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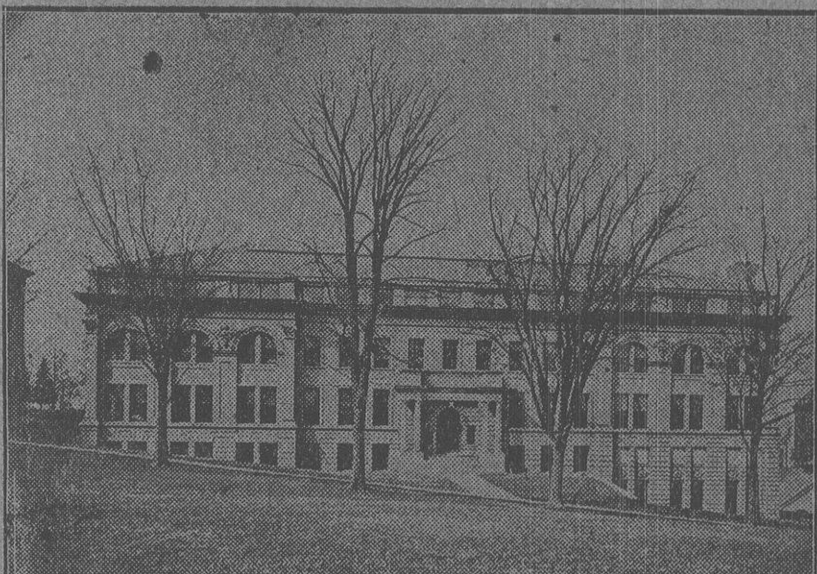
THE

WISCONSIN ENGINEER

Vol. 8 JUNE, 1904 No. 4



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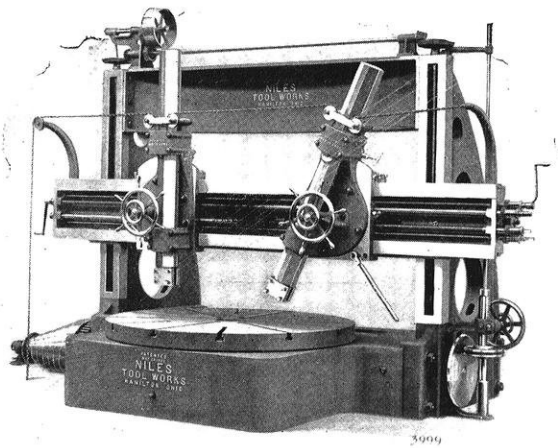

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Contents

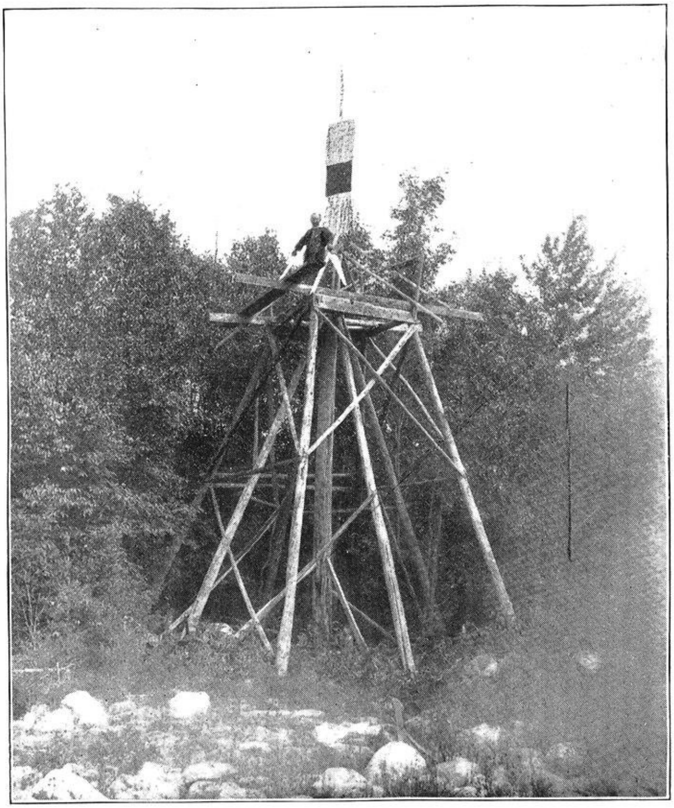
THE WISCONSIN ENGINEER

VOL. 8 JUNE, 1904 NO. 4

PRIMARY TRIANGULATION ON LAKE HURON.

By SHERMAN MOORE, '02, U. S. Junior Engineer.

During the many years that the United States Lake Survey has been engaged in general and particular surveys of the Great Lake region, there has been executed triangulation of considerable extent as a basis for the work. A primary system follows the south shore of Lakes Ontario and Erie to Toledo, crosses to the southern extremity of Lake Michigan, follows the western shore of that lake up through Wisconsin, and crosses the Northern Peninsula to Lake Superior over which it spreads in a net with some lines one hundred miles in length. Near Green Bay a branch crosses to Fox Island, and from there connects at the Mackinaw Base with another branch brought down from the Superior net by way of the St. Marys River. There is a small isolated system of primary work at Saginaw Bay. Most of this work was done in the early days under the direction of Gen. Comstock, and is of excellect quality. Secondary systems with an accuracy almost equal to that usually obtained on primary work, cover the St. Lawrence, the Detroit, and the St. Clair rivers. There is besides the usual amount of secondary and tertiary triangulation along all of the lake shores, necessary for a topographic and hydrographic control. Work of this latter character is constantly being done as the progress of the surveys demands it, but during the last ten years there has been no primary work executed.



Station Beaver Tail Point.

26 feet center post Station built in 1851, and used as secondary point in 1903.

In 1903, however, a party took the field for the purpose of connecting, by a primary net, the survey of the Georgian Bay region, made by the British Admirality with the Mackinaw Base. This net consists of three quadrilaterals extending across Lake Huron from the line Mackinac—Robinson, which is but one figure removed from the base. From stations Reid and Duck a connection with the Canadian system is obtained through a narrow quadrilateral. From the line Bruder—Presque Isle, the system narrows through a well conditioned pentagon to a system of quadrilaterals extending south along the western shore of Lake Huron for the purpose of connecting with the isolated system of Saginaw Bay. The plan, I believe, is to finally connect with the system on Lake Erie, either by new primary work or by the excellent secondary systems on the St. Clair and Detroit rivers. No reconnaisance for this work has been made south of Alpena.

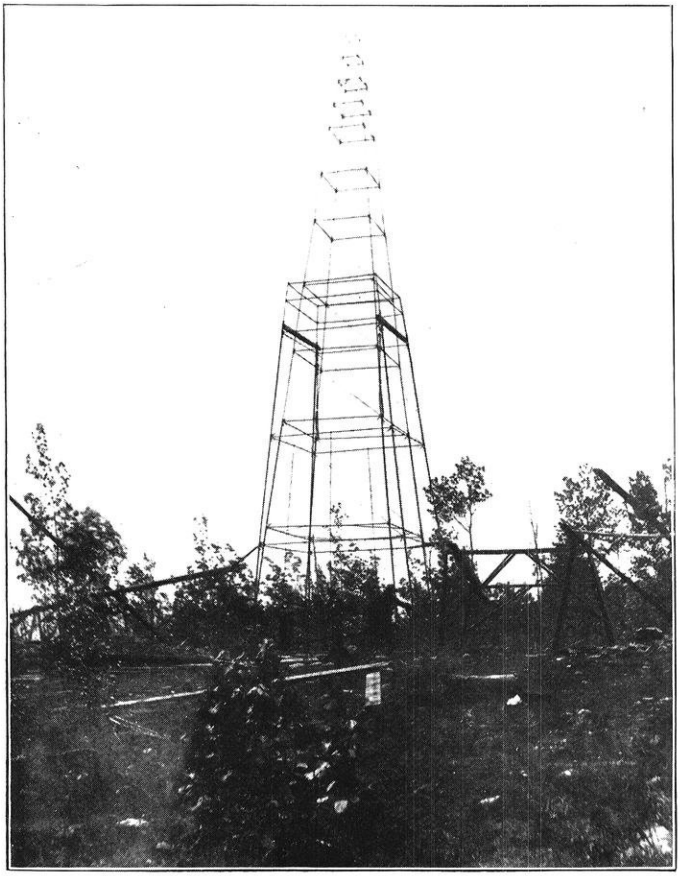
Owing to the length of the lines in the upper portion of this new system, stations of considerable height were necessary. Timber suitable for stations of 90 or 100 feet is now very expensive, in fact is almost unobtainable in most localities. Hence it was decided to substitute metal, and to make the towers of such a form that they could be readily removed from one point to another. This latter provision was to make them available for use on the lower portion of the work, where, although the lines are relatively short, the prevalence of high timber would otherwise necessitate considerable expense in clearing lines. A design for a station to be built of gaspipe was made by Junior Engineer H. F. Johnson, and was adopted. Contracts were let for six stations, which were delivered in May.

A complete station consists of two concentric towers, each of six 18 foot sections. The inner tower terminates in a 4 foot instrument stand, making a tripod 112 feet in height. The outer carries an additional section with two platforms, one for the observer and an upper one for the heliotrope or target. The total height to the top railing is 122 feet. Each tower is square in plan, with bases 23 and 30 feet on a side. The legs have a batter of one in ten, and are connected at each 18 foot section by horizontal girts. In the upper panels additional horizontal girts are introduced to make the height of the sub-panel not much greater than its width. Diagonal bracing is introduced into each panel and sub-panel. Where the girts exceed 10 feet in length, sway bracing extends in a horizontal plane connecting adjacent girts at points about one-third of their length from the corners, and central stiffening verticals are introduced.

The whole station with the exception of the diagonal bracing is of gaspipe. Each piece was cut to length and

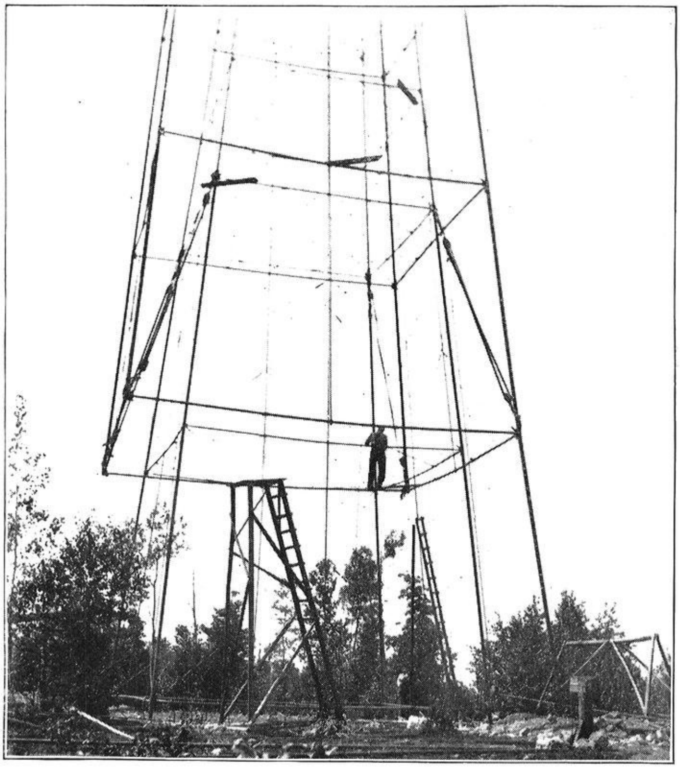
Station Duck.
Gaspipe Triangulation Station complete.
Great Duck Id. Ontario.

threaded in the shops. Connections are made by special castings into which the pieces screw. The corner posts range in size from $\frac{3}{4}$-inch at the top, to 3-inch pipe at the bottom. The cross girts range from $\frac{3}{4}$-inch to 2-inch pipe. In the first two sections, when they are less than 9 feet long, the girts are single pieces of pipe, threaded left and right. Below the second section they are made of four pieces connected by Y's and a cross, which take the sway bracing and the central verticals. Most of the sway bracing and all the verticals, excepting those in the lower two sections of the outer tower, are of $\frac{1}{2}$-inch pipe. The diagonal bracing is soft steel rods $\frac{3}{8}$ and $\frac{5}{8}$ inches in diameter, upset at the ends where necessary to allow for the threads. Where these braces would exceed 18 feet in length, they are made of two rods connected by a turnbuckle. All screw with right and left threads into clevises which are bolted to legs on the corner castings.



Gaspipe Station in process of erection.
The inside tower suspended from the outside tower.

Experience showed the following to be the most convenient method of erection. The first two sections, 36 feet, of the inner tower was built on the ground. This was painted and then lifted to an upright position. The weight of these two sections being only 500 pounds, this was easily done by six or eight men. All of the remaining pieces were painted before they went into the structure. Next, two sides of the first 9 feet of the outer tower, each carrying one of the floor beams attached by special straps, were put together on the ground, raised against the standing portion, and the connecting girts and tie rods put in place. Blocks were then fastened to the top of the inner tower and to the bottom of the outside section at each corner, and the latter raised high enough to permit the next 9-foot half section to be built under it. The blocks were then shifted to the bottom



Gaspipe Tower during Erection.
Outside tower supported from inside tower.

and the whole lifted again. When two full sections of the outer tower had been built, the blocks were shifted to the outside tower; and the inside tower was raised. In this manner, by raising alternately the inside and the outside towers, nearly all of the work was done on the ground. It was not necessary to send any man higher than thirty-six feet, and then only to shift the blocks. The lighter lifting was done with double blocks and $\frac{5}{8}$-inch ropes, but as soon as the weight became considerable, triple blocks and $\frac{7}{8}$-inch rope were substituted. Eight men lifted the towers easily, hauling either on all four corners at once or on one side at a time until the last section of the outside tower was reached. Then luffs were rigged with double blocks on two opposite corners, a rope fastened taut between the other two corners to resist deformation due to the inward pull of the tackle, and the tower lifted by two corners. When a team was available, one horse on each luff saved both time and labor.

When both towers had been raised 108 feet, the foundations were put in. These consisted of concrete masonry blocks, one at each corner of each tower. Those for the outer tower contained about 64 cubic feet, and those for the inner tower 27 cubic feet of masonry. The surfaces of these blocks were usually below the plow-line. The legs of the tower ended in short pieces of pipe threaded right and left for adjustment, and a cast-iron foot-plate about 16 inches square. These plates were fastened to the concrete by four half-inch anchor bolts extending entirely through the concrete, with large washers on their lower ends. The mortar was rather lean, mixed by guess in the proportions of about one to four. For stone, use was made of the hardheads which were always to be found in abundance near by.

When the towers were securely on their foundations, a bosun chair was slung on each of the four sides from the floor beams, and the joints painted, the sway bracing of the outside tower put in (this had to be omitted in building to permit the lifting of the inner tower within the outer), and the tie rods adjusted. At the same time other men built the upper section and the platforms. An elevator was experimented upon, but proved unsatisfactory, and instead a wooden adder was placed on the outer tower.

Gaspipe Station during Erection.
Entering a Big Leg.

The construction party consisted of ten men: The engineer in charge, Mr. H. F. Johnson; his assistant, a carpenter, six survey men, young men hired for the summer who served as heliotropers during observation work, and the cook. The party lived in camp throughout the season, from the 1st of June until the 1st of December. During the season this party erected five stations, averaging ten working days on each. The tower on Duck Island, of which a view is shown, was built in seven and one-half working days, with two of the men absent most of the time with the team.

These stations proved fairly stiff. One man on the observing platform with his back against one tower and his feet against the other could by a steady push produce only about one-half inch of relative movement. Each station, exclusive of platforms and foundations weighs about 9000 pounds. They are easily erected, and can be taken down and moved to another point in a very short time. As the longest piece is only eighteen feet they are readily transported. Last season one tower was carried in two loads from Alpena to Great Duck Island, a distance of seventy miles, in the thirty foot launch "Azimuth", which served as errand boat and transport for the party. The contract price of each station at Detroit was about $650. It is estimated that a station can be taken down, moved a distance of fifty miles, and re-erected at a cost not to exceed $350.

Only one of these stations has been occupied. That one, at Station Detour, gave excellent results. There was some vibration on windy days, but not enough to make pointing unsatisfactory. The maximum correction at this station for station error was 0.18 seconds. More than one-half the work was done in a twenty mile wind.

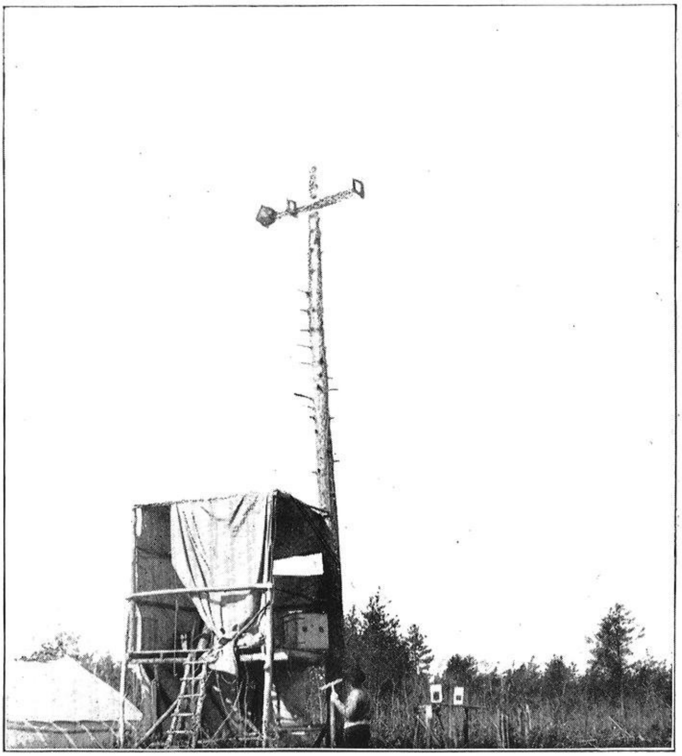
During the summer the weather proved very unfavorable for observing. Only four stations were occupied, with an average of nineteen days at each station. The instrument used was an old style Troughton and Sims direction theodolite with a fourteen inch circle read by three micrometer microscopes to tenths of seconds. The telescope was about thirty inches long with a two and one-half inch objective and a magnifying power of thirty diameters. It was provided with five single vertical cross threads. The instrument also carried a good vertical circle read by two micrometers. Each angle was measured separately. The program of observation was as follows:

Instrument Direct.

Point on A and read micrometers.
Point on B " " "
Point on B " " "
Point on A " " "

Reverse and Repeat.

This constituted one set. One set was read on each angle on each of five positions of the circle. The back angle, and such semi-angles as were to be used in computation were also read, and occasionally others. All primary pointings were on heliotropes, as the length of the lines made the use of targets impracticable or unadvisable. The maximum cor-

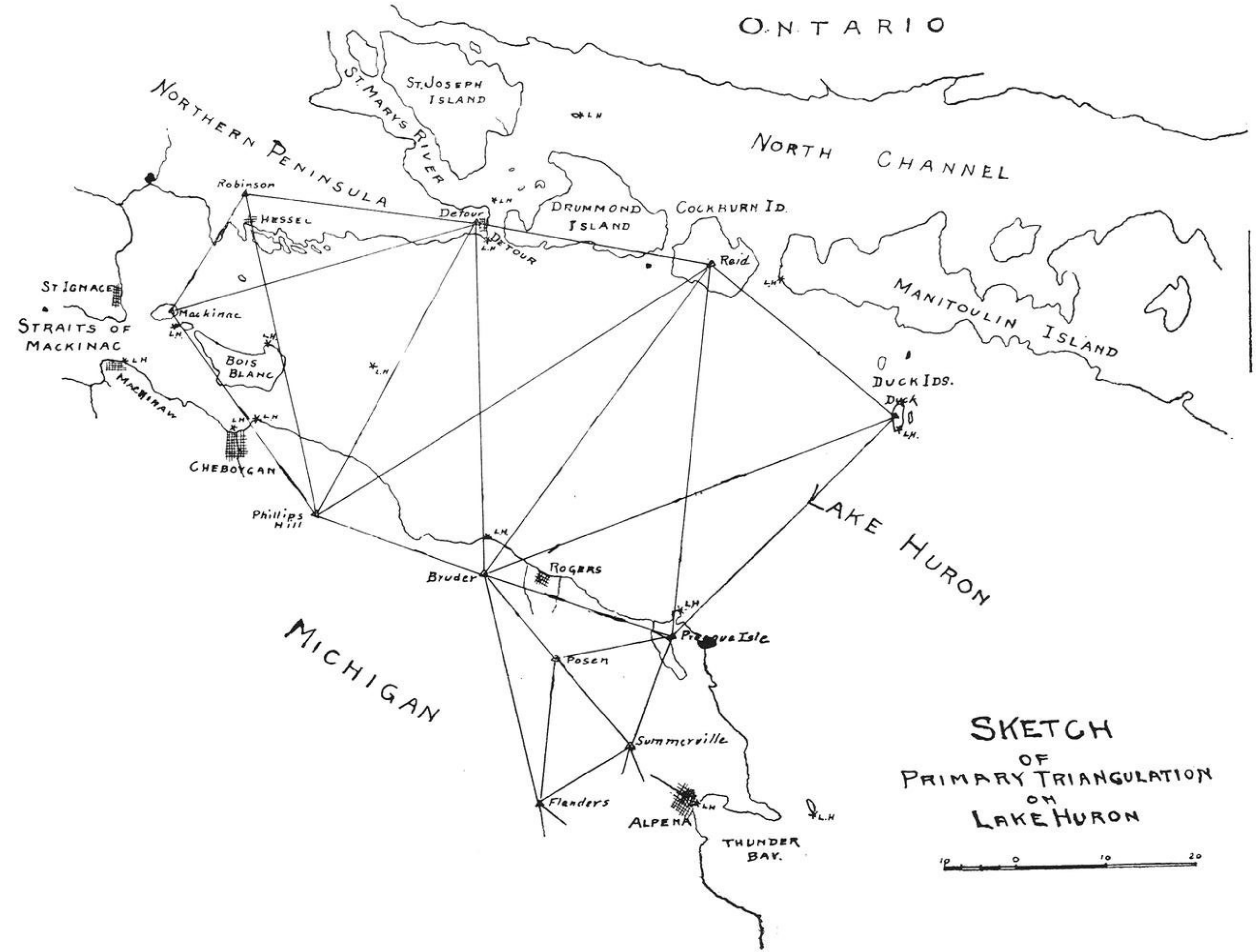


Station Phillips Hill.
Showing heliotrope on stub. Elevated to be visible from Station Reid.

rection to angles in the first quadrelateral was 0.45 seconds, and the maximum correction for triangle closure was 0.52 seconds.

At Station Phillips Hill, in September, an unusual condition of refraction gave trouble. The line Phillips Hill-Reid is 53 miles long. Station Phillips Hill is on a hill 350 feet above the lake, and has a twelve foot tripod. Station Reid is on the top of Cockburn Island which rises 480 feet above the lake, and has a sixteen foot tripod. Under normal conditions the line of sight should pass at least forty feet above the lake. But on only two days during the twenty-eight which the party spent at Phillips Hill, was the heliotrope on Station Reid visible from the station. On one other day, it was visible plainly from a point about twelve feet above the instrument. The height of station Phillips Hill was determined by barometric readings checked by angles to the lake. That of Reid was taken from Canadian Surveys. It is no unusual thing to see abnormally great refraction, especially in the region of the upper Lakes, but I do not remember ever seeing any account of such abnormally low refraction.

This work is to be continued during the coming season, and it is hoped that it will be completed by next fall as far as Alpena.



SKETCH OF PRIMARY TRIANGULATION ON LAKE HURON

THE PRACTICAL LIFE OF A CIVIL ENGINEER IN RAILROAD WORK.

BY GEO. W. KITTREDGE, CHIEF ENGINEER OF THE BIG FOUR RAILROAD.*

Some time last fall Professor Taylor asked me to come to Madison and give a talk to you boys. I told him I was too busy to prepare much of a paper, but if a talk was really what he wanted, and would allow a postponement until now, I would be glad to do it.

It is probable that some of you will take up railroad work, and those who are so inclined will be interested to hear something about the engineering phase of the business. Those not so inclined may be willing to learn a little of what their classmates may sometime be doing. Therefore I have selected for my talk the subject, "The Practical Life of a Civil Engineer in Connection with Railroad Work."

First let me tell you something about the business and organization of a railroad system, for nowadays there are few railways; they are mostly systems. Until a person gets into the study of it, it seems a comparatively easy matter to transport passengers and freight, but a student will not have progressed very far before he will be amazed at the great amount of detail found, and the great amount of care and application needed to bring about successful results.

In the organization there is first the Board of Directors, usually composed of those who own or control the bonds and stock of the company. Then the President. He must be a big man in every sense of the word. In his hands are the financial management and the outlining of general policies to be followed. He not only directs affairs of the present, but discerns and plans for the future. The officers reporting

*Lecture delivered in auditorium of Engineering Building, Friday, March 4, 1904.

to him are the respective heads of the various departments, sometimes with titles of vice-presidents, and sometimes with titles whose names indicate their respective branches of service.

The Secretary keeps record of all organizations, keeps the minutes of the Directors' meetings, attests all contracts signed by the President, and stamps them with the railway company's seal, of which he is the custodian.

The Auditor audits all accounts and checks all bills. He has a multitude of clerks, accountants and book-keepers, as every way-bill issued for the movement of freight, and all tickets collected must pass through his hands for verification.

The Treasurer, with his assistants, pay-masters, etc., handles the cash and disburses the funds.

In the Department of Law are the General Counsel and his Assistants, the local attorneys at points through which the road runs, the tax agents, claim agents, cow coroners, etc. They handle all legal matters, pass upon forms of contracts, etc. Multifarious and complex are their duties.

The Freight and Passenger Managers, with their division freight and passenger agents, solicitors, agents, rate clerks, division clerks, etc., are responsible for soliciting and routing of business, making rates and division of rates. This is a most important branch of the business, and advertising is a very extensive part of it. Business is frequently obtained and routed in consequence of the attractive features presented in favor of the successful carrier.

The General Manager is in charge of the construction and the operating department. Here are to be found the most subdivisions, and as this is the department in which the civil engineer will find himself first enrolled, I will tell you something about it. Take a road already constructed, it has to be operated and maintained. The title of the head of this operating and maintenance department is frequently vice-president and general manager, and sometimes general manager, and sometimes manager. His staff officers are, first, Purchasing Agent, who buys all supplies, from a paper of pins to the largest and heaviest machinery, and who sells all materials to be disposed of, such as scrap, old worn out cars, engines, etc.; second, General Superintendent, in charge of transportation and the record and distribution of equipment; third, Superintendent of Motive Power, in charge of motive power, rolling stock and machinery; and fourth, Chief Engineer, in charge of construction and maintenance of way. There are frequently others, such as Superintendent of Mails, Fuel, Agents, etc., who report direct to the General Manager. These are general officers whose duties extend over the entire system.

For purposes of economic operation a system is divided into divisions, about 300 miles (sometimes more and sometimes less) in length. On each division is a superintendent, who is or should be the king bee on his division. He must be a man capable of serving many masters. He comes in close contact with manufacturers and shippers, and must know how to meet and deal with them. He is subordinate to the General Superintendent in matters of handling trains and disposition of equipment, methods of switching, discipline of train crews, etc., to the Superintendent of Motive Power in matters of maintenance of engines, cars, shops, etc., and to the Chief Engineer in matters of construction and maintenance of roadway, tracks, bridges, buildings, etc. He must know that the work on his division is being carefully watched and looked after, and that public interests are properly and promptly served. The staff officers are Train Masters, with their dispatchers and operators, conductors and trainmen, the master mechanic who presides over the repair shops and looks after the engines, cars, etc., and the Division Engineer or Engineer of Maintenance of Way, who has under his direction the roadway, track, bridges, buildings, signals, etc.

Now we are getting down near the starting point for a young man just out of school. I have no doubt some graduates will be disappointed if they do not at once step into a position of chief of party in the field, or bridge designer in the office, but let me tell you, boys the main thing for you is to take a position—no matter what it is except that the better it is the more pleased you ought to be—and make up your mind to stick to it. I would advise getting a place on some large road where there are opportunities for advancement. I want to impress upon you that the position which you first accept may be a good one even if it has no high sounding title, and even if it doesn't bring you as much money as you think your services are worth. You can much better afford to spend a few years at the beginning of your career in making haste slowly, if by so doing you are laying a good foundation for your future growth and advancement. Therefore don't be too particular about the title you will receive or the pay you will get, but look rather to what you can learn, and how you can prepare yourself for future responsibilities.

After you once get a position your promotion and advancement will depend upon yourself in 99 cases out of 100. If you put the proper effort and zest into your work, even if the work seems unimportant, you may rest assured that it will not escape the attention of your superior officers. In railroad work, especially, there are lots of things that seem trivial and unimportant, but someone has got to do them.

Assuming now that you have a position, and to make the matter more pleasant and attractive let us suppose you are getting a salary large enough to enable you to live in comfortable quarters, to buy a few books occasionally, and to subscribe to some of the technical journals, in addition to keeping up a membership in your school and class societies. Your first duties will be making tracings, platting field notes of surveys and levels run, holding rod, carrying chain, or running the transit or level. Pretty soon some one will want to establish an industry along your line of road, and you will be told "Go out to Bradford and see what Mr. Blank wants, and how we can accomodate him." That is all that is said to you, and it is up to you to do the rest, and immediately the work gets more interesting.

For the next four or five or six years your work increases, and your time and efforts will be spent in many ways. You will be called upon to get up plans to develop industries, to make surveys and estimates for changes in allignment and for the elimination of grades, to design, stake out and over-see the construction of bridges, culverts and other structures. You will have to hunt up records of right of way and property, and to establish and permanently monument the company's real estate. Encroachments by outsiders will be found and these encroachments will have to be covered by leases or the squatters made to vacate. In these and many other ways you will be getting experience, and if you are keen and bright you will have given special heed to the subjects of handling men, and of how to get work done. Your advancement to responsible charge of work will depend largely upon your ability in these two particulars.

As a division engineer you will have a good many responsibilities. First of all you are personally responsible for the safety of your track and your bridges. You will have your track supervisors, your bridge supervisors, and your signal supervisors, but you yourself must know the exact condition, so far as safety is concerned, of your track and your bridges, and this you acquire through personal inspection, through reports of physical appearance and through calculations. What is safe track? This will depend entirely upon what is expected of it. If it is high speed trunk line, where heavy trains make eighty miles per hour, it is one thing. If it is a commercial track, a side track on which are set cars for receiving and delivering freight, where the cars are probably placed in the morning and removed in the evening by a slowly moving switch engine, it is quite another thing. In the first case your roadway must be of ample dimensions, usually 20 to 24 feet wide at sub-grade for a single track, with an additional 13 feet for each additional track, so constructed as to give proper drainage; your ballast must be clean broken stone or gravel, or equivalent, of sufficient depth and in sufficient quantities to keep the ties well supported and to hold them in line. The ties must be of sufficient size to distribute the weights of the engines and trains to the ballast, and of such age that they can be depended upon to stand up under the punishment that they will receive. The tie in most general use in the middle section of the United States is the white oak, its size varying from 7″ thick by 8″ wide by 8′ 6″ long to 6″ thick by 7″ wide by 8′ long, and in its natural state its life in a railroad track is about ten years. The use of so called inferior woods which have been subjected to treatment for prolonging their life is largely increasing, made necessary by the vast inroads upon the available timber supplies.

The rails must be in good condition, securely fastened to each other and to the ties. The rails used by trunk lines weigh from 75 to 100 pounds per yard, and in side lines or branches from 50 to 70 pounds per yard, and the length of the individual rail is 30 to 33 feet. A rail is described by its weight per yard; *e. g.*, an 80-pound rail is one weighing 80 pounds per yard. There are many forms of joints to fasten the rails together, the most common form being the angle bar, which has a vertical leg that fits in between the head and the base of the rail that gives vertical stiffness, and a nearly horizontal leg that furnishes lateral stability, and provides a place for spiking so as to prevent the rails from creeping. Angle bars are fastened in place by bolts $\frac{3}{4}$″ or $\frac{7}{8}$″ or 1″ in diameter, their number being usually four or six to each joint. It is now quite a general custom to stagger the bolts in a joint, that is alternate the position of the head with reference to the center line of the track; *e. g.*, the end bolt is put in with the end bolt on the inside of the rail, the next one with the head on the outside, the object being to protect the joint from injury due to derailed wheels. There are also many forms of patented joints—Weber, Continuous, Bonzano, etc., some built upon the principle of a bridge or support under the rails, some built like girders with dependent parts below the rails, etc. Each of the different kinds has its advocates.

The line must be in good line and surface and cross levee to be safe. By line of the track I mean the condition of the track in regard to uniformity in direction over short distances on tangents or uniformity in variation in direction over short distances on curves. By the surface of the track, I mean the condition of the track as to vertical evenness or smoothness over short distances. By cross level I mean that on straight track the tops of both lines of rails must be at the same elevation, and on curves the top of one line of rails must be elevated above the top of the other by a certain amount, to be determined by the speed and character of the trains over it. Obviously the elevation of one rail over the other that would be suitable for a passenger train moving eighty miles per hour would be too great for a freight train moving eight miles per hour, and might result in breaking of the trucks or the upsetting of the loaded cars. Again on a single track road a curve elevated for trains ascending a heavy grade would not be sufficiently elevated for trains rapidly descending it in the other direction. Usually the high speed train receives the most consideration, and the curve is elevated accordingly, although it might be true economy to lessen the elevation so as to make the freight trains pull more easily and slow the descending passenger trains to such speed as would make them ride comfortably. The elevation of the outer rails on curves is a very important matter, and the reputation and name of an entire system are made or marred according as its curves ride well or poorly. In order to have the elevation at all times adjusted to the curvature some form of easement curve must be used.

A spiral, or other similar curve whose radius at starting is infinity and constantly becomes less as the curve progresses, is the theoretical curve with which to join a tangent and a circular curve. If speed is high the curvature ought not to increase more than one degree in 100 feet, though physical obstacles may make it impractical to use a better one than one whose curvature increases one degree in 30, 40 or 50 feet. For a speed over 60 miles per hour an easement curve whose curvature increases one degree in 200 feet would be desirable. Where spirals or similar curves are impossible it is necessary to run the elevation out on the straight track—a very objectionable thing from the standpoint of comfortable riding.

There are a great many details of track work that will come under your charge and direction that are little things in themselves, but which go to make up the difference between good track and excellent track. A spike will probably hold as much whether it is driven near one edge of the tie or near the other, but in strictly first-class track it is one evidence of refinement to see all the spikes driven uniformly, *e. g.* it is essential for the maintenance of proper guage that the spikes should be driven so as to resist any movement of the tie. It is essential also that the spikes at each end of any one tie shall be separated as much as possible. These conditions make it necessary to drive the inside spikes on the same side of the tie, and the outside spikes on the outside side. For purposes of uniformity and as a matter of detail we specify that the inside spikes must be driven on the east side of the tie. In the same way we specify that the east bolt of each joint shall be placed with the head on the inside. It is easy to remember "inside spike on east edge of tie," and easy to remember "head of east bolt on inside of rail." The position of the other spikes and bolts naturally follows, and the men don't get confused in trying to remember too much.

The cost of preparing roadway to receive track varies very largely according to the location, the character of the country through which it passes, and whether or not there are tunnels, heavy bridging, etc. A certain stretch of road that is now being built for a double-track road will cost $90,000.00 per mile, while another piece of road of about the same length, but in a very different country will cost only $20,000.00 per mile. In the former there are heavy cuttings and high embankments and many bridges, while in the latter the cuts and fills are light and nearly balance each other, and the bridging is insignificant. General rules as to the cost of roadway cannot exist, but each has to be worked out itself.

In regard to the cost of tracks, at the present current prices new main track costs from $8,000.00 to $10,000.00 per mile, according to the weight of rail used and the kind of ballast. Side tracks cost from $5,500.00 to $6,000.00 per mile. The above figures assume that the roadway has been graded and made ready to receive them.

The cost of maintaining main tracks is about $1,000.00 per mile for high speed roads, and about $500.00 per mile for branches or side lines. Side tracks can be maintained for about $300.00 per mile. The methods of track maintenance are similar to a considerable extent on all roads of the same character. The division engineer, whose salary is $1,200.00 to $2,400.00 per annum, has under him his track supervisors. These men are in charge of districts varying from 50 to 100 miles in length. The supervisors are paid about $100.00 per month (from $75.00 to $135.00, depending upon the importance of their territory). They have under them section foremen, who have charge of about five miles of track. The pay of these section foremen varies from $40.00 to $60.00 per month. These foremen have under them four or five men for country sections, and up to 20, 30 or 40 men for yards and terminals. These laborers are paid from $1.25 to $2.00 per day according to location.

The supervisors are responsible for the materials asked for and distribute the various supplies needed on the sections. Supplies, such as bolts and spikes and tools, are usually kept at division headquarters in charge of a storekeeper. If the section foreman wants spikes, he makes requisition upon the storekeeper, who O. K.'s the request and sends it to the division engineer, who in turn directs the storekeeper to ship, provided the requisition is approved. Supervisors make a report each month of all material used, stating whether or not it is used in construction or maintenance, and whether used in main tracks, sidings or yards.

The accounting in the office of the division engineer is most interesting, and at first seems quite complicated, but upon becoming familiar with it it is more simple. Take the rails for example: when purchased the quality and value are entered upon the records, with the name of the manufacturer. When they are used record is kept of whether laid in main track or side track, and if laid in renewals credit is given for the quantity and value of the rails released. Inventories are taken every six months or year by actual count of all materials on hand, and the books are brought to balance.

An organization of the bridge and building branch of the service is similar to the track branch. Supervisors of bridges and buildings are paid $90.00 to $150.00 per month. They have their bridge gangs, and their buildings' gangs, composed of foremen, carpenters or masons and helpers. These men are paid from $2.50 to $3.50 per day for foremen, $2.00 to $2.50 for carpenters, and $1.50 to $1.75 per day for helpers.

The position of a division engineer is full of interest. There can be no monotony for the work changes so often and there are so many different things to be watched and regulated, that follow each other in such rapid succession, demanding your attention in the office and on the road, that each subject has been supplanted by another before it becomes tiresome. Then you have to keep up with so many branches that there is no opportunity to get rusty. There are constantly before you all sorts of problems that must be met and solved. Suppose for example you are called upon to design a terminal yard for a division. First how many trains must be accomodated. From what direction do these trains come and in what direction do they go; how many cars are handled in a train; is the volume of business large enough to warrant the establishment of a hump or gravity yard, or will the old fashioned push and pull yard answer the requirements and perform the work in the most economical manner. Where must the engine house be located, and what design must be followed to make it convenient and serviceable. Where locate the coaling station, and how shall the coal be handled to the coaling chutes; by inclined track or by hoisting machinery of some kind; how shall cinders and ashes be disposed of. Where shall the repair tracks be located. Will the ground that is available suit this plan or that. How much can be spent in acquiring additional land to bring about economic operation and maintenance. Where will you locate the scales. How will you operate switches and entrances to yards; by hand or by power appliances, and if the latter, what kind. How shall the yards, engine house, etc. be lighted. When you have decided on the kind and plan of the yards where will you get the materials with which to grade it. How will you drain it—and right here let me say that probably in the maintenance of a railroad no one subject is more important than the subject of drainage—without good drainage you cannot do anything economically or satisfactorily. It is often far better to incur a large outlay to properly drain your property than to try and get along in some way without it.

Construction work offers a great field for the engineer to display his abilities. In my opinion the construction engineer should have served his apprenticeship at maintenance so as to fully appreciate the necessities for his work. If he has put in many hours trying to overcome the difficulties resulting from faulty or bad construction he will be more apt to reach a desirable conclusion than if he never had had that experience. The man in charge of construction might be able to save a considerable sum of money by following certain methods, *e. g.* he might be able to cross a certain valley by means of a timber trestle at a small cost while to do the work permanently might call for a large expenditure. In the long run the permanent work might be the cheaper, and if the engineer has wrestled with the maintenance and repair of long and high timber trestles he will more readily appreciate the false economy of saving a few dollars at the outset.

Just where to draw the line is a question always before the engineer, and in many instances he must follow plans fixed by business principles rather than engineering ones. From what method will the greatest efficiency result. Shall the gradients be kept down to a minimum at large first cost, or shall the first cost be kept small, and helpers or pusher engines be maintained at intervals to get trains over the hills. Construction work demands the most careful thought. After once constructed your road must be lived with and operated over for years to come and the ability of a construction engineer is judged by the correctness with which he provides for what will happen. He can't look at the present only, he must live much in the future.

Whether his work is on maintenance or construction he must be alert. "Eternal Vigilance", etc. is well applied to the work of the civil engineer on railroads. Thousands of lives and thousands of dollars worth of property are dependent upon him and upon his work for safe movement from place to place. To fill his position creditably he must work hard and long. If at the age of thirty he commands a salary of $1800 per annum he may be called a success. One of the most attractive features of the profession is the fact that the upward limit knows no bounds. From the position of engineer he should look for that of superintendent, from superintendent to that of general superintendent, and from general superintendent to general manager, etc. Many of the best and most noted railroad men of this country have begun their railroad careers as civil engineers. The profession is still highly respectable and honorable and there is still plenty of room at the top. Those who enter it should aim at and strive for the topmost round in the ladder, and should not be satisfied with anything less.

THE NEW WATER STORAGE SYSTEM FOR THE UNIVERSITY OF WISCONSIN.

BY C. I. KING.

The year 1876 marked a new era in the history of the University of Wisconsin. In November of this year the first Science Hall was nearly completed, and some real recognition was given to the University by the state and legislature.

The addition of this building rendered it imperative that some kind of water supply should be provided, and as the city of Madison had no waterworks system, the regents were compelled to install a small local system of their own. As a part of this system a 24,000 gallon tank was located in the dome of the University Hall, and to this the Ladies' Hall and Science Hall were connected by the usual service pipes.

The second period of the University development began in 1890–'92, with the erection of the Dairy and Horticultural buildings, the Armory and the Law building, and the completion of the Ladies' Hall. These buildings as well as all others on the University grounds were gradually connected to the water system, and the use of water became so large that the small tank was entirely inadequate to supply it for any length of time, if the pumps were not in operation, and they were not supposed to be in use at all during the night period from May 1st to November 1st of each year.

Including the state capitol, there are at the present time twenty-two buildings connected to the system, and with the extension to the farm soon to be completed, more will be added. The water supply is obtained from Lake Mendota and is used only for steam and lavatory purposes, and for irrigation to a small extent.

In anticipation of a largely increased demand for water, an attempt was made about ten years ago to secure an appropriation from the legislature for a tower and water tank which would hold at least 175,000 gallons. This appropriation was not granted in the first instance, but later it was favorably acted upon, and $16,000 was appropriated for the purpose. Before plans could be worked out and a contract let, prices of material and labor increased to such an extent that the amount of money available was inadequate, and so the scheme had to be held over until the next legislature.

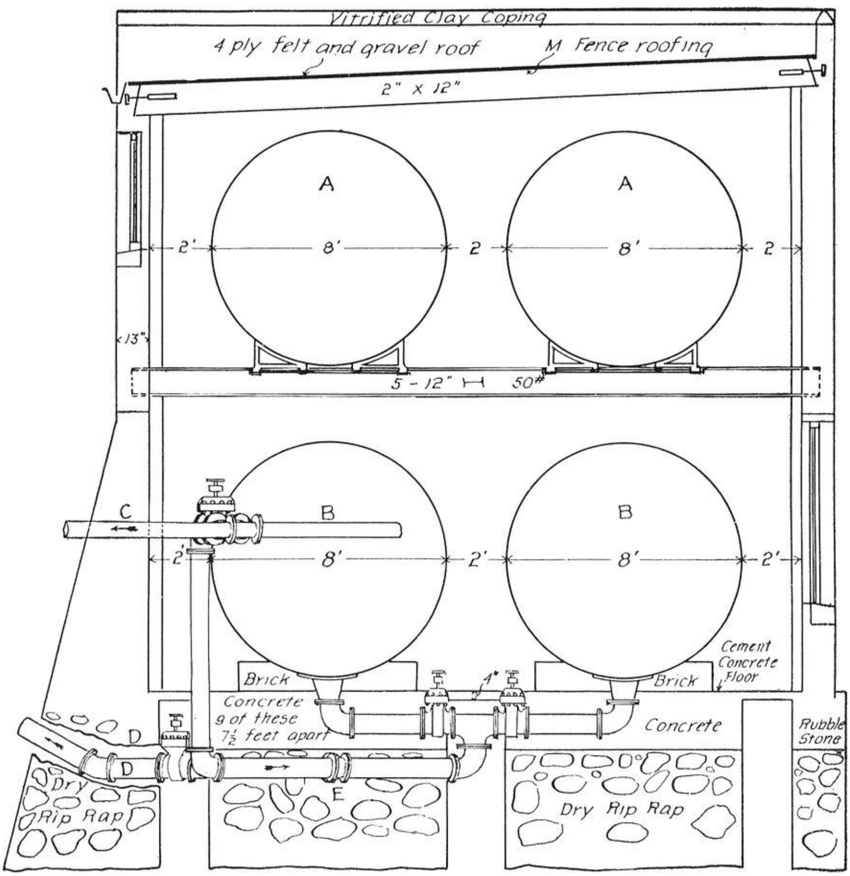


Fig. 1

It was fully realized that this structure as proposed would be the most sightly one on the University grounds on account of its height, and it was eminently fitting that it should be as pleasing to the eye as it was possible to make it. To meet all of these conditions it was found that an additional $16,-000 was necessary, but this extra amount the various legislatures from time to time refused to grant.

The necessity, however, had become so pressing for some improvement in the line suggested, that the last legislature was asked to authorize the use of the first appropriation, to install the system now being put in, the Acme Water Storage system. This scheme involves the use of two or more tanks, according to the amount of water used, one of which will be used for air and one for water.

In the University plant four tanks, each 8 feet in diameter by 66 feet long, are used. The service requires a pressure of 75 pounds at the pumping station for ordinary use, and to maintain this and to have the conditions equal a gravity system, the two upper tanks will be supplied with air at 150 pounds pressure by means of an air compressor. The lower tanks will be filled with water and will be connected to the air tanks by a pipe with a reducing pressure valve. As water is drawn from the lower tanks, air will flow in from above, and so maintain the pressure until the water tanks are empty. Thus the pressure will be 75 pounds in each, and as the water tanks are refilled, the air must be pumped back to the air tanks.

It may be noted that during the day service and while the pumps maintain the supply, the water will not go into the tanks, but will be delivered directly to the mains, and therefore during this period the air compressor need not be operated.

To prevent the air from flowing out into the service pipes, in case the tanks become empty, an especial float check valve has been designed, which will close with the water 3 inches above the valve seat.

In figure 1 an end elevation of the tanks is shown in place, together with a transverse section through the tank house. A. A. indicates the air tanks, and B. B. those for water. The upper tanks are supported on I beams with cast iron shoes to hold them in place. These shoes are so made that they may be drawn together with bolts, and a thin strip of lead was placed in between them and the tanks to insure even bearing. In this way a fairly even load may be put on each beam.

In figure 2 a plan of the water tanks is shown with foundations. Also a longitudinal section showing the position of air and water tanks. A double pipe circuit is obtained from the tanks to University Hall from the station by leaving the old six-inch main in service in connection with the new eight-inch one. In figure 1, C represents the old main and E the new one. The discharge in the new main being at the T. E. and as indicated by the arrow. The new main was extended up the bank from the station and across the roadway at the bend near the Electrical laboratory, thence it follows the road to a point near the University Hall, where a 120° Y was used, one branch of this was connected to the old main just in front of the University Hall, and the other was extended to and a short distance beyond the Dairy building. Hydrants were distributed along the line near the various buildings, and in case of fire a good water supply will be available, and in such an emergency the water pressure can be quickly increased to 100 pounds or more by opening the reducing pressure valve at the air tank.

A new eight-inch suction pipe has also been placed in the lake and connected with the pumps. It is 220 feet long and was put in during the winter when the water was covered with ice. Bell and spigot pipe with leaded joints was used. The pipe was all placed in position and the joints made, 4 by 4 scantling were laid along the pipe on each side four feet apart and were placed on blocking to bring them above the top of the pipes. For each length of pipe a wrought iron pipe roller was provided, with holes in the ends for capstan bars. Ropes were then wound on these pipes and made fast to the suction pipe. Blocks were spiked to the 4 by 4's to hold the rollers in place and the whole pipe was then raised from the surface and a channel cut out in the ice, when the pipe was quickly lowered to the lake bed.

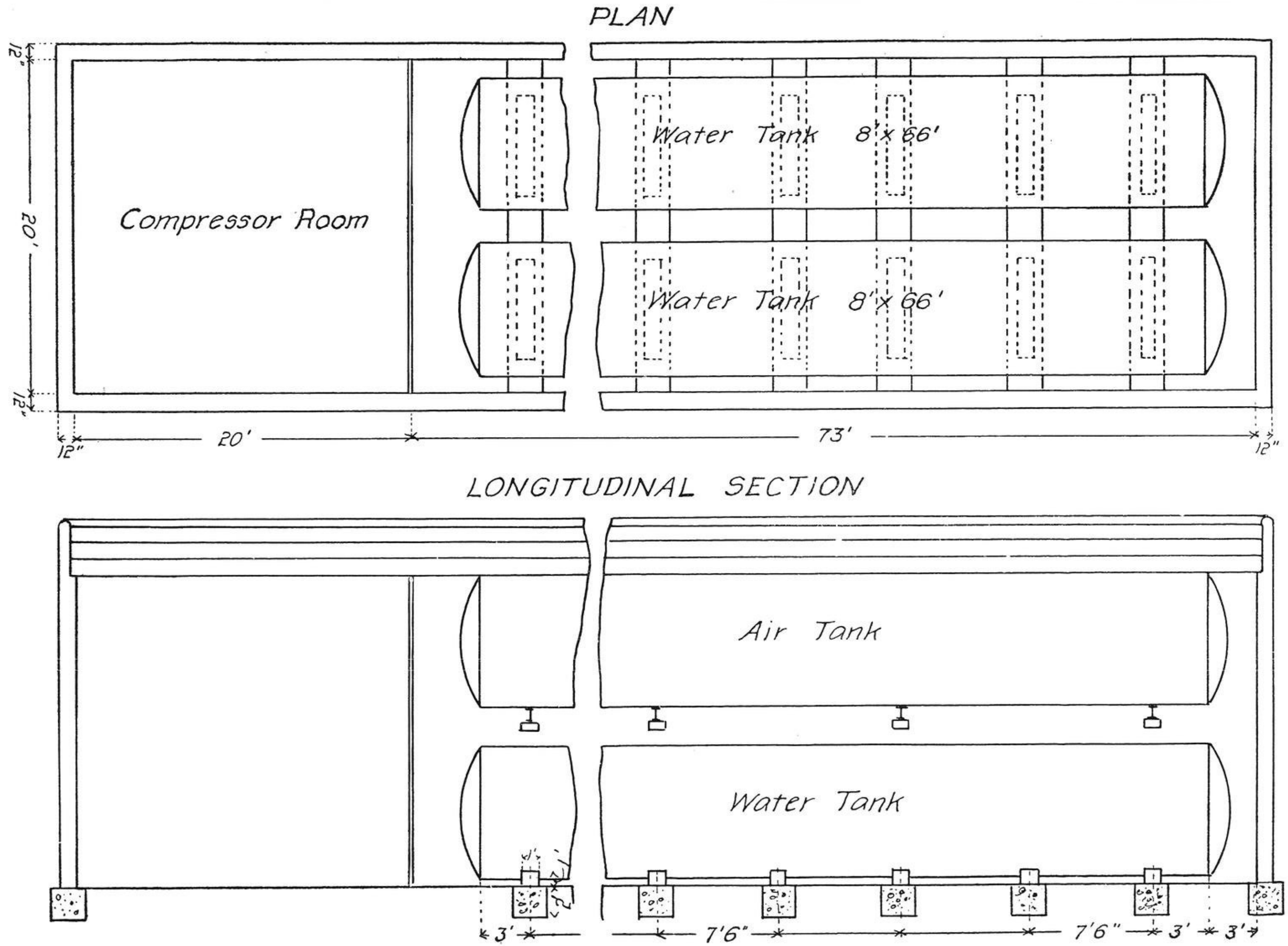

PLAN
Compressor Room
Water Tank 8'x 66'
Water Tank 8'x 66'
12"
20'
73'
LONGITUDINAL SECTION
Air Tank
Water Tank
3'
7'6"
3'

Fig. 2.

A strainer was made by using a 10-inch T with 3 foot pieces of 10-inch pipe in each end. These were capped and drilled full of $\frac{3}{8}$-inch holes; the aggregate area of these holes being about six times the area of the 8-inch pipe. The T is connected to the suction pipe by an elbow and stands up $3\frac{1}{2}$ feet from the lake bed.

For all purposes 250,000 gallons of water are being used daily at the University and considering the large number of laboratories and the bathing facilities at the Gymnasium this does not seem excessive for 3000 people.

CONSTRUCTION OF A MAIN SEWER AT RACINE, WISCONSIN.

This extension, the trunk of a combined storm and sanitary sewer which drains at present an area of 290 acres, was built in the spring and summer of 1903. Previous to its construction the sewage from this area flowed through Duck Creek into Root River, passing through private property occupied chiefly by lumber yards and factories. Above the point where the work began, the main sewer follows very closely the old channel of Duck Creek, which was the natural drainage channel of the district. The creek is now, with the exception of about 500 feet, entirely enclosed in the Duck Creek sewer.

The section of the sewer as it enters this extension is egg-shaped, of dimensions as shown in the accompanying figure. By using a 90-inch circular section, a saving of head room of about one foot was effected. It was imperative that the grade of Prospect street be raised as little as possible, because adjoining property was already lower than the street in some places. It was necessary to change the established grade at one point, raising it 3.60 feet. At 125 feet from the outlet of the river, the main channel of the sewer divides into two sections of 60 inches diameter to permit passage underneath a railroad spur track and also under Dodge street, and in order to render the outlet as low as possible at the dock, where a very flat section was required. At the river, the flow line is about two feet below datum, being about 0.9 feet below average water level. The water backs up into the sewer 90 feet.

The total length constructed in 1903 was 1668 feet, of which 948 feet was built in open cut, and 720 feet tunnelled. In open cut a great portion of the material excavated was filling, but generally the material below the springing line was good firm clay, so that no haunch masonry was required. The sewer is built in two rings of brick, in both 90-inch and 60-inch sections. Two feet of filling is the minimum amount between the top of the arch and the street surface, and at the point where this occurs, the grade was raised 3.60 feet.

Work was begun at Station 7 and proceeded westward in open cut. The lowest portion, with the special constructions, was carried on simultaneously with the tunnelling, until the former was completed. In open cut, close sheathing was required. The bottom of the trench was excavated by aid of a template, to the outside diameter of the sewer and the outer ring of brick laid on a bed of sand, where this was necessary to bring the backing up to required form. A sump was made at the place of beginning and the water was carried through a drain tile from here to the creek, a distance of 250 feet, until the sewer was built below this point, that is, until the whole piece of work was complete. The end of the old sewer was bricked up by a bulkhead wall, diverting the sewage into the creek. This bulkhead wall was not taken down until the new extension was ready to receive the sewage. Diaphragm pumps, operated by hand, were used to keep the water off the fresh masonry. In back filling, no large lumps or stones were permitted on the arch masonry.

Tunnelling began from two shafts, one at Station 9+75 and one at Station 13+10, as shown on profile, and work proceeded in both directions from these points. The shafts were about 8 feet by 6 feet, the line being carried down the shafts by means of 2 plumb-bubs. At the east shaft, there is an angle of 170°, where the masonry was carried around in a smooth curve. The shafts were carefully shored and close sheathed.

The material encountered in the tunnel was uniform hard blue clay, with no seams of sand nor any water, making excavation comparatively simple. At first, it was attempted to excavate by means of pick and shovel, but the work progressed too slowly. With this method five feet per day was the maximum rate. Using dynamite to loosen the material, 6 feet to 12 feet per day was the rate. Forty per cent dy-

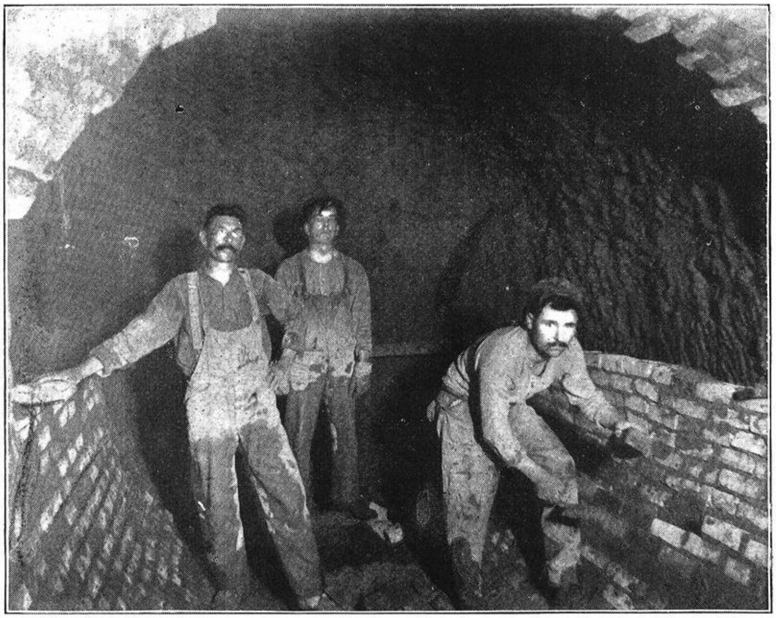


Fig. 1.

namite, in charges of one pound each, was placed in five 1-inch holes drilled 36 inches deep into the face of the tunnel, the holes being drilled so as to converge toward the center. The charge was fired by caps connected in series and ignited electrically from an external circuit. For some time the whole five charges were fired at once, but as this caused too much shaking of buildings in the neighborhood, and as the work was threatened by injunction, the method of firing was changed and the charge fired in groups of three and two at once. Occasionally the caps did not go off at first passing of the current, but ordinarily this method of igniting the charges was found very successful. Electricity was also used for lighting.

After the clay had been loosened by the dynamite, picks were used to excavate the tunnel to required form. Excavated material was brought to the bottom of the shaft on cars carrying steel buckets of 0.5 cubic yard capacity, and running on 2-inch by 4-inch stringers. The buckets were raised by a rope cable winding on the drum of a 12-H. P. Lidgerwood Engine. The engine has two cylinders turning a shaft which may be connected with two movable and separate windlasses on each of which was the cable from one of the shafts. The engine was located half way between the two shafts at the side of the street. The tunnel was finally dressed by pick to the form of the outside ring of brick, using the line and grade given by a stake driven into the ground as near as possible to the face of the excavation, and the invert laid, exactly as in open cut. No sub-drains were required in this nor in any other portion.

Fig. 1 shows the masons laying brick for the invert. The arch was then built up on a form shown in Fig. 2. The centering consisted of two arches built up of three one-inch boards and supported by piles of brick and wedges on the invert. Two-inch lagging was laid on as the arch was built up. The centering was left up about twenty-four hours after the masonry was completed. The number of brick per lineal foot was specified, the mortar used was 1:2 natural cement and sand, Milwaukee cement being used. The space between the arch and tunnel wall was filled compactly with brick and sand. No bracing nor shields were required in this work and no caving occurred except where the tunnel emerged at either end. At the west end, a cave occurred, filling about twenty feet of tunnel. No one was near when it happened. At the intersection of St. Clair Street, where 50 ton suburban electric cars pass over the tunnel twice an hour, and the rails were but 13 feet from the top of the tunnel, no bracing was used, and no cave occurred.

At the angle near Station 15 + 20, the 90 inch section merges into two 60-inch sections, built of two rings of brick. The rings were made in a smooth curve. See Fig. 3. The

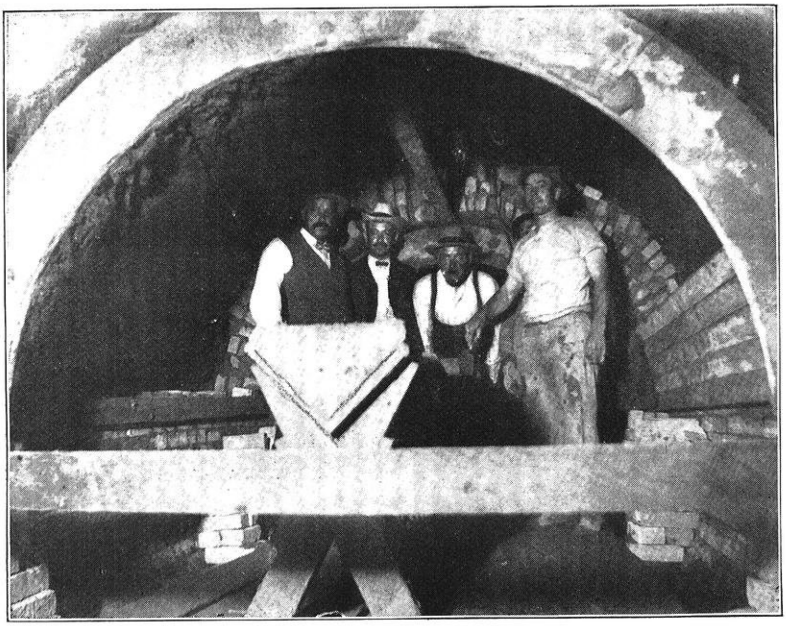


Fig. 2.

grade changes here from 0.4 per cent to 1.0 per cent. This portion passes under Dodge street where there is a large amount of heavy traffic, under a railroad spur of the C. M. & St. P. Ry., and then through a lumber yard to the outlet at Root River. Beneath the railroad track, the sewer walls are built up with the outside walls vertical and solid masonry between the two channels. There is 18 inches of filling between the top of the special construction and the ties. The outlet is built up of a block of concrete with following proportions: 1 part Portland cement, 2 parts sand, and 4 parts broken stone. The concrete encloses the two sewers, and rests on a timber grillage on pile foundation. The block is 9 feet long, 18 feet wide, and 8.5 feet deep. The pile foundation consists of three rows of five piles each, spaced four feet apart, on which are placed 12-inch by 12-inch by 18-foot cap sticks bearing two layers of 3-inch oak planking laid at right angles

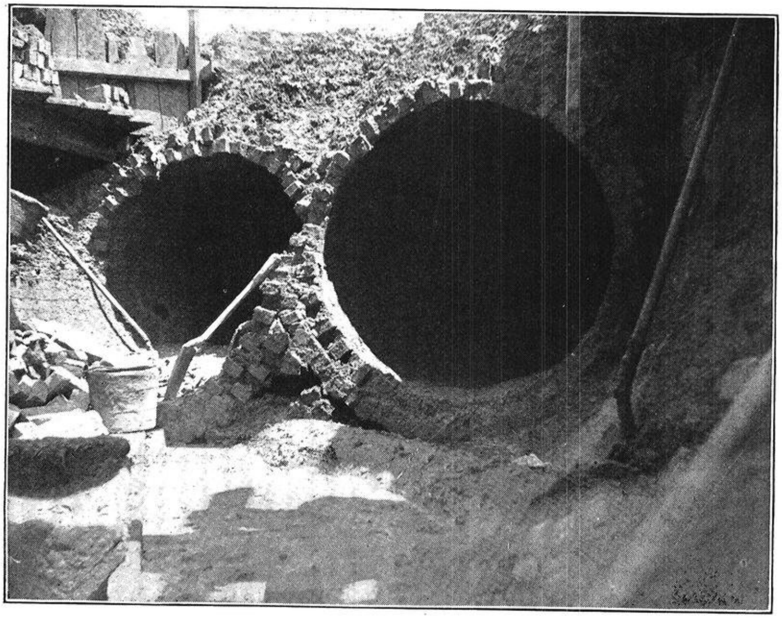
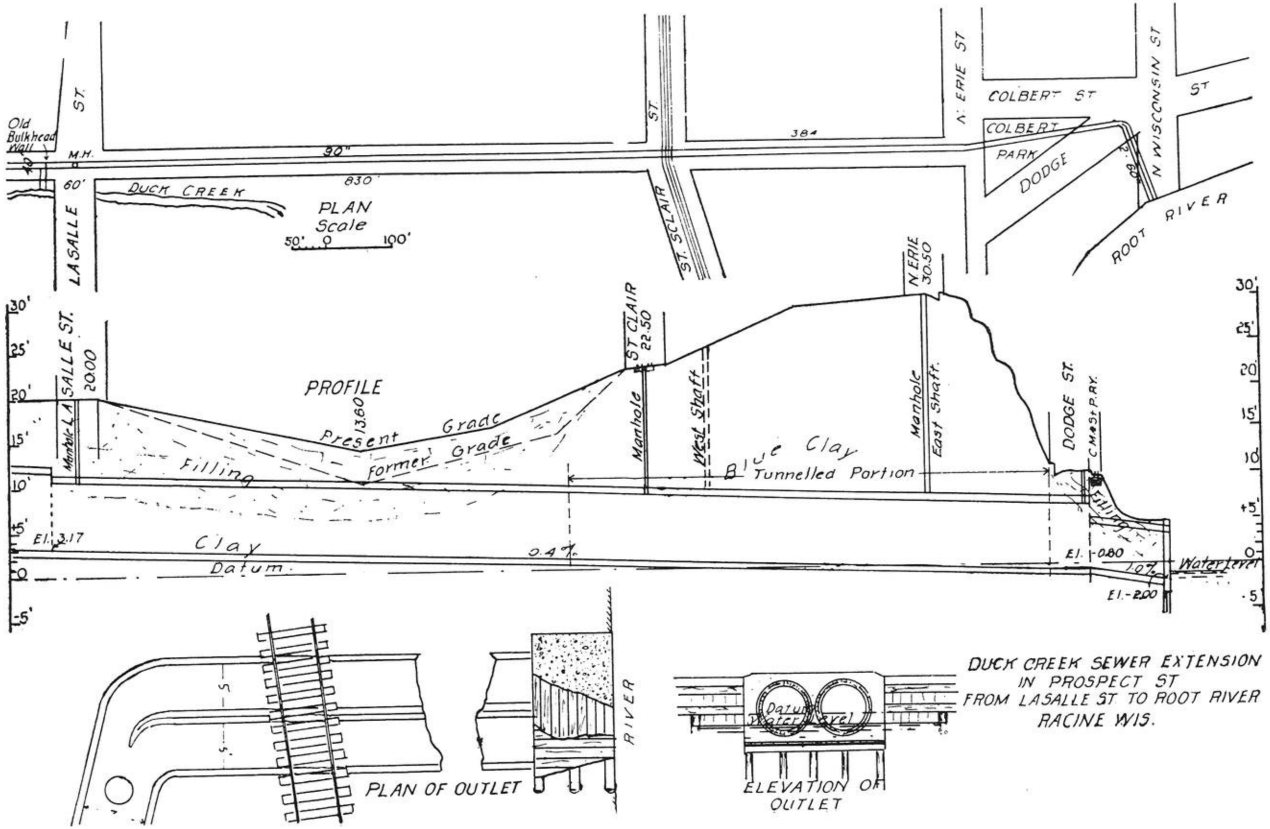


Fig. 3.

to each other. Just inside the outside row of piles is a row of sheathing composed of 3-inch by 12-inch oak sheet piles and 2-inch by 10-inch pine battens, whose object is to confine the material under the outlet.

Manholes are built where shown in the plan and profile. They are built up with one wall straight up from the springing line of the sewer arch. House connections of 6-inch pipe were put in at the springing line, at an angle of 45° with axis of tunnel, between Prospect street and St. Clair street. On Prospect street, east of St. Clair street, there was an old 8-inch sewer carrying the sewage of that block into St. Clair



DUCK CREEK SEWER EXTENSION
IN PROSPECT ST
FROM LASALLE ST TO ROOT RIVER
RACINE WIS.

street sewer. This had to be cut during occupation of west shaft. The sewer in St. Clair street formerly emptied into Duck Creek. This is now connected with the new sewer, and that portion south of Prospect street. It will be rebuilt with a grade toward Prospect street.

Property on Prospect street was assessed at the regular rate of $.60 per foot frontage, amounting to $700, and the balance of the cost was paid by the city. The contract was let to James Cape and Sons, for $17,000. Their bid was $8.50 per lineal foot for the 90-inch sewer, $10.00 per lineal foot for the 60-inch sewer, including special construction under C. M. & St. P. Ry., $1,000.00 for outfall, and $35.00 per manhole complete.

This work was designed and carried out under the careful supervision of Mr. P. H. Connolly, U. W., 1881, city engineer.

WM. E. BROWN, '04.

OBSERVATIONS ON A TRIP TO OLD MEXICO.

BY S. J. LISBERGER, '03.*

It was my good fortune not long ago to have a few days' spare time on my hands, and I seized the opportunity of taking a short trip across the border and into Mexico. While the scope of my observations was rather limited, the part of Old Mexico visited was typical of the country in general, and proved even less Americanized than some parts of the interior of the republic.

Glance, if you will, at the map of the United States and you will note that San Antonio, Texas, is about 150 miles from the border city of Laredo. It was toward the latter point that I, in company with two friends, set out. From the train window southwest Texas is all but picturesque—a sparsely settled country, desert-like, with nothing but sand, cactus and mesquite in sight—dry and arid, there having

*With the San Antonio Gas Company, San Antonio, Texas.

been no rain in six months, the desert plains stretched out for miles before the eye. There is an old legend, so a Texas poet (?) says, that relates how, when the devil was making hell, he cast out southwestern Texas, saying it was not good enough for the purpose. How true that is it is hard to say, but surely southwest Texas is in a class all by itself.

It was with much delight that we saw in the distance the rising hills of Mexico, and soon afterwards the housetops of Laredo. Not wishing to take chances with "unknown quantities" in the shape of Mexican hotels, we stopped on the American side. Having located ourselves, our first step was to have our money exchanged into Mexican money. The rate of exchange was about two Mexican to one United States. So, with purses doubled, we set out for the other side. Though we had twice as many dollars, we found it went about twice as fast, and so our "purses doubled" was proven to be a mere delusion.

Connecting the two opposite shores is a handsome bridge, and it was at this point we first beheld the majestic Rio Grande river. It was nearing dusk as we walked over the bridge. The setting sun, the beautiful color of the water of the river, combined with the foliage of the shores to make an ideal and beautiful scene. Withal one could not but think of thed ays of the Mexican war, when the waters of this now peaceful river "ran red" with the blood of the contending armies.

At the center of the bridge is a monument marking the boundary between the two countries, and it was here that we stood in Mexico, and shook hands with a friend in the United States. With a last look at our mother country, we turned our footsteps toward Mexico,—to "do" it, or be "done." Butthat is another story.

Mexico manufactures good cigars, and owing to there being no taxes on tobacco, cigars are very cheap. Conclusions may be drawn.

The general appearance of the city of Nueve Laredo is prepossessing. The houses are low, and few, if any, have more than one story. There are no front yards at all. They are built close together, and are made of stucco. All the front windows are protected by an iron grating, similar to the bars of an American jail. These gratings are not so much for a protection against robbers—not that Mexicans will not steal, oh no,—(for in Mexico City there is a regular thieves' market), but they serve more as a trysting place for the "senorita" and her suiting "senor." The customs of Mexico allow no senor to call on a senorita. All courtship is carried on through these gratings—the girl, of course, being on the inside. In fact when the suitor once puts foot inside the house, he is as good as engaged, and even then the father and mother of the bride-to-be must personally chaperone all calls.

The houses though dingy looking, seemed on closer inspection, to be really better than one would imagine. Here and there in the doorway would stand a pretty senorita, and very often we could hear the melodious sound of some catchy Spanish air played on a piano. Once there sounded forth an American piece of music—"Bill Bailey, won't you please come home," was certainly played in true American ragtime.

The streets are narrow, irregular in direction and width, and very poorly paved. Walking or riding is very trying. However, there are small parks or "plazas," with shade trees and pretty flowers, that are singularly beautiful. Here the concerts by a milltary band are given several times a week, and people gather from all over the city, to listen to the music, to talk over the matters of the day. Here the girls all walk together, and the boys likewise, walking in opposite directions around the band stand. Here it is that flirtations start, the sequel being the iron gratings which were mentioned before.

Surrounding the plazas are the important buildings, such as the post office, churches, court house and the jail. And such jails! I am not an expert on jails, but from what I have heard, American jails are palaces beside these. An uncovered court, with running water in the center, is surrounded by the cells, each of which is a good reproduction of the

Black Hole of Calcutta. Such bars and locks, why, it would take a man a lifetime to work his way out, even then he would find an insurmountable difficulty in the shape of a high perpendicula rwall, covered with broken glass set in cement, for there are no windows at all, and such filth beggars description. Prisoners are held a long time before they get a trial, often as long as twelve to eighteen months. During that time many support themselves, in preference to starving, by making blankets, and even then their food is something vile. When the Mexican army needs men, they put the prisoners in the army. The army of Mexico needs no further comment!

The policemen are thick as bees in a hive, yet are very poorly equipped. Some of the policemen had no coats; others wore trousers that scarcely came to their shoe tops. Yet each wore a badge about the size of saucer, and on his hip he carried a small sized Gatling Gun. Their pay is very poor, only about $15.00 a month.

At certain seasons of the year the Mexicans have what they call a "*fiesta*," which is none other than a carnival. They are, however, entirely different from the American carnivals. For the fiestas a separate plaza is set aside, called the Plaza de Fiesta. In the center is an elevated band stand, a promenading place surrounds this stand, and then on the outside circle is a maze of gambling stands, interspersed here and there with fruit stands, but more often with bar-rooms. It was not difficult to tell an American, and when we set foot on this plaza, how those people commenced to yell. We did not understand it, for Spanish was spoken, but when I came to think of it later, it sounded very like, "Here they come, let's skin 'em."

Of all varieties of gambling, I have yet to hear of one that was not to be found in this open and public Plaza de Fiesta. Roulette was the favorite, but there were others. In one a great arrow revovled, and never stopped, over a pile of money; at another a little ball rolled down through a series of pins, and into a slot, which as a rule brought the player nothing.

At another place they yelled, "Ze American Crap Game," and yet another, the famous game of Monte was the attraction. There were still more, and each was more crooked than the other, yet done so cleverly as to defy detection.

Young boys, mere children, ran many of the gambling stands, and they were certainly "on to" their business. Spotters were numerous, and it was more than interesting to watch them work their game on unwary visitors. Everbody gambled—little fellows, too, came up to the tables and laid down their couple of pennies like little men.

The band gave a concert during the evening, the crowd promenading as before described.

The saloons also are quite different from those we see at home. Their beverages are pulque and muscale, distilled from the catcus plant. We were afraid to try them.

Just a word as to the people. As compared with Americans they are slow—yes, even their time is thirty-six minutes behind ours. As a nation they are not progressive and up-to-date, seeming to have no ambition at all. They disgust the American; and yet the climate is doubtless partially the cause of their nature.

With few exceptions, save the old Castilian families, the Mexicans are poor and destitute. They dress poorly, and live a kind of hand to mouth existence. Many live in houses made of barrel staves, pieces of old tin and bagging, and during the dry season quite a few camp on the Rio Grande bottoms. The sudden rise of the river, such as often takes place in a night, completely annihalates their primitive house. They build another just like it, and live the same old life.

Gambling seems to be their main occupation, next to cock-fighting, while some of the more industrious do a little hauling of wood and water, for only a few people in the city have hydrants. The women do fancy work and make cigars, as everybody smokes, men, women and children. Their teams are really curiosities. Usually a yoke of oxen or a burro. Poor burro! His load is so great as to almost conceal the beast; in fact, when he can pull no more the wagon is loaded.

The driver never walks—that's American. There is no such word as haste in the Mexican vocabulary. Man and beast are all alike.

The foods of the average Mexican are peculiar. They consist of "fryoles" (beans) and "tertilleras," (this being corn ground in a crude mortar and then baked after being mixed with a little water). Coffee is their favorite beverage. The average Mexican family can live on about 30 or 40 cents a day. Goat meat is their favorite meat. Of other meats they eat but little. All foods are highly seasoned. Their favorite meat dish is "chille con carne," (pepper with meat), and next is "tomalies"—what we call "hot tomalies." With all they seem to enjoy life and live happily.

It was our fortune to have the opportunity of seeing a genuine bull fight. Of all so called sports, this one is without doubt the most cruel, brutal and inhuman. Descriptions and pictures fail to present it in its truly horrible light.

The Plaza de Toras, (Place of the Bulls), with the entering crowd reminded one somewhat of a football game at Camp Randall, for one side of the crowd commenced to yell at those on the other side, and though it was all in Spanish, they seemed to have a great time. The Bull Pen consists of an arena of circular shape, surrounded by elevated seats. Inside the arena five or six little protective fences, stoutly constructed, are built just close enough to the fence to permit the entrance of a man when he is cornered by the bull.

There is a judges' stand just at the top of the elevated seats. When the judges take their seats the band begins to play, a door to an adjoining enclosure is opened and the fighters enter. In the front rank are the Matadors; they kill the bull and are looked upon as the heroes. Following come the Banderillos, who tease the bull, and then the Picadors mounted on horses. After a bow to the audience they take their places around the ring.

At a bugle-blast the Picadors blindfold their horses, and through an open door dashes a bull. In his shoulder is sticking an arrow, moistened with turpentine. Thus angered, he dashes at the first thing in sight. One of the Matadors or Banderillas engages him, waving a red cloth before his eyes. The bull charges, catches the cloth on his horns, while the man deftly steps aside. A Picador then approaches, and to him the bull then gives his attention. The Picador is armed with a long pole, having a steel point in the end; with this he attempts to keep the bull at bay. Seldom does he succeed, for the bull usually gores the horse, and often so badly that the animal drops in his tracks.

Once in a fierce charge, horse and rider were knocked over, having gored the horse the bull started for the man, but a Matador caught the bull by the tail, and thus diverting his attention, saved the man. Again the bull charged at a horse, and with a toss of his head disentrailed the horse before our eyes. Eight horses were killed in the fight. The sights were truly horrible, yet the Mexicans yelled and cheered—and one especially enthusiastic spectator told us he would like to see a man gored. The Picadors withdraw after they have teased the bull into madness.

The Banderillos then come forward, holding in each hand a little stick with a steel arrow head in the end, and faces the bull. The man sticks these in the shoulder of the bull, and steps aside so quickly the bull cannot follow. This is done a couple of times, by which time the bull is furious—charging right and left, he sends all to cover.

The Matador now comes forward with a piece of red flannel in one hand and a sword in the other. After waving the flannel before the animal's eyes until the bull plunges at anything, the man with a quick stroke plunges the sword into the shoulder of the bull, aiming for the heart. It is here that the Matador shows his skill. The place in which he must strike the death blow is only about three inches in diameter, and, if struck properly, the bull falls dead at once; otherwise the weapon enters the lung, causing the animal much suffering, and then they have to make another attempt to kill him. Even with blood pouring from the wound, mouth and nose, the bull fights until he can no longer stand, continually attempting to gore his tormentors. And when at last he lies prone upon the ground, they stick a little dagger into the base of the brain to make sure he is dead. That's the only humane part of it.

In this manner were four bulls killed in that single afternoon fight. The sights were almost sickening, yet the Mexicans betook themselves there with their children, just as we would go to a matinee. Just in front of us sat a Mexican girl eating apples and smoking a cigarette. To her it was apparently an every-day affair.

While the trip was most enjoyable, we were indeed delighted to get away from that part of the country, for it's all but what one could desire.

I was just dozing off to sleep when I recognized in the adjoining berth the voice of one of my companions. He was calculating half aloud: "A Mexican can live on 10c. a day, 30 days to the month, 365 days to the year. Why, heavens! I can keep that gambler alive on my losings for several years to come." And that was my last thought of Mexico.

Next morning when we awoke we were again in God's country.

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TERMS:

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M. R. Bump, '02, who has been in the employ of the Madison Gas Company, has accepted a position with the Denver Gas and Electric Company, at Denver, Col.

Three graduate scholarships in engineering, of the value of $225.00 each, have been awarded to members of the present senior class. The successful candidates are Seymour W. Cheney, mechanical engineering, William A. Rowe, electrical engineering, and Ernest A. Moritz, civil engineering. Mr. Moritz will spend the year in the study of reinforced concrete, and will probably write a thesis for the degree of C. E.

THE ENGINEER is informed by Professor Richter, that the statement in the April issue to the effect that the Vilter Manufacturing Company, of Milwaukee, had begun the construction of a model of the refrigerating plant, installed by them in our steam laboratory, to be used in connection with the University exhibit at St. Louis, but had later abandoned the work, is entirely without foundation. The information was obtained from a source, which was afterwards found to be unreliable, and we take this opportunity of correcting the erroneous impression.

The work of each of the three engineering societies was brought to a close Friday evening, May 13th, by the election of officers for the ensuing year. Banquets had been held during the week preceding by the N. O. Whitney Society and the U. W. Engineers' Club. The officers elected by the different societies are as follows:

U. W. Engineers' Club—President, B. F. Anger; vice-president, O. O. Wagle; secretary and treasurer, L. E. Rice.

N. O. Whitney Association—President, Chester Hoefer; vice-president, H. A. Parker; secretary and treasurer, I. B. Hosig.

Civil Engineering Society—President. Harry Leyton; vice-president, L. R. Balch; secretary, L. R. Harlacher; treasurer, T. J. Irving; corresponding secretary, F. O. Dufour.

That the College of Engineering will be in evidence during the celebration of Jubilee week, is guaranteed by the enthusiastic interest with which the students of all classes are entering into the plans for this event. A mass meeting of engineers which crowded library hall to the doors was recently held for the purpose of organizing for the Jubilee. Committees were appointed in all classes, and general meetings of the committees were arranged for, in which Jubilee "stunts" of various kinds have been discussed. It is a foregone conclusion that the "terrible engineers" will lead the van in the matter of unique and spectacular methods of celebrating the big holiday season which is approaching. The committee will not be without funds, as a tax levy of 25 cents per member has been made, and is being responded to loyally in all classes.

Of the members of the senior class who have already received positions are the following: O. B. Cahoon, M. E., Madison Gas and Electrical Company; R. G. Griswold, M. E., H. W. Johns-Manville Company, at Brooklyn plant; E. J. Mac Eachron, M. E., Burns Boiler and Manufacturing Company, Green Bay, Wis.; R. E. Hagenah, M. E., Laclede Gas Company, St. Louis, Mo.; W. B. Uehlein, M. E., Schlitz Brewing Company, Milwaukee, Wis.; L. F. Van Hagan, C. E., Instructor in Mechanical Drawing at the University of Wisconsin; P. F. Zinke, E. E., Western Electric Company, Chicago, Ill.; Harry Gardner, C. E., city engineer's office, Madison, Wis.; M. G. Hall, C. E.; City Engineer, Clinton, Ia.; William S. Kinne, Structural Work with C. & N. W. R'y, Chicago, Ill.; Ray Owen, C. E., with C. S. Slichter on hydrographic work for the U. S. Geological Survey at Garden City, Kansas; J. G. Staack; E. J. Fisher, and H. L. McDonald, topographic work with the U. S. Geological Survey.

ALUMNI DIRECTORY.

The directory given below has received many corrections since its last publication, and is as near correct and complete as we can make it. We have received much help from alumni, professors and students in correcting errors and completing information, and we wish to thank them for their kind assistance. Any further corrections and additional information should be sent to the alumni editor.

Abbott, Clarence E., B. S. M. E., '01, 433 Murray St., Madison, Wis.

Adams, B. C., B. S. E. E., '03, Madison, Wis., Madison Gas and Electric Co.

*Adams, Bertram F., B. S. M. E. '02.

Adams, W. K., 6405 Stewart Ave., Chicago, Ill.

Adamson, Wm. H., B. S. C. E., '86, Seattle, Wash., Draftsman.

Ahara, Edwin H., B. S. C. E., '92; M. E., '96, Mishawaka, Ind., Supt. of Dodge Mfg. Co.

Ahara, Geo. V., B. S. M. E., '95, 1020 Oak St., Beloit, Wis., with Fairbanks, Morse & Co.

Ahara, Theo. H., B. S. M. E., '00, Williamsport, Pa., Williamsport Staple Co.

*Albers, John F., B. S. C. E., '77; C. E., 78, Antigo, Wis., Druggist.

Alexander, Walter B., B. S. M. E., '97, Minneapolis, Minn., Asst Mast. Mech., care of C. M. & St. P. Ry.

Allen, Andrews B., B. S. C. E., '91, 1022 Monadnock Bldg., Chicago, Ill., Wisconsin Bridge Co.

Allen, John S., B. S. E. E., '97, Beloit, Wis., Mgr. Beloit Electric Light Co.

Alverson, Harry B., B. S. E. E., '93, 40 Court St., Buffalo, N. Y., Cataract Power & Conduit Co.

Anderson, A. E., B. S. M. E., '03, 818 Lincoln Ave., Schenectady, N. Y., General Electric Co.

Anderson, Gustav A., B. S. M. E., '02, 367 Jackson Blvd., Chicago, Ill.

*Arms, Richard M., B. S. E. E., '94, Seattle, Wash., Asst. Mgr. Seattle Elect. Light and Power Co.

Aston, Jas. B., B. S. E. E., '98, 1042 National Ave., Milwaukee, Wis., care of Thomas Aston & Son.

Atkins, Hubbard C., B. S. M. E., '01, Milwaukee, Wis., Allis-Chalmers Co.

*Austin, W. A., B. S. M. E., '99.

Baehr, Wm. A., B. S. C. E., '84, St. Louis, Mo., Engr. for La Clede Gas Co.

Bailey, H. E., B. S. E. E., '03, 2 Eagle St., Schenectady, N. Y., General Elect. Co.

Baldwin, Geo. W., B. S. C. E., '85, Crete, Neb., Lumber Dealer.

*Bamford, F. E., B. S. M. E., '87, Philippine Is., Capt. U. S. A.

Barnes, Chas. B., B. S. M. E., '00, 200 Oakwood Blvd., Chicago, Ill., Engineering Dept. Sargent & Lundy.

Barr, J. M., B. S. M. E., '99, New York City, Consult. Engr. Westinghouse Mfg. Co.

Bassett, Henry Smith, C. E., '71, Preston, Minn., Lawyer.

Bauss, Richard E., B. S. M. E., '00, Pittsburg, Pa., Western Elec. Co.

*Bachelder, Clare H., B. S., M. E., '01.

Balsley, Eugene A., B. S. C. E., '02, 637 Jackson Blvd., Chicago, Ill., American Bridge Co.

Barkhausen, Louis H., B. S. M. E., '01, Racine, Wis., J. I. Case Co.

Bebb, Edward C., B. S. C. E., '96, Washington, D. C., U. S. Geol. Survey.

Beebe, Murray C., B. S. E. E., '97, Pittsbnrg, Pa., Consult. Engr.

Belling, J. W., B. S. E. E., '03, Schenectady, N. Y., General Electric Co.

Bennett, Chas. W., B. S. M. E., '92, Elwood, Ind., District Mgr. American Tin Plate Co.

Benson, F. H., B. S. C. E., '91, New Insurance Bldg., Milwaukee, Wis.

Bently, F. W., B. S. M. E., '98, 81 E. 48th St., Chicago, Ill., Prin. Manual Training Dept. Association College.

Berg, William C., B. S. C. E., '02, died 1903.

Bergenthal, V. W., B. S. E. E., '97, 4354 Oakwald Ave., Chicago, Ill., Automatic Switch and Signal Co.

Bertke, W. J., B. S. E. E., '03, Sioux City, Iowa, Sioux City Gas and Electric Co.

Bertrand, Phil. A., B. S. E. E., '95, Springfield, Mo.

Berry, Claude, B. S. C. E., '01, 2854 Minnehaha Ave., Minneapolis, Minn., Struct. Engr. Minn. Steel and Mch. Co.

Biefield, Paul A., B. S. E. E., '94, Prof. of Elec. Eng. School of Heilperghausen, Ger.

Bird, Henry, B. S. C. E., '94, died Dec. 22, '01.

Bird, Hobart S., B. S. C. E., '94; LL. B., '96, Madison, Wis.

*Bliss, Wm. S., B. S. M. E., '80, Williams, Arizona, J. M. Dennis Lumber Co.

Boardman, Harry B., B. S. E. E., '93, 2475 N. Paulina St., Chicago, Ill.

Boardman, Horace P., B. S. C. E., '94, 6600 Ellis Ave., Chicago, Ill., Savage Construction Co.

Bohan, Wm. J., B. S. E. E., '95, St. Paul, Minn., Elect. Engr. Northern Pacific Ry.

Boldenweck, Felix W., B. S. M. E., '02, 27 Stratford Place, Chicago, Ill., Engr. Dept. Western Elec. Co.

Boley, C. U., B. S. C. E., '83; C. E., '99, Sheboygan, Wis., City Engineer.

Boorse, Jesse M., B. S. E. E., '95, 721 S. Willow Ave., Austin, Ill.

Bossert, Chas. P., B. S. M. E., '88, 179 36th St., Milwaukee, Wis., Pfister & Vogel Leather Co.

Boynton, C. W., B. S. M. E., '98, Sedro-Woolley, Skagit Co., Wash.

Brace, Jas. H., B. S. C. E., '92, 225 W. 33rd St., New York City, Engineer P. N. Y. & L. I. Ry.

Bradish, Geo. B., B. S. C. E., '76; C. E., '78, La Crosse, Wis., Civil Engineer.

*Bradley, Wm. H., B. S. C. E., '78, Mingo Junction, Ohio, Junction Iron and Steel Co.

Brandt, Hugo W., B. S. C. E., '03, Madison, Wis., Ass't Engineer, State Board Assessment.

Brennan, Wm. M., B. S. C. E., '94, Cato, Manitowoc Co., Wisconsin, Ass't Engr, Wis. Central R'y.

Brobst, J. E., B. S. E. E., '03, Schenectady, N. Y., General Elect. Co.

*Broenniman, Arnold E., B. S. C. E., '97.

Brown, Geo. W., B. S. C. E., '86; C. E., '90, Tortugas, Monroe Co., Fla., Gov. Works.

Brown, L. R., B. S. E. E., '03, Schenectady, N. Y., General Elect. Co.

Brown, Perry F., B. S. C. E., '97, 412 E. 23d St. Oakland, Cal., City Engineer, Oakland, Cal.

Brown, Samuel L., B. S. M. E., '89, Tacoma, Wash., Tacoma Smelting Co.

Brown, Thane R., B. S. C. E., '95, box L, No. Milwaukee, Wis., Wis. Bridge & Iron Co.

Burdick, Wm. C., B. S. C. E., '01, 1015 Sycamore St., Milwaukee, Wis., St. Paul Depot.

Buerstatte, F. W., B. S. M. E., '01, 1440 Park Ave., Chicago, Ill., C. & N. W. R'y.

Bucey, John H., B. S. C. E., '95, died Dec. 4, 1896.

Buckley, W. J., B. S. E. E., '99, Milwaukee, Wis., Smith Concrete Mixer Co.

Bump, Milan R., B. S. E. E., '02, 620 Langdon St., Madison, Wis., Graduate, University of Wisconsin.

Burgess, Chas. F., B. S. E. E., '95, University of Wisconsin, Asst Prof. of Elec. Eng.

Burgess, Geo. H., B. S. C. E., '95, Pittsburg, Pa., Penn. Lines Chief Engineer's Office.

Burkholder, Chas. I., B. S. E. E., '96, Schenectady, N. Y., Gen. Elec. Co.

Burton, Wm. C., B. S. E. E., '93, 22 A, College Hill, Cannon St., London, Eng., J. G. White & Co., Limited.

Buttles, Ben. E., B. S. E. E., '00, 908 S. Central Park Ave., Millard Ave Sta., Chicago, Ill., Chicago Edison Co.

Cadby, J. N., B. S. E. E., '03, Milwaukee, Wis., T. M. E. R. & L. Co.

*Campbell, Bert, B. S. C. E., '98, Chicago, Ill.

Carey, Jas. L., B. S. M. E., '88, 306 Baird Ave., Austin Station Chicago, Ill., Amer. Strawboard Co.

Carlsen, Chas. J., B. S. M. E., '96, 279 Keystone Ave., River Forest, Ill., Elect. Engineer.

Carpenter, Chas. G., B. S. C. E., '82, City Hall, Milwaukee, Wis.. Park Sup't.

Carter, B. B., B. S. M. E., '88, 1644 Monadnock Bldg., Chicago, Ill.

Caverno, Xenophon, B. S. M. E., '90, Kewaunee, Ill., Gen. Mgr., Kewaunee Gas Light & Coke Co.

Clausen, Leon R., B. S. E. E., '97, Milwaukee, Wis., Chief Signal Engineer, C., M. & St. P. R'y.

Cochran, Rob't B., B. S. M. E., '97, St. James Park, Rochester, N. Y., Cochran-Bly Machine Works.

*Cole, Chas. M., B. S. M. E., '02.

Cole, Harry W., B. S. M. E., '02, Milwaukee, Wis., Allis-Chalmers Co.

*Colby, L. W., Beatrice, Neb.

Comstock, Nathan, B. S. M. E., '97, Arcadia, Wis., Attorney.

Connor, S. P., 301 W. 57th St., New York, N. Y.

Connolly, Pat. H., B. S. C. E., '85, Racine, Wis., City Engineer.

Conover, Allen D., Ph. B. C. E., '75, 151 W. Gilman St., Madison, Wis., Architect.

Conradson, C. M., B. S. M. E., '83; M. E., '85, Warren Pa., Amer. Turret Lathe Co.

Cook, Thomas R., B. S. M. E., '00, 421 E. Berry St. Fort Wayne, Ind., Penn. R'y Lines.

Coombs, Ed. C., B. S. C. E., '97, 310 Madison St., Madison, Wis.

Cooper, A. S., B. S. C. E., 81; C. E., 83, Savannah, Ga., U. S. Asst Engineer.

Cosgrove, J. F., E. E., '96, 919 Pine St., Scranton, Pa., Scranton Correspondence School.

Cornish, Ross C., B. S. C. E., '97, Milwaukee, Wis., 1st Asst Supt Milw. Gas Light Co.

Cowie, H. J., B. S. C. E., '03, "The Alexandria," Niagara Falls, Center Ontario, Ontario Const. Co.

Crandall, H. R., B. S. M. E., '98, 180 23d St., Milwaukee, Wis.

Crane, Edgar W., B. S. E. E., '95, Orizaba, Mexico.

Crenshaw, Thos. P., B. S. E. E., '95, died.

Crowell, Robinson, E. E., '96, Sacramento, Cal., Sacramento Elec., Gas & Ry. Co.

Curtis, Norman P., B. S. C. E., '01, Madison, Wis.

Dean, Chas. L., B. S. M. E., '01, 917 S. 10th St., Lincoln, Neb., University of Nebraska.

Dean, G. C., B. S. M. E., '03, Milwaukee, Wis., Nordberg Mfg. Co.

Dean, J. S., B. S. M. E., '03. Carbondale M'f'g Co.

De Lay, Frederic A., B. S. E. E., '02, Lock Box, 309, Houghton, Mich., Instructor Mich. School of Mines.

Diehl, Guy E., B. S. C. E., '02, Hibbing, Minn., U. S. Steel Corp.

*Dixon, Fred B., B. S. C. E., '97, New London, Wis.

Dixon, John E., B. S. M. E., '00, 68 4th St., Dunkirk, N. Y., Brooks Locomotive Works.

Dodge, Jos., B. S. M. E., '84, 707 Women's Temple, Chicago, Ill., Western Agent, J. R. Kein & Co.

*Dodge McClellan, B. S. C. E., '84, Eau Claire, Wis., City Engineer.

Douglass, C. C., B. S. M. E., '03, 1508 Union St., Schenectady, N. Y., General Elec. Co.

Dousman, Jas. H., B. S. C. E., '84, 73 31st St., Milwaukee, Wis., General Practice.

Dow, Herbert W., B. S. M. E., '02, Room 402, Engineering Hall, Ames, Iowa, Instructor, Iowa Agri. College.

Duffy, Wm. F., B. S. C. E., '84, Montgomery, La., Asst Engineer S. & R. B. V. Ry.

Durand, Samuel B., B. S. C. E., '91; C. E., Stanford, '94, died at Denver, Col., Oct. 29, 1900.

Dutcher, John E., B. S. E. E., '97, Kansas City, Mo., Swift & Co.

Earle, Roy R., B. S. E. E., '02 Schenectady, N. Y., General Elec. Co.

Earll, C. I., B. S. M. E., '85, 76 Williams St., New York City, Consulting Mech. Engineer.

Ehreke, G. W. R., B. S. E. E., '02, 917 State St., Schenectady, N. Y., General Elec. Co.

Ehrnbeck, Anton D., B. S. C. E.,'02, 925 College Ave., Appleton, Wis.

Ekern, E. A., B. S. E. E., '03, 502 N. Aurora St., Ithaca, N. Y., Fellow Cornell University.

Ela, Edwin S., B. S. C. E.,'96, Washington, D. C.,Topographer U. S. G. S.

Elliott, H. S., B. S. E. E., '03, Helena, Mont., Mo. River Power Co.

Ellis, John F., B. S. C. E., '87, died Dec. 9, 1890, Evansville, Wis.

Elser, R. C., B. S. C. E., died May 17, 1900.

Emerson, Fred M., B. S. C. E., '00, 299 2nd Ave., Milwaukee, Wis., Milwaukee Bridge Co.

Erbach, Wm. Z., B. S. M. E., '93, Athens, Wis., Supt. Rietbrock Land & Lumber Co.

Erickson, Erick T., B. S. C. E., '88; C. E. '90,1029 Fasaon St., St. Joseph, Mo.

*Evans, Ed. M., B. S. E. E., '94, 2277 Paulina St., Chicago, Ill., Bridge Inspector.

*Evans, Geo. B., B. S. C. E., '94, 348 Atlantic Ave., Pittsburg, Pa.

Fairchild, David L., B. S. C. E., '90, 17 Columbia Block, Duluth, Minn.

Falconer, Robt. C., B. S. C. E., '95, Vanceburg, Ky.

Farris, Jas. A., B. S. M. E., '00, Harvey Ill., Whiting Foundry Equipment Co.

Fehr, H., B. S. M. E., '84; LL. B., '86, Empire Bldg., Milwaukee, Wis., Lawyer.

Fisher, John J., B. S. C. E., '76, Prescott Ariz., U. S. Dept, Mineral Survey.

*Fisher, John R., B. S. C. E., '74; C. E., '80, Beaver Dam, Wis., Lumber Dealer.

Foote, F. I., Cincinnati, Ohio, Bullock Mfg. Co.

Ford, Arthur H., B. S. E. E., '95, Atlanta, Ga., Prof. Elect. Eng., Georgia School of Tech.

Ford, Fred H., B. S. E. E., '93, Milwaukee, Wis., Northern Electric Co.

Fowle, Fred F., B. S. C. E., '93, Wauwatosa, Wis.

*Fowle, Harry H., B. S. E. E., '95, So. Milwaukee, Wis.

Fowler, Myron M., B. S. E. E., '01, 841 W. Adams St., Chicago, Ill., Western Elec. Co., Engr. Dep't.

Fox, Henry, B. S. M. E., '92, 1620 N. Madison Ave., Peoria, Ill.
Frankenfield, Budd D., B. S. E. E., '95; E. E. '96., Pittsburg, Pa., care of Nernst Lamp Co.
Fratt, Fred W., B. S. C. E., '82, 1001 N. Broadway, Oklahoma City, O. T., Chief Engr. Texas & Oklahoma Ry Co.
Freschl, E., B. S. M. E., '99, 3405 Wells St., Milwaukee, Wis., Supt. Kalamazoo Knitting Co.
Fricke, August C., B. S. M. E., '01, Corliss, Milwaukee, Wis.
Friend, J. H., B. S. E. E., '03, Chicago, Ill., Sullivan Machinery Co.
Frost, O. J., '82, 1752 Champa St., Denver, Col., Assayer.
Fugina, A. R., B. S. C. E., '98, No. 1—W. Kinzie St., Chicago, Ill., Asst Engr. C. & N. W. Ry.
Fuldner, Henry C., B. S. C. E., '97, 366 Greenbush St., Milwaukee, Wis., A. Moensted & Co.
Funk, Wm. F., B. S. M. E., '91, 1407 Main St., La Crosse, Wis., M. Funk Boiler Works.
Gapen, J. C., B. S. E. E., '03, Chicago, Ill., Chicago Edison Co.
Gardner, Stephen, B. S. E. E., '02, 139 Adams St., Chicago, Ill., Chicago Edison Co.
Gerlings, H. J., B. S. M. E., '03, 248 29th St., Milwaukee, Wis., Allis-Chalmers Co.
*Gerdtzen, G. A., B. S. M. E., '93.
Gerlach, T. A., B. S. C. E., '98, 15124 Turlington Ave., Harvey, Ill., Head Draftsman, Paige Iron Works.
Gibson, Wm. J., B. S. M. E., '02, Madison, Wis., Fuller & Johnson Co.
Goddard, A. L., B. S. M. E., '96, Hadden Heights, N. J.
Golder, Lloyd W., B. S. M. E., '95; B. S. E. E., '96, 18-24 W. Randolph St., Chicago, Ill., Sec'y Lee Mfg. Co.
Goodenough, C. F., B. S. G. E., '03, West Depere, Wis., Asst Supt Paper Mills.
*Gooding, Wm. H., B. S. C. E., '73, Independence, Iowa.
Granke, Leo. E., B. S. C. E., '00, Washington, U. S. Geol. Survey.
Greaves, A. C., B. S. C. E., '03, Marshfield, Wis., City Engr.
Gregerson, Louis T., B. S. C. E., '95, 66 U. S. Nat. Bank Building, Omaha, Neb., C. & N. W. Ry.
*Gregg, H. B., B. S. M. E., Madison, Wis., Farmer.
*Grey, John C., B. S. M. E., '02.
Griffith, John H., B. S. C. E., '93, Pittsburg, Pa., J. R. Stewart Co.
Grover, A. J., B. S. C. E., '81; C. E., '83, Smithport, Pa., Res. Engr. P. S. & N. R. R.
*Grover, Allison, S., B. S. M. E., '95.
Haase, Alvin, B. S. C. E., '03, 620 Langdon St., Madison, Wis., Asst University of Wisconsin.
Hackney, Robert H., B. S. M. E., '93, 1719 Grand Ave., Milwaukee, Wis., President Pressed Steel Tank Co.
Hadfield, R. H., B. S. M. E., '03, Iowa State College, Ames, Iowa, Inst. in Mach. Design.

Hahn, J. F., B. S. C. E., '03, Century Bldg., St. Louis, Mo., St. Louis Experimental Co.

Hain, Jas. C., B. S. C. E., '93, 192 Fullerton Ave., Chicago, Ill., Engr. C., M. & St. Paul Ry.

Hambuechen, C., B. S. E. E., '99; E. E., '00, Modison, Wis.

Hamilton, Harvey F., B. S. C. E., '92, Havre, Mont., Asst Engr. G. N. R. R.

Hammerschlag, James G., B. S. M. E., '02, Milwaukee, Wis., Illinois Steel Co.

Hancock, L. M., B. S. M. E., '88, 234 Third St., San Francisco, Cal., Consult. Engr.

Hansen, Oscar, B. S, E. E., '94, 755 Chase Ave., Rogers Park, Chicago, Ill.

*Hanson, A., B. S. C. E., '99.

Hanson, Walter S., B. S. M. E., '95, Oklahoma City, Oakla., Pres. Okla. Cotton Product Co.

*Hanson, Henry O., B. S. E. E., 92 W. Jersey St., Elizabeth, N. J.

Hargrave, R. W., B. S. M. E., '99, Madison, Northern Electric Co.

Harris, H. J., '93, Pocatello, Idaho, Asst Engr. O. S. L. R. R.

Harrison, C. N., B. S. C. E., Portsmouth, N. H., U. S. Navy Yards.

Harriman, F. J., B. S. C. E., '89, 903 Perry St., Appleton, Wis., City Engr.

Hartman, Rudolph, B. S. C. E., '01, 916 24th St., Milwaukee, Wis., Consult. Engr.

Hart, Chas. W., B. S. M. E., '96, Home address, 609 Iowa St., Charles City, Ia., Hart, Parr & Co.

Hartwell, Frank I., B. S. M. E., '95, died 1897.

Harvey, John L., B. S. M. E., '00, 213 19th St., Milwaukee, Wis., Pres. Pump Works.

Haskin, Edwin E., B. S. M. E., '01, 3125 Wells St., Milwaukee, Wis., Trostel & Sons Tannery.

Hawn, Russell J., B. S. C. E., '01, Craigsville, Va., Portland Cement Works.

Hayden, Chas. B., B. S. E. E., '96, Sun Prairie, Wis., Pres. Elec. & Laundry Co.

Heald, Eugene H., B. S. C. E., '00, 314 Pleasant St., Oak Park, Ill., Contr. Agt. Amer. Bridge Co.

Hegg, John R., B. S. C. E., '00, killed on the Island of Luzon, Jan. 25, 1902.

Hedke, Chas. R., B. S. C. E., '00, Ft. Collins, Col., Consult. Engr. Stein & Hedke.

Heine, R. E., B. S. E. E. '98, University of Washington, Asst Prof. of Elec. Eng.

Hile, Chas. H., M. E., '94, 552 Harrison Ave., Boston, Mass., Boston Elevated Ry.

Hill, M. J., B. S. E. C., '03, Grand Rapids, Grand Haven & Muskegon Ry Co.

*Hinrichs, Christian, B. S. M. E., '90.

Hippenmeyer, Irving R., B. S., M. E. '02, Madison, Wis., Gisholt Machine Co.

Hirschberg, Walter P., B. S. C. E., '00, 223 Lincoln St., Johnstown, Pa., Cambria Steel Co.

Hirshheimer, H. J., B. S. M. E., '91, 218 N. 8th St., La Crosse, Wis., Supt. La Crosse Plow Works.

Hobart, F. G., B. S. M. E., '86; M. E., '90, 1259 Chapin St., Beloit, Wis., Supt. Fairbanks, Morse & Co.

Hogan, J. J., B. S. E. E., '99, 5725 Ontario St., Austin, Ill., Western Electric Co.

Hohnbach, R. O. G., B. S. M. E., Joliet, Ill., Draftsman Am. Steel and Wire Co.

Holt, F. W., B. S. C. E., M. L., '88; LL. B., '89, Washington, D. C., U. S. Patent Office.

Hoskins, A. J., Room 2, Iron Bldg., Denver, Col., Ch. Engr. Leyden Coal Co.

Hoskins, L. M., B. S., '83; M. S., '85; C. E. '87, Prof. of Mechanics Stanford University, Cal.

Hotchkiss, W. O., B. S. G. E., '03, 613 Frances St., Madison, Wis., Mining Eng. Work.

Howland, H. P., B. S. M. E., '03, 7663 Railroad Ave., Windsor Park, Chicago, Ill., Ill. Steel Co.

Hoyt, Warren A., B. S. C. E., '00, 434 Beldon Ave., Chicago, Ill.

Huels, F. W., B. S. E. E., '03, Asst. at U. W., Madison, Wis.

Humphrey, C. W., B. S. E. E., '00, Denver Col., Denver Gas and Electric Co.

*Hunner, Earl E., B. S. C. E., '00, Hibbing, Minn., U. S. Steel Co.

Hurd, John T., B. S. C. E., '01, Canton, China, Amer. Chinese Development Co.

Hurd, Nathanial L., B. S. M. E., '01, Joliet, Ill., Amer. McKenna Process Co.

Icke, John F., B. S. C. E., '00, Madison, Wis., City Engineer.

James, Ben W., B. S. M. E., '97, 401 Herkimer, Joliet, Ill., Illinois Steel Co.

James, Oscar B., B. S. M. E., '91, Richland Center, Wis.

Jenne, R. L., B. S. E. E., '98, died.

Jones, Geo. H., B. S. E. E., '97, 139 Adams St., Chicago Ill., Chicago Edison Co.

Johnson, A. L., B. S. M. E., '03, 695 N. Robey St., Chicago, Ill.

Johnson, Carl A., B. S. M. E., '91, Madison, Wis., Gen. Mgr. Gisholt Machine Co.

Joyce, Pat. F., B. S. C. E., '93, Abbottsford, Wis., Engr. with Wisconsin Central.

Keachie, G. R., B. S. C. E., '03, Madison, Wis.

Keller, C. A., B. S. E. E., '99, Chicago, Ill., Contr. Engr. Chicago Edison Co.

Kelley, Patrick J., B. S. E. E., 02, care of J. G. White, 43 Exchange Place, New York, N. Y.

Kiehl, Wallace P., B. S. E. E., '97, 52 Broadway, New York City.
King, Arthur C., B. S. M. E., '01, Madison, Wis., Northern Electric Co.
Kirchoffer, Wm. G., B. S. C. E., '97, Madison, Wis., Consult. Engr.
Klug, L. J., B. S. C. E., '98, 353 15th Ave., Milwaukee, Wis., American Bridge Works.
Knowles, J. H., B. S. C. E., '99, 112 N. Main St., Salt Lake City, Utah, Asst. Engr. S. P. Los A. Salt L. R. R.
Kohl, Oliver B., B. S. E.E., '02, Denver Col., Asst. Gen. Mgr. Lacombe Electric Company.
Kremers, John G., B. S. E. E., '98, 554 4th St., Milwaukee, Wis.
Kratsch, Wm. H., B. S. M. E., '97, 232 W. Irving St., Oshkosh, Wis., Supt. Geo. Challoners Sons Co.
Krumrey, R. G., St. Louis, Mo., Electric Plant, Laclede Gas Light Co.
Kurtz, Chas. M., B. S. C. E., '97, care W. E. Marsh, Ogden, Utah, C. P. R. R. construction.
Kurtz, Ed. B., B. S. M. E., '94, 4629 Wagner Place, St. Louis, Mo., Supt Laclede Power Co.
Lademan, Otto T., B. S. E. E., '97, St. Louis, Mo., St. Louis Elec. Construction Co.
Lacey, Frank H., B. S. E. E., '01, Council Bluffs, Iowa.
*Landgraf, F. K., B. S. M. E., '98.
Lapham, Chas., B. S. C. E., '81, 3118 Mt. Vernon Ave., Milwaukee, Wis., Div. Engr. C., M. & St. P. Ry.
Lardner, Henry A., B. S. E. E., '93; E. E., '95, 29 Broadway, New York City, J. G. White & Co.
Lathrop, Wm. F., B. S. E. E., '02, Denver, Col., Sullivan Mach. Co.
*Laurgaard, Olaf, B. S. C. E., '03, Asst. Engr. U. S. G. S.
Lawton, E. W., B. S. M. E., '89, De Pere, Wis., Sec'y and Treas., C. A. Lawton Co.
Lea, John M., B. S. E. E., '02, 846 Jackson Blvd., Chicago, Ill., Western Elec. Co.
Legg, Ernest F., B. S. E. E., '01, 734 State St., Schenectady, N. Y., General Electric Co.
Leich, Oscar M., B. S. E. E., '98, 610 Wilson Ave;, Ravenswood Sta., Chicago, Ill.
Lemon, Luther E., B. S. E. E., '96, 158 Iowa Ave., Aurora, Ill., Secy Vindex Elec. Co.
*Lennon, Hawley D., B. S. G. E., '02.
Leuth, Emil S., B. S. M. E., '97, 213 14th St., Milwaukee, Wis., Designer, Brown Corliss Engine Co.
Leuth, P. F., B. S. M. E., '98, Milwaukee, Wis., Cutler-Hammer Co.
Lindem, Olaf J., B. S. C. E., '00, died at San Antonia, Texas.
Lindeman, A. S., B. S. M. E., '85; M. E. '87, 2912 Highland Blvd, Milwaukee, Wis., Mgr. Imperial Spring Co.
Lisberger, S. J., B. S. E. E., '03, San Antonia, Tex., San Antonia Gas & Electric Co.
Lloyd, Conrad C., B. S. C. E., '96, 860 Cass St., Milwaukee, Wis., C. M. & St. P. Ry.

*Logemann, R. T., B. S. C. E., '99.
Lyons, B. F., B. S. M. E., '03, St. Louis, Mo., Laclede Gas Co.
Mabbett, Walter F., B. S. C. E., '02, Chicago, Ill., Eng. Dept. C. M. & St. P. Ry.
MacGregor, W. F., B. S. M. E., '97, Racine, Wis., Supt. J. I. Case T. M. Co.
McEvoy, George E., B. S. M. E., '02, S. Milwaukee, Wis., Illinois Steel Co.
*Maldaur, Arthur, B. S. C. E., '96.
Malec, Anton, B. S. M. E., '98, Chicago, Ill., Western Elec. Co.
Mathews, Oliver, '79, P. O. Box 153 Colorado Springs, Col., Min. Engr.
Maurer, Ed. R., B. S. C. E., '90, Prof. of Mechanics, University of Wisconsin.
Marvin, Arba B., B. S. E. E., '00, Washington, D. C., Patent office.
Mason, C. T., B. S. M. E., '99, 300 Mississippi Ave., Joliet, Ill., Illinois Steel Co.
Mayer, August, B. S. C. E., '83, 810 Jordan St., Shreveport, La., Cotton Planter.
McCollough, F. M., B. S. C. E., '03, 620 Langdon St., Madison, Wis., Inst. in Topographic Engr. U. of Wis.
McCulloch, A. L., B. S. C. E., '95, died.
McArthur, A. R., B. S. M. E., '00, 1529, S. J. St., Elwood, Ind., American Tin Plate Co.
McDonald, Clinton, B. S. C. E., '97, Madison, Wis., Road master, C. & N. W. Ry.
McKim, Jas. A., B. S. C. E., '91, 2150 N. Meridan St., Indianapolis, Ind., V. P. and Gen. Mgr. Noelke-Richards Iron Works.
MncNow, W. C., Buffalo, N. Y., Room 1, Erie Depot.
Mead, Geo. A., B. S. E. E., '95, Mansfield, Ohio, Ohio Brass Works.
*Mead, O. A., B. S. C. E., '92, Appleton, Wis., R. McMillan & Co.
*Mellville, Jas., B. S. C. E., '75; C. E., '78, Delafield, Wis., Supt. Home and Farm School.
Merrian, H. N., B. S. C. E., '98, Revelstoke, B. C., Canadian Pacific R'y.
Merriman, W. N., '81, 202 Wolvin Bldg., Duluth, Minn., Geologist for Oliver Iron Mining Co. and Minn. Iron Co.
Merrick, E. G., B. S. E. E., '00, 46 E. Housatonic St., Pittsfield, Mass., Stanley Elec. Mfg. Co.
Meyers, Alvin V., B. S. E. E., '01, Provo, Utah, Telluride Power Transmission Co.
Meyer, Ed. W., B. S. M. E., '95, 948 4th St., Milwaukee, Wis., Nordberg Mfg. Co.
Minch, H. J., B. S. M. E., '92 222 W. Gorham St, Madison, Wis.
Minch, Oscar J., B. S. M. E., '93, Odessa, Wash., Mgr. Odessa Milling Co.
Minch, Walter B., B. S. M. E., '00, 350 Ashland Blvd., Chicago, Ill., Western Elec. Co.
Monahan, J. J., B. S. C. E., '95, Milwaukee, Wis., Filer & Stowell Co.
Moore, Lewis E., B. S. M. E., '00, Instructor, University of Wisconsin.

Moore, Sherman, B. S. C. E., '02, 4 Old Post Office Bldg., Detroit, Mich., care of U. S. Lake Survey.

Moroney, Jas., '73, Dallas, Texas.

Morrison, R. H., B. S. M. E., '03, Sharon Pa., Amer. Tin Plate Co.

Morrow, Frank E., B. S. C. E., '92, North Milwaukee, Wis., Draftsman Mil. Bridge & Iron Co.

*Morrow, Homer, B. S. M. E., '01.

Mors, Geo. C., B. S. M. E., '92, Box 965, Pittsburg, Pa., American Tin Plate Co., Carnegie Bldg.

Mott, W. R., B. S. E. E., '03, Decorah, Iowa.

Mueller, E. B., B. S. E. E., '03, St. Louis, Mo., Laclede Gas Light Co.

Munger, Ed. T., B. S. M. E., '92, Havana, Ill.

Munroe, Wm., Ph. B., C. E., '73, Great Falls, Montana.

Murphy, M. N., B. S. E. E., '01, New York, West Elect. Co.

Nee, T. G., B. S. E. E., '99, 582 Congress St., Chicago, Ill., Chicago Telephone Co.

*Nelson, C. L., B. S. C. E., '00, 127 Turk St., San Francisco, Cal.

Nelson, F. W., B. S. M. E., '97, died at West Jordan, Utah, in August, 1902.

Nethercut, E. S., B. S. C. E., '89, 705 Michigan Ave., Evanston, Ill., Paige Iron Works.

Newman, Fred. J., B. S. E. E., '98, 442 42nd Place, Chicago, Ill., Woods Motor Vehicle Co.

Nicholas, A. A., B. S. E. E., '01, Chicago, Ill., Draftsman, Chicago Edison Co.

Nommenson, R. A., B. S. C. E., '99, died July 12, 1902.

Oschsner, R. J., B. S. E. E., '94, Cleveland, Ohio, Brown Hoisting Co.

Older, Clifford, B. S. C. E., '00, Slayton, Mo., Div. Engineer C. & Alton Ry.

*Olson, Arthur C., B. S. C. E., '02, C. M. & St. Paul. Ry.

Olson, L. W., B. S. E. E., '99, Mansfield, O., Olin Brass Co.

Olson, M. C., B. S. E. E., '99, Schenectady, N. Y., General Elect. Co.

Olson, Sidney, B. S. C. E., '02, died, 1902.

O'Neill, Wm. R., B. S. M. E., '87, R. F. D., No. 1, Boise, Idaho, foreman Barber Asphalt Co. Plant.

Ostenfelt, C. L., B. S. C. E., '85, 531 Unity B'dg., Chicago, Ill., Engineer for Oscar Daniels Co.

Owens, L., B. S. E. E., '97, 104 Flora Ave., Peoria, Ill., People's Gas & Electric Co.

Paine, Jas. P., B. S. C. E., '77, 223 Pleasant St., Milwaukee, Wis.

Palmer, A. H., B. S. E. E., '96, died July, 1901.

Palmer, R. B., B. S. E. E., '01, 22 A, College Hill, Cannon St., London, Eng., Care of J. G. White Co., Limited.

Parmon, A. L., B. S. C. E., '85; C. E., '89, died Oct. 3, 1899, at Spokane, Wash.

*Parmley, W. C., B. S. Met. E., '87; M. S., '93; 19 Burt St., Cleveland, Ohio.

Parr, C. H., Charles City, Iowa, Hart, Parr & Co.

Parsons, W. J., B. S. C. E., '00, 539 Rosendale, St., Pittsburg, Pa., Am· Bridge Co.

Pengra, Preston W., B. S. E. E., '02, Chicago, Ill., Inspector, Chicago-Edison Co.

Pennock, Wm. H., B. S. M. E., '83, 620 N. Y. Life Bldg., Omaha, Neb.

Perkins, J. H., B. S. E. E., '96, 670 Bryson St., Youngstown, Ohio, Youngstown Elec. Co.

*Perry, C. H., B. S. C. E., '03.

Phillips, J., B. S. C. E., '87, died, 1893.

*Phillips, N. F., B. S. C. E., '77, 3024 Holmes Ave., S. Minneapolis, Minn., Treasurer Twin City School Supplies.

Plumb, H. T., B. S. E. E., '01, Lafayette, Ind., Perdue University.

Polley, George A., B. S. C. E., '02, Winona, Minn., Eng. Dept. C. & N. W. R'y.

Pope, Geo. W., B. S. C. E., '98, Dooley Blk., SaltLake City, Utah, Minn. Steel and Mch. Co.

*Potter, Wm. G., B. S. C. E., '90; C. E., '94, 127 Hartford Bldg., Chicago, Ill., Alvord & Shields.

Powell, A. O., B. S. C. E., '80; C. E., '90, St. Paul, Minn., P. O. Box, 654, U. S. Engr. Office.

Powell, E. H., B. S. M. E., '91, Care of I. C. S., Scranton, Pa.

Powrie, Wm. R., B. S. M. E., '96, Waukesha, Wis., Powrie & Sons.

Prael, Fred W., B. S. M. E., '91, Lombard and Battery St., San Francisco, Cal., American Can Co.

Pugh, John, B. S. E. E., '03, 836 Park Ave., Racine, Wis., J. I. Case Co.

Purdy, C. T., B. S. C. E., '85; C. E., '86, 78 5th Ave., New York City, Private Practice.

Quigley, A. J., B. S. E. E., '03, 502 Summit Ave., Schenectady, N. Y., General Elec. Co.

Quirk, Jos., B. S. C. E., '73, 1920 Vine Place, Minneapolis, Minn., Joseph Quirk Milling Co.

Radke, Albert A., B. S. E. E., '00, Fairburn, Minn., Shattuck Milit. Academy.

Ramien, C. H., B. S. M. E., '96, 560 4th St. Milwaukee, Wis., Draftsman, Allis-Chalmers Co.

Ransom, Geo. B., B. S. C. E., '91, Portsmouth, N. H., Engr. U. S. N. Sta.

Reedal, P. E., B. S. E. E., '96, 687 Prospect Ave., Milwaukee, Wis., National Elect. Co.

Reilly, H. W., B. S. E. E., '97, Monroe, Mich., J. G. White & Co.

Rendtorff, E. J., B. S. E. E., '95, Lake Forest, Ill., Lake Forest Academy.

Reuping, L. H., B. S. M. E., '03, Omaha, Neb., Omaha Gas Co.

Reynolds, W. E., B. S. E. E., '99, Room 42, 203 Washington St., Chicago, Ill., Chicago Telephone Co.

Rhine, Chas. A., B. S. E. E., '00, 615 Clybourn St., Milwaukee, Wis.

Richards, J. T., B. S. C. E., '95, 339 W. 40th St., New York City, Pres. J. T. Richards & Co.

*Richards, W. A., B. S. M. E., '99.

Richards, W. J., B. S. E. E., '93, 501 A, Oakland Ave., Milwaukee, Wis.
Richter, A. W., B. S. M. E., '89, M. E., '91, Prof. in Engineering, University of Wisconsin.
Robinson, Geo. P., B. S. E. E., '96, San Francisco, Cal., Traffic Mgr. Pacific Coast Tel. & Tel. Co.
Rogers, Walter A., B. S. C. E., '88; C. E., '97, 1205 Manhattan Bldg., Chicago, Ill., Vice-Pres. Bates & Rogers Co.
Rollman, A. C., B. S. E. E., '01, 1226 Grand Ave., Milwaukee, Wis., Arnold Magnetic Clutch Co.
Rosenstengel, R., B. S. C. E., '94, 537 Broadway, Milwaukee, Wis., Nat. Elec. Co.
Rosenstengel, Wm. R., B. S. M. E., '87, 442 Northampton St., Buffalo, N. Y.
Ross, H. H., B. S. E. E., '96, Cleveland, Ohio, Asst. Engr. L. S. & M. S. R'y.
Rote, A. F., '82, Monroe, Wis. Lumber Merchant.
Rowe, W. J., B. S. E. E., '03, Chicago, Ill., Chi. Edison Co.
Rowell, L. D., B. S. E. E., '01, Milwaukee, Wis., Arnold Magnetic Clutch Co.
Ruka, Fred W., B. S. E. E., '96, Boscobel, Wis.
Rumsey, S. S., B. S. C. E., '97, 610 Wolvin Bldg., Duluth, Minn., Asst. Mech. Engr., Oliver Mining Co.
Salsich, Le Roy, B. S. C. E., '01, Hibbing, Minn., Care of Minn. Iron Co.
*Sanborn, J. N., B. S. M. E., '81; C. E., '84, Marshall, Tex., Master Mech. Texas So. Ry.
Sanborn, Roy A., B. S. E. E., '01, Chicago, Ill., Weston Bros.' Consulting and Contracting Engineers.
*Sands, E. E., B. S. C. E., '00, Eng. U. S. G. S.
Saunders, Albert B., B. S. M. E., '02, Hinsdale, Ill., Western Electric Co., Chicago.
Saunders, H. J., B. S. C. E., '03, 911 2nd Ave., Council Bluffs, Mo., Reclamation Service U. S. G. S., N. Mex.
Savage, J. L., B. S. C. E., '03, Asst. Engr. Reclamation Service, U. S. G. S.
*Sawyer, A. R., E. E., '96, State Agricultural College, Mich.
Schafer, Otto, B. S. C. E., '98, Minneapolis, Minn., C., M. & St. P. R. R. Depot.
Schapper, Kurt, B. S. M. E., '02, 1832 Arlington Pl., Chicago, Ill.
Scheiber, A. V., B. S. E. E., '99, 3333 Wabash Ave., Chicago, Ill., Chicago Telephone Co.
Schildauer, Edw., B. S. E. E., '97, 1023 Leland Ave., Chicago, Ill., Chicago, Edison Co.
Schmidt, C. J., B. S. E. E., '97, 1450 Monadnock Blk., Chicago, Ill.
Schmidt, F. E., B. S. C. E., '00, 220 Broadway, New York City, Engineering News.
Schroeder, F. A., B. S. E. E., '99, Johnstown, Pa.
Schuchardt, R. F., B. S. E. E., '97, 139 Adams St., Chicago, Chicago Edison Co.

*Schulz, A. G., B. S. C. E., '75, Porterville, Cal.

Schuster, J. W., B. S. E. E., '99, University of Wisconsin, Asst Prof. Elec. Eng.

Schumann, Theo., B. S. E. E., '95, died March 26, 1896.

Schneider, H. C., B. S. M. E., '98, Evansville, Wis., Supt. Baker Mfg. Co.

Schroeder, John T., B. S. C. E., '02, Oliver Springs, Tenn., Asst Res. Engr.

Schroeder, F. A., Johnstown, Pa., Cambria Steel Co,

Scott, A. C., Austin, Texas, Prof. Elec. Engr. U. of Texas.

Scott, Geo. A., B. S. E. E., '02, Butte, Mont., Mo. River Power Co.

Scott, H. H., B. S. E. E., '96, San Antonio, Texas.

Seaman, Harold, B. S. E. E., '00, Philadelphia, Pa., Elec. Storage Battery Co.

Seaman, Irving, B. S. E. E., '03, Philadelphia, Pa., Elec. Storage Battery Co.

*Severson, Harry, B. S. C. E., '01, Rockford, Ill., Barber & Coleman.

Seymour, M. E., B. S. E. E., '98, 44 Broad St., New York City, General Elec. Co.

Sheldon, S. R., B. S. E. E., '94, Moscow, Idaho.

Shelton, A. W., B. S. C. E., '83; LL. B., '85, Rhinelander, Wis., Lawyer.

Short, F. J., B. S. M. E., '97, Aspinwall, Pa., McClintock Marshall Constr. Co., Rankin, Pa.

Short, Jas. M., B. S. C. E., '89, 1251 Madison Ave., Indianapolis, Ind., Eng. Noelke-Richards Iron Works.

Silber, Fred D., B. S. E. E., '94, 5515 Woodlawn Ave., Chicago, Ill., Lawyer.

Smith, Allard, B. S. E. E., '98, 203 Washington St., Chicago, Ill., Chicago Telephone Co.

Smith, Alson I., B. S. E. E., '93, Wauwatosa, Wis., Smith Bros.

*Smith, F. H., B. S. C. E., '91, 117 Hinsdel Pl., Elgin, Ill.

Smith, Harry A., B. S. E. E., '98, Hoboken, N. J., Chief Engr. Office D. L. & W. R. R.

Smith, H. B., B. S. Met. E., '85, Colton, Cal., First Nat. Bank.

Smith, James E., B. S. C. E., '02, 708 S. Jefferson St., Mexico, Mo., Res. Engr. C. B. & Q. R. R.

Smith, James Elmo, B. S. C. E., '03, St. Louis, Mo., Res. Engr. A. B. Short Line.

Smith, L. S., B. S. C. E., '90; C. E., '95, University of Wisconsin, Prof. in Engineering.

Smith, P. S., B. S. E. E., '98, 421 W. Monroe St., Chicago, Ill., Kellogg Switch Board & Supply Co.

Smith, Robert T., Jr., B. S. C. E., '02, 324 Roland Ave., Roland Park, Baltimore, Md.

Smith, S. T., B. S. C. E., '00, 1472 Camp St., New Orleans, La.

Spalding, Wm., B. S. E. E., '03, 430 W. Gorham St., Madison, Wis.

Spence, Harry, B. S. E. E., '98, 1353 Kane St., La Crosse, Wis., Principal 5th Dist. School.

Spencer, R. C., Jr., B. S. M. E., '86, 340 Keystone Ave., River Forest, Ill., Architect.

Spindler, Max H., B. S. C. E., '98, 49 Breck Av., Cleveland, O., with Osborn Eng. Co.

Stanchfield, Bartley, B. S. M. E., '94, Detroit, Mich., Oldsmobile Co.

Stanchfield, Geo. H., B. S. C. E., '92, Watertown, Wis., City Engr.

*Starks, Sandford P., B. S. M. E., '02.

Stevens, Chester H., B. S. C. E., '02, St. Louis, Mo., Engr. Dept Chi. & Alton Ry.

Stevens, H. S., B. S. C. E., '03, Philippine Islands, U. S. Engr.

Stevens, John Jr., B. S. M. E., '89, 842 College Ave., Appleton, Wis., Banker.

Stewart, R. W., B. S. C. E., '99, Sacramento, Cal., Asst Engr. Southern Pacific Ry.

Stieler, Frederic C., B. S. E. E., '02, 451 Broadway, Milwaukee, Wis., T. M. E. R. & L. Co.

Stockman, Louis R., B. S. C. E., '02, 263 Dearborn St., Chicago, Ill., Asst Engr. Irrig. Work, U. S. G. S.

Stone, Melvin B., S. C. E., '00, 200 Commercial Bldg., Minneapolis, Minn., A. Y. Bayne & Co.

*Sturtevant, H. B., B. S. C. E., '80; C. E., '88, Duluth, Minn., Mgr. Mines for Rogers, Brown & Co.

Sunderland, Ira C., B. S. C. E., '02, 33 Campau Bldg., Detroit, Mich., care of U. S. Lake Survey.

Swatty, David Y., B. S. C. E., '98, Union Station, Pittsburg, Pa., Penn. Lines Engineering Dept.

Swenson, Magnus, B. S. Met. E., '80; M. S., '83, Madison, Wis.

Swenson, Bernard V., E. E., '01, University of Wisconsin, Asst Prof. of Elec. Eng.

Sweet, John F., B. S. M. E., '93, 285 Farwell Ave., Milwaukee, Wis., Browning Mfg. Co.

*Swinborne, E. D., B. S. M. E., '88, 1116 Lake St., Chicago, Ill., G. A. Harter & Co.

Taylor, J. C., B. S. E. E., '01, Halifax, N. S., Sullivan Machinery Co.

Tehr, Herman, '84, 14 Grand Ave., Milwaukee, Wis., Lawyer.

Terven, Lewis A., B. S. E. E., '02, Pittsburg, Pa., Nernst Lamp Co.

Tessier, L. L., B. S. M. E., '93 De Pere, Wis., De Pere Elec. Light & Power Co.

Thompson, Jas. R., B. S. Met. E., '87; B. S., '88; M. S., '92, Ironwood, Mich., Gen. Mgr. New Port Mining Co.

Thorkelson, H. J. B., B. S. M. E., '98, 915 University Ave., Madison, Wis., M. E. Instructor in Steam Eng., U. W.

Thorkelson, Wm. L., B. S. M. E., '02, 1812 Washington Ave., Racine Junction, Wis.

Thorp, Geo. G., B. S. M. E., '91, Clairton, Pa., Gen'l Supt Clairton Steel Co.

*Thygeson, N. M., B. S. Met. E., '85; LL. B. '87, St. Paul, Minn, Attorney.

*Thuringer, Chas., B. S. C. E., '93, Milwaukee, Wis., U. S. Engineer's office.

Tibbitts, H. L., B. S. C. E., '94, 814 Wells Bldg. Milwaukee, Wis., Sec. of Tibbitts-Cameron Lumber Co.

Townsend, H. I., B. S. E. E., '01, Hampton, Iowa, Cen. Iowa Tel. Co.

Trautman, G. H., B. S. M. E., '96, 2667 N. Hermitage Ave., Ravenswood, Chicago, Ill., Asst. Supt. Inspection Internat. Harv. Co.

Trippe, H. M., B. S. C. E., '96, Room 3, Marine Bldg., Chicago, Ill., Asst. General Bridge Inspr. C. & N. W. Ry.

*Trowbridge, J. B., B. S. C. E., '76; M. D. Rush, '82, Hayward, Wis.

True, E. B., B. S. E. E., '96, 1109 Cass St., Joliet, Ill.

*Turner, Jos. M., B. S. C. E., '77, 99 Dearborn St., Chicago, Ill., Pres. and Gen. Mgr., Wis. Outing Club.

Uehling,. O. C., B. S. C. E., '90, 330 Grove St., Milwaukee, Wis.

Updegraff, Milton, B. S., B. M. E., '84; M. S. '86, Washington, D. C., Naval Observatory.

Van Hise, C. R., B. M. E., B. S. '80; M. S., '82; Ph. D., '92, Madison, Wis., Pres. of University of Wis.

Van Ness, L. G., B. S. E. E., '96, Lincoln, Neb., Lincoln Gas & Elec. Co.

Van Ornum, J. L., B. S. C. E., '88; C. E., '91, St. Louis, Mo., Prof. of Engineering, Washington University.

Vaughn, F. A., B. S. E. E., '95, Milwaukee, Wis., T. M., E. R. & L. Co.

Vea, F. J., B. S. M. E., '01, Stoughton, Wis., Supt of Stoughton Wagon Works.

Viebahn, G. O., B. S. C. E., '93, died Feb. 2, 1897, Watertown, Wis.

Wade, C. G., B. S. C. E., '84, 346 1st Ave., Wauwatosa, Wis., Consult. Engr.

Waldo, Geo. E., B. S. M. E., '85, LL. B., '88, 1234 Monadnock Bldg., Chicago, Ill., Patent Lawyer.

Waldo, M. A., B. S. M. E., '84, 226 3rd Ave., Leavenworth, Kan., Mo. Valley Bridge & Iron Works.

Wales, C. M., B. S. M. E., '85, 11 Broadway, New York City, Cleveland Forge & Iron Works.

Warden, E. P., B. S. M. E., '92, 350 Kane Place, Milwaukee, Wis., Prescott Steam Pump Co.

*Warner, H. R., B. S. M. E., '98.

Warner, F. D., B. S. M. E., '96, 354 32nd St. North, Portland, Ore., Dealer in Real Estate.

Warner, M. F., B. S. E. E., '95, 100 Williams St., New York City, H. W. Johns Manville Co.

Washburn, F. E., B. S. C. E., '01, Minneapolis, Minn.

*Wassmansdorf, O. F., B. S. C. E., '00.

Wasweyler, H. W., B. S. M. E., '85, 251 Lapham St., Milwaukee, Wis., Pres. and Gen. Mgr. Milwaukee Brass Mfg. Co.

*Watson, C. H., B. S. M. E., '01.

Watson, James W., B. S. E. E., '02, 620 Langdon St., Madison, Wis., Asst. Instructor E. E. in U. W.

Webb, H. S., E. E., '98, Orino, Maine, Prof. Elec. Eng., University of Maine.

Weber, F. C., B. S. E. E., '03, 516 Smith St., Schenectady, N. Y., Gen. Elect. Co.

Wedemeyer, A. A., B. S. M. E., '03, Sheboygan, Wis., Asst. in High School.

Weed, L. B., B. S. C. E., '00, Bisbee, Arizona.

West, A. J., B. S. M. E., '87, Milwaukee, Wis., Asst. Supt. Allis-Chalmers Co.

Wheelan, Jas., B. S. C. E., '77, Hartford, Wis., Jun. Engr. River & Harbor Improvements, Milwaukee District.

White, F. B., B. S. M. E., '86, died June 27, 1886, Madison, Wis.

Whittemore, H., B. S. M. E., '03, Clairmont, N. H., Asst. Supt. Sullivan Machine Co.

Whomes, H. R., B. S. M. E., '00, M. P. Depot, 41 Hamlin Ave., Chicago, Ill., C. & N. W. R. R.

Wiley, R. R., E. E., '99, Peterborough, Ont., Packard Elect. Co.

Williams, C. H., B. S. M. E., '96, Madison, Wis., Gen. Supt. Madison Gas & Elect. Co.

Williams, Lynn A., B. S. M. E., '00, 1450 Monadnock Bldg., Chicago, Ill., Patent Attorney.

Williams, Wm. H., B. E. E., '96, 917 W. Green Street, Urbana, Ill., Asst. Prof. Elec. Engr. Univ. of Ill.

*Williams, L. D., B. S. C. E., '01.

Williamson, E. L., B. S. C. E., '00, Davenport, Ia., Asst. Engr. C. R. I. & P.

Willson, F. G., B. S. E. E., '03, Asst. U. of Ill., Urbana, Ill.

*Willson, E. F., B. S. M. E., '84, Suite 45, 161 E. Randolph St., Chicago, Ill.

Wilson, John, B. S. C. E., '03, 410 N. 4th St., Springfield, Ill.

*Whipfler, R. E., B. S. C. E., '00, Kelleyton, Ala., U. S. Geol. Survey.

Wise, P. L., C. S. C. E., '88, 434 Shawanee Ave., Topeka, Kan., Ch. Engr. Topeka Ry. Co.

Wolter, B. C., B. S. C. E., '75, Appleton, Wis.

Wood, H. H., B. S. M. E., '01, Stoughton, Wis., Stoughton Wagon Works.

*Wood, W. W., B. S. C. E., '76, Rushville, Neb.

Woodward, Wm. L., B. S. M. E., '94, 420 Main St., LaCrosse, Wis., Lawyer.

Worden, B. L., B. S. C. E., '93, Milwaukee, Wis., Wisconsin Bridge & Iron Co.

Woy, F. P., B. S. E. E., '03, 43 Exchange Place, N. Y., J. G. White & Co.

Wray, Jas. G., B. S. E. E., '93, 203 Washington St., Chicago, Ill., Chicago Telephone Co.

Young, Henry W., B. S. E. E., '02, 510 Marquette Bldg., Chicago, Ill., Associate Editor Western Electrician.

Young, Jas. R., B. S. M. E., '93, died July 6, 1895.

*Zabel, M. B., B. S. E. E., '98.

Zimmerman, C. I., B. S. E. E., '03, 516 Wallace Ave., Wilkinsburg Sta., Pittsburg, Pa., Asst. Chemist Nernst Lamp Co.

Zimmerman, O. B., B. S. M. E., '96; M. E., '00, Asst. Prof. of Mach. Des. U. of W.

Zinn, W. A., B. S. M. E., '98, 2908 Highland Blvd., Milwaukee, Wis., Malting Co.

Zwietusch, E. O., B. S. M. E., '86; M. E. '88, Engelufer 1, Berlin, S. O., Germany.

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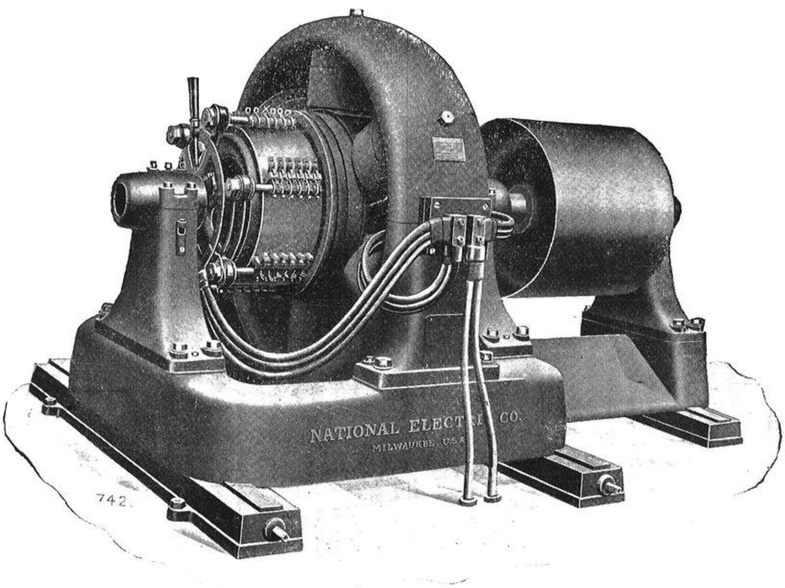

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