has returned to Wisconsin and is now engaged in special design and estimating work for the Wisconsin Public Service Corporation at Green Bay.

Thomas, G. H., e'24, met and interviewed non-technical students at the university on March 4 and 5, in the interests of the Bell Telephone System.

Wolfe, Harry, e'26, former editor of the Engineer, spent several days at the University as advance agent for the Westinghouse Electric Company. His address is 1305 Walnut St., Wilkensburg, Pa.

A LONE MINER

Werba, Edward, min'19, is now results engineer with the Grand Rapids Gas and Light Co., Grand Rapids, Mich. Mr. Werba vigorously denies the rumor that he is to be married. His address is 711 Fountain St., N. E. Grand Rapids, Michigan.

CIVILS

The **Military Engineer** for March-April carries two articles by Wisconsin graduates. **P. K. Schuyler,** c'21, who is a captain in the Coast Artillery Corps Reserve, writes on **The Mexican National Highway System** and **Edward K. Smith,** c'14, a captain in the Corps of Engineers Reserve, Consulting Engineers, Monadnock Building, Chicago.

Bartelson, Glenn S., c'25, is with Maury and Gordon, Consulting Engineers, Monodnock Building, Chicago.

Gillette, Paul C., c'18, in a letter to Prof. Volk, states, "I have been exceedingly rushed in taking care of valuation jobs in Burlington, Barre, Montpelier, and St. Albans, Vermont, for Mr. Barker of Barker & Wheeler, New York City. I finally finished up the work and am headed to New York. I hope that the Wisconsin Engineer has been progressing successfully this year. If there is any way in which I can help in its success, I will be very glad to do so.

I am planning on taking a vacation down through Kentucky and Florida, and expect to visit the hydro-electric project at Dix Dam and Louisville."

Hirsch, Edmund, c'24, is employed with H. C. Webster, consulting engineer of Milwaukee. His address is 1188 47th St., Milwaukee.

Nelson, Russell, c'26, is associated with his father in general contracting work in Madison. His latest piece of work was the placing of a foundation in connection with the installation of the new 2,000,000 gallon pump recently put into operation in the University Pumping Station.

Reynolds, Thos., c'12, of the La Crosse Division of the State Highway Commission, was elected president of the Wisconsin Club of that city. The new officers were chosen at the annual Founders Day meeting, which was ended by a spirited banquet, attended by a hundred alumni of the vicinity.

Richards, J. T., c'95, is affiliated with the engineering department of the Eastman Kodak Company, at Rochester, New York.

Rick, Norman, c'25, is acting in the capacity of assistant engineer for the Wisconsin Valley Electric Company, at Wausau. His address is 903 Seventh St., Wausau, Wis.

Smith, Robert, c'13, was married to Miss Marian Landsdowne, at her home in Kenosha, on January 22. Mr. Smith is at present city engineer of Kenosha. They are now at home at 6022 Third Avenue.

Mackay, Scott, has been appointed associate professor of Metallurgy. Prof. Mackay holds a B. S., 1913, from Rensselaer Polytechnic Institute and an M. S., 1926 from Wisconsin.

Berg, John, c'05, CE'19, state engineer of South Dakota, was re-elected president of the South Dakota Society of Engineers and Architects at the recent convention.

CHEMICALS

Breitenbach, W. E., ch'24, will leave the Marathon Paper Mills, Rothschild, Wisconsin, to take employment in the new sulphite mill now being constructed in the state of Washington, near Olympia.

Buckingham, Lyman E., ch'21, was married on March 12, to Miss Regina May Jones. Mr. Buckingham is affiliated with the Carborundum Company. They will be at home at 5000 Jackson Ave., N. Merchantville, N. J.

Fulkerson, R. P., ch'24, who is employed by the Proctor and Gamble Co., gives his address as 362 St. Marks Place, Staten Island, N. Y.

Hamblen, J. B., ch'21, has received the degree of M. S. in gas and fuel engineering at the Massachusetts Institute of Technology, and has taken a position on the technical staff of the Standard Oil Company. His address is 413-119 St., Whiting, Indiana.

Lacey, W. R., ch'18, formerly commercial manager with the Milwaukee Coke and Gas Co., has joined the organization of the Home Incinerator Co., of Milwaukee.

Mackey, W. C., ch'17, is sales engineer for the Universal Gypsum and Lime Co., manufacturers of "Insulex". He was in Madison on March 16th in connection with an installation being made in one of the new fraternity houses and while here called on friends on the campus. His residence address is 524 2nd St., Waukegan, Ill.

MECHANICALS

Bird, E. A., m'26, has completed his cadet training course at the Bailey Meter Co., and has been transferred to the erection department of the Fuller Lehigh Co., another subsidiary of the Babcock Wilcox Co. He can be reached through the Fuller Lehigh Co., at Fullerton, Pa.

Dresen, J. I., m'20, writes that he is leaving the Ogden Engineering Company, of Ottawa, Ill., where he was engaged in plant design.

Gunther, Gustav, Jr., m'24, has become engaged to Miss Henrietta Webster of Milwaukee. Mr. Gunther is employed at the Chain Belt Co., 753 Ellicott St., Buffalo, N. Y.

Henry, L. L., m'15, is listed among the recent visitors at the noon luncheons of the Detroit U. W. Club.

Jones, H. G., m'26, who is in the power plant of the Procter and Gamble Mfg. Co. writes, "After I had worked around the boiler room and learned about natural gas combustion, they possessed the idea that I was efficient enough to take charge, and ever since I have progressed gradually. I had no idea that so much interesting work could be tied up in the place. I am finding in the engine room another phase of the plant which attracts as well." His address is % the company, 1226 Loomis St., Dallas, Texas.

McMillan, L. B., M. E.'14, is Chief Engineer of Johns Manville, Inc., New York. At the Heat Transfer Session arranged by the National Research Council Committee on Heat Transfer, Mr. Millan presented a paper entitled "The State of Existing Data on Heat Transfer Through Insulation in the Moderate and High Temperature Fields." The paper has received high editorial praise and has been reprinted in the American Gas Journal.

Mason, Chas. T., m'99, has recently been appointed general superintendent of the Joliet works of the Illinois Steel Co. Mr. Mason entered the employ of the concern immediately upon graduation, progressing through the mechanical and engineering departments up to the office of assistant general superintendent, which position he has held for some years prior to his present appointment.

Polaski, Steve, m'26, former varsity football captain, coached the St. John's Military Academy eleven through a most successful season last fall during which only one game was lost. After the season, Steve picked the Forsyth Leather Co., of Wauwatosa, from a number of offers and in answering inquires as to his present status he writes:

1. I was and am working.
2. Am happy and so is the family.
3. Receive a living salary and have prospects.
4. Have made considerable use of my college training and expect to use more every day."

His address is 202 Avon Court. Wauwatosa, Wisconsin.

Traver, C. H., m'26, finished his undergraduate work at the university in February and has taken a position in the engineering department of the Leach Co., at Oshkosh, Wis., in which **B. A. Wiedeman** is Chief Engineer.

Zamzow, G. L., m'24, is Testing Engineer with the Chicago Surface Lines. His address is 1030 N. Central Ave., Chicago.

CAMPUS NOTES

(Continued from page 237)

AN ENGINEER'S IMPRESSIONS OF HIS WORKSHOP

A jagged trail beside the silvery lake . . . A lone figure standing in mute admiration of a glorious spectacle, while the tiny burro patiently twirls his ears in the shadow of the pines . . . The unbroken surface of the mountain lake reflecting the June sunset in chaotic splendor . . . The tall, sturdy red oak just off the trail silhouetted against the heavens, like a mighty leader towering head and shoulder above the scrub pines scattered helter skelter along the mountain slope . . . Darkness creeping on, unnoticed . . . The shadowy mists closing, closing bring a feeling of desolate loneliness, heightened by the now cold grayness of the whispering lake . . . A tiny, guttering point of light, growing and growing and soon becoming a dancing campfire, thrusting back the forces of the night and laughing a challenge to the spectre of loneliness . . . A host of dancing shadows and grotesque figures, jostling each other for a place about the circle of yellow firelight . . . The smell of the crisp bacon and the coffee mingled with the fragrance of wood smoke . . . A glowing coal in the bowl of a pipe, puffed reminiscently in the red glow of the embers . . . The forces of darkness, once defeated, now slowly closing in on the dying fire . . . Deepening night . . . The call of an owl from the crest of the hill. —*Jack Rivers,* m'29

—OR A FLYWHEEL

Prof, after explaining measurement of horsepower of various engines: "Are there any questions?"

Bright civil: "How would you measure the horsepower of a donkey engine?"

1927 THESIS STUDIES

(Continued from page 226)

pressed air needed in small plants such as this one is. G. J. Heimerl and W. Z. Lidicker are testing an air lift pumping unit (designed by L. H. Kessler) at the Oscar Mayer Packing Plant in East Madison. Air lift pump efficiencies as high as 65% with 52% submergence have been obtained. The eduction pipe is 174 feet long.

H. W. Hastings and George F. Liddle have a small experimental activated sludge plant in the sanitary laboratory, with which they have been studying the treatment of creamery wastes.

A. F. Horst, S. E. Ulrich, and O. K. Zeugner have been experimenting with a locomotive water crane in the Hydraulic Laboratory, to determine the flow losses and develop methods for relieving water hammer produced by the sudden closure of the valve. This work is a

continuation of experiments conducted last summer by L. H. Kessler, and has attracted wide interest among water service engineers of the railroads. Several roads have offered their facilities in the field for further studies along this line.

Figure 2 shows the base of the crane with gauges, relief valves, and water hammer recording mechanism in place.

W. O. Held is studying the loss of head due to flow through small wrought iron pipes. This is part of a series of experiments on pipes of various diameters soon to be published as a bulletin.

C. J. Westrich has been studying the loss of head due to flow through pipes with various bend radii. His apparatus consisted of a flexible pipe which could be made to conform to any curvature desired.

In addition to the graduate and undergraduate theses noted above, instructors in the department have been working on various problems. C. P. Lindner, is experimenting on rotary pumps, L. H. Kessler has a bulletin in preparation on losses due to flow in wrought iron pipe, and C. I. Corp and H. T. Hartwell have a bulletin now in press on the losses due to flow through pipe bends. An article will be published in the May issue of the *Wisconsin Engineer* giving some of the main results of the pipe bend bulletin.

GETTING SETTLED

(Continued from page 232)

realized this need and are meeting it through the introduction of personnel systems and the selection of personal advisors, either from among the faculty or individuals specially designated for the work, and through more informal means giving to prospective graduates reliable information as to the various lines of work open to graduates. It must be admitted, however, that only a fair start has been made. It is also probably true that the methods employed by the industries in the selection of graduates are not yet as completely organized and scientific as they ought to be if the turnover of young engineering graduates in industry is to be reduced. Perhaps this is partly a problem of coordination of industrial and collegiate personnel methods."

There seem, to be then, three principles involved in this business of getting ahead in the engineering profession:

1. Choose your first position wisely.
2. Consider changes carefully.
3. Deliver the goods.

HIGHWAY CONSTRUCTION IN MEXICO

(Continued from page 227)

some 40,000 automobiles in the Republic of Mexico at the present time, which is a very small number considering the population and the area of the Republic. A good system of highways will be of great benefit to the country as it will enable farmers to get their crops to market, miners to get their ore out, and will

also tend to prevent the rather frequent uprisings that have been and still are occuring, for if good roads are available troops may be moved rapidly by motor truck to the scene of such disturbances.

CUBA BUILDS NEW CAPITOL

(Continued from page 228)

The construction is being done by the Purdy and Henderson Co., an engineering and contracting firm with organizations in Canada, the United States, and Cuba. In the United States its work is limited consulting practice, but in Cuba and Canada construction is also undertaken. The Cuban organization is composed chiefly of native engineers educated either in the United States, or at the University of Havana. Mr. Purdy, senior member of the firm, is a graduate of the University of Wisconsin, class of 1885. Designs, plans, specifications, and inspection are being furnished by a governmental board of public works, assisted by the enginering organization of the Purdy and Henderson Company.

The work has been under way for about a year now, and probably could be finished within another year if complete plans were in the hands of the builders. However, in so large a project, minor changes and revisions are constantly being made, and this is especially true in this instance where the original plans were unsatisfactory in many details. This has hampered the contractors in organizing a definite program to effect the most rapid rate of construction. At present it is expected that completion will require about two more years.

OIL ELECTRIC LOCOMOTIVES

(Continued from page 229)

limiting resistors between the traction motors and the generator. Then, as the engine is speeded up by a further movement of the throttle handle, the exciter voltage automatically rises, which increases the generator excitation, and the increasing generator speed further increases its voltage. The differential series field immediately begins to act and tends to reduce the generator voltage sufficiently to prevent overloading the engine. As the locomotive gets under way and less current is required for tractive effort, the decreasing series field allows the voltage to rise automatically to utilize the full power of the oil engine for increased locomotive speed. A small electric controller, which corresponds to the reversing lever of a steam locomotive, is provided at each operator's position to reverse the motors, and to provide series and parallel motor combinations.

On the 100-ton locomotive the generators are connected in parallel. If any of you have ever attempted to operate two d-c. generators in parallel you may have opened breakers or flashed over a generator because they would not divide the load properly. This difficulty is not encountered here because the generators are connected to a flexible source of power so that if one machine tends to take more than its share of the loads, it automatically reduces the speed of its driving

engine to a point where the loads balance. Furthermore, the action of the differential series fields helps to stabilize the system.

The oil engine is started by compressed air. For initial starting an engine driven compressor is used which is small enough to be cranked by hand. The oil engine is equipped with a small compressor to automatically replenish the air supply for starting. Thus, the auxiliary engine compressor set is very infrequently used. Control is arranged so that the engine may be started or stopped from either operating position.

There are under construction for the New York Central, two higher powered locomotives. The unique feature of these two locomotives is that the New York Central specifications require the locomotives to be arranged for multiple unit operation, each with another of its kind. The multiple unit control of motor combinations and reversers is nothing new, and is quite common on electric locomotives. Train cables carrying control wires are connected between the two locomotives, so that power for operating contactors, reversers, and switches is supplied simultaneously from one controller. The problem of starting, stopping and controlling the speeds of two oil engines, each in different locomotives, was a new problem. This was accomplished by making the engine throttle electro-pneumatically operated, and applying electro-pneumatic valves to the air starting valves. This permits the use of train cables between locomotives, similar to those used on electric locomotives.

The New York Central has recently purchased a locomotive which may be termed a trolley, 3rd rail, storage battery, oil electric locomotive. It will be equipped with the ordinary control for electric locomotive with trolley and third rail shoes for operation as a straight electric locomotive when operating in electrified sections. In addition, there is a storage battery which will furnish power for the traction motors when the locomotive is operating on non-electrified track. A 300-h. p. oil engine generator set is also provided to charge the battery and for operation in multiple with the battery, to make the locomotive independent of outside power supply for battery charging. The control will be arranged so that the power supply to the motors will be transferred from trolley to battery when leaving an electrified section, or vice versa when entering an electrified section.

BRIDGE BUILDING IN SOUTH AMERICA

(Continued from page 225)

better. It is hard to please everybody and it is easier to see mistakes after they have been made than look ahead and avoid them.

At first the contractor's intention was to make the earthwork either with a traveling dredge or with bullocks, ploughs, and scrapers, but finally it was done by men with wheelbarrows.

In sinking the columns a bed of coarse sharp sand was passed, but not enough for the concrete and mortar. The contractors made a well in a convenient

place and tried to bring it up with a bucket dredge but the sand was too stiff and did not run into and fill the buckets, so the attempt was given up after a good deal of trouble and expense. A less suitable fine sand was carted from a place about fifteen miles away.

The Argentine national government supplied and sent the cement, steel, and paint in barges towed up the Parana; and delivered it on the left bank a little above La Paz, at a place where the charcoal burners shipped their charcoal down stream for way ports and the capital.

The most difficult part of the contract, the land transport of about 100 miles to the bridge site, was solved by the contractors, who arranged with the charcoal burners and their carters to take as much as they could on their return trips from La Paz.

The carters preferred cement and paint, which were easy to handle, but the long iron beams they did not like, and left to the very last when there was nothing else to load. One cross girder, the heaviest single piece, was hung up in the branches of a tree for quite a long time, the cart broke down and the girder was left for convenience of loading when the cart was mended. They travelled in troops of four or five carts and; when one got stuck, they added the oxen from another until the bad place was passed. The bullocks were driven by a sharp nail in the end of a long bamboo "picana".

The painting cost much more than was expected, owing to the deplorable state of the steel, long left exposed to the weather on the ground. Two coats were applied. It would have saved trouble if the first had differed slightly in color from the second, so that there would have been no doubt about the steel having gotten the two coats specified.

No lives were lost, nor were any of the men injured; perhaps due to absence of places for the sale of liquor. The contractors did their work well; both worked hard personally and attended strictly to business. They had little overhead expenses, except perhaps, interest for money borrowed, and cleared a reasonable profit, which they well deserved.

To suit the fixed abutments to a movable river bed is not easy, it takes care to fix them so that they will serve their purpose for some thirty years, which is the life of a steel bridge.

MEMORIAL UNION STRUCTURAL DESIGN

(Continued from page 223)

of the span, the concrete joist is widened at the support and thereby the unit compressive stress in the bottom of the joist is reduced at the support. The unit shear on the concrete joist is also reduced by the same process.

In the Alumni Hall — a dance floor — a live load of 100 pounds per square foot was used. In the third floor of the Tripp Commons Building a live load of 40 pounds per square foot was used. These loadings are in accordance with the requirements of the Wis-

consin Industrial Commission. Some rooms will have terrazzo floors, others will have wood floors (wood finish on top of the basic concrete construction), while others will have floors covered with linoleum. Thus we have varying live load and dead load requirements in the different portions of the two buildings.

From the above it may be seen that the live load, floor finish, weight of the construction, span length or combination of span lengths, and the degree of continuity of the joists all have a bearing on the design of a concrete-joist floor system. This will serve to bring to mind the work connected with a particular phase of the structural design.

Now I shall describe briefly the order of procedure which I generally follow in the structural design of a building. Bear in mind that there are three or four or a dozen other fellows working on the job at the same time. They all want to know the sizes of various floor slabs, beams, columns and footings in different parts of the building at the same time. In designing a reinforced concrete beam the structural engineer is interested in its width and depth, the size and bending of the longitudinal rods and the spacing of stirrups. But the architectural designer is interested only in the width and depth of a beam. Therefore I arrange my work so as to give the architectural men the information they need first and then I complete the structural design while they complete the architectural design.

At the beginning of a job I am furnished paper tracings of the floor plans. On these the framing schemes for the floors and roof are laid out. Roof-truss column loads are calculated without making any designs. The sizes of floor joists, beams, columns and footings are determined next. Now the architect can proceed with his work while I go back and fill in the gaps in mine. Most of my work is done in tabular form with a pad of letter-size double-ruled computation paper, pencil, slide rule, scale, steel handbook and a few design diagrams. Colored pencils are used to good advantage in studying various framing schemes on paper.

Our specifications require that the contractor must furnish us with shop drawings of structural and reinforcing steel. These must be checked before the work proceeds. In the case of the Memorial Union and Tripp Commons buildings about sixty sheets of structural details have been checked. This is an important job in itself and requires a good deal of time and patience.

Finally, while I have attempted to show that the structural design of a building is subordinate to architectural consideration, yet at the same time I have tried to show that it can become just as interesting as the design of a bridge or other engineering structure. Also I have attempted to point out some of the problems which were encountered and give the reasons for the solutions which were adopted.

"What's the future with a large organization?" That is what college men want to know, first of all. The question is best answered by the accomplishments of others with similar training and like opportunities. This is one of a series of advertisements portraying the progress at Westinghouse of college graduates off the campus some five—eight—ten years. Write for booklet reprinting the entire series.

He went in for instruments—with a vengeance!

H. P. SPARKES

WHEN H. P. Sparkes (Alabama Polytechnic '17) finished the Engineering School at Westinghouse he went in for instrument design. His career since then has been punctuated with solid accomplishments.

By the end of his fourth year here he had completed a thesis for his E.E. and had embodied the results of this thesis in an indicating watt meter—one of the largest in size ever built up to that day.

Shortly thereafter, because of his special interest in the instrument field, he was dispatched on an engineering trip abroad, visiting and working in England, Norway, Sweden, Denmark, and France. Upon his return he entered commercial work and was assigned to the Pittsburgh territory—(including such industrial centers as Cleveland, Youngstown, Pittsburgh)—as specialist responsible for the sales, service, and operation of watthour meters, instruments, and relays in this important district. Here he will be found today, acting as intermediary between the sales force on the one hand and the engineering and factory departments on the other. He backs up the salesmen with a highly specialized knowledge. He advises with the engineers and with the factory in the design and manufacture of apparatus that is best suited to commercial requirements.

His own pioneering spirit has still found field for play, so that this year he demonstrated to the A.I.E.E. the first advance in the method of calibrating watthour meters in thirty years. Some 16,000,000 tests of watthour meters are made in this country annually. They cost about 20c apiece. Sparkes has devised a practicable method that chops more than 50% off this bill. It eliminates the human element; it gives greatly improved accuracy.

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