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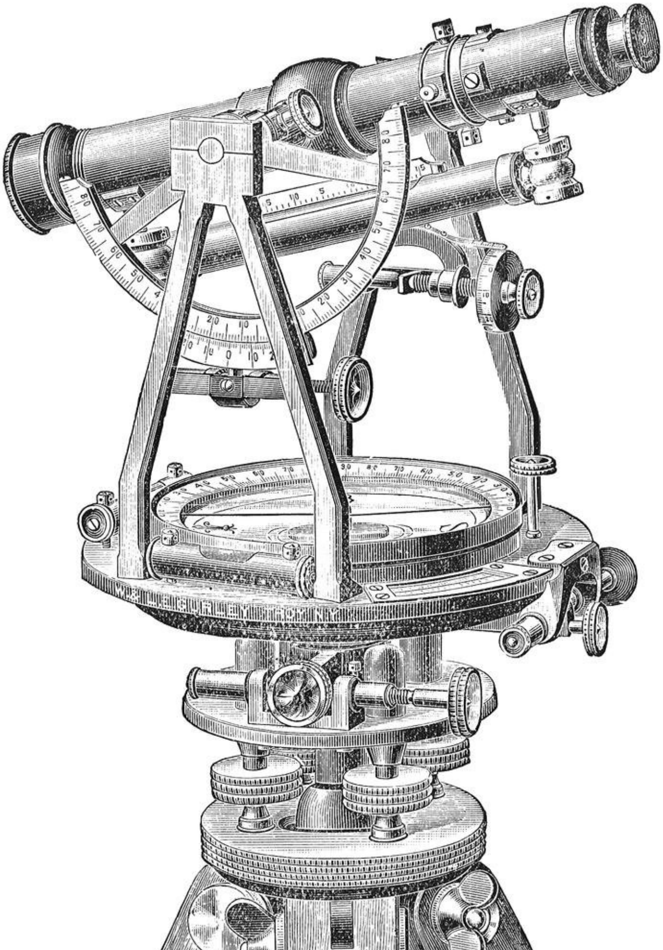

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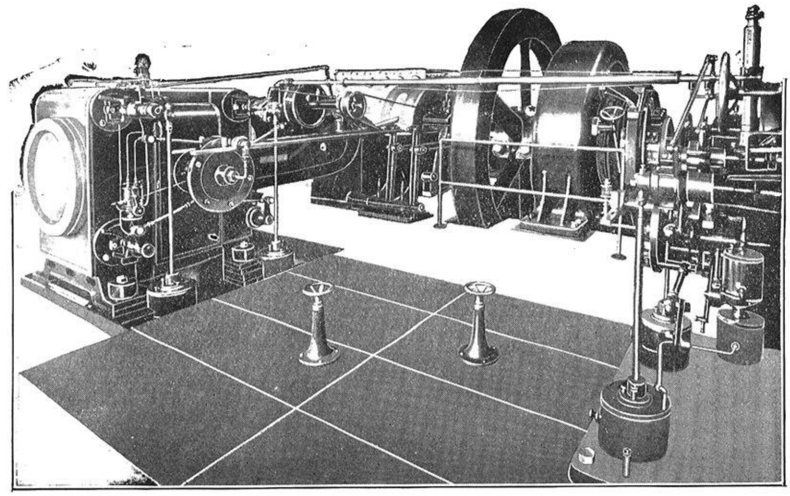

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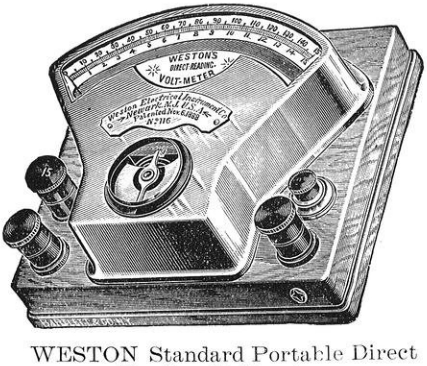

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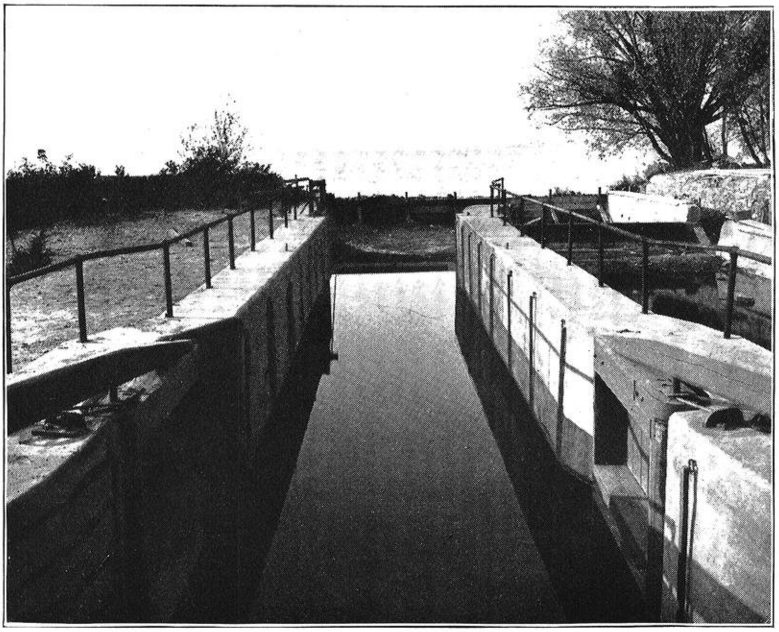
Contents.



The Yahara Lock.

THE WISCONSIN ENGINEER

VOL. 8. DECEMBER, 1903. NO. 1.

THE APPRAISEMENT OF THE PHYSICAL VALUE OF WISCONSIN RAILWAYS FOR THE PURPOSE OF TAXATION.

BY W. D. TAYLOR.

The so-called ad valorem bill for the taxation of the railways of Wisconsin passed both branches of the legislature and became a law in May, 1903.

The law as passed plainly indicates that in the appraisement of the railways their earning power is to be considered. That is, their franchise value, or what is sometimes called their intangible value, is to have considerable weight, as well as the physical value of the property, in determining what is the actual value of each railway property in the state.

By the terms of the law the State Tax Commission, consisting of three members and a secretary, constitute the State Board of Assessment, to which is assigned the work of assessing the railways of the state at their true value.

As a first step it was necessary to get an appraisement of the physical properties of each railway. It is held that the physical property of the railway is worth, not what it did cost, nor what it would sell for, but what it would cost to reproduce it today in its present condition.

The work of finding the value of all the physical property of even one large railway system is in itself a large undertaking. Besides many other roads there are two large systems operating in the state which have about 1700 miles of line within the state and 7000 miles or more in their whole system. Each of these systems have more than 1,000 locomotives and more than 40,000 freight cars employed in their business. The systems have been put together by the purchase of one short railway after another. When another line was bought and added to the system, it was sometimes the case that the construction records had been lost or burned, so that the new owners would know perhaps how many miles of main line and siding they were adding to their system; they would know, perhaps, what was the general condition of the new roadbed; they might take pains to learn how many cars and locomotives they were adding to their own list, and how many bridges of given span and material were included in the new track. But it did not matter with them whether the road was built on a forty foot enbankment, tunneled through solid rock, or had the ties laid flat on the natural earth. To them there were so many miles of track in good or bad condition which could be made to earn so many dollars per mile. So it was small concern to them if they did not know how many cubic yards of grading, or how many acres of right of way, or how many yards of masonry, or pounds of bridge steel had been used in the making of the roadbed. Thus it happens that the information needed for fixing the physical value of a large part of the railways, in the state, is not in the possession of the officers of the roads as it is not in existence.

Then there is the question of establishing the quota of cars and locomotives on inter-state roads. The ordinary freight car has no home. Any one particular freight car on an interstate system, unless it is constructed for some particular service that obtains entirely within a state, cannot be said to belong to one state more than another. But still in appraising the physical values of the railways of Wisconsin a certain number of each class of rolling stock used on the lines within the state should clearly be included in the property lists pertaining to the state. How is the quota to be determined?

There is the matter of the right of way lands of the railways for main tracks, yards, shops, and terminals. Is the right of way, owned in long strips, any more valuable than the contiguous lands? It certainly is, because as a rule it cuts contiguous property in twain and does damage in the way of drainage and inconvenience to adoining property. But how much more valuable is it? When the road was built the right of way may have been donated to encourage the construction of the road. The contiguous land may now be worth $60.00 or $5000.00 an acre. Is this right of way which may have been donated now worth $60.00 or $180.00; $5000.00 or $10,000.00 an acre?

Questions like these arise in regard to the value of almost every considerable item of property on a railway. It would seem at first glance that the value of steel rail in the track of a railway should be about as simple a matter as could well arise in such an appraisement. The market value of the new rail and of scrap rail is quoted each week in reliable trade journals, and the length of each different weight of rail in the track is on record in most railway offices. But what is the value of rail in the track that has seen service enough to bring about 60 per cent. of its reduction from new rail to scrap. Suppose the price per ton at the mills in Chicago is quoted as $28.00 and $14.00 respectively, for new rail and scrap steel. One would hold at once that the wearing value was $14.00 and since 60 per cent of that was gone, $5.60 of its wearing value still remained and the total present value, therefore, would be $5.60 + $14.00 or $19.60 per ton. But though this may be a correct solution there are some conditions connected with the matter that tend to make one doubt its correctness in all cases.

If the rail is used at a point 200 miles from Chicago it will cost $1.00 per ton to transport it to the point where it is used. It will cost $2.50 a ton to lay it, line it, and surface it. Thus by the time it is laid as new steel ready for use it has cost $31.50 a ton. Now if it remains in the track until reduced to scrap the market scrap value is not available till $1.00 per ton is spent on it in removing it from the track and loading it on cars, and $1.00 more per ton in transporting it back to the mills. In the mean time the rail has lost from wear and rust from 3 to 6 per cent. of its weight. How much of this cycle of operations is chargeable to operating expenses and how much of it should be taken into account in finding the physical value of the property? To further complicate the matter, only a small per cent. of the rail ever finds its way back to the market as scrap. After a varying number of years of service, in the main line track, it is taken out and loaded and sold to another road to be delivered f. o. b. cars at the extreme point of the system in the direction toward which the purchaser wishes to use the rail; or it is taken to a secondary line of the system to remain an indefinite number of years in the track, eventually to be removed into an unimportant siding or spur track where its term of probable service cannot be determined from any records that we now have.

Now to show the importance of a correct basis for deciding this matter: If we take the mileage of all railway track in the state at 10,000 and the average weight of rail to be 60 lbs. it will be seen that an error of even $1.00 per ton in the assumed price would affect the appraisement of the physical property of all the railways of the state by nearly a million dollars.

In the assumed standpoint that the physical property of a given road is worth what it would cost today to reproduce it in its present condition, there is a seeming inconsistency in that it involves an impossible condition. It would not be possible to reproduce the road in its present condition even were it possible to erase it. If reproduced it must be made new in every respect; it must have new cars, new rail and a new roadbed. To carry out the intent of such a rule it is necessary to figure, in finding the cost of reproduction, everything new, and make an algebraic addition to this to gain the present value by estimating the effect of wear and time upon each item. Now the roadbed, the part of the road below the ties, or at least that part of it which rests on the solid earth, appreciates with time and use. Nearly every other article, comprising the list of the physical property of a railway, depreciates with time. Rail, bridges, ties, masonry, rolling stock, shops, and all other structures depreciate; the best masonry and steel bridges very slowly, ties and timber structures very rapidly, rail and rolling stock accordingly as they are put into hard or easy service. The land for the right of way, yards and terminals, like the traffic, which does not belong on the list of the physical property, may appreciate or depreciate with time. The masonry built by one road may be of such excellent quality that its rate of depreciation may practically be taken at zero. That of an adjoining road doing the same business may be so poor that it will deteriorate faster than timber structures. Thus the question of depreciation is as puzzling as it is important.

Even after a resurvey of the roadbed is made so that the earthwork qualities are known, it cannot be said at once just what unit prices ought to govern in figuring the cost of reproduction. The road may have been graded by casting dirt from the sides with a shovel or by hauling the material from the cuts to the fills by wheelbarrows or wagons. Probably very different methods of doing the same work would be used in constructing such a road today. If the work was very heavy, cars, engines, and steam shovels would take the place of the hand laborer and wagon. If the work was lighter probably a grading machine would load the wagons instead of the laborer and nearly all the casting and wheelborrow work would be done by grading machines, or by slips and wheel scrappers. Thus in spite of the higher cost of material and labor the genearl cost of earth work would probably, but not necessarily, be lower. The general cost of rock excavation, on account of the higher cost of labor and of material, particularly explosives, would probably but not necessarily, be greater.

Thus at almost every turn the appraiser of the physical value of railway property is met by questions requiring special expert investigation before they can be answered. There is very little engineering literature to give information as to these questions, for although it is probable that almost every considerable railway property in the country has been appraised by experts at one time or another during its existence, the reports of these appraisements made for one railway expert by another, have not found their way into print. Even if they had, the standpoint from which these appraisements have been made was so entirely different from that here required, they would be of little value. The state of Michigan made, in 1900, such an appraisement of the railways of that state as the law here requires, but, though the results of the appraisal have been published, a full account of the means used to arrive at the results have not been published.

The law provided for the employment, by the state board, of such engineers and accountants as might be necessary in assisting it to arrive at the value of the railway properties. Under this law the state board, early in June, appointed the professor of railway engineering at the state university as engineer expert to assist it in making the appraisal.

In the same month the attorneys, tax agents, and chief engineers of a few of the large railways were invited by the state board to come to Madison to confer with the board and its engineer in regard to the plan of appraisement to be adopted. The roads included at this conference represented more than seventy per cent. of the entire mileage of the state.

It was suggested to the representatives of the roads that it might be the better plan for them to make up property lists and an appraisement of their own physical properties, to be handed in to the engineer of the board for examination, and such alteration as might appear to be necessary. Except for the expense to the roads in doing the work, this was a much better plan than that of having their property schedules made out by the engineers and employes of the state board.

The roads represented accepted the suggestion and then a general plan of appraisement was discussed at length at this and other conferences, till most of the disputed points were agreed upon by the board and the roads.

The plan of appraisement was then drawn up and printed over the signature of the board's engineer, and copies of it were sent to all the departments of each railway which undertook to make out its own appraisal. Under this plan the engineer of the board furnished the blanks for enumerating and evaluating all the property in each department of a railway. The blanks are furnished in sufficient number for the railways to keep such copies of their returns as they wish. In order to facilitate the checking of the property lists by the board's engineer or his assistants, it was arranged that each road shall divide its track up into numbered sections. All fixed property of a road within the corporation lines of large towns shall constitute one section, and a complete set of blanks shall be made out exclusively for each section. No track section is to exceed fifty miles in length. Under this arrangement the two large systems before referred to have divided their track in the state, one into 81, and the other into 76, sections.

After these arrangements were made with each of the large roads represented at this conference, one road after another in the state was approached, and finally all roads in the state having an organized engineering department, agreed to undertake the appraisal of their own physical property under this general plan, and some of the smaller roads which did not have an organized engineering department, in order to be in line in the matter, employed engineers to get up the information. The work was begun in July, and although one of the large systems had seventy men at work at one time on their appraisal, no one of the larger roads of the state has, on December first, completed the appraisal of its property.

There were several smaller roads in the state which had no engineering force, and which could not afford to employ extra help to compile the information. As the aggregate mileage of these smaller roads was considerable, it was necessary, in order to appraise them; as well as to eheck and unify the appraisment of the larger roads, for the state board to organize a considerable engineering force. Further, it was early decided that the state board would make an independent investigation of the value of the right-of-way lands and terminal properties, and of rolling stock, shops and machinery.

An engineer office for the state board has been established in the engineering building of the University, consisting of the seminary room on the second floor, and two large attic rooms on the fourth floor. Some thirty men, all told, have been employed in this work, and at the present time, (December 1st,) sixteen are still working. In the appointment of this force fitness alone for the work has gained the men their positions. Not one man has been appointed through political favoritism, and, be it said to the credit of Wisconsin's politics, and especially to the honor of the state board of assessment, there has not been a single application to the engineer of the state board, backed with even the shadow of an attempt at political pressure. Even residence in the state has not been considered in the appointments. Men have been engaged for this work whenever the men could be found who were especially adapted for it. They have come from New York state, from Pittsburg, Tennessee, Arkansas, Michigan, Illinois, Missouri, and Winnepeg, Canada, as well as Wisconsin.

No exhorbitant salaries have been paid. It has been found possible to get the expert men needed by paying only a very little more than the railways pay the same men. Considering the short terms of employment this is somewhat remarkable. For example, an engineer was working for a railway as division engineer of construction at $150.00 a month and expenses. It was arranged with him to leave the road and take service undert he state board for $200.00 a month without other expenses than his railroad fare when traveling on the business of the appraisal. The work is unusual, and educative and progressive men are glad to do it for the experience they get.

Some of the appointments have been as follows:

Mr. John Marston, Jr., is principal engineer inspector. He was chief engineer, until employed by the state board, in August, of the Mason City and Fort Dodge Railway, the line that the Chicago Great Western Railway has recently constructed into Omaha. He is a graduate of the University of Pennsylvania and has had long years of experience in railway work.

Mr. E. S. Fraser is first assistant inspector. He is a Canadian but was engaged in Tennessee from the Louisville & Nashville Railroad, where he was in charge of the construction of mountain railway work, including heavy tunneling and bridging.

Field engineer inspectors are Mr. E. A. Wilder, from the Illinois Central and Louisville & Nashville; Mr. J. M. Larned, from the Erie Road; Mr. Wesley Vandercook, from the Wabash Road at St. Louis; and Mr. Louis Shaw, from the Choctaw, Oklahoma and Gulf, and also from the corps of engineers who made the Michigan appraisal.

The chief land inspector is Professor E. B. Skinner of the department of mathematics of the state university. In appraising the land values, very laborious work had to be done in examining and compiling the records of sales and in making correct deductions from the mass of information so gathered, and Professor Skinner's training enabled him to do efficient service in this matter.

The chief mechanical inspector is Mr. J. G. D. Mack, professor of machine design in the state University.

Under Professor Mack are: Mr. Horace Mann, as mechanical inspector, who was formerly general shop foreman of the Pere Marquette Railroad; Mr. Henry Harvey, as locomotive inspector, who was brought from the service of the Canadian Pacific at Winnipeg, and who was recommended by the engineer in charge of the Michigan Appraisal, Mr. Harvey having inspected the Michigan locomotives; and Mr. J. K. Woolley, as car inspector, who was recommended by the general manager of the Michigan Central Railroad, and who was acting at the Pullman shops as car inspector for several railroads, at the time of his employment by the state board. Each of these men have efficient assistants working with them.

So far there has been no friction whatever between the railroads and the state board and its employes. The utmost courtesy has been shown on both sides. The employes of the state board are endeavoring to secure as fair and accurate an estimate of the physical values as the difficult problem will admit of, and since the majority of the railroads seem to be no less willing to give all necessary information and to have their property fairly accounted for, it is to be hoped that the forthcoming appraisal of the railway physical values will give satisfaction throughout the state.

As a matter which will principally interest university people it may be added that besides the above named professors in the College of Engineering there have been employed on the work as assistant engineer and inspectors the following students of the University:

S. M. Hadley, Graduate Student in Mathematics, 1902–03.

H. E. Brandt	C. E.	–03–
A. Haase	C. E.	–03–
P. J. Carter	C. E.	–04–
R. J. Coon	C. E.	–04–
Jas. Gilman	C. E.	–04–
C. M. Larson	C. E.	–04–
H. L. McDonald	C. E.	–04–
C. A. Moritz	C. E.	–04–
H. M. Warner	C. E.	–04–
W. J. Benedict	M. E.	–04–
J. A. Stewart	E. E.	–04–

Also as clerk and stenographer,

D. A. Crawford	L. S.	–05–

THE UTILIZATION OF CHIMNEY GASES IN BEET SUGAR PLANTS.

BY J. G. KREMERS, '99.

The introduction of the diffusion process into the beet sugar industry, aside from mechanical reasons, was of great moment, as it allowed a better extraction and prevented the larger part of the organic nitrogenous matter from entering the juice, making it possible to manufacture white sugar directly without the aid of boneblack.

As great as are all these advantages to the sugar manufacturer, there is however one disadvantage connected when viewed from an agricultural standpoint.

The pulp resulting from the diffusion process contains very much water and this can be reduced to only a small extent by means of pressing.

There are very few beet sugar factories in the United States which get rid of all their pulp, as the farmers in most localities have as yet not learned the feeding value of it. The result is that it has accumulated on their premises, which are now rapidly becoming too small, and furthermore, that the disagreeable odor given off from the fermenting pulp has brought the sugar factories in conflict with the health department of those places.

The importance of this question is steadily increasing not for the reasons, as in Germany, where none of the pulp is left to decay and the drying of it is only resorted to to preserve and increase the nutritive value, but for the ones given above, that is, it is an accumulating refuse and must be taken care of.

There are a great many drawbacks in the transportation, feeding and siloing in earth siloes. The losses in siloing according to Maecker & Morgan, amount to almost 33 per cent of the dry substance.

In consequence there was soon felt the want of a process which could change this pulp into a valuable dry feed.

The credit of starting the pulp drying question belongs to Professor Dr. Maerker, in Halle, S. Prompted by his investigations and in order to draw the attention of the sugar men to the importance of the drying of the pulp, the Society for the Beet Sugar Industry of Germany, in the year 1884, offered a prize of 15,000 M. for the solution of the problem of drying pulp profitably.

After continuing the offer for several years the prize was finally granted, in 1888, to the firm of Buettner & Meyer, Uerdingen, R, Germany. Soon afterwards other systems were introduced of which Petry & Hecking and Mackenson are the most prominent, the former giving as good satisfaction as the Buettner & Meyer in every respect.

The pulp as it comes from the diffusion battery contains about 95 per cent water. The dry matter can be increased, by pressing, to about 15–17 per cent. This result can only be obtained by feeding the presses regularly and 15 per cent. dry substances may be taken as an average, on which all calculations and the coal consumption are based.

In Germany during the last campaign over 125 factories operated pulp dryers. In Austria, France and other countries there are also a number of factories which work with dryers. In this country there was only one factory which operated a satisfactory dryer last year. For the last three years a Bay City, Michigan, factory experimented with a grain dryer, and is this year installing a Buttener & Meyer dryer.

All these dryers mentioned work according to the so-called direct system. In this system, as the name implies, the hot combustion gases come in direct contact with the wet pulp. The temperature of the gases as they enter the dryer is about 1,500° F. and about 200° F., as they leave it. There is no danger of burning the pulp as it is constantly being stirred by paddle wheels and the evaporation is so rapid at the beginning that the temperature of the pulp itself is often very much below 212° F.

When it has become partly dry it has already advanced far enough in the apparatus to a point at which the gases are very much cooled off.

Perfect combustion is obtained by creating a perfect mixture of air with the gases in a long arch and by feeding the coal at regular intervals, and small quantities at a time. It is indeed rare that the dry pulp has been discolored by soot, and from the exhaust chimney nothing but white vapors can be seen to escape. The coal used is either bituminous or lignite.

A few years ago an Austrian firm placed an indirect dryer on the market and for which it claims good results. The original cost of it is higher compared to the direct system, as it requires a large boiler capacity to generate the steam consumed in the drying. Furthermore, it can not be as economical for the reason that the chimney gases surely will have a temperature of 500° as compared with 200° in the direct system.

It is the purport of this article to draw attention to the large amount of chimney gases that go to waste in sugar factories which can unquestionably be utilized in drying the the greater part of the factory's pulp.

We will take for example a sugar factory with a capacity of 500 tons of beets in 24 hours. Factories in the United States with one or two exceptions work directly to granulated sugar, and consume about 15 per cent. of coal of 13,000 B. T. U. to weight of beets. In order to simplify the calculation the pulp produced is taken as 100 per cent. of weight of beets with 5 per cent. dry substance. The dried pulp is supposed to contain about 13 per cent. moisture.

500 tons in 24 hours. Temp. Pulp = 62° F.

100 per cent. pulp, 5 per cent. dry substance.

The pulp is pressed to 15 per cent. dry substance, and we have from the following proportion:

$500 : x :: 15 : 5$; $x = 166\frac{2}{3}$ tons of pulp with 15 per cent. dry substance.

Also:

$166\frac{2}{3} : x :: 87 : 15$; $x = 28.73$ tons dry pulp with 13 per cent. moisture.

$166\frac{2}{3} \times .85 - 28.73 \times .13 = 137.88$ tons $= 275,760$ lbs. water to be evaporated in 24 hours, or $\frac{275760}{24} = 11,490$ lbs. per hour $= 191.5$ lbs. per minute.

$191.5 \times 1,116.6 = 213,828.9$ B. T. U. required per minute to dry all the pulp. Now we have $500 \times .15 = 75$ tons of coal consumed in 24 hours, or $\frac{150000}{24 \times 60} = 104.1$ lbs. per minute.

$104.1 \times 13,000 = 1,353,300$ B. T. U. Temp. of escaping gases $= 550°$ F.

$104.1 \times 24 \times 550 \times .25 = 343,530$ B. T. U. escape in chimney. Temp. of gases at outlet of dryer $= 200°$ F.

$550 - 200 = 350°$ drop. $350 \div 550 = \frac{7}{11}$. This figure gives the ratio of the heat which is obtainable from chimney gases, and we have $\frac{343530 \times 7}{11} = 218,610$ B. T. U. which are available to dry the pulp.

To completely dry all the pulp it requires, as was seen above, 213,829 B. T. U., and there are 218,610 B. T. U. available, showing that all the pulp can be dried with the waste chimney gases. To show what a saving in fuel will result it is well to consider the following: The manufactories of the best German pulp driers guarantee 53 lbs. of coal to every 100 bs. of dry pulp, taking the pressed pulp on a basis of 15 per cent. dry substance. This means $106\bar{0}$ lbs. of coal per ton of dry pulp or for a 500 ton factory, $28.37 \times 1060 = 30,453.8$ lbs. or 15.2 tons of coal per day.

The drying of the pulp with the chimney gases may be accomplished in two ways, direct or indirect, that is, the gases can be drawn through the dryer coming in direct contact with the pulp and absorbing the moisture, or by having a series of large tubes provided with spiral conveyors through which air is drawn, which are placed in the gas passage, the heat of the gases being transmitted to the air. The former way would be the simpler but there is also a great objection to it, namely, as a perfect combustion even when using automatic stokers, is rarely obtained in the combustion chamber of the boilers, the soot would all be deposited on the pulp making it unfit for feeding purposes. The latter way would necessitate the installation of two exhaust fans instead of one as in the former and also would require a large number of spiral conveyors with tubing, as the transmission of heat between gases is not very rapid. With this method however, a dry pulp of a light color and a good quality could be obtained, making it a desirable feed.

The value of dry beet pulp is very high, as in Germany it for sells from $18.00 to $20.00 per ton. It is however, questionable whether the dry pulp would bring more than $10.00 per ton in this country and it is probable that in some cases it would not sell at all until the farmer has been educated as to its feeding qualities. In this latter case it would be admissable to burn the pulp in order to get rid of it, in which case the direct method of drying can be employed, but the burning of it should only be resorted to to prevent the accumalation of it, as it would be a sinful waste and would be looked upon by European eyes in the same light as the burning of scrap lumber and shavings at the lumber mills, for which better reasons can be given than in the case of the pulp.

The Wisconsin Sugar Co. at Menomonee Falls, Wis. intends to make some experiments in this line during the present campaign, the practical results of which are hoped to bear out the above conclusions.

THE IMPROVEMENT OF THE YAHARA RIVER.

The improvement of the Yahara River and the construction of a lock at the upper end are subjects which have long been the dream of many of the public spirited citizens of Madison, and it is now an assured fact that before another year has passed, these improvements will have been completed.

The Yahara is a small stream about 50 feet wide and about one mile long, connecting Lake Mendota with Lake Monona. Although it is wholly within the city limits of Madison, the land along its banks is, with a few exceptions, as yet unoccupied, a fact due principally to the low swampy condition of the district through which it flows. The river itself is very shallow, and during the dry months, is much choked with vegetation which often retards the flow to such an extent as to back the water (up) from one to two feet. Lake Mendota was originally only one foot higher than Lake Monona, but about 53 years ago Mendota was raised four feet, by damming the outlet, in order to produce water power for a flour mill, and ever since then the passage of boats from one lake to the other has been prevented by this dam. The water power thus created has not been used since the burning of the mill a number of years ago, and was finally bought up by the city, in order that it might control the level of Lake Mendota. Besides this dam, the eight bridges, four highway and four railway, which cross the river were so low as to prevent the passage, at high water, of even small rowboats.

One year ago last April, a paper was read before the Madison Park and Pleasure Drive Association, (an association formed in 1892, for the construction and maintenance of drives and parks in and about Madison) which first suggested the improvement of the Yahara River, and the acquisition of the land along the banks for park and drive purposes. Nothing was done about the matter at the time, but in January, 1903, a meeting of thirty or more citizens of Madison was held for the purpose of considering the improvement. Committees were appointed to secure the necessary land along both banks, and also to confer with the officials of both the Chicago & Northwestern and the Chicago, Milwaukee, & St. Paul roads concerning the raising of their bridges. A bill was also introduced in the legislature and passed, providing that, when a sum of $15,000 or more had been subscribed for the work, the railroad companies and the city of Madison should be required to raise all their bridges enough to allow 8 feet clearance between the bottoms of the bridges and the water. As this sum, as well as an additional $6,000 was easily secured, the bill became a law, March 28th, 1903.

The plans for the improvement, which were made by Prof. W. D. Taylor, were as follows: To dredge out the entire bed of the stream to a depth of at least 8 feet, and to straighten the lower end by dredging an entirely new channel; to acquire control of a strip of land along each bank of the river for its entire length, which was to be filled in with the material taken from the river, and to construct drives on both banks on the land thus formed, leaving a narrow strip between the drives and the stream for park purposes; to raise all bridges crossing the river, so that the minimum vertical clearance between the bridges and the water would be 8 feet and the minimum horizontal clearance between bridge supports to be 30 feet; and to construct at the upper end of the stream, on the site of the old mill, a lock, large enough to permit the passage from one lake to the other, of the largest boats on the lakes.

As regards the dredging of the channel, it was not at all necessary to make it so deep except to prevent the growth of water-vegetation, because the greatest draught of any boat on the lakes is less than $3\frac{1}{2}$ feet; but as a great quantity of material was needed for filling in the land along the banks, it was thought best to go to a depth of 8 feet. The contract for the dredging was let to an outside firm at a certain price per day, with the provision that a minimum amount of 350 cubic yards be removed each day. The dredge used was brought from Oconomowoc and rebuilt here; it is of an old-fashioned type and has a scoop holding $\frac{6}{10}$ of a cubic yard which is operated in very much the same way as the scoop on a steam-shovel. However, in spite of its many disadvantages, it has done very good service, removing on an average 40 cubic yards per hour. The dredging was begun on July 23d in the upper half of the river, and has continued almost

Lock Site Before Improvement.

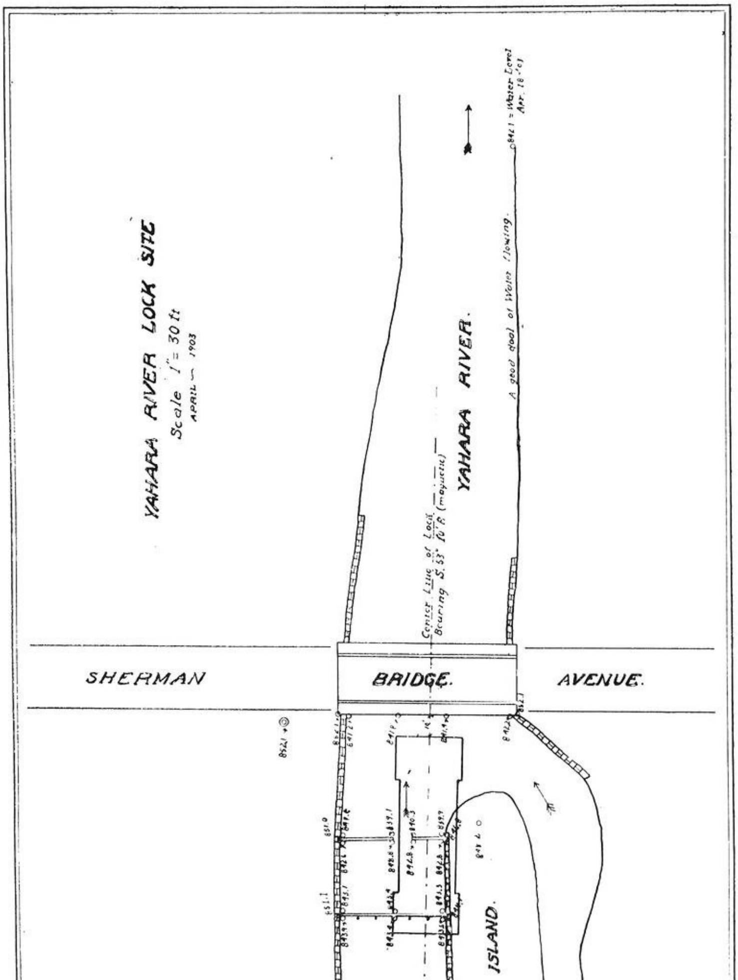
constantly ever since. Two or three weeks after starting, a small electric lighting plant was installed on the dredge, so that now work is continued night and day. The upper half of the river has already been finished, and the earth which was piled on the bank by the dredge has been leveled off by means of drag scrapers. The material so far excavated has been almost entirely a fine sand, although occasionally a little clay and gravel has been struck; but in the lower end of river it is very likely that more clay and more large boulders will be encountered. The straightening of the mouth of the stream was done by means of a (10-inch) sand pump (driven by a motor) which is engaged in filling in some low property in that vicinity.

The raising of the bridges, while costing the association nothing, will be by far the most expensive part of the undertaking. Four of the eight bridges crossing the river are highway bridges belonging to the city, and one of them, a through plate girder span, has already been raised. The other three are old, worthless affairs which will be replaced by new ones, and there is considerable agitation at present in favor of replacing one of them by an artistic steel-concrete arch. Of the four railway bridges, two belong to the Chicago & Northwestern, and two to the Chicago, Milwaukee & St. Paul Co. Three of these bridges had to be raised to provide the required clearance, and the raising of these necessitated the elevation of the tracks for a considerable distance each side of the bridges, and hence was a very expensive job. The Northwestern double track through plate girder bridge was raised 5 feet 8 inches, and in order to secure a 0.3 per cent. grade the tracks had to be disturbed for about 2,000 feet each side of the bridge. Both roads have finished raising their tracks and bridges, and the Chicago & Northwestern has placed heavy masonry abutmencs under both spans. The Chicago, Milwaukee & St. Paul is at present constructing concrete abutments, and when they are completed, will replace their present wooden trestles by plate girders. The total cost to the two roads of raising bridges and track, moving pump houses, lowering intakes, and altering side tracks affected, will probably amount to nearly $45,000.00.

The construction of the lock at the head of the river, while not very expensive as compared with the rest of the work, was probably the most interesting feature of the whole improvement. The lock, which is built of full concerete, was designed by Prof. W. D. Taylor. The basin is made 12 feet by 60 feet, which is sufficiently large to permit the passage of any boat at present on the lakes. A number of people have offered the criticism that the lock should have been designed to accommodate the larger boats which may be built in the future. These criticisms, are however, entirely unjustifiable, because, in the first place, any boat having a length of over 60 feet, or a beam of over 12 feet, would almost certainly set so high out of water as to be unable to pass under the bridges, which are only 8 feet above the surface of the water; and because, in the second place, the class of boats which will use the lock the most is small launches and pleasure craft.

The entire length of the lock, including approaches, basin, etc., is about 87 feet, while its greatest width on the bottom, including the footings for the falls, is nearly 30 feet. The southwest wall is placed directly along the side of a small island, located in the center of the stream, and thus acts as a retaining wall to the island; but the northeast wall is exposed on its back, the waste water from the lake flowing between the lock and the northeast shore of the river. The main parts of the walls have a width of 5 feet 6 inches on the bottom, 3 feet on the top, and a height of 11 feet 6 inches from the lock floor to the top of the walls, but at both ends of the lock; where the gates and valves are placed, the walls are made 1 foot thicker. The inner faces of the walls are perpendicular, all the batter being placed on the back. When filled to the level of the average spring height of Lake Mendota, the lock will contain 50,000 gallons, and when lowered to the level of the Yahara, 30,000 gallons, leaving a difference of 20,000 gallons which must be handled twice for each operation of the lock, as the head lost in passing through the valves and curved culverts is rather large, it will take nearly 2½ minutes for 20,000 gallons to pass each valve, or 5 minutes for the moving of the water, exclusive of the time required for the operation of the gates.

The work of building the coffer dams and tearing out the foundations and water wheels left from the old mill, was begun June 8th, but it was not until the 24th that any concrete was used. The construction of the coffer dam was a very simple matter, owing to the presence of the island. Temporary dams were built across from both upper and lower

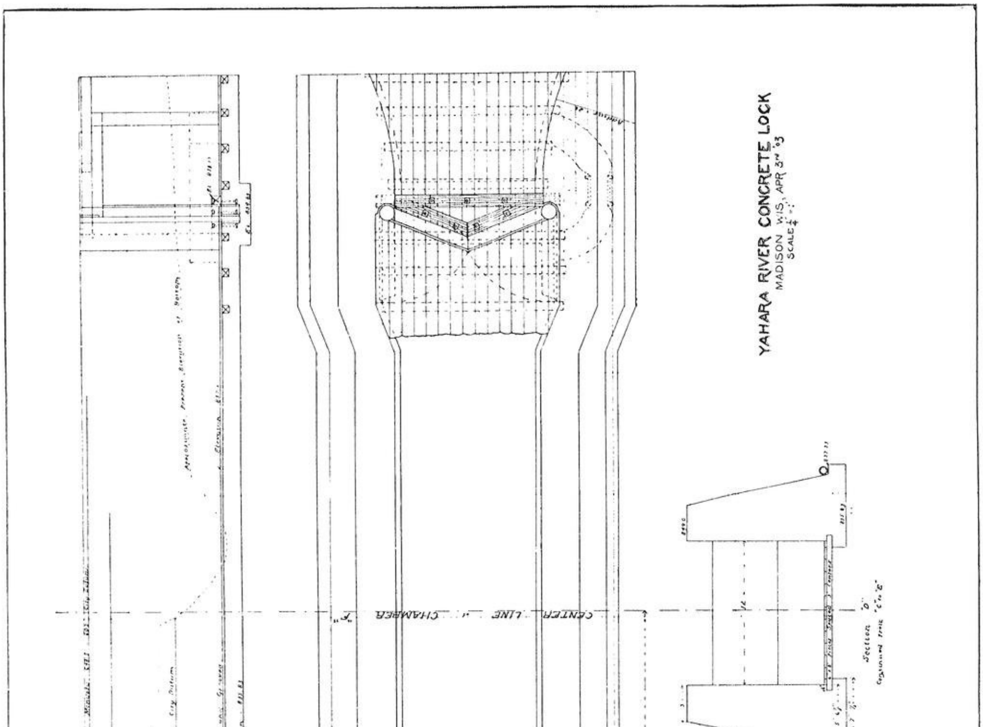

YAHARA RIVER LOCK SITE
Scale 1" = 30 ft
APRIL — 1903
SHERMAN
BRIDGE.
AVENUE.
YAHARA RIVER.
A good deal of Water flowing.
ISLAND.
LAKE MENDOTA

ends of the island, to the northeast bank, by driving sheet-piling and banking it up with sod, manure, and gravel, which made a water-tight mass. The upper dam was protected from the action of the waves by building a second dam about 30 feet above the first, of loose rock taken from the old foundations. No trouble whatever was experienced with these dams, but as a little water leaked through the island and burst through the bottom in the nature of small springs, it was necessary to keep a 3-inch centrifugal pump, driven by a 1 H. P. motor, running night and day during the entire construction of the lock.

The material which was encountered in the excavation for the foundation, was mainly a mixture of sand, clay, and gravel, but the amount of sand decreased as the depth of the foundation increased, so that, with the exception of one or two small spots where the water burst through the bottom, the walls may be said to be placed on a clay foundation. Wherever the springs burst through, the foundation was excavated a little deeper out and then the flow cut off by dumping in a batch of rather dry concrete. When the old oak floor beams of the mill were torn out, they were found to be perfectly sound, although they had been in place nearly 53 years. The new dam, which was built about 10 years ago to replace the one which burned with the mill, had been anchored onto a concrete foundation about three feet thick, and it was necessary to blast this out. One of the pieces of concrete which was taken out was found to contain two small cray-fish, whose shells were in almost perfect preservation. They had evidently either burrowed into the concrete when it was still soft, and been caught when it set, or else had been buried in between two courses.

The concrete used in the construction of the lock walls, was all a Portland concrete, mixed in the proportions 1 : 4 : 8 below an elevation 1 foot under low water, and 1 : 3 : 6 above this elevation. The cement used was Dexter, having an average strength of about 600 lbs per sq. in. in 7 days, and 700 lbs per sq. in. in 28 days. The sand was a good, clean, sharp sand of various sized grains, having 26.2 per cent. voids, while the stone was a broken limestone partially screened, and having about 44 per cent. voids. The size of the stone was much too large, some being unable to pass through a 3-inch ring; but as most of the large stone was contributed by Madison quarrymen, it had to be accepted and used. All the concrete was mixed by hand on wooden platforms 14 feet square. The sand and cement were first mixed thoroughly while dry. Water was then added and the mortar turned once or twice before the stone was brought on. After the stone had been scattered evenly over the mortar, it was sprinkled, and then the whole mass was turned three times, water being added occasionally, until it was wet enough to pour out of a wheelborrow without scattering or separating. A machine-mixer could have been used to very great advantage, as the lock contains over 450 cubic yards of concrete, and the location was exceedingly favorable. In placing the concrete in the molds, great care was taken to make a smooth face, by spading the larger stones away from the plank.

The method of building the walls was as follows: The southwest wall was the first to be constructed, and was by far the more difficult of the two to build, owing to the valves, culverts, etc., which had to be placed in it. After the excavation had been finished, a footing course 1 foot thick was first laid, and then the frames or molds for the wall proper were built on top of it. The wall was then constructed in sections about 20 feet long by inserting at the end of every section temporary cross partitions, so built that each section when completed would have a groove or tongue on its end to fit into the tongue or groove of the next section. Each section was completed in one day, without stopping work, from the foundation to above the water line, so that the only joints in the walls below the water line are the vertical, tongues and groove joints every 20 feet. No vertical joint was made within 10 feet of either gate. Above the water line the wall was built by simply adding course after course, about 8 in-



General Plan of the Yahara Lock.

ches thick. The only precautions taken for securing a bond between old and new concrete, was to partially imbed large, rough stones in the concrete whenever work was stopped, so that a very rough surface was left to start on again, and to wet the surface of the old concrete thoroughly before placing fresh concrete upon it when the work was resumed.

As regards the construction of the gates, they are built of oak and yellow pine, with iron braces, bolts, etc. The lower gate is of the type commonly used in small locks, and consists of two separate parts butting against each other in the center of the lock, and turning on vertical axes like ordinary doors. They are opened and closed by means of long levers or arms, bolted to the tops of the gates, and extending back over the walls, and when open swing back into offsets built into the lock walls, so as to allow the full 12 feet clearance. The upper gate, or the one nearest lake Mendota, is, on the other hand, of an entirely different design. It consists of only one piece, which revolves on a horizontal axis reaching from one wall to the other, instead of revolving about a vertical axis, as the lower gates do. The axis is placed low enough so that when the gate opens toward lake Mendota, and sinks to a horizontal position, there will be water enough above it, (about 4 feet 6 inches) to allow the boats to float over it, and into the lock. When closed it butts against two jaws made by building an offset of a foot into each wall, and when the lock is being emptied, the pressure of the water in the lake will force the gate tight against these jams, and prevent it from leaking. As the gate is built entirely of wood, with the exception of a few bolts, it will always float up of its own accord into the closed position, and therefore a winch and chain will be used to pull the gate down and open.

The valves for filling and emptying the lock are placed in the southwest wall, one just opposite each gate, and curved culverts lead in to the valves from above the gates and discharge below. The valves, which are two feet in diameter, are of the type commonly called the "butterfly" valve, and their design is very similar to that of the ordinary damper in a stove-pipe. Thus the water pressure is equal on both sides of the axis about which the valve-gate revolves, and therefore it requires very little power to operate them. All the bearings are of Babbit metal, which prevents any danger of rusting, and sticking and as the rod which connects the valve with the controlling lever on the top of the wall is protected from the concrete by a cast iron pipe, the rod may be removed and replaced at any time. This type of valve has been used successfully at the sewage disposal works, but its use in a lock is something new. Its advantages over the ordinary gate-valve are very great indeed. To open or close it, requires only power enough to overcome the small amount of friction in the axis, whereas in the gate-valve the water pressure forces the gate against its slides, and makes it hard to raise or lower. Also to open or close the "butterfly" valve requires the turning of the operating lever only about 60°, while in the case of the gate-valve, the lever must be revolved a great number of times.

The culverts leading to and from the valves are 30 inches square and are covered at their upper entrances by iron screens of about 1½ inch mesh, to prevent fish or floating obstacles from catching in the valves.

Under each gate there is a cross-wall connecting the two side walls of the lock. These serve as a means to anchor down the 12″x14″ timbers against which the gates close, and also to prevent the water from washing under the gates. The floor of the lock-basin is made of 2″ matched pine, laid on 6″x8″ sills spaced 3 feet apart and anchored in the bottom of the side walls. No mortar facing was used on the walls at all, with the exception of around the gate-posts and culverts, and on the top of the walls; but after the forms were removed, any small cavities were filled with mortar, and then all the exposed surfaces above low water were brushed with a thin wash of cement.

In order to cross from one wall of the lock to the other, a narrow foot-bridge was built at the lower end, and raised high enough to allow the necessary 8 feet clearance above the water.

It is not the intention of the Association to have a tender at the lock, but all valves and gates will be locked and keys will be given to all owners of boats who will be expected to operate the lock themselves.

Besides the lock which was constructed by the Park and Pleasure Drive Association, the city of Madison has built a steel-concrete wall along the northeast bank of the river, opposite the lock, and has connected this wall with the northeast wall of the lock by means of a long gate which operates in very much the same manner as the upper gate of the lock. By means of this, the level of Lake Mendota can be easily controlled.

Although the construction of the drives and park will not be begun this fall, and the dredging can not be completed before next summer, there is little doubt but that before another year has past, everything will be completed, and Madison will have, instead of a marshy, weedy creek, a deep, clear stream of which it will be proud. It has been a tremendous undertaking for a city of this size, and great credit is due to the officers of the Park and Pleasure Drive Association, to the Madison Common Council, and to the officers of both the Chicago and Northwestern, and the Chicago, Milwaukee and St. Paul railway companies.

JAMES M. GILMAN.

RAILWAYS IN SOUTH CHINA.

Through the courtesy of Mr. Justin Burns, Assistant Chief Engineer of the Yuen Han Railway in southern China, the ENGINEER is enabled to present a wonderfully interesting account of some engineering experiences in the construction of that road which are considerably out of the ordinary. The most important project in China to-day is the construction of the "Yuen Han" (Grand Trunk) Railway, which will connect Canton with the Luh Han Railway at Hankow on the Yangtse, and thus bring the southern metropolis of China into direct railway communication with Peking and, by way of Siberia, with Europe.

Mr. Burns, who is in charge of the Canton–Samshui line, is a brother of Joseph P. and Louis A. Burns, through whose kindness maps of the road have been supplied for the illustration of this article.

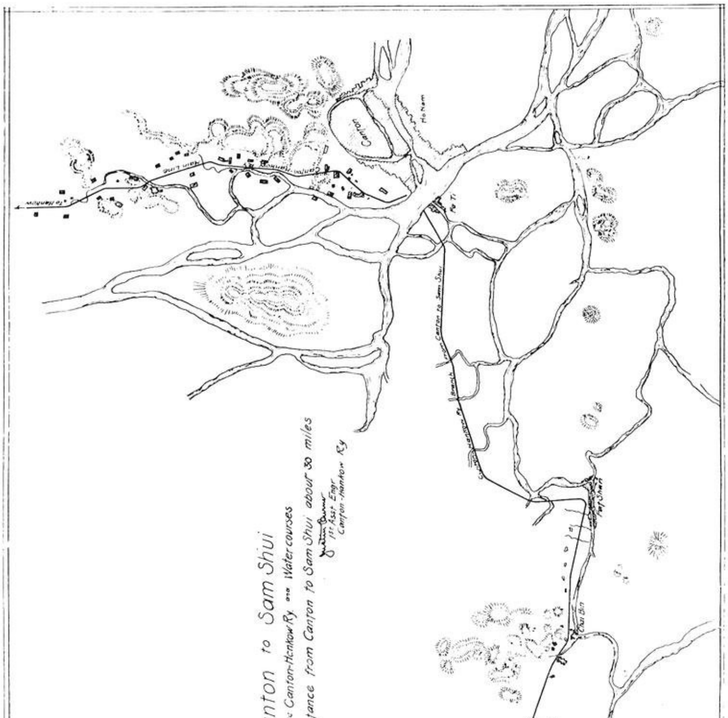
The main line of the railroad will follow the North River in Kwangtung province, going due north to cross the watershed into the Yangtse valley. The line will cross the mountains at an elevation of 12,000 feet above sea level at a point called Parsons' Gap, a pass discovered by General Parsons, who conducted the original survey for the American syndicate which is promoting the enterprise. The gradient will be low, at no point greater than .3 per cent. There will be a few tunnels and some heavy rock work in the first hundred miles north of Canton, but as there are no roadways in China as we understand them in the west, no overhead bridges will have to be constructed. The total length will be 750 miles, and it is anticipated that the whole of the main line, in spite of the unusual difficulties to be counted upon, will be completed by January, 1906.

The following is taken from the *China Mail*, Canton's leading daily, of September 12, a copy of which was supplied to the ENGINEER by Mr. Burns:

THE PEOPLE AND THE RAILWAY.

"The first 110 miles from Canton have been re-surveyed by what the American engineer calls 'locating parties,' and two locating parties are at work in the Province of Hunan. It is curious to notice that whereas in the hermit Province of Hunan—the last to open to foreign influence and residence—the officials have done all in their power to render the work of the survey parties easy; in the Kwangtung Province, which has been in touch with foreigners for some centuries, more or less, there has been a certain amount of hostility and still more 'passive resistance.'

There have been no anti-railway riots in Hunan, no attacks upon the surveying parties. At Yuangtang, on the North River, in the month of April, there was, on the other hand, a very serious attack upon the surveyors. Some of the villagers in an outlying village near Yuangtang objected to the railway passing through or near their village, and they were incited by an old woman to attack the engineers. This old lady beat a gong to attract the natives from the rice fields, and when the petty mandarin attempted to take the gong from her she harangued the mob. With cries of 'ta, ta' ('kill, kill'), the incensed natives began their onslaught, led on by a man with a heavy two-handed sword. The mandarin had a narrow escape of having his head cleft in two, and the survey party had to execute a strategic movement across the river to the village of Yuangtang, where they had their camp. The infuriated natives opened fire with muskets from the opposite side, and when the surveyors abandoned their house-boats and sought safety in the adjacent temple, the natives crossed the river and besieged them for four hours. Had they known how helpless the surveying party was, they might easily have rushed the temple and slain the defenders, who had no arms with which to make a fight. The villagers of Yuantang had no grievance, and the elders of that village, not wishing to incur the displeasure of the higher officials, were successful in persuading the rioters to return to their own village by a promise to hand over next morning the un-



The Canton-Sam Shui Railway.

witting cause of the trouble. In the darkness, the surveyors regained their boats and dropped down the river to Tsing Yuen, and reported the matter to the Prefect. In the meantime, Mr. Burns, assistant chief engineer, had gone up the river in a steam launch, and encountered the wreck of the surveying instruments and rods floating down the river. Seeing that some Europeans were in difficulties with the natives but were holding their own on the Yuantang side of the river, he posted back to Canton, whence the U. S. gunboat *Callao* was dispatched. As it happened, the surveyors escaped without hurt, but the incident might well have been more serious.

ENGINEERS MUST BE DIPLOMATS.

Incidents like this serve to show the nature of some of the difficulties pioneer engineers have to encounter. In China, the surveying engineer must be possessed of great courage, coolness and tact. If he is to be successful, he must have added to engineering ability the qualities of a diplomat.

So far, the only preparation for the main line is a large reclamation at Wong Sha, on the Canton side of the river. This will be the site of the southern terminus, but there is an idea of constructing an overhead line from one end of the city to the other, and to continue the main line to Whampoa, about ten miles further down the river, where wharves and docks could be erected and ocean liners with a draught of 30 feet come up at any state of the tide and load and discharge cargo.

CANTON-SAMSHUI BRANCH LINE.

On the Fa-ti side of the river, at Shek-wai-tong, opposite Canton city, is the terminal station of the railway connecting Canton with Fatshan, Sainam, and Samshui, the latter on the West River. Here a large station will be built of brick. It will have all the usual accommodations for railway officials, passengers and Customs officials. The other principal stations on the line, which will be 31 miles long, will be at Fatshan, Sainam and Samshui; but small stations, with landing platforms and shelter for passengers will be erected near the more populous villages on the route. Large ferry boats will convey passengers across the river to Wong Sha, where the railway headquarters are established.

The grading or embankment, for this branch line is completed between Shek-wai-tong and Fatshan, the rails partially laid, and all the bridges and culverts well in hand, and it is arranged to open the line for traffic as far as Fatshan in the month of November. In the first ten miles, there are thirteen steel girder bridges and four culverts in the latest type of reinforced concrete construction. Of the thirteen bridges, one is 10 ft. long, two 15 ft., five 20 ft., two 60 ft., and three 120 ft. long, the latter made up of one 60 ft. span and two 30 ft. spans in the clear. The bridges are founded on piles, and the abutments and piers are of concrete, with granite bridge seats. These bridges are designed to carry 180-ton locomotives, and are the type that will be used in the construction of the main line. The girders are now in Hongkong or at Shek-wai-tong, and as soon as the abutments are finished — a matter of a few weeks — the girders will be placed in position. All the girder work is arranged in standard sizes.

PAY FOR MOVING GRAVES.

On the double track between Shek-wai-tong and Fatshan, the formation width on the embankment is 31 feet, with slopes of $1\frac{1}{2}$ to 1. The maximum grade is one-half per cent. (1 foot in 200). The maximum curvature is three degrees (1910 ft. radius), and on these curves there is a spiral or easement curve. There are only two curves on this double track section, and they are made to clear villages and cemeteries. *Feng shui* and the disturbance of graves are two of the most serious obstacles to railroad construction in China. Sometimes large sums were demanded for removing a grave; but the Chinese interested in the railway were able to use their influence, and the average price now paid for a grave is Tls. 4. This sum is paid to the interested relative, who removes the remains of his ancestor elsewhere. At one point, considerable trouble was experienced owing to the settlement of the embankment, and after boring, and several experiments, the engineers decided to cease operations in the borrow pits, and the subsidence is being filled up with sand brought from the river.

At Fatshan, the line is on the same level as at Canton. The average height of the embankment is from 3 to 4 ft. above the level of the rice fields, rising to a height of about 15 feet at bridges. No large rivers are crossed, only sluggish streams, and at one or two of the bridges the junks will have to unstep their masts in order to pass underneath. No flooding is anticipated, as the grading is well above extreme high-water.

The signalling arrangements have not yet been decided upon, but it is expected the line will be operated by Americans upon the American system.

LABOUR DIFFICULTIES.

As might have been expected by anyone who knows anything of Chinese guilds, the greatest trouble of the engineers carrying out the works was with the contractors. They failed to fulfil their contracts on time, and in order to get the work finished expeditiously, and properly, the Company had to take over the whole of the bridging and grading themselves, organizing their labour and getting material and implements, such as wheel-barrows, pile-drivers, pumps, etc., for themselves. Since this was done there has been no trouble with the coolie labour. One of the engineers says it is a fallacy to say that Chinese labour is efficient or cheap, and he sighed for Irish navy labour, which, he maintains, would be less costly, more efficient, and would enable the engineers to gauge with a greater degree of certainty the time likely to be occupied on constructional work. Each coolie, man or woman, receives 40 cents per day. They are paid daily. With this they seem content, but occasionally they are got at by some of the long-gowned gentry or head-men, whe are naturally chagrined at losing their 'squeeze.' Sometimes a portion of a gang will strike work, but, on the whole, there is no longer any serious difficulty, and as the Company endeavours to get its labour from the villages along the route this has had some effect in producing a pacific attitude towards the railway scheme by the natives of the district.

The work is being carried out by the American China Development Company. It represents American capital, with Mr. Wm. Barclay Parsons as President. The actual work of constructing the railway and its branches is under the supervision of Mr. Willis E. Gray. General Manager, who has his head office in Shanghai. Captain C. W. Mead is the Chief Engineer, and Mr. Justin Burns, the First Assistant Engineer. The members of the engineering staff in connection with the Canton-Samshui branch line are — Mr. C. H. Farnham, Division Engineer; Mr. S. T. Neely, Resident Engineer at the Canton Residency; Mr. R. B. Manter, Resident Engineer at the Fatshan Residency; and Mr. C. E. Muller, Resident Engineer at the Chai Bin Residency. The foremen of works comprise Americans, Englishmen, Irishmen, Scotsmen, Australians, Frenchmen, Germans, Scandinavians, and other nationalities, mostly engaged locally or in the Philippines. These men are quartered in large houseboats on the principal streams along the line of railway, and, considering that they are engaged on pioneer work, they have, on the whole, a very pleasant time. For the protection of the works generally, the Company has a uniformed force of 500 soldiers, armed with rifles and carbines, but no serious disturbance has as yet occurred on this portion of the line."

FLUORIDE OF GOLD.

BY VICTOR LENHER.

(From the December Journal of the American Chemical Society.)

Inasmuch as fluorspar is frequently associated with gold in nature, and quite notably so in the deposits of the telluride ores, it has seemed important to study gold fluoride in order to determine, if possible, whether this substance can play any part in the genesis of these deposits.

The known compounds of gold with the halogens, chlorine, bromine and iodine, are, as a rule, fairly well defined. In the trivalent condition gold forms the relatively stable chloride while the bromide and iodide show greater tendency to break down into the lower state of valence of gold.

The halides in which gold shows a monovalence have received considerable attention, and it is known with a reasonable degree of certainty under what conditions aurous chloride, bromide, and iodide are capable of existence.

While the chlorides, bromides and iodides of gold have received more or less study, comparatively little is known of fluoride of gold. Prat (Comptes Rendus, 70, 843) has prepared an intermediate oxide of gold, $Au_2 O_2$, by the incomplete solution of gold in aqua regia, in which the hydrochloric acid is in excess, treated the solution with sufficient bicarbonate of potassium to dissolve the precipitate formed and warmed the clear orange-yellow solution to 95° when a dark olive green precipitate was obtained which when dried showed the composition $Au_2 O_2$. In studying the properties of this oxide, Prat states that hydrofluoric acid combines with it but without dissolving it. In his study of the action of fluorine on the various metals, Moissan states that at a red heat, gold is attacked by fluorine gas, a yellow hydroscopic substance being formed and that this substance is readily decomposed into gold and fluorine.

These two experiments give practically what is known of the fluoride of gold.

The activity of the halogens toward other elements is, as a rule, inversely proportional to their atomic weights. The first member of this group of active elements, fluorine, is certainly the most active of all the elements, be they halogens or not; yet, as will be demonstrated later, it appears to have little if any affinity for gold.

In studying the chemistry of gold, it should always be borne in mind that it is the most inactive of the metals, but the relative stability of the most of its salts, notably with the halogens, would appear to make probable the relative stability of the compound with the most active of the elements, fluorine. On the other hand, we have the marked difference of fluorine from the other halogens in the insoluble fluorides of calcium, strontium and barium, as contrasted with the very soluble chlorides, bromides, and iodides; and the soluble fluorides of silver and thallium as compared with the insoluble chlorides, bromides and iodides.

In order to study the relations between fluorine and gold, experiments were conducted with the view of bringing about if possible the formation of gold fluoride under various possible conditions.

The first experiment made was a study of the action of hydrofluoric acid on the oxide of gold. To this end, oxide of gold was prepared by the action of magnesium oxide on a solution of chloride of gold and the excess of magnesia removed with nitric acid. The oxide of gold thus obtained was finely divided and hence in the most suitable condition to be susceptible to any chemical action. This oxide of gold can remain in contact with hydrofluoric acid indefinitely or as has been the case, can be boiled for weeks with either hydrofluoric acid alone or with a mixture of hydrofluoric and nitric acids without suffering any change whatever. These experiments have been repeated several times but in no case has gold been found to enter into solution nor has it been possible to detect fluorine in the precipitate. It is obvious that fluoride of gold cannot be prepared by the action of hydrofluoric acid on the oxide. The next most natural method to try for the preparation of the fluoride would be that of double decomposition.

Silver fluoride and gold chloride, both being soluble salts, on being brought in contact in solution should yield theoretically:

$$Au\ Cl_3 + 3\ Ag\ F = Au\ F_3 + 3\ Ag\ Cl.$$

The actual case is that when solutions of these two salts are brought in contact, hydrate of gold is quantitatively thrown out of solution along with silver chloride, thus:

$$Au\ Cl_3 + 3\ Ag\ F + 3\ H^2\ O = 3\ Ag\ Cl + Au\ (OH)_3 + 3\ HF.$$

The accuracy of this reaction has been carefully established in the laboratory.

If gold fluoride is even momentarily formed it is immediately decomposed by water.

The method yet remaining for the preparation of a substance incapable of existence in presence of water would be the use of anhydrous solvents. A large number of organic solvents have been tried with this end in view but no substance has been found which would dissolve both gold chloride and silver fluoride; either these salts are insoluble or are decomposed by the substances worked with. Among the solvents examined, mention may be made of the following: alcohol, ether, carbon bisulphide, benzene, turpentine, pentane, hexane, chloroform, carbon tetrachloride, ethyl nitrate, nitrobenzene, ethyl acetate, ethyl propionate, and pyridine.

It thus appears that fluoride of gold is incapable of existence not only in presence of water but under the ordinary conditions met with in the laboratory and in nature.

THE M. E. AND E. E. INSPECTION TRIP.

Shortly after the University opened, the subject of the annual inspection trip of the senior electrical and mechanical engineers came up for discussion. It was the general wish of the class that we take an eastern trip, visiting the principal manufacturing establishments in the vicinity of Buffalo and Pittsburg, returning by way of Ann Arbor for the Mich.–Wis. game on Nov. 14, the details to be arranged by the faculty members. At 6:20 a. m. Nov. 5, some forty students accompanied by professors, left for Chicago in a special car. The banners used by the class of '03 were attached to the car whenever we were on the road, announcing the "UNIVERSITY OF WISCONSIN ENGINEERS," in large black letters. At Chicago we met a few more who swelled our number to forty-seven all told. The members of the faculty who accompanied the party were Proffessors Bull and Swenson, Mr. Shuster and Mr. Shaad.

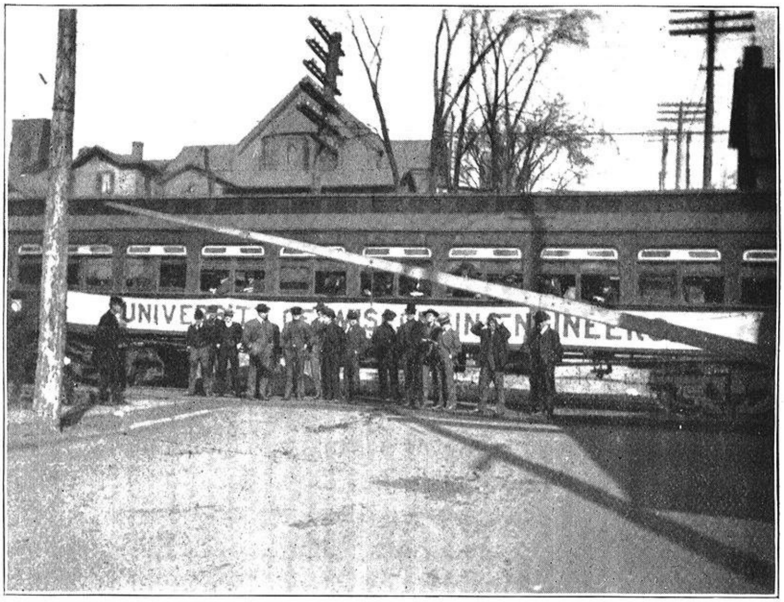
Before dinner we visited the Fisk street station of the Chicago Edison Co. This station is thoroughly up to date and when completed will cost between eight and ten million dollars. The power house is built between two slips so that the coal can be handled conveniently by machinery. Mechanical stokers are used and the coal is conveyed to the furnaces and the ashes away from them by machinery. Babcock and Wilcox boilers, provided with superheaters supply the steam. The units are 5,000 K. W. Curtiss turbines, direct connected to three phase generators, giving a pressure of 9,000 volts. The cooling water for the condensers is pumped from one slip to the other by centrifugal pumps direct connected to Corliss engines. Two of these turbines with their banks of boilers were in operation and others were in process of construction. These latter gave us an opportunity to see the construction of turbines, superheaters, etc. This company has also provided in the building bath and wash rooms, reading rooms, lockers, a large assembly room, and bed rooms for such of the men as cannot leave the plant.

Leaving Chicago at 5:15, the trip to Pittsburg was a memorable one, as we were still fresh and not *all* slept *all* the time. We arrived in Youngstown, Ohio, about six and found a restaurant with little delay. The trip from Youngstown to Pittsburg was made by daylight and the scenery was interesting to most of us. We arrived at Pittsburg about nine and were met by Mr. Frankenfield, '96, who piloted us to our hotel. Little time was lost here and we started for the plant of the Nernst Lamp Co. Here we found Mr. Frankenfield and Mr. Beebe, who conducted us through the works. All the details were explained to us, also the difficulties that arose and how they were over come, all of which was very interesting. After dinner we took the car to Homestead and visited the Carnegie Steel Works at that place. Here we saw ingots poured from open hearth steel; also the rolling of plate and I beams. This was probably the largest concern that we visited.

Friday evening we took the train to Wilkinsburgh. The Electric Club at Wilkinsburgh had invited us to one of their meetings but owing to a misunderstanding we were not given as warm a reception as had been planned. The Electric Club is an association of the employees and apprentices of the Westinghouse Co. for the purpose of further study in electrical engineering. Classes are formed and lectures delivered by eminent men. The Westinghouse Co. supports the club in part so that the dues from the members are not large. Saturday morning we were to leave at 7:45 but the evening at Wilkinsburgh was too much for some of us so that at 8:30 we were compelled to leave with only part of our crowd.

We spent the entire morning visiting the Pressed Steel Car Works at McKee's Rocks. This is an immense concern. We saw here a variety of hydraulic presses, pressing the red hot plates into the desired forms. Much of the riveting is done with pneumatic hammers and the din was deafening.

We were shown all departments and saw all the steps in the construction of cars. From here we went back to Pittsburg for dinner and thence by train to Crystal Park to see the National Tube Works. The works at Crystal Park were closed but we walked back to McKeesport and saw the manufacture of welded steel tubing in sizes from one inch to twelve.



The Car which Carried the Senior Engineers.

Sunday was spent in seeing the sights in and around Pittsburg. A number of the boys visited the Carnegie Institute and the surrounding park. Monday we went to East Pittsburg to see the Westinghouse works.

At the Westinghouse Electric Works we were provided with a guide for each three or four men. We spent the entire forenoon in this shop and had an opportunity to study many of the details in the construction of electrical apparatus. Here we saw some of the switchboards for the St. Louis Exposition, and the rotating fields for turbine work. The tour of this shop was completed about noon and after dinner which was generously provided for us by the company we took a car to Wilmerding to see the Airbrake Works. In the foundry at this plant the molds to be poured are carried past the cupolas on a traveling table. At the farther end of the table the molds are broken up and removed and replaced by new ones. The sand was mixed, sifted and conveyed by machinery, and molding machines were used. In the machine shop the jig system was used rendering all parts interchangeable.

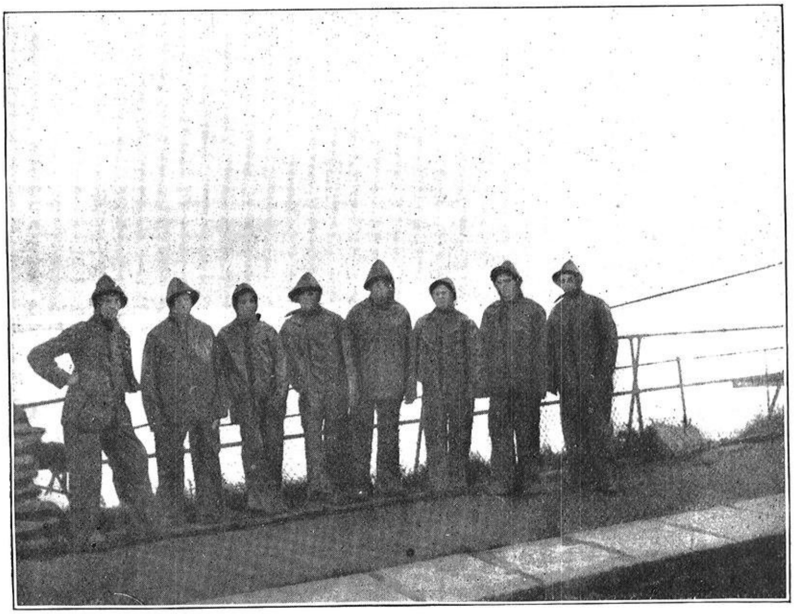
Returning to East Pittsburg we visited the Westinghouse Machine Works which are adjacent to the Electric Works. We were much interested here in the gas and Corliss engines and Parson's turbines, which we found in all stages of construction. There were several 1000 K. W. turbines in operation and under test. Here we saw the third 2000 K. W. steam engine for the World's Fair at St. Louis, and also the eleventh 5000 H. P. steam engine for a New York station, under construction. All engines are tested before leaving the shop.

Tuesday was spent in going from Pittsburg to Buffalo. The journey was uneventful except for the car-loads of apples we saw in passing through "Yorkstate." Wednesday morning we visited a substation and a distributing station of the Niagara Power Co., the city water works and a copper smelting plant, all in the city. At the substation the voltage is received at 22,000 volts from Niagara Falls, and is transformed down to 11,000 volts. This station when complete will have a capacity of 36,000 H. P. At the distributing station the power is received at 11,000 volts, three phase, and is transformed to 325 volts direct. At the copper works we first visited the ore bins and the ingot machine. This machine draws the melted copper from the furnace, pours it into molds and cools the ingots without any hand labor. The subsequent processes were by hand, as the machinery which is being installed was not yet ready. Pure copper is obtained by electrolysis. The current is produced by a direct-connected MacIntosh & Seymour engine and a 300 K. W. generator. The Buffalo City Water Works is an old plant, some of the engines dating from before the Civil War. In fact it was remarked by some of the boys that most of the men who helped to make these engines are dead, but the engines are still giving good service. Here were two new triple expansion engines of 1,200 H. P. each.

In the afternoon we visited the Lackawana Steel Co.'s works. This company has been operating less than a year, and all the appliances are new and up to date. We visited first the ore docks and ore handling machinery; then we went to the Bessemer converter house where were two converters in operation. So far as the spectacular goes, a Bessemer converter cannot be beaten. In the power house gas engines were in use, burning the waste furnace gases. The total power being 4,500 K. W., all of which is used for electric driving about the works. Here also were the blowing engines for the converters, which are driven by steam. At the rolling mill we saw the rolling of rails. From here we went to the "pig" machine. We had seen the blast furnaces being charged when we first arrived, and now the charge was being drawn. The pig machine consists of an endless chain of molds into which the iron is run. The molds move slowly along, passing into a tank of water which cools the "pigs," and then up an incline, finally dropping them into flat cars ready for transferring or shipment.

Thursday morning we visited one of the elevators of the Mutual Elevator Co. This elevator is built entirely of steel. All the machinery is driven by induction motors of which the aggregate is 1,200 H. P. All the switches are in one room to reduce the danger of fire by sparking. A large vessel was being unloaded here which was inspected with considerable interest. The bins of the elevator are cylindrical with hemispherical bottoms, each of 80,000 bushels capacity. The total capacity of the elevator is 3,000,000 bushels.

We now took the train for Niagara Falls, arriving in time for dinner and just one look at the falls. During the afternoon we visited both power plants on the American side and the Natural Food Conservatory. The Niagara Power Plant has been described so many times that repetition is not necessary. The engineers visited all parts from the wheel-pit to visitors' gallery, and from the canal to the cable conduits.



Ready to go Under the Falls.

The Niagara Hydraulic and Power Co.'s plant is situated over the cliff at the foot of the American Falls. The water is conveyed from a canal through steel penstocks eleven feet in diameter, to the turbines. The turbines are of the inflow type, mounted on a horizontal shaft, direct connected to two generators, one on each side. The complete plant calls for fourteen of these units. The Natural Food Co. has an establishment that is remarkable in many ways, and is well worth a visit. Everything has been done here fo: the comfort and convenience of the employees, and for the perfect cleanliness of the plant. Perhaps the most unique and ingenious contrivance is the lunch counter for men. Here each man has a small flat car provided with its own electric motor, the current being taken from the rails. The written order is placed on the car which passes off from the switch to the main track, and thence to the kitchen. The order is placed on it, and it is started on its return trip, passing all switches automatically until the right one is reached. The system is so arranged that collisions cannot take place or cars interfere one with another.

Friday morning we returned to Niagara Falls and went immediately to the Canadian side and visited the power plants there. There we found three plants all in course of construction. The largest, the Ontario Power Co., will take water from beyond the rapids above the falls and conduct it through a steel conduit 18 feet in diameter and 6,000 feet long to a power house at the foot of the Horse Shoe Falls. The construction for the intake is very extensive because provision must also be made to supply the numerous water ways of the park. The capacity of this plant will be 150,000 H. P.

The afternoon was spent in "doing" the Falls, and at 2:00 A. M., Saturday morning, we left Buffalo for Detroit over the Wabash R. R. Our experiences at Detroit and Ann Arbor will be treated on another page. We left Detroit at 11:00 P. M., and arrived in Chicago Sunday morning where we disbanded.

In behalf of the class I wish to thank the professors, alumni and others who so willingly contributed time and pains to make the trip so pleasant and successful. I am sure we will never regret having taken it.

R. G. GRISWOLD, '04.

The Wisconsin Engineer.

Published Quarterly by the Students of the College of Engineering, University of Wisconsin.

Vol. 8. Madison, Wis., December, 1903. No. 1.

The College of Engineering opened this year with an increase of one hundred and fifty students, the present enrollment being seven hundred and thirty-five. The unprecedented growth of the College is worthy of special notice. In 1898 there were 242 students in the department, and the need of a new building was recognized. In 1899 the number had increased to 327. In the fall of 1900 the new building was ready for occupancy, and the students numbered 411. A marked increase followed the first year in the new building, the actual increase being 102 students, making the enrollment 513 in 1901–2. A year ago the students numbered 585, and this fall we have the remarkable increase noted above. While the growth of the College is a matter for congratulation and pride, it nevertheless presents a very serious problem. It requires but a simple mental computation to realize that the college will suffer very serious embarrassment even in another year if the present rate of increase continues. At present there is crowding in many departments. There is a lack of large lecture rooms for the under-classmen, and to supply this need the auditorium is being used by several divisions of the freshman and sophomore classes.

The drafting rooms are also over-crowded, and to relieve this as much as practicable, the greatest economy of space is being practiced. As an example of the economy which these conditions compel, the entire drafting work of the freshman class of over 300 students is accomplished in a single room containing some twenty-five desks. Twelve different drafting periods are arranged, each desk being used by twelve different men. Because of the crowding the desk draws are kept locked, and each man is required to bring his instruments with him.

The increase in numbers has not been confined to the incoming classes. The Sophomore, Junior and Senior classes have also been noticeably affected, an unusually large number of students having entered with one or more years' credit from other schools. The number of graduate students is also larger than ever before in the history of the college, showing a very praiseworthy increase of interest in the matter of higher engineering degrees.

The logical solution of the problem is to be found in the building of the addition to the Engineering building, provided for by the foresight of the late Dean Johnson, and to this end the legislature will be petitioned at its next session for an appropriation for that purpose. That an ample appropriation will be granted is not to be doubted, but it will necessarily be two and possibly three years before the addition can be completed, and some temporary measures may have to be taken to relieve the congestion which another year will unquestionably bring.

In all this numerical prosperity we are pleased to notice that the equipment of our laboratories and shops has kept pace with changing conditions. The new equipment installed in the various departments during the past summer is mentioned on another page of the ENGINEER.

It is proposed this year to get out a College of Engineering circular, in the nature of a special catalogue of the College, giving all the statistical matter contained in the portion of the University catalogue allotted to the engineering department and in addition more detailed information in regard to our work and equipment. Heretofore the College of Engineering bulletin, a mere excerpt from the main catalogue, has served the purpose of advertising in a very inadequate way, although the need of something more in keeping with the growth of the College has been recognized for some time. The work is in the hands of the Dean and is already well under way. It will be well illustrateds showing up the work and equipmeet of the various departments to advantage, and will probably be issued during the spring semester. A feature of the circular will be a directory of the alumni giving present residence and the employment of each. Readers of the ENGINEER are earnestly requested to hand any additions or corrections to the directory as published in the June number, to the alumni editor, Mr. R. G. Griswold, or to the Dean.

A series of lectures on current topics will be held in the auditorium of the Engineering building, beginning shortly after the holidays with an address by S. B. Newberry, General Manager of the Sandusky Portland Cement Company, on some phases of the cement industry. The attention of all students, and especially of the incoming classes, is called to the broad educational value of these practical talks by practical men of affairs, which the faculty so wisely provides each year. The value of keeping in touch with the outside world during his college course is inestimable to the engineer.

The attention of new students is directed to the extraordinary advantages offered by the Engineering reading room, which is supplied with upwards of one hundred of the leading engineering periodicals printed in the English, French and German. The young engineer owes it to himself and to his profession to be familiar with what is going on in the engineering world, and we are safe in saying that no college offers more or better facilities in the way of current literature along all lines of engineering activity than are to be found in our reading room.

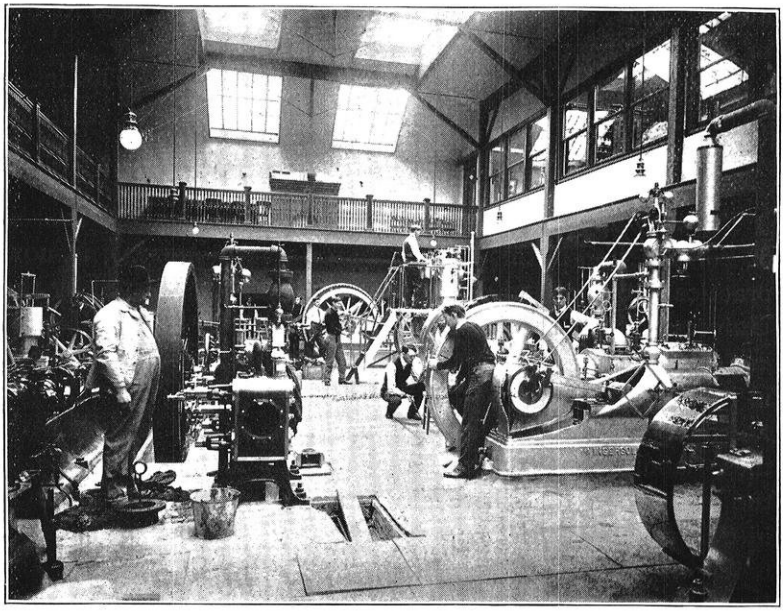
NEW LABORATORY EQUIPMENT.

We are particularly fortunate this year in the matter of new laboratory equipment. In the steam laboratory there is a new Walrath gas engine which has been installed since the beginning of the semester, by the Marinette Iron Works Manufacturing Company, of Marinette, Wis. This engine is a three cylinder, vertical type engine, of seventy-five horse power and a speed of two hundred and fifty revolutions per minute. It is completely fitted with a compressed air starting device. Besides being used for regular class instruction this engine will be employed in a series of special investigations by Messrs. John S. Hodge and John C. Potter for their thesis work. With this new installation no laboratory in the country is better equipped for the study of the gas engine than our own. This engine is evidence of the excellent work which is being turned out by the Marinette company.

Possibly the most striking new feature in the laboratory, is the ammonia compressor, direct connected to a Corlis engine, manufactured by the Vilter Manufacturing Company, of Milwaukee. The compressor is double acting, of a 15-ton capacity, and has a speed of 70 revolutions per minute. The dimensions of the steam cylinder are 9 by 24 inches, and of the ammonia cylinder, 8 by 16 inches. The engine and compressor form a very handsome piece of apparatus both in regard to workmanship and design, and, particularly when in operation, never fails to excite the admiration it deserves.

The compressor is connected to a 15-ton double-pipe, brine cooler, manufactured by the Fred W. Wolfe Company, of Chicago. It is fifteen feet long and 15 pipes high. The new condenser is also a double pipe condenser, patented and furnished by A. S. White, 5917 Normal Ave., Chicago. The White condensers and the Wolfe double-pipe brine cooler represent the best and latest types of this class of machinery.

The old Challoner 5-ton compressor has been removed to Science Hall and there installed with a 5-ton White double-pipe condenser. These two installations are cross connected so that either can be operated in connection with the system. Here are also installed a brine tank, ventilating coils for cooling air for ventilation, and coils in rooms for cooling the brine. The whole system is fitted with thermometer cups and other



Steam Laboratory—Installing New Equipment.

apparatus, permitting a large variety of tests to be made on the refrigerating plant as a whole. Besides being used for regular class work, the plant will furnish refrigeration for the anatomical laboratory in Science Hall. A series of special tests of the plant will also be made this winter by Messrs. Donald MacArthur and O. M. Jorstad, in connection with their theses.

The Vilter Manufacturing Company has a well established reputation in the building of refrigerating machinery, and the

University is particularly fortunate in having its laboratories equipped with so excellent a plant of their design and manufacture.

Another important addition to the steam laboratory is a 10-horse power Columbus engine, furnished by Cavanaugh & Darley, of Chicago. This engine is so constructed that either liquid or gaseous fuel can be fed to it at will, without stopping the engine. This engine will be used by Messrs. L. B. Moorhouse and S. W. Cheney for thesis work in addition to its use in the class room.

In the testing laboratory we have a new 125,000 inch-pound, Riehle torsion machine, for the testing of shafting. The machine will take a shaft 15 feet long by 1½ inches in diameter.

The new impact testing machine which has been in process of construction in this laboratory for several months, is now practically completed. The machine was constructed by the University from plans obtained from the city of St. Louis, and is a duplicate of a machine owned by that city and used in its city testing.

Among upper classmen, who are more or less familiar with these laboratories, there is a wholesome feeling of pride in the knowledge that there are probably but two laboratories in this country that compare favorably with our own, these being of course the steam laboratories at Cornell and the Boston Institute of Technology, and that even here the facilities offered are not greatly superior to those at Wisconsin.

SENIOR ENGINEERS AT ANN ARBOR.

One of the most enjoyable features of the Senior Engineers' inspection trip was the courtesy extended them by the senior engineers of the University of Michigan. The Michigan men, hearing of the proposed eastern trip, to include a stop at Ann Arbor, November 14th for the Michigan-Wisconsin game, communicated with the Wisconsin seniors expressing a desire to arrange to meet them at Ann Arbor.

Upon the arrival of the Wisconsin party at Detroit on the morning of the 14th, a committee of three was waiting to welcome them and accompanied them to Ann Arbor, where more of the Michigan class met the visitors and they were shown through the engineering department of the university.

A hasty glance through the shops and laboratories showed that the present equipment in that line must necessitate much crowding and inconvenience, with a senior class alone of some 120 members. But the need has been recognized and the new engineering building, while not yet completed, gives promise of an equipment in the near future which should give Michigan students opportunities which will compare favorably with those offered by the best schools of the country in most, if not all, branches of engineering.

In the evening the visitors were invited to the engineering building and, after an opportunity was given for all to become acquainted, a banquet was served, at which the best of good fellowship prevailed, the game of the afternoon having served only to make better friends. Following the banquet the Michigan men escorted their guests to the train and there, as well as many times during the evening, all joined in the Wisconsin and Michigan yells.

The Wisconsin men were royally treated throughout and all who were present feel that such a happy occasion not only served to bring into closer fellowship these two engineering classes and the engineering schools they represent, but has been an important factor in bringing about that better fellowship, understanding and unity of action, tending toward the more intimate relationship which we believe should exist between these two leading western universities. Wisconsin engineers are looking forward with pleasure to the time when they will have an opportunity of repaying in kind the hospitality extended them by their friends at Ann Arbor.

A. T. STEWART.

NOTES AND PERSONALS.

W. P. Hirschberg, '00, visited friends here during the second week of November.

Tau Beta Pi gave an informal dancing party at Keeley's hall, Saturday evening, Dec. 5.

E. A. Ekern, E. E. '03, holds a graduate scholarship on Sibley College, Cornell University.

H. W. Young, '01, is engaged in editorial work on the *Western Electrician*, published at Chicago, Ill.

R. H. Hadfield, '03, is an instructor in the Department of Mechanical Drawing at Ames University, Ames, Ia.

O. B. Kohl, '02, was recently made assistant manager of the city gas and electric company of Denver, Colorado.

G. A. Scott, '02, intructor in the dynamo laboratory during the past year, has accepted a position with the Chicago Edison Company.

Seymour W. Cheney, M. E. '04, represented the local chapter of Tau Beta Pi, at the national convention of the society held in Cleveland, Nov. 20.

Fifteen members of the Senior Civil class visited the French art exhibit at the Library building, in a body, one evening, during the recent exhibition.

Olaf Laurgaard, C. E. '03, who is employed in the reclamation service of the U. S. Geological Survey, is taking his annual leave of one month, at his home in La Crosse.

P. J. Kelley, '02, is engaged in electrical engineering work with the J. G. White Co., electrical contractors of New York. Mr. Kelley is located in Brooklyn at present.

Floyd A. Narramore, ex. '04, who will graduate this year from the Boston Institute of Technology, is president of the newly organized Wisconsin Club at that institution.

At a regular meeting of the Civil Engineering society, Friday evening, December 4, an interesting paper on the "Oil fields of the Middle West" was present by Mr. J. G. Staack.

M. L. Hurd, '01, of Joilet, Ill., recently visited his sister Miss Helen Hurd, '07, and old varsity friends. Mr. Hurd is connected with the Engineering Department of the Illinois Steel Works at Joilet.

The marriage of L. D. Rowel, to Miss Rose W. Toepfer, daughter of Mr. and Mrs. Otto Toepfer, of Madison, Wis., took place on October 20, in this city, at the home of the parents of the bride.

Joseph Mannington, ex. '03, who is in the employ of the Burlington, in the chief engineer's office in Chicago, recently took a vacation, going with a small party on a hunting expedition about one hundred miles north of Winnipeg. Mr. Mannington succeeded in bagging a moose.

Martin W. Torkelson, Gustave W. Garvens, Charles T. Watson and Edward E. Terrell, who were employed on the construction of the new lines of the Louisville & Nashville R'y during the past year, have returned to the University, and will take their degrees with the clsss of 1904.

The marriage of Mr. Frank Palmer Woy, E. E. '03, to Miss Mary Katherine Hobbins, took place at the home of the bride's parents, Mr. and Mrs. J. H. Hobbins, Tuesday, December 1. Their home will be in Brooklyn, where Mr. Woy is in the employ of J. G. White & Co., electrical contractors.

Ray Owen, C. E. '04, has been given a permanent appointment on the Irrigation Branch of the United States Geological Survey, with a nine months' furlough in which to complete his college course. Mr. Owen was employed on the reclamation service during the past summer in southeastern Montana.

The marriage of Professor John G. D. Mack to Miss L. Abby Davis, was solemnized at the home of the brides's mother, Mrs. Elizabeth Keck Davis, Walnut Hill, Cincinnati, on November 24. Professor and Mrs. Mack will be at home to their friends after January 4, at 125 East Johnson street.

The 1903 Civils have started a chain letter for the purpose of keeping each member of the class informed as to the whereabouts of the rest. The letter has already gone through the hands of about half the class. Under the plan adopted each member of the class is requried to write three letters.

The committee in charge of the preparations for the World's Fair exhibit to represent the University in St. Louis, in 1904, consists of Proffessors J. G. D. Mack, Chairman; A. W. Richter, F. C. Sharp, T. S. Adams, A. W. Whitson, and N. M. Fenneman. An appropriation of $4,000 has been made for the purpose.

The Madison Gas and Electric Company recently gave another evidence of its kindly feeling toward the University in general, and Prof. Richter's department in particular, by replacing all the 3-glower Nernst lamps in the steam laboratory with 6-glower lamps, at an outlay of about $100.00. The improvement in the illumination of the laboratory is greatly appreciated by students and faculty.

The first of the series of Engineering socials to be given during the winter occurred on Saturday evening, Dec. 12, at the Engineering building. The attendance was good and a very enjoyable evening was spent. Entertainment was provided by the social committee and a portion of the time was spent in the singing of college songs, which has always proved a popular feature of these entertainments.

A local branch of the American Electro-chemical Society, with a membership of twelve, has recently been organized at this university. C. F. Burgess has been made chairman of the chapter, and F. L. Shinn, secretary and treasurer. Three meetings are to be held each year, at which papers are to be presented on the results of experiments conducted in our laboratories. These papers will be published each year in the Transactions of the society.

W. E. Brown, C. E. '04, came very near losing the sight of one eye, as a result of being struck by a missile from a sling shot, in the hands of an employe in the city engineer's office, at Racine, Wis. The accident occurred just before the opening of the University, preventing Mr. Brown from taking up his work with his class. As a result of a recent operation it is learned that the sight of the injured eye, which had been despaired of, will be retained.

The professors and instructors of the College of Engineering were very pleasantly entertained at the home of Dean and Mrs. F. E. Turneaure, 1015 University avenue, Tuesday evening, Dec. 1. The affair, which was quite informal, was in the nature of a reception to the new members of the faculty of the College. The presence of President and Mrs. Van Hise afforded the new members an opportunity of becoming better acquainted with the president

At the October meeting of Tau Beta Pi the following men were admitted to membership: Bernhard F. Auger, M. E. '05, Milwaukee; Arthur T. Stewart, E. E. '04, Los Angeles, Cal.; Ernest A. Moritz, C. E. '04, Madison, Wis.; Merton G. Hall, C. E. '04, Baraboo, Wis.; Frank J. Saridakis, M. E. '04, Milwaukee; Norman Lee, E. E. '04, Cambridge, Wis.; Frank J. Petura, E. E. '04; Racine, Wis., Louis B. Moorhouse, M. E. '04; Elkhorn, Wis.; Edgar A. Goetz, G. E. '04, Milwaukee; and Harry L. McDonald, C. E. '04, Fond du Lac, Wis.

Geo. W. Wilder, formerly instructor in physics at this university, has been appointed Assistant Professor of Telephony at Armour Institute, Chicago. Mr. Wilder is also Technical Editor of "Sound Waves," published in that city in the interests of telephony and allied sciences. Professor Wilder's rare faculty of making friends of his students, combined with a thorough technical and practical knowledge of his subject, gave him a deserved popularity among the engineers who were privileged to be in his classes, and his leaving this university caused general regret among all who knew him.

Drafting room caucuses held in the different departments the last week of November resulted in the appointment of a committee of seniors to investigate the advisability of presenting a senior engineers' minstrel show or similar entertainment later in the year. At a recent meeting the committee definitely decided that an entertainment would be given, probably in the latter part of March, to take the place of one of the regular engineering socials. The following elections were made: Allan Lee, Pianist; F. W. Huels, Stage Manager; H. L. McDonald, Business Manager. The committee consists of the following: Civils, L. F. Van Hagan, J. H. Neef, and Edwin H. Omara; Mechanicals, Donald McArthur, and Walter J. Koch; Electricals, James A. Stewart, William E. Bradford and E. M. Hall.

SECOND ANNUAL JOINT DEBATE.

The Second Annual Joint Debate, between the U. W. Engineers' Club and the N. O. Whitney Engineers' Ass'n, was held in the Auditorium of the Engineering Building, Friday evening, December 4. The debate was won by the N. O. Whitney team by a close decision of two to one.

PROGRAM

PRESIDING OFFICER.....................PROF. E. R. MAURER
PIANO SOLO..Selected

ALLAN LEE.

DEBATE—

Resolved: That the State of Wisconsin should enact a law providing for the appointment of a commission to fix maximum reasonable freight rates on all articles whose shipping points and destinations are within the state.

AFFIRMATIVE—	NEGATIVE—
U. W. Engineers' Club—	N. O. Whitney Ass'n—
R. S. Peotter	A. F. Krippner
B. F. Anger	E. Zaremba
E. L. Leasman	A. T. Stewart

PIANO SOLO .... Selected
ALLAN LEE.

The audience was composed largely of the members of the two societies with a few visitors. There was no quibbling over the interpreting of the question and the arguments were well presented throughout. When Mr. Peotter closed his rebuttal it was felt to be a very even debate, and the decision of the judges was awaited anxiously by all. The decision was one for the affirmative and two for the negative.

While the judges were coming to their decision, Prof. E. R. Maurer took the opportunity to congratulate the two societies on the character of the debates presented, as did also Dean Turneaure, in announcing the decision. The judges were Dean Turneaure, the Rev. F. A. Gilmore and Prof. E. B. Skinner.

NEW MEMBERS OF THE ENGINEERING FACULTY.

Mr. F. M. McCullough takes Mr. Davis' place as Instructor in Civil Engineering. Mr. McCullough is also a member of last year's graduating class.

Mr. H. H. McPherson takes Mr. Merrill's place as Instructor in the steam laboratory. He is a Mechanical Engineer graduate of Cornell, class of 1903.

Mr. J. W. Watson takes the place of Mr. Scott as Instructor in Electrical Engineering. Mr. Watson has the degree of E. E. from this institution.

Mr. L. D. Williams is a new Instructor in Civil Engineering. Mr. Williams graduated here in 1901, since which time he has been in the employ of the Penn. R. R. Co.

Mr. J. T. Atwood, Instructor in Mechanical Drawing. Mr. Atwood graduated from the University of Illinois, in the Mechanical Engineering course. His home is at Rockford, Ill.

Mr. L. E. Moore is a new Instructor in Drawing and Mechanics. He graduated here in the Mechanical Engineering course in 1900; has had two years' experience in machine and structural work, and has spent one year in the Civil Engineering course in the Massachusetts Institute of Technology.

Mr. Alvin Haase and Mr. F. W. Huels are Assistants in Experimental Engineering. These are both members of last year's graduating class, Mr. Haase in Civil Engineering and Mr. Huels in Electrical Engineering. Mr. Haase's chief work is in the testing laboratory, and Mr. Huels' in the steam laboratory. The testing laboratory work was carried on last year by Mr. Hartman.

F. O. DuFour, Acting Professor of Bridge and Sanitary Engineering. Mr. Du Four is a grauduate of Lehigh, '96, having received his preparatory education in the high and manual training schools of Washington, D. C. After his graduation from Lehigh he was assistant division engineer of the L. V. R. R. until November, 1897, when he entered upon the duties of Instructor in Civil Engnieering at Lehigh University. In April, 1901 he was made Professor of Civil Engineering in the University of Cincinnati, which position he held until the present school year, when he assumed his present du ties at the University of Wisconsin. During his vacation periods Prof. DuFour was engaged in various lines of pratical engineering work. In the summer of 1898 he was principal assistant in bridge engineering on the Lehigh Valley R. R. and the following summer acted in the capacity of detailer and estimater for the Athens Bridge Co., at Athens, Pa., on the work of the C. & N. W. R. R. Since 1901 he has been connected with the American Bridge Co., Athens plant, in charge of the work for the N. Y. Central and the Vera Cruz & Pacific railroads. In the summer of 1902 he was placed in charged of the work on the Worth Street Station, of the New York subway, In the summer of 1903, Prof. Du Four was employed at Pittsburg on the extension of train sheds for the union station at

St. Louis. Since 1899 he has also been engaged in a general consulting practice in structural steel.

Prof. Du Four is a member of the Engineers' Club of Cincinnati, an associate member of the American Society of Civil Engineers, a member of the American Society for Testing Materials, and of the Theta Delta Chi fratenrity. He has contributed a number of articles of scientific interest to various technical periodicals, notably concerning the physical properties of concretes and cements, Puerto Rican timbers, and on the stresses in bridges due to rolling loads. Part III of Merriman and Jacoby's Bridge Design was also written by him.

BOOK REVIEWS.

Machine Design, Part II., Fastenings, by William L. Cathcait. D. Van Nostrand Co. Price $3.00 net. The book takes up in detail the different forms of fastenings, giving general formulae and tables relating to the proportions and material of the joints. The main purpose of the book, as stated by the author, is to present in compact form for the use of the student and designer, modern American data from the best practice in the branch of machine design to which the work refers. The subject is also fully treated from a theoretical standpoint in order to make the work cover the field completely. The large number of dependable tables and diagrams tend to make the work invaluable for the use of the student or practicing engineer.

IN THE COMMERCIAL WORLD.

Through the courtesy of the John A. Roebling's Sons Company, of Trenton, N. J., the seniors have been supplied with the Roebling's wire Hand Book, giving the properties of every variety of manufactured wire, cables, etc.

The attention of the readers of THE ENGINEER is directed to the advertisement in another portion of this issue of the

H. W. Johns-Manville Co., of Milwaukee, with its interesting little cut of the famous "Flat Iron" Building of New York city. The company manufactures all kinds of pipe and boiler coverings, in fact everything in the way of non-heat-conducting materials. Their catalogue is an interesting one.

The Northern Electrical Manufacturing Company, of Madison, Wis., has favored THE ENGINEER with a copy of their recent catologue, descriptive of their well-known electrically operated valves. The advantages of this system, in which this company are the pioneers, are described in an interesting way, aided by artistic illustrations. The catalogue is handsomely gotten up and forms a valuable book of reference on the subject of motor operated valves.

THE ENGINEER is in receipt of a copy of the latest catalogue of the John A. Roebling's Sons Company, of Trenton, N. J., which we believe to be one of the most interesting publications of its kind that has come to our notice. Besides containing the expected information concerning the large number of articles manufactured, it contains a wonderfully interesting account of the growth of the wire industry and of the Roebling's Company, since the manufacture of the first wire cables at Trenton, N. J., in 1848, in the primitive little shop of which an illustration is shown, down to the present time. The present mammoth proportions of the industry need no comment here. The catalogue also contains a dozen or more handsome full page half tone illustrations of famous bridges and cable ways errected by the John A. Roebling's Sons Company. Typographically it is a publication which will please even the most critical, and the tables and general information concerning every kind of wire product, make it an invaluable book for the young engineer.

SOME FOREIGN PATENTS.

741,940. COMPOUND STEAM-TURBINE. WILLIAM E. SHEPARD, Paris, France. Filed Mar. 27, 1903. Serial No. 149,805. (No model.)

The high pressure steam is delivered through an expansion nozzle to a set of guide vanes which cover only part of the buckets on the turbine wheel. The steam, having thus passed through part of the wheel is returned and again delivered to the wheel at a lower pressure through another larger set of guide vanes which cover the remaining buckets.

742,359. HEATING-BOILER. ALBERT SCHOLL, Mannheim, Germany. Filed Aug. 4, 1902. Serial No. 118,237. (No model.)

The boiler is formed of helical coils around which is the combustion chamber which is again surrounded by an elastic helical coil, through the windings of which the air is supplied. The air supply is varied by pressing the elastic coil together.

742,535. LOCOMOTIVE ENGINEER'S ALARM. ERNEST WATSON, Brainerd, Minn. Filed Apr, 14, 1903. Serial No. 152,558. (No model.)

A system of levers, which are moved by the passage of a train, are attached to the track at regular intervals and connected by wires so that the track is divided into overlapping blocks. Also a lever on the locomotive is arranged to engage the levers on the track if the block is occupied and so sound an alarm in the cab.

742,654. APPARATUS FOR DISTRIBUTING SAND BENEATH THE DRIVING-WHEELS OF LOCOMOTIVE-ENGINES, &c. JAMES HOLDEN, Wanstead, and FREDERICK V. RUSSEL, Stratford, England. Filed Apr. 15, 1903. Serial No. 152,795. (No model.)

The sand distributing apparatus is connected to the starting-handle of the locomotive so that sand may be supplied simultaneously with the starting of the engine.

743,541. BAFFLE FOR WATER-TUBE BOILERS. JIRO MIYABARA, Tokio, Japan. Filed Aug. 3, 1901. Serial No. 70,723. (No model.)

The combination with the water-tubes and casing of a water-tube boiler, of baffle-plates interposed between the tubes and means for supporting and moving said baffle-plates whereby they may be moved from a position to form a series of open shutters to a position forming a substantially continuous partition; the said water-tubes being so arranged as to leave clear oblong openings through which said baffle-plates extend transversely; the major diameter of said oblong openings being greater than the width of said baffle-plates whereby said baffle-plates may, when in open position be removed or inserted endwise into said openings.

Please mention the Wisconsin Engineer when you write.

The Only Double Track Railway Between Chicago And the Missouri River

The Chicago & North-Western Railway is the only double-track railway between Chicago and the Missouri River at Council Bluffs.

Three fast trains each way daily between Chicago and San Francisco, and two per day between Chicago and Portland, provide for passenger traffic between the East and the Pacific Coast over this transcontinental highway. These through trains are operated on fast and convenient schedules. They are drawn by powerful locomotives and carry an equipment of Sleeping Cars, Reclining Chair Cars, Observation, Dining, Parlor, Library and Buffet Cars of the most approved type.

The perfectly ballasted roadbed of heavy steel is maintained in the highest state of efficiency, equipped with automatic block signals, interlocking switches at railway crossings, and all devices for the safety and comfort of passengers known to modern railway management.

The 9,030 miles of railway embraced in the North-Western System penetrate to every point of importance in Wisconsin, Iowa, Nebraska, Northern Illinois, Northern Michigan, Southern Minnesota and South Dakota, with eastern terminals at Chicago, Peoria and Milwaukee.

The Overland Limited, daily between Chicago and San Francisco, via the Chicago & North-Western, Union Pacific and Southern Pacific railways, is the most luxurious train in the world. It possesses the most complete arrangements for the comfort of passengers and is operated on fast and convenient schedules—less than three days en route between Chicago and the Coast.

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