MINNESOTA TECHNO-LOG

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IN THIS ISSUE

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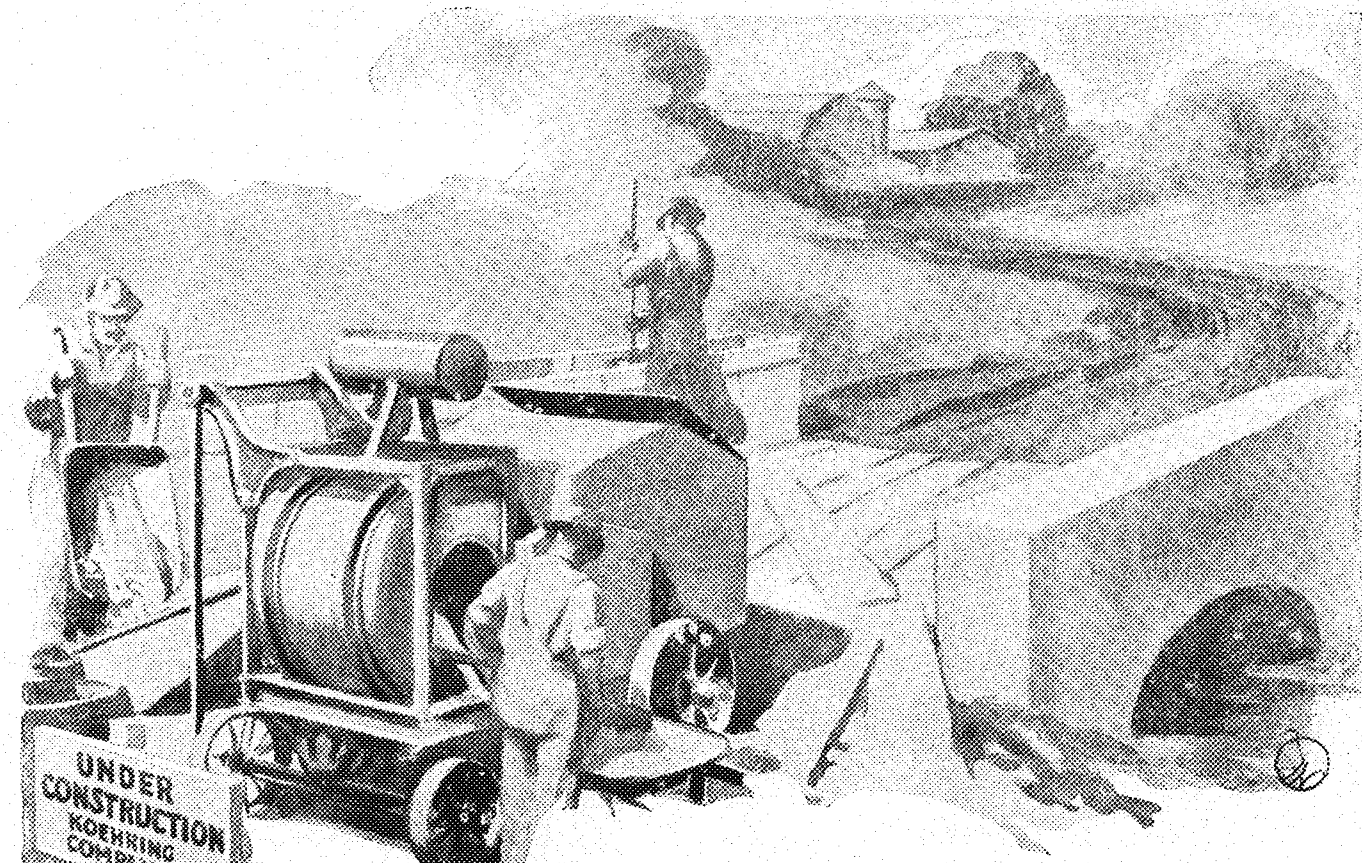

IN the construction of modern highways, time-saving machinery has taken the place of the huge armies of artisans which, by brute strength accomplished the road-building of the Egyptians and Romans.

The nerve center from which modern highway building radiates is the concrete mixer. Without it, the present wonderfully developed system of paved roads would be only a chimerical dream.

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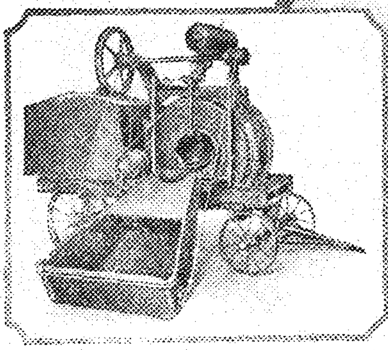

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MINNESOTA TECHNO-LOG

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CIVIL ENGINEERING SUMMER CAMP

Part 1 7:30 A. M.-4:30 P. M. by E. H. Lund, B.Sc. '22

Part 2 4:30 P. M.-7:30 P. M. by Geo. Bailey, B.Sc. '22

The C. E. 1922 class was in the dark as to the location of their summer camp until well along in the summer. They knew that it would not be held at International Falls again and were also positive that Paynesville would not be considered. The guesses were many, but all "bets" were settled when Prof. Cutler announced that the camp was to be established at Cass Lake, Minnesota, and that we would leave Minneapolis on the evening of the 11th of August.

Several of the fellows looked up Cass Lake on the map and found that it is situated about 240 miles north of Minneapolis and consists of two separate lakes—Pike Bay and Cass Lake—joined together by a narrow channel. Along this channel, we later found, are located a saw mill and a box factory, the two principal industries that keep the 2000 inhabitants of the town of Cass Lake busy.

On the morning of the 12th, we arrived at Cass Lake, after spending the night riding from Minneapolis to Bemidji and from there to Cass Lake. We found that the camp was located about four miles east of town in a magnificent stand of Norway Pines. Some of the fellows were already at camp when we arrived, but the majority of us had to pitch camp and start to make ourselves at home. This occupied practically the remainder of the day. The next morning we were introduced to a few general camp regulations. We found that first call was scheduled at 5:45 with roll call and breakfast at 6:00. All field and office work began at 7:00 A. M. and continued to 4:30 P. M. with a half hour at noon for lunch. After 4:30 the time was our own, except for the fellows who had been party chiefs during the day, and their day was finished after they had copied the day's work into the office note-books.

The surveying work was divided into two parts consisting of Railroad work under the direction of Prof. Cutler, and Topographic and Hydrographic work under Prof. Zelner. The first thing we did was to adjust instruments and establish a water gage. The elevation of the top of the gage was then determined and every day thereafter the gage was read and its readings, together with the barometer and the thermometer readings, were recorded on a weather chart. Several parties were assigned to establishing B. M. elevations and to measuring a baseline which was later to be the basis of all our triangulation work. In measuring the baseline every precaution was taken to be correct. Temperature, pounds of pull, and ground gradient were all determined and the necessary corrections applied to the results of each party, after which the results of all the parties were averaged to get the true value.

Prof. Zelner started the actual topography work with stadia parties. The stadia traverses proved to be a "jinx" for several of the fellows. The largest difficulty was in getting the traverses to close when they were calculated in the office. At first, the accuracy demanded by Prof. Zelner was a closure of 1:800, but this standard was reduced as camp progressed to 1:400 so that it would not be necessary to rerun several of the traverses. It was on this work that "Honey" Swanson discovered that a revolver and a raw-hide shoe-lace will take the place of a plumb-bob, in case you have forgotten the latter; and it was on this work that Nelson discovered, after failing to close a traverse by 20°, that it is a good policy to "Trust to Luck," but it is better to read your magnetic deflection at every set-up for good measure.

In order to tie all of these stadia traverses together, a system of triangulation was necessary. Parties were detailed to erect triangulation stations and to read angles between the stations. The stations were all located along the shore line in such a manner as to form triangles whose angles were as nearly 60° as possible. We did not use any triangulation towers as the 1921 class did at International Falls.

The office work, connected with triangulation, consisted of calculating the sides of triangles using the angles that were read and the measured length of the baseline. As a check, a second baseline was established and the actual length and the calculated length were compared with good results. The office work also included the balancing of the angles of the various triangles and it was in this work that "Andy" showed his heels to the rest of us.

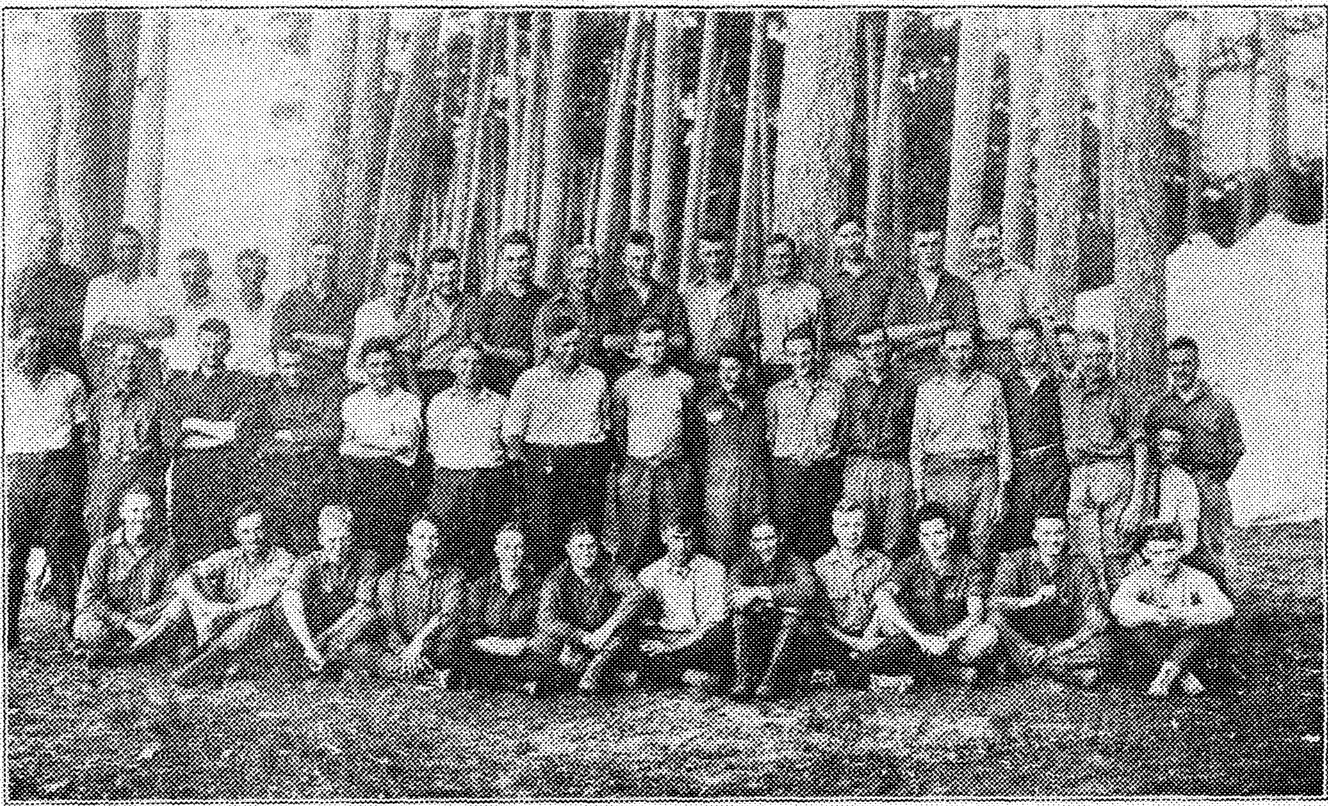
There are two railroads running through Cass Lake, the Soo Line and the Great Northern. For about fifty miles, beginning at Bemidji, these two roads parallel each other, being for several miles not over forty feet apart. At Cass Lake, the Great Northern has one of its yards and what Prof. Cutler wanted us to do was to map these yards and the two railroads for about a distance of six miles. He began by having some parties measure with tape line the portion of each road that he wished to have mapped. The parties started at a place known as Cuba, approximately 4½ miles east of Cass Lake, and continued through town and west for a distance of about 1½ miles. Deflections, curves, length of tangents, were all obtained and then a profile was run over the entire distance taped. In running the latter, we struck a difficulty in the way of high winds while crossing some trestles over the channel connecting Pike Bay and Cass Lake. The wind would sweep across the lakes with tremendous velocities, making the level tremble like a leaf and causing the levelmen to use language that is not printed in either Tracy or Breed and Hosmer.

The mapping of the G. N. yards was by no means a small one. Every frog had to be measured and its number determined and then every siding, spur, switch, frog, sign post, and building had to be accurately located by tape measurement and a description obtained of each. All this information was later put on a map in the office and if any additional data was then found necessary, a party was assigned to go and get it. It is doubtful whether the railroad engineers themselves have as detailed information of this portion of their respective roads as we took this summer.

Several cross-overs between the Soo Line and the G. N. were located, simply as problem work. At first we could not grasp these problems at all and two party chiefs pulled in their parties in disgust after spending a whole day in perusing the mysteries of Allen's "Railroad Curves and Earthwork" and then were not able to get the cross-overs properly staked. The next morning Prof. Cutler went over the problem with us in detail before we went into the field and by sun-down on the second day several cross-overs were staked with reasonable accuracy.

The work I have mentioned so far kept us busy for a good one-half of the time we were in camp. The remaining time was devoted to plane table work, section-line work, soundings, and plotting maps. The plane table was first put into use in drawing a map of the Forestry Service's Nursery at Cass Lake for the Forestry Marshal. In this instance a stadia traverse was run in as skeleton upon which the topography and contours were filled in by the use of the plane table. The map was neatly executed, although a defective table caused complications to arise among the contour lines. We used the plane table in mapping the saw mill in Cass Lake and also in filling in topography on a control traverse that was run several miles east of camp. The results of mapping the saw mill were not of the very best due partly to the small scale used (1″—400′) and partly to the fact no stadia skeleton traverse was run in before the plane table was used. The other plane table results were very good.

When it came to sounding we had some work that was entirely new. The parties were each made up of nine men. There were three instrument men on shore, four in the sounding boat, and two range men in a canoe. The instrument men were to "cut" in the location of the sounding boat whenever the party chief signalled with a flag, which he was supposed to do every minute. The men in the boat consisted of the party chief, an oarsman, a sounder, and a recorder. The business of the party chief was to see that everything was kept running smoothly and to show the flags every minute to the instrument men on shore. The two men in the canoe were kept busy setting range signals for the sounding boat and on a rough lake they had their hands full.



Junior Survey Class, Summer 1921

Several miles of section-lines were run. This work was especially hard on the axemen, because in many places the underbrush was so thick that nearly every foot of the line had to be chopped. Some of this work was done at the request of a government Forestry official who was in the woods to make experiments concerning the white pine blister that is so destructive in many of the United States forests. In running these lines we were not so very accurate as far as instrument work was concerned. The lines were run by bearings and the distances measured by tape. Every quarter-section and every section-section corner was established and we endeavored to find the old bearing trees, but with only a small amount of success.

We found that sounding is a wet job for the man on the pole in any kind of weather and a wet job for everyone, outside of the instrument men, when a heavy sea was rolling. One day the wind was so bad that it was impossible to keep the boat on range or for the range-men to set their flags. In trying to get back to shore it was necessary to put two men on the oars, and it was then that Erickson showed his sailor's skill by breaking one of the oars and making it necessary to use sails as well as the remaining oar in getting ashore.

In sounding, we sounded once in every fifteen seconds as the boat was rowed along at a uniform speed and we kept on sounding until we were beyond the 16′ depth. Most of the soundings were plotted on a map that the Forestry Marshal sent to Washington for the purpose of giving exact information to government officials regarding the location of a boys' camp that is to be established on Cass

Lake about a mile and a half east of where camp was located. The Forestry Marshal expressed himself as being well satisfied with the map.

The last few days of camp were lost as far as work in the field was concerned, because of rain. All the rain that did not come during the summer time decided to come during the last week of camp. Office work was cleaned up as far as possible. Notebooks were indexed, missing notes plotted, and everything was put in order preparatory to our breaking camp on the 21st of September. But, Zowie, how it rained. It rained on the 19th, continued to rain on the 20th, and was still raining on the 21st. Everything was packed ready to go except the tents, which were too wet to pack. About 10 A. M. the barge came out from town to get the luggage and equipment. Several of the fellows who were going home by the way of Duluth, were given permission to go to town immediately so as to catch the noon train to Duluth. The rest of us remained and loaded the luggage and equipment on board the barge. While this was being done, old Sol decided to shine again, so that shortly after noon the tents were also taken down and loaded aboard the barge. The trip to town was very rough, due to a heavy sea, but everybody and everything managed to keep from sliding into the lake.

In closing, I wish to state that we not only learned how to run the various instruments used in surveying, but we learned the value of co-operation and friendship. We discovered that the other fellow has feelings and that sometimes he also is right. The camp had its troubles, but it also had its benefits; and the C. E. 1922 class firmly believes that its camp was just as fine a camp as any that has ever been held.

PART 2

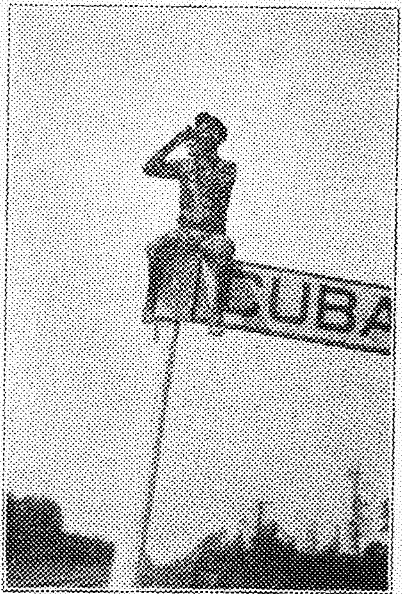
Look who's coming. Can you feature that? Why, you sawed-off, Billy-rigged old stepper, where did you come from? Did you come blind or did you ride the cushions this trip. Man, I'm sure glad to see you again; and isn't this the jake location for a camp though? Here, dump your junk over there and then come over here and help us move that supply tent over there. Who, those two? Oh, they're the camp flonkies till work starts, one is Leo Buhr and the other, the one with the dirty, ragged shirt, is Birdie Berdan. Don't mind what they say, they're both sore because all the tools are down at tent number nine. Max Feder is down there plowing up the earth with a ten pound maul in an effort to drive a little tent peg. Yeah, they got here all right, but they came so fast that Swanson's complexion was damaged two points and Paulson had three constables after him at the same time. Oh, he's a reckless guy. Always was. First night he was here he shot a hole thru his finger on a bet that his finger was so tough the bullet wouldn't go way thru. That Island over there? Say, guy, listen! On that island over there there's a girls' camp and one of these nights when——— Yea, bo, there's the chow call. Come on, you sap! Gangway up ahead there!

And in such manner did we open the social season at Norway Beach the summer of nineteen hundred and twenty-one.

Positively, we could have found no place so ideally situated for our wants and needs as that memorable camp snuggled into the edge of the big pine grove near the sandy beaches of Cass Lake. Why, there were hundreds of water-soaked logs half buried along the beach which could be dug up, if you worked hard enough and didn't mind the backache, and used to make bunks, tables and totem poles. Or, if you could get the crosscut saw away from Al Levens you could saw them up into little stools which were handy to sit on during afternoon tea or at poker games and could even be used to throw at the saxophone artists. There were great trees all about. In fact, they were always about and about always on line as well. These trees stood silent guard over the little white tents at night, shielded us from the storms that blew, served as washline poles and made excellent scratchers when you had poison ivy on your back. And that's where we all got it. I doubt if a man in camp ever had it where it could be reached conveniently, that is, in a place such that he could sit down during the hour of work and have a nice little scratch without unconsciously practicing physical contortion. Luke Aldrich, one of the brainiest little engineers that ever held a stadia rod upside down, suffered terribly with this malignant scourge. His screams at night became so piercing that the squirrels couldn't sleep and finally left the camp site altogether. Harry Cribbs and Lawrence Pinska shivered in their tiny bunk and threw their arms about each other as they listened to the marrow freezing strains of that awful and terrifying Aldrichian refrain; while Lawrence Teberg, the terrible tackle, paused in his midnight dance of the merry can-can and quivered in sympathy to the spirit of the cry so aptly set among those towering woods, whose darkness was shot with the flickering shafts of the cold northern lights.

In the mornings, Johnny Reardon usually slept about two and a half hours longer than anyone else, due to the fact that he kept Chuck Palda awake half the night playing rummy for keeps. While Johnny slept serenely and noisily, all other members of the camp were hurrying to the shore to see who might reach the water first. Life is always more worth living after a cold, early morning dip. Chub Johnson usually was first to plunge but he also was the first to splash out in order to also be first at messtable. There he entered the famous daily eating contest with Max Feder, the repartee king of Section 17. But, alas! Chub never won, although once or twice he came within a scrambled egg of winning.

One evening, it seems as though it were the evening of the Sunday that Prof. Zelner awoke us at five in the morning to explain a little matter of a five hundred foot error, all of the residents of Ante-Inn were out making little social calls on the rest of the camp pocketbooks. Even Wilson had taken down his halo from its hook and gone out. This Wilson will bear watching, incidentally. He it was who solved the problem of the excessive polar angle. The boys had been finding that the vertical angle when they shot Polaris was so great that the observer nearly broke his neck looking through the telescope—nothing simpler, Wilson merely picked up the transit and carried it back twenty feet away from the north, thereby making the vertical angle to Polaris less. There is probably no instrument on earth that could detect how much less, still it stands to reason that it was less. Well, on this evening in question, someone concocted the most diabolical plot that ever left a mental stench. It was decided upon among all those who were tipped off that it would be the logical thing to give Ante-Inn a wooden shower. No sooner said than begun. Stumps were dragged off the beach, logs were unearthed from heaps of brush and all were placed tenderly within the portals of that designated lodge. The beach combing soon became a fever and the observant onlooker often saw tree trunks move swiftly across the clearing under the impetus of fifteen grunting engineers. Vic Wood tried vainly to stem the tide but was swept aside by sheer numbers. However, Vic is a resourceful lad and he looked up Markson and they both ran and sobbed out their misery in the cook's lap. Gradually, however, the mania began to subside and long before the inmates of the afflicted tent put in an appearance no man nor

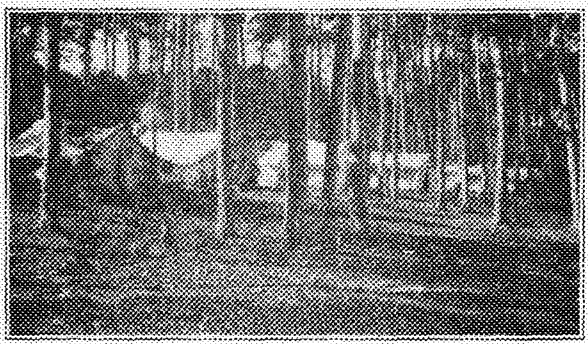


member of the lawless band could be found. When Wilson, who always came home first, reached home with roseate visions of a warm, soft bed, he forcibly introduced himself to the butt of a twelve inch pine tree that protruded from the usually welcome doorway. Mustering all his courage he ran to Swanson's tent, where they were having open house, as well as full house that evening, and blurted out the news of the calamity to Bill Frantz. Bill returned to observe the extent of the affair and after having lit a lantern he made a thorough examination, which disclosed about three car loads of assorted timber. Bill then came out and said a few words for the benefit of all hearers, some of his remarks being dangerously near the profane. The end of this entertainment was a sort of toting bee in which many of the perpetrators joined, being led through sympathy to help the victims re-establish standing room within their canvas domicile, especially as Bill had strained his back attempting to toss a fair sized tree outside single-handed. It did do us good to see how Chub worked that night. Without a word he pitched in and worked his little self into a perspiration, probably the first and last that he ever experienced in camp.

Another of the outstanding social events of the summer was the splendid dance given for the boys by the girls' camp across the lake. When news of the invitation was announced, George Meskal, alias Lew Cody, nearly went into hysterics. He and Eddy Soshnick and Herbert Frost spent most of the next three days preparing for conquest. In fact, Home-run Frost used so much hair grease that the flies used to slip and sprain their ankles when they lit upon his head. Oh, they were days of anticipation, those days previous to the grand dance. Newberry and Lund used to sit for hours looking out over the lake toward Star Island. On the evening in question, the boys gathered together for the happy event. Without a doubt there was probably never before such an imposing group assembled for a dance. Eddy's ice cream trousers were a sight for sore eyes, especially in conjunction with his natty straw hat which his Aunty had given him for his birthday. There was Johnny Morrison, typical product of the great outdoors, dressed like an unidentified delegate of the I. W. W. Johnny had on our best that night. He wore Fraser's shoes, Buhr's extra shirt, Harry Andrus tie, Tommy's cap, Nelson's socks, the pants that Andy wore the night he stepped on the skunk, and Ed. Erickson's underbodice. There was a certain charm about him anyway, he looked so sort of different. Gray was there, too, as well as Rosenthal and Silverman, who were trying to argue Arden White out of taking a quart of moonshine along to enliven the evening. At last they got away from the old wharf at the Norway Beach hotel and, with Dewey Mattson singing "Rock of Ages," passed successfully by Strawberry Point and headed for the Island. It would take too long to tell of the wonderful time that the boys had at the dance, even though one of the maidens did try and tell George that she bought all her shoes in California, so it can merely be said that it was a huge success. Mattson made a great hit with the haircut he got at Cuba, and they all thought that Cook looked like somebody that reminded them of someone. Paulson let some of the girls look at the hole through his finger and Swanson stood by to catch them as they fainted, being assisted in this by Palmer, who did it just out of generosity. After the refreshments had been served and the ice cream had been wiped off Keller's chin, the party broke up, and the gang returned to Norway Beach, where soon all were asleep, except Johnny and Leo, who sat up to eat cookies that Leo had jipped at the luncheon.

The major sporting event of the summer, however, was the trip to the roller skating rink in Cass Lake. Before the party broke up that night, Slade was not only the undisputed champion tumbler of the town, but had won a reputation for himself that extended eastward to the town of Bena. One of the strange occurrences of that evening was the tenacity with which the engineers clung to their habit of always skating around to the right. Stoutland was one of the most noted examples of this, and he circumnavigated the rink so many times in one direction that when he quit for the evening he walked like a side-hill-wampus and had to be helped along by Birdie Berdan, the corn-cob philosopher. Andy showed up to advantage on the skates, but was so charmed with the music that he never got far from the mechanical piano, whereas, Loring spread himself all over the floor in utter disregard as to where he flopped. It was then that Harry Cribbs and Lawrence Pinska took advantage of their opportunity to see some real western life. These two young men, instead of frittering their time away rolling around, went to a play and saw a splendid presentation of primitive life. After it was all over and Lawrence had awakened him, Cribbs admitted it was one of the finest things he ever slept through.

Gradually the nights began to be longer and the mornings a little more frosty, and we knew that before long we would break camp. Sadly the gang began to take last looks at all the old land-marks. Mattson had a farewell hair-cut at Cuba, Christilaw and Bailey put a last afternoon's work on the "337 to Cuba" traverse, Markson and Fraser picked a final bucket of berries on Strawberry Point, Harry Cribbs went out and caught a last pickerel and Nelson, Cray, Lund, White and Erickson had a last game of cards at which they couldn't hear each other's bids on account of the noise next door. The last week was one of extreme sorrow and depressed spirits. Sad faced engineers were seen roaming



about through the woods winding up the section lines, while others brought bucket loads of T. P.'s and B. M.'s in and packed them away under Mr. Cutler's direction. All of the main traverses were folded up and stacked away in the camp chapel, but the side shots were left just as they were. At last the day of departure was at hand the herculean beds of some were dug up and the flimsy cots of others thrown away. The tents were dismantled and packed and the sidewalks torn up. The lounging room was left, however, as it spread over the country for a radius of five miles and will be there to serve future generations of optimistic engineers. Max was sent to the kitchen and turned loose on everything that was left so that no food of any description would be wasted. Finally all equipment was loaded on the barge and everything set for the departure. As they stood on the beach, that fine, sandy old beach that they had come to love, the lips of many were seen to quiver and Leo Buhr and Oliver Stoutland buried their faces in the sand and sobbed aloud. The little chipmunks, many of whom had been tied up during the camp, lined the forest's edge and wept bitterly. They had learned to eat cheese, poor little rodents, and now where would they get it. Slowly the barge moved out into the lake, the long yellow beach glistening like a ribbon of brass beneath the deep, green phalanx of Norway Pines. Overhead, the sky was the dull blue of early fall and below the clear blue of the lake stretched shoreward till it merged into the soft mirage that clung like a banner to the water's edge. The honking of geese came faintly from above, a loon laughed in the distance and was answered by the chuckle of Lafalot Lodge. The melodious and far-away whistle of a Great Northern locomotive drifted lazily in on the wings of the faint breeze. The sharp cry of the gulls sounded over the placid expanse of Cass Lake. One by one the boys bowed their heads and as the barge rounded Strawberry Point, the old camping grounds receded from sight and were a thing of the past. Back at the Norway Beach Hotel, Minda sobbed and sobbed and sobbed as the bark bearing her Chub passed from view—the relief was more than her overtaxed nervous system could combat.

RATING OLD PLATE GIRDER BRIDGES

By E. Feldman, B.C.E., Instructor Civil Engineering

The necessity for rating an existing structure will seem strange to the young engineer as he cannot understand how it is possible for any bridge to be in use, the strength of which is not definitely known. Nevertheless such is the case, especially in the Eastern half of the country, where many bridges designed originally for a loading equivalent to Coopers E-35 or 40 * are carrying E-50 and 55 at sixty miles per hour with a doubtful degree of safety.

These conditions are an inheritance from the pioneer days of railroad construction in America, especially those days when railroad speculation was rampant. During that time many short lines were built connecting points of only local importance, usually from fifty to one hundred miles apart. It was the plan of the promoters to build these roads as cheaply as possible, unload the stock on innocent investors (usually the owners of the property through which the road ran), and then quietly withdraw before the crash came. These disjointed roads struggled along as best they could, rarely paying dividends, and with the evolution of the trunk lines were gradually absorbed into the larger systems.

It is not to be expected that records and other data pertaining to such speculative enterprises would be kept in a very satisfactory manner, remembering that this was long before the days of the Interstate Commerce Commission, and other regulating bodies. And thus when these smaller roads were taken over by the larger companies, very little information was available regarding them. This was especially true of the bridges and culverts, in many cases there being no records whatsoever. However, trains continued to operate safely over them and nothing further was done.

But with the advent of heavier locomotives and increasing speeds, these bridges have become greatly overloaded and their renewal has become a necessity. Of course these replacements cannot all be made at once, due to excessive cost, but are being made gradually, and in order to tell which bridges should first be renewed, the existing structures are rated and the weakest determined.

The problem of rating an existing structure is just the reverse of designing a new one. In one case the working unit stresses are known and the size of the members ascertained; while in the other case, the size of the members is fixed and the unit stresses resulting from the application of the external loads determined. By comparing the unit stresses induced in the structure from the application of the external forces (Live Load plus Impact) with the unit stresses permissible for the particular type of structure under consideration, we arrive at the rating

* Cooper's Conventional System of Wheel Concentrations.

of the structure, usually expressed in terms of Cooper's loadings.

The first thing then is to determine the proper value of the working stresses to be used. In arriving at the proper working stress to use for the materials of a new structure, we usually assume them to be about 50% of the elastic limit, giving a factor of safety of about 2 and making ample provision for future increases in the live load, secondary stresses and unforeseen contingencies. But in the case under discussion no increase in live load need be provided for, as the bridge is shortly to be removed, and we can therefore adopt a working stress equal to 75% of the elastic limit with the proper degree of

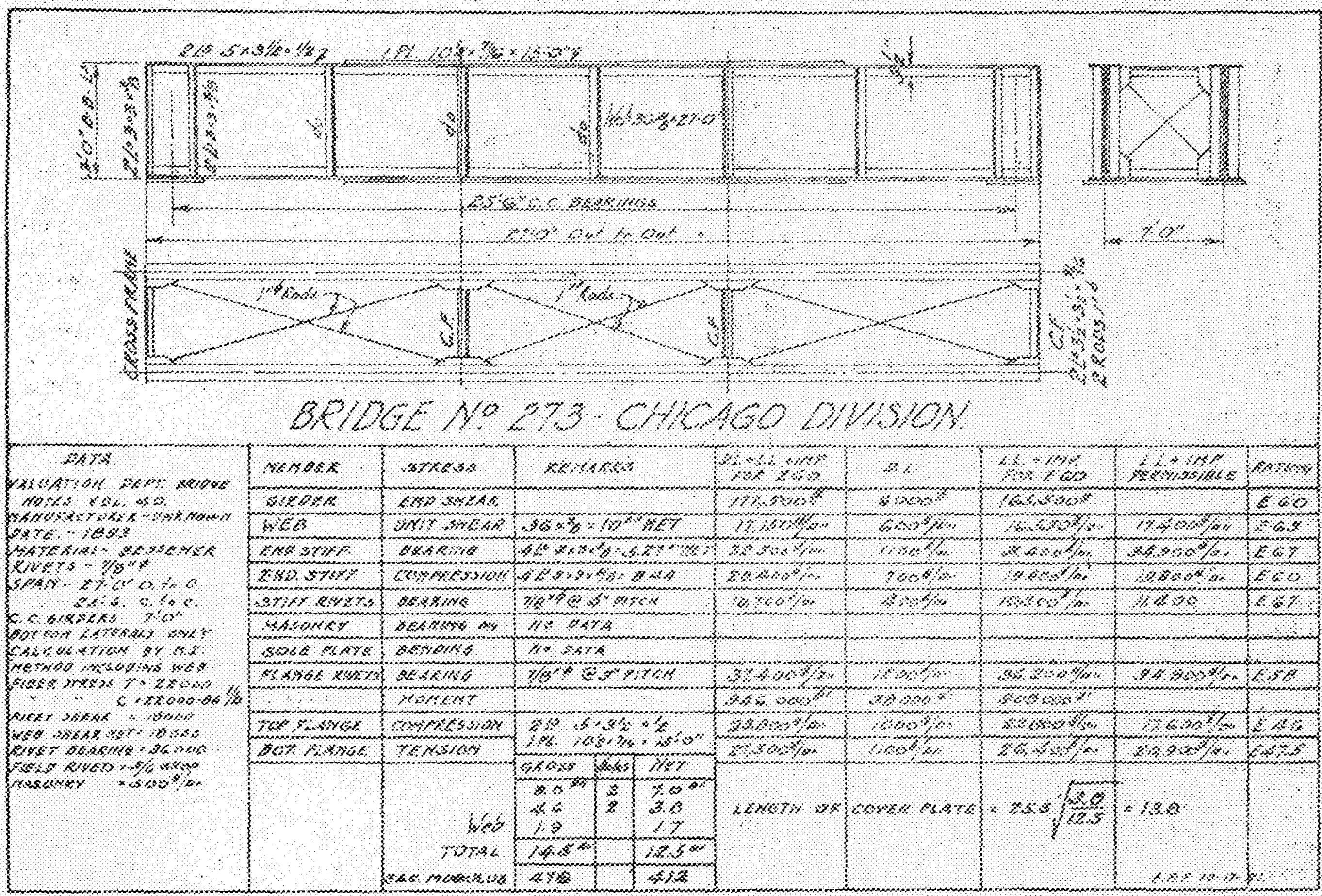
The working stresses adopted for old plate girders are given in the following table:

	O. H. Steel	Wrought Iron or Bessemer Steel
Extreme fibre stress tension	26,000 lbs. per sq. in.	22,000 lbs. per sq. in.
Extreme fibre stress compression	26,000—100 l/b	22,000—86 l/b
Shear on rivets	20,000	18,000
Average shear on net section of web	20,000	18,000
Bearing on rivets	40,000	36,000

Field rivets are considered five-sixths as effective as shop rivets.

Bearing on masonry 500 lbs./sq. in.

After the maximum allowable unit stresses have been decided upon, the next step is to ascertain the actual size of the various members of the bridge and then see if the application of the live load (usually assumed as E-60) will exceed these stresses.



safety. One of the factors most vitally affecting the adoption of a proper working stress is the determination of the material out of which the structure is made. Prior to 1890 wrought iron was used for most railroad work, but was superseded about that time by mild steel manufactured by the Bessemer process. Gradually open-hearth steel replaced Bessemer till, by 1900, it was the standard material in use. The fact that the allowable stresses for open hearth steel are from 10 to 15% higher than those for Bessemer steel or wrought iron shows the importance of having a date and name placed on every structure.

To do this a diligent search is made thru the files of the bridge engineer's office for any data pertaining to the particular bridge under consideration. Very often nothing is to be found. If the bridge in question happens to bear a name plate, the original manufacturer is consulted as to the plans and specifications under which the bridge was built. If, however, no distinguishing marks are found, recourse must be had to measurements taken in the field. It may be interesting to note, in passing, that prior to the Federal valuation there were a great many bridges on some of the largest railroads in America, about which no data whatsoever was on record in the bridge engineer's office.

The measurements taken by the valuation department or by a field party sent out for that purpose, are generally very few and very simple ones, and are as follows:

1. Bridge number. 2. Manufacturer. 3. Date of manufacture. 4. Material (usually assumed). 5. Span. 6. Center to center of girders. 7. Size of rivets. 8. Size of web. 9. Web splice if any. 10. Composition of flanges. 11. Pitch of flange rivets. 12. Size and number of end-stiffeners and number of rivets in same. 13. Intermediate stiffeners. 14. Lateral system. 15. Sole plate. 16. Bearing plate.

With this data at hand a sketch is made showing the plan, elevation and cross section of the girders, as shown in Fig. 1, which is a case taken from actual practice. The maximum moments and shears for dead load, live load and impact are then figured and tabulated as indicated. It is at once apparent that the permissible live load plus impact unit stresses are equal to the maximum allowable unit stresses, as given in a previous tabulation, minus the dead load unit stresses. A comparison between the permissible unit stresses and those produced by live load plus impact for E-60 will give the rating in terms of Cooper's loadings.

The method of arriving at the various figures is almost self explanatory, but a few additional comments may not be amiss. The calculations naturally divide themselves into two parts, one dealing with the shear and the other with the moment. From the maximum end shear we find the strees in the web, end stiffeners, sole plate, flange rivets and bearing on masonry; while from the maximum moment we find the extreme fiber stresses in the flanges.

The unit stress in the web is the quotient of the end shear divided by the net web area.

The stress in the end stiffeners in bearing on the lower flange angles is equal to the shear divided by the net bearing area of the stiffeners which is usually assumed as the area of the outstanding legs plus 25% of the area bearing on the flange angle fillets.

The axial compression on the end stiffeners is found by assuming them to be columns whose length is equal to one-half the effective depth of the girder.

The sole plate should be figured for bending, assuming that it is a cantilever beam uniformly loaded. The bearing on masonry needs no comment.

The stress in the flange rivets is expressed by the formula:

$$\frac{V.p\,A_F}{h\,A\,t\,d}$$

in which V=shear at point in question; p=rivet pitch; AF=area of flange angles; h=effective depth of girder; A=total flange area, i.e. area angles plus 1/6 net area of web; t=thickness of web; d=diameter of rivet; and r= stress per rivet. Of course, this value of r should be combined with the stress due to the local vertical shear produced by a wheel concentration immediately above the point in question, but this later will increase the resultant rivet stress by so small an amount that it is usually neglected. In figuring rivets at the quarter and center point the shear is assumed to be ⅝ and 2/7 of the maximum end shear respectively. The possibility that double shear will govern the stress in the flange rivets is very remote.

The stress in the stiffener rivets is then determined by dividing the end shear by the number of rivets in the stiffener angles, excluding those passing through the flanges, as these have already been stressed to the limit, due to horizontal shear. Do not think, however, that by placing sufficient rivets in the end stiffeners, exclusive of those passing through the flange angles, to take care of the end shear, that the rivets passing through the end stiffeners and flanges can be prevented from taking a part of the end shear. The overstressing of these rivets is an unavoidable evil and can at best be minimized by making the flange rivet pitch at the end as small as possible, and by using a thicker web. It is also true that these flange rivets receive no increment of stress due to a wheel concentration vertically above them as such loads are transferred from the ties to the top flanges and from the flanges directly into the end stiffeners without passing through the web, provided, of course, that the end stiffeners have been milled to bear on the flange angles.

The flanges are rated from the maximum moment calculation assuming 1/6 the net section of the web as effective flange area, provided there is no web splice. It is very rare on old bridges that a web is properly spliced for moment and consequently the web area is usually neglected in figuring the flange stress when a splice exists. The flange stresses are equal to the maximum moment divided by the section modulus in tension and compression respectively. These section moduli are very closely equal to the area of the flanges times the effective depth squared, divided by the distance back to back of cover plates.

The only remaining thing to do is to see that the cover plates are of sufficient length, which is quickly done by use of the parabolic formula:

in which L_1=length of cover plate; L=span; a=area of cover plate; A=area of flange.

TO A DISCARDED RAZOR BLADE

Keen was thy edge, well fashioned for its task,
And bright the sheen of polished steel;
Nor, didst thou hesitate, as from the mask
Thou stripped the creamy coating, to reveal
A countenance benign and real.
Each day thy humble duty thou fulfilled,
Forgetful that thou mightst have been
Part of the powerful girder that was willed
To span the flowing river; or within
A mainspring, delicate, refined and thin.
Gone, now, the keenness from thy edge,
An oxide dulls the sheen of former days.
Thy usefulness has passed. Upon that ledge
You rest a few brief hours. The changing ways
Of man consign you to an unknown maze.
E'en so, in human effort, we must meet
With keenest mind and brightest intellect
The duties laid upon us. All too fleet
The few short days. Too soon collect
The oxides, and our usefulness is checked.
But We, like thou, must give our best,
Unmindful of the brilliant things that lure.
To conquer, bravely, small things is the test
That proves our metal worthy to endure
And fits us for a happiness more sure.

—J. B. C.

THE UNIVERSITY HEATING PLANT

By Clarence E. Hoar, B.S. '23

In writing this article on the University heating plant it is not the writer's aim to consider the technical side of this interesting but little known feature of the campus, rather to give a description of the power plant and tunnel system which will interest those who have had no technical training in heating problems.

The plant is located on the Mississippi River bank below the Law College. The average individual wonders, perhaps, why the plant is located so far from a central position. The main reason is that this location saves the campus all the muss and dirt usually accompanying a power plant. The ashes are dumped into the river and thus economically disposed of. The coal is brought in on the railroad without cluttering up the campus. Furthermore the smoke and soot is not offensive as would be the case with a centrally located plant.

So much for the location. In the plant itself there are eight fire-tube boilers that furnish steam to the high pressure heating system. Last winter only five of these were used, while the sixth was kept with fires banked for emergency use. These boilers run at 480 to 490 H. P. each. The coal is weighed and recorded in three hundred-pound lots, and then dumped upon the automatic chain grate stokers. As much as one hundred tons of coal have been used in one day during the extremely cold weather. The plant is operated in eight hour shifts. Each furnace registers its delivery, so that the men in charge know what it is doing. The steam is delivered into the mains at 95 to 100 pounds pressure.

There are many students at Minnesota who do not realize that there is a system of eight foot tunnels from ninety to a hundred feet below the surface of the campus, in which are the steam mains to the different buildings. The main tunnel which leaves the plant, divides near the Psychology Building, one part going east to the Engineering Buildings and the other branch turning off toward the Chemistry Building and the University Hospital. These tunnels were dug through the Platville limestone and were left without lining. The heat from the lines, however, caused the limestone to harden and break off in large chunks which was extremely dangerous for the system as well as for the men who maintained the heating lines. Prof. Martenis tells of a narrow escape that a class of his had when a large part of the roof fell while they were inspecting the lines. Since that time the tunnels have been lined with brick.

The tunnel is horseshoe shape with the flat part down, and is eight feet high and six feet wide in the narrowest part. The main tunnel at the power plant enters the cliff at a point about 110 feet below the surface. It rises one-half inch in every twenty feet so that gravity may be used to return the condensate. The first vertical shaft is at the ore-testing laboratory. There are ladders in the shafts so that the tunnel may be entered from the surface. The second shaft is between the Mechanical Engineering Building and the tennis courts. Throughout the tunnel seepage of surface water has caused considerable trouble, this however has been lessened by the brick lining. On account of the depth of the system, radiation from the steam lines is reduced to a minimum.

The tunnel contains the various pipe lines leading to the different buildings, and the return lines for the condensate. The main heating line is an eight-inch heavily insulated wrought iron pipe which rests on flexible supports so that the expansion and contraction will not cause the joints to open up. The expansion was not properly taken care of when the line was first put into operation and as a result several joints broke down. The main line carries a pressure of 95 to 100 pounds, this is reduced at the buidings so that the radiator lines carry only a few pounds pressure. For various reasons the high pressure system is adapted to long distance heat transmission. Besides the main heating line there is an eight-inch auxiliary main, a fourteen-inch water main, a three-inch vacuum line, and the condensate return line. The condensate is taken from the storage tank by the boiler feed pumps and returned to the boilers. Electric lights are located every hundred feet in the tunnels and at the shafts, thus enabling the workmen to discover leaks and make repairs.

Any student who so desires will find a trip through this underground part of the campus very interesting as well as instructive.

VIBROLITHIC CONCRETE

By J. C. Worrell, Instructor in Highways and Pavements.

The Highway Department of the state of Minnesota is laying an experimental pavement near St. Cloud with Vibro Lithic concrete. This is something new in hard surfacing and the method has been patented by R. C. Stubbs of Dallas, Texas. To the ordinary observer not acquainted with the different kinds of hard surfaces for road building, he would probably say that it is simply a concrete pavement. The materials used are the same as the standard one course concrete pavement, but the method of laying is more like a two course concrete, and the latter is the ground on which Mr. Stubbs obtained his patent.

This experimental pavement is to be about one-half mile long and will be divided into 100 feet sections of concrete containing different proportions of cement, sand, and crushed stone in what may be called the first course. Sections are also to be laid using different mixes, some with reinforcing and some without. The second or top course contains St. Cloud red granite and is spread on over the first course in the proportion of about 1 cubic yard to 50 square yards of surface.

The sand and crushed stone for the first course is loaded into two-batch trucks at the proportioning plant and hauled to the mixer on the road site. One batch is dumped into the skip and the truck pulls up a few feet while the skip is being raised and emptied into mixer. After remaining in the mixer for one minute, the mixed concrete is discharged upon the subgrade and leveled approximately to grade by men with shovels. A Lakewood tamper strikes off the concrete to grade and tamps it once. Up to this point the method is the same as that for laying a one course concrete pavement, except that the consistency of the concrete is probably a little more dry. In order to make the second course successful, it is necessary to make each batch as nearly as possible of the same consistency.

Men spread crushed stone over the surface with shovels after it is tamped once with the Lakewood. Stone is required to pass a 2½-inch screen and be retained on a 1-inch screen. As stated before, one cubic yard of this crushed stone is supposed to cover 50 square yards of surface. A mat about 14 feet long and 2 feet wide is then laid on the stone and a Vibro-Motor settles the mat on the crushed stone and the stone is worked into the mortar. The mat is made of narrow boards about 1½ inches wide and spaced about ¼ inch apart so that mortar works up between the boards. The Vibro-Motor is a small upright gas engine mounted on four wheels about 6 inches in diameter. The balance wheel of the engine is hung a little off center so that a vibrating motion is produced. This engine shakes the mats as it runs over them and forces stone into mortar. The mats are then removed and the surface given a smooth finish, first with a wood float, and next with an 8-inch canvas belt. Both

Vibro-motor in use

the wood float and belt reach over the side forms at either side of the paved portion of the roadway.

For the purpose of determining later how far the top layer of stone goes into the concrete, a grey granite is used in the base and a red granite on top. At some future date the core machine will take samples from this pavement which will show the depth of the top layer of stone, and will give an opportunity to study the density of the concrete.

The advantages of this pavement are not easily stated at this time, but it is thought that the concrete will be denser, will have better wearing surface, and that it will cost less in parts of the country where it is hard to get a suitable stone for a wearing surface. It is somewhat of a problem in Minnesota as well as in other states to find a stone suitable for one course concrete pavement, as all the crushed stone in the concrete must be such that it will make a good wearing surface. With the Vibrolithic type of pavement a poorer grade of stone or gravel can be used for the base, and stone which will give a good wearing surface can be used for the top. Gravel suitable for base is usually easily obtained, and on account of the length of haul and expense of crushing the stone, the gravel is the cheaper, so, for some localities, the Vibrolithic concrete may be cheaper than the ordinary one course concrete. It seems certain that the expense of laying is more expensive than the one course concrete and may not be the success that it appears to be at this time. The building of hard surface roads is still in the experimental stage and it is possible that this type may prove to be one of the standards which will be used in many parts of the United States.

The Vibrolithic concrete pavement just described is being constructed by the McCree, Moos Company of St. Paul. Mr. F. C. Lang of the University of Minnesota is superintending the work for the state, and Mr. J. S. Geren of the Northern Vibrolithic Company of Des Moines, Iowa.

THE CARIBOU POWER PROJECT

On the third of October a very interesting illustrated lecture on the "Caribou Water Power Project" was given both morning and afternoon in the Engineering Auditorium, by Mr. A. A. Northrup, who represents the Stone and Webster Company of Boston. During the lecture, motion pictures were shown of the camp life, the project, and the principal features of the construction work. Mr. Northrup is traveling from college to college giving this lecture on the project to engineering students. The pictures have been made for the engineering colleges of the country by Mr. Stone and Mr. Webster who are very much interested in engineering education.

The Caribou project uses the water power of the Feather River and is located two hundred miles north of San Francisco in the Sierra Nevada mountains of California. The Feather River has been diverted into a large natural reservoir formed by the mountains, and from this reservoir the water flows through a tunnel back into the old bed of the river, where another reservoir has been formed by damming the river. A second tunnel leads the water from this reservoir to a point just above the power-house where, after an almost perpendicular drop of eleven hundred feet, it strikes the water wheels. This last eleven hundred foot drop completes the nineteen hundred foot drop from the first reservoir to the water wheels. The plant at present contains three reaction wheels all of which are directly connected to generators which develop sixty thousands horse-power, while total power expected to be developed is ninety thousand horse-power. The power developed at this plant is transmitted to San Francisco and neighboring coast cities.

The lecture was not only very interesting but also was very clearly and thoroughly explained. The students who attended it were very glad to have the opportunity to hear such a lecture and are very grateful to Mr. Stone and Mr. Webster for the consideration they have shown and the expense to which they have gone to make this possible.

SHE KNEW

"My dear," called a wife to her husband who was in the next room, "what are you opening that can with?"

"Why," he said, "with a can opener. What did you suppose?"

"Well," replied his wife, "I thought from your remarks you were about to open it with prayer."

MINNESOTA TECHNO-LOG

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EDITORIAL

The Minnesota Techno-Log is entering upon the second year of its existence with a strengthened determination to further the purposes which justified its establishment. The cooperation and encouragement received during its first year of activity from the student, faculty, and alumni bodies can only be indicative of the legitimate field which the Colleges of Engineering, Architecture, and Chemistry of the University of Minnesota offer to such a publication. The Techno-Log will aim to be of mutual interest and assistance, not only to those in direct connection with the engineering colleges, but also to its large alumni body. Students and faculty in the various departments have much in common to share with one another and much which is peculiar to each group but of interest to all. Throughout the world are scattered the alumni of the school. Engaged in engineering construction and research work they are continually encountering new experiences and making new discoveries. For them the Techno-Log offers a reliable way of keeping in touch with their college and its progress, while their contributions will be of absorbing interest to their classmates, as well as the undergraduate. The staff of the Techno-Log feel that the need of a purely technical magazine is well met by various professional journals. It shall be their policy not only to publish articles of technical interest but also articles on the many phases of school life and administration of vital interest to the student, faculty member and alumnus. Above all it is the desire of the staff to maintain a high literary standard and publish a magazine readable by the lower classman as well as the experienced, technically trained man.

With the publishing of the first issue of the Techno-Log by the new staff, there comes the realization that credit is due those who last year so effectively worked together in the formation of our "Minnesota magazine for Minnesota Engineers." Theirs has been no easy task. They had to assume the responsibility of justifying the existence of the paper by producing a magazine which because of its quality would demand attention—THEY SUCCEEDED.

Credit is due Martin F. Wichman, the first managing editor, who put out the initial issue practically single handed. This beginning number set a standard that was faithfully maintained throughout the year. To edit a paper of this type meant an expenditure of time, and labor, which only one who has been closely connected with a publication of this kind can appreciate. Even though his school work suffered, Wichman made sure that the current Techno-Log was what it should be.

When the pressure of other duties made it possible for Wichman to continue actively as managing editor, that position was filled by Carlos W. del Plaine. Though already a busy man, del Plaine took time to adopt the Techno-Log for his "hobby," as he calls it, and under his direction its existence was justified. Each succeeding issue brought favorable comment from the publications of other schools, particularly engineering institutions. Under del Plaine's management, the business and advertising departments were put on a substantial basis. Although, this year he has taken an advisory position on the staff, he still has an active interest in the Techno-Log.

To these men and also to the others who have so loyally worked to make the Techno-Log what it is, are accorded the sincere thanks and appreciation of the Association of Engineering Students and the Minnesota engineers of all time.

Your attention is called to the article of the functions of the Student Council of the College of Engineering, appearing in this issue.

ELECTROGRAPHS

In all the world there were only 778 telephones in use 43 years ago, it is said. There were 12,000,000 in the United States alone in 1919.

Since the armistice, 1,017 kilometers of the 1,036 kilometers of canals in France destroyed during the war have been rebuilt, and of the 1,120 locks, culverts, etc., destroyed 890 have been rebuilt. It is proposed to electrify all French canals which carry more than 2,000,000 tons of freight annually, which will mean, it is estimated, a saving of about 1,500,000 tons of coal per year.

Switzerland has adopted a standard voltage for electric circuits.

In 1919 there were 200,000 farm lighting plants in use. Now, it is said, there are 340,000.

A French scientist has devised an apparatus for utilizing the flow of water through the water pipes of his home to generate electricity. A water motor is used to operate a generator, and the electricity is fed to a storage battery.

According to recently published data, 92.6 per cent of American farmhouses are equipped with telephones, 27.1 are electrically lighted, 21 per cent have vacuum cleaners and 16.2 per cent have washing machines.

There are more than 900,000 telephones in New York City, served from 101 central stations.

Two new wireless stations have been established at Helsingfors, Finland, which will provide radio communication with all central Europe. Heretofore, Finland has had but one 3-kw. wireless station, the range of which did not extend much beyond Copenhagen, Denmark.

Seventy million electric automobile lamps are sold annually for renewals alone.

OBITUARY

PAUL C. KOOB

Death has taken from us our fellow student and former member of the staff, Paul C. Koob, of the class of 1922.

On Monday, October 10th, Paul was taken sick; on Tuesday, October 11th, he was taken to the University Dispensary where his condition gradually grew worse and on Saturday morning, October 15th, at 8 A. M. he died.

He attended the schools at Windom, Minn., and came to the University in the fall of 1918. He registered in the course of civil engineering and would have received a degree of Bachelor of Science in the spring of next year. Last year he was actively connected with the Techno-Log as Civil Editor. He was a member of Theta Xi fraternity and always a willing worker and supporter of activities in the Engineering College.

His pleasing personality and his sterling qualities as a student had earned our profound respect; his sudden death has created in us a feeling of regret and a realization of a loss.

THE FUNCTION OF THE STUDENT COUNCIL OF THE COLLEGE OF ENGINEERING

The students comprising the active body today know little of the history of the Student Self-Government Association of the College of Engineering. The Association was consolidated by a group of students and a ballot printed and submitted for election on May 20, 1915. The ballot was passed so that today the Association is functioning under the guidance of the Constitution voted on at that time. Below is a copy of the Constitution as passed at the above election.

CONSTITUTION
of the
Student Self-Government Association
of the
College of Engineering of the University of Minnesota

Art. I. NAME—The name of this organization shall be the Student Self-Goverament Association of the College of Engineering of the University of Minnesota.

Art. II. PURPOSE—The purpose of the Association is to promote the highest efficiency and best ideals in the College of Engineering, and to enable the students of the various departments to act as a unit in all matters concerning the general welfare and advancement of the College, and of the University.

Art. III. MEMBERSHIP—All students registered in the College of Engineering shall be active members of the Association.

Art. IV. GOVERNMENT—Sec. 1. The Government of the Association shall be vested in the Student Council.

Sec. 2. The duties and powers of the Council shall be:

(a) To control and regulate all student elections held in the College of Engineering.

(b) To call at any time, and for any purpose that it deems fit, a meeting of any or all of the students in the College.

(c) To raise funds necessary for the carrying out of its purposes.

(d) To afford a medium for the exchange of opinion between the student body and the Faculty.

(e) To exercise general supervision over student affairs.

(f) To collaborate with the All-University Council for the welfare of the University.

(g) To act on all matters which may come before the College and require settlement by an unprejudiced and representative body of students.

Sec. 3. The Council shall consist of nine members: one senior from each of the Civil, Mechanical, Electrical, and Architectural Departments, two juniors, one sophomore, one post-senior, and the Engineering Representative to the All-University Council, who shall be an ex-officio member without a vote: Provided, that from the time of election of new members until the end of the current college year, the Council shall have four additional members, the members of the existing senior class holding office until the end of the college year; and provided further that the classes of the newly elected members are nominally those of the succeeding college year.

Sec. 4. The annual election shall be held in the month of May on a date to be determined by the Council. Nominations shall be made, by the several class organizations, and two nominees shall be presented for each membership to be filled. The method of class nominations shall be determined by the Council. From these nominees, one junior from each of the Civil, Mechanical, Electrical and Architectural Departments, one senior, two sophomores, and one freshman shall be elected by their respective classes at a general election.

Sec. 5. Within five days after the general election the newly constituted Council will meet on the call of the outgoing President and elect officers as follows: President, Vice-President, Secretary, and Treasurer. The respective officers shall perform such duties as are customary.

Sec. 6. Regular meetings shall be held twice a month. Special meetings may be called by the President on his own initiative and shall be called at the written request of three members of the Council.

Sec. 7. A quorum necessary for the transaction of business shall consist of a majority of the voting members of the Council.

Art. V. Vacancies in the Council shall be filled by the remaining members of the Council.

Art. VI. AMENDMENTS—Amendments to this Constitution must be adopted at a general election by a majority of the total number of members of the Association voting.

Art. VII. The Constitution of the Self-Government Association of the College of Engineering of the University of Minnesota must be ratified by two-thirds of the students registered in the College of Engineering at the time of the election, before it shall become effective.

The present council will report its activities to date in the issues of the Techno-Log. Also, it hopes to bring matters of importance before the student body by the use of placards and through the Daily. At a recent meeting of the council the date book system for the arrangement of social and business meetings for organizations in this college was provided for. The organizations will benefit by its use by not having conflicting dates which cause failure to one of the two or both organizations' meetings. The council is organized to help the students or organizations and the students are urged to take advantage of the possibilities that the council affords them.

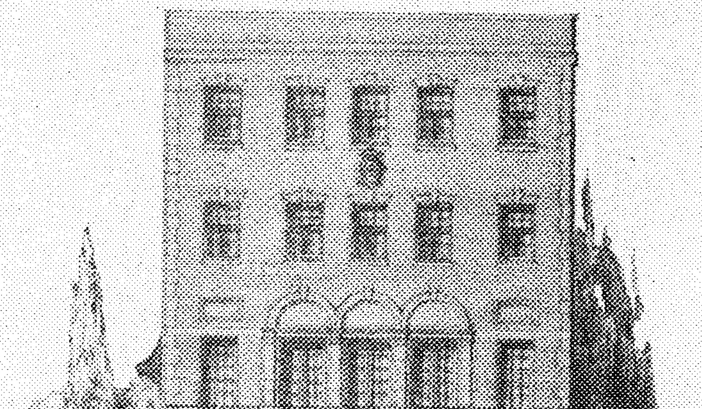
THE NEW DELTA TAU DELTA FRATERNITY HOUSE

by R. W. Hammett, Associate Arch.

Speaking of style in Architectural Design, several people have asked just what style the Delta Tau Delta house is going to be. This is, you know, a period of period design in all things such as furniture, millinery, architecture, automobiles, etc.; and speaking of architecture, we have such styles as New England Colonial, English, Dutch Colonial, Adam Style, Tudor, etc. Therefore, when it comes to the style of this particular house, I suppose it is quite necessary that we give some classification to it. To begin with, however, I might say that the designer in evolving the plans, gave little thought to style until he had satisfied himself by his scheme with the requirements of a house to fit the uses of this particular fraternity; fit and look well in this particular location; and typify in its very expression of exterior, as well as interior design, a city clubhouse for a college fraternity. The style is quite typically Eastern Colonial city house architecture, to some extent similar to that of Philadelphia and Fifth Avenue, New York, and could be classified as Adam Colonial if that pleases you better.

The main entrance of the house has been placed as a grade entrance at the side. In this way we are lead quite directly either to the ground floor, wherein has been placed a large coat and wash room, or to the main floor, the recreational rooms. Also located on the ground floor is the dining room, and kitchen service, boiler room, and rather obscurely located, a large chapter room. This room which is lighted and ventilated only by artificial means will be seen and used only by the members themselves, and entered only through a small rather secret vestibule. The room is to be supplied with a small fireproof vault for all fraternity records so that this particular part of the house is to be a unit in itself, the secret secorum of the fraternity apart from the other activities.

The first floor of the house is to be the recreational center. Here is the large lounge room with its full length french windows opening through a large alcove directly onto the terrace. This room is supplied with a stone face fireplace and in all will carry out the club-like atmosphere very well. Adjoining this room is an equally large game room to be supplied with card and billiard tables and typically the play room of the house. Here also is a fireplace, on axis, brick in design, masculine in character and embodying features such as a small brick pipe shelf, and roughly hewn mantel shelf. The

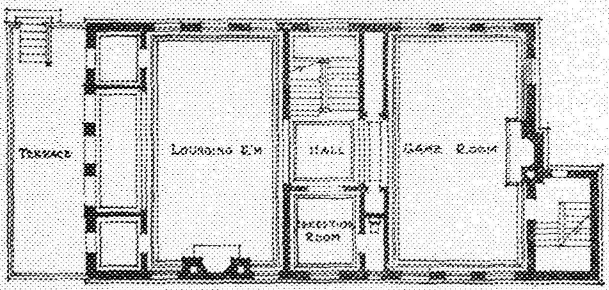


whole treatment of this floor in design will be quite simple but typically bold and masculine in its refinement; the woodwork will be roughly hewn weathered oak and will extend through the first floor from front to back. On this floor, also, immediately opposite the main entrance is a small reception room (for ladies' use in time of parties) with a small toilet adjoining, and a small telephone booth, storage closet for game tables, etc.

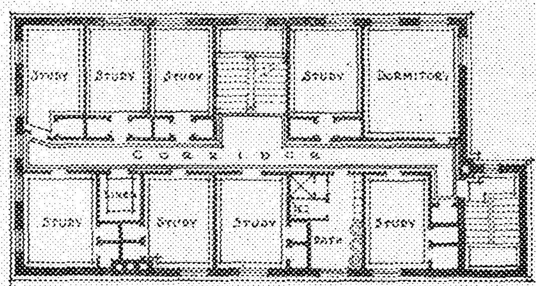
The second and third floors, for studying and sleeping purposes only, will accommodate twenty-two men without crowding. Here we have three small dormitory sleeping rooms so divided and dispursed that the men may choose for themselves either a fresh air room or a mediumly heated quarter, or at their option the study rooms have been so designed that a double decker bed may be placed in each and may be chosen as a private sleeping quarter. Each study room has been designed for two men, just large enough to conveniently suit a chiffonier, and two study tables besides the bed. Each room is supplied with two small clothes closets with shelf and clothes rod, and each room lighted not only by a center ceiling fixture, but also by a bracket light directly over the chiffonier and a desk lamp placed for each table. These two floors are supplied with large linen and bedding closets, and two very fine baths, tiled and equipped with the latest and best in plumbing supplies. Shower baths, two to each floor, take the place of tubs in a house of this kind and three lavatories to each floor give ample wash space. Another feature to the bath rooms is the locker equipment, one locker to a man wherein he is able to keep his towels and shaving supplies, separately, yet handy for his use in the room. The matron and maids' rooms with private bath are placed on the third floor in a little suite by themselves off the rear stair, which runs from ground floor to roof and is fire proof.

The architects in designing this house have worked very closely with the fraternity's representatives in the attempt to design a house just as economically as possible in disposition of room and to attain a result as perfect as possible. It might be said for F. M. Mann, Fellow in the American Institute of Architects, and architect for this particular work, that this is the fifth fraternity house that has been designed under his direction: The Acacia House of Illinois, Sigma Alpha Epsilon and Beta Houses of Texas, and the Kappa Kappa Gamma Sorority House of our own campus, and it is therefore with experience that he has tried to embody everything of convenience and fraternity character into this latest work.

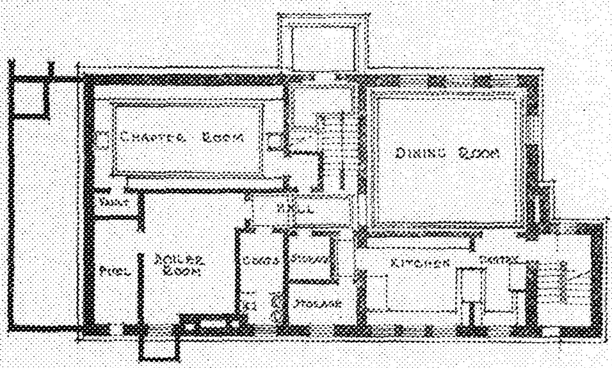
The house will be completed about January first.



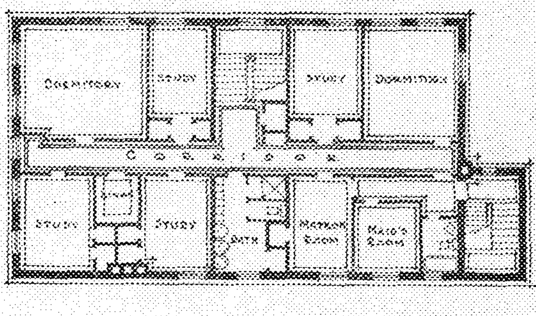
· FIRST FLOOR PLAN ·



· SECOND FLOOR PLAN ·



· BASEMENT PLAN ·



· THIRD FLOOR PLAN ·

DEAN LELAND TO GO ON BOUNDARY BOARD

The way was opened for Dean Leland of the college of engineering to join the Panama-Costa Rican boundary commission by the Board of Regents at its last meeting.

At its September meeting the board took the unprecedented action of holding up the appointment of Dean Leland because of conditions in the college of engineering and architecture which they believed required his close attention. Subsequently Dean Leland corresponded with Chief Justice Taft asking what absence from the University would be required in case his acceptance of the appointment.

Two letters from Chief Justice Taft in which he explained that Dean Leland's position on the commission would be administrative and that little absence from his post at the University would be necessary were read to the board by President Lotus D. Coffman. Chief Justice Taft declared it would not be necessary for Dean Leland to leave the United States and that the planning and other work could be done from his offices at the University.

After hearing the letters the Board of Regents approved of Dean Leland's accepting the appointment.

In the Tanana valley, Alaska, though the rainfall is very light, crops draw ample moisture from the melting of subterranean ice for the first few years after the land is first cultivated. Eventually the ice recedes to such a depth that it no longer supplies the plants with water.

Starfish are very destructive to oysters, which they devour after opening the shells by a steady strain on the valves. The injury to the oyster beds of Rhode Island caused by starfish in one year was estimated at $100,000.

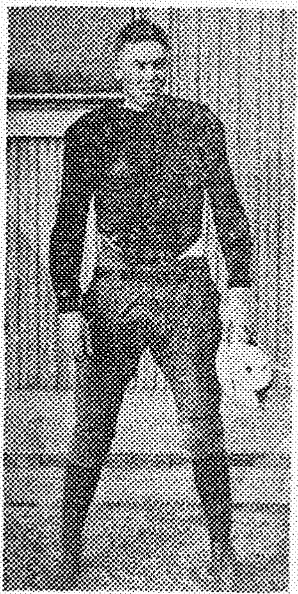
It has been calculated that dust storms in the western United States are responsible for carrying 850,000,000 tons of dust 1,440 miles every year.

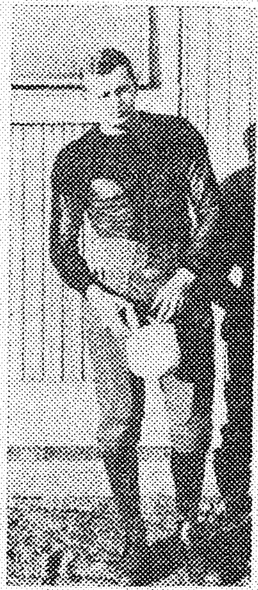
In Denver there is a mark, near the state capitol, which is just one mile above sealevel.

Dust from the Sahara desert is cometimes carried by storms as far as England and northern Germany.

College News

ENGINEERS IN FOOTBALL



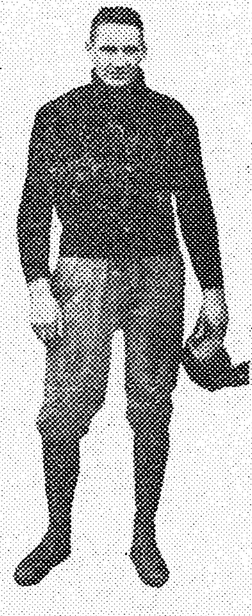


Teberg *Bailey*

Captain Laurence Teberg's stellar work at left tackle has been one of the outstanding features of Minnesota football games this fall. Big and powerfully built with the stamina to withstand any amount of punishment, Larry's desperate defense and encouraging roar to the team have gone far to bring the Gophers through a disastrous season with morale unshaken.

Filling Oss' place after he was crippled in the Northwestern game, George Bailey proved a find. His excellent line-bucking and consistent playing have earned him a regular berth at left half; the manner in which he ripped the Northwestern line to pieces especially during the first half of the game proves him a backfield man of no small caliber.

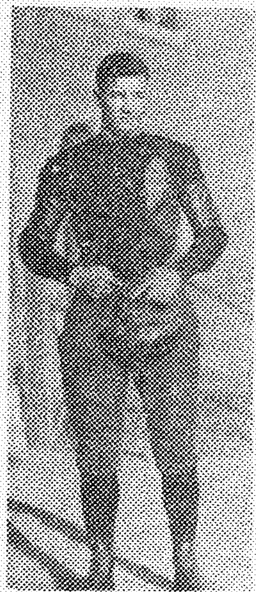
Quarterback Harry Brown has proved himself by his heady generalship, choice of plays, and judgment in handling the team to be the best all around man for his job Minnesota has seen for many moons. His ability in returning punts and hitting the line for badly needed yards is too well known to need repetition; he is one of the mainstays in our ground-gaining machine as well as a wily field general.

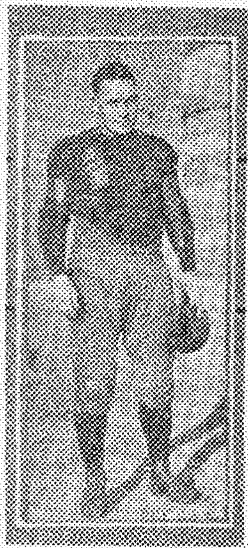


Brown *Tierney*

"Pat" Tierney, with his 195 pounds of concentrated fight, has put the fear of the Maroon and Gold into heart of more than one opposing player. His best feature is his consistency; other players may have their ups and downs, but no gain is ever made through right guard if Festus has the strength left to stop it. His superb line playing was one of the few bright spots in the terrible Wisconsin game, and so it has been in every other game, win or lose. It is of such stuff that All-Westerns and All-Americans are made.

A smashing, driving, hard hitting full back on offense and one of the hardest tacklers and best judges of plays on defense is Art Gilstad, the man who outkicked the famous Steketee in the Michigan game last year. Gilstad has a lot to learn yet, but





Gilstad *Larkin*

power and endurance coupled with his natural fighting spirit have made him a big cog in the Gopher machine.

"Gay" Larkin, sent in to plug the hole left by Tryg Johnsen when a broken rib put him out of play, surprised everyone by his ability to get down under punts and drop the runner in his tracks. Short, stocky, and firm as iron, he is a fitting understudy for Minnesota's greatest tackle.

The student branch of the A. I. E. E. held its first meeting of the year, Wednesday evening, October 19th in the main engineering Auditorium. Fifty persons were present.

Mr. A. W. Wilson gave a short talk on the "Aims and Purposes of the Student Branch of the A. I. E. E." He was followed on the program by Mr. Otto Heidelberger, who played a violin solo. Mr. Langland, B. S. '18, then spoke on "Getting Your First Job." A report of the activities and work of the summer camp of the R. O. T. C. Signal Corps at Little Silver, New Jersey, was made by J. E. Sorenson. Mr. J. E. Magnusson demonstrated "The Freaks and Fallacies of Mathematics."

At the first meeting of the Student Branch of the A. S. M. E., President Vaule outlined the plans for the coming year. The Society will give a dance in the near future. At the end of the year a banquet will be held to which the members of the National Society will be invited.

The Student Civil Engineering Society held its first meeting of the year October 10th. Previous to this year this organization had not been connected with the National Society, thus limiting to a great extent its ability to obtain worthwhile speakers and educational films. The affiliation with the A. S. C. E. is now under way however, and this difficulty will be minimized. Meetings of the society will have a two-fold purpose: first, to keep abreast with current engineering problems through lectures by prominent engineers, and second, to foster a sentiment which will bind its members together.

Paul H. P. Brinton is one of the new members of the chemistry faculty. Dr. Brinton, who is a national authority on the rare elements received his early education in Wiesbaden, Germany, at the Chemische Laboratorium Fresenius, at Trinity College and Stevens Institute of Technology. Dr. Brinton was instructor of chemistry at Minnesota from 1912 to 1916, when he received his Ph.D.; after that he went to the University of Arizona where he remained eight years as professor of analytical chemistry.

A tea-dansant given by the Student Council for freshmen chemists, was held in the new addition of the Chemistry Building on October 17. Mr. Gene Ingalls was in charge of arrangements.

FALL DESIGN AWARDS

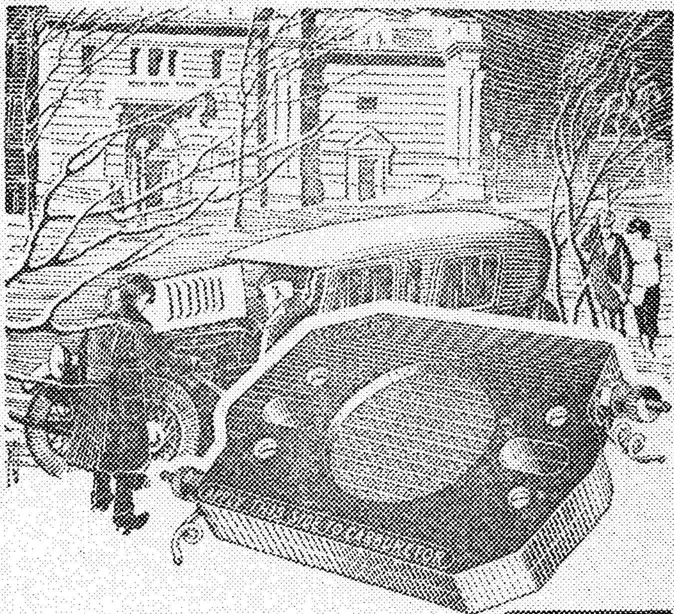
Two architectural problems have been completed and judged this fall. First the sophomores presented their first short problem, a small stone bridge, followed a week later by the juniors' dairy farm solutions.

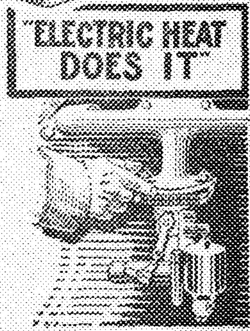
For the uninitiated, the mark of credit is given a design that satisfactorily meets all the prescribed requirements while those of mention and mention commended go to those doing more meritorious work.

Mention commended was the mark awarded Isadore W. Silverman and Edward Hawkins in the bridge problem. The former received the additional honor of "placed first."

Seven other members of the class drew mentions —Glanville Smith, Marion Petri, Herman Witte, William Wollett, Rhienhart Teige, Tressa E. Snure and Donald Harper Works. Twenty others received credits.

In the junior grade problem—the dairy farm—Edward Holien, Richard Hennessey, Elving Johnson and William Ewart Willner were given mentions while eight others drew credits.





"A stockade of Indian corn." This was the method of describing the orchestral screen at the Delta Phi's Hallowe'en dance, given in the main engineering auditorium Friday evening, October 21. The sorority is composed of coeds, enrolled in architecture and interior decorating, who exercised their artistic spirits in seasonal decorations and refreshments.

Friday night, October 14, was the date of the annual Architectural Society stag and mixer held for the incoming freshmen.

Prof. F. M. Mann was introduced first as head of the department and in a talk to the newcomers outlined the aims, policies and traditions of the department and profession. Messrs. Johnson and Hammett were also called upon for short talks.

Carl Weiss and Frank Moorman furnished the humor of the evening. Frank with an impersonation of a small boy reciting and Carl with his interpretations of Profs. Hammett and Jones. The numbers were realistic and consequently well received.

A boxing match between Lounsberry and Silverman, two reel comedy and "stag" refreshments completed the affair.

Alumni Notes

James Child, '08, is chief sanitation engineer for the Minnesota State Board of Health. His offices are in the Psychology Building of the University, much closer home than many of his class mates. He acts in a consulting and advisory capacity, helping Minnesota communities to secure pure water supply and an efficient method of sewage disposal.

O. E. Brownell, '10, is assisting Mr. Child in the Division of Sanitation of the Board.

Louis Kisor, '21, is connected with the Truscon Steel Co. Laboratories as their Minneapolis representative. He has an office in the Metropolitan Bank building.

Fred Enke, '21, is as interested in football as in the days when he played on the varsity. He is in Brookings, S. D., where he is assisting Coach West of South Dakota State College. Fred is in charge of the line.

Burt L. Newkirk, M.E. '99, of 15 Regal Avenue, Schenectady, New York, is with the General Electric Company there. His work is in the turbine engineering field.

A. B. Fruen, C.E. '09, is now in political pastures. His entrance is a marked success, for he not only secured the election of alderman of his ward, but was also chosen as president of the council. The honor is quite distinctive, too, as he was the only member on whom an agreement could be reached. Ballots were cast 177 times before Mr. Fruen was elected. An impressive political future looms up for our public spirited alumnus.

J. C. Czock, M.E. '20, is also in the East. He has been discovered at the plant of the Worthington Pump & Machinery Corporation in East Cambridge, Mass. He is doing special work on internal combustion engines there. His home is at 30 Chatham St., Cambridge.

A. C. Godward, C.E. '10 Alumnus and former member of the engineering faculty, has been recommended for city engineer by Mr. Fruen to succeed the late F. W. Cappelen. Mr. Godward is now active as engineer for the park board.

LETTER FROM DEAN LELAND

To the Alumni of Engineering, Architecture and Chemistry:

The academic year opens with about the same number of students as last year, namely, 875 in Engineering, 111 in Architecture, and 112 in Chemistry. For the first time, all of our post-seniors and other graduate students are registered in the Graduate School so that the above figures should be increased for comparison with those of last year.

Several changes have occurred in the instructing staff. Professor P. H. M. P. Brinton comes from the University of Arizona to the division of analytical chemistry. He has an enviable record in research. Among the new instructors is Mr. Victor Gauvreau, in Mechanical Engineering, an automobile designer of wide experience.

Professors Parcel, of Structural Engineering, and Burton, of Architecture, are on sabbatic leave of absence for the year. Professor Shipley, of Mechanical Engineering, was given a second year's leave of absence at the request of the trustees of Robert College, Constantinople, Turkey, where he has charge of mechanical engineering.

Professor B. L. Newkirk, of Mathematics and Mechanics, has resigned to accept a research position with the General Electric Company at Schenectady, New York. We are very sorry to lose him.

Associate Professors Cutler, Holman, and Shipley have been promoted to full professorships. Assistant Professor Dalaker has been made an associate professor. The following instructors have been promoted to assistant professors: Messrs. Lang and Lagaard (Civil), Jansky (Electrical), Robertson (Mechanical), Myers (Drawing), Herrmann, McClintock, Siler, and Wilcox (Mathematics and Mechanics), Smith (Organic Chemistry), and Ryerson (Inorganic Chemistry).

The Chemistry Building is nearly completed, although the entire equipment has not been installed. On the top floor are six new drafting rooms which are being used for freshmen. This relieves the Main Engineering Building so that the rhetoric classes which were omitted last year can be accommodated. The School of Chemistry now has the largest building on the Campus and one of the best of its kind in the country. The new laboratories will be equipped with the best types of working tables; the older equipment, which antedates the entire building, needs much reconstruction and replacement.

Preliminary studies are being made for the new Electrical Engineering building. In the summer, inspection trips were made by Professors Springer and Forsythe and myself, in which many of the best elec-

trical laboratories in the country were visited, for the purpose of securing data regarding the most desirable features of such buildings. The Board of Regents has allotted funds which will make it possible for us to go ahead with the plans. It is hoped that the building may be under construction in that department.

Temporary additions to the Mechanical Engineering Shops have been built in order to so increase the capacity as to render it unnecessary to operate the shops at night, which was the case last year.

Through a special allotment of funds for the purpose, the laboratory facilities in engineering are being increased by the purchase of modern steam and gas engines suitable for experimental work, testing machines, electric dynamometers, shop machinery, electrical equipment, and miscellaneous apparatus. This will enable us to improve the quality of instruction and to handle the increased classes of the junior and senior years.

The Department of Architecture has received a notable acquisition in a collection of original drawings purchased in France by Professor Arnal during the past summer.

On the whole, the outlook for the year is much brighter than a year ago. While the Legislature did not give us all we hoped to receive, it did afford much relief and we are endeavoring to take advantage of the increased opportunities to recover from the disastrous effects of the war period and to make real progress towards our educational ideals.

O. M. LELAND.

Arthur Baker, '18, is on the rolls of the Chicago, Milwaukee & St. Paul Railway as special apprentice. He says the meaning of the title is ambiguous to him. A man should be pleased to work for a railroad these days, transportation gratis is an inducement when football games are so far from home. Mr. Baker resides in Milwaukee, so no doubt saw the Madison game.

Saul B. Ebert, '17, stopped in on his way to Oklahoma where he will resume as an army flier. It will be remembered that he was with the air forces during the war. He is interested in observation work.

Robert Jones, '15, was married to Maud Schaffer of New York in the "little church around the corner" September 23, 1921. They will reside at Schenectady. Charles Gillen, '17, assisted at the ceremony.

G. N. Moffatt M.E. '20, and his bride spent their honeymoon this summer in Minneapolis. He is located at Lockport, N. Y. on the engineering staff of the Buffalo Forge Company.

Sam Aronson, '16 Mines, is at Butte, Montana, with the Butte Superior Mining Company.

Tresham D. Gregg, '05, of Gregg & Company, Engineers, has a reason for favoring the Volstead Act. He has lately gained fame through his successful fete of transforming a brewery into a textile mill. The Busch interests retained Mr. Gregg to effect the transformation of their Lone Star Brewery into a modern textile mill. Under his direction $1,000,000 were spent on the project. Ten thousand spindles and three hundred and seventy-five looms were installed in the short period of six months. The plant is now turning out 20,000 yards of chambray cloth a day. It is evident that congratulations are in order. Gregg & Company are located at Trenton New Jersey on Clinton Street.

L. W. McKeehan, '08, is now living at 3 Highland Place, Maplewood, New Jersey. He is doing research work for the Western Electric Company as a member of the engineering staff. Some of his classmates may as yet be unaware of his marriage to Miss Grace Badger of the class of 1917.

Arvid E. Nissen, Mines '13, and wife, who was Miss Agnes Werdenhoff, announce the birth of a daughter, Shirley Anne Fayette.

R. L. Goetzenberger, '13, of Philadelphia, was here for the alumni day festivities. He is consulting engineer for the Army Ordnance Department. His work is a continuance of mechanical and electrical researches begun by him in England, France, and Germany during the war. He says that this civilian service is more to his liking.

Henry M. Lende, '20, has won a warm spot in the editor's heart. He volunteers this information concerning himself.

"I am here as manager of a small construction company on highway work, building concrete bridges and culverts. It is a real job with real experience."

He asks that his copies of the Techno-Log be sent to Lisbon, North Dakota. We believe letters from his classmates would also be welcome at the same address.

The man whose courage and foresight gave alternating current to America, and founded the Westinghouse industries.

George Westinghouse

Thirty years ago the alternating current system was but an infant, for whose life those who believed in it were fighting daily and nightly battles; today this same system is a giant of almost inconceivable size, so capable of defending itself that no one seeks to attack it. For 95% of the electricity that is generated and transmitted today is alternating current.

The story of the development of alternating current is a story of courage and vision and faith; of misunderstanding and misrepresentation; of engineering failures and triumphs; of commercial ability and organization. It reads like a classic romance. In its chapters are credit and honor for all who have deserved it, but the central figure, the man whose motives and acts furnished the basis of the plot, was George Westinghouse, the founder of the Westinghouse Industries.

When, in 1886, he brought over from Europe the crude Gaulard and Gibbs system, even he, great as was his foresight, did not dream of the coming magnitude of the idea which he was fostering. The development work undertaken by the strong engineers whom he put to work led at first into many serious differences with those who favored direct current. Legislatures were even importuned to prevent the use of the "deadly Westinghouse Current," as many extremists described it.

That the little 50 horsepower generators of those days have grown to sizes two thousand times as large; that stations of a few horsepower have been succeeded by stations with a capacity of hundreds of thousands of horsepower, while at the same time, distribution voltages have grown from 1,000 to 220,000, is due largely to the vision and the courage of George Westinghouse, and to the qualities of the engineers whom he called, characteristically, to help him. By no means the least of the achievements of this man was his ability to organize the greatest aggregation of engineering intelligence ever known, men of analytical ability, consummate mathematicians, great inventors; and to promote in this great group the most harmonious and intelligent co-operation.

The same energy and courage and purpose that forced the acceptance of the air brake, the modern systems for the economic and safe distribution of natural gas, and later of the steam turbine, led and won the fight for alternating current, which has grown to be one of the world's greatest and most necessary commodities.

Westinghouse

WESTINGHOUSE ELECTRIC

MINNESOTA TECHNO-LOG

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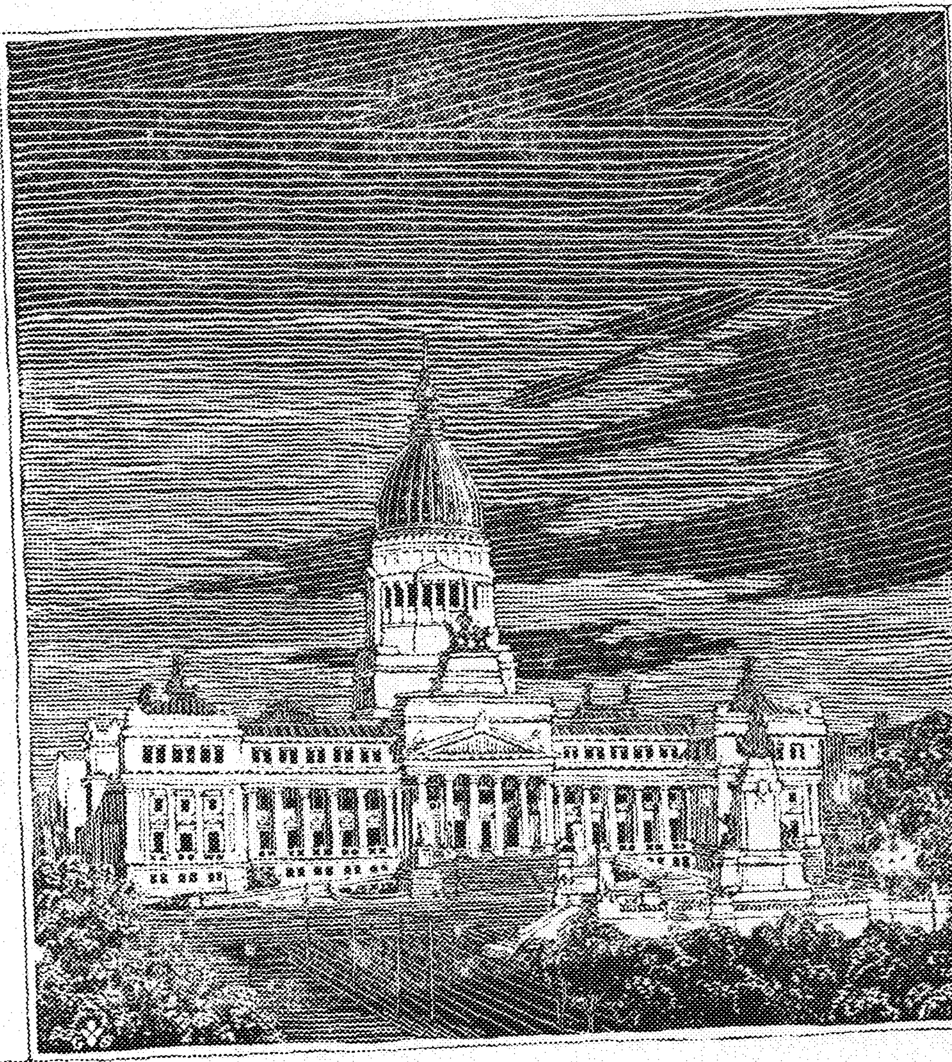
IN THIS ISSUE

Published monthly during the school year
by the students of
The College of Engineering and Architecture and the School of Chemistry
University of Minnesota



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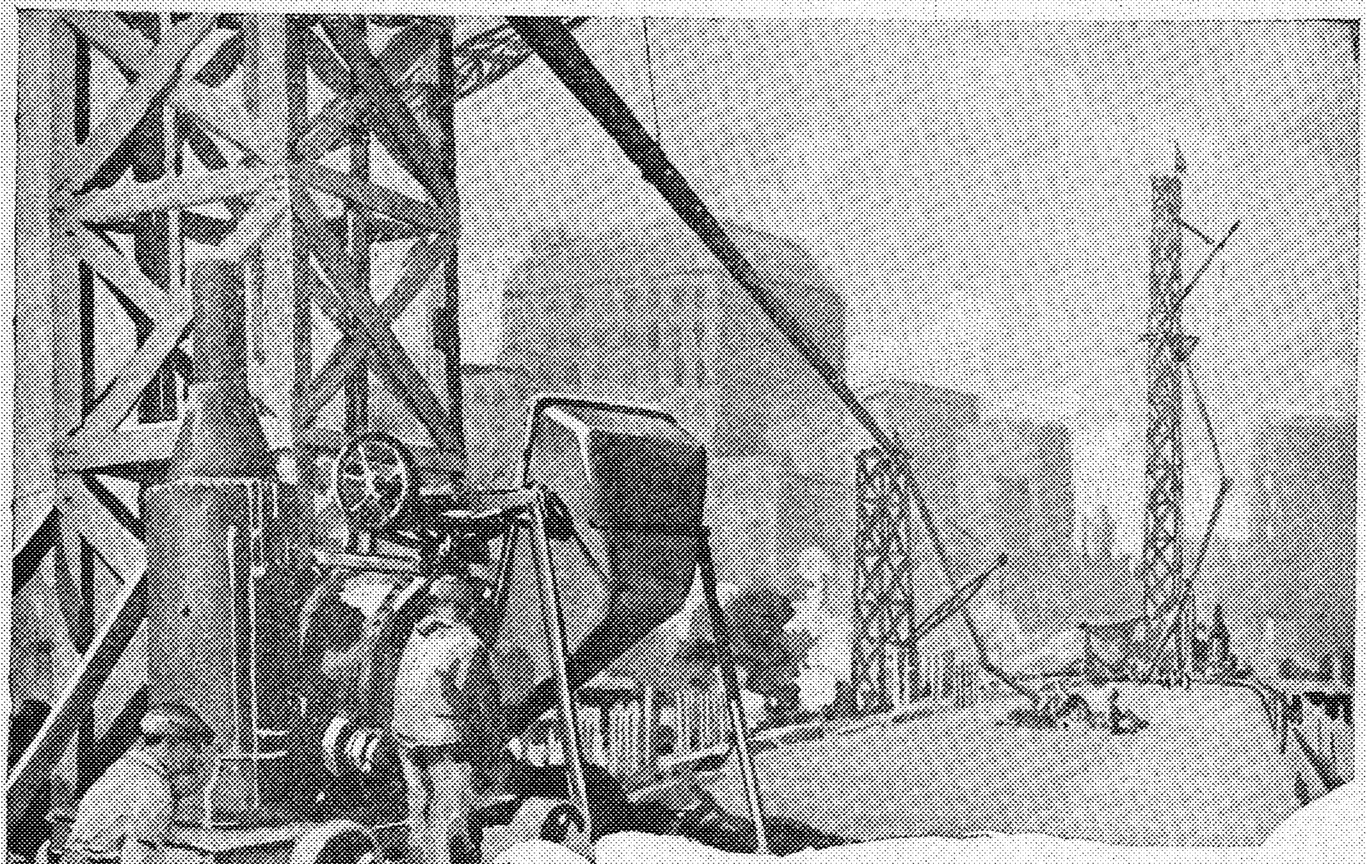

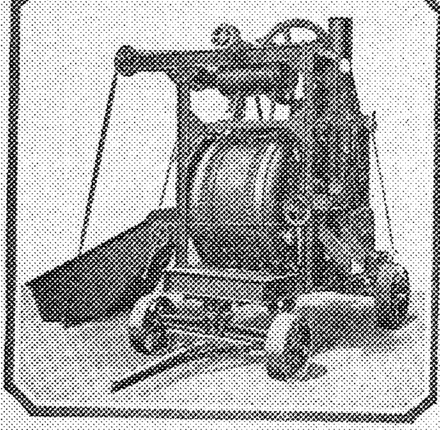

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University of Minnesota Branch of American Association of Mechanical Engineers.—Pres., S. A. Vaule; Vice-Pres., E. S. Mikesh; Treas., E. A. Nordstrom; Sec., Floyd E. Copeland.

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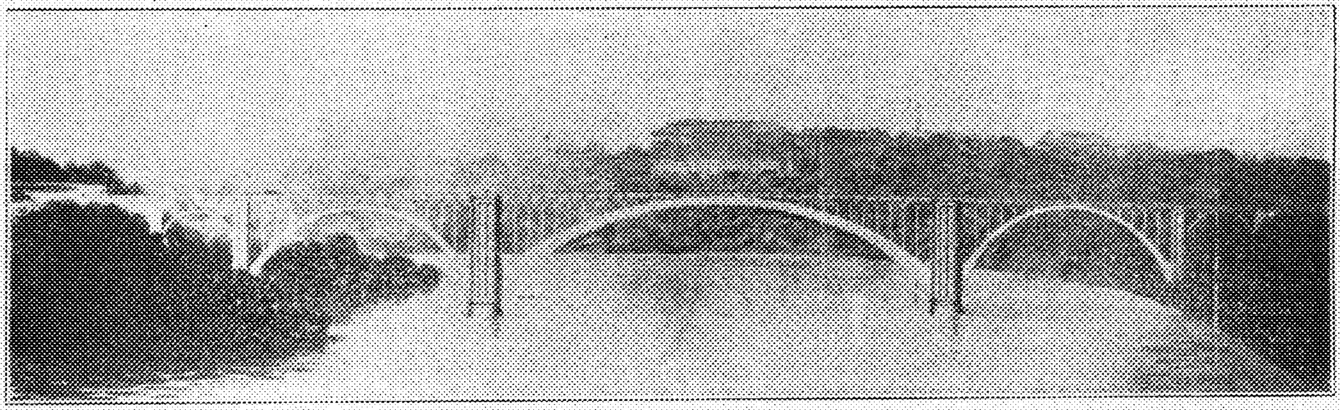
Architectural Society.—Pres., W. E. Willner; Vice-Pres., Paul Damberg; Sec., Edward Holien; Treas., John A. Walquist.

University of Minnesota Society of Civil Engineers.—Pres., C. L. Swanson; Sec., Nels Johnson; Treas., John Morrison.



CAPPELEN MEMORIAL BRIDGE

By O. H. Hosmer, '23

THE NEW FRANKLIN AVENUE BRIDGE

The four hundred foot concrete arch constituting the main portion of the Franklin Avenue bridge will be the longest concrete arch bridge in the world. This span surpasses the Risorgimento Arch across the Tiber river at Rome by sixty-two feet. The record span of the Franklin Avenue bridge and its engineering achievement make it a noteworthy structure.

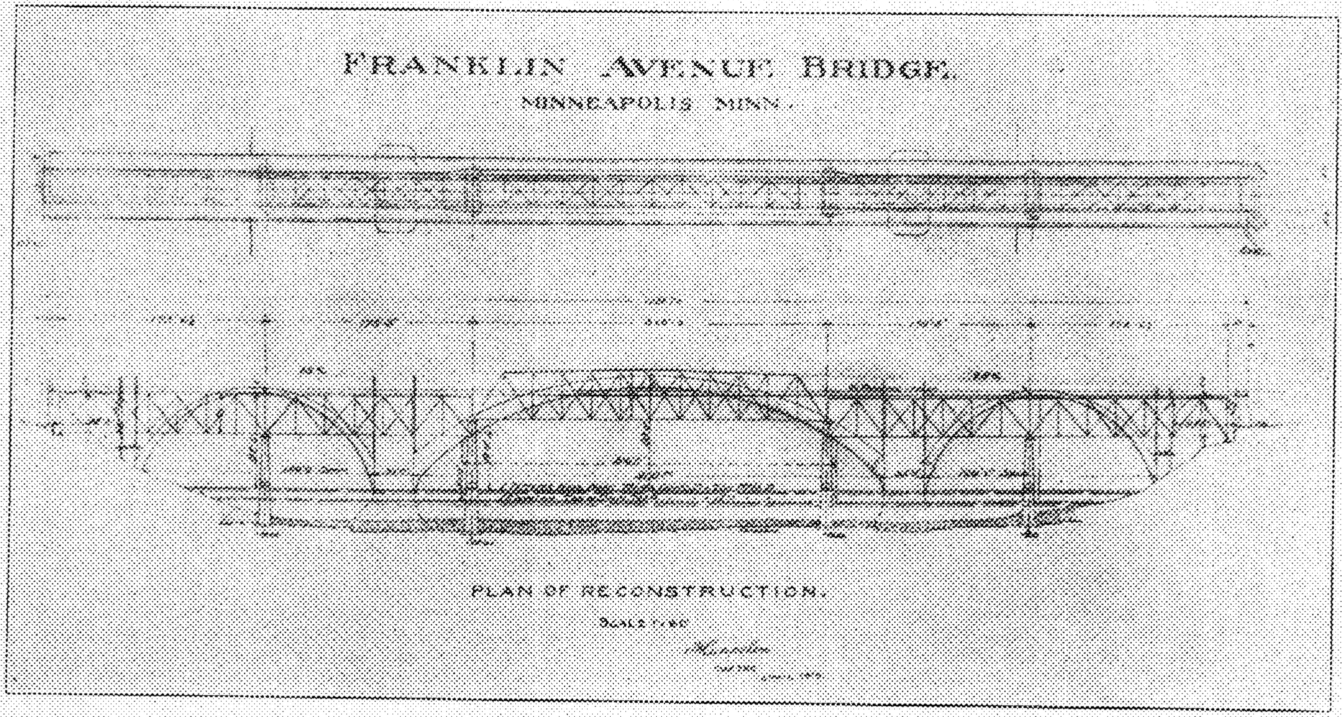
The main arch will consist of two separate ribs of 400 feet between the faces of the piers with a rise of 88 feet above the springing line. The two arches on each end, already completed, have a span of 199 feet and 55 feet 5 inches respectively, making a total length of 1011 feet 6½ inches between the shore abutments. The 400-foot span is necessary to give a channel clearance of 50 feet by 300 feet above the springing line elevation as required by the War Department for navigation purposes.

The geological conditions of the river bed at Franklin Avenue are typical of this section of the Mississippi river. Overlying the bed rock are huge boulders and a conglomerate of glacial deposit and limestone debris varying in depth from a few inches to a few feet. As the foundations for the new bridge are only 50 to 75 feet from the foundations for the old steel bridge, new shot-drill core borings were unnecessary. Sufficient holes were drilled at the time of laying the foundation for the steel bridge to determine the condition of the various strata, to make certain that the sandstone strata lay in its natural bed, and that there were no breaks or caverns beneath the top layer. The piers for the approaches are founded on solid limestone, and in a few instances on hard compact clay.

In July, 1919, the building of the cofferdam frames was begun about a half mile up the river from the bridge site, and when completed were floated into position. These frames were 80 feet up and down stream, and 64 feet wide, and divided into two compartments, 40 by 64 feet to facilitate handling. The 14-inch steel sheetpiling which surrounded the frames was driven through the conglomerate of gravel and the limestone debris into the underlaying sand rock. The boulders were removed from the foundation site before the cofferdam frames were in position, and to further expedite the work, excavation of the debris with a clamshell bucket was begun before the driving of the piling was completed. The forms for the piers, which measured 35 feet by 73 feet at the springing line and 64 feet by 80 feet at the base, were set in place after the cofferdam had been unwatered by three motor-driven centrifugal pumps. Although it was late in December before the forms were in place, the work of pouring the concrete was carried on regardless of the weather. This was accomplished by heating the water and the aggregate with steam coils, and the concrete in place by coke fires in salamanders. The temperature of the concrete mortar when poured into the forms was about 60 degrees fahrenheit.

Each rib of the main arch will be 12 feet wide with a radial thickness of 8 feet at the crown and 16 feet at the springing line, and will carry spandrel walls 14 feet 4¼ inches apart with concrete cross girders to support the concrete deck. The rib reinforcement frames for the main arch, five for each rib, will consist of 6x6x½ structural steel angles. Smaller angles were used for the arches already completed. Cantilever sidewalk beams overhanging 5 feet 3 inches cast with the spandrel walls, support the sidewalk. These beams typical in design to those of bridges of this type give a solid support and a most graceful effect.' The floor slabs over the main arch will be continuous over four spandrel walls at the crown and over two spandrel walls at the abutments.

The floor slabs and girders under the trolley



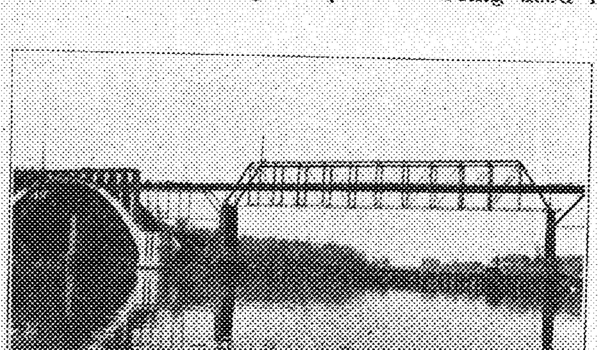
tracks are designed for 50-ton cars with 25 per cent. impact, and under the remainder of the roadway for 150 pounds per square foot, or an axle load of 40,000 pounds, with 25 per cent. impact.

For slab and girder design the permissible stresses in the concrete are 650 pounds per square inch for compression, and 16,000 pounds per square inch tension in the steel; for arches, 600 pounds per square inch for compression in the concrete which includes temperature stresses for a total range of 75 degrees fahrenheit. The sidewalks are designed for a load of 125 pounds per square foot.

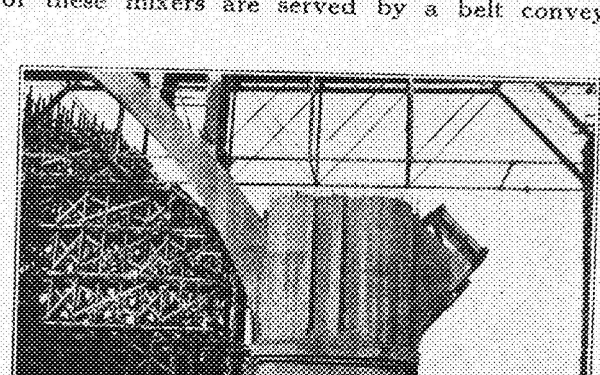
Each rib of the center span when complete will contain approximately 2,000 cubic yards of concrete, and each rib of the approach spans contain 1,450 cubic yards and 95 cubic yards respectfully. The 199-foot span was poured in three operations, each requiring about 10 to 12 hours. Each rib was divided into five sections. The crown section of the span was poured first, the haunches next, and last the key section completing the span.

The old steel bridge in place is being used for traffic as well as construction purposes. Its roadway is 18 feet wide, so that by removal of the sidewalks the concrete ribs which are 25 feet apart, clear the steel work, which will be removed when the main arch is completed. The floor for the 25-foot space will be cast in slabs and will be placed in position by a traveling crane from the completed floor over the arch ribs.

The concrete mixing plant is located along the C. M. & St. P. R. R. tracks about 2,000 feet from the east end of the bridge. Dump holes under the track allow all aggregate which is delivered in bottom-dump cars to flow into a hopper bin. Belt conveyors elevate it to the top of the storage bins, and dump onto a reversible carriage-mounted belt conveyor. This carriage can be moved to allow dumping into any bin. Just to the north of the storage bins, and at a height about the industrial railway system so the concrete can be dumped directly into bucket cars are located two one-yard motor-driven concrete mixers. The batch hoppers for these mixers are served by a belt conveyor



OLD AND NEW



PIER AND FALSE WORK

running the full length of the storage bins. To the west, but directly built onto the mixer feeding platform, parallel to the track siding is the cement shed, with a capacity of 2,000 barrels of cement. This arrangement allows using cement directly from the railroad car to the mixers. The outstanding feature of the mixing plant is the efficiency with which the material is handled. Undoubtedly it is one of the best of its kind in the northwest.

The field office and falsework plant are located just to the south of the east abutment.

The structure when finished will contain approximately 860 carloads of crushed rock, 400 carloads of sand, 250 carloads of cement and 260 carloads of reinforced steel. The steel is divided into 460 tons of reinforcing bars, and 584 tons of fabricated steel frames which are used for the arches. One million feet of lumber will be used for the falsework. Arches, floor slabs, copings, parapet and superstructure details are made of a 1:2:4 mix. Below where the ribs tie into the piers, the piers are of a 1:2½:5 mix, and where the ribs tie in of a 1:2:4 mix.

The estimated cost of the structure is $750,000.

The bridge was designed by the late F. W. Cappelen, city engineer, and K. Oustad, city bridge engineer. W. N. Elsberg is superintendent in charge of construction.

The "pontias" is a local night wind blowing out of a narrow valley near the town of Nyons, France. According to a prevailing legend, the wind was brought thither from the sea by a bygone saint in order to increase the fertility of the region.

Ordinary London air contains black particles which vary in diameter from one one-hundred-thousandth to one twenty-thousandth of an inch. Exhaled air yields similar particles.

The police of Colorado Springs, Col., have utilized an airplane to carry bloodhounds promptly to the scene of a crime.

Water, generally regarded as practically incompressible, decreases 20 per cent in volume when subjected to a pressure of 180,000 pounds to the square inch.

MR. F. W. CAPPELEN

Mr. F. W. Cappelen first entered the city employ in 1866 and during the time until 1896 held various offices including bridge engineer and city engineer. He again entered the city employ in 1912 as city engineer and held that position until his death. During his term of office he either built or else supervised the construction of nearly all the large bridges in Minneapolis, including the bridges at 32nd and 40th Avenues North and the Third Avenue bridge. He designed the Franklin Avenue bridge and until his death was supervising the construction.

Mr. Cappelen was a graduate of the Technical Schools at Orebro, Sweden, and Dresden, Germany. He was recognized as an authority on concrete bridge construction.

TEMPERATURE VARIATION IN HOUSE HEATING

By E. A. Stewart,
Associate Professor of Agriculture Physics

The amount of variation in room temperature in houses has very frequently been incorrectly estimated. In order to get some facts concerning the actual temperatures, the actual humidities and the actual air circulation in private homes, I have been carrying on some investigations. Isolated individual readings, even though taken at regular times, were almost worthless. Continuous records on recording thermometers and hygrometers, however, have given some very interesting and reliable data.

The graphs accompanying this article will indicate some of the facts found in this investigation. Someone may object to these as being conclusive evidence as they are only single cases. These are representative graphs selected from a number of such records. I have many other records which show the same features. While my investigations are not completed, yet I have carried it far enough to warrant, I believe, several conclusions.

These graphs were taken during the past two winters. Part of the records were taken in Kansas and part in Minnesota. I have the records of out-door temperatures and the characteristics shown in these graphs are not due to outside temperature effects. The records were taken for approximately one week each.

The first record, as the chart shows, is a record in a warm air furnace heated house. This furnace has sufficient capacity. The installation has several faults, but in spite of these, the whole seven-rooms (hall and bath in addition) are well heated. The regulator on this system was not changed during the week. The furnace was operated by an eighteen year old son. The dampers were partly closed at night instead of changing the regulator. This graph shows that outside temperatures did not influence the temperature variation much inside. One day during this time the outdoor temperature was up to 63° F. and one night it was as low as 60° F. This was our largest weekly variation in temperature for the winter.

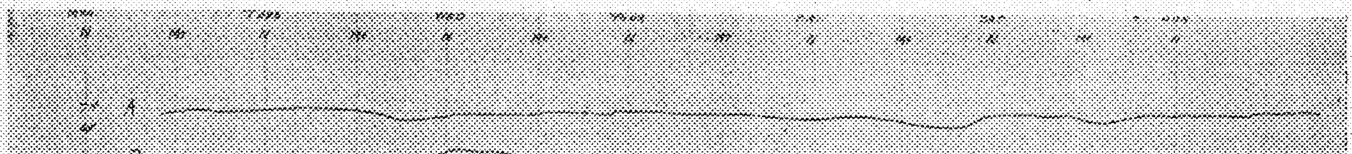
The second record (B) was taken in a well built eight room house that was heated with a hot water system. The difference in variation in temperature is very noticeable. The temperature remains low in the morning and then raises higher than it should because the regulator cannot prevent it. The two graphs on Saturday show distinctly the difference in response of the two systems after a sudden drop in temperature out-of-doors early Saturday morning.

The third graph shows the fine result that it is possible to secure with a warm air furnace of good capacity, when well regulated. I have never been able to secure a record from a hot water heated house which approaches this in uniformity of temperature. The variation in this house from 7:30 A. M. to 10:00 P. M. is usually only two degrees. The ten degrees drop in temperature at night secures some saving in fuel. The large capacity furnace in the warm air type enables the owner to secure the proper daytime temperature in from twenty to thirty minutes after the regulator opens the draft. Note also the raise in temperature secured Saturday evening at 8:00 P. M. They wanted the house warmer for bathing the children.

The graph in D shows a more uniform daytime temperature than was shown in B, even though this was a hand operated plant. This man's thermometer was on an inside wall, but near the corner close to an outside wall. He kept the proper temperatures as shown on his thermometer, but the radiation to the cold wall allowed it to register about 3° low.

The result shown in E of a hand operated hot water system is as good a regulation as is secured in B. I find this to be nearly always true when operated intelligently. Low temperature in the forenoons is quite noticeable, however.

Graphs F and G are given to show poor hand regulation of warm air and hot water systems. The one in F is the type of temperature variation that many people think is characteristic of warm air heating. This is not so. I have never secured a variation in any other house that approaches this in its irregularity. Undoubtedly the warm air gave more fluctuations in temperature than did the hot water system in G, but the variation from maximum to minimum from 8:00 A. M. to 10:00 P. M. is greater in the hot water heated house. Another advantage in favor of the warm air heated house was that the house was warm every morning by 7:30 A. M., even though he shut the furnace almost air tight at night, thereby saving considerable fuel. This was not true of the hot water heated house.



The fluctuation in temperature in F in the daytime was caused by poor operation. This man was above 60 years of age and had never operated a furnace until the last three years. He was around the house most of the time and would open the drafts wide open as soon as the house began to feel cool to him.

He used no thermometer. When the house was warm, he would close the dampers again.

The man operating the boiler in the house where record G was taken, tried to see how fast a raise in temperature could be secured on Friday morning. The outdoor temperature dropped suddenly during the night to 6° above zero, but came up to 22° at noon. The man fired up heavily at about 9:30 because opening the draft in the morning had not raised the temperature. The temperature was raised 10° in about one and one-half hours. This is the most rapid raise in temperature that I have found to occur in a hot water heated house in cold weather. When the temperature reached 70° F., he closed the draft. At this time, and for nearly the whole hour preceding, the chimney damper was red hot. Note that the temperature still increased to 74° after closing the draft. This is very characteristic of hot water heating.

These graphs are eloquent testimony to the need of regulators on heating systems. They also show that a regulator is more efficient when applied to warm air heating than when used on hot water heating systems. After taking a large number of records, I must say that the argument so frequently used, viz: "Put in a hot water system so as to secure an even temperature" is not true. Warm air heating under intelligent operation or when automatically regulated will give less variation in temperature. It will also enable the owner to warm up his house, if once cooled, much quicker than he can with hot water heat.

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HIGH LIGHTS ON THE BELGIAN CONGO

BY L. S. HELIG

For the accompanying photographs I am indebted to Mr. G. W. Bertilson my companion in Africa.

This interesting but little known country lies in Central Africa, the greater portion of it below the equator. On the Congo River is the port of entry. Steamers leave from Antwerp, direct for Boma. The ocean trip from Belgium to the Congo takes from two to three weeks.

Boma is the capital of the Province. Here one is supplied with a matriculation card, which shows that the bearer has the permission of the government to travel in the Congo.

Boma is situated at tide water on the right bank of the river. From Boma one goes by steamer to Matadi, which is some distance up the river from Boma and is the real seaport of Congo. The river at this point is quite narrow and the water is so deep that the ocean steamers dock right alongside the bank. The surrounding country is nearly all rock and, because of this fact, during the hot season the heat becomes almost unbearable. During the hottest part of the season one of the ocean steamer captains claimed to have placed a thermometer on the dock at mid-day and at three o'clock that afternoon this thermometer registered 80 degrees Centigrade or 176 degrees Fahrenheit. This gives a person some idea of the extreme heat in the lower part of the Congo.

Matadi is the native name for rock, and the officers of the State are called Buli Matadi. This name was given to them by the natives and means to break the rock. The reason for giving this name was on account of Stanley, who, in making his roads from Matadi to Leopoldville, used dynamite to break up and move rock. Subsequently, all Congo officials, when recognized as such by the natives, have been termed Buli Matadi.

The river from Matadi to Leopoldville, a distance of about 400 kilometers, is not navigable, due to numerous rapids. Therefore, a narrow-gauge railway has been built. Chinese labor was employed along with natives. The death rate was very high. Some person in estimating the number of human lives lost in building this railroad said that one white man died for every kilometer and that one Chinaman or Negro for every tie. I do not claim to vouch for this statement, but at short intervals along the way are white monuments, which, I have been told, mark the graves of white men who died during the process of the construction.

About midway between Matadi and Leopoldville is a station called Thysville, which is situated on high land. This station marks the completion of the first day's journey from Matadi to Leopoldville, the trip from Matadi to Leopoldville requiring two days by railroad. The trains are in the complete charge of black people and the entire trip is very interesting, but often very uncomfortable. Tickets are sold for first and second class, the natives riding second class and in open cars. Each person carries his own food on the trip. My recollection is, that the longest piece of tangent was not over a quarter of a mile in length. Some of the grades were very steep and my actual experience has been, on this road, that the engineer had to take at least three runs at some of the grades before being able to reach the summit. Each car has a brakeman, as there is no air-brake equipment. The engines are small and equipped with a shrill whistle like that on a merry-go-round. This whistle is in continuous operation as the engineer signals to his brakemen to release or apply the brakes. Crude oil and wood are the fuels used, with now and then a little soft coal.

The second day the traveler arrives at Kinshasa, which is about four miles from Leopoldville. This station has outgrown Leopoldville and has a very fine hotel. Many of the companies make this place their headquarters, as it is on Stanley Pool, which marks the beginning of river navigation. It is here that one may see a great variety of the products of the Congo for which the white man barters with the native. Great stores of ivory may be seen, vast amounts of palm kernels from which palm oil is extracted, and piles of native sacks containing crude rubber.

One leaves Kinshasa by river steamers which are of very shallow draught for continuing the trip into the interior. There are thousands of miles of navigable water ways and these are the main arteries of travel in the Congo. Passing from the lower Congo to the upper Congo the scenery is very striking and interesting. Vast forests are succeeded by more or less open country. These forests extend to the water's edge and are very thick and interlaced with undergrowth and vines. Wild game abounds both in the forests and swamp lands. Birds of gay plumage, crocodiles, and hippopotami are seen in vast numbers while steaming up the Kasi river, which is one of the largest tributaries of the Congo.

Steamers travel only during the day, tying up at night at some favorable point along the river or at some trading post or Christian mission, established on its banks. The steamers are officered by white men, the remainder of the crew being native labor. Wood is used as a fuel and frequent stops have to be made to replenish the supply. At every stop the natives come down to the river to barter and trade with the crew, or to sell native produce and food stuffs to the captain of the boat, who has charge of feeding the passengers. Many years of trading with the white man has produced its effect upon the prices asked by the natives for food stuffs, and in some cases the captain has a very difficult time in obtaining enough supplies to feed his passengers.

When the traveler has reached his destination by steamer, he must then travel on foot, or canoe, if possible, farther into the interior. Travel is made by caravan, the natives carrying the white man's effects, slung from a pole, two men to a load. Sixty or seventy-five pounds is the largest load that most of the porters or bearers will carry. The travel is somewhat lightened for the white man if he can procure good tepoy men. The tepoy is a hammock swung from a pole and carried by two men at a time. From twelve to fifteen miles is the average day's travel, and six or eight tepoy men are usually used. The tepoy men change about every half hour while the white man is riding. The native African is a very proud person and a good tepoy man is very jealous of his position and social standing.

TRAVELING BY TEPOY

They carry the white man along in his tepoy at a gait which is in reality a shuffle, being out of step with each other, preventing the hammock from swaying from side to side. As they shuffle along, they sing a sort of a chant, in which they all join and which is directed by one who elects himself as a leader. This chant may be a part of a song or it may be made up on the spur of the moment and, depending upon the spirit with which the work is being done, is either in praise of the white man or tells the white man how much abused and how hard-worked are the tepoy men. The service a man gets from his tepoy men depends upon how he treats them. If the white man walks a fair share of the time, the tepoy man is very willing to carry him the rest. Along the trip they show off at almost every conceivable opportunity. They wear, as ornaments, little bells, anklets and bracelets, a small dry gourd in which the seeds rattle, and portions of monkey skins having long white or black hair. When they approach a native village they gather together and enter the village at a swift trot, going through all sorts of pantomime and singing and yelling at the top of their voices.

Contrary to the general idea, these native people are in most cases very clean. The Congo is a land of much rain and streams are numerous. On reaching one of these streams the white man is courteously asked to wait while they bathe. During a day's caravaning they may bathe as many as ten times. At the end of the day's travel, as soon as the porters arrive, the tepoy men set up the white man's tent. His native servants begin to prepare for the night. The first thing that is done is to open the chop boxes or food cases and to have the white man select what he wishes for the evening meal. The cook and cook-boy get the fire started and get water for all purposes. While they are doing this, the boy, as he is called, who is the personal body servant, gets the bath tub ready, the chairs out, the table set up, the bed set up and made and the mosquito net hung and tucked in about the bed to keep out the mosquitoes and insects. He also lays out a supply of clean clothing. Generally by the time this is done water has been heated for the bath, the boy takes the bath tub into the tent, fills it with water and gets all the supplies needed. While the white man is bathing and changing clothes, the boy sets the table. In the meantime the cook has prepared the meal and is waiting to serve it.

In the morning, by the time the white man is ready, the breakfast is on the table. While he is eating, the boy drags out all of the effects in the tent and packs them away, and the tepoy men take down the tent and pack it, ready for the trip. As fast as the proper loads are ready the porters pick them up and carry them away, the white man, tepoy men and servants being the last to leave the camp. This is the ordinary procedure in overland travel, and after a little experience things work very smoothly. The day's travel is begun in the early morning and continues for about seven hours. This is done to avoid as much of the heat of the day as possible.

The whole Congo is peopled by tribes much the same as America was by Indians. The people live in villages, one of 500 inhabitants considered large. Each village is presided over by a chief, who is treated with great respect. Over several villages there is a big chief and he, in turn is responsible to a higher chief, all being responsible to the big chief or King.

On arriving in a village, after a short interval of time, the Chief comes to call on the white man and always brings a present. The size of this present depends upon the richness of the Chief, and also depends upon what he thinks the white man will give him in return. He always expects a present from the white man which shall exceed in value several times that which he gave the white man. These presents are called matabish and the native is always looking for a matabish. Small children, grown men and women are continually asking the white man for matabish, working on the theory, I presume, that it costs nothing to ask and that there might be a chance of the white man giving a present. These presents are usually trade goods that the traveler carries with him. Money is of no value to the native, and he wants something more tangible for his use. Cloth, salt, iron, copper, brass beads, second-hand vests, knives, hatchets, hoes, hats, coats, any kind of trousers, bells and all sorts of trinkets are the things most dear to the native and he labors chiefly to satisfy these desires.

MEDICINE MAN

The matter of clothes is a matter of taste with each individual as it is with the white man. The longer the natives are in contact with the white man, the more clothes they wear. The ordinary clothing consists of a breech cloth. In the interior, children up to the ages of eight and nine years wear no clothes at all. Some of the elders wear little more. The natives are very imitative and their contact with the white man causes them to desire white man's clothing. They are very proud and cannot stand ridicule. In ridiculing one another, they use the word Basengi, which means Bush man, and is a very great insult. This term, applied, does not have the same significance to them as it does to us. In the sense that they use it, it means a person who has travelled but little, who has small amount of intelligence; in other words, an ignoramus. The natives who have worked around with the white man and have acquired clothing and imitate the white man's manners, feel themselves superior to those who have not had the same contact and experience, and apply this term Basengi to all who come to the white man's camp. I cannot convey on paper the expressions of contempt and the ridicule it implies when used by one of the superior natives in addressing the ordinary native. An illustration and its result is humorous enough to be written down here to show what affect this ridicule has. It is the customary practice in the Congo to pay workmen a stated sum a month and also each week a ration or pozo, as it is called. This enables them to buy native food each week, from the natives in the surrounding country. In pushing forward into some new country, a friend of mine came into contact with natives who had never before seen a white man. In such a case they are always very shy at first. The women brought in baskets of food on Saturday afternoon to sell to the workmen in exchange for salt and cloth. These women wore no clothing at all. The workmen wore brilliant colored cloth from the white man's trade goods. They, of course, applied this term Basengi to these women and ridiculed them for not having been partially clothed. After the day's trading was done, most of these women went back to their villages with various and sundry pieces of cloth and cups of salt. The following Saturday these same women brought in their native food to again trade with the workmen. Each woman wore a string about her waist and a piece of trade cloth about the size of a pocket handkerchief suspended from this string in back, and considered herself very much dressed. They wore this cloth as an affect of the ridicule and as a proof of the fact that they were not Basengi.

The tribes in the Congo have certain distinguishing characteristics so that a man who has become well acquainted can distinguish fairly well the people of the different tribes by their personal appearance. As a general thing the people of a certain tribe in the majority of cases are either large, medium or small sized. The color is a deep chocolate rather than a black. Contrary to prevailing ideas, tatooing is very scarce among the natives. They decorate themselves by cutting short deep gashes in their bodies or faces and filling these cuts with charcoal or some other substance. When this is healed, these cuts are again opened and the process repeated. This may be repeated several times. The design of the cicatrization and the place where it is done are peculiar to the different tribes. The Bengala decorate themselves down the center of the forehead and along the nose. Some tribes decorate the breast, others the back. Some cover almost the entire body. It has been my experience that in one tribe at least, the relatives of the chiefs or, as we might call them, the artistocracy, decorate themselves with a certain design which is not found upon any other members of that tribe.

The natives, on the whole, are bright and intelligent, and many people have noticed their quickness in picking up foreign languages. One of the peculiar things about their acquiring foreign languages is that if you are Englsih or American you can seldom prevail upon them to air their knowledge of English; but, on the contrary, if they can speak French will seize every opportunity to talk to you in that language. The white man gets many surprises, as once in a while they will speak to you in English about something of which you did not think they had any knowledge. In my particular case, I took some pains to teach my boy that there was a difference between English and Americans. A rather laughable incident occurred one day while caravaning. While passing through a village, several of the native women came out and called to the caravan and asked the white man to buy meat. My boy, to show his knowledge said, "My white man is not English. He is American. He does not eat meat."

When a white man wishes to obtain workmen in many sections of the Congo, he has to apply to one of the white officers in charge in that district. In other sections word is sent to the different villages that the white man desires workmen. As slavery is practiced freely, the slaves are the ones who are generally sent first as workmen. After they have worked a while, and if they carry good reports of the white man back to the chiefs, other members who are not slaves will then come and ask for work. They call the white man Tata Mukelengi, which means, Father Chief. Because they practice slavery so freely, they have some rather peculiar ideas as to the white men when they are working for them. They will insist that they are your slaves while working for you and instead of coming to you when they want to quit, as a white man would do, they will wait until they get their pay and at night steal away. You cannot convince them that they are free to come and go as they please and I have had the depressing experience, in a working crew of 130 men, that on the day after pay day 110 would be missing. They work to obtain salt and cloth for the most part, along with other trinkets which their hearts desire.

DIAMOND CONCENTRATING PLANT

When they have earned as much as they think they want, they run away. In two or three months' time, when they have disposed of all of the salt and cloth, they will come back again to ask for work. For beginners, back in the interior section, the monthly wage amounts to about $1.20, with a ration of twenty cents per week. This seems like very small pay, but when one considers what a native can do with $2.00 this wage compares very favorably with what the average workman receives here in the States. A native who is a good manager lives very well on twenty cents a week and with his $1.20 wages is able to buy an eight yard piece of cloth.

A man's wealth is measured by the number of women and slaves he possesses. As the women do most of the hard work their value is based upon the amount of work that they can do. Consequently, a large woman is worth more than a small woman. The average price of a woman is about 200 francs, and when a man starts out to buy a wife he barters with the father in much the same manner that two horse traders do over a horse. The father extols the fine qualities of the daughter, while the prospective husband points out her flaws, and they barter and dicker back and forth until they reach a price acceptable to both. In most cases the woman has nothing to say. If at any time a man does not desire the woman any longer, she returns to her father, who must refund a part of the purchase price.

In the white man's camp the white man is the sole authority, and all matters of dispute are brought to him for settlement. The superior wisdom and wealth of the white man is greatly respected and his decisions, no matter how wrong or unjust they may be, are accepted as final authority with good grace. It is no easy matter for the white man to settle many of these palavers, due to his imperfect knowledge of the native languages. With a large working force, a white man may have members of several tribes in his employ. Because of this fact a jargon has been devised which is called the trade language. It is made up of nouns, adjectives, adverbs and infinitives. There are no verb tenses so that one can imagine how difficult it is to get the time, meaning, or action, when only expessed by an infinitive. It is a rather significant fact that the natives use ten as a basis of their figures. When one gets above 10,000, the average native gets lost in his figures.

The land is very fertile and a wide variety of things are grown. The main article of diet is "Tschombi," which is the Manioc root from which tapioca is derived. This crop is raised by planting the stocks, which sprout a root that will mature in

OX TRAIN TRANSPORT—INLAND

from eleven to thirteen months. They also raise corn, beans, sweet potatoes, onions, tomatoes, egg plant, peanuts, rice, millet, and sugar cane. Cattle are very scarce. Goats, sheep and chickens furnish the meat. Antelope are quite plentiful and the rivers abound with fish. Practically the only things the white man misses are wheat and Irish potatoes. From the foregoing it is seen that a white man may live very pleasantly on the produce of the country. There are several kinds of fruit which may be had, but not nearly the variety that one would expect in a tropical country.

Two years in Africa is the period for which most companies demand that the white man contract. With reasonable care, such as that of wearing a solar helmet, and taking from 5 to 7 grains of quinine every day, the white man passes two years in the Congo without fear of injury to his health. Lack of care means that a man will suffer from malarial fever, which, if neglected, is very apt to bring on the dreaded black water fever. Any man entering the Congo and taking the necessary precautions may pass two very busy, interesting and instructive years there.

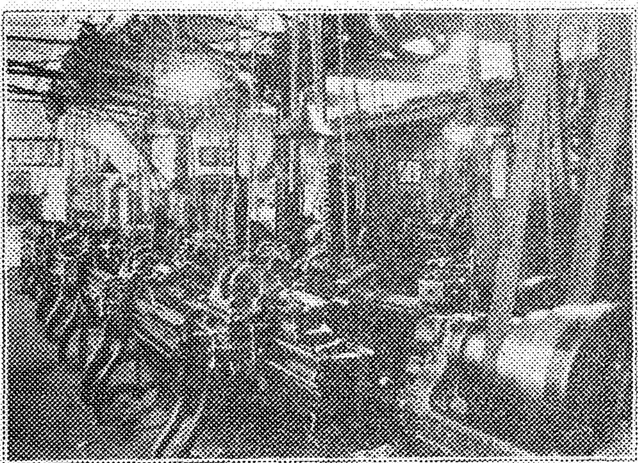
MECHANICAL ENGINEERING SHOPS

Sheldon S. Hibbard, '23

Previous to the year 1900, the College of Engineering of the University of Minnesota had kept pace with the other colleges of the University in their remarkable growth, but while other colleges were being provided with new buildings, the rapid increase in size of engineering classes was for a long time unaccompanied by any increase in accommodations or facilities. The Department of Mechanical Engineering shared the ill effects of existing conditions and each freshman class in shopwork was crowded into space that was none too ample for its predecessors.

In 1900, following an appropriation by the State Legislature, the present Mechanical Engineering building was built. The shops and class rooms were laid out and designed to include all modern features of that period and to allow for ample expansion. Professor Flather, the present head of the Department of Mechanical Engineering, was serving in the same capacity at that time. It is interesting to note that at this time one instructor and two assistants took care of the pattern, foundry, and forge shops. An instructor and a machinist taught the machine work.

In 1918 the shops were running at about 100% capacity as originally planned. The Department had realized the value of having specialists in each of the shops and accordingly each shop had its instructor, and in addition the pattern and machine shops each had an assistant.



MACHINE SHOP

In 1919 a crisis was reached. Due to the unusually heavy enrollment in the Freshman class there were from thirty-three to forty students in a class. This was an unanticipated 100% overload. It was necessary to resort to many schemes to keep each section running and not conflict with the other sections. It was necessary to divide the large sections alternately into classes for recitation and classes for shop trips so as to accommodate all of them. It was also necessary to assign two students to each of the lockers, which were none too large for one student. An additional assistant was secured for each shop. Every piece of available equipment was pressed into service, and temporary equipment was added to meet the emergency. Lack of permanent and adequate equipment is still a vital point and the unsatisfactory conditions existent cannot be fully overcome without more equipment.

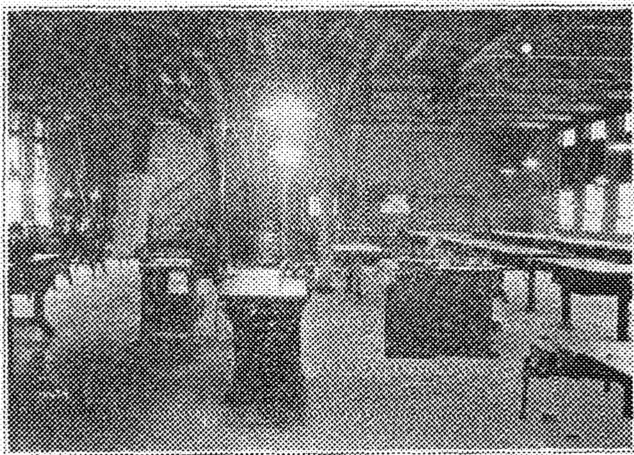
It is interesting but deplorable to note the contrast between the amount of shop floor space per student at Minnesota and that of the average of seven other mid-western universities. The comparison follows:

Shop	Minnesota	Average	Comparative Capacity
Machine	71 sq. ft.	142 sq. ft.	50%
Pattern	76 sq. ft.	119 sq. ft.	64%
Foundry	83 sq. ft.	103 sq. ft.	80%
Forge	75 sq. ft.	101 sq. ft.	74%

The Mechanical Department has endeavored to bring about as parallel and modern a development in all shops as the funds and available space would allow. It has made a special effort to furnish the shops with modern production equipment.

To the machine shop, has been added modern production machines such as lathes, drill presses, and grinders. War-time machinery was purchased from the U. S. Government at fifteen cents on the dollar, and a dozen machines were purchased from the Pan Motor Company at about one-third their original value. The forge shop equipment has recently been increased by 18 forges and 10 welding outfits. To the foundry has been added a production moulding machine. The foundry will get more equipment as soon as the necessary funds are available. In the pattern shop the entire equipment including all lathes and benches has been pressed into use.

It has been the policy of the present shop management to employ modern methods of instruction and in this way bring before the student such phases as are met with in practice. A safety first campaign is continually carried on. Blue-prints and instruction sheets are given to each student for reference and guide in all shops.



PATTERN SHOP

The department has recently added to its teaching staff Mr. John H. Moffett, Metallurgical Engineer to take charge of the work in Foundry Practice.

Mr. J. W. Nilson has also been secured to take charge of the machine shop. He has had a wide experience in tool making and machine shop work.

The follbwing table will serve as a comparison of facilities for instruction in the Department of Mechanical Engineering for the years 1900, 1918 and 1921.

	1900	1918	1921
Shop students	82	233	528
Instructors	2	4	5
Assistants	3	4	6
Equipment—			
Machine Tools	31	41	81
Forges	21	29	47
Wood Turning Lathes	11	17	17
Lockers	162	209	344

With the above increase in students and equipment new shops will soon be imperative.

MAN IS A FAILURE

When he has no confidence in himself nor his fellow men.

When he values success more than character and self-respect.

When he does not try to make his work a little better each day.

When he becomes so absorbed in his work that he cannot say that life is greater than work.

When he lets a day go by without making some one happier and more comfortable.

When he values wealth above health, self-respect and the good opinion of others.

When he is so burdened by his business that he finds no time for rest or recreation.

When he loves his own plans and interests more than humanity.

When his friends like him for what he has more than for what he is.

When he knows that he is in the wrong, but is afraid to admit it.

When he envies others because they have more ability, talent or wealth than he has.

When he does not care what happens to his neighbor or to his friend so long as he is prosperous.

When he is so busy doing that he has no time for smiles and cheering words.

HARD ON THE MAJOR

Zealous Sentry—"Afraid I can't let you go by without the password, sir."

Irate Officer—"But, confound you, I tell you I have forgotten it! You know me well enough. I'm Major Jones."

Sentry—"Can't help it, sir; must have the password."

Voice from the Guard Tent—"Oh, don't stand arguing all night, Bill; shoot 'im and come in to dinner."

HE SPOUTS NO MORE

Mrs. French Vanderbilt praised at a tea given by Mrs. Cavendish Bentinck on the Mauretania the diplomacy of the German kaiser.

"He has learned," said Mrs. French Vanderbilt, "the advantage of reserve. The schoolboy's description of him has now lost its point."

"A teacher said:

" 'Timothy Hopkins, how is Germany governed?'

" 'By a kaiser, ma'am.'

" 'And what is a kaiser, Timothy?'

" 'A kaiser is a stream o' hot water spoutin' up and disturbin' the earth.' "

FAMOUS ARCHITECT VISITS UNIVERSITY

Cass Gilbert, former St. Paul architect, designer of the Minnesota State Capitol, the Woolworth building and many other prominent buildings and author of the University plan, spoke to members of the architectural department and their friends in the Freehand studio, Thursday afternoon, November 10.

Mr. Gilbert, as he expressed it, "was just fresh from a trip to Europe." He returned with new conceptions and refreshed visions of old world accomplishments. On the boat coming back he was introduced to Marshal Foch. "It was a great pleasure to meet such a great man," he said.

The outstanding impression on this trip as on all others was the quality of the architecture of Europe. "From the simplest to the greatest it simply 'reeks' with beauty—good fortune has indeed presided." In contrast with the centuries of continental experience American architecture is only about 500 years old.

The architecture of even the farm houses and stables of France is charming and speaks of a simple living, peaceful minded people. The same was true in Italy. Americans on the other hand have over-adorned their work. "The more mature we get the more the big, simple, quiet thing appeals, ornament becomes secondary to usefulness, utility and proportion."

In old Venice, Mr. Gilbert "realized again the refreshment of beauty to the soul." Florence bespoke of vigor and intelligence. Rome's ruins, the day he saw them, presented a contrast with a modern dirigible flying aloft—the last word in modern art and science. Yet he hastened to point out the old ruins too showed a "moderninity" in the old baths where the problems of heating and plumbing were worked out even as today. The remains showing plainly sections of plehnum chambers of ancient ventilating systems.

While talking of Rome he urged that the American Academy there should be the aim of every student because of the facilities for study, investigation and and exploration of old world art at first hand. Paul Manship, the St. Paul sculptor, he believed, was the only Minnesotian to attend the Academy. Mr. Gilbert continued, "the cultivation of the love of beauty is the greatest thing in man's life—anyone may cultivate it, for riches are not necessary."

Then shifting back home he pointed out that imagination is the keynote of successful men. James J. Hill he cited as a man with a great imagination—a man who "saw visions and dreamed dreams." Mr. Gilbert urged his auditors to start now to develop civic pride and ideals—to think of their home towns in terms of fine arts, planning of public improvements so that in later days they might devote a portion of their time to the intelligent assistance of public welfare.

Finally he urged the students to "cultivate the love of beauty of things and in things folks do; bear your part as citizens—approaching things from the practical standpoint and to cultivate the capacity to illustrate, draw, paint and sketch—observation counts—see things accurately. Keep your hand, mind and eye working together—render value for value."

MINNESOTA TECHNO-LOG

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EDITORIALS

Our college life—what will be our reflections upon it in years to come? Surely, with the passing of time we will gain a perspective of the vast opportunities offered at college; a broader perspective than that which we now possess. Perhaps our entire order of the relative importance of things concerning life at school will be rearranged, when, with the passing of years we shall enter into that outside world of hard knocks and practical experience. What may now seem of uppermost importance to us, may pass into comparative obscurity, while the things we may now be neglecting may finally appear to be in reality of primary and vital importance.

So much has been said about importance of scholarship and school activities, and no doubt we all recognize the prominent part that both should occupy in the disposal of our time. However, it is very seldom indeed that we consider the importance of cultivating staunch, and lasting friendships while in college. Unfortunately, we as students do not possess the same point of view as the alumni. Perhaps if we did, we would realize that in after life, no other thing in this world will mean so much to us as the good opinion and firm faith of friends.

Our professional associates of tomorrow are our college associates of today. A kindly interest in their welfare now may be well repaid in the future. But perhaps, this is a mercenary way in which to regard the value of friends. Certainly nothing will bind us closer to our Alma Mater than those intimate associations which college life offers. Moreover, it will this ability to meet people, which we can cultivate now, that will stand us in good stead after we are graduated, and will mean so much to us towards our final achievement of success.

Among the visitors at the Iowa-Minnesota football game were Messrs. Alan C. Rockwood and Vern C. Price of the 'Transit' (Iowa) Engineering Magazine.

They called on the various members of the Techno-Log staff. Many things of common interest were discussed and we gained considerable enthusiasm from these men.

It is hoped that this custom of looking up the staffs of the various technical magazines of the universities will become widespread. There is no better way to become acquainted and to solidify friendship between the different engineering colleges.

"Not that you need swing to the other extreme as a 'grind' or a hermit. Let's concede it is all right to minor in sociabilities—but certainly it is only common sense to major in math and sciences and English that will mean bread and butter to you later on."

In a recent issue of the Minneapolis Journal there appeared the following headline, "Nine Out of Ten Do Not Speak English, Says W. F. Webster." In the article which followed were these statements: "Constantly?"—"All the time." "Consciously?"—"I do not know." College graduates, men and women are the worst offenders in using incorrect English.

In the past the engineer and good English were not thought of at the same time. They were foreign to each other. Recently, a prominent engineer whose writings have good style and who has a command of good English, was approached by an engineering magazine in regard to a series of articles. He was forced to refuse the offer, for if it appeared that he was a good writer his reputation as an engineer would be lessened. This was yesterday.

Today in the industrial development which has taken place new demands are being made of the engineer. He must make reports, describe new processes and write up other information regardin particular line of work.

The engineering student on leaving college may forget the process of triple integration, or the runoff of a Minnesota river, but for his own good cannot forget how to use the English language correctly. He should begin to cultivate its proper use in his freshman year and continue on his own accord throughout the remaining years that he is in school. When he enters the business world his command of good English will be an important factor in his success.

COLLEGE NEWS

On November 23, William H. Hunter addressed the Minnesota section of the American Chemical Society on "Recent Advances in Organic Chemistry," discussing particularly new ideas on steric hindrance and on the use of platinum as a catalyst.

About 50 couples attended a dance given by the School of Chemistry on December 2 in the Chemistry building. Mr. Norman Cassell was in charge of arrangements.

The student branch of the A. S. M. E. sponsored an all engineering meeting Saturday, November 19, at which Mr. Gilbreth, a very prominent speaker, and enthusiastic member of the A. S. M. E., gave an hour lecture on "Industrial Management." He expressed his desire to have every mechanical member of the A. S. M. E., that he might get the most out of his future and put the most into it. His lecture on industrial management proved to the student that a real engineer was not merely a foreman or a manager, a draftsman, a lathe operator, or a transit expert, but an industrial manager who could mke engineering standards and efficiency a maximum.

Future meetings will be held with other prominent speakers on the program. Watch the bulletin boards for announcements.

OBITUARY

DR. STANLEY H. HAYNES

Dr. Stanley H. Haynes, '15, passed away on the eighth day of August, 1921, at the Northwestern Hospital in Minneapolis. Dr. Haynes was also a graduate of Rush, class of 1919. Since his graduation he had acted as resident surgeon of the Lakeside Hospital in Cleveland. He came to Minneapolis last July. To his wife, who was Miss Ruth McKay of Xenia, Ohio, his mother, Mrs. Arthur E. Haynes of 703 East River Road, Minneapolis, and a brother, Dr. Manley H. Haynes, the staff of the Techno-Log extend their deepest sympathy.

Dr. Haynes was very active as a student. He was a member of the Theta Tau and Chi Psi fraternities. He was also a member of the Garrick Club and a Grey Friar.

FINANCIAL REPORT OF THE ENGINEERS BOOKSTORE FOR YEAR ENDING MAY 31st, 1921

The following statements have been taken from the books of record and reflect the financial condition at the time the 1921 dividend was declared:

Balance Sheet, May 31st, 1921

BALANCE SHEET, MAY 31ST, 1921.

ASSETS			LIABILITIES	
Cash		$1,175.07	Notes Payable	$ 350.00
Accounts Receivable		229.05	Accounts Payable	186.51
Office Equipment		563.88	Accounts Payable, Pending	7.27
Furn. & Fixtures		91.66	H. C. Jacobson	99.41
Deferred Debits		122.84	Certificates— 786 members	3,930.00
Inv. 5/31:			Dividend	2,127.98
Cost	$5,389.93		Surplus	238.76
Less reserve for shrinkage	633.47			
		4,756.46	Total Liabilities	$6,939.93
Total Net Assets		$6,939.93		

The above balance sheet shows the general assets of the store on the left and all the liabilities outstanding against the store on the right, as well as the amount due to members for their certificates and dividends. The surplus item is a part of the year's profits which has not been appropriated.

The inventory has been shown in two figures, first, the cost of all goods on hand, ($5,389.93), and second, at an estimated value, the probable worth. The reserve for shrinkage, ($633.47), was made from a careful estimate based on the probable decline in price of some articles carried in stock.

The members will note from comparing the amount of cash with the dividend declared why it was that the cash dividend could not be paid until this fall.

Income Statement, School Year 1920-21

The income statement shown above gives the net profit for the year. This amount, $3,000.21, was distributed by action of the Board as Directors as follows:

INCOME STATEMENT, SCHOOL YEAR 1920-21.

Merchandise Sales		$29,706.85
Cost of Sales:		
Merchandise Purchases	$27,663.16	
Less Discount	14.73	
	$27,648.43	
Add Delivery Expense	443.79	
Net Purchases	$28,092.22	
Less Inventory May 31	5,389.93	
		22,702.29
Gross Profits from Sales		$ 7,004.56
Operating Expenses:		
Profit and Loss	$ 21.30	
Interest	39.50	
Insurance	28.80	
Advertising	135.06	
General Expense	121.42	
Postage	20.50	
Salaries and Commissions	3,196.81	
Stationery and Supplies	189.79	
Telephone and Telegraph	28.21	
Depreciation	215.82	
Exchange	1.05	
Discount	2.88	
		4,004.35
NET PROFIT FOR YEAR		$ 3,000.21

DISTRIBUTION OF PROFITS

Cash Dividend	$2,127.98	
Reserve for Shrinkage in Inventory	633.47	
Unappropriated for special use	238.76	
		$3,000.21

The books of the store were audited by Mr. Heilman, a member of the accounting department and a report submitted to the Senate Committee on Finance.

NOTE-Summary of Proceedings Page 20

ALUMNI NOTES

Maurice Chernus, '21, was on the campus last week. After a summer in the contracting field he said that business was as good as he expected it to be during his first year. He has been engaged in highway construction in the western part of the state, but is now located at 329 Hennepin Avenue, Minneapolis.

Burt L. Newkirk, '97, who at one time helped many of us over calculus' threatening menace, writes that he is enjoying his present work in turbine engineering with the General Electric Company at Schenectady. He resides with his family at 15 Regal Avenue.

Rockwood C. Nelson, '15, is doing valuation work on Michigan interurban properties for the Michigan public utilities commission. He is in the employ of Froehlick and Emery, an engineering company of Detroit.

Harold Langford, '18, and Robert Meussel, '21, are at the present time engaged in valuation work on the Minneapolis Street Railway's system. They are in the employ of Delos Wilcox, valuation engineer, who has been retained by the city for the work.

George L. Lindsay, '21, who has been busy in the chemical laboratory of the Universal Portland Cement Company at Duluth, is now salesman for the same concern.

A. P. Peterson, '19, is now instructor in drawing here. He is living at 5010 Third AvenueSouth.

With the Engineering College snow bound in the earliest winter since '54, it is indeed pleasantly warming to here from more fortunate brethren in sunny Mexico.

O. L. Rosenthal, '19, writes that he is located at 22 Calle Alto Monte, Tampico, Tampualipas, Mexico. In spite of the handicap he is enjoying life as material superintendent on a refinery contract for the Royal Dutch Shell Company. Mr. Rosenthal is in the employ of the Foundation Company of New York.

H. M. Sushan (formerly Sushansky, '20) has just finished an extensive location survey in Southern Vera Cruz for the Transcontinental Petroleum Company.

E. B. Sherwood, '20 (also Mexican) is chief engineer for the New England Fuel Oil Company. He is at present engaged in the construction of their Santa Margarita terminal.

F. C. Halladay is engaged as an independent transportation operator throughout Tampualipas. He is known through his territory as 'Happy' Halladay. Mexico appears to be a most excellent hole for Gopher engineers.

John W. Farmer, '21, is with the Northwestern Manufacturing Company as plant inspector of gas engine governors.

H. T. Odegarde, '20, is with the C. B. & Q. at Aurora, Illinois. He is doing test work on materials there.

H. E. Bernt, '20, is now in the construction department of the U. S. Steel Corporation at Duluth. 'Hans' lives at 301 Commonwealth Avenue, New Duluth, but left the fire side to be on the campus for Homecoming.

Clifton A. Glass, C. E., '98, is contracting engineer for the Kansas City Structural Steel Company of Kansas City, Kansas. During the war Mr. Glass had charge of the fabrication of ship parts at that plant.

Roy A. Palmer, '21, is an electrical engineer with the National Lamp Works of Nela Park, Cleveland, Ohio. He lives at 1839 Hastings Avenue, East Cleveland.

Two architects who have recently jumped the matrimonial gap are Stuart Wright, '19, and George Dahl, '20. Mr. and Mrs. Dahl are now living in Cambridge, Mass., where George is attending Harvard.

Alfred A. Petrich, '19, who married Frances Lila Olmstead, B. A., '20, has made his home at 622 East 131 Street, Cleveland, Ohio. Mr. Petrich is sales engineer for the Electric Controller and Manufacturing Company of Cleveland.

F. A. Dever, '20, is with the Bridge and Buildings department of the Duluth, Messaba and Northern Railway. Dever was with us at Homecoming but left for his home at 1228 East First Street, Duluth, directly after the now historical Iowa track meet.

S. A. Vaule, '21, is now doing experimental work at the College with the avowed purpose of securing one of those elusive M. E. degrees. The Northern Fire Apparatus Company of this city has generously granted Mr. Vaule a fellowship to aid him in his work. The resulting thesis will be a comprehensive study of the proper clearances in oil pumping apparatus, with the purpose of securing methods of handling most efficiently oils of varying viscosities. The Techno-Log wishes Mr. Vaule success, and hopes to hear from him more fully on the completion of his interesting work.

Ralph Hammet, '19, an instructor in Architecture at Minnesota, has been associated with F. M. Mann, Architect, for the past summer. In company with him, he is the designer of the new Delta Tau Delta fraternity house, now under construction.

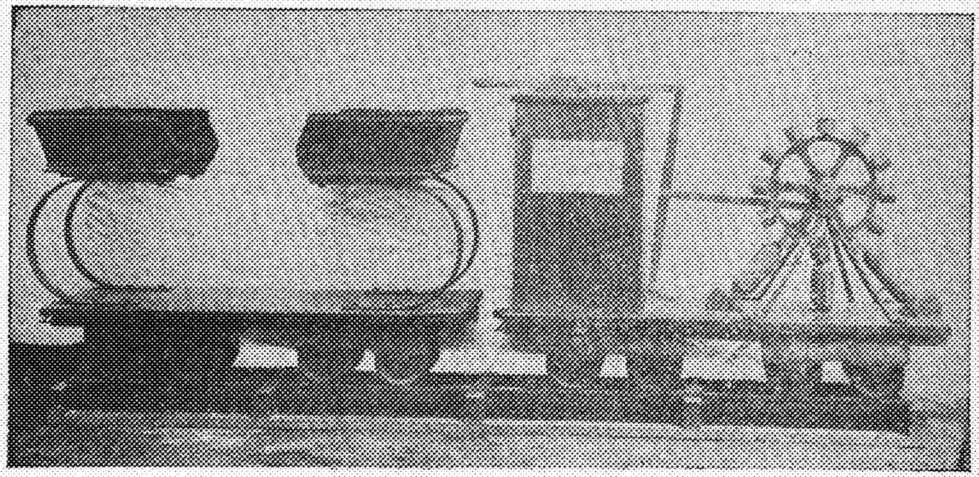
Harvey King, '17, has just returned from a trip abroad, where he traveled in Italy, Spain, France and England.

H. A. Barber, '21, is now engaged in municipal work for W. L. Tahey, consulting engineer at Spencer, Iowa.

DESIGN WINNERS FOR NOVEMBER

Six men earned points in the Junior-Senior design sketch problem of a combined fire station and town hall. Credits were awarded Arthur Strom, Frank Moorman and Henry Gerlach while concredits went to Edward Holien, Paul Damberg and Donald T. Graf.

The next judgment of work in the department was the Sophomore's belvidere in a public part. Mention commended was given Otto C. Person, W. A. Kendall, H. E. Nelson and Wallace C. Bonsall. Mention was the mark placed upon work by Edward Hawkins, David T. Silver, Tresa Snure, Melvin Foster, Rienhart Teige, Frank R. Root, Herman Frenzel, Glanville W. Smith and E. K. Crowell. Sixteen others drew credits.



FARMER'S ELECTRIC LOCOMOTIVE

THE ELECTRIC LOCOMOTIVE IS 75 YEARS OLD

by Robert Muller
Courtesy—General Electric Co.

On a steep railroad grade near Butte, Montana a 288-ton electric locomotive is dragging a 1500 ton freight train over the crest of the North American Continent. Ahead of it another silent electric giant of 265 tons is hurrying a long, dark glistening passenger train down the western slope of the Rockies at high speed—80 miles an hour over favorable stretches. Today's transportation wonders, these.

In a cool, quiet glass case in the Smithsonian Institute at Washington, D. C., stands a queer looking 3x5x10 foot contraption on wheels. It is somewhat suggestive of the old time hand car on which railway section men occasionally are seen pumping their way to or from their work. This pigmy pulls no freight trains. It is hardly suggestive of power, even. But there stands the first electric locomotive the world ever saw, built and exhibited in 1847 by Professor Moses G. Farmer, an ingenious Vermont Yankee.

This crude, almost humorous trinket on its little pieces of rail in the museum is the direct and original antecedent of the most powerful railroad locomotives known today. It refutes a claim persistently circulated by the Germans, that Siemens and Halske of Berlin in 1879 ran the world's first electric locomotive.

Studies made recently for the General Electric Company, builder of 61 great locomotives for the Chicago, Milwaukee and St. Paul's mountain divisions, turn public attention to the German error.

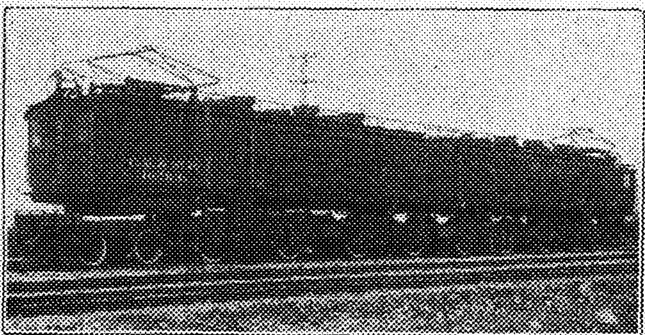
These studies show that "modern" electric traction can be traced as far back as 1835. In that year, Thomas Davenport, a blacksmith in the village of Brandon, Vermont, turned his natural inventive talent to a use which his neighbors thought peculiar. He couldn't see why an "engine" need be run by steam neccessarily. (Those were in the early days of the steam locomotive, and of course the country was talking of that wonderful thing, the locomotive of Stephenson). So he mounted an electric battery on a tiny wooden car and ran it around on a circular track. In the next year or two this enterprising blacksmith neglected his forge to build about 100 such models. But he never made anything bigger than a model.

For years nobody did anything of note to follow up Davenport's ideas. But in 1847 Farmer's new traction device appeared. It was a real locomotive, operating on real rails and developing power enough to move itself up and down the track with a four passenger car attached. He took it to Dover, N. H., first and showed it their and at Springfield, Mass. Three years later, in a more developed form, the Farmer electric locomotive attracted much attention in Boston.

The Farmer machine was driven by a motor built crudely on the very principle of the motors of today. Magnetic attraction drove it; a wheel was mounted on a frame above the floor of the locomotive. Magnets on its rim were attracted on their downward course by a three-coil field fixed on the floor of the machine directly in the course of the wheel. As each magnet on the wheel passed the ends of the coils it was repelled upward on the next quarter of its revolution, and so on. The shaft of this wheel was geared to the locomotive's wheels on the track. Thus the magnet wheel corresponded to the armature of today's motor and the fixed coils on the floor formed the field.

Electric current was supplied by batteries, first carried in a box on the locomotive. Later, these primary cells were grouped in a "power plant" beside the track so that the current was transmitted to the locomotive through the rails. This was the first known instance of transmitting electric power from a central source to a traveling apparatus.

While Farmer's first use of his train was to run it around the edge of a lecture hall in which he explained the mysterious machine, yet it actually carried passengers in 1847, thus establishing its claim as the father of electric traction. In a larger size it also operated out of doors, but years elapsed before electric traction was made commercially successful. The battery of that day was too expensive and too fragile to be used in great quanities, and the current generator, which did not come for 20 years, had to be developed before electric railroading could make a decisive start toward the high goal it has now attained.



MODERN LOCOMOTIVE

SHIRKING THE BLAME

John Reed Scott, the lawyer-novelist of Pittsburgh, ridiculed, at a dinner, a venal politician.

"He has taken a bribe," said Mr. Scott, "and now he tries to throw all the blame on the bribe-giver. It reminds me of Hones, a barber in my native Gettysburg.

"Hones was drunk one Saturday when the minister came in for his weekly shave. The minister was afraid Hones would cut him, but nevertheless he sat down in the chair, and, sure enough, the first stroke of the razor was followed by a bright red gash.

"The minister frowned and pressed the apron to his wound.

" 'Hones, Hones,' he said, 'this shows what liquor will do.'

" 'It does make the skin tender, doesn't it?' Hones replied."

THE THINGS THEY ASK

A woman living in an aristocratic suburb a mile and a half from her grocer goes to the 'phone:

"This you, Central? 454, please."

"This you, Mr. L.?"

"Please charge and send 10 cents worth of animal crackers and pick out the elephants, as the baby is afraid of them."

ELECTRIC VAPORIZER

A new electric device has recently been placed on the market by the Kase Electric Company of Duluth, designed to give instant starting to gasoline motors in cold weather. Its use effects a considerable saving in battery current and time.

The vaporizer consists of four electrically heated grids, mounted within a thermoplax case, the current being supplied by the 6-volt starting battery, and controlled by an automatically releasing switch, mounted on instrument board. The device is installed between carburetor and intake manifold, and furnished complete with all necessary material for installation. The vaporizer is so constructed, that it has an inherent property of automatically controlling the temperature of its heating element with changes of temperature of fuel. This exclusive feature effects a continuous supply of vaporized gasoline at cranking speeds of motor. The motor is started by pressing the vaporizer switch for about 10 seconds before cranking the motor. A very high efficiency is claimed for the device, due to the unique construction of its heating grid and intimate contact it makes with the carburetted fuel.

OFFICIAL SUMMARY OF PROCEEDINGS
June 1st to November 1st, 1921
BOARD OF DIRECTORS, ENGINEERS BOOKSTORE

The main problems confronting the new Board of Directors which went into office the latter part of May, 1921, have been problems of operation rather than of policy. With but few exceptions the general plan of procedure was so well laid down before the bookstore went into operation that few changes have since been necessary.

The Board of Directors have interpreted some doubtful phrases in the by-laws of the organization, and clearly defined who are and who are not eligible to share in the dividends. They have authorized the purchase of new equipment, including a typewriter, showcase and adding machine, adjusted the salary schedule for employes, and decided upon a general policy of broadening the stock so as to include everything that students of the Engineering College may need. At the meeting, held October 18th, 1921, it was formally decided to post all actions of the board regarding matters of immediate interest to the members of the bookstore upon official bulletin boards located at convenient points in the engineering buildings.

The findings of the Board of Directors are open to members of the bookstore at all times and suggestions will be gladly received. The greater share of the work for the fall quarter is now completed, and the biggest problem at hand is the selection of an assistant to the manager who can qualify to fill the manager's position next year.

Respectfully submitted,
LeRoy A. Grettum, President.
By, A. E. Horstkotte, Secretary.

December 1st, 1921.

HIS SNAP

"By gorry, I'm tired!"

"There you go! You're tired! Here I be a-standin' over a hot stove all day and you wurkin' in a nice cool sewer!"—The Masses.

BOOST

Boost, and the world boosts with you;
Knock, and you're on the shelf;
For the world gets sick of the one who kicks
And wishes he'd kick himself.

Boost when the sun is shining,
Boost when it starts to rain;
If you happen to fall, don't lie there and bawl
But get up and boost again.

Boost for your firm's advancement,
Boost for the things sublime;
For the worker that's found on the topmost round
Is the booster every time.

—Tenney Service.

Freshman (to old lady)—"May I accompany you across the street?"

Old Lady—"Certainly, sonny. How long you been waitin' here for someone to take you across?"

ENOUGH SAID

"Captain, could you tell my husband what to do in case of an attack of sea-sickness?"

"It isn't necessary to tell him what to do, ma'am," said the old captain grimly. "He'll do it."—Lippincott's.

GOT THE JOB

Police Commissioner—"If you were ordered to disperse a mob, what would you do?"

Applicant—"Pass around the hat, sir."

Police Commissioner—"That'll do; you're engaged, sir."—Pathfinder.

ALWAYS TOO LATE

"Old chap, didn't your better judgment tell you not to make that investment?"

"No; my better judgment never tells me anything until after I've gone and made a fool of myself."—Chicago Tribune.

MORE NIGHT SCHOOLS NEEDED

As the early morning train out of the city drew up at the first station one morning, a pleasant looking old gentleman stepped out on the platform, and, inhaling the fresh air, enthusiastically observed to the brakeman:

"Isn't this invigorating?"

"No, sir," replied the conscientious employe, "it's Oak Park."—Biff!

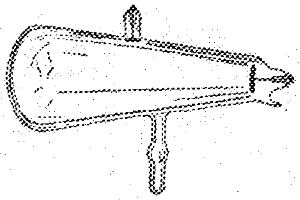
ERRATA

November issue, page twelve.

Fourth sentence, paragraph two, should read: The ashes are dumped into storage space made possible by the construction of a retaining wall on the river bank.

Second sentence, paragraph four, should read: The main tunnel which leaves the plant divides near the Mechanic Arts building, one part going to the Chemistry building and the School of Mines, and the other part to Pillsbury Hall, Engineering buildings, Medical buildings and ends at the Elliott Hospital.

Second sentence, paragraph six, should read: The main heating line is a fourteen-inch heavily insulated, etc. Sentence six, same paragraph, should read: Four-inch water main.



Hittorf or Crookes Tube

How Were X-Rays Discovered?

SIR James Mackenzie Davidson visited Professor Roentgen to find out how he discovered the X-rays.

Roentgen had covered a vacuum tube, called a Hittorf or Crookes tube, with black paper so as to cut off all its light. About four yards away was a piece of cardboard coated with a fluorescent compound. He turned on the current in the tube. The cardboard glowed brightly.

Sir James asked him: "What did you think?"

"I didn't think, I investigated," said Roentgen. He wanted to know what made the cardboard glow. Only planned experiments could give the answer. We all know the practical result. Thousands of lives are saved by surgeons who use the X-rays.

Later on, one of the scientists in the Research Laboratory of the General Electric Company became interested in a certain phenomenon sometimes observed in incandescent lamps. Others had observed it, but he, like Roentgen, investigated. The result was the discovery of new laws governing electrical conduction in high vacuum.

Another scientist in the same laboratory saw that on the basis of those new laws he could build a new tube for producing X-rays more effectively. This was the Coolidge X-ray tube which marked the greatest advance in the X-ray art since the original discovery by Roentgen.

Thus, scientific investigation of a strange phenomenon led to the discovery of a new art, and scientific investigation of another strange phenomenon led to the greatest improvement in that art.

It is for such reasons that the Research Laboratories of the General Electric Company are continually investigating, continually exploring the unknown. It is new knowledge that is sought. But practical results follow in an endless stream, and in many unexpected ways.

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by the students of
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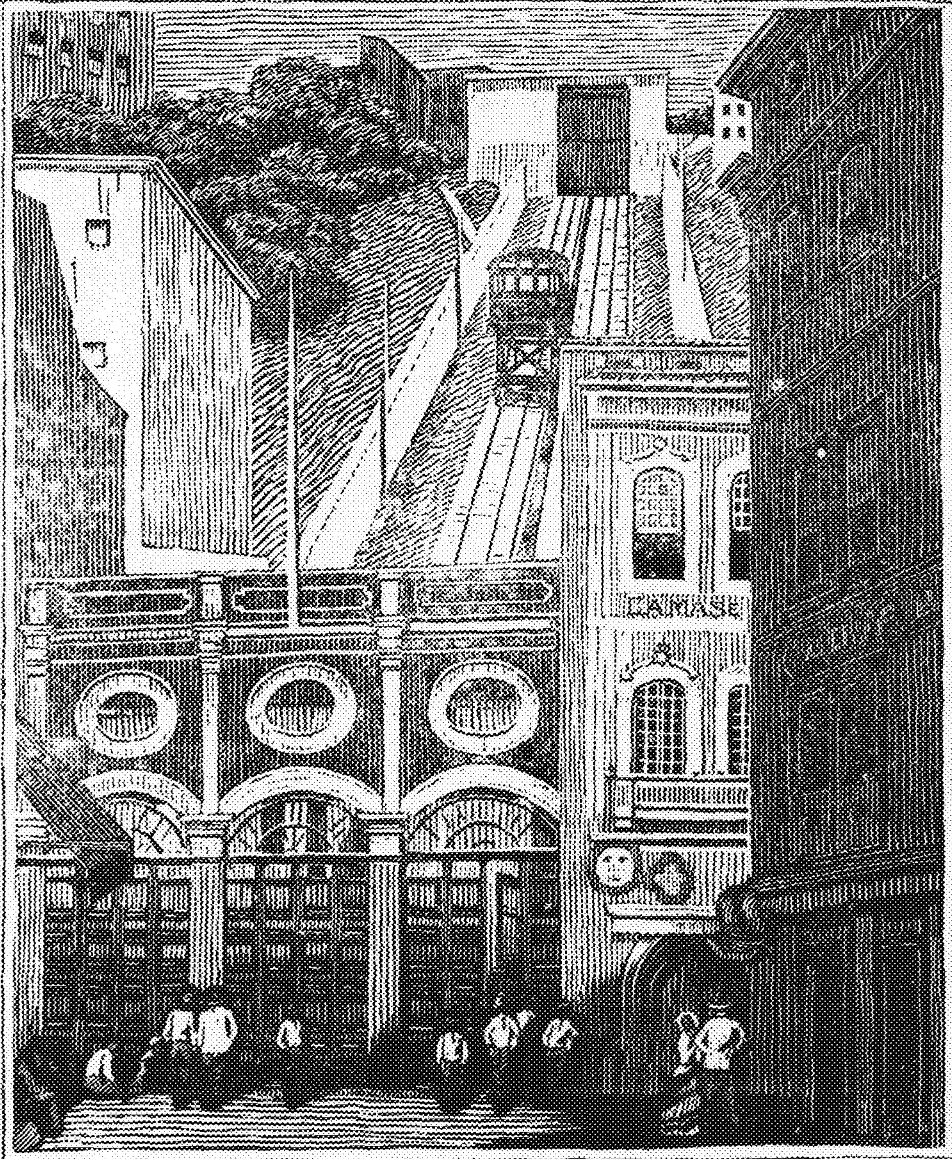
University of Minnesota



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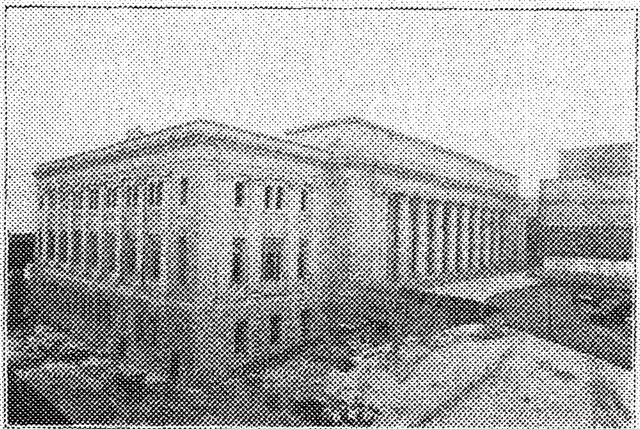
ST. PAUL'S NEW UNION DEPOT

By L. M. Bergford, '23

The construction of the new St. Paul Union Depot, a project made imperative by the destruction of the old station in 1913, is gradually progressing toward completion. The head house, a structure of monumental proportions and classic design was placed open for service on April 5, 1920, and since that time steady progress has been made on the remaining portions, which include the station tracks, concourse, train sheds, and accommodations for mail, express and baggage.

Contrary to previous announcements, the lack of finances will not necessitate the discontinuance of work this year. According to W. C. Armstrong, chief engineer for the terminal corporation, the work of construction will proceed along the original plans which cover a future period of three years.



UNION DEPOT HEAD HOUSE

History of Depot Project

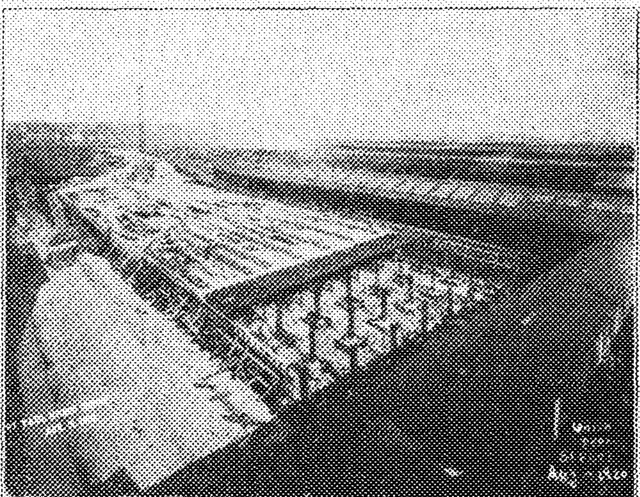
The history of the union station project, reviewed briefly, dates back many years. Reconstruction of the old station was long under consideration. Facilities were outgrown and the busy tracks at the street level were both dangerous and undesirable. Difficulty was experienced, however, in co-ordinating the ideas of the various railroad, city, and government officials, so that no definite steps were taken until the burning of the old station in the fall of 1913 made immediate action necessary. Studies on plans for the new terminal were then begun.

The first plans developed, provided for increased trackage by taking advantage of the long bend in the Mississippi River near the depot site. By straightening the river alignment the reclaimed land could be utilized and the former station yards could expand in that direction. The plans, however, required the approval of the War Department and the objections raised by the Chief of Engineers, placing certain conditions necessary to their acceptance, made it impossible for the railroads to comply and the first plans were abandoned.

Starting anew, with the river bank as a limiting boundary, successful plans were drawn up and adopted in 1917. These plans provided for the needed expansion in a northerly direction and embodied an important advantage by which construction was made possible without interference with the temporary depot facilities then existing.

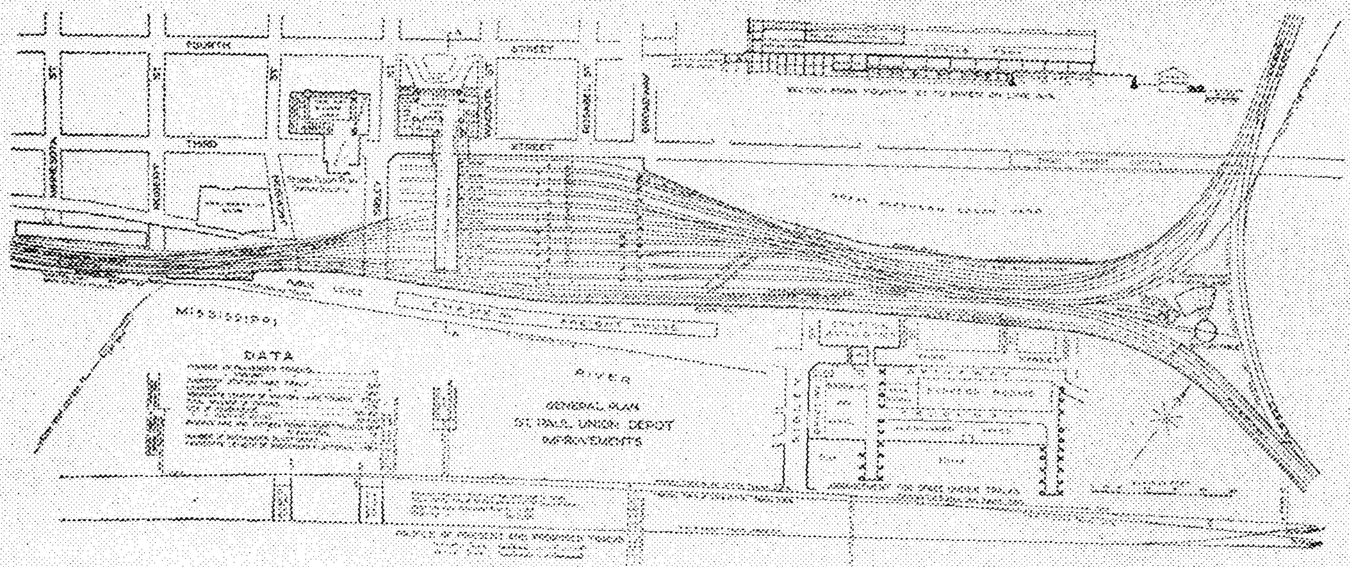
Increased Facilities of Depot Plan

The general plan of the union depot improvements is shown in the accompanying drawing. The head house or station proper, a building of 150 feet by 300 feet, occupies the whole city block bounded by Third, Fourth, Wacouta, and Sibley Streets. The concourse and waiting room extends to the rear bridging Third Street and crossing the station yards at right angles. It is 80 feet by 400 feet and is independent of the head house. The station yards have been enlarged by the purchase of additional property to the north of the old site and the tracks now extend to Third Street. The new tracks, six of which have already been elevated, will all be raised to an elevation of 16 to 18 feet above the old yards. This will provide headroom for subways at Sibley and Jackson Streets and will give free access to the water front, where there is a public levee for river steamboats. The Robert Street bridge will in turn be raised, the old truss span being replaced by a plate-girder structure giving 17 feet overhead above the old track level. Concrete retaining walls are being constructed along the right of way with earth fills to permit the elevating of the station tracks.



POURING FLOOR SLAB

The old terminal facilities which were entirely inadequate provided 8½ miles of trackage. The station yards contained but 14 tracks with an available trackage of 12,457 lineal feet. The new terminal, when completed, will have 22 tracks for passenger purposes and 2 tracks for freight traffic within the station yards. They will represent an aggregate length of 27,200 lineal feet, or more than



twice that of the former system. The outside yards will have about 12½ miles of combined trackage.

The Head House

The completed head house has four floors, viz.: Basement, Third Street Level, Main Floor, and Office Floor. The Basement Floor contains the work rooms, immigrant rooms, and mechanical equipment. On the Third Street level is the restaurant office, supply rooms, janitors' quarters, storage rooms, and surplus space for rental purposes. The Main Floor contains the business lobby, lunch and dining rooms, women's waiting rooms, ticket office, store, barber shop, toilets, and parcel check rooms. The smoking room and baggage check room are on this floor over Third Street. The Office Floor accommodates the Depot Company's offices, women's retiring and emergency rooms, and the Terminal Railway Postoffice.

The type of construction is reinforced concrete throughout. The main floor and Third Street level floor are of flat slab design, while steel beam design with hollow tile and concrete joist floor slabs were used on the main floor.

The portion of the station yard south of Third Street and included between Sibley and Broadway Streets is on a concrete structure providing 260,000 square feet of floor space underneath for baggage, mail, and express purposes.

The train sheds are of the "butterfly" type. There will be eleven altogether, each taking care of two tracks.

Nine Roads Will Be Served by Terminal

The new station is being built by the St. Paul Union Depot Company, a terminal corporation, the stock in which is shared equally by the nine railroads which it serves. The stockholding roads are those operating trains terminating or passing through St. Paul and are namely, the Great Northern; the Northern Pacific; the Chicago, St. Paul, Minneapolis and Omaha; the Chicago, Milwaukee and St. Paul; the Chicago, Great Western; the Chicago, Burlington and Quincy; the Minneapolis and St. Louis; and the Chicago, Rock Island and Pacific. These roads combined operate at present, 140 trains arriving and 142 trains departing in each 24 hours. The average number of people handled daily by the depot is over 20,000, of which a larger portion are through passengers. Some idea of the business to be handled by the new terminal can be obtained from statistics taken from the calendar year of 1919, given below.

Number of tickets sold in 1919	1,069,621
Average daily sale of tickets	2,944
Ticket revenue	$4,408,849.55
Average number of pieces of baggage handled daily	7,170
Average number of tons of mail handled daily	746
Number of train and engine movements	206,006

The work of construction has been so planned that at no time has it interfered seriously with the temporary accommodations which were established in a former mercantile warehouse on Third Street after the fire. Construction work is to be completed in stages. The first unit was the head house, completed in 1920, followed this year by the elevation of the first six tracks and the partial erection of the concourse. Operations in the future will be carried on so that units of six tracks will be elevated at a time until the entire yards are complete.

Mr. Armstrong, when interviewed, stated that the work of elevating the station yards would be entirely completed in 1923 or 1924.

Architectural Treatment Distinctive

With the acquirement of a new depot, St. Paul has replaced an old eyesore by a truly modern and beautiful edifice. The construction embodies not only the ingenuity of the engineer but is also a commendable architectural achievement. Both exterior and interior are of a dignified applied classic design. Bedford gray limestone was used for the exterior, while the interior is largely of Tennessee, Kasota, and Missouri marbles. Spaciousness is an outstanding feature with good lighting and ventilating systems so desirable in a public building.

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DR. HENRY T. EDDY

By President Cyrus Northrup

It is difficult, in a brief address, to do justice to the character and achievements of our distinguished friend, Dr. Henry T. Eddy. It is impossible to enumerate his various contributions to Science or to analyze minutely the nature and extent of his influence upon the scholarship of the Country. I can only outline in a general way some of the most important characteristics of his life, leaving it for you who have known him well for many years to fill in the picture.

My acquaintance with Henry T. Eddy began in 1863 when we entered the Freshman Class in Yale College. I knew him very well throughout his College Course of four years. He graduated in 1867. Among his classmates were Rev. Dr. David J. Burrall, at one time pastor of Westminster Church in this city; Bishop Boyd Vincent, Episcopal Bishop of Southern Ohio, and two United States Senators, Newland of Nevada and Wetmore of Rhode Island. As a student in College, young Eddy was from the first distinguished as a mathematician and if there were any mathematical prizes to be awarded he was pretty sure to receive them. He won several, including the highest prize of the Senior year. After graduating at Yale, he entered the Sheffield Scientific School and took the course in engineering. After completing his work in New Haven, he was for a time instructor in Latin and Mathematics in the University of Tennessee, then was assistant professor in Mathematics and Civil Engineering in Cornell University; then Adjunct Professor of Mathematics at Princeton; then first professor of Astronomy, Mathematics and Civil Engineering in the new University of Cincinnati, and then he became president of Rose Polytechnic Institute. In the meantime, when granted a leave of absence, he had pursued his studies both in Berlin and in Paris. He was indefatigable in his pursuit of knowledge.

Upon his retiring from the presidency of the Rose Polytechnic Institute, the opportunity came to secure him for Minnesota. I take credit to myself for his coming. It seemed to me that we had the chance to secure a great man for the University and we did secure him. He came to the University in 1894 as professor of Engineering and Mechanics. He was afterwards made Dean of the Graduate School and continued in that position until he reached the age for retirement. His years in the University were filled with original investigations, the preparation of scientific treaties, and instruction of classes in the higher mathematics. His reputation grew as the years passed on, and one Commencement Day in New Haven I had the pleasure to see and hear the President of Yale confer on him the degree of Doctor of Science. He had previously received the degree of Doctor of Laws from Center College.

Dr. Eddy was born in Massachusetts, but of Connecticut ancestry. His father, a member of the Yale Class of 1832, was first a Congregational Clergyman and later a physician and inventor. His mother was a graduate of Mt. Holyoke Seminary and for some years a teacher of Mathematics in that institution. There are some parts of the country where Congregational Churches do not exist, and

DR. HENRY T. EDDY

members of Congregational Churches who have taken up their abode in such district usually join a church of some other denomination, as they ought to. Dr. Eddy, though originally a Congregationalist, with a long line of Congregational ancestors, had lived in the Middle West where there was no Congregational Church, and in consequence he had joined the local Presbyterian Church. But in coming to Minnesota he and Mrs. Eddy became members of the First Congregational Church, and from that time till their death they were both active and influential members of the church. They were both deeply interested in Missions, foreign and home. Dr. Eddy was president of the First Congregational Society of St. Anthony and his name is signed to the pending call for the Annual Meeting, December 27th. He had been a deacon of the Church; and the Church's representative on numerous councils and associated charitable and religious conferences. If there was anything which needed to be done, Dr. Eddy could always be relied on to help. He was wise in council and efficient in service.

And when we come closer to him and cease to think of abstruse mathematics and church offices and college degrees, and look at him as a man, we see that he was a learned man, a distinguished man, but above all, a good man—a modest Christian gentleman. Can anything better really be said of any man? Men who die drop everything they **have.** But they do not drop what they **are.**

ELECTROLYSIS

By Walter C. Beckjord, Eng. 1909

EDITOR'S NOTE

Walter C. Beckjord graduated in 1909 from the Electrical Engineering College, University of Minnesota. He is now assistant engineer in the American Light and Traction Company, New York, and as such is engaged in Rate Work, electrolysis investigation, coal mining operation, and general gas and electrical construction. He is an Associate Member of The A. I. E. E., the American Gas Association, and the A. A. E.

It is customary in writing a paper of this sort to define fundamentals, but this subject has been covered so well that no attempt will be made here to repeat these definitions; nor will any attempt be made to give an exhaustive history of electrolysis. This paper will be confined to a simple discussion of the subject, methods of survey, the difficulties involved in mitigation and a brief description of some of the methods used in this country to reduce electrolysis damage to a minimum.

Much study has been devoted to the subject of electrolysis for the past twenty-five years, and more particularly the last ten years, but as yet no cure-all has been suggested. The Bureau of Standards and the Research subcommittee of the American Committee on Electrolysis have done much constructive work in the last few years, but more remains to be done.

It is a matter of common knowledge that when current flows through a metal conductor, the only effect on the conductor material is the production of heat, but when current flows through a liquid conductor, a chemical reaction takes place, causing corrosion on one electrode and a deposit on the other. Ordinary soil carries salts in solution and when a cast-iron or steel pipe is buried in the ground it is easily susceptible to electrolysis where stray currents from the track return of street car systems leave the pipe to return to the negative pole of the generator at the station.

Cast-iron pipe resists the action of electrolysis better than steel, for it will retain its original form, even tho practically all the iron may have been dissolved into the soil and will still hold gas pressure even though it will not stand any strain. In the case of water pipe, of course, the greater pressure would cause rupture of the pipe. In the case of steel pipe the material is dissolved into the soil by the oxidizing action and nothing remains. For this reason it is common practice for gas and water companies to standardize on cast iron mains. Gas services, however, and smaller mains are laid with steel pipe. Water services in the ordinary commercial sizes are laid with lead pipe.

Primarily the cause of all electrolysis is due to current leakage from street railway tracks. If this could be prevented, all trouble of this nature would be over. In some of the larger cities, such as New York and Washington, where traffic conditions warrant the greatly increased investment, or consideration of civic beauty outweighs economic measures, the double contact underground trolley, if properly maintained, will eliminate electrolysis of underground structures. This has been used in some cases—notably in Cincinnati, where a decision of Judge Taft in a telephone case years ago compelled the trolley company to install a double trolley. This decision, however, was based on interference on telephone circuits and not electrolysis. However, this is very cumbersome, unsightly and rather expensive construction, and as practically all the trolley companies in the United States are standardized for single trolley construction, it would be practically out of the question to change to double trolley solely for electrolysis mitigation. It is generally recognized, however, that substantial protection can be effected by other measures—such as proper track bonding, cross bonding, negative feeders, reduction of overall track potentials by installation of additional substations, proper roadbed construction, and such measures as are applicable to underground piping system, viz: insulating joints, where they can be used; protective coatings in some cases of steel pipe installation and proper location of pipe underground with reference to street car tracks.

Attention might be called to the recent development in trackless trolley busses, which is really an auto truck driven by electric motors, securing power from a double overhead trolley, using a traveler and flexible power cord in order to swing from side to side of the street. This development is so recent that no definite statement can be made concerning it. Possibly the next few years may bring some substantial results.

The engineer should endeavor to prevent damage rather than mitigate it by makeshift measures after it has occurred, if it can be done in accordance with broad principles of economics. All things built by men wear out eventually, and even the mighty works of nature are subject to decline—mountains are broken down, the contour of the seashore changes—and so it is with street railway tracks and other things. Bonding that may be all right this year may be badly broken down next year, and as a chain is no stronger than its weakest link, one or two broken bonds will destroy the effectiveness of an entire branch line return track circuit.

Eternal vigilance is the price of safety, and frequent electrolysis surveys are just as essential as traffic surveys, or voltage and pressure surveys on a distribution system for gas and electricity. At least one man in every organization should be delegated to this work and be kept constantly in touch with it. The expense is negligible, considering the investment in underground structures, and it is very cheap insurance against future trouble.

Electrolysis investigation has been very materially handicapped in the past because of the lack of proper knowledge in making surveys. Hitherto all surveys have been generally qualitative, rather than quantitative and it is only recently that the Bureau of Standards has been able to develop methods for measuring the flow of current leaving a pipe. The instruments are not fully developed as yet, but much constructive progress has been made. This device will make the tracing out of current flow more a question of fact than of conjecture.

The difference of potential readings as made between pipe and rail indicate what may occur, but are no real criterion of actual damage. A high voltage reading may indicate high soil resistance, or poor rail bonding, or both, and in many instances no current would be found on a main, even though it might be several volts positive or negative to the rail. Potential difference between main and rail is a measure of track drop and for this reason it is a very useful method of checking up broken bonds. A survey made year after year over the same tracks will indicate the relative improvement or lack of it in rail bonding. A track drop survey is extremely useful and very essential in a complete electrolysis survey, but it requires considerable apparatus and telephone wire to make this and for ordinary purposes a potential survey will indicate relatively the condition of the bonds. All potential difference measurements depend directly upon track drop at a distance from the station, and the potential from track to main is practically the same as the drop in the track from the point of measurement to the point of lowest potential in the station. The current flowing back to the station will naturally divide inversely as the resistance of the several paths, and the main or cable in the street will get its proportionate share, carrying it until a point near the station is reached, where the current leaves the main to return to the negative bus. This is where the damage most generally occurs.

Current surveys may be made on mains and cables by taking the drop of potential over a given length of the main or cable with no joints intervening, and the resistance of the pipe or cable being known, the current can be calculated. These results are only approximately correct, because the resistance of various pipes may vary from that of the sample tested, and the weight of the pipe may vary, but they suffice for tracing out the flow of current and indicate to some extent the damage to be expected. One ampere of current will take away 20 pounds of cast iron per year and almost 80 pounds of lead. Stray current resembles gravity in that what gets on must get off somewhere. The difficulty is to find out just where the current is leaving, and the new device perfected by the Bureau of Standards is solving this problem. Cable companies generally have been able to protect their cables by drainage, that is, attaching a conductor to their cable sheathes and from thence to the street railway track or negative return. Their problem is somewhat simplified because the cable sheathes are continuous conductors, relatively small, laid up in tile duct and manholes and therefore not so intimately in contact with the earth as cast iron or steel pipe, which on account of their larger size and close contact with the earth could carry extremely large currents. Likewise, cast iron pipes have joints, a good many of which usually become of high resistance because of the pulling out of the pipe from the lead joint—moisture creeps in and forms a high resistance oxide. Current would shunt around these high resistance joints causing serious damage even in districts where the pipe is negative to the track and thus not expected. Like segregation in smallpox, it is preferable to have electrolysis damage confined to areas around stations where at least it can be watched and the damage confined to relatively small areas.

Excessive drainage of cables causes heating and thereby limits the carrying capacity, but most American experience indicates that this is not a serious handicap. However, there is another more serious danger in over-drainage of cable sheathes, main, or any underground structure—and that is the danger to contiguous structures. Where the potential of one structure is lower than another, current flows from all other structures in that vicinity to the one of lowest potential, and as telephone and power cables and water and gas mains are all mixed up together in cities of any size, the danger of this situation may readily be seen. It spreads the danger areas all over town instead of on car track streets, where it can be watched to some extent. Many cases have been known where damage has occurred far from car tracks, due to exchange of current between substructures. If drainage were simply a problem of tying the affected structure to the track with a cable, then the problem would easily be solved, but it would be impossible to prevent exchange of current in all the ramifications of the various systems, and much damage would occur in least expected places, instead of being segregated in a pesthouse, as it were, on car track streets. Likewise, in the case of gas mains, there is much danger of fire and explosion in making connections for new mains and services or repairs, and also setting meters. Much damage has already occurred from this source and it is a potential danger which should not be lightly regarded. In some cities it is necessary to put a wire jumper across gas meter piping before removing the meters. This is sometimes done when mains are disconnected for repairs. Cases have also been known where disastrous oil fires have been caused by sparks igniting the oil at a break in the pipe line.

In water pipes the danger of explosion is not present, but on account of leakage at the joints there is apt to be more moisture surrounding the pipe than in the case of gas mains, thus making conditions more favorable for electrolysis. Also there is danger from internal pitting where current leaves the pipe and passes through the water around a joint. The lead service from the water main is four times as easily corroded as cast iron and as stray currents usually return to the street railway track by the service on account of their proximity thereto, they are usually the first to go.

In order to follow up current tests year after year, test stations are frequently installed on gas and water mains, with brass corporation cocks screwed into the pipe at a known distance apart and copper wire insulated terminals brought to the surface in a test box at the curb. These are marked for identification and frequent tests can be made without excavating the main.

Another method of testing for current without excavating the main is to bar down to the main with a 1-inch bar, as in testing for leaks, and then insert steel rods with wires attached leading to a millivoltmeter. Great care must be taken—first, not to break the pipe by striking it too hard with the bar, and second, to secure good contact on the main with the steel point, inasmuch as the reading is of the order of millivolts.

Electric cables are more easily tested for current flow, because they are readily accessible every three or four hundred feet in manholes. They are more uniform in size and thickness and current measurements are fairly accurate.

In the past, considerable stress has been laid on potential readings to ground because electrolytic action only takes place where pipes, cables, or other underground structures are electrically positive to the surrounding earth. If properly taken, these ground readings afford a valuable index to electrolysis conditions, but unless carefully taken by competent engineers familiar with possibility of error involved, they are worthless or positively misleading. An auxiliary earth electrode must be used that is known to give a very small galvanic potential against the metal of the structure under test. For lead cables a piece of lead is satisfactory, but for iron pipe the problem is more difficult because of the variability of iron and the possibility of complication, due to oxidation of either the pipe under test or the auxiliary iron electrode.

It is not the purpose of this paper to give detailed methods of electrolysis investigation, the routine of tests or records, or minute descriptions of mitigation methods. These subjects have all been so well covered in the Bureau of Standards' reports, American Electrolysis Committee reports and numerous other papers, that repetition here would be superfluous. There is so much ground to be covered in a short paper, that these subjects will be only touched upon briefly, and it is hoped that those sufficiently interested in the subject will be encouraged to proceed further in their study of electrolysis.

Potential readings and current readings have already been discussed. These may be amplified by the use of recording instruments and thereby stray currents easily identified with their source, as the curve will follow that of the street railway load. Track drop readings are useful in checking up the condition of the track bonding, and may be made over 1,000 foot sections, or from distant points to the station by the use of telephone wires. An average drop of 1 volt per 1,000 ft. during off-peak hours is usually taken for a standard of good practice, or a maximum overall voltage drop of 7 volts. Drop in potential measurements through the earth may be taken by using non-polarizable electrodes and thus the flow of current traced through the ground, but these measurements require a high degree of skill. Ordinary potential and current readings will be found extremely useful in following up electrolysis problems, and they are simple enough so that it does not require a high degree of technical training to make them.

It is important that proper records of these tests be kept, so that comparisons may be made year after year to check the progress of improvement work and maintenance. It is customary to plot voltage readings pipe to rail as ordinates to the street car lines as abscissae using a convenient scale. Track positive readings are plotted in green and pipe positive readings in red to clearly indicate the danger zone. A mass of readings on paper does not show up the situation nearly as well as a graphic chart and a comparison of maps year after year is a much simpler and better method than checking one figure with another. Current readings may be plotted in small circles representing the various stations where tests are made and the direction of flow indicated by arrows. The bad bonds on the railway track will be shown up clearly and distinctly by the high voltage readings. It is interesting to mark on the map the number of broken bonds discovered and repaired by the street car company after such a survey.

A physical examination of the pipe should be made from time to time at the various danger points and a record kept of the depth of pitting to see if it increases year after year. It would be good practice for any distributing company using pipes in the ground to examine them at every excavation made in the course of construction for new service connections, etc., and make a few simple electrical measurements as a matter of record. In this way a close check can be kept of all damage done and possibly a continuance of the same prevented.

In early days the use of pipe coatings was considered good practice, particularly in the case of steel service pipes. A wooden box was placed around the service and filled with coal-tar pitch. This makes very good protection, if properly installed, and steel pipe has been known to last 40 or 50 years, where subject to electrolysis, under this method. However, the least imperfection in the covering concentrates the current escaping at this one point, thus rendering the whole coating useless, and moreover, the added expense has become too much of a burden to distributing companies. It is sometimes considered good practice, even now, to cover services passing under street car tracks, but the necessity for this is often obviated by laying a main on each side of the street in the boulevard. The expense of this construction, however, has increased to a point where it is no longer economically possible for utilities to use it as a prevention against electrolysis.

The subject of track bonding might be mentioned at this point. In the old days a compression type bond was used under the fish plate, a copper terminal was expanded in a hole drilled in the web of the rail. Moisture getting in between the copper and the steel rail forms an oxide and destroys the conductivity of the bond. The usual type now used is a copper bond welded to the head of the rail with an acetylene flame, or electric weld. These can be readily inspected and kept in repair, but they are apt to be knocked off in unpaved streets by passing wagons or trucks. In the down town paved districts the rails are usually welded, either cast weld or thermit. Electric welding of the fish plates is now being used also. In ordinary practice a bond is supposed to be the equivalent of 3 or 4 ft. of rail.

One of the methods of mitigation suggested for use on mains is insulated joints. Cement joints on gas mains have been in use for some 30 years past and some companies have had remarkable success with them. Soil and climatic conditions have a good deal to do with it, however, and where the ground is apt to settle, or frost action occurs, it is not considered safe to use them, as the pipe is held absolutely rigid by the cement joints and a break is apt to occur. With a lead joint there would be some play. With most companies it is not considered good practice to use cement joints for larger than 8-inch pipe, but in proper soil conditions some companies have used them up to and including 16-inch pipe. The difficulty seems to be that the ordinary gas pipe joint is not deep enough to afford sufficient mechanical strength in the larger sizes. A new joint has been designed which is 6 inches deep and slightly tapered so as to make a wedge of cement. These are being used experimentally in some cities, and further data should soon be available. The cement joint will eliminate stray current on pipes, if it can be used, and its use on new construction should be studied carefully. On construction already in place, of course, it would not be possible to remake all the joints, and the question of installing insulating joint in mains already laid hardly

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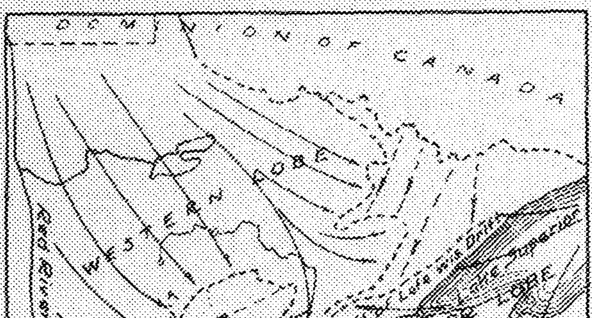
EFFECT OF SHALE PEBBLES IN CONCRETE AND REMOVAL OF SHALE FROM GRAVEL

By Prof. F. C. Lang

From paper given at meeting of County Commissioners and Highway Engineers at Ames, Iowa, April, 1921.

The effect of shale pebbles and the removal of shale from gravel is of considerable importance to many localities. In vast areas of the Middle West about the only available material for coarse aggregate in concrete is in the local gravel deposits and yet these otherwise good materials are in some cases of no value on account of the shale they contain and in others the value is doubtful depending on the amount of shale present. The cost of bringing in aggregate from outside the district is sometimes prohibitive on account of cost of transporting it in addition to all the other inconveniences and annoyances which result. You who have been getting aggregate by rail fully realize the difficulty in trying to keep a steady flow of material to your job. For the benefit of such districts an investigation should be made of what percentages of shale pebbles may be permitted in various classes of concrete and then the specifications so written. At present, specifications usually prohibit the use of any shale and then, oftentimes, no attention is paid as to whether it is present or not, especially if the quantity is small.

In order to permit the use of limited amounts of shale in the coarse aggregate we would need a laboratory and field method of determining the percentage present, and, in order for the producer to meet the specifications we would need a practical commercial way for him to separate the shale from the stone pebbles. In this we have made a start, but only a start; much yet remains to be done.



Map of Minnesota showing extent of glacial ice sheets and directions of ice movements

FIG. I

Figure No. 1 illustrates the shale problem as we have it in Minnesota, and our problem is small indeed compared to other areas, the Dakotas for instance. In the area marked as Late Wisconsin Drift, coming from a northwesterly direction, practically all the gravel contains shale, while in the northeastern part of the state in which an earlier drift came from the N. E. and was not covered by the later drift, we have practically no shale. These gravels are locally referred to as gray and red. We are fortunate in having large quantities of ledge rock in parts of this area as, for instance, the granite along the Minnesota River and quartzite in the southwestern part of the state. I know that in Iowa you also have large areas in which practically all of your gravel contains shale and you are perhaps farther from good rock.

Before discussing the damage shale does to concrete, I will describe in a general way what shale is and how it occurs. Shale is a compacted clay with laminated or stratified structure. As we are familiar with it in some of our Minnesota gravel deposits, the pieces of shale are intermixed and closely resemble the ordinary stone pebbles when first excavated, except that it is of a grayish color, but the color is not sufficiently distinctive to make the shale pebbles noticeable to ordinary observation. Permit this material to be exposed to the elements for a short time, however, and the pieces of shale are very much in evidence, especially if there is an appreciable percentage present. We will find that the shale has completely split into thin flat pieces and then if still longer exposed to air and rain that these thin flat pieces will completely crumble and we eventually will have only a little pile of clay where was once our counterfeit stone pebble. Obviously such a material will not be satisfactory in the surface of a one course concrete pavement, will decrease the strength of any concrete, and when present in excessive quantities will completely disintegrate the concrete.

In discussing the effect of such material in concrete there are at least two items we must consider:

1. How it affects the abrasive wear on a one course concrete pavement.

2. How it affects the compressive strength which has an important bearing on nearly every use concrete would be put to in highway construction.

Shale is especially detrimental in one course concrete pavements. In our present methods of tamping and agitating concrete, practically all of the shale comes to the surface on account of its relative light weight. We have repeatedly found on our concrete pavements that if we place a piece of coal on the subgrade we would later find that piece of coal in the surface of the pavement.

Figure No. 2 shows you the difference in specific gravity of our Appleton shale and the ordinary rocks—the shale, for instance, is 1.6 times the weight of water, while the lowest stone is 2.53 times; the specific gravity of ordinary bituminous coal is about 1.40.

As the shale practically all comes to the surface very little can be permitted in a one course concrete pavement. Our Minnesota specifications permit one-half of one per cent.

The final result, then, of permitting shale pebbles in aggregate for one course concrete pavement is that practically all the shale works to the surface during the tamping and agitating. Later the clay softens from weathering, and is removed by traffic and the elements, until we have holes in the surface where once were the shale pebbles. Then if the pavement is subjected to heavy traffic the edges of the holes break down from the tire chains, etc., the size of the holes rapidly increase under the impact of traffic and the pavement is well started on its way to destruction.

SPECIFIC GRAVITY OF VARIOUS ROCKS IN MINNESOTA

NAME	SPECIFIC GRAVITY
FARIBAULT LIMESTONE	2.66
KENYON LIMESTONE	2.53
PIPESTONE SANDSTONE	2.76
NEW ULM QUARTZITE	2.69
JASPER QUARTZITE	2.65
DULUTH GABBRO	2.75
DRESSED JUNCTION TRAP	2.95
ST. CLOUD GRANITE	2.62
MORTON GRANITE GNEISS	2.66
GRANITE FALLS GRANITE	2.65
SHALE (APPLETON)	1.60

FIG 2

The effect on the compressive strength, as in a concrete base or bridge construction, is not quite so obvious, although, as we can readily see, these particles of compressed clay must be detrimental, the presence of moisture and frost action makes them especially so.

Figure No. 3 shows the effect of varying amounts of shale on the compressive strength according to some test cylinders we made this past winter. You will note that the strength of the concrete decreases as the percent of shale increases but after the shale content of the coarse aggregate is over 20% the decrease in strength was very slight. Be sure to keep in mind, however, that this curve is the result of only one proportion of aggregate and one set of weather conditions. The concrete specimens were 6"x12" cylinders, the mix was 1:2:4 and the amount of water was only such as to make the concrete workable. The consistency, the sand, cement, grading of coarse aggregate and curing was the same for all cylinders. The shale had the same grading as the coarse aggregate. The cylinders were broken at age of 28 days. They were cured as follows: stored in wet sand in a warm room (70° F.) for the first 7 days, then alternately placed out of doors for 24 hours and frozen, and brought inside and placed in water for 24 hours. This process was repeated for 12 days. Each point on the curve is the average of three cylinders. If the cylinders had been broken when the concrete was saturated with water, I think the difference in strength would have been even more marked. I believe further investigations should be made.

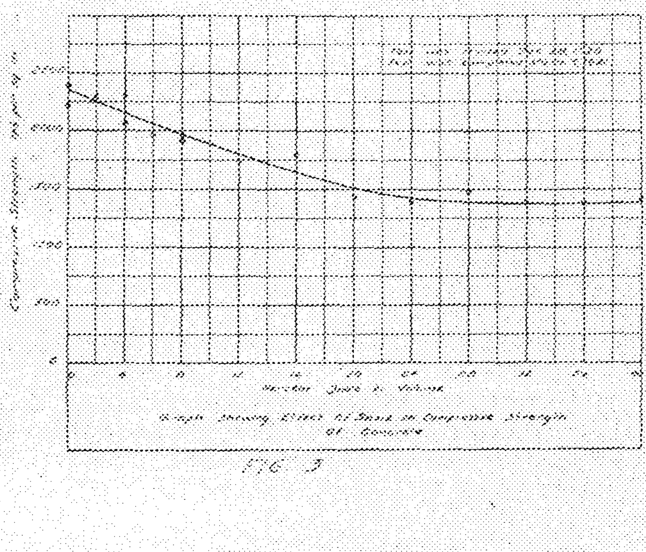


FIG 3

Inasmuch as there can be no question but that shale is injurious to concrete we must have a laboratory method of determining how much shale is present in the gravel and a practical commercial way of removing it. One method of determining the amount of shale present is to hand pick a representative sample and by scratching each pebble with a knife, determine whether it is shale or not. Then by weighing the stone and shale separately and taking the specific gravity of each, we can determine the percentages by volume of each. This is a laborious and somewhat inaccurate method.

Another method is to make up some solution having a specific gravity higher than the shale and lower than the rock. For this we use a saturated solution of zinc chloride. A tray about 12 inches wide by 18 inches long and 8 inches deep is filled about two-thirds full of the solution, the gravel is placed in a screen which is just a trifle smaller than the tray so that it can be placed inside. This is then immersed in the liquid and agitated by stirring. The shale is skimmed off the surface, then the screen is lifted out and placed in another tray to drain off. Both the stone and shale pebbles are then washed and dried to constant weight and the percentage of each determined. Although we have never used this method in the field, I see no reason why it could not be used.

As to a practical commercial method of removing shale, I feel that we have made considerable progress. In November, 1919, Mr. McLaughlin, of the Minnesota Pipe and Tile Co., and I consulted Mr. Davis of the Mines Experiment Station at our University as to the feasibility of removing the shale by jigging as ores are separated from rock. Mr. Davis considered the matter entirely practical. Later in the winter an experimental run was made at the station and as the result of that Mr. Davis designed a jig which was built and operated at the pit. In order to show you conclusively that this method is more than a theory, I wish to quote from a letter I received from Mr. McLaughlin on Feb. 15, 1921.

"We carried on three series of tests at Appleton, the first two of which will not be of much interest to you as the time was practically all consumed in perfecting the jig. The third test proved without any question that with a jig of the type which we have, known as the Bull Jig, practically every particle of shale can be successfully removed from the gravel."

"I am fully convinced of one feature and that is that jigs must be set on very rigid foundations and I would recommend the concrete type of jig box which could be built to use the piston type or round valve. We propose to construct this type of jig at Appleton and attach them together, making two jigs to each unit and we will add units as capacity demands."

In the laboratory method for determining the percentage of shale we used a liquid of such density that the shale would float and the stone sink. It is not practical to so separate the shale on a commercial basis. Therefore we must find some method of making this separation with water which is always easily obtainable at a gravel washing plant.

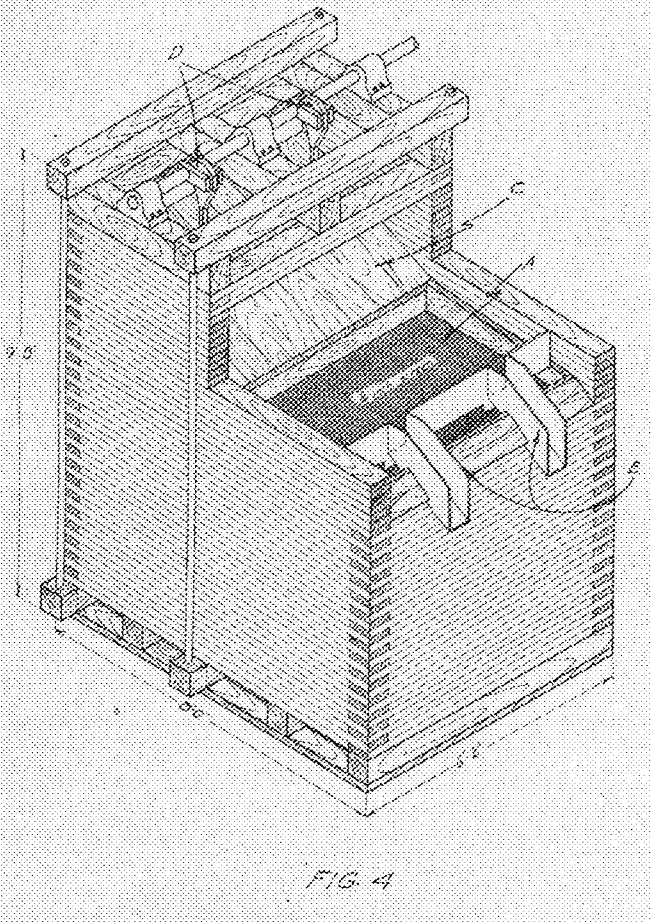


FIG. 4

Figure No. 4 shows the outside appearance of the jig. You will note that it is about 6 feet wide, 8 feet long, and 9 feet 8 inches high, and that it is built to hold water. The space, (A), about 4x5 feet, has a ¼ inch screen at the bottom. Across the front we have a weir about 4 inches above the screen bed. Approximately 4 inches from this a metal plate extends across the space with openings about 3 inches high or 1 inch below the top of the weir. The opening into the metal spouts, (B), is about ½ inch above the top of weir across the front. There is, however, a gate at this spout entrance so that the elevation of the spout inlet may be varied as conditions warrant. (C) is simply a platform sloping toward screen and (D) are piston connection rods which operate the pistons. This will show better in Figure No. 5, which is a longitudinal section through the spout.

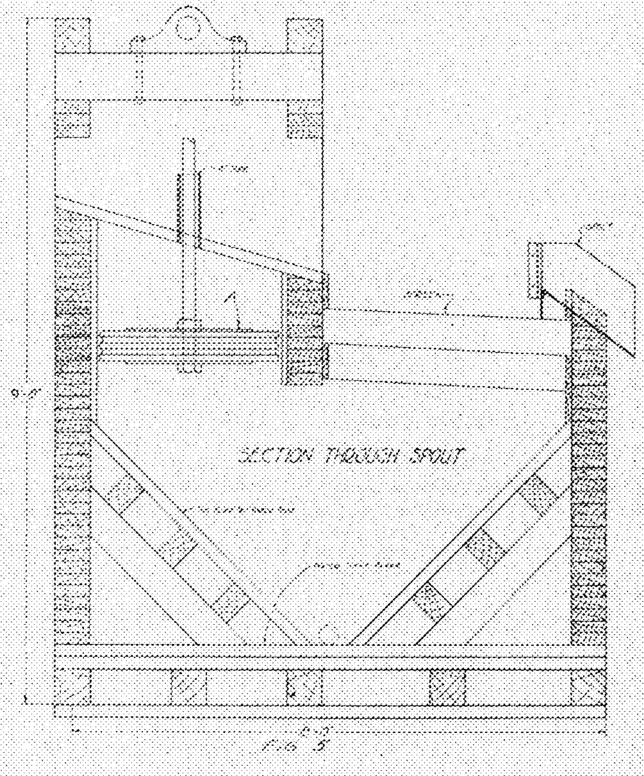


FIG. 5

In this section, Figure No. 5, we have the wooden weir which was across front in the other view, also the screen, metal spout and sloping platform. (A) is the piston I spoke of in the other view.

When the jig is in operation this bed is filled with gravel up to and somewhat above the elevation of this weir, and it is full of water up to the same level. The pistons, which are about 26"x32", make about 154 2-inch strokes per minute. The effect of this is to keep this bed of gravel jumping with the pulsation of the water, which causes the heavier stones to settle and the lighter particles or shale to come to the surface. Then if we further consider that we have a constant stream of water entering the jig and also a constant supply of gravel being furnished on this sloping platform, I think you can readily see that it is entirely a matter of adjustment to have the shale and water flow out these spouts from surface, and pebbles, and of course water, flow out under this plate and over the weir. Once the separation is made they can be run into different bins. Sand below ¼" goes through screen and is removed from bottom of hopper. A jig this size has a capacity of about five tons an hour.

In conclusion I wish to summarize as follows:

1. There are large areas in this Upper Mississippi Valley where gravel pebbles containing shale is the only material available for concrete.

2. This material is not suitable for concrete unless the shale is removed.

3. As yet only a start has been made in determining the amount of shale present and methods of removing it on a commercial basis.

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EDITORIALS

THE ENGINEER'S INSIGNIA

Toward the end of last quarter a campaign was started to adopt a design significant of the Engineering College and which later would signify the Technical Institute into which the College of Engineering will gradually develop.

This movement, we believe, should have the support of every student, for if one is adopted at this time it will mean that for the years to come it will mark the Minnesota Engineer the world over.

We understand that it is not the idea of those fostering this movement to develop something which will separate the Engineering College from the University; rather that in boosting the College it will boost the University. In this we believe they are right. During the period of the War, everywhere was heard the cry. "Do your bit." The same should hold true in our every day life. The students of any college can best carry on the "Better Minnesota movement" by bettering their own college.

THE SHYNESS OF THE ENGINEER

The engineer is notoriously ill at ease, awkward, and inept in public; he shrinks back upon himself and his profession. That stands in the way of his prominence as a leader, and ties him to the chariot of some man with no greater or with less ability, less command of facts, principles, and logic, but of more direct though cruder force, more versatile, fluent, and sympathetic with those moods of men which sway them more than reasons.

Of all the types of engineer, the mining engineer possibly has these characteristics most pronounced. Dinners are a terror to him if he imagines he may be called upon for a few words. His reason works best alone with facts. He thinks in the mine, or over the drafting board—not on his feet or eye to eye. He theorizes about his duty as a citizen, but makes little practical start at coming forward. Realizing his own small share in the universe, he is inclined to stand in awe of men of no heavier caliber than he.

It is a healthful sign of the times that our citizens, great and little, are tending more and more to chip in and do their bit cheerfully, whenever they see a chance to help out. You will note this earnest spirit everywhere—men of business, of affairs, of statesmanship, are democratic in their willingness to serve in small things, to be conferred with, to speak, to write, to fulfill all reasonable and helpful demands so far as they can. In a less measure this is true of engineers; and least of all perhaps of the mining engineers.

On going over a recent appraisal of leading engineers, a prominent technical journal discovered that of the mechanical and electrical engineers rated as the leaders all were occasional contributors to its columns. A survey of the corresponding mining engineers revealed the fact that many of them had never contributed out of their experience any written article to any publication. Their sense of brotherhood, of helpfulness, of service to their fellow-engineer was deficient. It is each man's duty, if he has had special experience, to share that experience, by writing and speaking, when he can—when he is requested, which is a fairly good rule, for he will not be asked unless his help is needed.

We have another example of this quality in the shrinking from publicity, in the refusal to have personal notices, photographs, or intimate sketches published. Those of us who are or have been in this frame of mind—and it is a very common malady with the most of us mining engineers—mistake, or try to pretend to ourselves that we mistake, our failing for a virtue. It is not a virtue; it is the fault of exaggerated selfconsciousness. The man who is hungry for publicity, who maneuvers so that he may hear the sound of his own voice raised in public papers, so that he may see his name in print for the pleasure of feeling himself in the limelight, suffers from precisely the same malady—an exaggerated ego.

Your really balanced man—the man we all would like to be—has lost sight of his little self in the contemplation of swirling humanity, of many figures of men whom he respects, of the marvelously great universe around him. He has lost self-consciousness. He is no longer shy. He will speak if asked—or if he has an idea he will out with it without trepidation. It is all one to him whether his picture is published or not—if it will please anybody, ever so little, he is willing to help. If he can help by writing from his experience, or if anybody thinks he can help, well and good: he will write. But if no one wants him to write, if he has no conscious message, it is all one to him whether he never sees his name in print, or whether the newspapers are spotted with his name and doings.

He loves mankind, and is humble, yet is thankful for his ticket to the stage of life; he is determined, yet kindly; he wants to serve, in all things big and little. He does not pride himself on his modesty, nor does he pride himself on his ability to get on. He is not oppressed by his greatness, if he has risen to one of those little great positions which look so large to the man of narrow experience and of short perspective.

When some future city shall be to New York as New York is to Rome, as Rome was to Babylon—when then will be your little eminence? Verily, the future historian, a hundred years hence, shall not be able to locate thee with a fine-toothed comb. That time will come soon enough. Therefore, shed the oppressive robes of sequestered dignity, and get busy, and circulate freely while your little day is still bright. You'll be a long time dead.

(Engineering and Contracting).

HOW TO DO RESEARCH

I have never done any research. I am therefore able to give unbiased advice regarding it.

Research—in the broadest sense—consists largely of repairing leaks in glass tubing.

More specifically, it consists of gathering in a cell down in some basement a weird assembly of switches, wires and glass tubing—and then keeping others from borrowing it.

Apparatus may be borrowed or acquired. If you borrow it you are expected to return it. If you acquire it, you keep it until you are found out.

In order to do research, one must have ideas. **One** idea is sufficient. Two ideas are apt to contradict each other.

By all means do **not** search for something original. If you think you have a **new** idea read Professor Groszkopf's articles in "Zeitschrift fur So und So," published about 1700. You will find he suggested the same thing two centuries ago.

After all, it is doubtful whether even one idea is necessary. Merely get some apparatus, solder it together and take readings.

Readings are always taken through a telescope.

You will get certain numbers. Plot these numbers against other numbers which you get from variable parts of the apparatus.

If you get a straight line on plotting your observations you know at once that the results could have been predicted.

However, if you get a curve the situation is different. Examine the curve carefully for sharp bends or breaks. If you find one, you have made a discovery. These breaks are significant. Consider carefully what may have caused these breaks. Try to trace them to atomic or electronic phenomena. Draw a picture of the atom. Don't be discouraged if your picture doesn't agree with other pictures, it doesn't mean anything anyhow.

Having obtained a curve and concocted a theory, it is befitting that you present the whole to some Club.

It is fitting here to give yo.. details or your conduct at the meeting.

The latter is always preceded by tea. While this is being served go into the lecture room and copy a few weird sketches of your apparatus on the board. Make everything as complicated as possible. Also prepare a few slides. They may be shown at embarrassing moments.

As soon as the club is assembled, gaze upon them with a dreamy eye and begin your talk.

The first step is to write nine long equations on the board.

Somebody will call your attention to the fact that the fifth term of the first equation should have a minus sign.

Memorize the equations beforehand if possible. Write them rapidly.

The success of your talk will depend directly on the number of people you can shake off at this point.

Mathematics is always helpful in this way. If your audience looks too intelligent, cover the board with partial derivatives and integral signs.

Having presented the equations dwell at great length on the sub-electron, the rigidity of the ether, or the density of petrified rhubarb in Siberia.

Finally, when you see that vacant stare, indicative of a temporary lapse of intelligence, steal into the eyes of the front row, it is time to stop.

Pause for effect. Gather up your books—several volumes of "Annalen der Physik" and four score and seven sheets of loose notebook paper and ask for questions.

There will always be questions. They are indicative of an intelligent audience.

Then there will be a discussion. In this **you** will have no part. However, at its close you will be convinced of three things:

First: that you were entirely wrong.

Second: that you did a fine piece of work.

Third: that it doesn't mean anything.

The moral of this paper is: It is much easier to take data than to interpret the results.—Science.

HIGH ARCHITECTS IN DESIGN

Senior designers completed their study of "a small golf club," a Beaux Arts problem, the last of November and the awards were—"Mention Commended," Henry Gerlach; "Mention," Frank Moorman, Edna Croft, Paul Damberg and C. H. Hinman. The final problem of the first quarter for the seniors was "a naval pantheon," and the high grade in this short problem was "Con-credit," Arthur Strom, Donald T. Graf, Paul Damberg and W. A. Backstrom receiving that mark.

John Walquist, E. L. Johnson and W. A. Backstrom received "Mention Commended" on the Junior's long problem, while Edward Holien, M. J. Markson, Theodore L. Sime, William E. Willner and Richard Hennessy drew "Mentions." The problem was "a commemorative chapel." Credit was the high mark on the final Junior short problem, "a music building," Walquist, Johnson, Willner and Holien scoring.

The final short problem for the Sophomores, a plan problem of "an orphanage" brought one "Mention Commended" for Christmas. Herman M. Frenzel received that mark while Harold E. Nelson, Horace W. Tousley, Tresa E. Snure, Reinhart Teige, R. W. Ward and Isadore W. Silverman drew "Mentions." Six others receiving "Credit" were Florence Knox, L. A Tvedt, William Woolett, Glanville Smith, Paul E. Nystrom and Wallace C. Bonsall. Two men, Harry Hanson and Smith scored "Concredits" in the sketch problem for "a foreign colony building."

Professor A. S. Cutler was called to Ashland, S. Carolina, during the recent illness, and death on November 26, of his father. The Techno-Log extends its sincere sympathy to Mr. Cutler and to the other members of his family.

TAU BETA PI ELECTIONS

The following men were elected by Tau Beta Pi, honorary engineering fraternity, at the close of last quarter: O. B. Anderson, Thomas S. Lovering, Norman S. Cassel, William E. Willner, C. Floyd Olmstead, A. S. Levens, Clayton E. Hemsey, Ronold E. Ost, H. J. Frost, J. F. Keeler, W. K. Cook, Paul S. Damberg, Charles M. Burril.

ALUMNI NOTES

Ralph A. Greenman favored us with a most interesting letter last week. Writing from his new home at 1723 Thirty-fifth Street, Washington, D. C., he gives the impression of being very well satisfied with the city as a pleasant place to live and work in. He has just completed a ten months' job of transforming a brewery at Rosslyn, Virginia, into a modern lithographing plant. He says that skilled labor at reasonable wages is difficult to secure there as war-time pay is still being demanded. For this reason he has been obliged to spend a lot of time on detail and supervisory work, gaining, he says, some interesting and valuable experience. We wish him continued success.

Clayton F. Gibbs, '18, is with Holmes and Sanborn, consulting engineers, with offices in Los Angeles. Last July he married Margaret Hoffman of Minneapolis. He informs us of another benedict of the college in the person of Louis W. Tannehill, '16, who also chose a Flour City bride—Miss Dorothy Weston. Mr. Tannehill is heating engineer for the same concern that employs Mr. Gibbs.

Lee M. Coleman, '97, is with the Curtis-Yale-Holland Company, sash and door manufacturers of Minneapolis.

Ed. G. Chilton, '13, recently married Martha L. Anderson, '14, of Decorah, Iowa. They have made their home at 1002 Summit Avenue, Detroit, Minnesota.

Lieutenant Willard W. Scott, E.E. '17, is now at Fort Winfield Scott, San Francisco. He has been an officer in the Coast Artillery since October 26, 1917.

A. W. Luce uses his training as a Minnesota man to aid others to aspire to the same heights. He is an instructor in chemistry and mathematics at Pleasant Hill Academy in far-off Tennessee. Mr. Luce also has charge of athletics at that institution.

H. A. Barber, '21, is now engaged in municipal work for W. L. Tahey, consulting engineer at Spencer, Iowa.

Edward Berenger, Arch. '19, was married August 12 to Miss Gertrude Webber of St. Paul. After a short honeymoon they have returned to their new home on Jefferson Avenue, St. Paul.

George Frazier is an assistant professor at Ohio State.

Roy O. Papenthien, '21, is an architectural engineer for Van Ryn and De Gellere, 726 Caswell Building, Milwaukee. He changed his address of residence last month to 758 51st Street, Milwaukee, Wisconsin.

Wen Ping Pan, '18 Mines, is a mining engineer with the Oliver Mining Co. at Hibbing, Minn. His residence is at 311 Sellers Street, Hibbing, Minn.

Clayton P. Gibbs, '18, recently moved from San Gabriel, California, to 215 East Bay State Avenue, Alhambra, California. Mr. Gibbs has been with the Holmes and Sanborn Co. as an electrical engineer.

A. E. Ellsworth, C.E. '06, is now District Engineer for the Great Northern Railway at Great Falls, Montana. His home is in the same city at 1918 Second Avenue South.

Edward Anderson, Chem. '08, is assistant professor in chemistry at the University of North Dakota. He resides in Grand Forks at 121 Vernon Avenue.

E. A. Arzt, E.E. '97, is an electrical contractor in Sioux City, Iowa. He is very prominent there, being a Rotarian and a member of the local Chamber of Commerce.

R. B. Bauer, '20, is with a St. Louis concern installing automatic substation and power-house equipment in a coal mine.

Wallace H. Martin, '10, is professor of heat engineering at Oregon Agricultural College.

Carl S. Johnson, '21, who is with the Oliver Mining Company, is now at their Holman mine. He is making monthly stripping estimates. He spends much time on field work. Carl should become an Arctic explorer,—it's just as frigid.

R. Elstad, '19, L. Battles, '18, are other Minnesota men in the same district. Wen Ping Pan, '18, is in Hibbing with the same concern, and lives at 311 Sellers Street there.

A. E. Elsworth, '06, is district engineer for the Great Northern Railway at Great Falls, Montana. His home address is 1918 Second Avenue North.

Edward Anderson, Chemistry '08, is assistant professor of chemistry at the University of North Dakota,

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Walter K. Hartman, '19, is in the engineering department of the Western Electric Company. He lives at 3210 Arthington Street, Chicago, Illinois.

C. C. Ruchhoft, '20, is sanitary bacteriologist with the stream polution division of the United States Public Health Service. He has recently been transferred from field service in Illinois to the central laboratories in Cincinnati, Ohio.

George Frazer, '19, is an assistant professor in architecture at the Ohio State University.

Henry B. Avery is with the Flour City Ornamental Iron Works. He is designing and selling bronze memorial tablets.

M. H. Gerry, '19, has left Montana and is in Minneapolis as chief engineer at the St. Anthony Water Power Company's plant.

AS THE EAST IMPRESSED A GOPHER

By Rheuben Damberg, '21

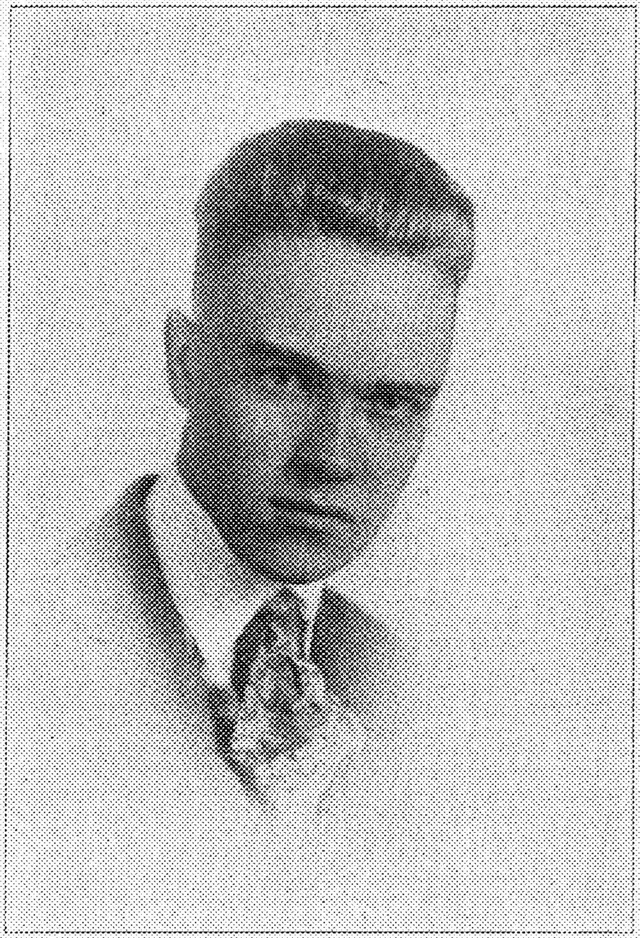
Winner 1921 Moorman Prize

It is my intention to give you in this story a brief account of the important places I visited and some of the impressions gained of the East. It may be well to state, for the benefit of those who do not know, that the Moorman Prize in Architecture is a domestic travelling fellowship offered each year by Mr. A. Moorman, St. Paul, to the winner of an architectural design competition. It consists of a trip through the largest cities of the East for the purpose of studying the best examples of modern architecture and of visiting the Eastern colleges and architectural schools.

On my tour of the East, I visited in Chicago, Detroit, Boston, New Haven (Yale), New York, Princeton, Philadelphia and Washington. My stay in each city, depending upon its size and importance, varied from three to six days. In order to "cover" the larger cities as thoroughly as possible I used surface, elevated and subway cars to advantage, and found that ten to fifteen miles a day on foot not only proved the best means of sightseeing but was a great appetizer as well. Naturally, in every city I rode the celebrated "rubberneck wagon," whose leather-lunged skippers I found could locate for me in two hours more points of interest than I could glean from a week's study of guide books and histories.

From my contact with people both in a business and social way, I unconsciously formed impressions of the Easterners which, I value as important factors in the study of the modern American style of architecture. The typical Easterner, with his extreme culture and refinement; his typical dialect; his slow, deliberate way of expressing himself; and the almost abstinance from slang or short-cut expressions, was, until I became accustomed to him, really quite amusing. One very noticeable trait of Eastern city people which particularly impressed me was the straightforward, independent manner in which they go about their work. They seem unconcerned and apparently oblivious to everything going on about them. Even an automobile accident fails to attract much attention (possibly because it is such a common occurrence). I am convinced, however, that the conditions under which the city folks live accounts for this outward air of indifference and that, if given an opportunity to show it, they are every bit as human as Westerners. Invariably, when asked a question, the average city person would give me a civil answer and would often go far out of his way to lend a helping hand.

I received my first indelible impression of modern city life in all its complexities during my sojourn in Chicago. But even Chicago was forced into the background when I had experienced the thrill of a Sunday night on upper Broadway, New York. It is on this world famed thoroughfare that are found the dazzling and bewildering lights that inspire men to do great things, and it is here that movie fans and window shoppers satisfy their hungry eyes. New York, especially lower Broadway, exemplifies the extreme in concentration of business, characteristic



RHEUBEN DAMBERG

of all our large Eastern cities, which has resulted in the modern skyscraper. My impression of the height and magnitude of these architectural wonders was strengthened as I wandered down through the shadowy canons towards the country's great financial center, Wall Street. I did not get a true conception of New York and the vast scale on which business is carried on until I had gone through some of the typical skyscrapers and studied their organization in detail. Each of these office buildings is a small city in itself. A population of from five to fifteen thousand is housed under one roof during business hours. Each building has its "railway system" in its elevators, its water system, light, heat and power plants, postoffice and telegraph station, uniformed police force, restaurants and shops. In the Woolworth building alone are housed great banking institutions, executive and clerical staffs of great industries, representatives of big business enterprises and leaders in all professions.

I had the privilege of going through the architectural offices of McKim, Mead and White while in New York and at that time a large force was at work on drawings for a new skyscraper to be built on lower Manhattan. The amount of study and labor put on a set of plans for such a building is almost beyond conception. The construction alone of these, the tallest buildings in the world, is so complex that a volume would be required to do justice to the subject. It is sufficient to say that they are so well designed and constructed that at the top of the most modern types, where scientific observations have been made, no vibration whatever is detected even during severe wind storms.

The view from the observation gallery of the Woolworth building, fifty-five stories above the street, is even more thrilling than a good bill at the Minneapolis Gaiety. From this great height one can see for twenty-five miles in every direction, and looking into the street below one can obtain an excellent plan view of New York's congested but well regulated traffic. The people resemble an aggregation of pygmies and the streetcars and automobiles a collection of toys. But New York is not all skyscrapers. There is beautiful Central Park with its zoo, Riverside Drive, the Metropolitan Art Museum, Fifth Avenue (the fashionable thoroughfare of New York, famed for its aristocratic mansions and exclusive shopping district), Columbia University and scores of other extremely interesting places which for lack of space I dare not begin to describe.

In contrast with the tense business atmosphere of New York I found Boston a comparatively quiet, dignified and quaint old city. The very layout of the old part of Boston, with its crooked streets and narrow alleys leading sooner or later to the large centrally located Commons and with its historical old churches and burial grounds set down in the heart of the business district, presented such a picture of interest and appealed so to me that I enjoyed being hopelessly lost my first day there. Boston and some of its neighboring old New England towns abound in examples of the purest and finest Colonial architecture in the United States and with the aid of my camera I was able to take away much for future use. The review of history one gets from a visit in Boston and its surrounding sections is delightfully refreshing. Some of the most historical landmarks are Christ Church, where the lanterns were hung warning Paul Revere of the approach of the British, the identical spot where this hero began his famous "midnight ride," Bunker Hill, where the battle of that name was fought, Hawthorne's birthplace, and at Salem, the House of Seven Gables.

Boston is the center of culture and learning in the East and I availed myself of the opportunity to visit its numerous institutions of learning, the most important of which are the Massachusetts Institute of Technology and Harvard. At the latter I met three Minnesota graduates—Loye, Kleinschmidt and Dahl, who are taking advanced work in the architectural school. I had a most interesting visit with these friends and through them had an opportunity to meet and talk with Harvard students both at the architectural school, where I attended some of the classes, and at Memorial Hall, where I sat down to some of the most enjoyable meals during my trip. Most of the men whom I had occasion to come in contact with, I found were much older and more experienced than the average run of students at Minnesota, Columbia or the University of Pennsylvania. This is due possibly to the fact that Harvard's technical schools are graduate schools. Many Western college men go to Harvard, Yale or Princeton for their graduate work, not because of better courses or instruction offered at these schools, but because of the prestige and traditions behind them.

I was told by the former Minnesota men that there is a decided lack of co-operation among students at Harvard, due to the fact that there is no University Postoffice. This fact can well be accounted for when we recall that Harvard is not a co-educational institution. Can you imagine a campus, or rather a "yard," as the students there insist on calling it, without women? It may be difficult for some of you engineers and architects to realize such a sad state of affairs but think of the blessing of getting up two minutes before class time, saving a precious moment by letting your hair go uncombed and forgetting such a minor detail as a collar and tie, and just "making" that class.

On my last Saturday in the vicinity of Boston, I followed the Harvard band across the Anderson bridge to the huge concrete stadium, where I was one of the 45,000 who saw Center defeat Harvard in what I considered a poor exhibition of football. The crowd showed little interest and enthusiasm and even the teams lacked the necessary pep and punch. I might have gone back with a poor impression of Eastern football had it not redeemed itself on the following Saturday when, after a week in New York, I went down to Princeton to witness the spectacular game between Princeton and Harvard, in which all the scoring was done in the final period. It was a clean, fast, hard-fought game, full of thrills and with student support such as only Minnesota can give.

After spending three profitable and enjoyable days in Philadelphia, during which time I visited the architectural school at the University of Pennsylvania and witnessed a grand reception for General Diaz, the Italian commander, I left for Washington, where I celebrated the last days of Armistice week. I found the capital city suggestive and stimulating, not only because of its spaciousness, dignity and architectural beauty, but because of its numerous scenes with which one associates historical events and well known heroes of the past. The government buildings and grounds, which include the Mall containing the Washington Monument and the magnificent Lincoln Memorial, were especially attractive.

On Armistice day, my last in Washington, I witnessed the burial of America's Unknown Hero, and in the evening took part in a spectacular celebration for the opening of the Armament Conference. Words can scarcely describe the feelings which surged over me during these impressive ceremonies. They were indeed a fitting climax to this most eventful and educational trip.

MODERN MIRACLES

An Irishman, who had returned from a visit to the old country, was telling a friend of the sights that had impressed him.

"But the funniest of all is their little tillyphone," he said. "'Tis a quare little insthryment that ye put up to your face, wan end to your ear and wan to your mouth; and then ye say, 'Are you there?' and the fellow at the other end answers yes or no—as the case may be."—Youth's Companion.

QUITTING ON TIME

"Bill's going to sue the company for damages."

"Why? Wot did they do to 'im?"

"They blew the quittin' whistle when 'e was carryin' a 'eavy piece of iron, and 'e dropped it on 'is foot."

ELECTROLYSIS

Continued from page 8

seems economically possible. From that standpoint the problem should be approached in another way. Insulating joints have been used to some extent on services, but this also involves considerable expense, and has not been generally adopted.

With water mains, the use of cement joints has been limited by pressure conditions. Cement has not been used on gas mains where the pressure is above five pounds and water main pressure is sixty pounds and above. Some water companies have used cement, but it is not in general practice. Leadite and metallium have been used on water mains, but while they are high resistance to start with, after a time the chemical reaction in the setting of the sulphur compounds seems to reduce the resistance to a very low point. They are not as yet in general use.

Combination joints of lead wool and cement seem to make up very rigidly and the electrical resistance is apparently very low. There is no chance for pulling of the joint and the formation of oxide which makes for high resistance joints when only lead is used.

It is not to be understood that if gas mains are laid up with cement joints, that it will eleminate electrolysis altogether, particularly if the water mains are heavily drained to the car tracks. The numerous connections through water heaters will cause interchange of current from the water mains to the gas mains, and current may leave the gas services or mains to go somewhere else. This illustrates the danger that draining one system may have on the other, and the difficulties of drainage in general. The same trouble arises in over-drainage of cable or any other underground structure.

The effect of electrolysis on reinforced concrete should be mentioned. The bond between the reinforcing iron and the concrete is destroyed, whether the current flows to or from the structure. In one case the formation of oxide swells and splits the concrete and in the other case the crystalline structure of the concrete is destroyed. This is another danger to be attributed to electrolysis.

There has been much discussion on the subject of pipe drainage and at present it is extremely controversial matter. It has been a fairly successful remedy in the case of cables, with their continuous sheathes, but in the case of mains, particularly gas mains, the high resistance joints and inflammable nature of the substance carried therein make it dangerous to drain excessive currents from the pipe. The subject of high resistance joints is now being investigated by the Research subcommittee of the American Committee on Electrolysis, and there is yet much to be learned on this subject, but it is a fact that high resistance joints exist and their shunting effect on the current on the main with its consequential damage is a danger seriously to be considered. If one underground structure is to be drained, all should be drained, otherwise, all the evils of competitive drainage exist, and, moreover, all substructures would have to be joined together by cables whenever they came close together.

In the case of an interurban running into a small town, it is difficult to handle the stray currents, except by proper drainage, because the whole main system acts as a ground plate to collect the stray currents permeating the earth from far out in the country and is generally positive to the tracks all over town.

The insulated negative feeder system has been used with very material benefit in combating the electrolysis evil. It consists of insulated cables of large capacity connecting the negative bus and the tracks at some distance from the station. In effect it creates a number of substation districts, wherever it taps the rail, and in theory it is intended to break up the current density in the rails to within their proper capacity, instead of having all the current come down to one point on the system. It increases track drop because it raises the potential of the tracks above the bus-bar by about 10 to 12 volts in most systems, but it relieves the danger of a low potential sink hole and excessive concentration of current on substructures in the down town district. The equipotential negative feeder system is one in which all points on the track system, where the negative feeder cables are attached, are at the same potential, and consequently at some points the current in the track will be flowing away from the station. This system does not utilize to full advantage the carrying capacity of the rails. The graded potential insulated negative feeder system is one in which the potential at the various negative feeder taps to rail is adjusted so the current flow in the rails will always be toward the station. This system utilizes the carrying capacity of the rails as much as possible, and as the average rail is equivalent to copper in the ratio of 10,000 circular mils per lb. weight per yard, this is quite an item, viz.,—a 100 lb. per yard rail is the equivalent of a 1,000,000 c.m. copper cable. In general the insulated negative feeder system when properly installed and kept up and in conjunction with properly bonded rails will cut down electrolysis damage very materially. The advent of the automatic substation will undoubtedly forestall any great extension of the negative feeder system, because it reduces the overall potential and does not consume a lot of idle K.W.H. in heating up resistance grids, or long lengths of copper cable. It also reduces the positive feeder losses. A noteworthy example of this is the City of Des Moines, where they took down enough copper to install sufficient automatic substations to operate the entire system. This is one of the greatest strides forward in street railway power distribution, both in the reduction of distribution losses generally and in electrolysis mitigation as well, for it hits the evil at its source. To put it another way, 500 K.W. available out where it is needed on a moment's notice, is worth 1,000 K.W. several miles away in a station down town.

A word might be said as to track construction. Of course, it is practically impossible to construct a roadbed in the city streets which would absolutely prevent leakage of stray current, but much can be done in the way of properly installing crushed stone ballast and ties, so as to keep the leakage down to a minimum.

The three-wire system of distribution for street railways was suggested some 25 years ago, but has never been put into general practice. There are some half dozen cities in this country using it with some degree of success, but there is undoubtedly much pioneer work to be done on this phase of the problem. There are several methods in vogue, notably,—the sectionalized trolley and the parallel three-wire system. In the first, alternate sections of trolley are made plus and minus, with the region in the vicinity of the substation trolley positive. The difficulty of this system is the interchange of current between cars, which may be a long way apart and the consequent reversal of potential in the outlying districts. The cable owning companies find it extremely hard in this system to find a point of low potential to drain to. The overall track drop is greatly reduced by this system and relatively small current is returned through the tracks.

In the parallel three wire system the two trolley wires on a double track system are plus and minus, 1,200 volts between them. This system seems to be more easily balanced than the other, but there is some difficulty with the electrical construction at crossings. Usually they are made of one potential, so as to avoid danger from arcing, etc., with 1,200 volts between the wires. There is much to be said for the three-wire system and it may be that it will be worked out to be the ultimate solution of the electrolysis problem. The results on those street railways now operating three-wire should be studied carefully.

Some companies have tried reversing the trolley wire potential, making it negative, but this spreads the trouble to outlying districts where it is more difficult to watch, and it is only a makeshift at best. Other companies have tried reversing the potential every twelve hours and have claimed some degree of success, but this has not come into general practice and little is known of it. One property, out on the Pacific coast, operates under this system.

The problem of electrolysis is one that requires co-operation of all utilities, it is an engineering problem that is susceptible of analysis if constructive work is done by all the interested parties. There has been a great deal of real progress made in the last few years, but there is still much to be learned. This can be done only by the active work on the part of the technical men of the various operating organizations and the problem should be met fairly and squarely on the basis of facts. Many of the larger cities of the country now have active electrolysis committees, consisting of representatives of all the utilities, which meet frequently and discuss progress in the past and plans for the future from an unbiased standpoint. The American Committee on Electrolysis, consisting of representatives from all the national engineering societies association, has done a great deal of good work in the past few years, in co-operating with the Bureau of Standards and through their research subcommittee, much original matter has been worked out. Their report will soon be published, but their work is not yet done and they have a very comprehensive plan of work for the future mapped out. Much good will be accomplished by their work and the problem of electrolysis will eventually be solved as it should be, by a careful weighing and consideration of all the economic features involved.

ST. PAUL'S NEW UNION DEPOT

Continued From Page 6

In comparing the St. Paul depot with other large terminals in the west, Mr. Armstrong said that it ranked with the Northwestern Station at Chicago, and the Union Depot at Kansas City. The total expense of the St. Paul project, he said, would be less than that of the Kansas City terminal because of the greater difficulty experienced there with track approaches to the station yards.

The depot contract has been in the hands of Morris, Shepard, Dougherty, and George J. Grant Construction Company. This contract expired December 15, 1921, and the terminal corporation proceeded alone to the completion of the work. The withdrawal of the contract at that date, Mr. Armstrong stated, was not due to any dissatisfaction with the contractors, but mainly because the Depot Company felt that they were in a position to execute the work to completion themselves.

The original estimate for the cost of the terminal was $11,000,000. The final cost, however, will, in all probability, exceed this amount because of the fluctuation in the prices of materials and wages during the period of its construction.

The union station project has been carried out under the direction of W. C. Armstrong. Mr. Armstrong was for many years bridge engineer for the Northwestern Railroad and won a commendable reputation in building the Boone Bridge in Iowa.

The construction organization includes W. C. Armstrong, M. A. S. C. E., Chief Engineer, with G. H. Wilsey, structural engineer in charge of design, and O. L. Hoebel, assistant engineer in charge of construction. Charles S. Frost, of Chicago, is the architect and was represented by Lambert Bassindale on the ground. W. R. Powrie, M. A. S. C. E., was the general superintendent for the contractors.

Cirilo Romero, '17, has recently returned from Panama, where he has been engaged in engineering work.

F. W. Hvoslef, '17, is with the United States Radiator Corporation as assistant chief engineer. He is also secretary of the Detroit chapter of the General Alumni Association.

I. C. Morris, '08, is also living in Detroit. His address is 822 Book Building.

J. W. Pierson, '19, is assistant boiler engineer at the Quarry Street station of the Commonwealth Edison Company in Chicago.

Albert E. Peterson, '19, is in the efficiency department of the same concern. He lives at 2125 Jackson Boulevard.

Clarence Q. Swenson is now living at 50 West Euclid, Detroit, Michigan.

Roy O. Papenthien, '21, is architectural engineer for Van Ryn and Gellere of 726 Caswell Building, Milwaukee. He lives at 758 Fifty-first Street, Milwaukee.

HE WAS SAVING IT

Two boys came across an old darky belaboring a balky mule with a stake. One of the boys, being tender-hearted, went up and expostulated with him.

"Don't beat him with a club that way," pleaded the boy.

"Wut will I do with 'im?"

"Kick him in the stomach!" said the tender-hearted boy.

"No, suh! No, suh!" said the old chap as he prepared to resume hostilities with his club.

"Why not?" demanded the boy.

"'Caze I'm savin' the kick in de stomach fer de hill yender."

BETTER LIGHTING NEEDED IN INDUSTRIAL PLANTS.

In a paper read before the Illuminating Engineering Society, February, 1920, entitled, "A Survey of Industrial Lighting in Fifteen States," R. O. Eastman submitted some very interesting data regarding the lighting conditions in industrial institutions. The survey comprises some 446 institutions, in which lighting was considered by 55.4% as being vitally important, and by 31.6% as being moderately important, and by 13% as being of little importance. Practically 58% considered that lighting was as important as power in the operation of the plant, and a small proportion would give more attention to lighting than to anything else.

In considering the present condition of lighting as found in the various plants, only 9% ranked as excellent, about ⅓ ranked as good, 29% fair, 18.8% poor, 3.5% very poor, and 7.8% partly good and partly poor. It was found that the lighting in the offices was far superior to that in the shops; 19% being excellent, 36% good, 31% fair, and only 13% poor and none very poor.

On consulting the executives regarding what factors were most important in considering lighting, the following facts were revealed: Increase of production 79.4%, decrease of spoilage 71.1%, prevention of accidents 59.5%, improvement of good discipline 51.2%, and improvement of hygienic conditions 41.4%. Manufacturers who have good lighting appreciated its value largely from the standpoint of its stimulating effect upon output.

There is no question that any intelligent man who carefully considers the necessity for good lighting in an industrial plant, will agree that it is impossible for a person to do as good work, either in quality or quantity, in poor light as in good light, but yet the result of a careful analysis discloses the fact that only about 40% of industrial plants are furnishing good light to their workers and 60% are operating under poor lighting. It is hard to understand why such a proportion of concerns can be satisfied with a condition which is universally admitted to be a curtailer of efficiency and a prolific causer of accidents. The principal cause of this condition is that those in charge of such establishments have not given the attention to lighting that it demands. They do not know what constitutes good lighting, and in their absorbing interest of other factors of production have overlooked a vital one.

Every safety official should deeply interest himself in the lighting of his plant and insist upon good lighting as much as good goggles, good guards and other necessary accident prevention equipment. Every production manager should insist upon good lighting because the efficiency of the working force is increased by the condition of the lighting furnished. The plant physician should examine the lighting, for eye strain and eye fatigue are directly affected by poor lighting, as is the hygienic condition. Well lighted plants are invariably cleaner than poor lighted places. Plants equipped with Factrolite Glass in all windows are well lighted.

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No. 5.

January 27th

BIG MASS MEETING

OF

Association of Engineering Students

JANUARY 27th

Final Selection of Emblem by Engineering Students

JANUARY 27th

Announcement and Awarding of Prizes to Winner in Emblem Contest

JANUARY 27th

Election of Junior Represenitive to National Convention of Association of Collegiate Engineers

JANUARY 27th

Election of Officers for St. Pat's Day

JANUARY 27th

EATS ENTERTAINMENT FUN

JANUARY 27th

EVERY ENGINEER INVITED

January 27th

MINNESOTA TECHNO-LOG

Vol. II | February, 1922 | No. 4

IN THIS ISSUE

Published monthly during the school year
by the students of
The College of Engineering and Architecture and the School of Chemistry
University of Minnesota


KOEHRING
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CONTENTS

Direct Radiation in Residence Heating

By F. W. Hvoslef, '17

The appearance in the December number of the **Minnesota Techno-Log** of an article entitled "Temperature Variation in House Heating" prompts me to make a statement on the use of direct radiation, in which my conclusions will be somewhat at variance with those arrived at by the author of the above mentioned article. His conclusion seems to be that there is a definite need of regulation on heating systems, and further that "warm air heating under intelligent operation or when automatically regulated will give less variation in temperature" than in the case of direct radiation; further, that warm air heating will enable the owner to warm up his house more quickly than is possible in the case of hot water heat.

I quite agree to the need of regulation in any heating system, although manual regulation may frequently be very satisfactory in the case of a properly installed heating plant. In the present day, however, automatic equipment has reached such a stage of development that automatic heat regulation becomes almost a necessity, and is in any case quite desirable. That there will be less variation in temperature with hot air I must deny. It fluctuates more rapidly and more extremely, and in the following discussion I shall endeavor to show the superiority of direct radiation as a heating medium, both from the view point of regulation and of satisfaction given.

Before going on to the discussion of the advantages of this type of heating, I wish to briefly outline some of the common objections to hot air heating. A hot air plant depending upon gravity for circulation is satisfactory as a heating agent only in small installations. By a small installation I mean one in a residence of six rooms or less. Such a plant, if properly installed, will satisfactorily heat the entire house on normal days; that is, to say, on days when climatic conditions are steady and the wind is moderate. The force of wind is the cause of most of the difficulty encountered in the use of hot air systems, owing to the fact that it causes a pressure on the windward side of the house, which counteracts the very small pressure in the heating pipe due to the difference in temperature of the air in the pipes and outside. In the case of a moderately high wind, therefore, it is practically impossible to heat a room on the windward side without aid of some mechanical agency. It is very difficult to construct a hot air system which will not be a nuisance, because of the presence of dust and dirt carried up in the pipes and the frequent appearance of coal gas in the air admitted by the registers. Only in the very best hot air systems is the coal gas and dust thoroughly obviated, and then only by the use of a more expensive construction than is usually allowed. Inasmuch as air is a comparatively poor conductor of heat, it is necessary that the metal parts of a furnace become much hotter than in the case of a boiler, with the result that the life of this installation is very short. It soon develops leaks and cracks and becomes an ever increasing nuisance, due to dust and gas. Nothwithstanding, the use of a water reservoir in the air chamber, the air which passes from the heating surface of the furnace is parched and dry and frequently gives rise to uncomfortable throat and nose conditions, unless extraordinary means are taken to humidify the air. Furthermore, a hot air system once installed is not susceptible to easy expansion of the system nor correction of errors in installation, in case it is found that certain registers are of improper size. From the view point of efficiency, the hot air furnace shows a loss considerably greater than is found in the case of steam or water installation. Tests performed by the University of Illinois Experiment Station, show that under the very best conditions the efficiency of good hot air furnaces is only 54½ per cent. Even with the above objections in mind, however, I am quite ready to admit that a small system of hot air heat properly installed can be quite satisfactory. Under similar conditions with a properly designed system a direct heated job will be far more satisfactory.

As the conditions which constitute a properly installed plant are of great importance, I shall digress from my topic for a time and outline in a general way the essentials which go to make up a well working heating installation. Possibly the following ten conditons cover the requirements to be looked for in rating the perfection of a heating plant: namely, a good house; a proper chimney; the best boiler available; the proper size of boiler; proper fuel for the conditions given; proper operations under the conditions given; sufficient radiation; properly placed radiation; correct pipe sizes and properly installed piping. Upon these heads I shall enlarge somewhat and explain what conditions are to be looked for under each.

It was a favorite statement of Dean Allen that it took more coal per room to heat houses in Texas than in Minnesota. A comparative study of the type of construction used in these places, together with a study of heat transmission tables will explain this statement. In Texas the houses are poorly built, with single windows and possibly loosely fitted sash. There are undoubtedly many Texas houses to be found in Minnesota as well, but in general the people in the Northern States have found it necessary to build houses with well insulated walls, double windows and with the best fitted sash. Such construction more than pays for itself in the saving of fuel and in the ease with which a heating plant may be operated.

Few people realize the importance of correct chimney construction. Frequently the chimney is squeezed into any available dimensions which may be found after the house has been fully designed As architects and engineers are becoming aware of the importance of this item, greater attention is being given to it. A good chimney must have the proper area and must be of suitable height, otherwise the fire will respond very slowly to changes in draft. These requirements are usually to be found in catalogs of the boiler manufacturers. The December, 1921, issue of the Heating and Ventilating Journal gives a table of proper chimney heights. I might say in connection with this table that the dimensions given are probably the very minimum to be allowed. The chimney must be of the best masonry construction and should preferably be tile lined. There should be no other openings in the chimney.

All boilers now on the market will probaly operate with more or less satisfaction. In choosing a boiler, however, it is wise to choose the product of an established manufacturer, whose output has stood the test of time. This manufacturer will always be ready to furnish repairs when such may be needed, and, as his continued success depends upon the satisfactory service given, it will usually be found that the claims which he makes for his product are valid. There is great competition in the field of boiler manufacture, and there is a tendency on the part of some to resort to price wars and price cutting. The established manufacturers stand by their prices unflinchingly.

Without going too much into the details of boiler construction, I wish to say that one of the important items to consider is the depth of fire pot. A deep fire pot with tapering sides, resembling a truncated cone standing on its base, is the best type. In such a fire pot, as the fire settles during combustion, the ashes drop away from the sides and always leave a clean heating surface exposed to the direct rays of the fire. A large body of fuel aids in the easy regulation of the system as it is more quickly responsive to changes in draft conditions. An additional detail of some importance is the number of nipples used in assembling the fire pot with the intermediate rings and dome. In order that a steady flow of water may take place with proper circulation, there should always be two nipple connections between sections. It is understood, of course, that I speak only of Round Boilers in this case.

The proper size of boiler to select depends a great deal on the draft available. With a properly constructed chimney of sufficient height to give a good draft, the boiler should be assembled with several intermediate sections, in order that the heat of the gases may be thoroughly absorbed by this indirect heating surface. Where the draft is poor a boiler having a large fire pot should be used with less indirect surface. In this case the direct heating surface is depended upon to give the best efficiency, and if the draft rises beyond reasonable limits, a high smoke-hood temperature will probably result. In general, the evaporative efficiency of a boiler with several intermediate sections will be somewhat higher than in the case of a boiler with few intermediate sections, although this general statement must be modified for the varying draft conditions encountered.

The proper fuel to be used depends upon the draft available. In every case pea coal and coke require plenty of draft, and in the case of coke particularly a large fire pot with ample direct heating surface is very desirable. The use of soft coal demands ample draft with a large volume in the fire pot to compensate for the lower specific weight of bituminous coal. The high volatility of soft coal makes it also necessary that ample indirect heating surface be supplied for efficient results.

On the item of proper operation it would be possible to write a volume. In general, I might say that proper operation is intelligent operation, and is attained only with experience. The boiler manufacturer usually supplies operating directions with the boiler, and if these directions are followed, good results should be obtained. A few essentials might be pointed out, however: A deep fire is always the best fire. In mild weather the fire may be kept deep by allowing the ashes to accumulate on the grate, agitating them slightly to permit the passage of air for combustion. A clean ash pit is necessary for the long life of the boiler.

If ashes are permitted to accumulate below the grates, the grates will soon burn out. Frequent sweeping of the flues greatly increases the efficiency of the boiler. Tests performed by the Institute of Marine Engineers show that accumulation of soot on heating surface of boilers causes loss in conductivity as follows:

Thickness of soot.	Loss per cent.
Clean	0.0
1/32″	9.5
1/16″	26.2
⅛″	45.2
3/16″	69.0

The best results will always be obtained by regular and careful attention. It is disastrous to the efficiency of the plant to permit it to cool off until the house is very cold, and then attempt to heat the house quickly by forcing the boiler.

The remaining items mentioned have to do with the transmission of the heat from the boiler to the rooms of the house, where it is to do its work. Proper balance of radiation is essential for satisfactory heating. If the radiation has been carefully selected to give the proper temperature in the various rooms, it should be a simple matter to regulate the heat at all times so that all rooms are comfortable. If some rooms have too much radiation and others too little, it will never be possible to obtain satisfactory operation. If there is too little radiation, the time required to heat the rooms after cooling off will be so great as to cause considerable discomfort. If there is too much radiation, quick heating may be obtained but it is more than probable that the rooms will be overheated after the fire has been checked. It is essential that the amount of radiation be balanced to suit the size of the boiler, if satisfactory regulation is to be obtained.

Proper location of radiation is important in the elimination of draft and in the dissemination of heat. The location under the windows and near the outside walls is usually found to be the most satisfactory. If the radiators are of proper size but are supplied by improperly selected pipes, they cannot be expected to do their work. In order that each radiator shall obtain its full quota of the heating medium supplied, it is essential that the pipes be of proper size. Furthermore, the piping layout must be properly made in order that there may be quick drainage and unobstructed flow of the heating medium. Covering of pipes saves heat in a very measurable degree and will often serve to cause circulation in a radiator which previously received no heat.

It is not my intention to go into the details of design or operation of a heating plant, but having given the above general outline of the qualifications which go to make a satisfactory heating plant, I shall go on to discuss the subject of regulation.

Giving a reasonable share of the qualities above mentioned in any installation the problem of heat regulation to give comfortable conditions under any circumstances should not be a difficult one. When the system is well balanced and properly porportioned, it is a small matter to get a very great satisfaction by the old fashioned method of manual operation and regulation. To the man who is really interested in the problem of heating his home, this method may frequently be the most satisfactory and will probably be the most efficient, because of the fact that the most intelligent attention is given. Such a system supplemented with some automatic means

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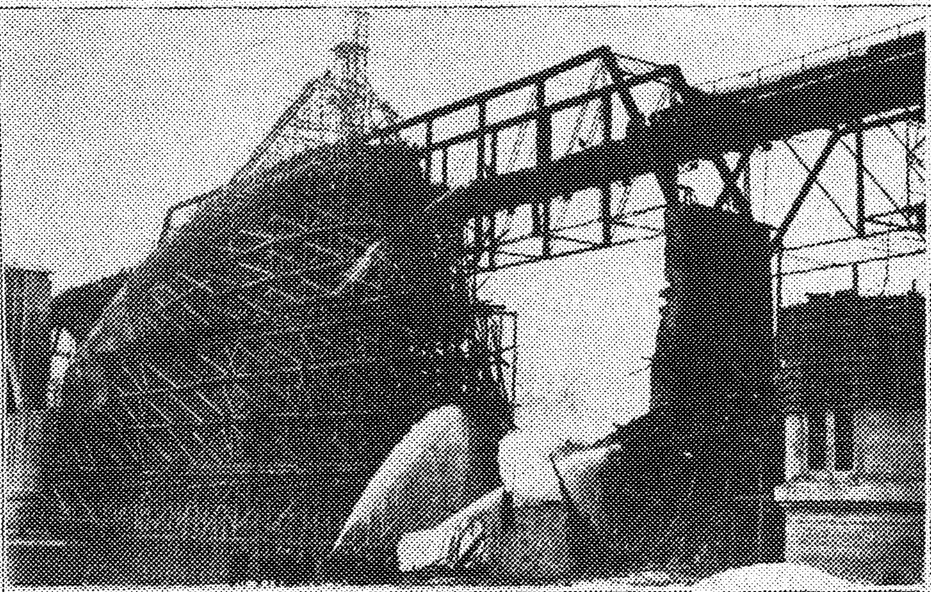
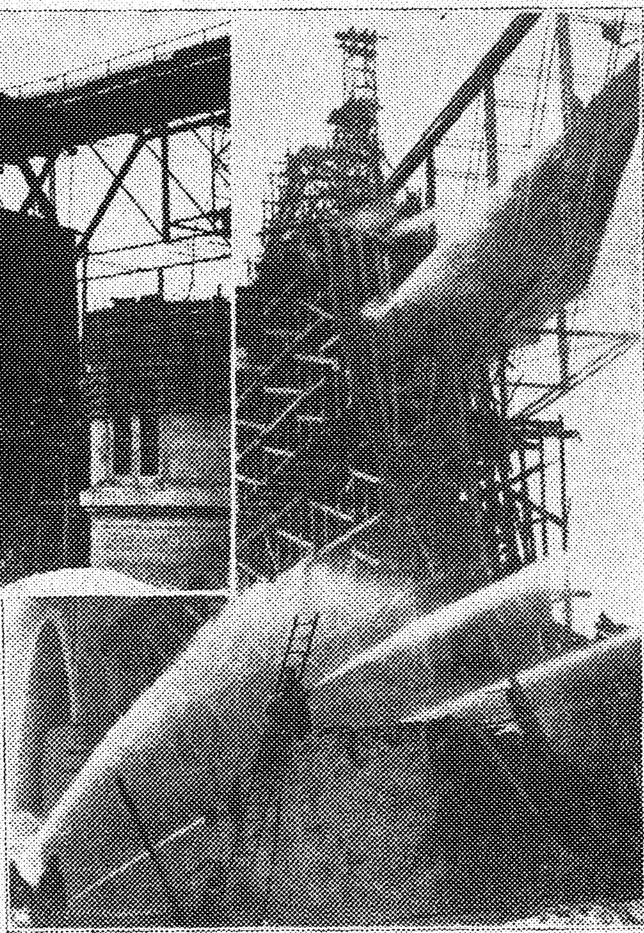
FIRE HITS CAPPELEN BRIDGE

New Minneapolis Bridge Threatened





Above is a general view of the wreck taken from the east bank downstream from the bridge. At the left is the west abutment of the center span. In the center foreground is the arch segment which fell, destroying the reinforcing ties to the east pier shown at the left. In the upper left hand corner of the second picture note the distorted steel post damaged by the intense heat.

A small explosion of a salamander, a shower of flying coals falling on dry falsework and the Cappelen Memorial (Franklin Avenue) bridge was in danger. Men at work on the construction of Minneapolis' new concrete bridge had just returned from their noon hour Friday, January 27, when the cry of "fire" sent them fleeing for their lives. Before firemen could get the fire under control, a large portion of the forms under the east end of the main span had been destroyed, a massive block of concrete arch had plunged into the river and the old bridge had been injured so that police closed it to further traffic.

Readers of the **Techno-Log** will remember that the December, 1921 issue carried a feature story on the bridge. It was described as a reinforced concrete structure with a center span of 400 feet between piers, the longest in the world. Each span is designed with twin ribs rising either side of the old steel bridge. Work had been completed on the 199 foot shore spans at either end of the bridge. In pouring the concrete the engineers for the city of Minneapolis have taken one rib at a time. Forms had been completed for the down river rib and concrete was well under way when the fire occurred.

At this publication accurate figures are not available, but it is conservatively estimated that when the forms burned that at least one quarter of the great arch which had been poured at the east end was plunged into the river below. When the great piece of concrete made its fall, firemen working below narrowly escaped death. The nozzle which they dropped as they fled was caught under the mass.

Several special calls brought scores of firemen to the scene and after a two hour fight, the flames were under control. No accurate figure on the loss had been set at press time, but the loss in centering, the concrete masonry which fell, and the cost of replacement, may reach $75,000. When the segment fell, the tying steel in the large abutment was torn out at the bottom and sheared at the top. Some work will be required to seat the new rib where it meets the pier at the spring line.

In addition to the physical and time loss on the new structure, fire distorted the steel truss members so much that the old Franklin Avenue bridge has been closed to traffic. Two 100 wire interurban telephone cables connecting Minneapolis with the Midway and Nestor exchanges in St. Paul were put out of commission for several hours.

By reference to the pictures, the reader will note the end of the mass of concrete which fell. The rib measures 12x16 feet at the end shown. The close observer will note the distortion in the steel lattice post in the upper right hand corner. Firemen are shown playing three lines of hose on the fire from the ice below. They experienced great difficulty in reaching the fire because of the distance from the hydrants, down the bank and across the flat. The five 6x6x½-inch steel angles which form part of the reinforcing of the great ribs are shown hanging over the ruins.

—H. W. T.

EINSTEIN THEORY OF RELATIVITY

By Douglas McHenry, Chem. '25.

The following article was read and criticised by Prof. W. F. G. Swann, an authority on Einstein's Theory. Although Prof. Swann questioned several minor details, he proclaimed the article as a whole deserving of much merit and a commendable student production.—EDITOR.

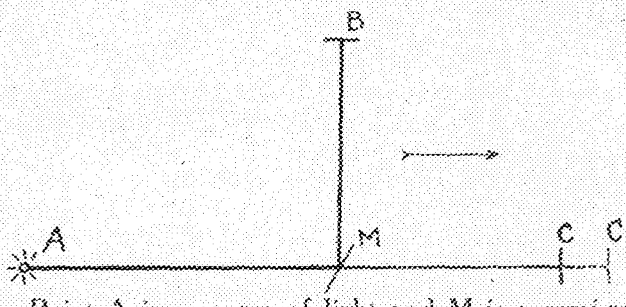
If an attempt is made to throw a pebble through a long tube which is moving at a right angle to the direction of its length, it will be found that in order to prevent the stone striking the sides of the tube, it must be thrown at an angle to the axis of the tube, which varies proportionally to the speed of the tube and of the stone.

It was discovered a long time ago that a similar phenomenon was exhibited by light rays from a fixed star passing through a telescope tube which moved with the earth. In order to keep the light rays in the exact optical center of the tube, it was necessary to point the telescope slightly in advance of the star. The required deviation from a straight line depended upon the ratio of the earth's velocity to the velocity of light.

The only acceptable theory of the nature of light, defines light as vibrations, or waves, in the ether. These waves are propagated in straight lines, and so long as the ether through which they move remains stationary, they will continue to move in straight lines.

From the foregoing considerations we must conclude that since a ray of light from a fixed source does not partake of the motion of the earth, the ether does not partake of this motion, and consequently we are moving through the ether.

A method of measuring this motion through the ether was devised by Professors Michelson and Morley. Consider an apparatus like the one diagramed here.



Point A is a source of light and M is a semi-reflecting mirror, arranged so that one-half the light from A is reflected to B while the rest passes through to C. It is evident that if the apparatus is in a state of absolute rest, the two light rays will reach B and C at the same time, the distance MB being given equal to MC. If, however, the apparatus is moving in the direction of the arrow, the time occupied by the light in passing from M to C will have given C time to advance to the position C'. The path of this ray will then be longer than the path MB, which is not affected by the motion. As a result, the light will reach B sooner than it reaches C. If these two rays are again united, the waves of one will be slightly in advance of the waves of the other, and interference will result. This is what we should expect, since we have already found that the earth, and consequently this particular apparatus, is in motion relative to the ether.

This experiment was carried out in a somewhat more complicated form with an extremely accurate apparatus. A totally unexpected result was obtained. It was found that regardless of the direction in which the apparatus was pointed, no interference of the light waves was produced. In other words, the path MB exactly equaled the path MC' in length.

Although this result was unexpected, it was not necessarily incorrect; nor did it mean that two experiments contradicted each other. It signified merely that somewhere back in our elementary conceptions a change must be made which would reconcile the two experiments. This was effected by accepting an ingenious suggestion proposed by Lorentz and Fitzgerald, called the contraction hypothesis, and accounting for the results of the Michelson-Morley experiment by assuming a contraction of the apparatus in the direction of its motion. This contraction is so slight that it may be neglected for ordinary measurements involving velocities which are small compared with that of light. The difficulty of comprehending this idea lies in the impossibility of proving it directly. It is evident that if we try to measure this contraction, all our measuring instruments will be contracted correspondingly, and all our units of measure will be changed.

All this means that it is impossible to detect the unaccelerated movement of any body by experiments confined to that body. This is a simple statement of the first postulate of Einstein. The conclusion reached from this postulate is that all motion is relative. Absolute motion cannot be conceived. That is, we cannot imagine a body moving except in relation to some other body.

This principle of relativity, however, and this contraction theory do not apply only to motion as we ordinarily consider it. Heretofore we have assumed that the contraction of the moving body affects one or more of the three space dimensions—length, breadth, and thickness. A body with these three dimensions, however, and lacking the fourth dimension, time, cannot exist. An instantaneous cube, for example, has no real existence. It must have time, or duration. H. G. Wells, our most versatile literary character, says that the only difference between time and any of the three dimensions of space is that our consciousness moves with time. This means that we cancel time, because, moving with it, we cannot detect its motion.

Accepting time as our fourth dimension means that we must include it in our idea of relativity. This leads us to Einstein's second postulate, which has been stated as follows: "Two events which are simultaneous when regarded from one co-ordinate system are not to be regarded as simultaneous when considered from a co-ordinate system which is in motion with respect to the first." If we were to send a body with a watch to a world moving at a different rate from ours, his watch would run at a different rate and he would grow at a different rate, although he would never realize the fact because the change in speed would cause a contraction or expansion of his time units, so that his second might be equivalent to two of our seconds.

All these considerations of space and time require the employment of some universal constant to which everything else can be compared. We cannot use the earth nor any of our own units because that would be to suppose some particular preference for this body over all others. We cannot use the ether because we know nothing about its state of motion or rest, nor, so far as concerns the theory, are we concerned with its state, or even with its existence. The only acceptable standard has been found to be the velocity of light, which is 186,000 miles per second, regardless of the velocity of its source. An example may serve to make clear the application of this standard in the theory.

Consider an observer equipped with measuring instruments and a source of light moving toward another observer similarly equipped at the rate of 100,000 miles per second. Each of these observers has never heard of relativity, and he considers that his system is at rest and the other system is in motion. If the first observer emits from his lamp a momentary flash of light and measures its velocity, he will find that it leaves his system at the rate of 186,000 miles per second. This flash of light followed by its source, will perhaps pass near the second observer. If he also measures the velocity of light, he will find it to be 186,000 miles per second. He will then measure the velocity of the source of this light and find it to be 100,000 miles per second. Now, if the light has been traveling one second it will have separated itself from its source by 186,000 minus 100,000, or 86,000 miles. Thus reasons the second observer, and in order to check his calculations, he will measure the distance and find that he is correct. But according to the first observer, the light left him at the rate of 186,000 miles per second. Therefore at the end of one second it should be 186,000 miles from him. In order to prove that he is right, he measures the distance and finds that his calculations are correct. The second observer is not satisfied, however. He does not believe that 186,000 is equal to 86,000. He applies his mental faculties to the problem with the following result: "This fellow's mile is not the same as my mile, or else his second is not the same as my second." Accordingly, the next time the two systems pass, this observer steps over to the other system with a clock and a foot rule. There he applies his own foot rule to that of the other observer, and will find that the two coincide exactly. It will then be evident that the difference is in the time unit employed. He will then compare his clock with one on the other system, but to his surprise they will register exactly together. The two observers will then either give up the problem as unworthy of their consideration, or they will get together, compare notes, and formulate a series of sentences equivalent to the following: "Neither of us is in motion, yet we are both in motion. Our mile and our second correspond exactly, yet they are not the same. All corresponding quantities, abstract or material, on our two systems are exactly alike, yet totally different, except the velocity of light, which is the same everywhere." In other words, they would have discovered the principles of relativity, and they would have been hopelessly muddled. All this muddle would be cleared up, however, if they accepted the two postulates which we have mentioned, together with the deductions derived from them. The question of which system was in motion and which was at rest would no longer trouble them; they would omit it from their considerations. Their units of space and time would be the same when the two systems were at rest, relatively, and different when in motion. Time would be accepted as the fourth dimension, and light would become their mutual constant.

Any theory may be proved by one of two methods. The first is by an analysis of the logical processes by which it was derived. If no flaws are discovered, the theory may be accepted as a law. The Einstein theory, however, contains one or two conclusions reached by very doubtful reasoning. One of the most important of these incomplete proofs is the derivation of the statement, that the velocity of light is independent of the velocity of the source from the proved statement that it is independent of the direction of the source. Logical proof for this is lacking. For this reason we must resort to the second method. This method consists of proving by some direct method, as by experiment, some one part of the theory. If this is done, we accept the entire theory as proved, since all the parts are interdependent.

The Einstein theory presents three possibilities in this direction. The first is in the explanation of a slight variation in the perihelion of the planet Mercury not accounted for by Newton's laws, which are approximates to those of Einstein. The formulas of Einstein not only explain this variation, but prove the necessity of it.

The second possibility was proved during the last solar eclipse. If the velocity of light is substituted in Lorentz's equations for determining contraction, we find that the length of light is zero. If we could reduce this velocity, light would assume definite dimensions, that is, it would become an actual, ponderable quantity. But something cannot be created from nothing, so something must be present in the first place. If something is there, that something must have mass in some form or other, and thus be subject to gravitation. An experiment which showed a deflection of light due to gravity of an amount closely agreeing with Einstein's calculations constituted the proof of the second possibility.

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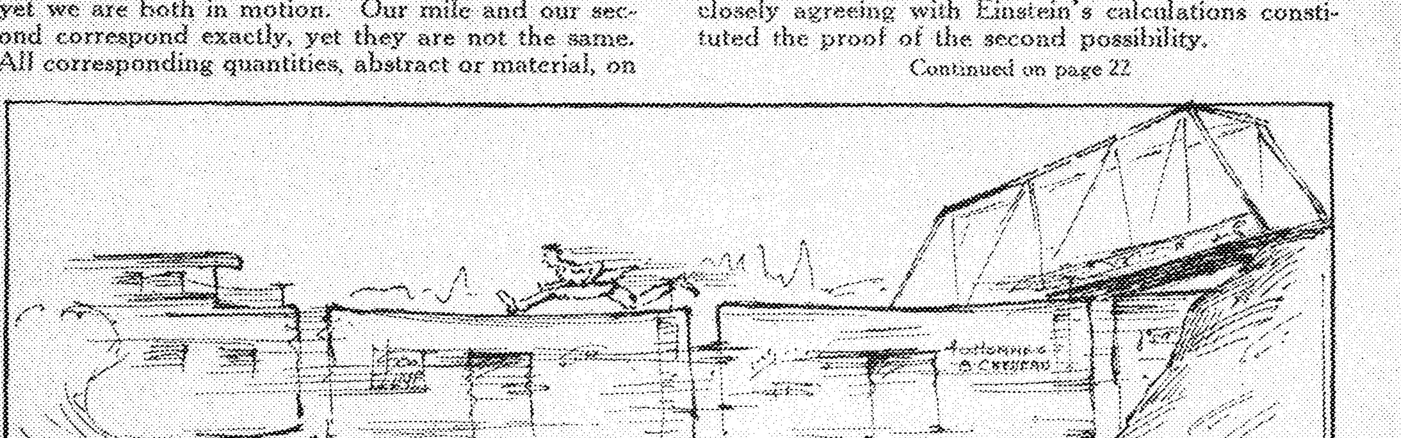

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EDITORIALS

OUR BLUEPRINT DEPARTMENT?

What is the matter with our blueprint department? Suppose that the typewriters in the departments were allowed to get into such condition that they could not be used or would no longer turn out legible work. What would happen? But this is only a supposition, yet apparently a similar condition exists in the blueprint department.

To the engineer a blueprint affords as an important means of conveying information as does the type-written sheet. The lack of blueprints has proved to be a hindrance to some of the classes in their work. Last quarter one section in the Experimental Department was unable to obtain laboratory manuals because the blueprint department could not or did not make the prints necessary to complete the manuals.

If a set of prints returned recently is a fair sample of the department's work, it is time that something be done as the blueprints could not be used and the tracings had been ruined by careless handling.

Keep the equipment of your department in shape and you boost your college, boost your college and you boost your University.

WANTED—A PUBLICITY DIRECTOR

A campus contemporary has sounded the cry for a university publicity man. Ski-U-Mah has indorsed the movement which was started by the members of the Sigma Delta Chi journalistic fraternity, through the columns of the Minnesota Daily.

At the time the matter was presented to the public, the University of Minnesota was very much concerned with the athletic situation. Among other reasons for athletic conditions, it was said that high school students were not coming to Minnesota. Many felt that if the University received publicity of the proper sort, this condition would partially right itself.

Several weeks have passed. Clouds on the athletic horizon are almost gone. We have a new athletic director. There is no doubt but that in time he will put into operation lines of communication that will link the high schools of the state with the University.

In the meantime, what of adequate publicity for the University? While an organized news service would assist in attracting athletes to Minnesota, that is not, and never should be, its big objective. THE UNIVERSITY is the larger interest. So in the peaceful settlement of the athletic difficulties, let us not forget the need for a publicity office.

Far off China is spending money to advertise. At regular intervals the TECHNO-LOG receives, from one of the departments of the Republic of China, news bulletins setting forth the attractions of the country and its unlimited resources. If the reader of the press of the state will observe carefully he will see in almost every issue stories that can have no other source but an organized publicity bureau in some American college or university. Minnesota has many stories to tell. Shall they be told?

One neighboring institution has as its publicity director the head of the Greek department. Although a keen newspaper man himself, the actual work is done by a recent graduate of the department of journalism. The director also serves as university editor and ex-officio faculty advisor for the several student publications.

Such a plan might not be feasible at Minnesota. But, once the need for a publicity man is fully appreciated, Minnesota will fill that need.

ENGINEERING INTRAMURAL ATHLETICS

There is among the fraternity of salesmen a group known as the "Go Getters." A little magazine has been published for these with the title of "The Go-Getter;" in its pages bits of homely wisdom are mingled with a practical idealism. A story of three workmen is recounted. An owner of a quarry who was inspecting his property stopped to ask a workman what he was doing. Without lifting his head, the workman replied: "I am cutting stone." Another answered the same query, saying: "I am making $7.50 a day." When the question was put to a third, he answered: "I am helping build a cathedral."

The last man had all of the skill and ability of the others but he had something more, he had a full comprehension of the meaning of his work. We spend four or more years of our lives in a university not only to gain a knowledge which will make it possible for us to become better workmen and perhaps gain greater compensation, but also to obtain a wider appreciation both of the particular field in which we are to work, and of the work of other men in other fields and of the men themselves.

In order to know men we must see them in action at close range; properly organized intramural sports probably can bring this opportunity to college students more effectively than any other activity. The engineering course requires close application to school work and what little time is left for recreation and other occupations must be pretty definitely planned if it is to be of the most value; the tendency is now for the average student to have a small range of interests and acquaintances, much less than if all classes and departments were organized and got together frequently as they might in the friendly rivalry of class and departmental football, basketball, baseball, tennis, track meets, hockey, wrestling or boxing.

The participation in intramural sports should be general, every man should for his own physical benefit engage in some form of college athletics. Many men are reluctant about it because they believe that they can never excel and that college sports are for those who can; some of these men would surprise themselves if they really tried, all of them owe it to themselves and the University to try.

President Coffman has publicly expressed himself as a warm advocate of intramural sport; President Lowell of Harvard University has commented in his annual report on the desirability of it. For many years it has been thought by some people that college athletics should be for the many rather than for the few, that they should be organized so that the students would receive their full values rather than in such a way that they should simply amuse the general public. One of the finest and greatest values in any sport is that of its discipline. Every man likes to win, and if he be uncivilized or without moral quality will employ any trick to win; but to be able to win without vaunting and to lose without flinching is a test of a gentleman. We all can afford to cultivate this power; playing a game and playing it fairly furnishes an excellent opportunity. No power gained from academic studies is comparable to it.

Intercollegiate athletics have for many years been the prinicipal means of expression for the University spirit of loyalty, although it may have been a blind loyalty. Intramural athletics when fully developed will open our eyes to many resources in university life as yet only practically appreciated and our loyalty will be of a higher and finer order.

Let the students of the College of Engineering and Architecture organize each class in every department and from each send a representative to a committee on organization which will lay out a program and get busy.

—Frederic Bass.

POINTED PUNTUATION

Prof. R. T. Jones, architectural construction man, believes in puntuation—at least he put an unmistakable period at the end of a recent lecture.

"I can positively guarantee that you'll remember absolutely nothing of this stuff."

Class was dismissed immediately.

THE NEW SCHOOL OF MUSIC BUILDING

By O. F. Beeman, Arch., '22.

In articles published by various campus journals the history of the school of music has been given. Its origin, its ups and downs and finally its triumph in the new building have been told.

Other stories have stated that the various floors would contain certain rooms and departments and that certain arrangements made for good ventilation and sound deadening. In this story the methods employed to care for these engineering features are presented in a way that will interest all engineers.—Editor.

The exterior of the latest addition to the group of new University buildings is an adaptation of the tapestry brick with trim of gray Indiana limestone. A border of variegated designs of tile mosaic carries around the principal facades.

No especially complicated structural problems were met within this building. The largest beams are the steel plate girders with a span of about forty feet over the auditorium or concrete hall. These make possible a beam ceiling inside, adding interest to the interior decoration as well as furnishing some acoustic properties by breaking the sound waves. Reinforced concrete and steel make up the skeleton frame.

Heating and Ventilating

The heating and ventilating problem is interesting in that three separate and distinct systems are used. The first system serves the auditorium from a plenum chamber in the basement. Under each seat is placed an individual mushroom vent which diffuses the fresh air. Foul air is exhausted through the stage loft, washed, humidified and recirculated.

Class and instruction rooms on the first and second floors are supplied by the second system. The fresh air for these rooms is carried in individual ducts from a concrete plenum chamber in the sub-basement while the foul air is exhausted into another chamber in the second floor ceiling.

The third system serves the thirty practice rooms on the third floor. The air is handled in the same manner as in the preceding group of rooms. There is no recirculating in the last two systems. These three independent systems will be clearly recognized as the only economical way in which to handle rooms that serve entirely different purposes and which may be operated at different times throughout the day.

Acoustics and Insulation

The problem of acoustics was not a serious one in the concert hall because of its comparatively small size and rectangular shape. A large sounding board

Continued on page 24

ATHLETICS

By A. B. Greene.

Minnesota is a rejuvenated institution athletically. An alumnus no longer turns to the sports page with the forebodings that were his a short time ago. The consistent winnings of the past month in hockey, basket ball and swimming are characteristics of a new spirit that seems to have permeated Minnesota teams of late. The recent survey of the athletic situation, and the subsequent drastic action of the authorities in placing new men in important positions are no doubt factors in the successes. Coaches and men have felt the pressure of student, faculty, and alumni perseverance in the fight for winning teams. The reorganization is well under way, and the old spirit restored if the present evidences of successful competition may be taken as criteria. Recent events must be an inspiration for Minnesota's new athletic heads, Director Leuring and Football Coach Spaulding. These men and Doc Cooke and Nels Thorpe form a nucleus, around which Minnesota is building a powerful coaching staff. The material is here, always has been here, but it needs trained development, and as it now appears will have it.

CAPT. KEARNY

It is well to remind the sport world occasionally that the Engineering College is not the most unlikely place from which to pick athletic material. The said world should bow with all ceremony to our veteran fighting ace, Captain Kearney. Although this is but his second year in varsity togs, he is already known throughout Big Ten circles as the "Fighting Demon." When he gets that wicked slant to his eye it means battle. Aside from his bewildering offensive game, he is known as a deadly guard, and has held his man practically scoreless in every game this season. It gladdens the heart of the Gopher fan to see his shooting eye keep pace with his fighting ability. He is now one of the four Gophers who stand among the upper one-fifth in Big Ten scoring records, and he has tossed seventeen fouls to date, which is two more than those made by the famed Shimek of Iowa.

Another Gopher first-string fixture has struck caution into the hearts of our conference competitors. Severinson is a permanent cog in the great Minnesota scoring machine. His clever floor work has made him the subject of uncanny guarding in every game; but in spite of this handicap, he has come through with enough baskets to place him fifteenth on the list of Big Ten "dead-shots."

It is a source of gratification to read of the occasional uncovering of an athletic "find." Often they represent men who are not "finds" at all, but have worked long and diligently to develop themselves in their game. It now leaks out from reliable "inside" sources that a new basket ball star of dependable qualities has been uncovered in the person of Grant Bergsland. It is not good policy to count the bridges before they are hatched, but we are just marking time until his chance comes. Bergsland is a junior and has another year to play.

ENGINEERS SWIM

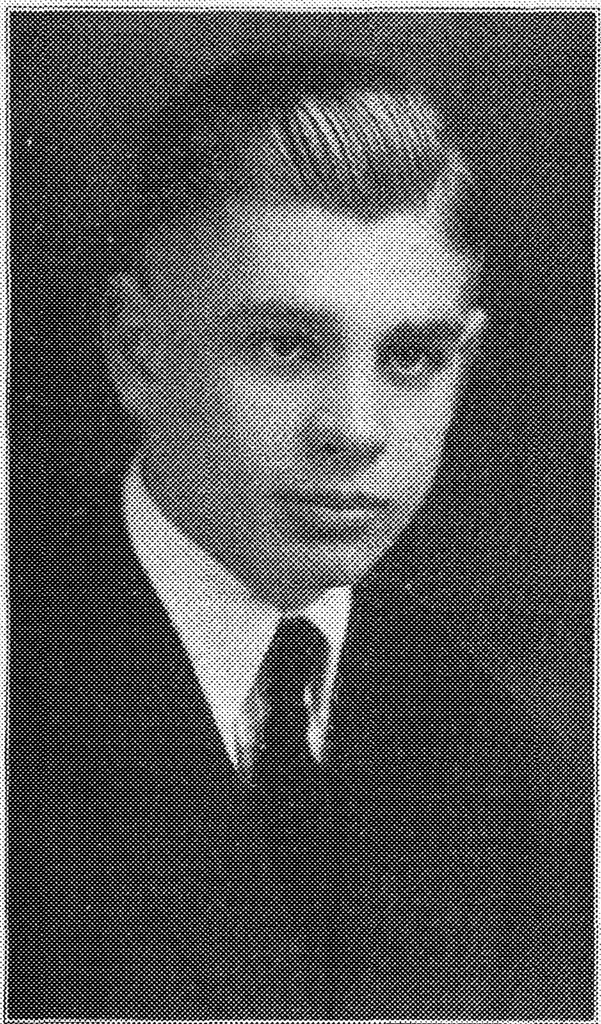
When Minnesota took the swimming meet from the Minneapolis Y. M. C. A. in the Armory pool January 2, a woeful lack of respect for existing tank records was most evident. Murray Lanpher, Eng. '23, bettered his own time in the 220 free style by three and a half seconds, hanging up a new Northwestern A. A. U. record of 2:37 3/5.

Alec Gow, also '23, placed second in the hundred, and swam with Hibbard Hill of the same class in the relay. The relay team traveled the 160 yards in 1:20 even, bettering the old A. A. U. record by three and three-fifths seconds.

John Fariey, academic, displaying real engineering form, broke the world's record in the hundred yard breast stroke. His time was 1:10 2/5. This time bettering the old mark by two fifths of a second. The squad as a unit appears to be very well balanced, although good men could be placed in the hundred and back stroke. The squad deserves the conference title.

WITH THE PUCK CHASERS

"Chet" Bros, captain of the Varsity pucksters, has been carrying the wares of the engineers into the enemy camps with telling regularity. Under the guise of right defense, he broke into the play at Madison and swept the offense off their feet, we dare say literally as well as figuratively, breaking up every play that came his way.



"CHET" BROS
Captain Hockey Team

E. T. Bergquist also played a stellar game at Madison, revealing himself as an all-wool, yard wide goal tender. He will be certain of a place on the lineup when the Badgers invade the home rink for a two game tilt next week.

Diminutive Paul Swanson did not make the trip to Madison because of an injury he received when a puck struck him in the right eye during the game with Mechanic Arts High School.

The story that St. Pat used a hockey club in his historic drive appears to be substantiated.

ST. VALENTINE'S DANCE

A Saint Valentine's dance is being planned by the Architectural society for February 11. Elton K. Crowell is in charge of arrangements.

An open lecture on "Life as a Colloidal Phenomena" was given January 24 in the Chemistry Auditorium. The lecture was the second of the series given under the auspices of Phi Lambda Upsilon, honorary chemical fraternity.

THE ARABS ARE COMING

In the "Arabs," a dramatic club recently organized, members of the College of Engineering and Architecture, and School of Chemistry have entered a new field. The engineers are famous for their freshmen-sophomore scraps, the Saint Patrick's Day parade, and the architects for their Architects' Jubilee. Until now, this has been the extent of their outside activities. With the formation of the Arabs an advance step has been made.

The club was first suggested by Mr. R. W. Hammett, an instructor in the Department of Architecture. A meeting of the men interested was held. University recognition was soon received and the club founded as a college organization. Stanley Hahn was elected president; Merle De Forest, vice-president; E. F. Moore, treasurer; Dorance Ryerse, business manager, and E. W. Kraft, secretary. Mr. Hammett was made Honorary President of the club in recognition of his untiring interest and his efforts to make the organization possible.

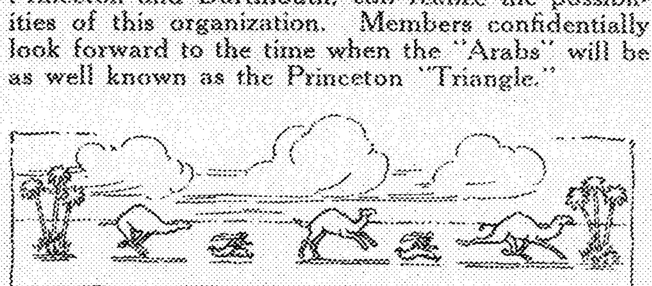
Quoting the constitution, the purpose of the club, is, "To give the students of the College of Engineering and Architecture, and School of Chemistry an opportunity to express their dramatic, artistic, and business talent, and to give productions which will help to maintain the high standards of dramatics at the university."

Like the Garrick Club on the Academic Campus, membership is restricted to men alone; but unlike that body, the Arabs is a larger organization, not only acting, but writing and producing its own plays from start to finish.

Outside of the periodic meetings, the activities of the club are restricted to the production of one large play each season. The first presentation will be a musical comedy. The plot has been written and music is being composed. The offering will give great opportunity for the design of scenery and costumes. Much stress will be placed on the lighting, attempting to secure effects which are impossible in the more ordinary productions. Although not an original feature of the club, it now seems quite probable that an orchestra will be formed among the members to play at club performances.

"Arabs," the name chosen for the club seems particularly fitting because of its suggestion of "wildness" and the general rugged quality usually ascribed to engineers. They make no promises. But it is expected that the first play will try to live up to the name of the club.

The future of the Arabs is promising. Anyone who is familiar with organizations like those at Princeton and Dartmouth, can realize the possibilities of this organization. Members confidentially look forward to the time when the "Arabs" will be as well known as the Princeton "Triangle."



ALUMNI NEWS

By F. O. Elfstrom, '25

H. M. King, '18, Professor or Architecture, University of Oregon, sent us a very interesting account of trip abroad that he enjoyed last summer. He says, "Left Oregon in the middle of June for the East to catch a steamer sailing direct for Palermo, Sicily. Spent some time there, and then went through Italy and France to England, recrossed the Straits to Belgium and returned to London as a starting point. Then took a hurried trip across South England to Wales, from where I sailed for New York, arriving back here in Oregon by the first of October. On the way through in the spring, I visited McGill School of Architecture, Montreal, and Harvard "U", where I bumped into Florian Kleinschmidt, a post-graduate, who got his B. S. at Minnesota the year previous." Mr. King was in Minneapolis over the Christmas Holidays.

Harold Coe, '19, is now stationed at Fort Snelling as a Lieutenant in the Infantry.

Dean Leland received a card from Arch Robinson, '09, sending Christmas Greetings from the "Land of flowers, fruits, and sunshine." His present address is in care of the Southern Utilities Company, West Palm Beach, Florida.

Professor Shipley, according to word received by Mr. Richards, will be back in September, from Roberts College in Constantinople.

F. L. Nemmic, '08, is with the Fegles Construction Company, of Minneapolis, as mechanical engineer.

G. N. Bjorge, '12, of Duluth, was in Minneapolis the twenty-eighth of January, for consultations with the faculty of the Mines college, of which he is a graduate. He has been living in San Francisco of late, and was on his way through to Calumet, Michigan, when he stopped over. Mr. Bjorge is a mining geologist by profession.

O. B. Bjorge, '07, is chief engineer of the Clyde Iron Works in Duluth.

Emil F. Norelius, '08, is located at 430 Andrus Building, Minneapolis, as a consulting engineer, along mechincal lines. Among his latest accomplishments are the successful design and building of a caterpillar traction stump-puller, and also an ore digging machine.

George T. Peterson, '08, left the Santa Fe a year ago to organize an apprentice department for the Duluth and Iron Range Railroad. He is now managing that department.

John Nekola, '07, was last heard from in La Crosse, where he was in the employ of the Burlington. Any reader knowing of his whereabouts now or since then, will favor Prof. Martenis by giving him any information concerning Mr. Nekola.

Jimmy Wise, '21, has returned to Minneapolis from work with the State Highway Department.

Clifford Cowin, '21, returned from Alaska to a colder climate last month. While in Alaska he was with the Coast and Geodetic Survey, but says the work was not to his liking.

Ralph Forsberg, '23, is now the assistant county engineer of Kandiyohi county. He has charge of the re-location of the state aid road running north of Willmar.

Donald C. Smith, '18, at 401 West 18th St., New York City, recently sent in a subscription from the Minnesota Alumni Association of that city. Mr. Smith is now in the employ of the American Telephone and Telegraph Company.

Along with the recent cold snap came a letter from O. M. Rufsvold, '15, who sent in his subscription from Anchorage Alaska. He is now with the Alaskan Engineering Commission.

Harry Beeman, '21, who has been in the employ of the highway department for the past six months, has returned to the city to spend a few weeks. He has been working on a paving job in Kandiyohi county.

Glen Lyons, '20, of the Architectural Department is now located in Grand Rapids, Michigan. In his last communication, he informs us of the fact that he is now the proud father of a baby boy.

A. R. Melander is now an instructor in the department of architecture at the State University of North Dakota.

Lorin Luedke, '21, was married last December. He is now the county engineer of Itasca county.

Lief Sverdrup, '21, who is now with the bridge department of the highway commission, took second place in the recent ski tournament at Chicago.

L. D. Burwell is in the engineering division of the South Philadelphia Works of the Westinghouse Electric Manufacturing Company. His address is P. O. Box 1522, Philadelphia, Pennsylvania, in care of the company. He says, "About all my time is spent in the field, doing research work mainly, and also development work on mechanical stokers.

Carlos W. del Plaine, '21, is now taking graduate work in Civil Engineering, and will receive the C. E. degree in June of this year. He is taking the problem of "The Disposal of Creamery Wastes" as a major subject, and is minoring in City Planning. Mr del Plaine is also acting as class assitant to Professor Frederic Bass in Civil Engineering.

George R. Duncan, '19, writes, "I am still with the General Electric Company of Schenectady, New York, but have been with the Glen Alden Coal Company of Scranton, Pennsylvania, for the past eight months under special arrangements for experience in electrical coal mining work." Mr. Duncan lives at 810 East Main Street, Nanticoke, Pennsylvania.

DIRECT RADIATION

Continued from page 6

for opening drafts in the early morning, is really all that is necessary, and there are many small devices on the market, such as the "Little Draft Man," most of which are merely applications of the alarm clock to the drafts of the boiler. In a heating system using direct radiation each radiator is to some extent self-regulated, because of the fact that if the air surrounding it becomes cooled, the circulation in that radiator is immediately increased, thus bringing a greater quantity of heat to the point where it is most needed. This is not true in a hot air system where the cold air at the top has a tendency to prevent the warm air coming up the registers, and in case there is a pressure caused by the wind, it is a fact that the cold air will be pushed down into the heating plant.

In the case of manual operation a large fire pot is desirable, in order that the fire may be easily regulated and maintain a constant temperature over a long period of time without frequent attention. One of the outstanding advantages of the direct heating system is the mass of the heating elements, consisting of the iron in the radiators and the water enclosed in them which serves to store up a considerable quantity of heat, thus avoiding the rapid cooling which is experienced when hot air is used. This necessarily works in the reverse manner also, and causes a somewhat slower heating with this type of heating; but when the system is properly managed, wide fluctuation in temperature will not be permitted and this objection is entirely overcome. With the hot air plant under manual operation constant attention is required to avoid having either too great a temperature or too low a temperature. Hot air is very sensitive and also very erratic.

In these days of labor saving devices some means of automatic temperature regulation is usually desired in any installation. There are many types of Thermostats on the market which control the drafts by means of some motive power actuated by a sensitive thermostatic couple located in some representative part of the house. These machines are remarkably well developed at the present time and with a properly installed heating plant will regulate the temperature within 2° of any temperature required. If the system is not properly designed, or if the thermostat is improperly located, it is more than probable that by the time the temperature has reached the proper point for actuating the instrument the heat stored up in the system is so great that the rooms will become considerably warmer than desired. Such a condition may be corrected by adjusting the thermostat or relocating it in case it is improperly placed, but a more permanent correction of the fault will be obtained by increasing or decreasing the radiation in certain rooms in order that they may be properly balanced with other parts of the house. Thermostats of this type are made in various designs, the most common type being that in which the draft is fully opened or entirely closed. There is one type on the market which operates with multiple steps, so that the draft may be one-third, two-thirds or fully opened or closed. It is evident that such an instrument, if well made, will give a much finer regulation than in the case of the simpler type. This is of importance from the view point of efficiency, because there is great danger with wide open drafts that the smoke-hood temperature may become too high with consequent loss of heat in the flue gases.

A type of heat regulator which is now becoming very widely used in hot water plants is that which depends upon the pressure in the system to regulate the drafts. So-called D & T Tank-In-The-Basement System is a very good example of this type. This installation is a closed system in which the expansion tank is located in the basement close to the boiler. The expansion tank is about one-third full of water, the remainder of the space being full of air which makes a cushion with varying pressure, depending upon the temperature of the water. The variation in this pressure actuates a regulator which is attached to the drafts of the boiler, and consequently the minutest variation in temperature of the water in the system is instantly transmitted through the regulator to the drafts, with the result that there is no opportunity for excessive variation in temperature to take place in the rooms. With a closed system higher temperatures may be used, and the D & T system may be so adjusted that the temperature will go to 220°. Ordinarily, however, temperatures are much lower and it is not recommended that the amount of radiation be reduced because of this permissible increase in temperature.

In the case of a small steam system, without any special arrangement, regulation may be obtained entirely through the use of the pressure regulator located on the boiler. In the case of straight steam system, it is very important that every radiator be of the proper size because there is no means of controlling the heat to each radiator, as it is not permissible to partly close the valves. Steam valves on a straight steam system must be fully open or fully closed, otherwise there will be a storing up of condensed water in the radiator with resultant disagreeable noises and also the removal of water from the boiler, which is very undesirable. The pressure regulator may be combined with a thermostat, such as previously described, with much more economical and satisfactory results.

The most modern method for the utilization of steam as a heating medium is the so-called vapor system which operates at pressure less than atmospheric. With this system more radiation must be used than in the case of the straight steam system, because of the lower temperatures used. In fact, the amount of radiation used approaches that required for a water system. Each radiator is operated with a graduated valve, which may be partly opened or fully opened, as desired, thus admitting just enough steam to properly heat the room. It is evident that where each room is operated with individual control in this manner it is much simpler to get balanced conditions than in the case where each radiator must be very carefully chosen before installation.

Steam and vapor systems entirely overcome the objection which is found in the case of water systems, in that they are slow to respond to demands for heat. Steam is perhaps the quickest of all heating mediums, being quicker and more constant than air, and as the mass of the radiation used is considerable, this system may retain its heat for some time, although it is by no means as constant as the water system. The efficiency of a boiler under ordinary conditions is between 60 per cent and 70 per cent as compared with the best efficiency of less than 55 per cent to be found in hot air systems. Cleanliness is one of the chief factors in the superiority of direct heating systems, and these systems are much more susceptible to control and regulation, resulting

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COLLEGE NEWS

By C. M. Burrill, '23

MECHANICAL RESEARCH WORK

In the Mechanical Department we find C. A. Johanson, Lehan Hamlin, Elmer Forsberg, C. J. Eddy, A. G. Holmstine, and Sven A. Value back to obtain the coveted M. E. degree.

C. A. Johnson and Lehan Hamlin are studying the relation between heat treatment and impact toughness of carbon and alloy steels. Impact toughness is the measure of ability to withstand suddenly applied loads or impact; this property cannot be determined by the usual static tests. Mr. Hoyt, formerly of the School of Mines, and many other metallurgists, regard impact toughness as an independent property which should be included in specifications.

Impact testing is of recent development and the exact relation between heat treatment and maximum impact toughness is not settled. The requirements of the automotive industries have stimulated investigations of impact toughness; Messrs. Johnson and Hamlin have already obtained some interesting data on .49 per cent carbon steel and they hope to be able to make a contribution of some value to the science of impact testing.

C. J. Eddy and Elmer Forsberg are carrying on an investigation in conjunction with the Hackney Manufacturing Company, Ventilating Engineers. Their problem relates to the flow and distribution of air from a ventilating fan. In testing a fan the practice in the past has been to use a length of pipe twenty times its diameter which often brought the pipe to a length which made testing impossible in the ordinary commercial laboratory. By the use of a device placed in the pipe near the fan, Messrs. Forsberg and Eddy hope that the flow of the air will become evenly distributed with a much shorter length of pipe, and thereby making the long cumbersome pipe unnecessary. The investigation is a good problem and we wish them success.

Sven A. Vaule received a Fellowship from the Northern Fire Apparatus Company of this city and is busy with an investigation on the Pagel Rotary Pump. The specific subject of his thesis is, "The Relationship of the Viscosity of a Liquid to the Proper Pump Clearance and to the Characteristics of a Rotary Pump." Practically no data are available on the subject although pump manufacturers have long sought for the information, but due to the lack of facilities in commercial laboratories have been unable to obtain the data necessary. The principle parts of the apparatus consist of a Pagel Rotary Pump, a 600 gallon tank with steam coil for heating the liquid, a 350 gallon weighing tank with automatic trip, and a 50 horse power electric dynamometer. Oils varying in vicosity from that of kerosene to that of Mexican Crude Oil will be pumped.

A. G. Holmstine, after having obtained valuable practical engineering experience in ship building for several years, is back for graduate work. The subject of his thesis is, "An Investigation on the Efficient Operation of Various Types of Steam Radiator Traps." The economy of a steam heating system depends to a large extent on the efficient operation of the radiator trap, its function being to allow the condensed steam in a radiator to escape without permitting a loss of the live steam. The set-up for the work consists of a radiator connected to the steam line, measuring tanks for finding the amount of the condensate, and a device for measuring the steam which escapes through the trap. Various pressures are obtained by the use of a reducing valve in the steam line.

Prof. W. T. Ryan is now working in connection with the Minnesota Tax Commission, on the valuation of electric power plants and transmission lines. He has a separate office in the Main Engineering Building for this work, and an assistant under him.

The telegraph and telephone laboratory in Room 204 has been completely re-arranged and improved. Wiring has been installed so as to furnish four sets of outlets giving 24-48-120-240 volts D.C. and 120-240 volts A.C. each. Many new instruments have been added, including two very sensitive galvanometers.

Our University Radio Station broadcasts daily at 12:30 P. M. and at 8:30 P. M., Weather Bureau reports for Minnesota, Wisconsin, North and South Dakota, and Montana; and market reports of St. Paul livestock and Minneapolis wheat and potatoes. The transmission is by telegraph followed by telephone, on a wave-length of 485 meters. These broadcasts are of great value to farmers and dealers, especially those in outlying and inaccessible districts. Specially prepared concerts of high grade music, including program notes, are sent out every Wednesday from 7:30 to 8:30 P. M. on a wave-length of 360 meters. Three different calls are used; WLB, the commercial call, on broadcasts and official communications; the military call WX2, on all Signal Corps work, and communications with military or naval stations; and the amateur call 9XI on all general experimental work. The Station is open from 10 P. M. to 1 A. M. for test communication, and some notable records are being made, distances of over 1,000 miles having been covered. The staff is as follows: Director, Prof. C. M. Jansky; Chief Operator, H. C. Forbes; Operators, G. A. Backus, M. G. Goldberg, R. E. Mathes, J. Carpenter, W. W. Brown, D. C. Wallace and W. F. Kannenberg.

JANUARY DESIGN JUDGMENTS

In the Senior's short problem, "A Memorial Hospital," Henry Gerlach earned first place with the award of Mention. Credits were received by five others—Frank Moorman, W. A. Backstrom, Paul Damberg, Charles Hinman and H. H. Haines. Mr. Horner, St. Paul, who has had wide experience in the designing of hospital groups, was a member of the jury and made the criticism after the judgment.

The Sophomore's short problem was "An Entrance to a Courtyard." Fourteen credits were awarded. Carl Matthias Wise was followed by Arnold Melius, Wallace Bonsall, Paul E. Nystrom, M. E. Foster, W. A. Kendall, I. W. Silverman, Horace W. Tousley, L. A. Tvedt, H. E. Nelson, Frank R. Root, R. W. Ward, D. T. Silver and Wayne Hunt.

Two sketch problems have been judged this quarter. In the Sophomore problem, "A School of Chemistry," only two awards were given. Silverman and Hunt received Conditional Credit. The upper classmen's esquise-esquise was "A Stone Lucarne." In the solutions offered for the dormer window William E. Willner, Donald T. Graf, Henry Gerlach and Edward Holien scored Credits.

ELECTRICALS EAT

Members of the Electrical Department met at a banquet at the Oak Grove Hotel, February 1, 1922, for the purpose of promoting good fellowship and increasing mutual acquaintances in the department. W. M. Nielson was in charge of the general arrangements. The Student Branch of the A. I. E. E. sponsored the meeting, and J. M. Downie arranged the program, which included speeches by M. F. Wichman, Roy H. Olson, Leroy A. Grettum, and Prof. G. D. Shepardson, and several musical numbers.

The Civil Engineers Society has now completed its affiliation with the national organization, the American Society of Civil Engineers, which until recently did not recognize student branches. A spirited meeting of the Society was held recently, at which plans for the year were discussed. Prof. Bass talked on the national society, following an historical sketch of the local club by C. L. Swanson. Other numbers on the program were: boxing by C. C. Loss and Geo. Bailey, a reading by Laurence Teberg, a piano solo by W. L. Maiser, and a "swat contest" by Geo. Guesmer and O. H. Hosmer.

R. E. Donahoe is working on a new system of power distribution and lighting for the University Campus.

Alpha Chi Sigma entertained at an informal dance on January 20 in the ballroom of the Minnesota Union.

"Tendencies in Modern Art," was Mr Dudley Crafts Watson's subject when he spoke before the Architectural Society in a supper meeting at the Union, January 31. Mr. Watson is an extension lecturer in the Minneapolis Institute of Art. His subject together with the fact that this was his first appearance on the campus, made the meeting one of more than departmental interest, so the meeting was open to the University public. A large number took advantage of the opportunity and the combination of lecture and supper meeting was a decided success.

THE LAY OF A PHOEBE KEY

My Phoebe key has been with me since nineteen hundred and four,
And on the square, I won her fair, though some of the gang were sore.
I didn't mind being called a grind, and I wore her then with glee,
And you can bet I wear her yet, right out where folks can see.

In college days I won no bays in the giddy social rout;
I was de trop at any show where women were about.
I tried for glee; but they soon dropped me, and a freshman won my place;
I hit the booze with other stews, but I couldn't stand the pace;

At end I proved so punk I moved the football coach to tears;
I was a dub, and on the scrub I played for three long years.
I tried for third, but a faster bird took the regular job from me;
And at the mile I plugged a while: my best was a poor 5:03.

At every game it was the same; I never could reach the top;
And though it's true I won a U, it wasn't a good fair cop.
But the Phoebe key they handed me when I took my cap and gown,
Was proof enough, if he has the stuff—you can't keep a good man down.

* * * * *

Believe me, boss, it's been no loss, when hunting a job or such,
To swing a key and let 'em see your brains don't need a crutch.
I've got a hunch when you size the bunch that's setting the pace today
Along in the van you'll find a man who's wearing a P. B. K.

—Mick.

The Conning Tower, New York Tribune.

CUPID MAKES TACKLE

Arthur Gilstad, '23, was married January 14, 1922, at the Bethany Lutheran Church in St. Paul to Miss Idah J. Nelson of Owatonna. A reception in honor the event, was held at the bride's home on the following Sunday. The Staff of the Techno-Log heartily wishes Art a happy success in his matrimonial project.

DIRECT RADIATION

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in more satisfactory and comfortable conditions. The use of proper humidifiers permits of very careful control of the moisture conditions in the room, and it may be safely said that the result of past experience in the heating world has shown the great superiority of direct radiation as a means of giving comfortable living conditions under the most variable climatic changes.

F. W. Hooslef, '17.

THE MINNESOTA LAW FOR THE REGISTRATION OF ARCHITECTS, ENGINEERS AND LAND-SURVEYORS

By Charles M. Burrill

A bill "To Regulate the Practice of Architecture, Professional Engineering, and Land-surveying" which has been before the Minnesota legislature for the last six years, finally became a law on April 25, 1921. It follows very closely the Model Law proposed by the Council of the Federated Engineering Societies in December, 1919, and may be summarized as follows:

Limitations Imposed: Provision is made for the registration of architects, engineers, and surveyors having certain qualifications, and the use of the titles "Registered Architect," "Registered Engineer," and "Registered Land-surveyor" is restricted to the holders of unexpired unrevoked certificates of registration.

Definition: No attempt is made to define Engineering or Architecture. Land-surveying is only surveying which involves the determination of areas and land boundaries, or the subdivision and platting of land.

Exemptions: The following are exempted from the provision of the act:

1. Offering to practice by non-residents.
2. Practice by non-residents legally qualified in their own state not to exceed thirty days per year.
3. Practice while an application for registration is pending.
4. Practice as an associate or employee of one holding a certificate of registration.
5. Officers and employees of the United States.

Administration: The administration of the law is to be by a Board of Registration, appointed by the Governor, of seven members, three architects, three engineers, and one land-surveyor, no two of which may be from the same kind of work. They are appointed for terms of four years, expiring alternately. Board members must be citizens of the United States, residents, registered (except the first members), and must have been in practice in responsible charge of work for five years. They must also be members of a recognized technical society. The Board has the right to compel the attendance of witnesses, to administer oaths, and to require the services of the attorney-general. It shall adopt an official seal for its use, and shall fix all by-laws rules, and standards necessary for the operation of the law.

Qualifications for Registration: An applicant must be a citizen of the United States, or have declared his intention of becoming one, must be able to speak and write English, and must be over 25 years of age and of good character and repute. Architects and engineers must have engaged in active work for at least six years, while only four years are required of land-surveyors. A year of study or teaching in a recognized technical college is to be considered equivalent to a year of practice. The Board may require any additional evidence which it may deem necessary to establish the applicant's qualification. This may include a written or oral examination.

Reciprocity: A certificate of registration may be issued to any one holding a like unexpired certificate issued by any state or Canadian province having requirements for registration equal to those fixed by the Board.

Fees: The fees are fixed at \$25.00 for first registration of architects and engineers, and \$10.00 for land-surveyors. The yearly renewal fees are \$5.00 and \$2.00 respectively. Penalties of \$2.00-1.00 are made for late payment, and a charge of \$1.00 is made for re-issue of a certificate revoked, lost, destroyed, or mutilated.

Revocation: Certificates may be revoked by a vote of five Board members, after proper trial, for fraud or deceit in obtaining registration, or for gross negligence, misconduct, or incompetence in practice.

Penalty: Violation of this Act is a misdemeanor, punishable by a fine of \$50.00 to \$500.00, or three months imprisonment, or both.

Corporations may engage in engineering work, provided those in responsible charge are registered.

The Minnesota Board of Registration of Architects, Engineers, and Land-surveyors was appointed by Governor Preus in accordance with this law, and met for organization July 28, 1921. The members are Paul Doty of St. Paul, chairman, N. Y. Taylor of Litchfield, vice-chairman, H. T. Downs of Minneapolis, secretary-treasurer, A. F. Gauger of St. Paul, F. M. McKellip of Faribault, F. G. German and Dwight E. Woodbridge of Duluth. The registration procedure was determined at a second meeting August 11, 1921. H. T. Downs, Secretary of the Board, kindly furnished the following information. Up to December 31, 1921, 266 applications for registration have been received, and 227 have been approved. Of these, 70 were for architects, 12 for architects and engineers, three for architects, engineers, and land-surveyors, 119 for engineers, 52 for engineers and land-surveyors, and 10 for land-surveyors. Twelve certificates have been issued to those registered in other states, including Michigan, North and South Dakota, Illinois, Iowa, and Washington. The Board has a difficult task to perform in deciding just what is engineering, since they know of no workable definition. For example, when are "sales engineers," or "efficiency engineers" entitled to registration under this law? Mr. Downs stated that he believed that the law should be amended to include a definition if possible. He also said that no technical graduate need fear difficulty in registering after having obtained some practical experience. However, he believes that some experience should be required.

As stated in this, and practically all similar laws, their object is to "safeguard life, health, and property." Whether this is the best method of so doing has been the subject of much debate. It is a difficult matter to frame a law which will be entirely just and still effective. Almost any law will be all right for those who can register under it, but those who cannot may be done an injustice. The right of a man, however small his ability, to earn a living in any way which does not endanger the rights of others, must not be interfered with.

It seems to be almost impossible to obtain a satisfactory legal definition of engineering, and this fact

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The Minnesota Law for the Registration of Architects, Engineers and Land-Surveyors

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has been used as an argument against such legislation. This difficulty has been realized and generally no attempt at definition has been made, as in Minnesota. But the matter then rests with the courts and lawyers, and should not engineers be able to do it better than they?

It has been asserted that there is positive need for registration—that ample protection is afforded by building codes, and inspections of plans and execution by city building departments, etc., and that if anything needs to be done, it can be accomplished by improving these existing regulations. But these aim at the act, while registration aims at the actor. Building codes and inspection may check incorrect work, but as long as an incompetent practices there will be the possibility of his "getting by" with something unsafe.

It has been pointed out, however, that some of the most notable of engineering failures, such as the Quebec bridge disasters, or the mine cave-ins at Scranton, Pa., were in charge of men who could easily have satisfied any reasonable registration requirements. In fact, some are engineers enough for certain grades of work, and others are big enough for more difficult work—no fine distinction can be drawn between engineer and non-engineer. So it has been suggested as a substitute for registration, that a severe penalty be placed on accidents due to incompetence, and in this way deter a man from attempting work for which he is not qualified.

A registration law is of advantage to the public, in that at least a certain standard of excellence is assured. But this is accomplished by the disadvantage that those just able to gain registration are given the same legal status as those who may have a great deal more ability. In this way, the inexperienced, although well educated person may be given undeserved prestige.

If the principle of registration or licensing is of value as applied to those other professions, law and medicine, and this is practically proven by its universal application, it should be advantageous in engineering and architecture for the same reasons. The titles "Engineer" or "Architect" should convey to the public, as much distinction, and as clear a meaning as the titles "Doctor" or "Lawyer." For an engineer's mistake may be as costly in life as a doctor's. Faulty design of a skyscraper, bridge, or tunnel, or incorrect construction might easily endanger thousands of lives.

The matter, however, is now far beyond the stage for debate or argument, for registration laws exist in twenty states, and similar bills are pending in fifteen more. These laws are all very similar, so the disadvantage of non-uniformity will not be very great. Previous to 1921, such laws were in effect in California, Colorado, Florida, Idaho, Illinois, Iowa, Louisiana, Michigan, New York, Oregon, Virginia, and Wyoming; and in the past year Arizona, Indiana, Minnesota, New Jersey, North Carolina, Pennsylvania, Tennessee, and West Virginia were added to the list. It now remains for all those involved to see to it that these laws are justly and wisely administered and enforced, and that they are corrected as faults appear, so that maximum benefit for all may be derived from them.

GRADES VS. ABILITY

Under a system where grades as determined by examinations form a standard, the question of the significance of these results is often raised. In general, the conclusion seems to be reached that men who rank high in the knowledge of fundamentals also rank high in character, judgment, and efficiency.

However, from an observation of students and graduates, it would appear that these standards are not always exact. Grades, as determined by examinations in large sections are not an absolute index of ability, because they are influenced by other factors and cannot be strengthened by any inquiry or observation on the part of the instructor, who very often has no part in correcting the papers. Similarly, grades as determined in courses based upon a mere swallowing of facts form a poor criterion, for natural ability should be stimulated by the lecturer and not quenched by a mere recital of facts which are better learned in books. Moreover, grades may be very often obtained without exceptional ability. Examinations are standardized, pet questions recur, and the resultant preparation in general gives good results.

Grades are very often obtained at too heavy a sacrifice. Such is the case of the man of average ability who becomes engrossed in nothing but study and in his specialty. This condition might be excused on the part of genius which in its enthusiasm to create must sacrifice; but for the average undergraduate who expects to go out into the industrial world, it is a mistake. This mistake is realized eventually by many graduates. It will be fatal to the man who fails to find work in his specialty and who is therefore in a hopeless quandary because of his narrow-mindedness.

Ability will very often be expresed in good grades and such should be the aim of all ambitious men. But for those who aspire to leadership in the industrial world, to the community of men of ideas and of enterprises, it is essential to broaden out by coupling good grades with good health and broad-mindedness. Student activities and athletics prepare for that real success which comes, not alone from the ability to make money, but also from the ability to render service and to live a full and well rounded life of usefulness and satisfactory achievement as an individual and as a citizen member of co-operative society.—Tech. Eng. News.

EINSTEIN THEORY OF RELATIVITY

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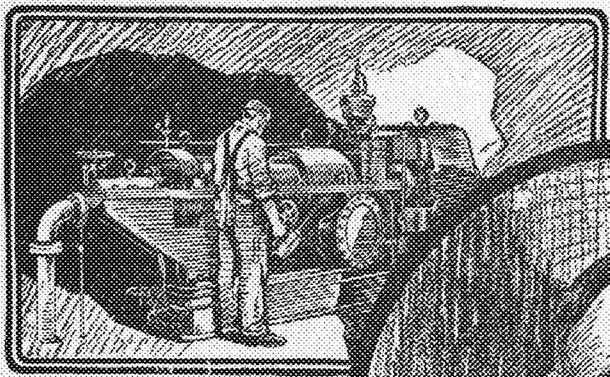
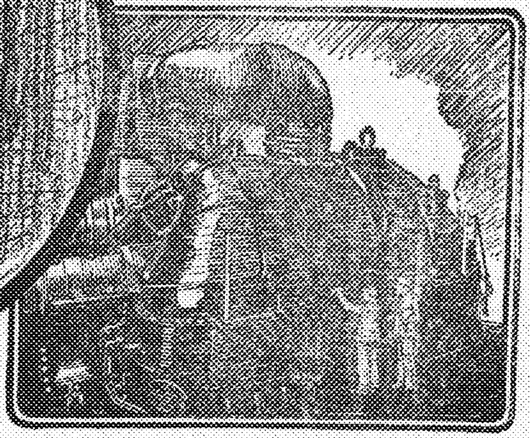
The third point which is open to direct proof is that a displacement of the lines of the spectrum toward the red should occur according to Einstein's explanation of the nature of light and of gravitation. This displacement has so far not been observed, but has not been proved absent. A single flaw would render the entire theory unacceptable; so it must be regarded as nothing more than a theory until this last point has been more thoroughly investigated.



1898, 300 kv-a. Unit

1921, 70,000 kv-a. Unit



Beginning with what would now be called the tiniest sort of a unit, a turbine which had a normal rating of 400 hp. at 3600 rpm., Westinghouse has developed turbine construction to a point where three cylinder, two stage, turbines are now in service developing 100,000 hp. And a most significant fact about this development is that practically every step in this progress has been a step forward.

Francis Hodgkinson

DURING the last twenty-five years power generation practice has been revolutionized. The steam turbine has definitely displaced the reciprocating engine as the standard prime mover in large generating equipments. And Francis Hodgkinson has had more to do with this achievement than any other one individual.

Mr. Hodgkinson came to this country along with the Westinghouse Licenses under the Parsons patents, in 1896, upon the recommendation of the inventor himself. Since that time practically every commercial steam turbine Westinghouse has built has been designed and built by him and his able associates.

In this quarter-century of steam-turbine development inventive genius has been paralleled throughout by practical level-headedness. There are few cases in engineering history where the record is writ as clearly and impressively as this. There can be nothing but credit for the engineer who puts his errors underfoot and rises upon them, and most of the world's greatest achievements have been so reached. The World also honors progress that is surefooted and far-visioned, such as the development of steam turbines under Mr. Hodgkinson's direction.

Many inventions of tremendous value in steam turbine practice have been devised and perfected by him and his co-workers. Among the more important of these are the construction, in 1907, of the first low-pressure turbine to be built in America, and in 1911, of the first Bleeder type of turbine; the perfection, in company with H. E. Longwell, of the water-seal gland; a balancing machine for turbine rotors that is almost superhumanly sensitive; a trouble-proof method of supporting turbine cylinders; and a very superior process for affixing turbine blades to rotor and cylinder.

One of the fundamental Westinghouse policies is insistence upon the uttermost in engineering. The observance of this policy in form and in spirit has provided genuine opportunities for many men of remarkable engineering gifts, one of the most notable of whom is the man whose name appears as the title of this article, Francis Hodgkinson.

Westinghouse

WESTINGHOUSE ELECTRIC

THE NEW SCHOOL OF MUSIC BUILDING

Continued from page 11

will separate the stage proper from the working space behind.

Considerable attention was paid, however, to the insulating of the music rooms against intercommunicating sound waves. A canvas joint is used in each individual air duct to prevent vibration in the metal. All music room walls are of three inch hollow tile covered with one-half inch flaxlinum or linofelt fiber insulation. On these are placed furring strips, metal lath and plaster. On the concrete floor slabs will be placed a one inch thickness of flaxlinum, the wood strips or sleepers and finished floor.

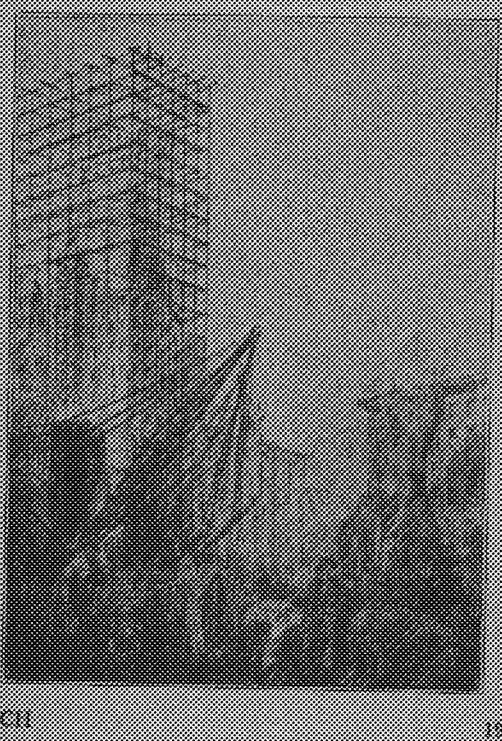
The ceilings are deadened in a manner similar to the walls. This is to prevent the sound from carrying from room to room rather than through the slab above. The doors to be used are known as the "Evanston" soundproof. They have a refrigerator bevel and are three inches thick.

Lighting for the concert hall is semi-direct and is handled by what is known as the "Major" remote control. This, as the name suggests, controls every light in the hall and is so devised as to be an absolute proof against mistake or accident.

It may be said that the building embodies the last word in every detail of its construction and equipment, and will stand as a monument to all who had a part in its planning and design.

(NOTE:—The writer is indebted to Prof. J. H. Forsythe, University Architect, and to the office of Mr. H. A. Hildebrandt, Superintendent of Buildings and Grounds, for the above information.)

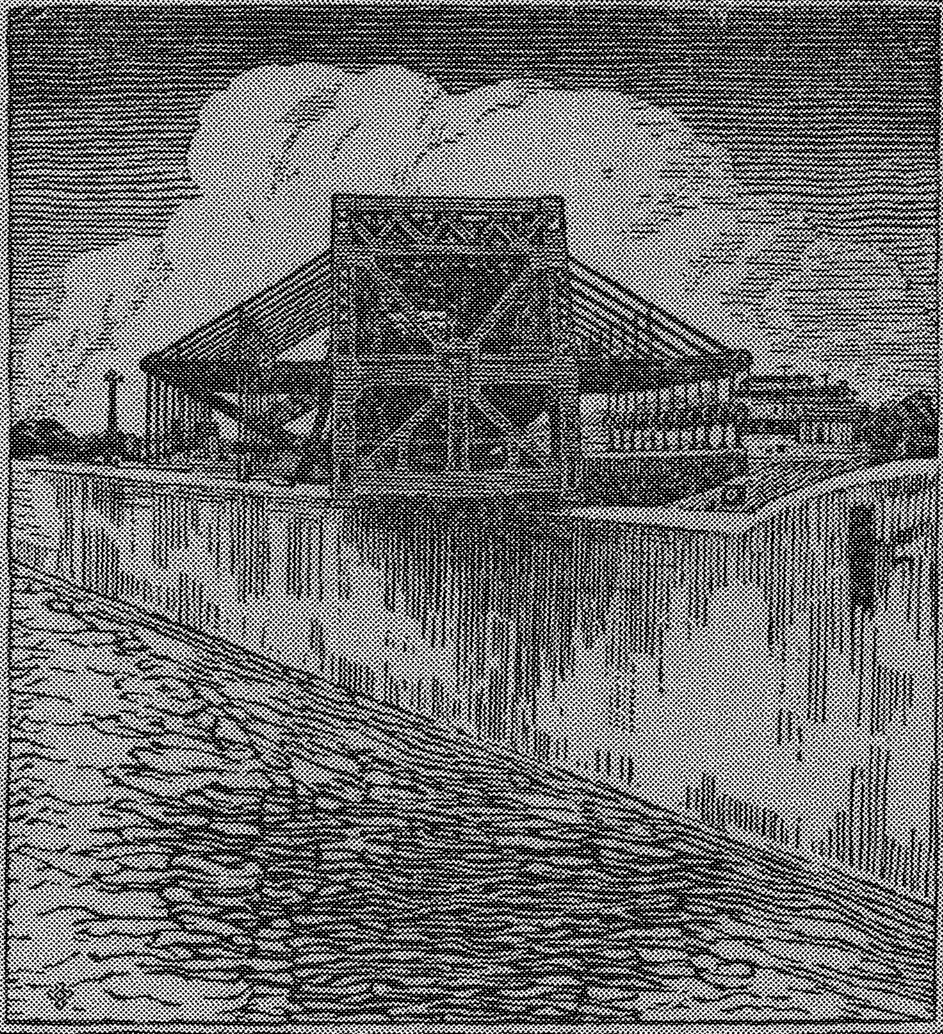
MINNESOTA TECHNO-LOG



MARCH 1922

PUBLISHED MONTHLY DURING THE SCHOOL YEAR BY THE STUDENTS OF THE COLLEGE OF ENGINEERING AND ARCHITECTURE AND THE SCHOOL OF CHEMISTRY.

VOL. II UNIVERSITY OF MINNESOTA NO. 5



The WORLD'S WORD for ELEVATOR SAFETY

The WORLD'S WORD for ELEVATOR SAFETY

PANAMA CANAL EMERGENCY DAMS

GATUN LAKE, eighty-five feet above sea level, is the reservoir holding the water to feed the Gatun Locks (which lead to the Atlantic) and the Miraflores and Pedro Miguel locks on the Pacific end of the canal.

Every ship going through the canal in either direction uses the water from Gatun Lake to lift it from the one ocean and lower it into the other. Should some accident destroy a lock, the weight of the water released might force down the others and cause tremendous damage and, by lowering the level of the lake, make the canal inoperative until rain had refilled the lake.

Therefore these big emergency dams were constructed. Normally they are not used. In emergencies they would be swung over the locks, the gates would drop into position and effectually dam the opening.

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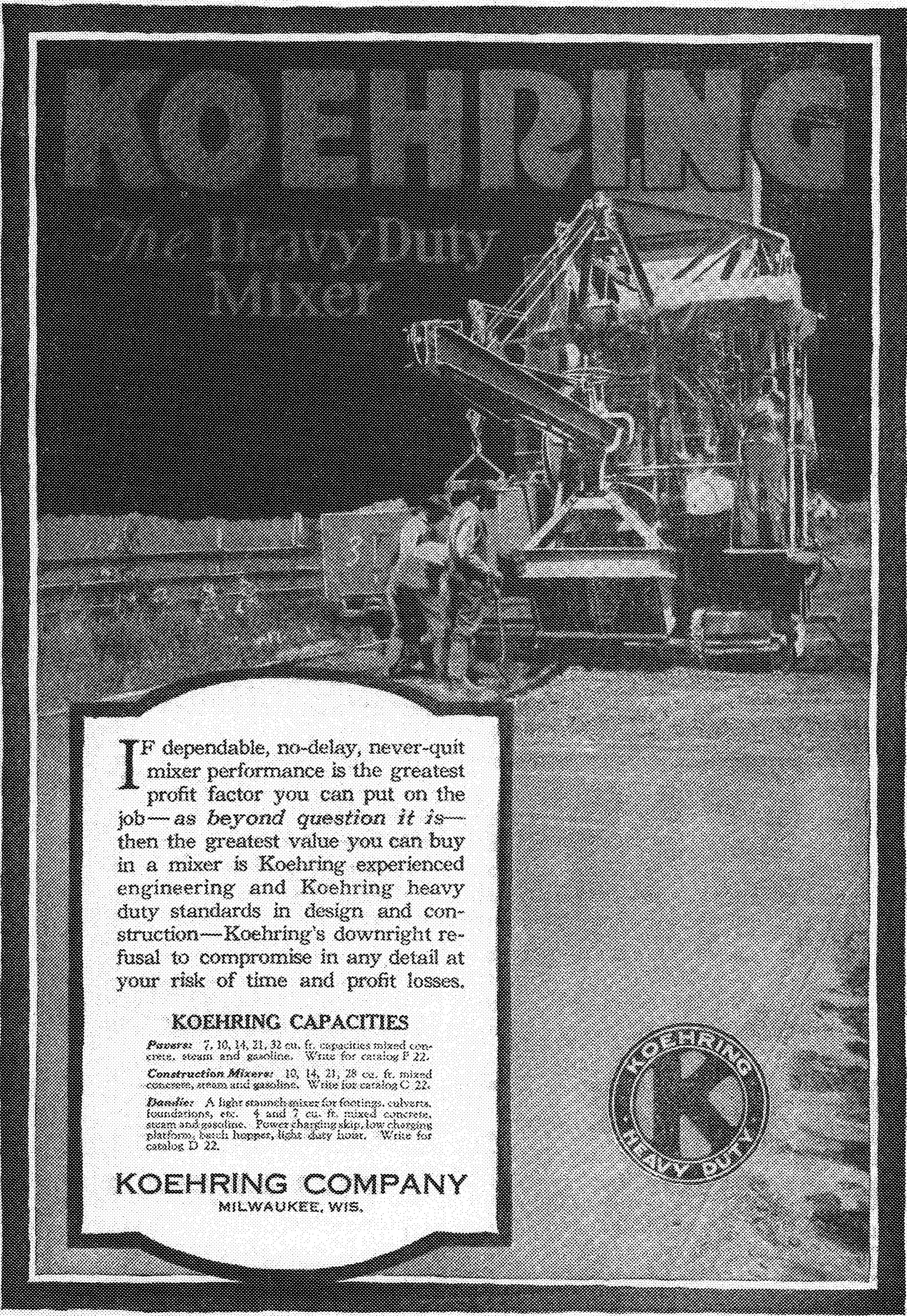
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VOLUME II | MARCH, 1922 | NUMBER 5

THE BEST USE OF THE HIGH DAM POWER

By Prof. Geo. D. Shepardson
Head of the Department of Electrical Engineers

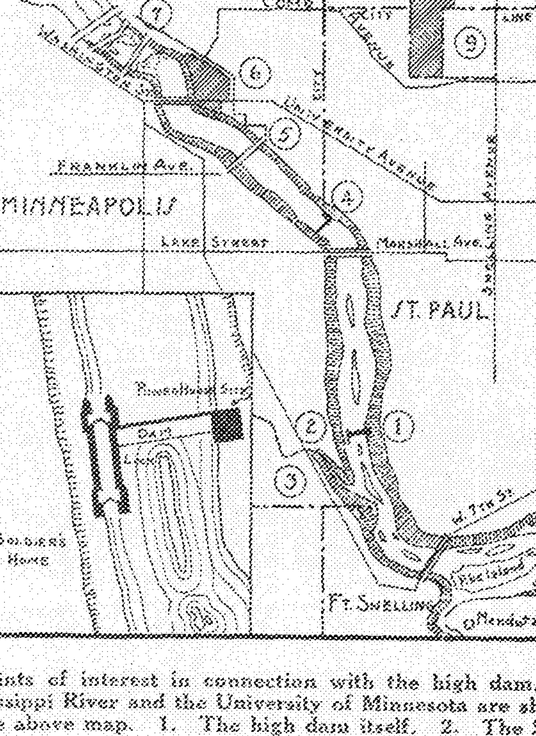
When the Federal Government undertook to make the Mississippi River navigable to Minneapolis, it planned to construct between the Twin Cities two dams and locks, each with a lift of 13 feet. The upper dam a few blocks north of the Lake Street bridge was completed and its lock put into operation in May, 1907. Favorable attention was then given to the argument of Professor Benj. F. Groat, of the University of Minnesota, to the effect that valuable power might be developed if one dam with a head of about 30 feet were adopted instead of two dams of 13 feet head each, and the University Alumni Committee on the High Dam undertook to secure power rights for the University. What became known as the "High Dam" project was adopted in June, 1910. Lock No. 2 was abandoned. Its dam was partially blown up to avoid obstructing navigation, and the lower lock and dam were constructed to the greater height.

Available Power

An idea of the power involved may be gained from data discussed by Professor J. J. Flather in the "Minnesota Engineer" of November, 1912, and of January, 1913. Records over a number of years show that the amount of water flowing in the river at this point varies between about 1,300 and 60,000 cubic feet per second, the available head at the High Dam ranging from about 33 feet at minimum flow to about 24 feet at times of flood. There is thus from about 4,500 to 160,000 gross hydraulic horsepower, or (assuming 80% hydraulic and 92% electrical efficiency) from 2,500 to 85,000 kilowatts available at the switchboard if the entire power were developed. It is possible to increase the smaller amount during part of the day by drawing on the pool above the dam, or continuously with cooperation of Federal agencies in connection with the water storage reservoirs further north.

Professor Flather estimates that an average of from 8,800 to 10,000 kilowatts at the switchboard could be secured for seven months in each year, 10,000 to 11,000 kilowatts or more for the remaining months, without lowering the pool or using flashboards to raise the height. The substructure of the powerhouse constructed as part of the dam, provides for four units of 2,500 kilowatts each.

It would not be advisable to provide equipment for utilizing the unusual flow of water under flood conditions. On the other hand, it is generally advisable to provide steam or other auxiliary power to help out during periods of low water. Such auxiliary power might be obtained from steam power stations, such as the Riverside Station of the Northern States Power Company, or from the standby emergency Waterworks Pumping Station, or from the University Heating Plant, the latter then using exhaust steam for heating. It will be noted that the minimum flow of water in the river is coincident



Points of interest in connection with the high dam, the Mississippi River and the University of Minnesota are shown in the above map. 1. The high dam itself. 2. The State Soldiers' Home. 3. Minnehaha Falls. 4. Old No. 2 dam which was blown up leaving only the lock on the St. Paul side of the river. 5. New Cappelen Memorial Bridge which featured in the news last month. 6. The main campus of the University. 7. St. Anthony Falls. 8. University Farm campus. 9. State Fair grounds. The insert in the lower left hand corner shows the general arrangement of lock, dam and power house site.

with the coldest part of the year, when also the hours of artificial lighting are nearly the longest.

Claims of the State

Before the High Dam was constructed, competition developed for the rights to the power. Since the Mississippi River was navigable, open for interstate commerce and improved by Federal funds, any power developed within the navigable portion seemed to be at the disposal of the Federal Government. At hearings before the Government representatives about ten years ago, ex-Governor John Lind, then President of the Board of Regents of the University, made a strong plea for the rights of the State (represented by its University and otherwise) as against the proposals of various private corporations which desired to supplement their other sources of power.

Among other arguments, Mr. Lind urged that the relations between the Federal Government and the States had never been on a bargaining basis as between buyer and seller, but rather as between partners or as between parent and child, and that therefore the power rights should be assigned to the State even though private or public utility corporations might offer higher pay for such rights.

Attention also has been called to the fact that the power from the High Dam lies entirely within the State of Minnesota, as does also the entire watershed from which its water supply is obtained, and that therefore the rights to the power belong inalienably to the State of Minnesota and are not at the disposal of the Federal Government. After the somewhat extended hearings, about ten years ago, it was decided that no final action could be taken until Congress had disposed of the pending Water Power Act. This held up all progress until late in 1920.

Municipal Electric Company

Since each of the Twin Cities had yielded certain riparian rights, had donated overflowed lands and had incurred the liability to required construction of expensive intercepting sewers to prevent pollution of the pond above the High Dam, it was early recognized that they as well as the State had certain moral if not legal equities in the water power that should be available. The Minnesota Legislature of 1913 therefore made provision for organizing the "Municipal Electric Company" consisting of the Mayors of the two cities and the President of the Board of Regents of the University. Subsequent legislation, to enable them to finance the proposed construction, became involved in the congestion of business at the close of the session, thus leaving the Municipal Electric Company without power to secure funds. Early in the coming session of the Legislature it is expected that this will be remedied.

Applications For Power

Shortly after the Federal Water Power Act passed Congress in May, 1920, the Federal Power Commission organized to carry out its provisions, and soon had applications for more than ten million horsepower. The Municipal Electric Company was one of the first to apply informally for action on the High Dam between the Twin Cities. The Northern States Power Company requested a permit to begin immediate utilization of this power, on the ground that it was ready to stop the waste of power at once, and that it was best prepared to use this power for the greatest benefit of the public in general, including both cities and the State.

St. Paul put in an independent claim on various grounds, holding that the Municipal Electric Company was not a workable organization. Minneapolis then followed with an independent claim to protect its rights, and Mayor Leach and his associates succeeded in having Federal action deferred until the cities could get together and secure any necessary legislation.

In the meanwhile President Snyder proposed (see Minnesota Alumni Weekly, February 16, 1922) in view of the apparent weakness of the Municipal Electric Company, that the State should take over the entire power, as seems to be its right.

Arguments of Claimants

Each of the claimants for this water power presents appealing arguments, some of which are of general interest. The public utility company argues that by reason of the diversity and extent of its customers' demands and by reason of its variety of sources of power, it is best prepared to develop and utilize the maximum of power from the High Dam, thereby best conserving natural resources; urging further that the general trend of engineering practice is toward connecting many power sources into large super-power systems for greater economy and reliability.

On the other hand the several members of the Municipal Electric Company claim prior rights and equities because of the ceded rights and of prospective expense for new sewers incurred by reason of the construction of the dam, and further claim the right and necessity of using this power as a means of curbing monopoly. While some favor every opportunity to extend public ownership, a conservative element holds that the best use of the major portion of the power from the High Dam should be as a rate maker. It is urged that since the municipalities have less and less control over the public utility corporations, and since there is no public utility commission with adequate power in Minnesota, the most effective way to regulate rates for power is for the municipalities to control the waterpower which should be theirs, and thus be able to show what power really costs, and what are reasonable rates for public utility companies to charge. Similarly, as the State in connection with its reformatory and protective functioning at Stillwater, has found the manufacture of binding twine and of agricultural implements a means of reducing prices to the farmers, so the manufacture of artificial fertilizers and other products of electric furnaces and associated processes might reduce the prices of such necessities to farmers and others. The State can also properly utilize considerable power for conducting researches that would benefit the entire commonwealth.

While the University and other agencies of the State, as well as the Twin Cities, could use to advantage the power normally obtainable from the High Dam, the writer believes that the strongest case for the University is for the reservation of rights to power for research purposes.

Importance of Research at U.

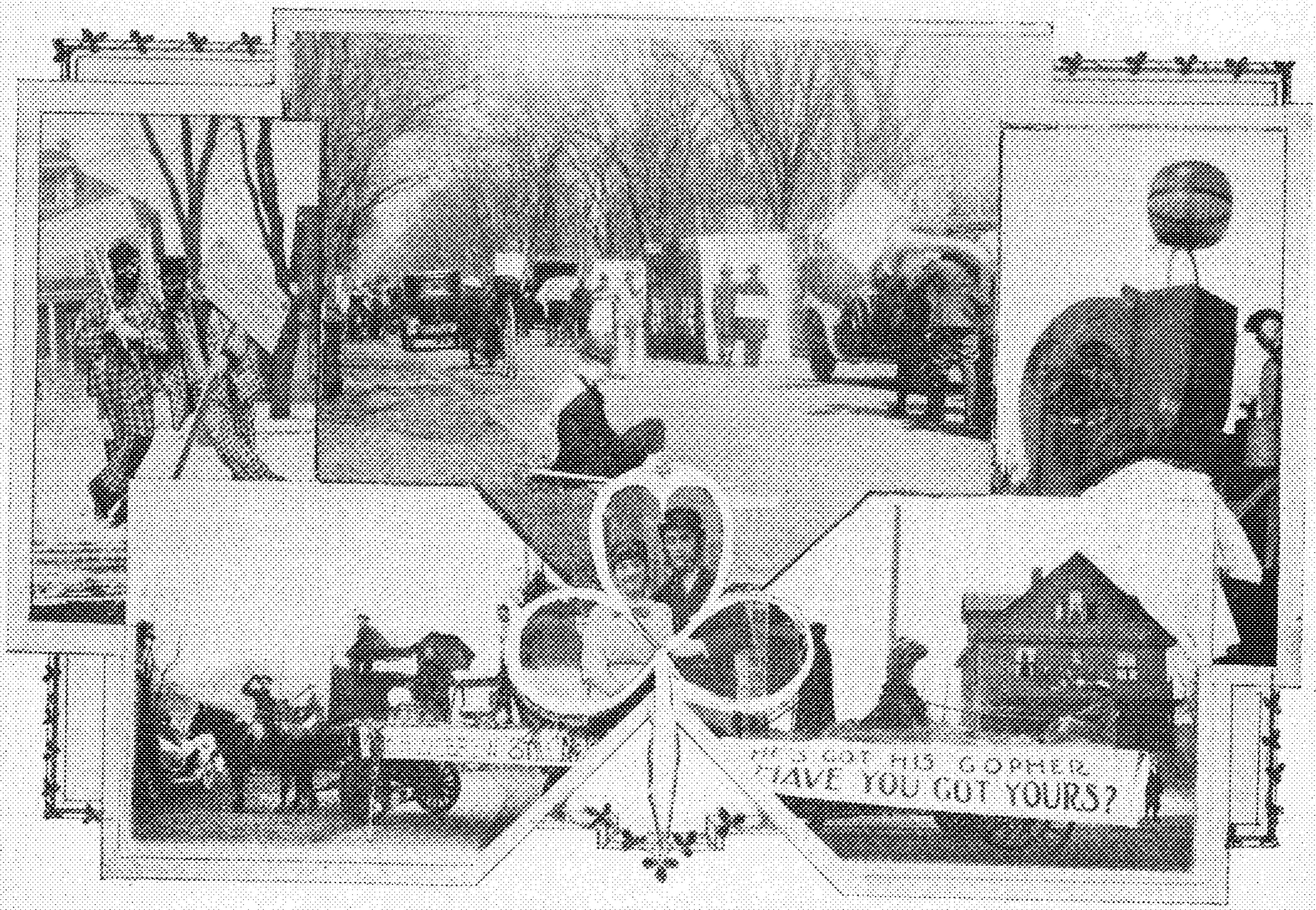
Research is an important factor in the tri-partite duties of the University; education of students, diffusion of knowledge and extension of knowledge.

The opportunity of cooperating, if only in a minor capacity, in the search for new truth, is a stimulus

(Continued on Page 14)

THE ENGINEERS' ANNUAL

A Composite Story of the Past, Present and Future St. Pat's Day Celebrations



GLIMPSES OF PAST PARADES —Courtesy of Photo Art Shop

HISTORY OF MOVEMENT

By Irving H. Marshman, '23

"Let profs. do their worst, there are moments of joy,
Bright dreams of the past which they cannot destroy;
Which come in the night of flunker's despair,
And bring back the feathers St. Pat used to wear."

Engineers' celebrations began with the discovery of the Blarney Stone during the excavation for the foundation of the Engineering Annex in 1903. This stone was covered with figures resembling ancient hieroglyphics. After many months of research the strange writings were translated to read, "St. Patrick was an Engineer."

On the evening of March 16, 1903, after the seniors had divulged to the world the real meaning of the Blarney Stone hieroglyphics, the following resolution was presented by a Senior:

"Whereas, in the ranks of the Engineering College, there are many of noble birth and Irish blood and

"Whereas the ancestors of many of our illustrious students came from Erin's Isle, and

"Whereas, St. Patrick was an engineer;

"Therefore, be it resolved, that the Engineering Department take a holiday and celebrate in a body."

On the morning of St. Patrick's Day, 1903, a large group of Engineers held a later meeting in the general library, where they dedicated themselves unflinchingly to the service of their patron saint forever and ever. After this they followed the band about town, singing Irish songs, and endeavoring to raise the lower regions up to the level of the surface. With this introduction of the St. Patrick spirit to the University, they departed to their rooms.

The next year, 1904, was marked by a new spirit. Ne'er a nay was heard to the motion to cut all classes. That night the Seniors celebrated with a banquet at the Gordon Hotel. The year 1905 marked the beginning of the extensive celebration that we now know. The Senior banquet which marked the celebration of the previous year gave way to the St. Patrick's Ball which still holds sway.

In 1907 the Missouri School of Mines, at Rolla took up the celebration. The same year Miss Ade Wilson, the only lady who ever graduated in Engineering at the University of Missouri, was knighted, and thus became the first "Lady of the Guard of St. Patrick.

The University of Iowa and Iowa State College took up the celebration in 1909. In 1910 Prof. George C. Priester, fresh from Iowa State College, inoculated several of his undergraduates with the St. Pat's spirit. These men took up the proposition and with the aid and advice of that first immortal knight who ever trod the Minnesota Campus, put on a successful celebration, consisting of a big parade in the morning, headed by St. Patrick himself; a knighting ceremony in the afternoon at which the Seniors were knighted into the Ancient and Mystic Guard of St. Patrick; a Green Tea Dansant in the afternoon; and in the evening the premier social event of the University year, the St. Patrick's Ball. The day was a great success, and the celebration received the unanimous praise of the entire University, including the Faculty.

Of all the traditions at Minnesota, the one which Prof. Priester introduced holds predominance. The entire student body of the University look forward to the 17th of March each year when the Engineers rule the campus. Every loyal Guard looks forward to the great day when he will finally realize his great ambition, when he will kneel and kiss the mystic Blarney Stone and hear the words of our illustrious Patron Saint, "I dub thee Knight of the Guard of St. Patrick."

In 1917 two hundred brave miners undertook to purloin the Blarney Stone from a small but loyal body of Guards. By force of numbers the Blarney Stone was captured, placed in a one-wheeled Miner's jinrikisha and accelerated toward the Father of Waters. They had not proceeded very far when they were overtaken by a detachment of Priester's Prides and the Blarney Stone recaptured. Several dozen Miners were treated to a needed, and deserved bath in the cool and placid waters of the river.

The University of Arkansas began celebrating St. Patrick's Day in 1913, and then in rapid succession followed the University of Mississippi, the University of Tennessee, Washington University, the University of Oklahoma, Oklahoma Architectural and Mechanical, and the University of Colorado followed in rapid succession.

Last year the name of the National organization was changed to "The Association of Collegiate Engineers," with the hope that the organization would expand rapidly into other universities and colleges. The ideal and purposes which this organization fosters are the promotion of student government, the exchange of ideas and experiences, the promotion of student enterprises such as cooperative purchase of books and supplies, the promotion of athletics, dramatics, debate, oratory and other activities which tend to broaden the scope of the Engineer.

ENGINEERS' DAY PLANS

By L. A. Grettum, '23

THE COMMITTEES

EXECUTIVE—Harold E. Peckham, general chairman; Edwin Brossard, treasurer; K. W. Keiser, secretary; Ralph Dunnevan, dance; Otto Person, tea dansant; Chester Marshall, open house; Byron Curry, reviewing stand; Irving H. Marshman, knighting ceremony; L. A. Grettum, publicity; and Jordan Haney, alumni invitations.

PARADE—Election of members by the several classses had not been consummated at press time.

DANCE—Harold Pause, Lloyd Peck, P. V. Johnson, Walter Maiser and Frank Christlieb.

TEA DANSANT—Mark Nelson, E. L. Johnson, John Walquist, C. H. Luedeman and Tressa Snure.

FINANCE—Arthur Gilstad and Charles Rheinstorm.

OPEN HOUSE—Shelden Hibbard, H. Staehle, Orville Hosmer, S. C. Chapin and Henry Hecht.

REVIEWING STAND—Hibbard Hill, Adrian Kearney and Alvin Miller.

KNIGHTING CEREMONY—Les Amidon and George Fairbanks.

PUBLICITY—Albert Morse and Russell Graves.

By the time this edition of the Techno-Log appears preparations for the biggest and best Engineers' Day celebration ever held will be well under way and every detail arranged for. Immediately after his election, Harold Peckham, general chairman, selected the executive committee and called the first meeting. Since that time three meetings have been held, all committees except the parade committee have been selected, and financial arrangements made.

From nine o'clock in the morning until after the grand ball is over at midnight there will be something doing every minute. All the regular features of the day such as the open house in all the Engineering buildings with every machine running, the knighting ceremony in the afternoon, the famous Green Tea, and the dance in the evening are on the program. Every effort is being made to carry on the tradition, begun last year, of making it a homecoming for engineering alumni. The parade will leave our campus at noon and follow the usual route over the main campus, after which there will be a brief respite until the knighting ceremony begins in the Experimental Engineering Building.

For the benefit of students who may not know what this ceremony is, an explanation follows. Each year on March 17, all the members of the Senior class who graduate in the spring are initiated into the Royal Order of the Knights of St. Patrick. This is a national society existing in about a dozen technical schools in the United States, whose membership is composed of graduates of those institutions. The ceremony consists in kissing the Blarney Stone and being knighted by a touch of St. Patrick's sword in the regular manner, after which the certificates of membership are issued.

All section leaders and the men from the section delegated to appear in the parade will report at

8:30 a. m. at the place agreed on beforehand and make absolutely certain that their float or stunt will be ready in time for inspection by the parade committee before they take their assigned place in the line of march. Vernon Babcock, P. O. Box 403, is the man to see for information of any sort regarding the parade.

As in past years, each section in the Freshman, Sophomore and Junior classes will receive a specified sum from the committee to spend for their stunts. The Freshman class provides the humorous floats, and it is upon the spirit and cooperation they show that the success of the whole affair depends. Their stunts attract most attention, and they must be up to the required standard. The Sophomores and Juniors put on the educational stunts showing work being done in the Engineering College or symbolical of the profession.

Tickets for the dance must be spoken for beforehand; the capacity of the Armory is limited, and the ticket sale will absolutely be kept within the limits of comfortable accommodation for those who attend. Ralph Dunnavan, chairman of the dance committee, promises something new in the way of decorations. The number of tickets placed on sale in each class will be in proportion to its size, and all those planning to attend must act quickly if they wish to obtain tickets. Engineers will be given first choice; they will have plenty of chance to obtain them before the sale is thrown open to outsiders. This policy will absolutely be carried out, regardless of any objection from outside.

Tentative Program Drawn Up

The other features of the celebration will be run off in the usual manner. At the open house in the morning and afternoon and later at the Tea Dansant the Engineering College will be host to the entire student body of the University and to all its outside friends. Every effort will be made to take care of the alumni who return for the festivities; this feature will be especially emphasized in an attempt to build up a really worthwhile homecoming day for graduates of the Engineering College.

As usual, the immediate financial demands will be met by a sale of buttons, bearing the new emblem selected by the A. E. S. last month. This will be the first appearance of the emblem in a form which may be kept as a souvenir. The emblem will also appear on the programs for the dance in the evening.

All purchases will be made only upon an order from the treasurer, and no cash whatever except very small sums will be handled before the day is over. Everything will be done upon a credit basis at stores at which accounts have been opened and in this way by cross-checking the receipts an absolutely accurate account of all expenditures for any purpose whatever will be kept.

The tentative program drawn up at a meeting of the executive committee on Tuesday, February 21, follows:

8:30 a. m.	Section leaders and assistants report on Eng. campus to prepare floats for the parade.
10:00-11:30 a. m.	Open house in all the Engineering buildings.
12:00 noon	Parade assembles on Engineering campus.
12:20 p. m.	Parade starts on the line of march.
1:30-2:30 p. m.	Open house in all the Engineering buildings.
2:30-3:30 p. m.	Knighting ceremony in the Exp. Engineering building.
3:30-6:00 p. m.	Tea Dansant.
9:00-Midnight	Grand St. Patrick's Day Ball in the Armory.

WHAT OTHERS DO

By Harold E. Peckham, '23

Engineers' Day celebrations staged in virtually every engineering college of importance in the country vary widely in nature and time. But Engineers always celebrate. A small group of spirited students gather on a certain day each year to promote college spirit and to advertise their identity, or an organized student body may plan for months to stage an Engineers' Day celebration such as Minnesota is familiar with. In either case the idea is the same. The difference is merely one of degree.

In the ten chapters of the Association of Collegiate Engineers, of which Minnesota is a member, Engineers' Day is reputed the biggest tradition on the campus where it is an annual event. The nature of the celebrations range from traditional St. Patrick's Day, through Engineers' Days similar to that observed at Minnesota, to an Apple Fest at one institution.

The Apple Fest is staged annually at the University of Colorado, the location of the newest Association chapter. An event reserved to members is the stag party and smoker, at which boxing, wrestling and other forms of amusements are enjoyed. Open house is planned for visitors, and this year, for the first time, a Mother's and Father's Day is on the schedule. On this day classes will be held as usual, to afford parents an opportunity of seeing the regular routine of college work.

Ace Day, which took its name from the Association of Collegiate Engineers, is a new feature at the University of Tennessee, replacing the St. Pat's celebration of former years. In place of a traditional St. Patrick in charge of ceremonies, the Ace of Spades is high. The other three aces of the deck act as chief assistants, while fair sponsors are given titles of Queens of the corresponding suits. Other members of Ace Day committees are Kings and Jacks, while the Joker acts as court fool.

Engineers at Washington University, St. Louis, this year will follow a new ritual, featuring King Coo Coo, builder of the pyramids, said to have been the first engineer. It is planned to feature some famous engineer each year, until the present day is reached. Washington University, located as it is in a large city, faces much the same problems that are met at Minnesota. The celebration must be confined to the campus community, and publicity planned to attract the desired visitors.

One school which is not forced to confine its celebrations to the campus is the Missouri School of Mines, at Rolla. The town is a small, and guests are invited from outside cities. St. Louis, Chicago, and numerous girls' schools in the vicinity furnish their quota of the fair to assist. The celebration lasts for two days, and during their stay at Rolla the

(Continued on Page 22)

NEW CHEMISTRY UNIT FINISHED

Additional Laboratory and Library Facilities

With the completion of the last unit of the new School of Chemistry building additional space is provided for chemical engineering, an advanced laboratory, a new library and large qualitative and organic laboratories.

The organic laboratory, on the third floor, is a noteworthy contrast to the temporary, crowded and insufficiently lighted quarters in the basement of the older part of the building. The laboratory is well lighted, with south and west exposure and cross lighting from the court.

Working space in the laboratory is designed to accommodate 146 students at a time, each having desk room to set up distillations and other complicated apparatus. Three lockers are provided under each unit, so that 438 students are given locker space, although only 146 students can work in one laboratory section.

Each desk has water, gas, vacuum for filtration, and low pressure steam, with a steam bath for every two positions. There are A. C. and D. C. outlets on each table affording power for stirrers and direct current for electrolytic organic preparation. Desk tops are of alberene stone, with stone bottle-racks. A central stone trough is provided for effluent from condensers, with alberene sinks at the ends of the desks.

Five large hoods and tables cover all available wall space. The tables are of alberene with a rear trough. Four are fitted with gas, water, vacuum and steam baths. The fifth intended primarily for more advanced work also has hot water and compressed air. A separate storeroom, part of the general supply service of the building, occupies the northeast corner of the laboratory.

The laboratory is intended primarily for students beginning organic chemistry; including the regular organic course, taken by chemists and offered as an elective in other colleges, and special courses offered to professional students in medicine, pharmacy and dentistry.

The New Qualitative

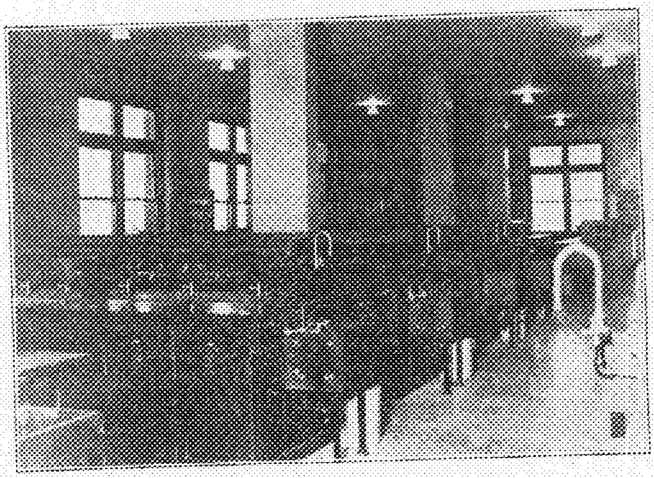
Laboratory 290, situated on the second floor below the new organic laboratory, is designed primarily to meet the needs of students working in qualitative chemical analysis. In this laboratory there are twenty-three desks with lockers to supply 635 students.

The desks, the tops of which are made of alberene stone, are each equipped with cocks for water, gas, and suction. These are arranged conveniently and marked so that no time will be lost locating the desired cock. Compressed air for blast lamp work is also on each desk.

Another feature of the qualitative laboratory is that each table is supplied with individual hoods for ventilation. This system is supplemented by the larger hoods to care for the more penetrating and obnoxious fumes. Hydrogen sulfide supply outlets are also placed in the large hoods.

One of the greatest hopes of the chemistry students has been realized in the space allotted the new library and reading rooms which occupy the first floor of the southwest wing. The former library is now used as a reading room. In the new library there are sixteen low, round tables with four chairs of the Windsor type at each table.

The newly acquired quarters provide a most valuable working and reference library, well equipped for supplying the needs of graduates, undergraduate students and faculty. The library contains 4,764 bound volumes of works treating directly of chemistry as well as hundreds of government publications, dissertations and pamphlets.



A LABORATORY IN ADDITION

The library is especially rich in complete files of practically every chemical journal, in which respect Minnesota outrivals many of the older eastern colleges. A subscription list of sixty current chemical periodicals is maintained and standard works bearing on the subject of chemistry are purchased as they appear.

The general subject and author card index is always at the disposal of students to aid them in locating the information which the library contains. Although the library is designed especially for chemists, the expansion of the reading room is sufficient to accommodate engineers, academic and medical students.

The first floor of the new addition in addition to the new library contains a laboratory which will eventually care for any increase in the number of students registered for beginning chemistry. Until

(Continued on Page 16)

COLLEGE NEWS

By C. M. Burrill '23

ELECTRICAL RESEARCH

E. C. Manderfield and L. C. Larson are perfecting a new system of telephony over high tension power lines. It is practically equivalent to radio-telephony confined to a transmission cable and not spread in all directions through the ether. A fundamental or "carrier" current of high frequency (75,000 to 1,000,000 cycles per sec.) is generated by vacuum tubes, and this is modulated or controlled by the voice through the telephone transmitter. This high frequency current does not interfere in any way with the power transmission but special provision must be made for getting it through transformers and other parts of the line which have very large impedance at such frequencies. This is the phase of the problem on which they are working at present. This system is more efficient than radio-telephony because the energy is concentrated in one direction, and it also has the advantage of secrecy. It is more stable and reliable in operation than the ordinary line telephone. It will prove particularly valuable where power lines span sparsely settled country, devoid of other lines of communication. Messrs. Manderfield and Larson are fortunate in having the hearty cooperation of the General Electric Co., which is very interested in the problem. They have met with complete success as far as they have tested their apparatus—for short distances about the Twin Cities, and hope in two years more to have their system on a firm commercial basis.

"Penetration Macadam and the Maintenance of Roads by the Use of Tarvia" was the subject of an illustrated lecture by Mr. Martin of the Barret Co., on February 17, 1922, in the Main Engineering Building.

Dean Ora M. Leland has written a book entitled "Practical Least Squares," which has recently been published by McGraw-Hill. It is designed for use in short courses in the subject, and for reference, and is essentially practical. The single library copy is very popular with several engineers who are now taking a course in least squares.

Prof. Frederic Bass is confined at his home with an attack of influenza. For this reason his scheduled speech at the convention of the American Federation of Architects and Engineers, meeting in Minneapolis last week, was cancelled.

Rolf Bergford, '22, is a sufferer with the same malady. The return of both in good health is the wish of the college.

The Arabs were entertained very appropriately with an Arabian dance by Arthur H. Ruddy at the Phi Sigma Kappa chapter house February 16, 1922. Their orchestra was also on hand to assist with the refreshments in banishing care for the evening. W. E. Willner, Elving Johnson, and Olaf Fjelde, selected to write a play for production in the spring, reported on their progress, and the dates were set at April 22-23 for the staging of the club's first attempt.

Chester Marshall, M. E. 23, was elected junior representative to the Engineering Student Council February 10, 1922. He will take the place of Merle DeForrest, who has changed his registration.

Engineers from all parts of the state met at the Curtis Hotel, Minneapolis, for the Annual Convention of the Minnesota Federation of Architectural and Engineering Societies, and of the Minnesota Surveyors' and Engineers' Society, February 21, 22, and 23, 1922. Among those appearing on the program were Dean Ora M. Leland, Prof. F. H. Bass, Prof. F. C. Lang, Prof. H. B. Roe, and E. W. Kibbey of the University.

Tau Sigma Delta, national honorary architectural fraternity announces the initiation of W. E. Willner and Frank S. Moorman. The initiation ceremony and banquet were held at the Alpha Rho Chi chapter house.

An address by Max Toltz of Toltz, King, and Day, St. Paul consulting engineers, was the feature of a meeting of the Minnesota Branch of the A. S. M. E. on February 11, 1922. His subject was "My Recent Trip to Europe." He has but recently returned from abroad where he has been connected with the United States Department of Commerce. An employment commission to assist the mechanicals in securing vacation employment and permanent positions after graduation was established at this meeting. Rudolf Kuhlman was made chairman, and it is his plan to cooperate to the utmost with the University Employment Office and with the agencies of the national engineering societies. It is hoped that all the students will be placed in summer work with local firms, and a great effort will be made to find work which will be of engineering value, and which will lead to permanent positions. Other members of the commission are Ed. Mikesh, senior representative, and H. R. Langman, sophomore representative.

MINNESOTA TECHNO-LOG

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EDITORIALS

A WORD OF THANKS

We are indebted to W. A. Kendall, '24, for the execution of our new cover design, and to R. W. Hammet, whose symbollic pencil sketch so artistically gives to the cover an atmosphere of constructive industry. Mr. Hammet also designed our page headings used in this issue and that of last month. They are a distinct addition to their respective pages, lending a needed touch. Not only these men of the architectural department, but the department as a whole, has been an incalculable aid in the editing of the publication, through the inspiration the members have afforded the staff by their willing spirit of generous cooperation.

THE SPIRIT OF THE DAY

Work had been progressing rapidly for the annual Engineers' Day parade. A member of the parade committee dashed into the engineering building and up a flight of stairs toward an upper floor. On the landing midway he surprised the dean of the college who was standing, watching, meditating upon the activity on the campus below him. Both smiled and the student ventured a "What do you think?" The Dean paused a moment as he stroked his vandyke beard; then he said, "I like it. Of course some people do not look upon the day as I do; but they do not realize that the students are having to work along practical lines, they must conceive, plan and organize, to carry out their dreams and plans. Personally, I believe that the efforts they put forth in this way, and the relative success or failure of their work, can not help but make them appreciate larger things, affairs of greater importance." Will the students of this year enter into the Engineers' Day plans this year with a spirit that will make them better leaders and followers than they have ever been? Minnesota Engineers! Press on!

THE ARABS PRODUCTION

Secrecy of action is productive of rumor. The Arabs have quietly gone about their work of placing the Engineering College in the University's dramatic field. As may have been surmised, rumors of a "snappy production" are circulating. These rumors are unfounded. It is sufficient to say at this time, that the Arabs' efforts will be worthy of the most able dramatic criticism. The manuscript has been finally accepted, and its contents remain undivulged. Any deprecable remarks as to the propriety of the matter are malicious. Huge obstacles in the way of production, at which other organizations would have balked, have already been overcome. Mechanically and dramatically the production will be one of distinctive merit.

YOUR MAGAZINE

We of the staff are exerting every effort to present a publication that will truly represent the College of Engineering and Architecture, and the School of Chemistry. We feel that Techno-Log not only offers to each student a wonderful opportunity to receive journalistic experience, but that it can be made into a powerful form of advertisement for our institution. Circulated throughout the country it will reflect everywhere the spirit and character of the Minnesota Engineer.

We are anxious that all students appreciate this fact and that they make the Techno-Log their publication; that they contribute articles; and that they see that their department is well represented. As a student publication the Techno-Log relies upon their support for its merit and continued existence. With the moral and material assistance of the student body we feel certain that the Techno-Log will continue to be a magazine of which we all may be justly proud.

THE ENGINEERS' EMBLEM

The results of the $50.00 competition, for a distinctive emblem for the Minnesota Engineers, were announced at a recent mass meeting. The first prize of $25.00 fell to John Morrison, '22, whose design was not adopted, however, because of mechanical difficulties. Don Capstick, '22, was given the $15.00 second prize, and Mr. Winter $10.00 for third. The contest was in charge of the Bookstore and the A. E. S., who offered the prizes. The judges were Dean O. M. Leland, Prof. R. C. Jones, and Mr. Fred Beygeh of the Beygeh Engraving Co.

The chief merit of the design adopted is in its simplicity, and in the fact that it can be distorted into many different shapes without losing its identity. This is shown by the two very different forms in which it appeared in the February issue of the Techno-Log, in the heading for Athletics, etc., and in the Engineers' Bookstore advertisement.

The Bookstore will have stationery printed, and will have lapel emblems, watch-fobs and possibly other forms made, and we must do our part by using, wearing, talking about the emblem. Give it all the publicity you can and help to firmly establish its significance.

FEBRUARY DESIGN AWARDS

"A Doorway in an Italian Sunken Garden" was the subject of the first Freshman design problem. E. W. Krafft, A. H. Grisson, and F. O. Elfstrum scored A's while George Freeberg, Merrill M. Madsen, and Hugh Eaton received B plus. In the Junior problem, "The Children's Group in a Large Hospital," J. A. Walquist, Edward Holien, and T. L. Sime were awarded mentions. Henry Gerlach and Edward Holien received credits in the Junior-Senior esquisse-esquisse, "A Waiting-station For a Trolley-line." In the Interior Decorators' design problem, "A Colonial Dining Room," mention was awarded Faith Nixon, Myra Metcalf, and Gladys Brouillard.

THE MAN IN THE IRON MASK

By William T. Townes, '24

A great French novelist once wrote a book in which one of the characters was confined in a most horrible prison—an iron mask covering his head and face with its bars, and obscuring his features. An opening in the front was designed to permit him to eat with greater or less facility. He was allowed the freedom of one of the King's villas, but how isolated, how alone in his constricting cage he must have been!

It is hard to imagine a more solitary and lonely position—to be surrounded by humanity, in physical contact with it, and yet absolutely out of mental touch with it. The solitude of one existing in the deserted places of the earth is far preferable to this confinement. The hermit feels himself one with the great out-of-doors; he feels the buffet of the winds of heaven and the ardent caress of the sun. But this poor creature, immured in an iron box, was cut off from these and other pleasures. He had nothing to contemplate but a blackness like interstellar space or a checkered outlook like the view from a prison window.

The lowliest ragamuffin of the streets has his cronies and his family, but the miserable prisoner was a stranger to all, even to his gaolers, from the first day of his incarceration by the King's order.

The plight of the unhappy man in the iron mask is only an aggravation of the difficulties under which all of humanity labors. We are all bound by restrictions, most of which are our own shortcomings, some mere conventions, hallowed by time, but cursed with arbitrary rules.

The convention which prevents equality between two men speaking together, which even prevents one person from addressing another without an introduction, which in a hundred other ways hampers our intercourse, these conventions tend to cripple our capacity for expression and bind us into masks of iron.

Even more than these silly and meaningless proprieties, our own shortcomings prevent us from true expression. When we have lost something, we sigh for the "gift of the probable places," but how much more do we constantly need the gift of tact. Only too often good friends are estranged by a misunderstood or an untactful remark, and a pride that would not stoop to explain or make amends.

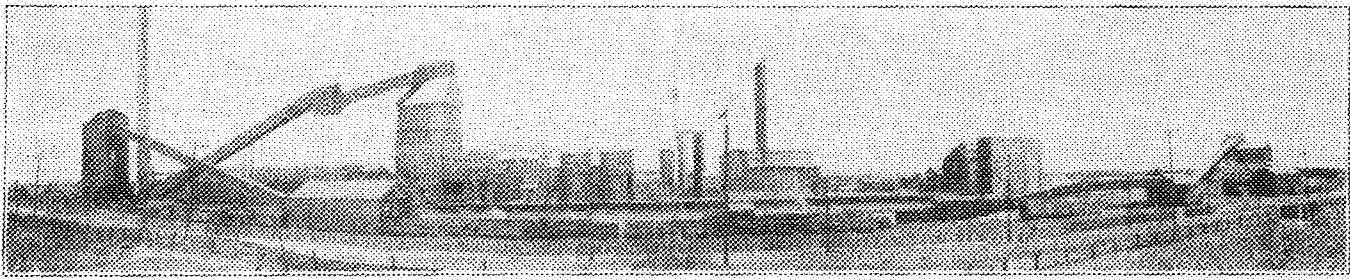
The rigid and unbreakable masks that hamper and stultify man today are composed of stubborn pride, uncompromising ignorance, harsh intolerance, and egotism, impervious to correction. These tend to isolate man and cut him off from his fellows, and it is only against the restraint of these that man may express himself. All mankind is bound in an iron mask.

This is the first of a series of Freshman Engineer Themes. A regular feature if you like them.—The Editors.

Three observations of Reid's Comet, made by P. H. Swanson and C. M. Burrill with the 10½-inch telescope at the University Observatory, have been published recently in the Astronomical Journal, with similar observations by Prof. F. P. Leavonworth.

THE BY-PRODUCT COKE INDUSTRY

By Cal. K. Katter, M. E. '22



An industry that has made rapid progress in the last few years, is that of the Minnesota By-Product Coke Company, located on Hamline Avenue, St. Paul. This plant has been in successful operation since 1918, when the manufacture of gas, coke, and by-products began. It is one of the selected few of industries that was not forced to close down since the war or in the present period of depression.

During the war the plant was particularly active in the production of explosives and chemicals for the government, and at the same time making coke for both metallurgical and domestic use. During the coal shortage and due to a desire for cheaper fuel many local customers had their first experience with coke as a fuel for furnaces. Metallurgical coke has been successfully adopted for industrial purposes for some years and has practically taken the place of all other fuels for such purposes. A committee of prominent engineers was appointed by the U. S. Steel Corporation some years ago to investigate the use of by-product coke for blast furnaces. They were instrumental in bringing about this adoptation and the saving of millions of dollars and vast amounts of our valuable resources.

The By-product Coking Process

The development of the by-product coking process is of interest. Like other industries the coking process developed in the embryo as a part of another industry.

About the beginning of the 19th Century a Scotch engineer discovered a method of making gas by distilling coal. He placed the same upon a commercial basis and the manufacture of coal gas began. The gas was made in retort ovens where it could be driven off and recovered, leaving the heavier carbons which probably were rejected as refuse. Later a Frenchman made the recovery of tar and ammonia commercially successful. This made recovery of the gases imperative, and the by-product process began its development.

A view of the plant of the Minnesota By-Products Coke Co. is shown in the accompanying photograph. As can be seen from the picture, a modern coke plant is a highly developed technical establishment, requiring a large investment of capital, rather unrestricted acreage, and elaborate outlay of equipment. This plant of 65 oven capacity is somewhat smaller than other plants of its type at Pittsburgh, Jersey City, and St. Louis.

Recovery of the by-products increases to a large extent the equipment needed. Some of that required is the coal and coke handling equipment, machine shop, power house, electric generating station, laboratory, gas, benzol, and ammonia recovery plants, garage, cranes, locomotives, etc. To build and operate a plant of this kind every type of engineering skill and talent are incorporated in some capacity. Chemical, Electrical, Mechanical, Civil and Mining engineers, besides other specialists are employed to solve the daily problems and make developments to suit new conditions.

Operation of the Ovens

Coal used by the plant is brought by rail and either unloaded upon storage piles or directly into the bin to be mixed with other coals and elevated to the crushing building. The coals being used at the Twin City plant consist mostly of Pocohontas, Coxton, and Youghougheny with percentages following of volatile matter, fixed carbon, and ash.

	Volatile matter	Fixed Carbon	Ash
Pocohontas	18.95	72.83	8.58
Youghougheny	34.40	57.06	11.58
Coxton	32.12	56.73	11.66

The resulting coal has following analysis:

Volatile matter	1.04
Fixed Carbon	88.41
Ash	10.55

Sulphur and other impurities are included in the ash content. These coals are unloaded into a pit, fed upon a belt conveyor, and elevated to the crushing tower or building mentioned above. Here they fall by gravity through the crushing machinery and are broken up until from 60% to 90% of the mixture will pass through a ⅛-inch wire mesh. From storage bins the finely ground mixture is fed into the charging hopper and delivered to the ovens as desired. The end doors of an oven are sealed air tight with luting clay and the coal is charged into the

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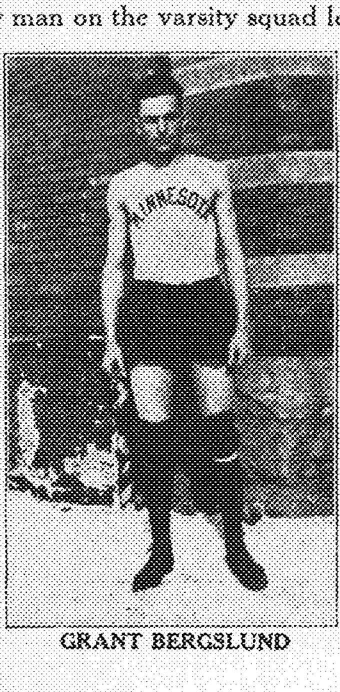
ATHLETICS

By A. B. Greene, '24

There has been so much said of late concerning the stress that has been laid upon individual college attainments along many lines, that the writers of various departments have been condemned for seeking to promote college spirit at the expense of University Spirit. In that respect we cannot agree. In reviewing the activities of the University, particularly with regard to athletics, the Engineering College points with pride to those from our ranks that have achieved distinction along these lines, not merely because they are from the College of Engineering, and, therefore, one of us; but rather because they are one of us and have helped us to make our contribution to the success of the University's projects. It should be an inspiration to the rest of us to see these men, whom we know by constant association, make good in athletics, and our highest hope for the new future upon which Minnesota has entered in athletics should be to see a constantly growing representation from our college, not for the glory alone of the engineers, but for the honor and success of a great Minnesota, of which we are proud to be a necessary part.

Although sport critics throughout the conference are making not unkindly comments of Minnesota's untimely slump in basketball affairs, there is much comfort to be found in the situation, that although we may be losing games, we are training players. The ever-shifting dopesters may shake their heads as Minnesota's chances of annexing the conference top-honors, but meanwhile our men are not forgetting all they have learned about basketball. Practically every man on the varsity squad looks forward to seeing the thousand per cent team sweep into existence next year. Nearly every man will be a veteran.



GRANT BERGSLUND

Bergslund will be a formidable Big Ten factor in the grouping of 1923 material. The indomitable Kearney will be a circuit veteran. Severinson, the wirey and untiring forward of forwards is but a sophomore. These three alone, all from the College of Engineering, would be a nucleus of incalculable value, but in addition to them are the stars from the other colleges, all of whom have one or more years to play, with the exception of Hanson, who graduates this year.

Minnesota's hockey men met with disaster, when they tackled the Michigan Miners. While MacDonald's men were handicapped by the size of the Michigan rink, they found themselves at Lexington and put on as pretty a battle as one would want to see. Although the final score made the series a complete one for Michigan, Minnesota, in the face of such class as her opponents showed, has little to be disheartened about.

The advent of Minnesota's new athletic directorate is already reaching out to place its benefits within the reach of intramural athletics. Fred W. Luehring, our new athletic "engineer," has declared that the secret of successful university athletics lies in universal participation in all branches of sport by those possessing even in a slight degree the qualifications of an athlete. Intramural contests provide just such an opportunity. We can have but one university football team, one varsity basketball team, and to enter a field as large as university athletics, knowing that of the many called but a few will be chosen, takes a courage and a confidence that the scholasticly heavy-laden hesitate to assume. It would be folly, we admit, to foster inter-college contests for the sole purpose assuaging college rivalry; but to offer to the many of athletic ability an opportunity of discovering themselves is an aim worthy of development.

Since taking over intramural sports, Prof. Zelner has brought them to a stage of valuable readiness, and with the new cooperation from the powers that be we can see for the many the golden opportunities that in the past have been the privileges of the few. The whole of this success that we foresee in intramural athletics, however, is contingent upon a basic condition—student cooperation. This means student interest, student boosting, and above all student participation. The college will profit, the university will reap its championships, but above all, the individual entering in will gather the greatest gain.

BEST USE FOR HIGH DAM

(Continued from Page 4

and a reward to the ambitious energetic student. To the instructor, a reasonable amount of search for hitherto unattained truth acts as a stimulant and as a preventative of growing stale and obsolete.

Aside from internal educational benefit, institutions of learning are and should be looked to as the source of new truth. The extension of the boundaries of knowledge, the discovery of new phenomena and new laws, the better interpretation of known truth, are properly considered to be both the privilege and the duty of an institution of higher learning. To the technical school there comes in addition the opportunity to find new useful applications of known phenomena, to find new processes for achieving desired results, to make new uses of materials or to find other materials for obtaining cheaper or better products.

Increased Facilities Needed

Research has justified its cost. While the immediate value of a given study may not be evident, and while there are doubtless many fruitless journeys into the realm of the unknown and much retreading of old and possibly blind trails, it is frequently found that some apparently useless observation may become the basis of valuable developments. Witness the development of radio communication from Hertz' experimental verification of Maxwell's mathematical conclusion that light and electricity were similar or identical wave phenomena.

The opportunities for fruitful research are many, especially in new fields of knowledge, such as electrical engineering which has practically all developed within fifty years. The field bristles with interrogation points, and many recognize that what we do not yet know is much more than what we do know. The greatest regret of the electrical thinker is that he is unable to follow up the innumerable problems that lure toward the quest for further truth, and this is true to some extent in every line of science. The possibilities of future developments seem to be practically boundless.

The economical value of research is so fully recognized in the commercial world that the larger manufacturers invest large sums to develop and maintain extensive industrial research laboratories.

In recent years a large part of the new discoveries in the physical sciences and in engineering have come from the great industrial research laboratories, and from them comes so large a proportion of the papers before the technical societies and in the technical journals as to cause uneasiness as to the future independence of these institutions. Moreover the discoveries in these commercial laboratories are generally held secret until patents have restricted their manufacture, and frequently their use, to the purpose of the owners, with little regard to the interests of the public except as customers.

Public interest seems to demand that facilities be made available whereby more qualified workers may follow research, to the end that the new knowledge may not be monopolized and that with the increased number of researchers may come more frequent discoveries of valuable truth.

While many lines of research may be conducted with comparatively small amounts of power, there are many electrical or electro-chemical or hydraulic studies which cannot be fully or thoroughly conducted without the use of more power than is available in a laboratory.

For example, in the electric furnace, larger scale and long continued operation is necessary for maintaining the very high temperature and uniform conditions necessary for securing reliable and uniform results for some desired products, an illustration being the production of artificial graphite such as has largely superseded the natural product. While many valuable products are now made in the electric furnace, its capabilities have by no means been exhausted.

Among the many problems that involve the use of considerable amounts of power and that are of special interest in Minnesota may be mentioned:

Improvements looking to the higher efficiency of methods of fixing atmospheric nitrogen and the manufacture therefrom of artificial fertilizers and various other products.

Smelting of iron and steel from the ore.

Refining of steel and development of new steels.

Purification of city water supplies.

Reconstruction of native stones into more valuable materials.

Development of new artificial material for highways or pavements.

Extraction of aluminum from common clay.

Application of electricity to plant growth and to agriculture.

Utilization of forest and other vegetable products now but partly utilized.

Purification of atmosphere from smoke, dust or fog.

Electrical reduction of peat.

Development of off-peak and seasonal loads for waterpower.

Determining the conditions under which known electrical phenomena may become the basis of commercial processes.

Making new discoveries of properties of matter and of its behavior.

The public value of developments along these and similar lines is readily apparent.

The vast iron and peat deposits in Minnesota make every improvement in their utilization a matter of public interest and benefit.

Nitrogen Manufacture

Using methods now known for fixing atmospheric nitrogen, it is estimated that the power available at the High Dam could produce approximately one million dollars worth of fertilizer per annum. Engineers at the University have in mind certain fundamental improvements that might increase the efficiency and output very materially and thereby further decrease the cost of fertilizers.

It is generally recognized that the possibilities of wider application of electricity to agricultural processes are but scantily realized.

The development of successful methods of purifying sewage rapidly may save the Twin Cities from expenditures, estimated at approximately $3,000,000, that may otherwise be required for constructing intersecting sewers to prevent the pollution of the five-mile pond above the High Dam.

The vast amounts that are being invested in highways add interest to every possibility of making better road material.

The above suggestions may be multiplied almost indefinitely as one studies the possibilities of research where ample power is available. As mentioned elsewhere, the possession of such power by the University would make it unique, and would go far toward securing funds necessary for conducting such researches to successful completion.

The University of Minnesota is unique among universities controlled by the States and affiliated

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ALUMNI NEWS

By F. O. Elfstrum, '25

L. E. Ashbaugh, '00, has recently returned to New York City from South America, where he has been engaged in making investigations in regard to a hydraulic development project for the Engineering Business Exchange of New York.

Edwin Larson, '21, is now in the employ of Bertrand and Chamberlain, architects of Minneapolis.

Leslie L. Halladay, '21, now has a position as instructor in surveying and drafting at Dunwoody Institute.

Herbert S. West, '21, is now located in Kellogg, Idaho, with the Bunker Hill and Sullivan Mining Company.

Hugh Smith, 18, writes that since he has returned from the service he has been associated with the Idaho Power Company, having spent a year on power plant appraisal work and a year in the office of the general superintendent, and is now connected with the Boise Division, as Division Engineer, dealing with all line extensions and construction work.

Henry Leude, '20, has been with the La Moure Construction Company since September 1, building bridges and culverts on highways in Ransome County, North Dakota.

Laurence Wyly, '20, in a letter to Henry Lende, writes that he was married last summer and recommends that step to all engineers. His advice may be all right so let's think it over. Wyly is now doing bridge construction work for the Northern Pacific Railroad, his permanent address being Livingstone, Montana.

Geo. Cottingham, Jr., '11, is now the Engineer, Maintenance of Way, for the Chicago Great Western Railway. His address is 303 W. Harrison St., Chicago.

Sydney T. Smith, '11, who has been City Engineer of Mitchell, South Dakota, is now engaged in private practise as a consulting engineer.

Carl Nordstrom, '14, is now working for the United States Bureau of Public Roads as an inspector, with headquarters in St. Paul.

C. L. Motl, '10, who has been with the State Highway Commission for several years, is now a division superintendent in charge of the southwestern part of the State of Minnesota, headquarters in St. Paul.

C. C. Cowin, '10, successfully passed the United States civil service examination last spring for the U. S. C. & G. S., and has been engaged in this work on the U. S. S. Surveyor off the coast of Alaska.

Milo P. Fox, '10, is a Lt.-Colonel of Engineers in the regular army and when heard from last was stationed at Fort Leavenworth.

Ralph L. Goetzenberger, '13, is a consulting Engineer in Philadelphia.

Louis Riegel, '11, sends his best wishes from Savannah, Georgia, where he is affiliated with the Electric Power Company.

Don Wesbrok, '10, is the manager of the Chicago Pneumatic Tool Company, Minneapolis Branch.

Wendel P. Chapman, '14, is a Division Engineer with the Minnesota Highway Department.

Ben Walling, '09, is now with Confer Brothers in the real estate business in Minneapolis.

Pierce Furber, '08, is with the Butler Construction Company in St. Paul.

Chas. Seikenen, '18, has left Dunwoody, and is now president of the Copher Machine and Tool Works at Minneapolis.

George A. Geib is a captain in the Engineers Corps of the army and is at present stationed at Camp Humphrey, Va.

Leonard F. McKenzie, '18, is in Minneapolis for a short time. He has a new position as resident Engineer in the construction of a power plant and system at Martin, Tenn.

After reading the following article in regard to James W. Everington, '00, in the Minneapolis Journal we are of the impression that Minnesota Engineer can do anything.

"Information reached friends in Minneapolis today that Colonel James W. Everington, retired, formerly of Minneapolis, has been appointed Chief of Police of Los Angeles."

G. W. Morey, '08, is living in Washington, D. C., where he is said to be doing some remarkable work in Physical Chemistry and Thermodynamics.

Minneapolis newspapers indicate that Messrs. and Boerner, both '11, are preparing the plans for two new buildings with which Hennepin Avenue is to be improved. They will be located one at the corner of Eighth street and the other at the corner of Eleventh.

J. A. Childs, '12, gave a paper on the present practice of sewerage disposal in Minnesota before the convention in Minneapolis of the American Federation of Architects and Engineers. Mr. Childs is with the State Board of Health, with offices at the University.

NEW CHEMISTRY UNIT

(Continued from Page 8)

it is needed for the purpose, it will be used by senior chemists for laboratory work on their theses problems.

The desks are of the same type as those in the qualitative laboratory, with the addition of steam baths on one-half of them. An unusual amount of hood space is provided, and altogether the laboratory is one of the best in the building.

In the addition suitable laboratory space has been provided for chemical engineering. Four rooms in the basement are made available; one, in which chemical manufacture is to be carried on, is about 45x85 feet with a 16-foot head room; the second, the Control Laboratory, supplies desk space for thirty students; the third is a storage room for equipment and for heavy chemicals, and the fourth an office space for one of the instructors.

The Chemical Manufacture Laboratory is supplied with high and low pressure steam, hot and cold water, gas, compressed air, and vacuum, so arranged that any piece of equipment can be connected or disconnected without interfering with the remaining equipment. Electrical connections are arranged on pillars and in the walls, so that connections can easily be made with motors used with the apparatus. A special drain for condensed steam and separate flues to carry off acid fumes are provided.

New equipment is being added, which, when installed, will establish for Minnesota a Chemical Engineering Laboratory equal to any in the country. The apparatus will not consist of miniature plants for the manufacture of various technical products. Instead, the individual pieces of apparatus will demonstrate certain processes and principles common to several industries. In this way the student will obtain a thorough training in the construction, operation and use of equipment for a general chemical engineering practice. All of the apparatus is of commercial type, of smaller capacity, suitable to carry out processes from which cost data, comparable to commercial practice, can be calculated.

Synthetic Provisions

The laboratory will be particularly complete for organic synthetic work. For this purpose, there will be a sulphonator, nitrator, reducer, acetylator, a fusion pot, autoclaves, and several steel stills. For inorganic manufacture there are to be eight mixing or reaction pots made of various materials, all steam jacketed; and also six fifty-gallon precipitation tanks with mechanical stirrers for making paint pigments and which can also be used for certain organic reactions.

Another part of the laboratory will be devoted to filtration purposes, with three types of filter presses; the plate and frame, the Kelly, and the Sweetland filter presses. Other filtration can be carried out under vacuum, for which suitable apparatus will be supplied.

For the concentration or distillation of liquids, several types of equipment will be furnished. One for distillation under vacuum, another under pressure, and a third type for distillation by double-effect evaporators. A part of this equipment will be glass enamel lined for the manufacture of very high-grade chemicals.

There will be available for extraction purposes an 80-ton hydraulic press and a Lummus copper extraction apparatus which can be used for continuous extraction of solids and recovery of the solvent. This piece of apparatus can also be used for fractional distillation of organic liquids.

The finishing apparatus will consist of a 12-inch centrifugal, a Gordon dryer for dehydrating materials under atmospheric pressure and a vacuum shelf dryer used for such things as are easily dried by ordinary atmosphere. Two concrete tables 25 feet long are provided, one for furnaces and heating devices for reaction under fused conditions and the other for direct evaporation and crystalization.

Finally, the control laboratory will be used for the analysis of raw and finished products and to work out the conditions in connection with the manufacture of chemicals. After the students have mastered several manufacturing processes on a semi-plant scale, they should be qualified, after leaving school, to carry on more intelligently the work in plant manufacturing of chemical products.

We are indebted to Doctors Mann, Hunter and Sneed and Mrs. Katherine Crowley, librarian, for the above information relative to the new addition to the School of Chemistry.—The Editors.

BY-PRODUCT COKE INDUSTRY

(Continued from Page 12)

oven through holes in the top. The holes are closed tight and the coking takes place for from 20 to 72 hours depending upon the grade of coke desired. The gases and by-products pass off through hydraulic mains and are recovered. When all the gas has been driven off the doors are opened and the coke pushed into an electric-driven quenching car by an electric pusher or ram. This quenching car is quickly moved to the quenching tank where water is sprayed upon the hot coke. This prevents burning of the coke and still leaves it hard and dry. Then it is dumped upon sloping racks, fed upon another belt conveyor and raised to the screening building for sizing. After being sized it is either loaded upon cars for shipment or piled for storage.

Coke as a Domestic Fuel

The depletion of the anthracite coal fields and the consequent decrease in quality and increase in price has made it necessary to adopt some new fuel for furnace use. Coke was first made to take the place of hard coal in industrial plants, but by experiments and development it was found to be admirably adapted for domestic use. The transformation from coal to coke was like the change from soft to hard coal, i. e., not so easy to accomplish. Oftentimes if it failed to give immediate satisfaction it was unduly criticized and discarded as a poor experiment, rather than investigated as to its merits and proper firing methods. To acquaint the public with its use and proper operating characteristics the coke people have established service departments to demonstrate to their customers how to burn the fuel in their own furnaces. Only a small percentage of their customers have resorted to these demonstrations but that the idea was valuable is shown by the results. Less than 5% of the people demonstrated to have been disappointed or not thoroughly convinced that coke gave better satisfaction and economy than coal. The number of customers in the Twin Cities has increased from year to year, and since July, 1921, the coke sales have increased 50% over any previous year. January sales were on the increase instead of the decrease as has been the custom during preceding years.

One of the popular reasons for its use is the elimination of the smoke nuisance. In large cities, such as Pittsburgh, Pa., where, for example, it has been estimated that the smoke nuisance costs $10,000,000 a year, this is important. Investigation has shown that most of the smoke was produced in the residential districts where it could do the most harm to public property.

Quick Heating Feature

Many customers also find the quick heating qualities of coke an advantage. Having a higher carbon content, coke is more susceptible to drafts, burns more readily and gives off more heat. The statement that coke contains more heat is justified by the fact that one and one-half tons of coal are required to produce one ton of coke, and with the exception of a small percent of hydro-carbons all the carbon from that amount of coal is concentrated in the ton of coke.

Another reason why coke shows greater heating characteristics than coal is that in burning the latter it is improbable that the volatile matter will be burned. The gases pass through the upper layer of coal and become too cool for ignition before the same can take place.

Some customers are slightly handicapped in burning coke because of the small firepots in their furnaces. In the older type of furnace the firepots were none too large to burn anthracite properly but the tendency today is for furnace builders to allow ample room for any fuel by making the firepots deeper.

Instructions upon the proper firing of the fuel are always available, and where these are understood and adhered to the fuel has been found to burn satisfactorily under most any conditions.

The Future of the Industry

As stated before in this article the adoption of coke for blast furnaces and in iron production was a step forward in the development of those industries. It is not difficult to conceive that here might lie a solution, in part at least, of the domestic fuel situation and the conservation of much fuel that is now being wasted. The above problem has been given much thought and expression in the last few years but has not been unduly stressed. We are all aware that our best grades of coal, anthracite, wood, petroleum, and natural gas are rapidly being depleted. But how to arrest this depletion of our valuable resources without impairing or restricting our industrial and commercial development is a question. There are not more than five issues that might help in part to conserve our disappearing resources. They are:

1. Extension of by-product coking processes to include greater percentages of the total coal used for the production of coke, with a corresponding increase in the by-products recovered.
2. Development of water power.
3. Electrification of railroads.
4. Utilization of more low grade fuels, such as lignite coal coke, coke breeze, anthracite cull, etc.
5. Use of solar heat.

An effort was made to place the above in the order of their importance. By-products coking processes have been given first place because of the potential possibilities. The amount of fuel that could be conserved by the development of water or the electrification of the railroads is practically fixed, but that conserved by coking is unlimited. The essential qualities of coal required to make good coke are still rather indefinite but progress has been made in recent years to the point, that coals are now adapted for coking that were previously considered in the non-coking class. It is not unreasonable to suppose that many of our poorer grades of coals could be utilized in this way and by-products recovered from them that would help to supply the present demand and increase the apparent resources that we now have. This would boost rather than hamper our commercial development. But will coke take the place of coal, will by-product gas furnish the entire demands of our cities? These are questions of the future, of development and progress and will need public assistance for their realization. It is not a question of supply. Assuming the proper quota of 266,000,000 tons yearly for by-product coking and assuming the recovery of 6,000 cubic feet of gas per ton, we have enough gas to supply 65 cities the size of Chicago. It has been anticipated that in the near future the entire gas consumption of that city will be furnished by coking plants.

The benzol that might be recovered from these 266,000,000 tons, assuming 2.5 gallons per ton, 18 miles per gallon, and 5,000 miles yearly per car would give enough satisfactory fuel to keep over 2,300,000 automobiles in operation. Then we have not considered the other chemicals and by-products that could also be added to the list. Evidence of the commercial importance of the latter was given during the war. Much credit for the phenomenal change of this country from a dependence to an independence in chemicals and dyes is due to the recovery of the materials from which the chemicals are made.

The importance of having a plant of this type in a city or locality in full operation in the recovery of by-products and manufacture of coke is not so easily over-estimated in the light of the above facts. It may be an actuality in a few years. The plants now are not operating at highest efficiency, partly because of lack of demand, consequently prices are higher. But with production at a desirable point the cost of fuel, of gas, of motor fuel, could be materially reduced with their resulting commercial effects, and, perhaps, most of all, we would have stopped that leak that is eating the heart out of our natural resource reserve.

An old colored man was burning dead grass, when a freshman dropped himself over the fence: "You're foolish to do that, Uncle Ed," he told the bent figure. "It will make the meadow as black as you are."

"Don't worry 'bout dat, sah," responded the undisturbed Uncle Ed. "Dat grass will grow out an' be as green as you is."

Fruit Vendor (yelling in front of his stand)—"Twenty cents a doz."

Bystander (full of home brew): "Twenty cents he don't."

BEST USE FOR HIGH DAM

(Continued from Page 14)

with the Federal Government in various cooperative activities, in being the only one close to a large waterpower now under Government control. It is therefore the logical institution which should be selected for jointly carrying on researches which require large amounts of power.

The possession of large power available for research purposes would, in association with military or other branches of the Government, be of incalculable value in developing processes and solving other problems of a military nature. In case of military emergency, such a laboratory already in working order and ready for new problems would be able to begin immediate study of problems that demand prompt solution.

The established right to such power for research purposes would not only give the University of Minnesota a unique position among the Universities of the World, but would also be a strong incentive toward placing here funds for establishing **memorial research foundations.** Such foundations would strengthen the ability of the University not only to conduct useful investigations for general public benefit, but would also help preparedness for prompt and efficient study of military or other problems of the Government as such might arise.

Power requested for research work can be adjusted to meet the varying supply of waterpower and the varying demand for other public purposes. For example, since the flow of water in the river is smallest during the winter season, when the public lighting loads of the two cities are the heaviest (compensated partly by the pumping load for city water being then the least), the research work requiring large amounts of power could be arranged to avoid dark hours during the winter, and to make its heavy and long demands during the months when there is an abundance of water.

It is therefore urged that, independently of the determination of which claimant secures the right to the High Dam power as a whole, there be incorporated in the grant a proviso securing to the University of Minnesota the right to use three thousand kilowatts or less of power from the High Dam for experimental and research purposes when and as long as may be required, it being understood that so far as practicable the demand for large parts of such power shall be arranged to avoid times and seasons when the flow of water in the Mississippi River is less than the normal average flow.

FIRST ANNUAL EFFORT

O. F. Beeman has been appointed chairman of a committee to arrange for the publication of an Architects' Year-Book, this spring. The book will contain the best work in the design, freehand, and construction courses, much in the manner of the year-book put out by Cornell, Illinois, and other of the architectural schools. The possibility of having one's work thus neatly "immortalized" offers a strong incentive to greater effort; hence the year-book is an institution to be fostered. With cooperation of the department and its alumni Minnesota's Architectural Year-book, already a probability, will become an actuality.

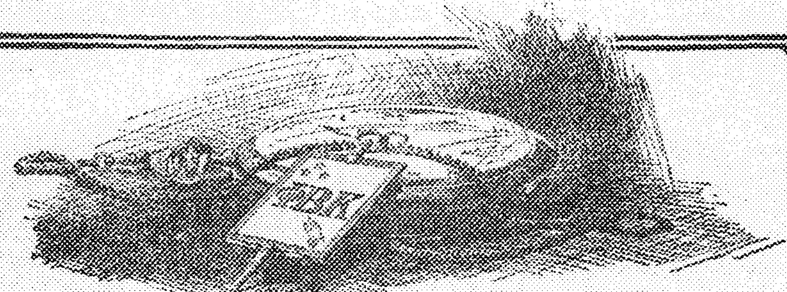
ARCHITECTS' VALENTINE PARTY

February 14, 2522.—The following story inscribed on a gold plate and signed "Ole" was discovered recently during excavations of the Architectural Department buried by the land slide some six hundred years ago:—

"The architects' dance given on the evening of February 11, 1922 A. D. in the Engineering Auditorium was a heartbreaker, judging from the number of hearts which can be found scattered about. The prominent and outstanding interior decoration was a frieze of blue and red hearts of all sizes, while streamers of them hung from the ceiling.

"In the center of the atrium stood a podium, where the masters of the saxaphone, banjo, and piano, known to the world as Peyers Orchestra, clad in togas of green, (garments held in high esteem by the architectural mind), kept 75 couples in a continual whirl of merriment. All these hearts were the brainwork of the famous Carl Wise, although what part of the work he did is uncertain because of the many industrious laborers assisting.

"The high priest of the festival was Elton Crowell, another famed architect, whose interest in music led to the unique arrangement of the orchestra. Prof. and Mrs. F. M. Mann and Prof. and Mrs. R. T. Jones chaperoned."



THE ENGINEERS' ANNUAL

(Continued from Page 7)

girls are entertained at fraternity house parties. A parade, two dances, one for students of the Missouri School of Mines and their guests, and the other a general masquerade for townspeople and students, are staged at Rolla.

At Iowa City the town also cooperates in the celebration known as Mecca Week. The name Mecca is derived by using the initials of the mechanical, electrical, chemical, civil and architectural branches of the profession. Tuesday evening is usually the banquet night when Seniors are made members of the League of Meccasacius, the last letters of which when reversed stand for State University of Iowa, College of Applied Science. The Engineers' play comes Thursday and Friday nights while Saturday is devoid of classes as the parade, public inspection and the annual ball close the celebration.

Ames' Engineers this year, for the first time, will unite with other colleges in an elaborate celebration, lasting three days. St. Patrick's Day will be devoted entirely to Engineers' activities, but they will hold open house during the entire celebration, and will cooperate in representing work of the entire school.

The University of Missouri, at Columbia, holds fast to St. Patrick's Day. St. Pat's celebrations, it is declared, originating there and they cling to the tradition. National headquarters of the A. C. E. are at Columbia, and much encouragement is given Engineers' celebrations.

Minnesota's Green Tea, which has become one of the biggest events on the Engineers' program, was the only stunt of its kind reported at the last A. C. E. convention. The tea last year attracted more members of the whole University faculty and student body to the Engineering campus, affording a better opportunity for visitors to become acquainted with the Engineers at their best, than any other event on the program.

The time of Engineers' Day celebrations varies but little from the traditional "17th of Ireland." The University of Arkansas celebrates March 28; Washington U. March 10; Tennessee, April 1; Oklahoma A. & M., Minnesota and Colorado have had but one day, March 17, while Missouri, Rolla Mines, Ames and Oklahoma U., have staged their annual celebrations on two consecutive days, March 16 and 17. Iowa's week includes March 17.

INDUSTRIAL LIGHTING CODES.

In order to protect workers from accidents and eye sight damage, no less than five states, New York, New Jersey, Pennsylvania, Wisconsin and Oregon have now in force lighting codes for industrial establishments. Other states are now considering the adoption of an industrial lighting code, and it seems only a question of time when all the states will adopt such a code.

Proper lighting of work places is not only of great importance to the operators working therein, directly affecting their safety and eyesight, but it is a factor of equal importance to the employer, as quality and quantity of output are deciding factors of profit or loss in the operation of the plant.

The introduction to the Wisconsin code reads as follows: "Insufficient and improperly applied illumination is a prolific cause of industrial accidents. In the past few years numerous investigators, studying the cause of accidents, have found that the accident rate in plants with poor lighting is higher than similar plants which are well illuminated. Factories which have installed approved lighting have experienced reductions in their accidents which are very gratifying.

"Of even greater importance, poor lighting impairs vision. Because diminution of eyesight from this cause is gradual, it may take the individual years to become aware of it.

"This makes it all the more important to guard against the insidious effects of dim illumination, of glaring light sources shining in the eyes, of flickering light, of sharp shadows, of glare reflected from polished parts of work. To conserve the eyesight of the working class is a distinct economic gain to the state, but regardless of that, humanitarian considerations demand it.

"Finally, inadequate illumination decreases the production of the industries of the state, and to that extent, the wealth of its people. Factory managers who have installed improved illumination, are unanimous in the conviction that better lighting increases production and decreases spoilage."

The Wisconsin Commission has adopted a rule to the effect that, "diffusive or refractive window glass shall be used for the purpose of improving day light conditions or for the avoidance of eye strain, wherever the location of the work is such that the worker must face large window areas, through which excessively bright light may at times enter the building."

A glass is now available which meets the above requirements. It properly diffuses the light and prevents sun glare passing into the building and is known as Factrolite.

Engineers of to-day are making a thorough study of illumination, so that they may be able to plan and lay out industrial plants, to scientifically increase their efficiency to as near the maximum as possible. This accomplished the engineer is not only doing something worth while for his employer, but is doing quite as much for himself by coming into prominence with modern ideas.

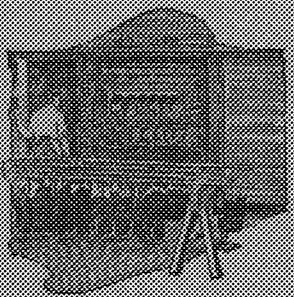
If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,

220 Fifth Avenue,

St. Louis. New York. Chicago.

No. 8.



What Is Water Japan?

JAPAN—not the country but a metal-coating varnish—and your morning bottle of milk. Totally unlike, yet associated!

Ordinary japan consists of a tough, rubbery, tar-like "base" and a highly inflammable "solvent." The solvent dilutes the base so that the metal may be coated with it easily. The presence of the solvent involves considerable fire risk, especially in the baking oven.

Milk is a watery fluid containing suspended particles of butter fat, so small that one needs the ultra-microscope to detect them. An insoluble substance held permanently in suspension in a liquid in this manner is in "colloidal suspension."

The principle of colloidal suspension as demonstrated in milk was applied by the Research Laboratories of the General Electric Company to develop Water Japan. In this compound the particles of japan base are colloidally suspended in water. The fire risk vanishes.

So the analysis of milk has pointed the way to a safe japan. Again Nature serves industry.

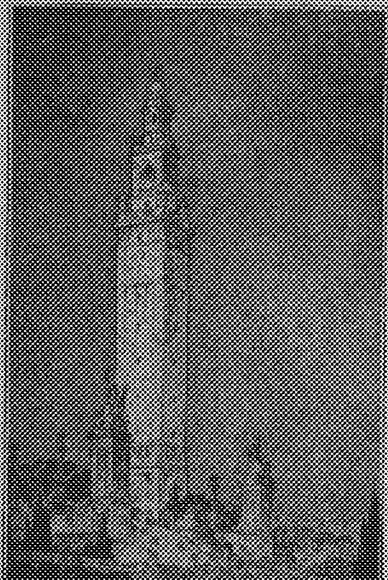
Connected with the common things around us are many principles which may be applied to the uses of industry with revolutionary results. As Hamlet said, "There are more things in Heaven and earth, Horatio, than are dreamt of in your philosophy."

General Electric Company

General Office Schenectady, N. Y.

MINNESOTA TECHNO-LOG

ETOILE DU NORD



THE CAMPINILE

APRIL 1922

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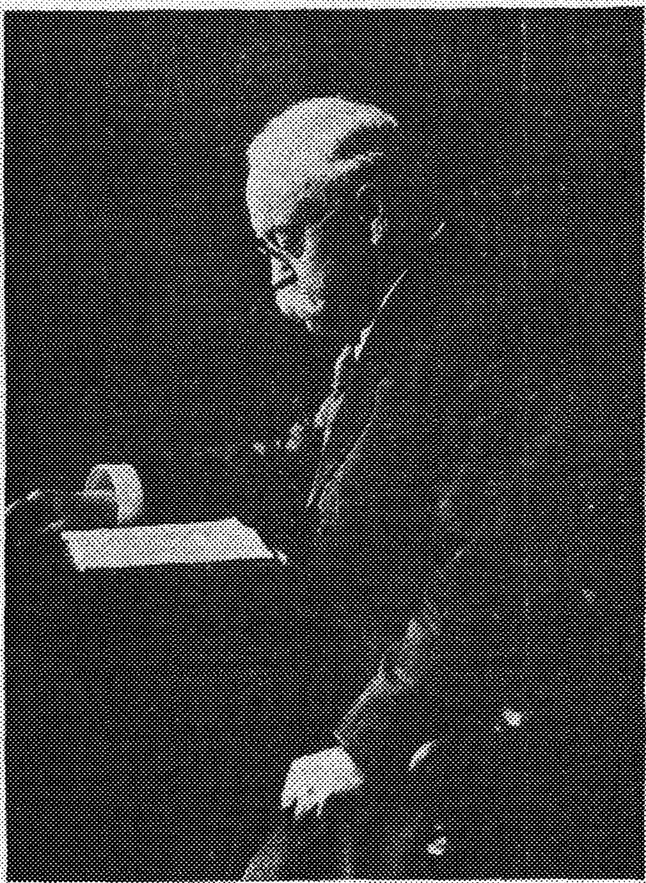
MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

In Memoriam



Dr. Cyrus Northrup

1834 1922

MINNESOTA TECHNO-LOG

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PORTLAND CEMENT

It's History and Manufacture

By John T. Stewart, C. E.

Cementing materials in structural work have been used since the beginning of civilization. The blocks of stone in the pyramids of Egypt were set together with mortar. The Appian Way, the 142-foot dome of the Pantheon of Rome and the ruins of numerous arches, columns and piers in Italy are ocular proof that a plastic building material which would harden after being placed, and stand the ravages of time was in use before the Christian era.

Quick lime which will only harden in the air was the first cementing material to be used. Later it was discovered, probably by the Romans, that slaked lime mixed with volcanic ash, each being a fine powder, would form a mortar that set under water.

Classification of Cementing Materials

Cementing material may be classified as non-hydraulic and hydraulic.

Non-Hydraulic cements (commonly known as limes or plasters) are those which will slake when placed in water and will harden (set) in the air but will not harden under water. They are made by burning pure limestone or gypsum at a low temperature, the first forming quick lime and the second, according to the degree of burning, Plaster of Paris, Keene's Cement and Cement Plaster.

Hydraulic cements (commonly known as cements) are those that will not slake after burning but when finely ground and mixed with water will harden in either the air or under water. They are grouped under one of four classes: 1, Hydraulic line; 2, Natural cement; 3, Puzzolan cement; 4, Portland cement.

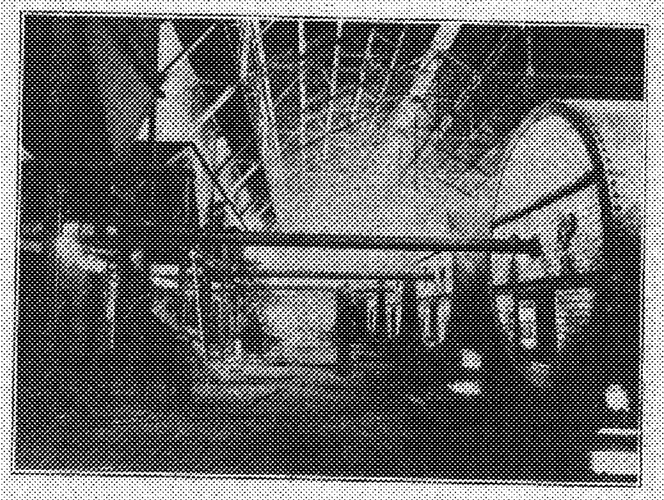
1. Hydraulic lime lies between a true lime and a cement. It is produced by burning at a low temperature an impure limestone that contains silica, alumina and lime carbonate in such proportions that it slakes slowly when wet and hardens under water.

2. Natural cement is produced by burning, and then finely grinding an impure natural limestone which when mixed with water hardens in either the air or under water.

3. Puzzolan cement is produced by mixing slaked lime with either volcanic ash or blast furnace slag and then grinding but not burning. It is better adapted to use under water than in the air. The hydraulic cement of the ancients was of this character, a natural fine ash being mixed with slaked lime.

4. Portland cement is produced by burning and grinding a properly proportioned mixture of select and ground raw material. When mixed with water it will set in either the air or under water.

The use of hydraulic cement was evidently discontinued with the decline of Rome, as lime is the only cementing material found in the structures of the Middle Ages.



FUEL FEEDING APPARATUS

Natural Cement

During the construction of the Eddystone Light House on the coast of England in 1756, John Smeaton accidently discovered that a clayey limestone when burned and powdered had the property of becoming hard under water. This discovery led to the practice of making hydraulic cement by grinding the products, formed in line-kilns from the burning of clayey limestone (cement rock). Factories for making this material were established in England and other parts of Europe and it was known as Roman cement on the supposition that it was the cementing material used by the Romans.

Canvass White, Construction Engineer on the Erie Canal in 1818 discovered a cement rock, and hydraulic cement was first made and used in the United States on the Erie Canal in 1820. A cement mill was established at Rosendale, New York, in 1828, and one at Utica, Illinois, in 1838. The product of these mills was made by burning and grinding cement rock (native clayey limestone) and was a natural cement.

Portland Cement

Joseph Aspdin, in 1824, took out a patent in England for an improved cement which was a powdered clinker obtained by burning a mixture made of pulverized clay and the dust from a limestone road. This product was named Portland Cement by the inventor for the reason that when hardened it had the appearance of stone quarried on the Isle of Portland near the coast of England. The development of the Portland cement industry was slow, because of the high cost of manufacture, and it was not until 1875 that any of it was produced in the United States. The invention of the rotary kiln and improvements in grinding machinery in 1886 cheapened the process of manufacture and since that time its development has been very rapid.

It should be noted that Portland cement is not a special brand produced by any one company, but is a separate variety manufactured in many countries, and by over 100 independent companies in the United States and Canada.

It is the grade of cement universally used where strength and durability are a consideration, and to a large extent has replaced all other cementing materials in structural work. Its superiority over other grades of cement is the result obtained by selecting and mixing in the proper proportions, the ingredients which experimental work has shown is necessary to produce a cement of uniform high quality.

Comparison of Cement

The distinct characteristic of the two modern cements in general use may be briefly stated thus. Natural cement is made of a material in which the essential elements are used as combined by nature. Portland cement is one in which the essential elements are combined artificially in the cement mill.

Essential Elements of Portland Cement

The essential elements which enter into the mixture forming Portland cement are: Pure limestone (calcium carbonate), 60 to 65 per cent; Silica (SiO_2) 20 to 24 per cent; Alumina (Al_2O_3), 5 to 10 per cent; Iron Oxide (Fe_2O_3), 2 to 5 per cent; Magnesia (MgO), 1 to 4 per cent; Sulphur, alkali and other impurities, 0.5 to 1.75 per cent.

A rock deposit is occasionally found which contains all the elements of good cement but usually it requires the bringing together of two or more materials to get the proper mixture. Since lime carbonate composes nearly three-fourths of the mixture it is desirable to have one of the raw materials contain all of this and it is usually furnished by limestone, chalk or marl. The other material elements are supplied by clay, shale or slate.

The combination of raw materials used in the United States is one of the following:

1—Pure limestone and cement rock, a clayey (argilacious) limestone.

2—Pure limestone and clay or shale.

3—Marl and clay.

4—Pure limestone and granulated blast furnace slag.

Essentials for Industrial Production

The essential elements which enter into the composition of Portland Cement are abundant and widely distributed by nature in many forms. Theoretically it would be possible to prepare cement by some combination of materials in nearly all localities. Deposits containing cement materials are so common that their presence is not a factor in determining the price of land on which they are found. An available fuel supply and ample transportation facilities are as important in the location of a cement plant as a supply of the raw materials. From the standpoint of a commercial product there must also be a market for large quantities of cement within a reasonable distance.

Manufacture of Portland Cement

Portland cement has been manufactured by three different processes:

1—The wet process in which the raw materials are mixed, ground and fed into a rotary kiln with enough water to give a fluid consistency.

2—The semi-wet process is similar to but dryer than the wet process.

3—The dry process in which the materials are ground, mixed and fed into the kiln dry.

Since the dry process is the one generally used at the present time it is the only one that will be described. The preparation of Portland cement for the consumer may be divided into six different stages:

1—The collection of raw materials at the mill.

2—Drying and grinding the raw material.

3—Proportioning and mixing the raw materials.

4—Burning the mixture of raw materials to a clinker.

5—Grinding the clinker and mixing with gypsum.

6—Storing, sacking and shipping the finished product.

The collection of raw materials may require digging, quarrying, mining, pumping and then transportation to the mill by rail or some special track facilities according to the materials used and the location of the mill. Granulated blast furnace slag is a waste product in the production of pig iron, reduced to a granular form by deluging with water while hot.

At the mill coarse materials are reduced by crushers then dried by being passed through a rotary kiln heated with pulverized coal to 300 degrees F. They are then ground. The object in this stage is to reduce each material to a very fine, dry powder that can be intimately mixed.

A hopper for each material is mounted on a scale and connected electrically so that the hoppers dump together when the weights on the scale beams are reached. The scales are set and sealed by the chemists, who make frequent analysis to determine the proportion of each material used. After leaving the weighing hoppers the materials are thoroughly mixed and again ground by passing through a tube mill approximately 22 feet long, 6 feet in diameter, and containing 25 tons of 1¼ inch steel balls.

The mixture is then passed through long rotary kilns and burned until it forms a clinker by heating the mixture to a temperature from 2,500 to 3,000 degrees F. These kilns range in length from 60 to 240 feet, 6 to 8 feet in diameter and are placed at a slight inclination downward from where the mixture enters. The heat is developed from petroleum, gas, or by feeding pulverized coal, carried in an air current at the lower end. The clinker ranging in size from a pea to that of a walnut is placed in piles and permitted to cool and season for about 10 days.

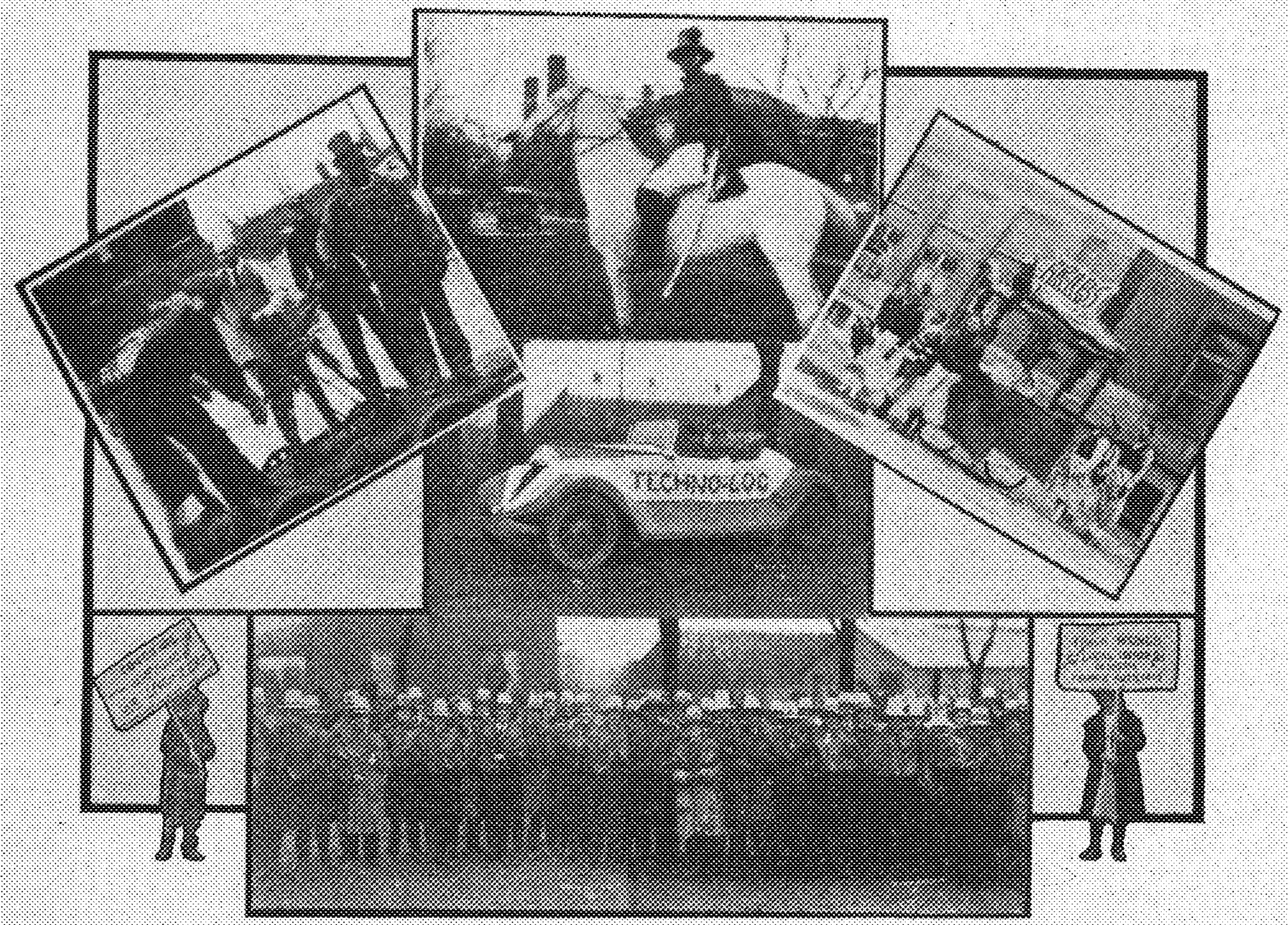
The clinker after seasoning is ground and mixed with not to exceed 3 per cent of gypsum. The object of the gypsum is to slow up the hardening of the

(Continued on Page 22)

DONNYBROOK, MINNESOTA

The College of Engineering Celebrates the Birthday of its Patron Saint

By William T. Townes, '24



VIEWS OF 1922 CELEBRATION

On the morning of March 17, 1922, the Engineering Campus presented a scene of suppressed excitement and concentrated activity. Few signs of this activity appeared to the casual observer, but in the various buildings tow-headed and other Mickeys were feverishly preparing for the grand parade. In the Main Building every floor resounded to the tooting of horns, the pounding of hammers, and the splash of paint. In the other buildings similar sounds attested the energy and pep being expended on the preparations. Behind the Experimental Building two large trucks were submitting to embellishment as floats. Between the Electrical and Mechanical Buildings more trucks were being converted into laboratories, battleships, and perambulating radio apparatus. At another place, a dormitory was being built, and everywhere, in nooks and corners, paint and cloth combined to disguise the prosaic trucks and make them into symbols of various kinds of engineering work.

The day was far from perfect. A cold wind, clouds, and misting rain were good from the point of view of the busy workers, but not from the standpoint of the unfortunate spectators. As noon approached, the clans began to gather, and the engineers flocked into the Main Building to get into their costumes. The halls presented more the aspect of a lunatic asylum than a staid, dignified scientific school. Characters famous in the history of the University rubbed elbows with bolsheviks, clowns, and international spies. The darker race, also, was well represented in the assemblage.

When the fourth period classes let out, a dense crowd began to form on either side of the street in front of the Postoffice. Here the official Police Force of the College of Engineering vindicated their reputation by subduing and capturing a band of desperate put-take gamblers. These disreputable villains put up a stiff fight, but nothing could withstand the fierce onslaught of the police.

All waited in tense expectation for the parade to come. The thrilling battle of the toddle-top artists and the police served as an appetizer for the wonders to come. Everyone crowded up to the line of march, presumably for warmth. At last, from far down past the Mines Building came the blare of a band. Every head turned southward; every neck craned for a glimpse of the van of the parade. At last the impatient watchers were rewarded by the inspiring sight of a detail of mounted policemen, followed closely by the band, breaking all previous records in harmony. Behind the band marched the entire body of Seniors, clad in conventional green capes and hats, and headed by St. Patrick himself, in the person of Sven Vaule. Following the Seniors came the trucks bearing the various exhibits. Chemists carried great jars of liquid gold and laid a smoke barrage. Mechanicals solved the problem of perpetual motion, and showed the evolution of the Engineer, from coal passer to bull shooter.

Electricals boasted that "We make the Grade" with a road grader, and presented exhibits, much enlarged, of electrical apparatus. Architects put in a plea for the new Stadium. The Intercampus Special, covered with advertisements, carried a Freshman section from place to place at odd moments. One of the great problems of the University was well represented by a Civil section, who had a truck arranged to show a typical University rooming house, emphasizing the need of Minnesota for adequate dormitories. The house was about to fall to pieces, and was so crowded that the inmates did their washing out on the porch roof, hanging their clothes to dry on a line attached to the gable. A Freshman section showed the typical Hygiene lecture, and advised all comers to "Bring your own beds." A Sophomore section got out some fire apparatus, by what means was never discovered. An amazing orchestra satisfied the wildest jazz fiend among the spectators with the wierd moans and shrieks they elicited from tortured saxophones. The Arabs were out in full force, and showed Fatima being borne through the streets in her palanquin, preceded by an Oriental herald. An association of colored gentlemen, called themselves the Sons of Bitulithic, escorted a tar machine at the end of the parade.

As soon as the bewildering array of examples of Engineering talent had passed through the narrow lane of students, all the spectators made a wild dash for shelter and fifth hour classes, while the Engineers hastened to divest themselves of their rags and paint. About two o'clock, a large crowd of Engineers, firemen, and others, gathered at the Church Street bridge to watch the chariot race between Seniors and Sophomores. The two teams retired with their respective hand-cars down the Northern Pacific tracks nearly to Minneapolis. The crowd craned to watch the struggle as the two cars thundered up the track. The Senior team crossed the white line some twenty feet ahead of the Sophomores. Of course, the Sophomores claimed that there was soap on the track. There were no casualties, except that the firemen, who were intently watching the race, lost their balance and fell down the bank, and had to be helped up again.

Following the race, the visitors repaired to the various buildings, where open house was being held. At 2:30 a crowd began to gather in the Experimental Building, where the exercises of the afternoon were to be held. The Seniors gathered around a platform in the center of the floor, and the visitors found vantage points on the gallery and about the walls. When all had assembled, the famous Blarney Stone was carried in by two husky Engineers, and placed on the platform. Presently Mr. Williams, the Senior President, mounted the stage and asked the Seniors to form by classes, the Mechanicals first, then the Civils, Electricals, Architects, and Chemists. When all was ready, St. Pat pushed forward through the crowd, mounted to his position, drew a long sword, and proceeded to knight each of the Seniors in turn. In this ceremony, the candidate mounted the stage, kneeled before St. Pat and kissed the Blarney Stone, while the venerable saint gave the stroke with the sword that made the Knight. As he left the platform, the newly made Knight was given a diploma, and signed the roll of the Knights of Saint Patrick.

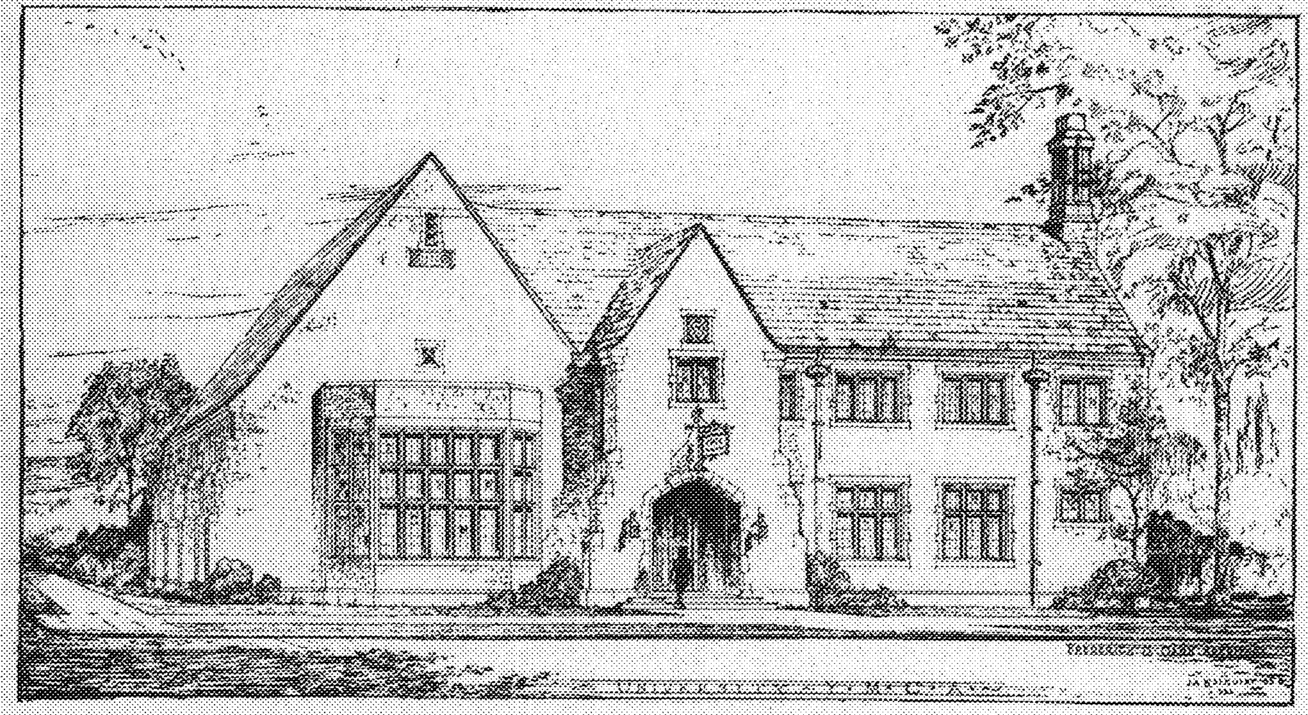
After the Mechanicals had filed by, each bending to kiss the Blarney Stone, the Civils came forward. The first Civil, scorning to touch the spot that had been kissed by a Mechanical, turned the Stone over for good Civils to salute. In the same way each class shifted the Stone so that the kiss would not be spoiled by a previous class. At last the entire Senior class had filed by and kissed the Blarney Stone. But when the ceremony was over, not all were Knights of St. Patrick, for two of those who received the honor were ladies, and obviously, women can't be knights. Some other name will have to be invented for the feminine auxiliary.

Following the impressive rites at the feet of St. Pat, the crowd adjourned to the Auditorium and Library of the Main Building, where the floors had been cleared and preparations made for dancing. In the Auditorium, the Architects had been busy all morning decorating with alternate green and white streamers, which gave an attractive lightness to the usually somewhat somber room. The orchestra was seated on the dais in the center of the floor, and from there afforded the dancers truly excellent music. The green tea and dansant broke up at six, and everyone went home to prepare for the grand ball at nine.

Much had been promised for the ball, and expectations were high. The efforts of the decorators resulted in an effect unequalled in the history of the Armory. Streamers were woven into varicolored mats, and indirect lighting cast a soft moonlight glow throughout the building. The Arabs presented a temple dance, a most remarkable performance, which raised great enthusiasm among the guests. In the midst of a pale, bluish light, a gorgeous Oriental monarch entered the stage and seated himself on a throne. Immediately an exotic dancer entered, and danced before the potentate with a wild abandon. Soon after, four priestesses and four priests of Isis or Ptah came in, bearing a mummy in a decorated case. They laid the mummy on the floor in front of the king, and performed a strange incantation over the body. They then unwrapped the body from the voluminous linen mummy cloths, and it turned out to be the Queen of Sheba, who came to life and also danced with abandon. The dance was unusual in that all of the actors were Engineers, and the music was written by one of the students in the Engineering College.

The St. Patrick's Day's ball this year was not as crowded as the one last year, and it was more comfortable dancing, as one of the guests said. A special feature was the Grand March, led by Mr. Vaule and Miss Grace Watson, in full Irish regalia, and followed by President William of the Senior class. The ball broke up at twelve, and all agreed that it was the best St. Pat's ball in many years.

In view of the work and money spent on this year's St. Pat's day, it is a reasonable conclusion, considering the results in the parade, the dansant, and the ball, that it was a vast success, and an encouragement and incentive for future celebrants.



THE NEW UNIVERSITY Y. M. C. A.

By Charles H. Hinman, '24

The necessity for larger quarters for the University Y. M. C. A. has been apparent for some time. In 1916 a building fund was started by a contribution of $50,000 from Mr. John D. Rockefeller, Jr., conditioned upon the raising of an equivalent amount among students, faculty and alumni of Minnesota. The war, the rapid rise in building costs and inability to acquire a suitable building site caused postponements.

In the fall of 1920 a design competition was carried on among the senior architects with a view toward securing solutions which would embody the needs of such a building. The results were highly satisfactory to those interested in the project and it is regretted that the location of the building was changed from the one considered in the competition won by Stanley Hahn.

The change in arrangement and orientation made a new design necessary. Prof. Frederick M. Mann, head of the Department of Architecture, was chosen architect. In working out the new building plan such parts of the competition drawings were used as were suitable under the new conditions. He has endeavored to keep the building as nearly a student inspiration as possible.

Located at the corner of University and Fifteenth Avenues S. E., the structure will overlook the Campus Knoll and form a picturesque and beautiful edifice near the entrance to the campus. In design the Early English secular spirit has been kept. Simplicity is the important characteristic which depends upon fine proportions and severe dignity to make a striking and dignified building. The exterior will be of blue limestone in a small rubble pattern.

The main entrance on Fifteenth will be an important feature. It will be large and spacious with a spirit that is inviting and hospitable. From the entrance vestibule one will step into a social room which will take on the informal atmosphere of a Y. M. C. A. hut. There will be a refreshment bar where drinks and candies will be sold while at the north end of the room one will find a comfortable fireplace nook.

Opening off the south end will be a spacious "quiet room" overlooking the campus. This room will occupy the entire University Avenue side of the building, and forms the important feature in both plan and elevation. The east and west ends will have large bay windows. A low platform at the west will serve for writing purposes, and may be cleared for entertainments.

The roof over this room will be supported on hammer beam trusses which will add spirit to the design as well as beauty to the interior. A large fireplace will add to the cozy restfulness of the surroundings. These various details are characteristics of the great hall in an old English home. Adjoining the social room will be a suite of offices where secretaries will be accessible for conferences.

The main feature of the basement plan is a good size banquet room which will not only be used for entertainment purposes by the Y. M. C. A. but will be available to other campus organizations. A room for students who carry their lunches and a kitchen where they may secure hot soup and coffee complete this unit of the plan. Provisions are also made for

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COLLEGE NEWS

A. S. C. E.

"A Civil Engineer is a man who can do anything." This was the definition offered by Col. John T. Stewart of St. Paul, whose article on the manufacture of portland cement appears in this issue. He was the first man to cross the Everglades of Florida with a survey line, and this work was the subject of a most interesting talk by him which was the feature of the meeting of the Student Branch of the A. S. C. E. on March 16, 1922. Col. Stewart covered his subject in such an interesting manner that those present received an accurate and unforgetable impression of the topography of that peculiar country. To all appearances, he enjoyed his visit with the Society as much as the fellows, and his recitals of hunting incidents continued to interest his auditors almost till the dawn of St. Patrick's Day.

The officers of the A. S. C. E. and the staff of the Techno-Log wish to take this opportunity of thanking Col. Stewart for the interest which he has always taken in our College activities.

An illustrated lecture on "The Manufacture of Vitrified Clay Products" was given by W. D. Gerber of the Red Wing Sewer Pipe Co. on February 28, 1922 under the auspices of the A. S. C. E. He showed samples of the clay in various stages of its preparation, and of articles molded but not fired, and left, as he said, for a souvenir of his visit, one six-inch sewer pipe complete, which, we believe, is now in Prof. Bass' office. Mr. Gerber extended a cordial invitation to all students interested to visit the company's plant, either at Red Wing or at Hopkins, and see first hand the processes which he described.

A. S. M. E.

At the meeting of the A. S. M. E. Student Branch, on March 11, 1922, C. L. Jamison of the School of Business gave an impartial exposition of the Pittsburg Plus rule of the U. S. Steel Corporation, which has been the cause of continued complaint and controversy, culminating in the investigation of its legality now being made by the Interstate Commerce Commission. The price of steel at any place is a certain base price plus the freight from Pittsburg, whether the steel was shipped from there or from Chicago or Duluth, and this is believed by many to be an unfair discrimination against western concerns,—certainly it handicaps them in competition with eastern fabricators. Following the meeting, the Society had its picture taken for the Gopher, and while waiting for the photographer, the boys amused themselves by playfully snowballing the passing students.

The A. S. M. E. also held an open meeting in the Engineering Auditorium on March 18, 1922. This meeting was an exceptional opportunity, as was fully appreciated by some fifty-five who recovered from St. Pat's Day in time, and were prepared for their finals well enough to attend. C. K. Culbertson of Robinson-Cary-Sands, dealers in power plant equipment, machinery, and supplies, of St. Paul, was the speaker. A moving picture showing the actual behavior of fires within different types of furnaces, and especially the action of the Riley automatic underfed stoker was shown and explained by Mr. Culbertson. This was the first film of its kind ever made, and it is in great demand throughout the country, but according to President Vaule of the A. S. M. E., it could probably be procured again. All who would like to have it shown again had better let Mr. Vaule know.

Graduating Seniors' Banquet

At a complimentary dinner on March 23, 1922, at the Minnesota Union, tendered by the Board of Governors of the Union, 71 seniors, 31 of them engineers, received their diplomas. R. P. Chase, State Auditor, was the principal speaker, his subject being "Welcome Alumni." The conferring of degrees followed an address by President Lotus D. Coffman on "Broad Friendships Among Alumni." It was noticed that the "sheepskins" were not sheep skin, and were considerably smaller than heretofore, but they will mean as much nevertheless. Dancing concluded the evening's program.

Electricals Inspect

Anyone can operate a telephone,—at one end; but the operation of the other, the exchange end, is a far different matter. The truth of this statement will not be questioned by any of the Electricals who made the trip through two of the downtown Minneapolis exchanges on March 13, 14, 1922. The large number of wires seem to the uninitiated to be in a hopeless tangle, not to mention all the apparatus which must be connected to each line, for some classes of service, 29 different relays controlling various signals, fuses, lightning arresters and batteries, are required. Improvements have been made in cable manufacture until now 2,424 wires can be enclosed in a sheath 2⅝ inches in diameter, and this is the way in which they enter the exchanges. In Minneapolis there are now in use 96,438 telephones, and the average number of calls per day is 657,144 so it can be seen that the operators really have plenty to do. A close study of the number of calls handled at different times and by different operators, and at different switchboard positions, is made by the telephone engineers, so that they may

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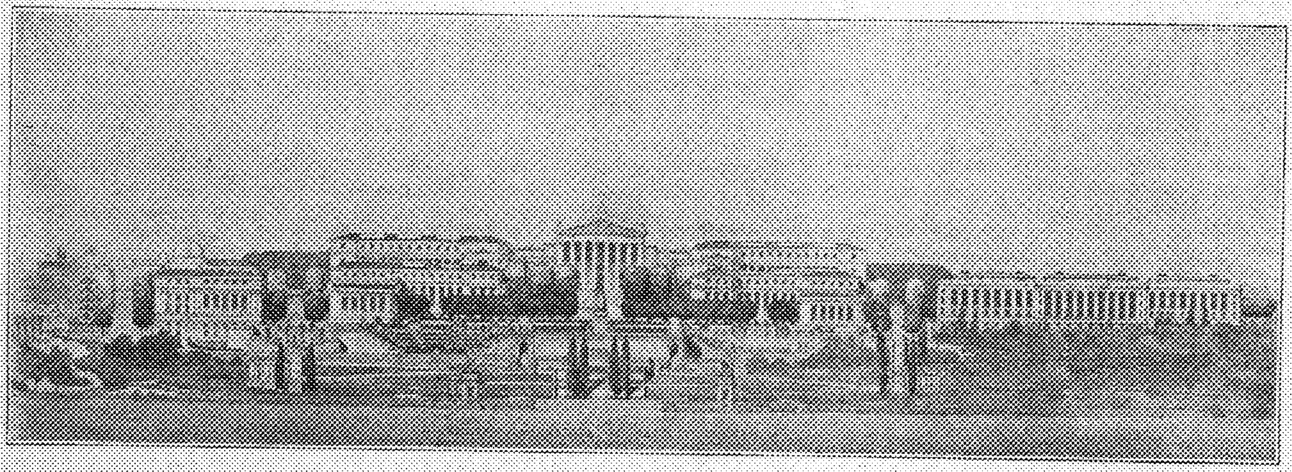

ELEVATION FROM THE SOUTH

OUR FUTURE MINNESOTA

By Samuel Sutherland, '23

Interest in higher education has so rapidly grown within the past half century that our great universities are finding it more and more difficult to cope with the situation and provide themselves with adequate buildings for the use of the students now on their rolls and the many more yet to come. Technical education, in particular, is being more earnestly sought after and has created a crying need for laboratories, drafting rooms, shops, and the like.

In the beginning, a few buildings, nondescript architecturally, and flung without rhyme or reason on the campus, was considered all that was necessary. But the conviction began to grow that this sort of thing would not do at all, and an absolute maze of buildings would result if an orderly plan was not adopted.

This was true of all universities save one—the University of Virginia. At its very start it had a plan for its future development drawn by the statesman-architect, Thomas Jefferson, in 1810. This plan was so broad and so well conceived that the fundamental scheme is still being followed to this day, being only slightly changed, due to new conditions, by the firm of McKim, Mead and White.

The rest of the great universities were not so fortunate. Yale, Harvard, and Columbia have all met, in common with all others, a great difficulty in providing physical plants for their students. The trustees, however, of nearly every college in the country have adopted a comprehensive scheme for their future enlargement. Columbia University now has one, so has New York University.

In a like manner, the Board of Regents of our own University, after falling into the same pitfall as the others, decided in 1909 to secure a plan for its development. No longer were the different schools and colleges to be placed helter-skelter about the knoll, but a broad, well defined scheme was to be adopted.

They therefore adopted a general program, and invited some of America's greatest architects to enter a competition which was to provide the University with a plan for the development of the forty-acre new campus, secured the year before. The winning plan was that suggested by Cass Gilbert, and, after the judgment, he was commissioned to work out the plan in detail.

The plan suggested by Mr. Gilbert took in the advantages afforded by the irregularities of the site and were as follows:

A formal grouping of semi-classical style buildings of brick and stone about a large mall. The mall consisting of two open courts, one north of Washington Ave., 275 feet wide and 1,300 feet long; the other south of Washington Ave., and about 500 feet square, and at a lower elevation. The larger was to be known as the North Court and the smaller as the South Court. In the old stone quarries in the bluffs along the river were to be placed a Greek theater and a Botanical Garden.

To the east and the west of this central mall were to be grouped smaller buildings on courts parallel to the main mall. At the head of the mall were to be placed an Academic hall, a Library, and a Museum. Rectangular buildings were to face on the North Court and L-shaped ones on the South Court. The Engineering group was allotted the east side of the larger court and also a smaller minor court east of Church Street. To the south of the Engineers were to be placed the Medical group with the Biological group, the Chemistry group, Astronomy and Geology west of Pleasant Ave.

In accordance with the scheme, Main Engineering, Experimental Engineering, Anatomy, Millard Hall and Elliott Memorial Hospital were built. Biology, which is one-half of one of the L-shaped buildings on the South Court, was built latest. Two of the

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MINNESOTA TECHNO-LOG

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EDITORIALS

AN EDUCATION TOO

With the advent of another quarter of study comes the usual search on the part of the student for a suitable program, one in which courses that he is really interested in predominate. If the student is following the usual curriculum of his class, after he has satisfied the requirements of his course, the choice is usually limited to a few vacant hours. By a series of mental gymnastics he tries to insert in those vacant hours the course he desires. The result in most cases is not worth the effort, and with a feeling of discouragement he arranges for one of the "stand-by electives" of the College. These several courses do not include literature, language, or art, three divisions of study essential to an education.

A student seeking courses in a language, as an instance, finds only five hour courses offered. In literature there are many conflicts with the engineering courses of study, and in art the laboratory hours are impossible.

The only solutions to this situation are, the inclusion of several three hour courses in the program of the Engineering College, or a better co-operation of the academic college to the extent that it would offer three hour courses in wanted subjects to engineers, catering to their programs. For a beginning we suggest such courses in French, Spanish, and German, also courses in the literature of England and America. An art appreciation course might be an added feature. These would offer an instruction in more of **lo gai saber** as an educational incentive to an otherwise strictly scientific course of study.

These suggestions may seem academic to the average underclassman, but to the Junior and Senior in more intimate touch with the faculty, and the men of other colleges they are vital problems. It is observed that the engineer of today in public life must compete with the liberally educated man, or be relegated from the executive position to the all too prevalent role of workman. As men ambitious for a successful engineering career, let us make sure while we have the opportunity, we not only receive a foundation in engineering, but also an education.

RESEARCH

We have frequently been asked why more research is not carried on by the Engineering College of our University. This question has, no doubt, arisen from the fact that the proper publicity has not been given to the many investigations that have been conducted and carried to a successful completion.

There are, at the present time, many research problems in the process of solution. Following the recent action of the Board of Regents creating a separate department within the College of Engineering for the promotion of research, it is to be expected that more and more of this valuable work will be done. Your attention is called, therefore, to a new section of this magazine which will be devoted each month to the interests of research. Professor F. B. Rowley's general survey of the research now in progress, appearing in this issue, will be followed each month with the publication of an illustrated description of specific problems as they are completed. In doing so we hope not only to stimulate interest in research but also to inform the student and alumni bodies of the valuable work being done at Minnesota, in which they are greatly concerned.

STUDENT EMPLOYMENT
By Rudolf H. Kuhlman, '23

About two months ago the executive committee of the A. S. M. E. brought to a climax the vague plans and desires of that organization which had been advanced from time to time towards the solution of the problem of securing permanent employment for graduating students and summer jobs for under graduates. The dearth of jobs last year and especially of positions which would give the student training in his profession made it urgent that something be done this year to avoid a similar situation. Consequently, the A. S. M. E., the principal organization of the branch of mechanical engineering, decided that here was a field in which great good could be done and which the organization could logically develop.

President Vaule corresponded with student employment bureaus all over the country and placed his information before the executive committee and Prof. Flather. It was finally decided, after many plans had been discussed to leave the details to a committee of three, one senior, one junior and one sophomore with full powers to formulate a policy and execute it. E. Mikesh, R. Kuhlman and H. Langman were appointed as the representatives on this committee.

The first step was to interview the University Employment Bureau and it was found that they were more than willing to cooperate with time and money. The following plan was then evolved:

Questionnaires as to experience and special preferences were to be made out by each mechanical and kept on file. Then it was planned to send letters to all the firms in and about the Twin Cities who would be likely to need men with mechanical engineering training. This was to be followed up with personal calls on some of the most promising of the firms by members of the committee. Furthermore, representatives of larger firms from the East who are accustomed to employ graduates of technical schools were to be invited to speak to the men. A special effort was to be made to urge these firms to employ students during their junior-senior vacation as trial for permanent employment after graduation.

It was expected also to be informing the Minneapolis and St. Paul branches of the national engineering organizations, such as the A. A. E. and A. S. M. E., of our intentions so that they could use our files to fill applications which come into their regular employment bureaus for men to fill positions that university students would be competent to handle. In fact, these organizations had already assured the president of our student branch that they were anxious to do all in their power to help us out.

In time it is hoped that the work of the committee can be carried even farther by establishing a file of all Minnesota Mechanical Engineering graduates. According to Prof. Flather, many a good job comes into his office and must go begging for lack of adequate information as to location and experience of former graduates.

Active steps were immediately taken by the committee towards the carrying out of this program. A mechanical engineering file was established at the Employment Bureau and over four-fifths of the mechanical engineers have already filled out application giving full data in regard to their experience and qualifications for special branches of work. A general letter has been sent out to all the firms of the Twin Cities telling them of the organization we have here at the University and the opportunity they have of using our employment agency files to select the particular type of man which they need to fill out their personnel. Another more personal letter designed for particular firms will have been sent out by the time this is printed. The committee intends to start visiting some of the firms as soon as possible. It is believed that this service will be an aid both to the employer and the employed.

Although the specific results of the venture are as yet uncertain, it would seem that the fundamental idea is a good one. It is a course of action which not only other departments of the Engineering College, but every college on the campus might well afford to follow.

It should be a part of the benefits derived from attendance at a university that an organization should be working to efficiently place every student in a good position in his chosen line of work. Moreover, it is up to the student to do his share and not sit idly back hoping for a lucky chance to land him an easy job. When there is an abundance of work, an employment bureau is but useless overhead, but it is now when jobs are scarce that every effort should be made by the organizations in the various departments of the University to handle the unemployment situation.

PRIZE POSTER CONTEST

To promote general campus interest in the poster work of the art department and of the College of Engineering, the Cosmopolitan Club offers a prize to be awarded by popular vote of the University public. The posters submitted will be on display in the rotunda of the library for a week, and then a popular vote will be taken as to the best poster. Six prizes will be awarded, a first prize of fifteen dollars, and five prizes of two dollars each. In case of too large a class, the Club reserves the right to have the better ones chosen by competent judges and only those submitted to the popular vote.

All posters must be not larger than 20x30 inches, and should be designed to advertise the International Revue and Dance to be given in the University Armory, at eight o'clock, April 29. The program of the Revue this year will consist of "The Pageant of Peace," which will represent the nations of the world bringing together the fruits of peace and happiness. America, Canada, China, France, England, Scandinavia, Japan, Russia, and the Philippine Islands will be represented. Their national music and anthems will be featured by an orchestra of twenty-four pieces under the direction of Mr. A. Pepinsky, and by the Andrews Presbyterian Quartette.

Sam Berg, graduate student in electrical engineering, is in general charge of the Revue. Rasmus Rasmussen, '23 medic, is program chairman, and Raymond Bowers, '23 M. E., is stage manager.

One-half of the net proceeds will be donated to the Foreign Students' Loan Fund, recently established by a gift of two hundred dollars made by the Cosmopolitan Club to the University.

The Poster Contest closes April 21, 1922.

ATHLETICS

MINNESOTA SWIMMERS, CHAMPS

Running true to pre-season predictions, Minnesota's tankmen, March 18, emerged from Chicago's pool with the conference championship securely stored away. Wisconsin ran the Gophers a tough race, losing the meet and the championship in the last event to the tune of 34-29. Chicago, Illinois, and Northwestern trailed in that order.

Murray Lanpher, Junior Electrical, was the deciding factor in Minnesota's championship aggregation. When Lanpher toed his mark in the 440, the last event, the score stood Minnesota 29, Wisconsin 28. Lanpher had to beat Wisconsin's best man to win the meet. Murray felt his responsibility so keenly that he not only won the race, but knocked two and four-fifths seconds from the national intercollegiate record in that event.

With the bacon safely in the ice-box, it is interesting to look back over the past season.

November 1, a large squad, including nine letter men, reported to Coach Niels Thorpe in the Armory Pool. Lanpher, "Hib" Hill, and Louis Bevans made up the Engineer's delegation. "Axel" Gow, Harry Dinmore, and Don Brunner, all letter men, represented the Miners.

The Thorpemen first showed their wares in public by defeating the strong Minneapolis "Y" team, January 27, by a 43-25 score. This meet saw one world's, and four Northwest, records go by the board. John Faricy, swimming his initial race for Minnesota, cracked the world's record in the 100-yard breast stroke by two-fifths of a second. Lanpher, Capt. Day, and the relay team brought three Northwest records to Minnesota. February 4 saw the Gopher natators at Iowa where they won a meet featured principally by the score, 41-17.

A two weeks' rest and the Gophers took on Northwestern in the Minnesota pool to the tune of 39-19, the first time Northwestern swimmers have been defeated in a dual meet in nine years. Minnesota took first in all but one event. The relay team, "Hib" Hill, Cliff Holmes, Jean Foley, and Cliff Johnson, started the scoring by tearing one second from the conference record.

A week later Thorpe's water burners lost 36-32 to Wisconsin, in the Badger's pool. This meet was featured by the deep black color of the water and the work of Bennett, Wisconsin's star dash-man.

Smarting from the defeat at Wisconsin, the Gopher tanksters romped home with most of the goldware and the state championship in a meet at the Minneapolis "Y" pool. Here the dope was only upset once, when Johnny Day, Gopher captain and star, was defeated by Jim Hill of the "Y."

The grand finale came with the conference meet in Chicago's pool. With Director Leuhring and Doc Cooke to cheer them on, the Gopher fish fought to victory in the greatest meet in the annals of conference swimming. The relay team took a second, where less than a foot separated the first three places, Faricy came through with an intercollegiate record in the 200-yard breast stroke, equalling the world's record, Lanpher took a third in the 220, Atwood a first and Jordan a third in the plunge, Day a first in the backstroke, Gow a fourth in the 100, Lanpher a first in the 440, the championship was ours, and the 1922 season was over.

ENGINEERING PARTICIPATION

"Maximum participation is the secret of successful varsity athletics," declares Fred W. Luehring, the "power that is" in Minnesota athletics. "If Minnesota is to build up winning teams in the years that come it means that she must have every man with athletic ability trying to find a place in the curriculum of sports.

"I know it is hard," he continues, "to carry the heavy schedule of the technical student and find time for the extensive training of a varsity squad, but too many men that were whirlwinds in high school are passing through our University unheard from. The old system of athletics has been in great measure responsible for this, but a great deal of the blame rests with the individual himself. A man that starred in high school cannot wait until his junior or senior year to start his athletic training at the University. The coaching staff has not the time nor the equipment to offer these men the special rush training that they need, when there are so many undergraduates that, with their more extended period of training will be of far greater value to the game.

"It is in the new spirit toward intramural athletics that the new University spirit will find itself. I do not believe that boosting college competition damages the spirit of the University. I am for it. Every college should be represented by a team in every branch of sport.

"When this universal interest in athletics becomes noticeable the time will be ripe for the installation of Junior Varsity Teams. By these I mean varsity teams composed of men unable to make the first squad, but of high athletic caliber. I foresee the formation of a Junior Varsity Conference among the Big Ten with a regular season schedule, with all the importance and attention devoted to the teams in the premier class. And this is no dream. It has been brought up by several of the leading coaches of the conference, and it only awaits the building up of the personnel.

"The most important side of the arguments in favor of greater participation in athletics by engineering students is that from the standpoint of health. You have seen a classmate of yours give out under the strain of a technical course because he practiced all work and no play. Physical care ranks in importance with mental precaution, and a manly sport played in a red-blooded way becomes play, and makes possible the perpetuation of Minnesota's high athletic reputation.

"As for baseball—wait and see!"

TYPES OF HIGHWAY PAVEMENTS

By Prof. F. C. Lang, C.E.

Up to the present time only two general types of pavement have been used for hard surfacing highways in Minnesota, a one course cement concrete pavement, and an asphaltic concrete pavement on a cement concrete base. By far the greater mileage has been of the one course concrete pavement type. In fact there are no asphaltic concrete pavements on highways outside of Hennepin, Ramsey and Dakota Counties.

A one course concrete pavement, according to present specifications, consists of a 7½ inch slab of 1:2:4 concrete, usually 18 feet wide, and reinforced with two ¾-inch round bars placed 6 inches from each edge, and ⅜-inch transverse reinforcement spaced 8 feet on centers. The reinforcement is placed 3 inches from the top of the slab. A cross section of such a pavement is shown in Fig. A. The purpose of the reinforcement is to tie the slab together across cracks that may form and prevent displacement of the parts, although it does act too, in distributing the load over a greater area at cracks. The slab is not reinforced for so-called beam action. Tranverse cracks, spaced about 40 feet apart, are expected in this type of pavement, and are caused by temperature changes. In order to prevent disintegration at the cracks they are filled as they occur with some form of bituminous material. Approximately the following materials will be required per square yard of pavement:

Cement	.3 bbls.
Sand	.09 cu. yds.
Stone	.18 cu. yds.
Steel	2.64 lbs.

The cost of these materials will vary according to the locality in which the road is being constructed. The cost of mixing and placing the concrete will also vary according to the size of the job and the locality.

As usually constructed, asphaltic pavements may be divided into two classes, sheet asphalt and asphaltic concrete. The latter may be further subdivided into two types, the coarse graded, or as we are familiar with it, bithulithic, and the fine graded, or Topeka. There are also variations in these types. Asphaltic wearing surfaces are, as a rule, laid on a concrete base about 6 inches thick.

All asphaltic pavements are composed of stone, sand, Portland cement or limestone dust filler, and asphalt. The size and proportions vary according to the different types. The asphalt may be either natural lake or of petroleum derivation, according to whether it is obtained from a natural formation on the earth's surface, or from the refining of petroleum. All asphalt pavements depend at least in part upon the adhesiveness of the asphalt for their stability, and not upon any chemical action as is the

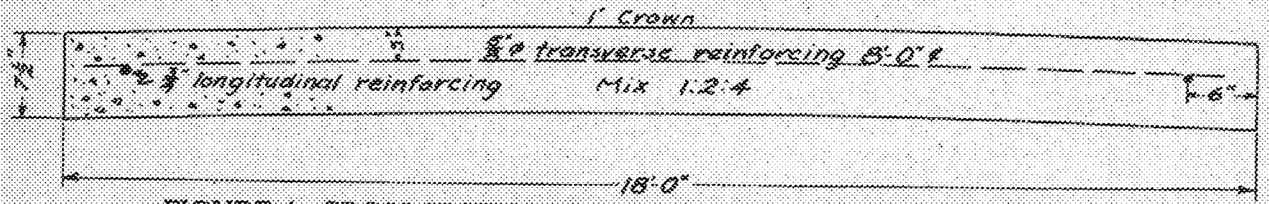


FIGURE A, CROSS SECTION ONE COURSE CONCRETE PAVEMENT

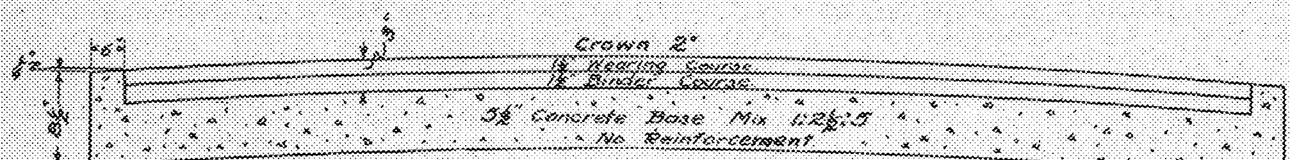


FIGURE B, CROSS SECTION TOPEKA WITH BINDER

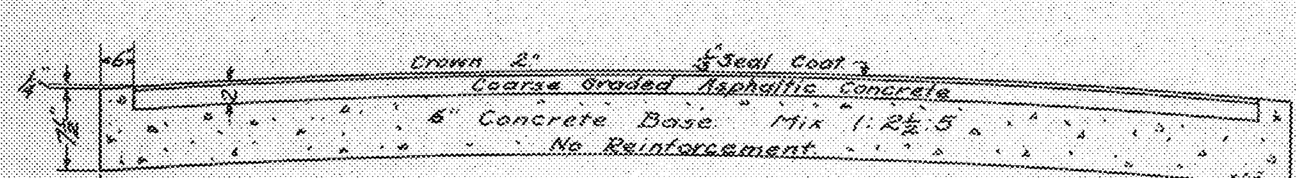


FIGURE C, CROSS SECTION BITULITHIC

case with Portland cement concrete. In order to properly distribute the asphalt over the surfaces of the aggregate and secure this glueing action, the aggregate and asphalt must be heated separately to a high temperature and thoroughly mixed together while hot. The temperature required is about 300°F. In order that the mixture may be thoroughly consolidated by rolling on the street, while the asphalt is in a partly fluid condition, the mixture must be transported from the plant where it is heated and mixed to the street with very little loss of heat. All mixtures are dumped ahead of the pavement, shovelled into place, raked to the required thickness and compacted by rolling.

Bitumen is that part of the asphalt which is soluble in cold carbon disulphide. Specifications always call for a certain percentage of bitumen by weight. The percentage of bitumen present in the asphalt varies according to the kind of asphalt used. This must be taken into consideration when computing the amount of asphalt which is to be used in the pavement.

A typical highway section for a Topeka mixture with binder is shown in Fig. B.

The sheet asphalt pavement is entirely similar to this except in the grading of the wearing course. The largest size of the aggregate ordinarily used in a sheet asphalt wearing surface will pass a number 10 sieve, while in the Topeka mixture it is up to about ½ inch. In the coarse grade or bithulithic the maximum size is about one-half the thickness of the wearing surface or up to about 1¼ inches might be used in a 2-inch top.

A typical highway section of this type of pavement is shown in Fig. C.

The amount of asphalt used per yard of pavement varies with the thickness of the top, and also with the size of the aggregate. The more coarse stone that is used in the mixture, the less asphalt will be required.

The sheet asphalt pavement is always constructed with a binder course as is shown in Fig. B. The bithulithic is constructed without a binder course as is shown in Fig. C, while the Topeka being an intermediate mixture, is laid sometimes with, and part of the time without a binder course. The main purpose of the binder course is to prevent creeping. Asphalt pavements crack because of the temperature changes but iron out and almost disappear under the action of traffic in warm weather.

The amount of materials required per square yard of pavement for Fig. C would be about as follows:

Concrete Base	
Cement	.18 barrels
Sand	.067 cubic yards.
Stone	.134 cubic yards.
Asphaltic Top	
Stone	138.3 pounds
Sand	117.5 pounds
Limestone Dust	9.4 pounds
Bitumen	19.0 pounds

The 1½-inch binder course shown in Fig. B consists of broken stone, sand and asphalt. This is laid and rolled. After rolling, the top, while smooth, has not the dense appearance which you are familiar with on the top of an asphaltic pavement. This is due to the fact that the mixture is rather coarse and contains considerable stone. As soon as possible after the binder course is laid, the wearing course, which consists of small stone, better grade sand, limestone dust, and asphalt, is laid. This is thoroughly rolled. After the rolling a seal coat of Portland cement or limestone dust is brushed over the pavement to fill the surface voids.

As shown in Fig. C the coarse graded or bithulithic type consists of a 6-inch base and a 2-inch surface. The upper layer, approximately one-third of an inch thick, is a seal coat which is practically the same mixture as is used in the top of a sheet asphalt pavement. This seal coat is applied before rolling. The approximate amount of material required per square yard of pavement is as follows:

Cement	1.97 barrels
Sand	.073 cubic yards
Stone	1.46 cubic yards

The amount of material required per square yard in the top is approximately as follows:

Stone	97 pounds
Sand	73 pounds
Limestone dust	6 pounds
Bitumen	12 pounds

The cost of asphaltic pavements will, of course, vary according to the locality and size of the job.

There are other good types of highway pavements which have not been laid in Minnesota up to the present time. Brick is a popular highway pavement in some localities, but the high freight rates make it difficult for it to compete in Minnesota.

FUTURE MINNESOTA

(Continued from Page 9)

smaller laboratories on the west of the North Court were combined into the Chemistry Building, and the School of Mines was set on a minor axis north of Chemistry. These small changes did not radically change the original scheme.

Due to the unparalleled growth of the University since the adoption of the plan thirteen years ago, it has been found advisable, by Prof. Forsythe and his colleagues, to revise the scheme in order to utilize the ground area more efficiently and also to use the ground provided by the removal of the Northern Pacific tracks.

The plan as it now stands is to have at the head of the mall an Auditorium seating 7,000 people. The funds for this building are to be raised by private subscription or endowment. The library is to be just to the north of Chemistry and of equal size. Two buildings of this same size are to be set across the mall. These are as yet unassigned but one will probably be the Technology Building and the other Physics.

Four smaller buildings, two parallel to Washington Ave. (one of which will probably be the School of Architecture), and two flanking the Auditorium are yet to be built. At the extreme southern end of the mall will be placed the campinile, designed by Mr. Jefferson Hamilton, a University alumnae practising in Minneapolis, the sketch of which appears on the cover.

About the Engineering Court are to be erected two or three buildings to complete the rectangle. One of these will be the electrical building.

In order that the landscape effects will not be spoiled, the car tracks on Washington Ave. will be depressed.

Other changes in the plan will undoubtedly be found necessary, but the original conception of the University's needs was in such a broad and comprehensive spirit that eventually Minnesota will have a dignified and efficient campus.

RESEARCH AT MINNESOTA

By Prof. F. B. Rowley

There can be no doubt in the average engineers' mind as to the value of systematic and well directed research. As viewed from any angle the arguments all appear to be on the same side. It must be of intrinsic value to industrial organizations since many of them are willing to spend large sums of money to create and maintain research departments. It is also conceded to be of great value to educational and public institutions, both to the institutions themselves and to those supporting them. Those taking part in productive research are practically unanimous in their opinion as to the personal benefits derived from the work, which opinions to be sure are not all prompted by financial gains.

It is therefore not in a presentation of the argument for or against research, but rather in a brief statement of what the engineering college has done and is doing in engineering investigation that I believe the alumni will be interested.

It is not new to most alumni that by an act of the Board of Regents an Engineering Experiment Station and Bureau of Technological research has been established at the University with the Dean as Director. Although this station was created without specific funds, it is a distinct step forward in the organization and promotion of research work in the college. Specific research problems will go on as at present and also the work in the Graduate School will continue, but in addition a specific department is created in the college which may cooperate with the industries of the state and which may handle funds as given by the industries for the prosecution of specific problems of commercial value. In fact it is hoped that this may be a source of considerable revenue for the research work of the college. While research work on many theoretical problems can be carried on with small funds it is a fact that most projects in which the engineering profession is interested require considerable sums of money for their solution, and that in many cases the solution of these problems will be a direct financial benefit to the industries concerned. It is therefore not unreasonable to look for financial cooperation from this source.

While one of the greatest handicaps to research in the college during the past years has been the lack of sufficient funds this has not been due to any want of desire on the part of the administration to furnish the college with such funds, but rather due to a healthy growth in the college, with a corresponding demand for increased equipment and staff which has naturally made it impossible to increase the research funds to any considerable extent. In spite of this financial handicap a survey of the projects carried on in the college shows that there are over 30 well developed projects now under way, a partial list of which follows:

Shrinkage & Time Effect on Concrete, by M. B. Lagaard and G. L. Maney.

Secondary Stresses in Kenosha Bridge, by J. I. Parcel, G. A. Maney.

A Study of Shrinkage and Time Effect in Reinforced Concrete Columns, by M. B. Lagaard, G. C. Staehle.

Investigation of One Course Concrete Pavements Constructed by the State During the Past Three Years, by F. C. Lang, R. E. Bergford.

Investigation of Vibrolithic Concrete, by F. C. Lang.

Investigation of Sheet Asphalt and Topeka Pavements, by F. C. Lang.

Suitability of Certain Limestones and Sandstones of the State For Use in Concrete Pavements, by F. C. Lang, R. E. Bergford.

The Effect of Weathered and Unweathered Feldspar on Concrete Mortars, by F. C. Lang, R. E. Bergford.

Effect of Shale Pebbles in Concrete and Removal of Shale From Gravel, by F. C. Lang.

Value of Marl as a Binder in Sand Roads, by F. C. Lang.

Radiant Heat From Direct Radiators, by F. B. Rowley.

Heat Transmission Through Insulating Material, by F. B. Rowley, M. S. Wunderlich.

Test of Radiator Traps, by F. B. Rowley, A. G. Holmstine.

Characteristics of Rotary Pump When Pumping Oils of Different Viscosity, by C. F. Shoop and Sven Vaule.

Determination of a Suitable Method of Measuring Air Flow in Short Air Ducts, by G. L. Tuve.

The Use of Alcohol as a Fuel in an Internal Combustion Engine, by B. J. Robertson.

Effect of Temperature on the Physical Properties of Steel, by G. O. Priester.

A more complete outline of these problems with the progress of development will appear in the next issue of the Techno-Log. It should be pointed out that manuscript has been completed for bulletins on the Kenosha Bridge and Radiant Heat from Direct Radiators, and several other bulletins and papers will be published by the end of the year.

The investigation of the action of a pump when pumping oil is being partly financed by a fellowship given by the Northern Fire Apparatus Company. The work on heat transmission through insulating material is being partially provided for by the Flaxlinum Insulating Company of Minneapolis and the United States Radiator Company. The Minneapolis Steel & Machinery Company and the American Society of Heating & Ventilating Engineers Research Bureau at Pittsburgh, have also furnished small amounts of money in the form of fellowships during the past three or four years to cover special problems.

In the investigation of problems relating to highway construction and maintenance the University is particularly fortunate in its connection with the Highway Department, since Professor Lang who has charge of the Highway work at the University, is also Engineer of Tests in the Highway Department. This makes it possible to correlate very closely the experimental research work in highways carried on at the University and in the highway department, and valuable data may be expected in this line.

ALUMNI NEWS

OUR NEWEST ALUMNI
Class of March, 1922

CIVIL ENGINEERING

N. Sevrin Anderson
Walter K. Cook
Harry E. Cribbs
Carlisle Fraser
Herbert J. Frost
Arthur E. Hortskotte
Ellsworth Johnson
Jasper F. Keeler
C. W. O. Markson
Charles H. Palda
T. S. Paulsen
John M. Reardon
Edward J. Soshnik
Loring Slade
Oliver A. Stoutland
Clifford L. Swanson
Lawrence Teberg
Claudius A. Thompson
Arden D. White
Charles A. Wilson
Victor R. Wood

MECHANICAL ENGINEERING

Frank Fahland, Jr.
Richard Hoffman
Howard Kelsey
Ernest Nordstrom
Harold Rohendahl

ELECTRICAL ENGINEERING

Arnold B. Hendrickson
Gerhard L. Oscarson
Glen B. Ransom

GENERAL ENGINEERING

Donald W. Capstick
Rudolph E. Meili, Jr.

REUNION OF THE CLASS OF '08 C. E.

The Curtis Hotel of Minneapolis on the evening of March Fourth was the scene of a well attended banquet of the Civil Engineering Class of 1908. Eighteen interested, reminiscent Civils together as of class room days, talked, joked, and enjoyed each other again for an all too short evening. Professors Lang and Shoop of the College were there, and the latter brought away some very interesting statistics. Out of twenty-five members of the class, only one man remains unmarried, but then 1908 is not so very far passed. Altogether there are fifty-eight members of the class of 1908 Jr. This record stands, as no other class of the College has ever threatened it.

The meeting was informal, the discussion lively, and the interest in the College gratifying. The class echoed the plea that continually comes from our alumni bodies for the establishment of the University as a medium for research. The alumni believe that adequate equipment, information, and new methods, should be furnished the engineering profession of the state as an aid to constructive progress in engineering science.

Formal action was taken to inform the University authorities as to the immediate needs of the profession in securing research in current problems of general interest. If proper funds and equipment are made available the University can act to make itself an institution of public benefit to its supporters. The members of the Class of '08 are to be commended for their interest in bringing the matter of research to the attention of the official University once more.

E. H. Grochau, '21, sent in the following letter:

"No doubt you are interested in news concerning men who have left the Engineering College. If so the following may be of interest as material for your Alumni column.

Upon discovering that there were about fifteen '21 C. E.'s in the Twin Cities there was only one thing to do and we did it—had a get-together meeting which consisted of an Orpheum party followed by a lunch in a well known St. Paul establishment. All those present gave a detailed account of their activities since leaving the University. Plans and specifications for future monthly meetings were drawn up and the contract for the next meeting has been let. The following men were present: Leslie Halliday, Earl H. Grochau, Edwin Espenett, Carlisle Fraser, E. J. McCubrey, Burt C. Henry, Maurice Chernus, Lyle A. Dills, L. J. Sverdrup, Harry J. Beeman, Richard Daly, C. E. Olson and Joe Young.

Others of the class who may happen to be in the city are requested to communicate with Earl Grochau for particulars as to further meetings."

We received the following in a letter from Albert Peterson, '20: "Have been receiving my copies of the Minnesota Techno-Log since the paper started, and want to congratulate you fellows on the type of magazine you are publishing. Keep up the good work."

Christian Anderson, '88, is senior Highway Engineer with the U. S. Bureau of Public Roads. His home address is 466 10th Street, Portland, Oregon. In 1881 Mr. Anderson graduated from the Military Academy of Denmark, and from 1881 through 1882 he was a Lieutenant in the Danish army. During the recent war he was a Captain in the Ordinance Department of the U. S. Army.

William M. Elsberg, '09, recently appointed city Engineer of Minneapolis received the degree of Knight of St. Patrick at the last annual Engineer's celebration. A special certificate was issued Mr. Elsberg in consideration of the position he holds.

ELECTRICALS INSPECT

(Continued from Page 8)

detect in advance, need for additions, and may devise ways of improving the service. The peak load at the exchange is from 9-10 A. M., with a secondary peak at 7-8 P. M. This secondary peak is noticeably greater on Wednesday, so they say that most of the "dates" for the week are made on that night. This sounds plausible enough. How about it?

Dean Leland Honored

Dean O. M. Leland, who is a Colonel of Engineers in the Reserve Corps of the United States Army, has been assigned to command the 313th Engineer Regiment (Combat) of the 88th division with headquarters at Minneapolis. A number of the alumni of this college who served with this regiment during the World War have been commissioned in the Engineer Officer's Reserve Corps, and have been assigned to the reorganized regiment.

Dean Leland has also been elected president of the recently established Minneapolis-Saint Paul Post of the Society of American Military Engineers. This is a national society composed principally of professional engineers who served in the World War.

See Minnesota First

"See Minnesota First" should be the first corollary to the now well estalbished proposition "See America First." This was proven in the showing of some wonderfully beautiful pictures taken in the state and national forests of our own state, as a part of a lecture by Mr. Wheeler on March 13, 1922. He is connected with the Industrial Relations Department of the Federal Forestry Service, Rocky Mountains Division, with offices in Denver; and spoke on "Federal and State Forestry Service in Minnesota." Besides the pictures already mentioned, there were many others, stressing the evils resulting from the destruction of the forests, the enormous loss from forest fires, and methods of planting, protecting, and maintaining forests, all explained and discussed by Mr. Wheeler. In conclusion, a film showing the forest ranger at work, during ordinary times and while fighting a fire, was shown.

THE NEW UNIVERSITY Y. M. C. A.

(Continued from Page 7)

a number of shower baths for the use of students who do not have adequate facilities at their rooming houses. On the second floor are located a number of class or committee rooms also open to campus organizations.

Since it is the intention to provide restful and quiet surroundings in the new building, no space has been allotted for noisy games as they are cared for at the Minnesota Union. Quiet games such as chess and checkers will be provided for in the Quiet room. The purpose of the building will be to carry out two of the four aims of the Y. M. C. A., namely the social and spiritual. The other two, educational and physical, are amply provided for by the University. The new building will place at the disposal of every University man a much needed factor in school life. It will not only be a means toward social entertainment but will provide an inspiring and helpful environment.

DO IT ELECTRICALLY

A. A. Waligoski, E. E., '24

When Milli Ampere first saw Volt,
Her charms passed all resistance.
A spark coiled in his heart, poor Volt—
He needed prompt assistance.

And she, tho plighted to old Watt,
Could alternate affection,
So let her eye bolt glances hot,
Right in poor Volt's direction.

The current of Watt's wrath flowed strong!
He vowed Volt should not meter,
For daughter Poly Phase had long
Hoped that Volt would be sweeter.

And so to Milli Ampere, he
A stern note did transmitter,
Requesting she transform, and be
If possible, less bitter.

So Milli Ampere flirted not,
But knew that it was wise
To regulate the rage of Watt,
And with him synchronize.

Then Volt with Poly Phase did fuse—
From her he did not roam.
They rectified divergent views
And started a little Ohm.

GOOD WORK

Minnesota men received no slight honors in the New York judgment of the Beaux Arts problem, "A Town Hall." William E. Willner, '22, received first mention, placed, while Paul Damberg, '22, and Donald T. Graf, '22, scored first mentions. Mr. Willner's design is to appear in a forthcoming issue of the American Architect according to information received by Prof. Leon Arnal, of the Architectural department.

PORTLAND CEMENT

(Continued from Page 4)

cement a sufficient time to make it usable in construction. It is then reground to a degree of fineness that 78 per cent of it will pass through a screen having 200 openings per lineal inch.

The finished cement goes to the storage bins from which it is drawn for shipment by being packed in sacks or loaded on the car. If sacked, 94 pounds are placed in a paper bag or cloth sack, the cloth sacks usually being filled through a self-closing valve at the bottom, the top having previously been tied. Bulk cement is weighed over an automatic scale into the car.

From the arrival of the raw materials at the mill until the finished cement is in the bins, samples from the various stages of manufacture are examined in the chemical and physical laboratories for the purpose of making a uniform, standard product.

The production of Portland cement is now carried out carefully and accurately by the manufacturers in conformity with the specifications of the American Society for Testing Materials. If proper care has been used in handling and storing after leaving the factory it can be used by the consumer with absolute confidence that it is of good quality.

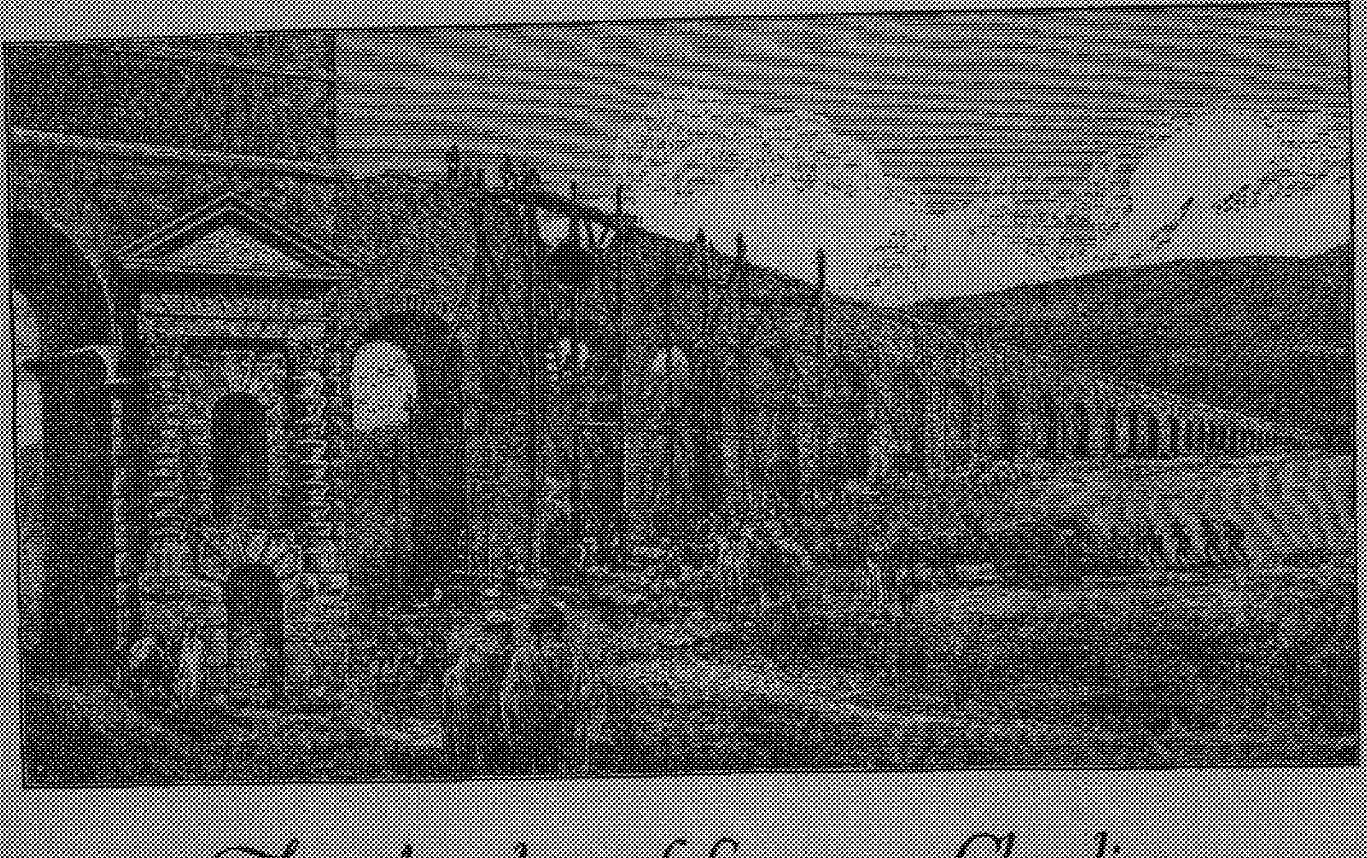
DAYLIGHT ILLUMINATION.

The angle of refraction being equal to the angle of incident, it is a simple matter to determine the correct angles to use in manufacturing glass which will give good illumination. But for proper industrial plant illumination, there is more to be considered than mere deflection of light. The direct beam of light must be eliminated in order to prevent sun glare, which is objectionable on account of its causing heavy shadows and strong contrasts which decrease the efficiency of employees and necessitate the use of shades which in turn reduce the light to such an extent that daylight illumination any distance from the light source is not sufficient. Therefore, in order to produce a glass which when used in the windows of industrial plants will produce as near to ideal illumination as possible, we must first eliminate the direct rays of the sun by deflecting the light to the ceiling and side walls which re-deflect it back to a distance 25 to 50 feet from the window throughout the entire working area. To accomplish this we have scientifically designed a type of glass which is named "Factrolite."

Factrolite consists of 30 ribs to the inch, running at right angles, forming 900 pyramidical prisms or 3,600 light deflecting surfaces which completely disintegrate the direct beam of light from the sun. Furthermore, the depressions in the surface of Factrolite are so slight that the accumulation of dirt and dust is minimized and can be perfectly cleaned with an ordinary dry scrubbing brush. Incidentally, the cleaning of windows is most important for keeping up production and increasing the efficiency of any industrial plant and should be given more consideration in plant management.

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

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.



The Aqueduct of Emperor Claudius

Prisoners of the Roman victories—slaves of the Emperor Claudius—were set to the task of bringing a water supply over 45 miles of hill and valley to Rome.

They labored long and in great numbers. Energy was measured then by hands and by backs to bend to the task; explosives were unknown.

Tools of metals were used to chip the rock and cut large grooves around the blocks to be excavated, wooden wedges swelled by water were used to break out the large pieces, fire was used to heat the rock which was then cooled and shattered by water. But men grew old at the task. The tunnel under Monte Salviano, 3½ miles long, ten feet by six, took eleven years to complete with thirty thousand laborers at work.

Today, with the aid of Hercules Explosives, San Francisco is building the Hetch Hetchy aqueduct which will include 69 miles of tunnels. An advance of 776 feet in thirty-one days was made in one heading of the Priest tunnel on this project.

At this rate, Claudius' tunnel could be driven by a few men with Hercules Explosives in less than a year.

A lesson on explosives economy is contained in our booklet, "Volume vs. Weight". Write for a copy to our Advertising Department, 942 King St., Wilmington, Del.

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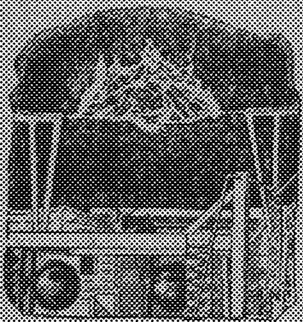
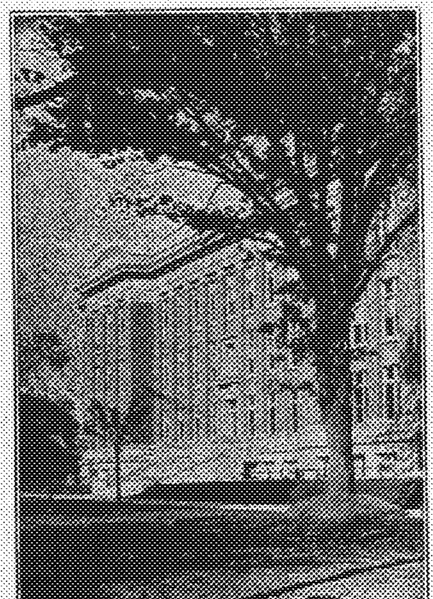


MINNESOTA TECHNO-LOG



MAIN ENGINEERING BUILDING

MAY 1922

PUBLISHED MONTHLY DURING THE SCHOOL YEAR BY THE STUDENTS OF THE COLLEGE OF ENGINEERING AND ARCHITECTURE AND THE SCHOOL OF CHEMISTRY.

VOL. II UNIVERSITY OF MINNESOTA NO. 7

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

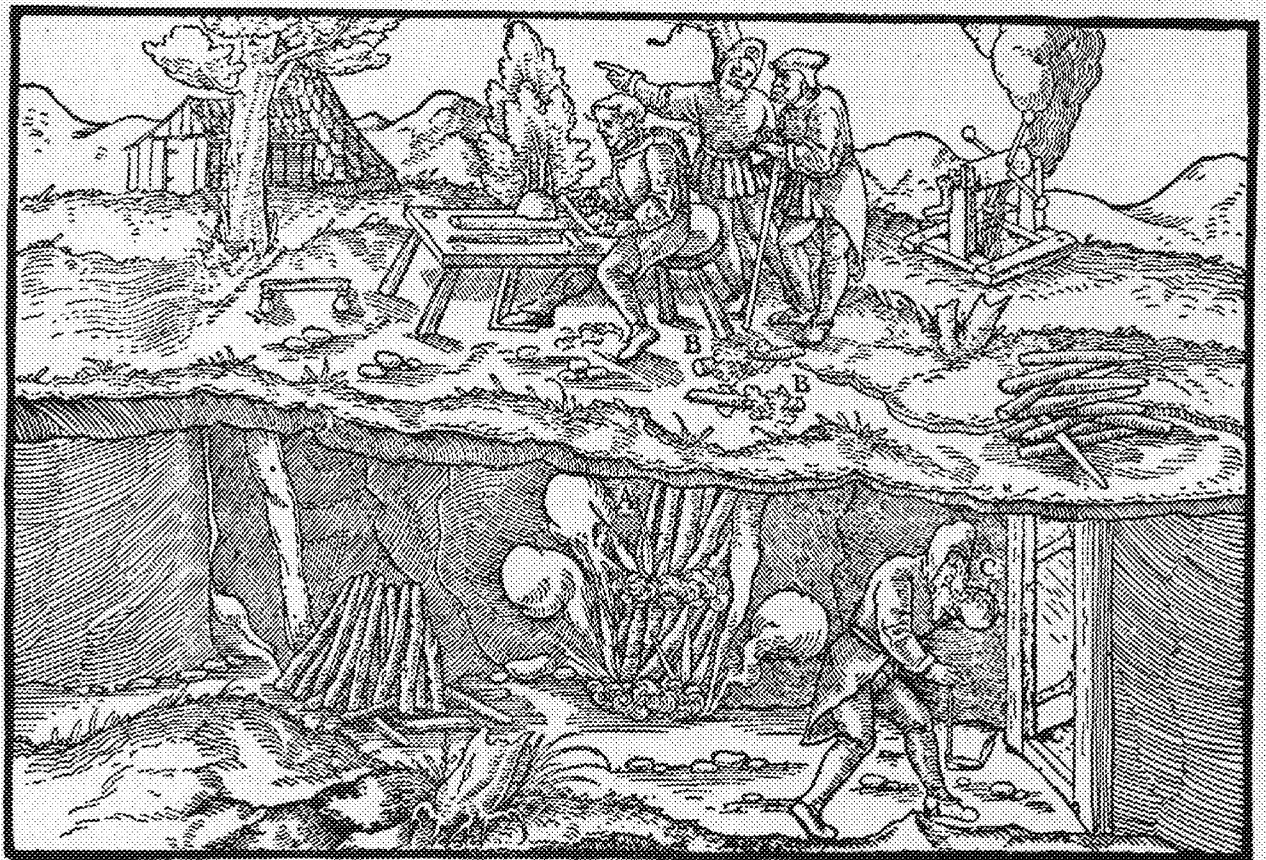


Illustration from "De Re Metallica" by Agricola, published in 1546

Breaking Ground by Fire-setting

The ancients "blasted" by fire-setting—slow, laborious, dangerous, and ineffectual.

Describing Hannibal's crossing the Alps in 218 B. C., Livy says: "The cliff heated by fire was broken by iron tools so that not only the beasts of burden but also the elephants could be led down."

In "De Re Metallica" (1546) Agricola explains the early fire methods in detail—how the sticks were prepared; how these were piled against the face of the rock; how the fire softened or cracked the stone for a certain depth; and how water was sometimes dashed on the heated rock, which was shattered by the sudden and uneven cooling. Even as late as the 17th century, fire setting was practised, and an advance of 5 feet per month in headings was often considered good.

In May 1921, a contractor drove a total of 942.3 feet in 4½' x 6' drifts and crosscuts, using Hercules Dynamite. An average of 11 feet advance was made per machine shift with a dynamite consumption of 8.7 pounds per lineal foot. Explosives have made possible greater results in eight hours than our ancient brethren accomplished in a month.

For years we have recommended the use of Hercules Special No. 1 and Hercomite for many kinds of work because of their high cartridge count, and low cost per cartridge in comparison with other dynamites. No high explosive on the market is more economical.

A lesson on explosives economy is contained in our booklet, "Volume vs. Weight". Write to our Advertising Department, 942 King Street, Wilmington, Delaware, for a copy.

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WIRELESS TELEPHONY

A Modern Development of Wireless Telegraphy

By John G. Frayne, Ph.D. Lt. Signal O. R. C.

The recent remarkable growth in the popularity of the wireless telephone is unparalleled in the annals of scientific development. Today, thousands of non-scientific men and women have in their homes devices whose operation depends on physical principles unknown to the scientific world half a century ago.

The propagation of electromagnetic waves through the ether was predicted in 1865 by the great British scientist, Maxwell. However, no concrete evidence of the existence of such waves was obtained until the German scientist, Hertz, in 1888, in a series of, now classical, experiments produced electromagnetic waves. Evidence of the existence and transmission of such waves through space was secured when he detected these by a resonator placed on the other side of the room from his oscillator. Hertz produced these waves by discharging the secondary of an induction coil between two polished brass knobs, to which were attached two square sheets of metal. He received the waves on a circular hoop which was slit across in order to provide an air gap. When the hoop was of the proper dimensions an electric spark traversed the air gap.

Dots and Dashes by Air

About ten years later Marconi using Hertzian waves, but employing an antenna to propogate the radiation, succeeded in sending waves for considerable distances. Means of detecting these waves were discovered and perfected and soon messages in dots and dashes began to be sent by the aerial route. The value of this new means of communication for ships at sea soon was realized. Later, powerful land transmitting stations were built, whose ranges of operation were continually increased until at the present time they girdle the entire globe.

The waves used by Marconi were produced by an electric spark discharge. Every discharge produces a train of waves with successively diminishing amplitudes, and they are generally spoken of as being damped. This kind of wave was objectionable on account of its "broadness," for it was possible to receive it over a large range of wave length, and much interference between stations resulted.

The production of undamped waves was brought about through use of an electric arc or high frequency generator. The detection of these waves presented a difficulty, until it was discovered that undamped waves could be produced by means of an "audion." The audion acts on the basic principle that platinum or tungsten wire when sufficiently heated in vacuo becomes a source of electrons whose movements can be influenced by an electric field. Electrons are the smallest charges of electricity which can exist independently. They were but recently scoffed at as the product of the overworked imagination of the physics professor, while now they are a household word in the homes of America and elsewhere.

Oscillator Produces Waves

Wireless telephony is but a modern development of wireless telegraphy. Although telegraph messages in the dot and dash language have been travelling through the ether for a quarter of a century, the human voice has only recently been emancipated from the controlling wires of the ordinary telephone system. The recent successful development in aerial telephony is due to the operations of the audion as an oscillator for the production of undampened waves.

In both wireless telegraphy and telephony a carrier wave is used whose wave length (distance from crest to crest) may vary from a few up to several thousand meters. In telephony the wave is not pure, but consists in addition to the main wave of a number of side tones, these tones being produced by a modulation of the electromagnetic wave by the human voice. By modulation is meant the alteration of the amplitude of the undamped wave by superposition of the voice frequencies. Neither the electric arc nor the high frequency generator easily admit modulation of their output power by the human voice. Since the efficiency of a wireless telephone depends on the amount of power modulated, no progress in wireless telephony was made until it was found possible to modulate the high frequency output of an audion tube by the voice frequency output of another and similar audion. As much as 90% of the power could in this way be utilized in effectively transmitting the voice through the ether.

First Results Seven Years Ago

The first successful experiments in wireless telephony were made in 1915 between Arlington in the United States and the Eiffel Tower, Paris. At the same time the etheral telephonic message was heard in Hawaii, thereby establishing a record in long distance talking, not since exceeded. At the same time the U. S. Navy was carrying on experimental work with short range wireless telephony. However, it was not until we entered the Great War that the great advance in short range, low power transmission was made. The wave-lengths used in the telephone sets used by the Army and Navy ranged from 90 to 1000 meters. The short range sets were used for inter airplane communication while the longer waves were used for transmitting between ground stations separated by fifty miles or more. The newness of the art and the necessary delicacy of the instruments prevented the general usage of the wireless telephone for war purposes before the Armistice. However, the work which had been done under the stress of war laid a solid foundation for the further development in times of peace.

Wire vs. Wireless Telephone

The future of the wireless telephone is very uncertain. Its immediate rival is, of course the ordinary wire telephone, and it is almost as certain that the former will never oust the latter in safe communication as, that the airplane or dirigible will replace the railroad in safe transportation. Important developments in wire telephony in recent years have made it possible to converse with surety over the entire breadth of the continent. As an example, wire telephonic communication was recently carried on with success between Catalina Island off Southern California across the United States and thence to Havana, Cuba. When messages can be sent successfully over such long distance it would seem that the wireless telephone would be a hopeless competitor over land areas. "Everybody's business is nobody's business" says the old proverb, and this is surely true of the wireless message, where secrecy is impossible when all who desire can listen. The voice at the end of a long distance line will soon be heard as plainly as though the speaker were in the same room with the listener, but the voice on the wireless telephone may be so garbled by atmospheric disturbances as to be practically unintelligible at the receiving end. Another disturbing feature about wireless telephony is the possibility of interference between the countless communications that are always going on in this wireless age. The factor of safety in the wire telephone is constantly on the increase while in the wireless route it is a function of the whims of nature.

Another mitigating factor in the success of the radiophone is the fact that up to the present no satisfactory system of duplex telephony has been devised. On the ordinary phone we listen and talk as we will, but on the etheral route we must talk first and listen afterwards or vice-versa. In this way it is impossible to stop the flow of conversation at the other end. However, it must be said that these latter defects are capable of being remedied, and much research is being done at the present time to obviate them.

Fascination Popularizes Radio

It is the fascination of hearing words "out of the air," without any physical links in the sending chain that has started the world agog in this modern wireless craze. Taking advantage of this situation the Grand Opera Companies in New York and Chicago have been nightly broadcasting their choice productions to the listening public in the homes of their nearby territory. No other advertising plan could possibly be more effective, for in this way a public sentiment is developed for good opera which will inevitably in the years to come result in a greater patronage of high class productions. Government weather reports are being sent out nightly, and up-to-date farmers are installing radio sets in order to keep in touch with the latest caprices of the weather man. Lectures, concerts, market reports and everything else of general interest are being flashed in all directions, free to all those who may care to listen and enjoy the benefits of the present day. In the future inaugural speeches of Presidents and other important addresses will unquestionably be broadcasted, and even the deliberations of Congressmen and Senators may be heard all over the country. Already a New York University is planning to give educational courses by this means, and it is reasonable to suppose that certain kinds of instruction in the lecture form might well be distributed in this manner.

The connecting up of the land telephone system with wireless telephone stations for communication with ships at sea is now in the experimental stage. The American Telegraph and Telephone Co. recently carried on conversations by this route between Boston via wire to a New Jersey wireless station and

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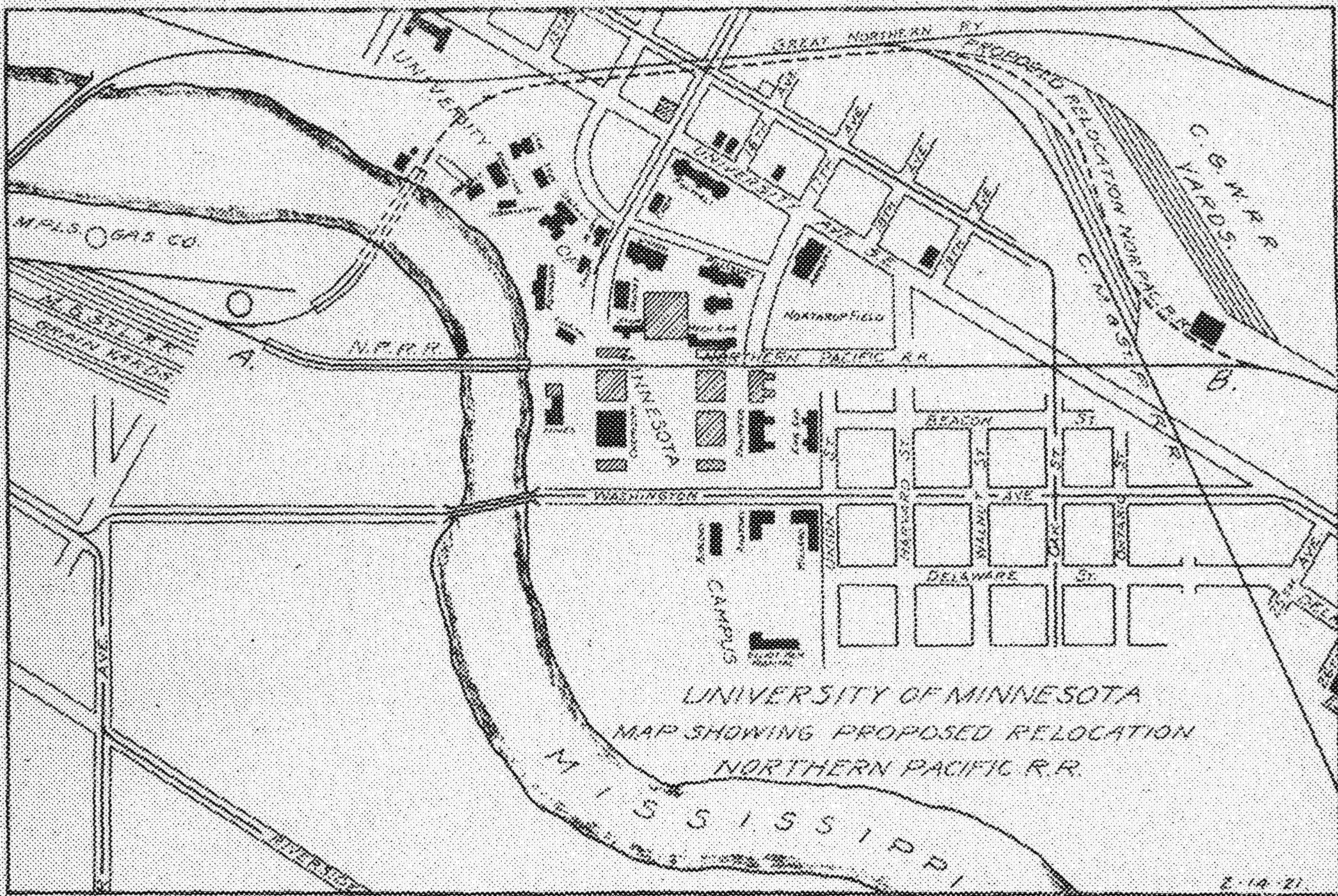
TRACKS TO GO

Authorities Agree on Details of Plans for Removal

By Prof. A. S. Cutler, C.E.



The bill recently passed by both houses of Congress and signed by the President authorizes the Northern Pacific Railroad to build a new bridge across the Mississippi River as proposed in the plans for the removal of their tracks from the campus. This action removes the last legal obstacle in the way of the immediate construction of the new line.

The contract under which this work is to be done calls for the removal of the Northern Pacific railroad tracks from their present location, beginning at a point about 1,000 feet east of Oak Street and extending through the campus to the westerly end of their bridge across the river, and for the location and construction of a new line lying just south of the present Great Northern Railroad right of way.

The drawing of this contract was an exceedingly difficult task as the interests of the seven parties concerned, including the University of Minnesota, City of Minneapolis, Northern Pacific R. R., Minneapolis & St. Louis R. R., Chicago, Milwaukee & St. Paul R. R., Chicago, Great Western R. R., and Great Northern R. R., had to be properly taken into consideration. The fact that a contract has been executed which is agreed to by all parties, not only indicates that the proposed plan is satisfactory from the construction and operating standpoints but more especially demonstrates the fine spirit of cooperation which exists on the part of the railroads in the attempt to solve this problem which is of benefit only to the University of Minnesota and the City of Minneapolis.

The removal of the tracks, the filling of the cut with the material from the excavation for new University buildings, the acquiring, under the terms of the contract, of the present right of way and other lands owned by the Northern Pacific Railway, and the purchase of all the property as far as Oak Street lying between Beacon St. and University Ave. S. E., allows the University authorities to proceed with the plans for the development of the campus which have for so many years been impossible of execution.

Change Affects Other Roads

The new alignment of the Northern Pacific Railroad will leave the present tracks at a point about 500 feet east of the present crossing of the C. M. & St. P. R. R. and turn to the right by an 8°00′ curve having about 76°00′ central angle; it then curves to the left using a compound curve of about 95°00′ central angle to a point near 17th Ave. S. E. and the Great Northern Railroad. This location will necessitate the rearrangement of the yards of the C. M. & St. P. R. R. and the Chicago, Great Western R. R., and the installation of a new interlocking plant to take care of the connections to these yards and the Great Northern main line. The alignment from 17th Ave. S. E. to a point near the present Music Building is a tangent parallel to the Great Northern Railroad but on a right-of-way owned by the Northern Pacific Railroad. The line here turns to the left, using an 8°00′ curve, across the westerly end of the campus, passing between the Heating Plant and the new Mines Experiment Station clearing the concrete stack of the Heating Plant by about 30 feet. The tracks will be carried across the river on a new double track bridge consisting of deck plate girder approaches at each end and deck trusses for the main spans. It will connect with the present tracks of the M. & St. L. R. R. at a point near Cedar Ave. S. passing to the east and south of the gas holder of the Minneapolis Gas Light Company.

Length of Route Increased

The construction of this line will provide about 100,000 cubic yards of excavation which will be used for partially filling the approach at the west end of the bridge. It will also necessitate, in addition to the rearrangement of the yards, tracks, and connections near Oak St., under crossings of 4th St. S. E., 15th Ave. S. E., 14th Ave. S. E. and University Ave. S. E., and the extension of the present bridges which now cover the Great Northern R. R. tracks at all these crossings. It will also require the razing or moving of a number of buildings including the houses in the block between 14th Ave. and 15th Ave. S. E. and the building now occupied by the Cooperative Bookstore at corner of University Ave. and 14th Ave. S. E. This block will ultimately be occupied by the University Storehouse and Shops, with spur tracks serving these buildings, and by the University Y. M. C. A. which has plans nearly completed for a new building located at the corner of University Ave. and 15th Ave. S. E.

The new location of the Northern Pacific Railroad will increase the length of their operated line by about 1190 feet and will add about 250° of curvature. The present location is practically all tangent and this increase in distance and curvature will affect very decidedly the cost of operation of the line. The capitalized value of this extra cost of operation is one of the items making up the total amount the University must pay for this improvement.

The cost of covering the present tracks, from the river to Harvard St., as originally agreed to by the University and the Northern Pacific Railroad would have been about $1,539,000 and the work would have been done entirely at the expense of the railroad company. The total cost of the proposed new line including additional operating costs will be about $2,225,000. The difference between these values represents the amount the University must pay the railroad company for the privilege of having the tracks removed from the center of the campus. The University secures title, however, to the old right of way, 132 feet wide, extending from the river to Oak St. and several lots owned by the railroad company lying just east of the campus.

In addition to the great benefit to be derived by the University from this track removal, the City of Minneapolis is to be greatly benefited by the elimination of the dangerous grade crossing at University Ave. S. E. and Oak St. This will be accomplished without any expense to the city, but indirectly at the expense of the University.

The contract specifies Dec. 31, 1923, as the date on which this work is to be completed. Plans for the bridge across the river and the extension of the overhead street bridges are nearly completed and work is expected to commence in the immediate future.

RETURNS TO DO RESEARCH

Mr. C. H. Dow, formerly instructor of Surveying and Transportation, has returned from highway work in South Dakota, and is now doing research work in the Experimental Laboratories, investigating the use of marl as a binder on sandy roads. Marl is somewhat similar to clay, and is more or less pure precipitated calcium carbonate, found most frequently on or near lake bottoms. Sand or clay in the proper proportions make a very satisfactory road, and experiments are being made to determine whether marl, which occurs in large quantities in Minnesota, at Coon Creek, near the Twin Cities, and elsewhere, and which is very convenient to the roads, could be used equally well in place of the clay.

ENGINEERING IN SIAM

Minnesota Graduate Writes of Far East

By Roger W. Gannett, E. M. in Geol

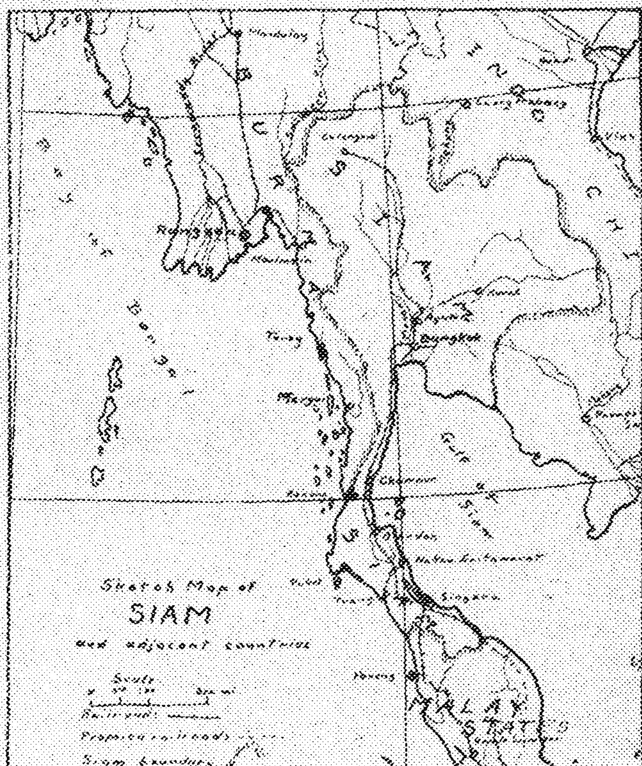
The Kingdom of Siam lies in the southeast part of Asia, occupying part of the Malay Peninsula and extending northward nearly to China. On the northeast lies Indo-China with its French Protectorate; to the northwest and west is Burma, a part of the territory which is called "India" by the British. On the west, Siam has a short coastline on the Bay of Bengal. To the south are the non-federated Malay states; and on the east the Gulf of Siam. It takes nine days to travel from the south end to the north end of Siam. The area of the country is 220,000 square miles.

Two large railroad systems have been built in Siam: The Northern Railway, which is standard gauge, and the Southern Railway, which is metre gauge. The Northern Railway connects Bankok with Chiengmai in North Siam, and with Korat to the east. The Korat branch is being extended to join with the French railroad across the border. Ultimately the railroad will be extended westward into Burma. The Northern Railway will probably be changed to metre gauge to connect with the French and British roads. The Southern Railway connects with that in the Malay states so it is possible to go by train from Bankok to Singapore. The map shows the railroads and proposed railroads. Up to the time of the war, all the railroad work was designed and executed by German engineers.

No Night Trains Run

The passenger trains are equipped with first, second, and third class coaches. The first class cars are usually a modified form of compartment car with a corridor along one side and compartments to seat six along the other; some of the cars are American style. There is on the Southern Railway one dining car which is well kept up and on which good meals, English style, are served. The car makes one round trip a week. On account of limited equipment, the trains run only during the day; the nights are spent in neat resthouses at the lay-over points. The freight cars are usually dinky, four-wheeled affairs of British build. Travel by rail is comfortable if one has with him a good Chinese servant to look after the baggage and meals.

There are coastwise boats on both the east and west coast of Siam. Most of the boats start from Singapore. Many of the smaller ports have poor harbors, and in the monsoon storms, it is sometimes impossible to land. Ocean-going boats of small size can go up the river past Bankok, and launches go up for a long distance. I saw small steamers on



the Bandon River in Southern Siam over 50 miles from the mouth of the river. It is frequently possible to travel into the jungle regions up the larger streams on dugouts. Natives pole these boats, or where the water is shallow, get off and pull the boat; the passenger has a comfortable, lazy time meanwhile. On one day's trip I wrote 20 letters, and listed about fifty photographs I had taken. Many of the lesser streams would be navigable by small

(Continued on Page 18)

ALUMNI NEWS

By W. T. Townes, '24

William A. Walker, E. E. '11, is sales engineer for the Gilbert and Barker Manufacturing Co., Springfield, Massachusetts. His home address is 2116 College Avenue, Indianapolis, Indiana.

Neal C. Towle, E. E. '13, is commercial engineer with the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

William A. Cuddy, Chem. '16, is now in Tientsin, China, with the Standard Oil Co., of New York.

Chung Hsieh, M. E. '18, is with the mining bureau, Grain Street, Kirin, China, in an engineering capacity.

Max Feder, who has been doing engineering work at Grand Rapids, Minnesota, is going to York, Pennsylvania, to teach Hebrew in a Jewish institution.

C. M. Rader has recently been made Production Engineer for the Midwest Refining Company, with headquarters in Caspar, Wyoming.

C. F. Moore, C. E. '20, who has been in the Bridge Department of the Chicago, Burlington and Quincy since graduation, has been temporarily transferred to the office of Lewis West, Chief Engineer, at Lincoln, Nebraska, following the fire which destroyed the records and plans in the General Offices at Chicago.

George Christilaw, C. E. '21, is assistant engineer with the State Highway Department at Lumsboro, Minnesota.

Shu Ming Lin, Architecture '20, has recently visited Minneapolis en route to Peking, China, from New York City, where he has been taking advanced work in architecture and allied subjects. While in New York, Mr. Lin worked in some of the large offices of that city. He intends to practice architecture in China.

Henry Wolff, C. E. '12, who has been for several years City Engineer of Winona, Minnesota, is at present acting as a Consulting Engineer.

J. O. Morris, M. E. '88, for a long time mechanical engineer for the International Harvester Company, is now in practice for himself, designing farm machinery and automatic tools, and acting as a consultant on tractors. Mr. Morris has offices in the Monadnock Building in Chicago, and is interested at present in a new process of milling sugar cane, which has recently been tried out in Cuba on a large scale. This method dries and pulverizes the cane, then resoaks and crystallizes out the sugar in the usual way. The result is that the yield of sugar is almost doubled, a fact of great economical importance.

Mr. Morris was one of the early manual training teachers in Minneapolis. As teacher in Central High, he designed the four-year course now used in the Minneapolis high schools. His present address is 4445 Berkeley Ave., Chicago.

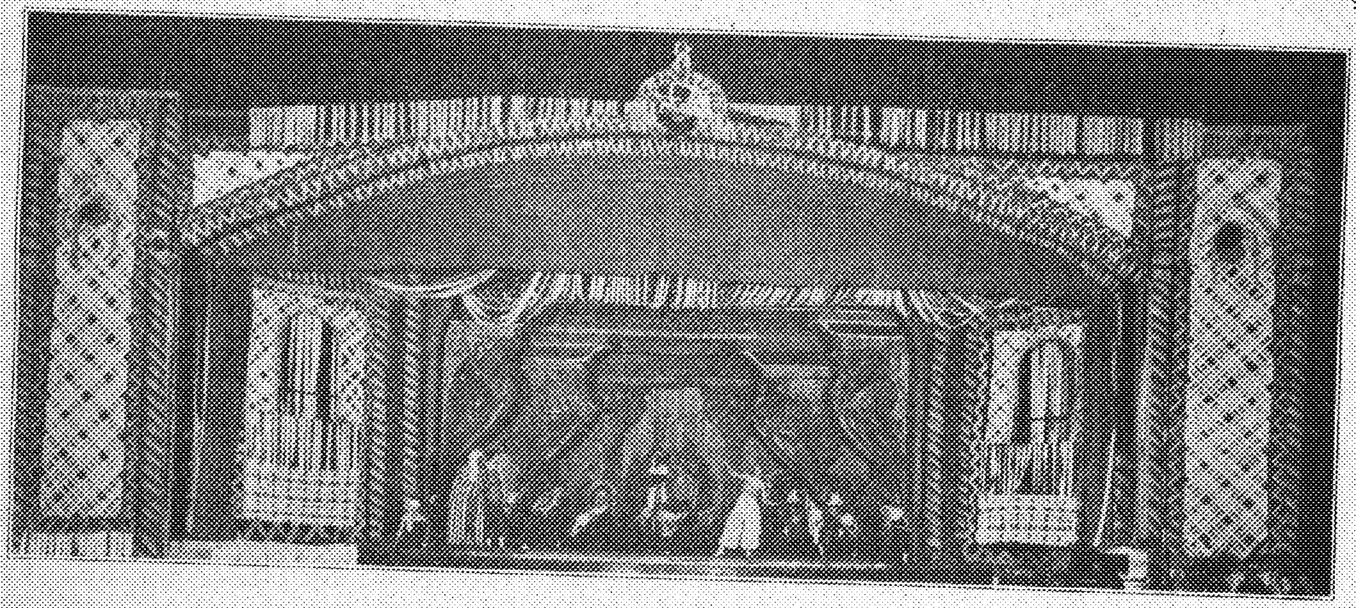
MARCH DESIGN AWARDS

In the Senior problem: "A Town Hall," mention was awarded Henry Gerlach, Don Graf, Frank Moorman, W. E. Willner, Charles Hinman, Edward Holien, and Paul Damberg. In the short problem: "A Country Residence," Arthur Strom and W. E. Willner were awarded mentions.

In the Junior problem: "A Surgical Operating Pavilion," John A. Walquist was awarded a mention. In the construction problem for this pavilion mentions were earned by Theo. Sime and M. J. Markuson. In the Junior Interior Decoration problem: "A Studio Living-Room," Faith Nixon, Gladys Brouillard, and Myra Metcalf were awarded mentions.

Three Sophomore problems were judged during March. In the long problem: "A Monumental Portico," mention was awarded L. A. Tvedt, H. E. Nelson, Elton K. Cromwell, I. W. Silverman, Frank Root, and Edith Gardner. Conditional credits in the first sketch problem, "A Building For an Art-Dealer," were received by D. T. Silver, William A. Olson, Glanville Smith, and I. W. Silverman. In the second sketch-problem: "The National Headquarters of a Scientific Society," I. W. Silverman and Olive Prescott scored mentions.

Hubert Magoon, student in the Architectural Department, won the $250 first prize in the Right-Grade Shingle Association Competition. This competition, which called for drawings of an already-constructed house sided and roofed with shingles, was open to students and architects in both the United States and Canada. Many prominent architects from New York to Seattle submitted designs, but it was a Minnesota student's honor to receive first place.



THE CALIPH WINS

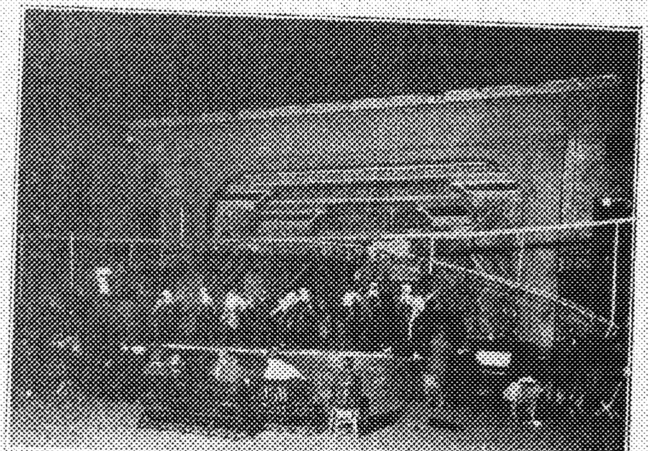
Arabs Establish New Tradition on Campus

By Byron K. Curry, '23

By far the most talked of dramatic event of the year on the campus was the production of the Caliph of Colynos by the Arabs on April 21 and 22 in the University Armory. Be it known that the Arabs Club is a dramatic society of the College of Engineering whose aim it is to produce one play a year, entirely dependent on the abilities of the male students of the College.

The Club which was formed late in 1921 chose for their dramatic debut a musical extravaganza written by three of its members, and dubbed "The Caliph of Colynos." The Caliph was none other than Pat O'Mara of Southeast Minneapolis, and he with his wife "Biddy," accompanied by their charming daughter and co-ed Elizabeth, through an inheritance brought home rule to the oriental land of Colynos. But then, a plot is no more than a plot, the music and setting the show. Songs there were a plenty, some catchy and tuneful, others melodious lyrics of the East, all written by students of the College. Dancing to the music was bizar to say the least, and enjoyably sensational.

With but a month's time in which the cast might be selected, rehearsals and mechanical work carried out, the play from an engineering point of view was a success. It was a hurryup project successfully carried through by its dynamic members. The correlation of scenery, lighting effects, and properties seemed for a time an insurmountable obstacle, because of the full courses of studies carried by the engineering student. Gradually though the work was accomplished, the garret of the Main Engineering building becoming the scene of unprecedented industry. The pastel work decorations on the wings was masterfully executed, the finished designs lending a colorful yet subdued depth of setting for the Harem scenes. Change in intensity of lights on these wings gave the stage entirely different aspects in accord with the action. Drops of pastel work



PROSCENIUM SKELETON

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MINNESOTA TECHNO-LOG

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CONTENTS

EDITORIALS

WELCOME BACK

Friends of Lester M. Bergford and John M. Newman will be glad to know that they are out of the hospital. Mr. Newman who suffered from a severe case of inflammatory rheumatism, will not be back to the University until next fall.

FIVE YEARS?

One man's food is another man's poison. In answer to the question as to the desirability of a standard five year course for engineers, I would say that for the majority of men reaching the fourth year it would be well worth the time, but for a considerable minority it would be a waste of time. Furthermore it may be truthfully stated that even four years in the engineering course of today is more time than some men expecting to become engineers should spend; they would better be in practice where their chances of developing ability would be greater. This is not necessarily a reflection upon their ability; some able men can learn best how to do things by doing them.

The best way for any student to test himself as to how much time he should allow for study apart from practice is to try both,—alternately, and to closely observe the effect that each has upon his interest, upon his ambition and upon his mental powers of concentration and perseverance. The time comes in any real engineering student's experience when he feels that he simply must get out on a real job and build something. If the feeling becomes so strong that he loses his interest in his academic work to such an extent that he can't make the grade it is time for him to go. If, on the other hand, he finds in practice so many problems that need explanations unobtainable except by prolonged study and he is not satisfied to do routine work in a constructive enterprise without making mental progress, he ought to get back to college.

In brief, some men need only a short practical course and upon that basis can best prove their usefulness, while others can profit most by a five or six year course in which specialization comes only near the end. Unfortunately few colleges can give courses to fit all individuals and the present four years is thought to fit the greatest number of men planning to become engineers. Undoubtedly the engineer who will reach the greatest success is the one who most correctly appraises himself and deliberately plans to develop himself along lines which will not only make him an efficient economic unit but which will react so as to add to his appreciation and understanding of non-economic human values.

Frederick Bass.

ST. PAT'S DAY REPORT

Engineers' Day was a financial success this year, according to the statement presented by E. V. Brossard, treasurer, and Harold E. Peckham, general chairman, to the executive committee of the Association of Engineering Students at the last regular meeting. Receipts, as outlined in the report, amounted to $976.45, while expenditures were $879.91. With probably $40 in bills still outstanding at the time of making the report, the celebration is expected to net a profit of $50 for the Association of Engineering Students.

Three sources of revenue are listed in the report, the sale of buttons, dance tickets, and a loan of $40 from the A. E. S. to provide for incidental expenditures before receipts were turned in. Expenditures have been distributed under various headings to show as closely as possible the cost of each feature of the celebration. The report follows:

Receipts

A. E. S., loan	$40.00
Ticket sale, dance	650.00
Button sale	286.45
Total	$976.45

Expenditures

A. E. S., loan	$40.00
Dance	324.88
Buttons	42.03
Parade	174.66
Reception (tea)	120.51
Open House	22.64
Advertising and publicity	84.90
Knighting ceremony	46.56
Alumni	7.42
Stationery	16.31
Total	$879.91

Profit turned over to A. E. S., $96.54.

ILLUMINATION

When the fourth floor was added to the Main Engineering Building, during the war days, it was planned first of all to provide barrack space for members of the Students Army Training Corps. Little attention was paid to the proper lighting of the addition. Foresight was used, it is true, in providing at that time the great north window in the freehand room. But—the electric lighting installed at that time in the present sophomore architectural drafting room is nothing more than a hit or miss system of illumination. Perhaps the matter has not been noticed by the proper authorities heretofore or the lighting system would have been improved. As matters now stand some students work with a glare of several incandescent lamps in their eyes. Others work in the shadow cast by their own bodies. The Techno-Log is not prepared to say just how the situation may be remedied—it will take some study. But the fact remains that students who are obliged to work evenings, as those in the Department of Architecture must, should be given uniform light which will not cause undue eyestrain which now comes after several hours work under present conditions. A student who loses the service of his eyes loses all!

ARCHITECTS' JUBILEE

"He is wisest who has the most caution" said Walt Whitman, but old Walt would have changed his tune (as he often did) had he seen the 1922 Jubilee Ball, April 6. Gamboge and Nile green frolicked around together; crimson sported with shell pink and salmon; saffron, lapus-lazuli, taupe, cobalt, fuschia, vermillion, turquoise, and all the rest wound in and out in combinations **not** cautious, certainly, but very intriguing and vivid. It was an orgy of color; while the wild, unearthly "strains" of an alternately moaning and exultant orchestra served to heighten still further the bizarre and exotic atmosphere.

In an intermission between dances the Jubilee playlet, "The Monotonous Wedding," by Glanville Smith, was presented by the Freshmen. The scene for the piece was laid in the mediaeval court of King Cadmium and Alizarine, his queen. How their daughter Angela came to wed her lover Archie, the page, rather than the princeling bride-groom chosen by the king formed the basis of a story fraught with hair-raising incidents and numerous side-lights on the hectic life of a student of architecture. Carl Matthias Wise coached the production, and Tressa Snure was in charge of the costuming.

Patrons and patronesses of the ball were Governor and Mrs. J. A. O. Preus; the Hon. Fred B. Snyder, President of the Board of Regents, and Mrs. Snyder; President and Mrs. L. D. Coffman, Dean and Mrs. O. M. Leland, Dean and Mrs. E. E. Nicholson, Mayor and Mrs. George Leach, Mr. Dudley Crafts Watson, Professor and Mrs. A. C. Krey, Professor and Mrs. W. F. Holman, Professor and Mrs. F. M. Mann.

But the Jubilee was more than a Ball. In the afternoon the department was festive for the annual Tea Dansant, under the management of Edith Gardner. Departmental work was exhibited in the corridors, and tea was served in the library and studio.

The committees arranging for the Jubilee, under W. E. Willner, President of the Architectural Society, were:

General Arrangements: O. F. Beeman, Gladys Brouillard, and J. A. Walquist.

Invitations: E. F. C. Backstrom, chairman.

Publicity: W. A. Backstrom, chairman.

Play: Glanville Smith, chairman.

Coach: Carl Matthias Wise.

Decors: Paul Damberg, chairman.

Carpentry: C. H. Luedeman, chairman.

Dansant: Edith L. Gardner, chairman.

AT ST. PAUL EXHIBIT

The Architects' Exhibition in the Saint Paul Public Library during the early part of April contained some designs by students in the University Architectural Department. Henry Gerlach's "Memorial Lighthouse," Olaf Fjelde's "Monastic Shrine," J. A. Walquist's "Chapel on a Crag by the Sea," and a "Portico" by I. W. Silverman, together with some renderings by alumni members, comprised the departmental contribution to the exhibition.

ATHLETICS

Very little intensive outdoor track work has been done so far this season on account of cold weather. If the sun will stay out for a while, Minnesota should have one of the best teams in the conference. There are only two Engineers on the track squad this year, "Bill" Kelley, pole vaulter, and "Stew" Willson, dash man.

Minnesota is strongest in the distance runs and field events. The loss of Hrutfiord and Juhnke in the dashes has weakened the team considerably. Hirt, who placed second in the half mile at the conference, Winter, one of the best runners in the west, and Howard are the best men in the half mile run. Captain Sweitzer, Hoverstad, and Barnes are milers who need no further introductions. In the field events Schjoll, Gross, and Neubeiser are sure to give visiting teams plenty of competition.

Anderson and Martineau are working daily on the hurdles, and are getting into shape slowly. In the 440 yard run "Al" Johnson, Hultkrans, and Sperling seem to have the call. Coach Leonard Frank may decide to run Hultkrans with Willson in the dashes. "Bill" Hawker has had hard luck this season with a sprained ankle and wrenched knee, but is on the mend, and he and Kelly will take care of the pole vault.

There will be two good dual meets on Northrop Field this season. Northwestern and Wisconsin come here to take on the Gophers. Minnesota had a field day with the Purple at Northwestern during the indoor season, and should give the Evanston runners another good drubbing.

The Badger meet at Minnesota May 20, is the athletic carnival par excellence of the year. In past years more records have fallen in the annual Gopher-Badger scuffle than in any other dual meet in the country. This year both teams are stronger than ever, and with both coaches pointing to the fracas, it will be a gory affair. Nothing is more soothing to the Badger heart than a victory over Minnesota, and the reverse is not less true.

The Western conference outdoor season opened at the Drake Relays at Des Moines, April 28-29, with Minnesota entering 25 men in all events. A dual meet at Ames May 6, was second on the schedule; Northwestern at Minneapolis, May 13; Wisconsin at Minneapolis, May 20; Iowa at Iowa City, May 27; Conference Meet at Iowa City, June 3-4; National Meet at Chicago, June 17.

DR. MANN TALKS ON SHOALS

Professor C. A. Mann, of the Chemistry College, discussed power possibilities at Muscle Shoals as related to the manufacture of nitrogen and nitrates at a meeting of the A. S. M. E. Saturday, April 15. Professor Mann's consideration of the project was a thorough one, outlining necessity for American manufacture of nitrates, power available at the Shoals, methods of manufacture of nitrates and something of future possibilities.

Interference with shipping during the war cut off the supply of nitrates usually coming from Chile, Professor Mann declared, and made it necessary for the United States to provide a source of supply which would be reliable at all times. Natural nitrate deposits did not exist in sufficient quantities in the United States, he said, and so it was ordered that nitrate be manufactured, as a war emergency. The continued need in case of war has been augmented by the need for nitrates as fertilizers for agricultural lands, and so the manufacture of nitrates still is as needful.

In determining the site for nitrate plants, Professor Mann said, several considerations were necessary. Cheap power was a first requirement, followed closely by the need for raw materials, transportation, labor, security from attack and freedom of the water power source from freezing. Muscle Shoals was picked as being ideally located and it was decided to build the proposed plant there.

The new dam at Muscle Shoals, according to Professor Mann, will yield 285,000 horsepower, primary and secondary, while a total of 600,000 horsepower is available if the project is completed.

The question to be decided now, Professor Mann declared, is disposition of the property, the use to be made of the plants already erected and the water power available. People in the south favor Henry Ford's proposition to take over the property and to manufacture nitrates for agricultural use, others have various plans, but virtually all agree that continued operation of the plants is necessary and advisable.

HIGHWAY RESEARCH

Effect of Moisture on Strength and Elasticity of Concrete

By R. E. Bergford, Assistant Engineer of Tests

In the summer of 1921 the Minnesota Highway Department started an investigation of the one-course concrete pavements which had been constructed by the state up to that time. The specimens used in this investigation consisted of 350 concrete cores, 4½ inches in diameter and of the same height as the thickness of the slab at the various points at which the cores were taken.

In obtaining these cores the Highway Department used a mobile outfit consisting of a 1½-ton G. M. C. truck carrying the following equipment: A Calyx drill, material for repairing holes left by cores, and accessory tools for the work and repairs.

Considerable time was spent in investigating the effect of moisture on the modulus of elasticity and the compressive strength of concrete. It is a well accepted fact that the strength of concrete varies greatly with the amount of water used in mixing. Water becomes a very important factor also during the curing period of concrete. The securing of the proper mixing and curing of concrete on a paving job nevertheless is merely a matter of proper specifications and rigid inspection.

Moisture, however, is still an important factor after the concrete has set. This may be seen by an examination of table No. 1, which gives the compressive strength and modulus of elasticity for the dry and wet concrete. The tests on the dry concrete were made on cores which had been dried to constant weight in an oven at 100° C., and then cooled to 25° C. before testing. The tests on the wet concrete were made on cores which were immersed in water at 25° C. for four days and which were tested immediately after taking out of water. All cores were capped with a 2:1 cement mortar before testing.

The age of the concrete when tested ranged from 150 to 800 days.

Other investigations are also being made in connection with these cores with the object in view of determining the advisability of using expansion joints in the construction of one course concrete pavements.

Job No.	Number of Tests Represented	Compression Strength in lbs./sq. in. Dry	Wet	Per Cent Reduction in Strength	Modulus of Elasticity Dry Tangent	Dry Secant	Wet Tangent	Wet Secant
16	4	6315	3350	47.0	3,330,000	3,280,000	2,625,000	2,320,000
19	4	4410	3195	27.6	2,400,000	2,360,000	2,700,000	2,530,000
44	4	4395	3370	23.4	2,750,000	2,680,000	2,750,000	2,670,000
48	4	4440	3180	28.4	3,250,000	3,230,000	3,550,000	2,990,000
58	4	5630	3240	42.4	3,000,000	2,900,000	2,500,000	2,410,000
63	4	3900	2755	29.4	3,000,000	2,820,000	2,900,000	2,830,000
64	4	5110	3895	23.8	3,100,000	3,030,000	3,050,000	2,860,000
73	4	4970	3455	30.5	2,175,000	2,170,000	2,500,000	2,080,000
92	4	5055	4545	10.2	3,300,000	3,280,000	2,825,000	2,780,000
95	4	5330	2965	44.4	3,750,000	3,750,000	1,950,000	1,750,000
107A	4	4395	3225	26.7	2,375,000	2,370,000	2,250,000	2,040,000
114	4	6010	4695	21.8	4,300,000	4,160,000	3,950,000	3,850,000
10-8	4	4350	3695	15.1	2,550,000	2,530,000	2,900,000	2,720,000
3-21	4	4500	3335	25.8	2,520,000	2,510,000	2,800,000	2,460,000

Average Reduction in Strength—28.4%.

"What are those large iron things?" said the young lady who was being shown the railway shops.

"Those are locomotive boilers," replied the mechanical official who was doing the honors.

"What do they boil locomotives for?" was the next question, and the reply came:

"Why, to make the engine tender."

Mary had a little calf,
It made her feel quite hurt,
And that is why she never wore,
The latest style of skirt.

Some of us get into the limelight before we have time to put on our makeup.

THE PASSING OF THE CATS

By Lawrence C. Warren, '24

"I wish you would put those cats out of the way," Mrs. Babson had remarked that morning. "We mustn't go away and leave the poor things with no one to care for them."

Mr. Babson objected. He said he didn't like to drown cats. But his spouse was prepared for this objection.

"Yes, it does seem cruel to drown them," she said; "they hate water so much. But I bought a bottle of chloroform yesterday, that you can use. It's sitting on the medicine shelf. And you had better chloroform the cats tonight, so that you won't need to feed them all next week."

Mr. Babson acquiesced, though not in an enthusiastic manner, and hurried away to catch the 8:45 for town. Mrs. Babson was leaving that Saturday morning to spend the summer at the seashore. When his annual vacation began, a week later, Mr. Babson intended to join her. In the meantime—to use the common term—he was going to "bach it."

The cats which Mrs. Babson had sentenced to death so unfeelingly, were three in number. The oldest of the three was Hamlet. Hamlet had been a member of the family for more than two years. He had adopted the Babsons wholeheartedly when, on a cold winter's morning, he discovered that they possessed a garbage can with a very loose cover. Mrs. Babson promptly christened the stray cat "Hamlet" because of his dark and gloomy face. Not long after the advent of Hamlet, he presented the astonished Babsons with a family of five kittens. Obviously, "Hamlet" was not the proper name for this pussy, but Mrs. Babson refused to change it because, she said, it seemed so appropriate for that gloomy countenance. The death rate among the kittens was high, however, and only two of them attained maturity. Mrs. B. named one of them after the heroine of her favorite novel, "Imogen." The other, for lack of a more descriptive title, she called "Sancho." It may be seen that Mrs. Babson was of a literary turn of mind. Imogen was small, with a dainty and retiring disposition. Sancho was—well, Sancho was all that Imogen was not.

When Mr. Babson returned to his deserted home at evening time, all memories of his wife's parting instructions had left his mind. But as he came up the walk Hamlet arose from under some nearby shrubbery and solemnly came to meet him. Suddenly, with a sinking sensation, he remembered the dark deed which lay ahead of him. He decided that he needed a bite to eat, first, and went into the house to prepare his simple meal. As he sat by the kitchen table, slowly consuming his bread and butter and fried eggs, the three felines came and sat beside him. They eyed him contentedly, as though they believed that here was a friend in whom they could trust. Each of the trio was purring his or her hardest, and the resultant noise sounded like a distant car with its cut-out wide open. As Babson gazed at these unsuspecting cats a great aversion to his role of executioner rose up within him. He hadn't liked the idea when his wife first suggested it, and the more he thought about the matter, the less he liked it. But he could not deny the facts of the case. The cats could not be left alone all summer, to starve. A speedy death would be far better, since they must die.

Having finished his supper, Babson arose and prepared to carry out the death sentence. But first he gave the doomed cats one last, bounteous meal.

"They may as well die in comfort," he thought and fed them cold chicken and cream until they could eat no more. When even Sancho had come to a stage where he could "meow" in only a choked, creamy whisper, Babson sadly made his way to the barn.

This barn had been, at one time, the abode of a driving horse. With the advent of automobiles, the horse had been sold, but Babson had never purchased a car to take its place. Now the barn contained nothing but old packing boxes, broken-down furniture, and several years' accumulation of old magazines and papers.

The proper procedure for the chloroforming of cats was not quite clear in Babson's mind. He was not even sure of the manner in which the chloroform should be applied, never before having had anything to do with this particular chemical. He had heard a friend tell of killing a puppy, by placing it under an inverted pail, along with a sponge soaked with chloroform. At first, Babson considered the practicability of using a pail for the cats. But he could find only one pail which would serve the purpose, and it was plain that the three kitties could not be crammed under it at one and the same time. So he looked about for something larger.

The cats had followed him to the barn, and now sat watching his activities with the keenest interest. Now and then, one of them would rub against his leg in a friendly way. Evidently they approved of this man who fed them in such a generous manner. Babson began to feel like an infanticide.

APRIL DESIGN AWARDS

The annual Magney and Tusler Competition was won this year by I. W. Silverman. The program, as is customary, dealt with some possible civic improvement for the city of Minneapolis; this year calling for the design of a "Floating Band-Stand" for one of the lakes. Mr. Silverman won first place, Henry Gerlach winning second.

In the Senior short problem, "A Ceiling Decoration," W. E. Willner, Frank Moorman, W. A. Backstrom, and Donald Graf received Mentions.

Judgment on both the Sophomore sketch-problem "A School of Architecture," and the short problem "A Village Store-Front" occurred during April. In the sketch problem con-credits were awarded H. E. Nelson, F. R. Root, Walter Kendall, L. A. Tvedt, D. T. Silver, C. H. Luedeman, and Elton Crowell. In the design of the "Store-Front" Mentions were received by Paul Nystrom, who exhibited a fine design of the Colonial type, L. A. Tvedt, Florence Knox, and Wayne Hunt.

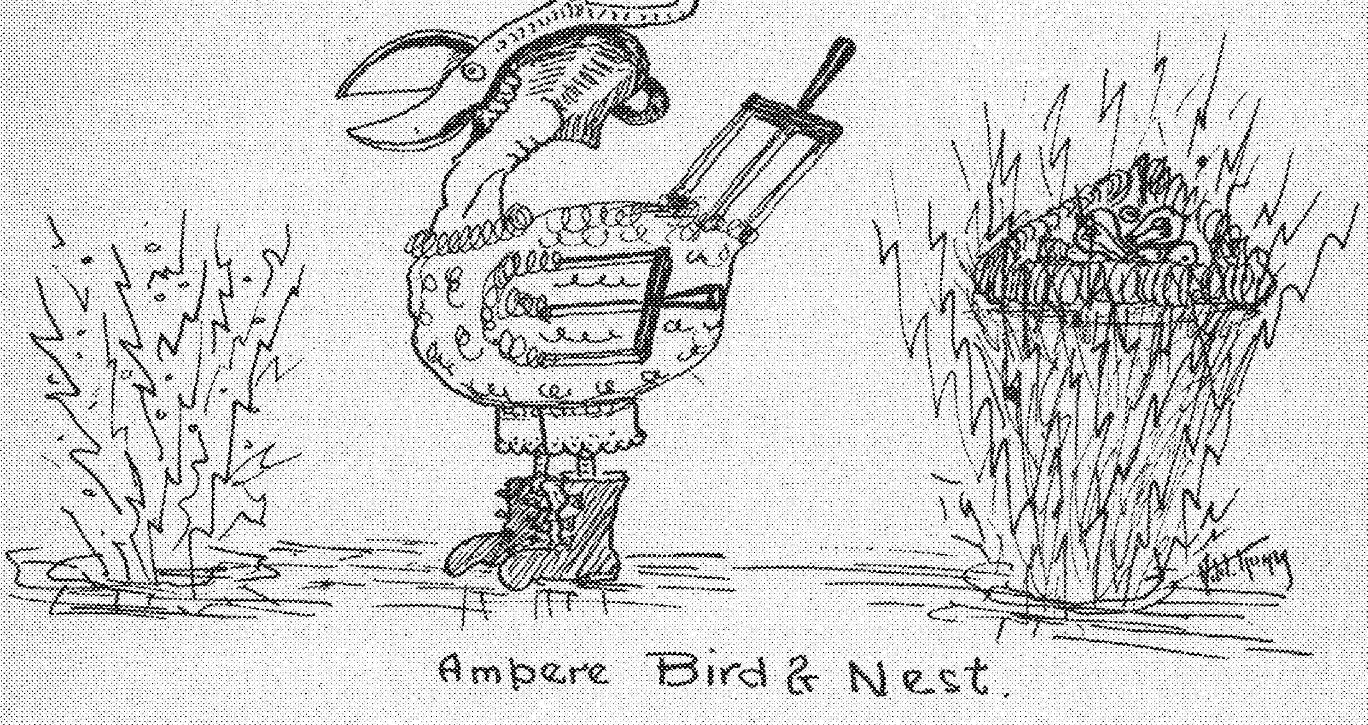
THE AMPERE BIRD

National History Shockingly Revealed

By A. W. Kumm, '22

Few people, when they buy an electric light globe, realize from whence it came or the hazards and risks taken to procure it. Few know that this common article is the egg of the ampere bird. In view of the general lack of knowledge on this subject, the following observations may prove to be of more than ordinary interest.

The rare ampere bird lives on the banks of the Lamp River in southern Australia, a section noted for the magnificance of its currant bushes. It is in these that the ampere builds its home. The nest is formed mainly of wire grass which is formed into coils and so arranged as to give the nest a triangular shape, like the Greek letter "delta."



Ampere Bird & Nest.

The bird itself is a peculiar looking object. Its bill resembles very much a wire snippers. With the aid of this it cuts the wire grass from which it builds its nest. Even more remarkable is the appearance of wings and tail, which resembles closely a three blade knife switch.

In size this marvelous species varies from a bird like the robin which lays the eggs that are used in flashlight globes, etc., to those the size of an ostrich which produce the two hundred Watt eggs.

The smaller birds feed on the Eddy currants which abound in profusion; while the larger amperes prefer the somewhat rarer polyphase currants.

Mere words cannot describe the soulstirring qualities of its song. It is from this that it has gained its name. One can imagine no more beautiful sound than to hear in the Australian dawn an ampere bird perched high in a tree and calling "Ampere! Ampere!" to its mate. As the song ceases, he flies down to meter. Often in the early morning, they stop their warbling to bathe in the Lamp River and can be seen splashing about in the sine waves.

The natives in this particular region of Australia make their living by gathering eggs of the ampere, and shipping them to all parts of the world. Due to the extreme hazards of this occupation, the work is done at midnight when the natives blend well with the Australian darkness. If aroused, the birds cause a great commotion and flutter about the nest, switching their tails, and crying "Hysteresis! Hysteresis!" They dart at the heads of the natives and clip at their wiry hair with their wire clipper beaks. This accounts for the apparent baldness of the men who make egg-gathering their profession.

The gathering of the bigger eggs is exceedingly dangerous as the large amperes clip off the ears and sometimes even the noses of the natives.

From this we can see how pitifully small is the sum which we pay for a choice egg of the ampere bird, in view of the hazards and dangers which have been undergone in its collection.

COLLEGE NEWS

By Charles M. Burrill, '23

An all-Engineers' banquet, to be held May 9 at the Minnesota Union, was being planned as the present number of the Techno-Log went to press.

Twin City Engineers were to meet with members of the student chapters at the banquet which was under auspices of the A. S. M. E.

The Junior Engineers, April 29, 1922, at the Oak Grove Hotel, held what many who attended have characterized as the finest class party in their experience. The dance was well attended, the music was good, and continued until the full twelve numbers were completed. Dr. and Mrs. W. F. Holman and Prof. and Mrs. H. B. Wilcox chaperoned.

CHEMIST ACTIVITIES

The Minnesota section of the American Chemical Society held its monthly meeting, Wednesday, April 26th, at Hamline University. Professor Lincoln, of Carleton College, spoke on "The Teaching of Chemistry." Dr. F. H. MacDougall, of the School of Chemistry, is president of the Minnesota section.

Plans for the organization of a "Chemists' Club" to be started next fall are being projected by the Student Council of the School of Chemistry. This club will be, in most respects, similar to the School of Mines Society, its function being to bring all the Chemists into a group which will promote the best interests of the School. It is planned in addition to this to have social activities for members of the club and also trips which are to be taken to the different chemical plants near the Twin Cities. There will be no faculty members in the club.

Twenty senior Chemists took the annual Chemical engineering inspection trip during spring vacation—visiting plants in Milwaukee and Chicago, and outlying plants. Dr. Mann, Mr. Montillon and Miss Cohen were the faculty members who took the trip.

A tennis tournament, both singles and doubles, for students and faculty of the School of Chemistry, is now progressing. About twenty have entered the tournament. Mr. Charles Johnston is in charge of the matches.

TAU BETA PI ELECTION

Tau Beta Pi held its spring initiation on April 25, 1922, followed by a banquet at the Minneapolis Elks Club. This meeting, at which about 40 alumni were present, was featured by the presence of State Auditor R. P. Chase, and W. N. Elsberg, City Engineer of Minneapolis, who spoke on "Taxation," and "The Relation of the Engineer to the Municipality," respectively. H. M. Hill, E. F. Carlson, Norman S. Cassel, and Dr. C. A. Mann, also had a part in the program. Prof. F. W. Springer, as toastmaster, introduced the speakers with an ability which would not be questioned by any of the Electricals who know him. The initiates were:

Lee L. Amidon, Mechanical; Rudolf H. Kuhlman, Mechanical; Chester R. Marshall, Mechanical; Henry W. Hecht, Electrical; Hibbert M. Hill, Civil; Edward C. Dindorf, Civil; Lloyd A. Peck, Civil; Paul H. Swanson, Civil; Elving L. Johnson, Architect; Frank E. Mooney, Mines; Raymond M. Larsen, Mines; Paul N. Paulson, Chemistry.

Tau Beta Pi is the Honorary Engineering fraternity, founded at Lehigh University in 1885, "to mark in a fitting manner those who have conferred honor on their Alma Mater by a high grade of scholarship as undergraduates, or by their attainments as alumni; and to foster a spirit of liberal culture in the Engineering Schools of America."

ETA KAPPA NU BANQUET

Eta Kappa Nu held a banquet at the Leamington Hotel on the evening of May 2nd in honor of seven initiates who have recently been accepted into membership. These men were chosen from the highest one-third of the Junior class in electrical engineering, this being the basis upon which the organization selects its members. The following are the recent initiates:

Robert H. Tunnell	Frank W. Wilson
Otto F. Heidelberger	Charles M. Burrill
James P. Johnson	Emanual C. Manderfeld
LeRoy A. Grettum	

Eta Kappa Nu has been established as an honorary association in order that those men in the profession of electrical engineering, who, by their attainments in college or in practice have manifested a deep interest and marked ability in their chosen life work, may be brought into closer union whereby mutual benefit may be derived.

TALK ON ELECTRIFICATION

The longest main line railway electrification in the world, that of the transcontinental line of the Chicago, Milwaukee and St. Paul, was the subject of a paper read by Mr. E. L. Baker of Chicago, at the joint meeting of the Minnesota section and the student branch of the A. I. E. E., April 24, 1922, in the Main Engineering Auditorium. The paper was followed by illustrative slides, two reels of film, and an open discussion.

The installation is 3,000 volts D. C. transformed from 100,000 volts A. C. by motor generators at 22 substations. Sixty-one electric locomotives, having from 8 to 12 motors with a total horsepower of about 4,000, do the work of the 120 steam locomotives which they replaced. In descending the long mountain grade the function of the motors is reversed and they become generators, feeding back energy into the trolley circuit. Not only does this result in a saving of power, sometimes 20 per cent, but by braking the train in this manner, a great amount of wear on the wheels and brake shoes is avoided. In the electrification, 22,682,000 pounds of copper were used.

AS A SLIGHT TOKEN

A widower belonging to a country village lately led to the altar a fourth bride. After the honeymoon, the happy couple settled down in his home, and, as the surrounding country was new to the lady, she was anxious to visit all the places of interest in the locality.

Among the spots visited was the village churchyard, and there the husband and wife paused before a very elaborate tombstone, the property of the bridegroom. The bride, being a little shortsighted, asked him to read the inscription. In solemn tones he read:

"Sacred to the memory of Sarah—, beloved wife of John—; also Jane—, beloved wife of John—; also Mary—, beloved wife of John—."

He stopped abruptly.

"What are the words beneath?" innocently asked the lady, and her horror can be imagined when he read:

"Be ye also ready."

He who will not reason is a bigot; he who cannot is a fool; and he who does not is a slave.—Byron.

Daughter—Shall I take an umbrella to post this letter, mother?

Mother—No, stay in the house; it isn't a fit night for a dog to be out; let your father post the letter.

POOR SMITH

Smith (meeting an acquaintance of the previous evening): "Ha, my boy, got home all right, then?"

Jones (gloomily): "Yes, but my wife wouldn't speak to me."

Smith (enviously): "Lucky fellow, mine did."

WIRELESS TELEPHONY

(Continued from Page 4)

thence to the steamship America at sea. This service will undoubtedly become popular on incoming and outgoing steamers.

A service similar to that from ship to shore is possible on railroad trains. At present the railroad traveller is cut off from communication with the world, except for brief stops along the way. But the radiophone will change all that. The business man will be able to converse with his associates, or order his hotel room at the other end. The homeward bound youth can inform the waiting parents of the time of his arrival, and the worried lover can again hear the voice of the sweetheart he has just left behind. The tedium of the Pullman riders will be largely removed when selections from Wagner and Tschaikowsky come floating in, and the gaity of the distant vaudeville entertainment will enliven the erstwhile mournful aspect of the crowded day coach.

Expansion Presents Difficulty

Costly churches will no longer be necessary to house the faithful. The travelling salesman can hear the sermon in his hotel room; the automobilist will worship as he takes his Sunday outing, and the golfer will be admonished for his sins as he "puts" on the green. The tourist in the wilds can keep up communication with his friends back home, and loneliness need be nobody's lot in this wireless age.

This expansion of wireless communication presents one serious difficulty, namely the clogging of the ether with interfering messages of the same or nearly the same wave-length. Conditions became so chaotic that the U. S. Government recently called a conference of men vitally interested in the future of wireless transmission. This conference has been given the task of drafting legislation to completely regulate the transmission of wireless messages. Although the introduction of undamped waves has removed the broad characteristics of the undamped waves, the increase in the number of the transmitting stations makes it imperative that definite wave-lengths or bands of wave-lengths be assigned either to individual stations or stations sending out similar kinds of messages.

Whether the recent growth of wireless telephone followers is to increase or decrease none may predict. If it will provide during the winter evening the same enjoyment as the auto in the balmy days of summer, such words as wave-length, power tube, modulator, variometer, will become as common as carburetor, spark plug, piston ring, and all the other technical verbiage of the automobile world. In concluding, it may be said with certainty that the wireless telephone has come into its own place in our everyday life and will stay there just as all other inventions have held their ground, provided its usefulness persists after the present storm of enthusiasm has calmed down.

ENGINEERING IN SIAM

(Continued from Page 7)

steamers if the snags were removed from them. A picture shows dugouts going up the Menam Tapee.

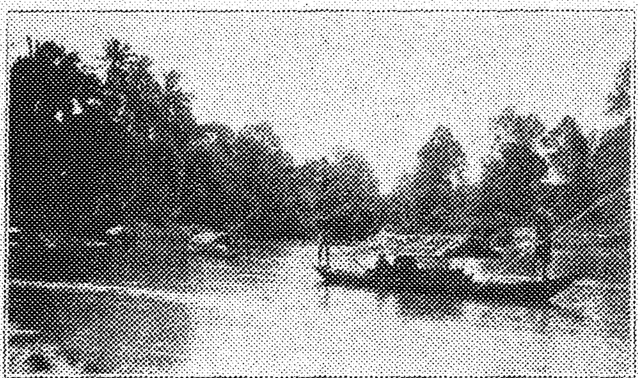
Labor is paid somewhat higher in Siam than in other parts of the Orient. One tical a day is a minimum (one tical is 35 to 40 cents) and for any kind of skilled labor 1.50 to 2.00 ticals are paid. The Siamese do not take to work, outside of running their farms, and are not efficient labor. Chinese are the best available labor, and do well if properly treated. Proper treatment means differently than one might think: it means:

1. Not too large wages.
2. Firmness, and absolute equity.
3. Not too much kindness.
4. Medical attention.
5. A bonus and fine system for rewarding good and poor work. It is true that firing a man has no influence as an example on those left: but that docking a man a quarter of his day's wage is an object lesson which reaches every man working.

Engineering Activities

There are several branches of engineering activity in Siam; most of these relate to communications: road building, bridge construction, waterways, and railroad work. Some relate to industry, as rice milling, irrigation, and mining.

Except around Bankok there are few good roads in Siam. Many of the Siamese realize the value of good roads, and so new roads are constantly being built. Even of poor roads there are not very many. At one time we wished to visit a tin mine at Ronpibun; we were at Nakon Sritamarat and were told that we could make the trip by auto. The road was



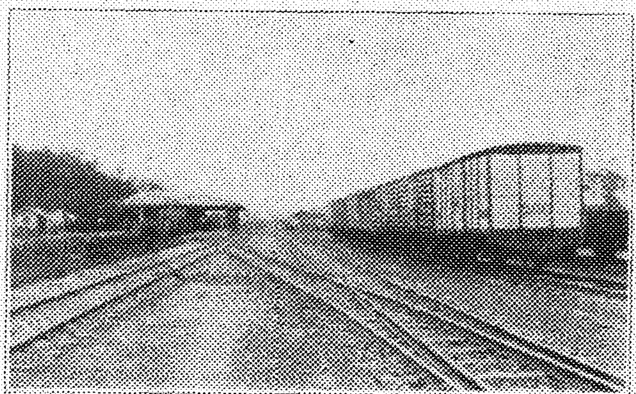
over a plain, crossed by many streams. The first bridge we came to had four or five planks missing, but our chauffeur just speeded a bit and got across with only a little jolt. The next bridge was worse, the support under one corner had been washed out so that that corner of the bridge hung in the air sagging about three feet; but we got across all right. I asked the chauffeur why the bridges were not repaired, and he said that nobody had yet broken through the bridges. So there is a great need for roads kept in good shape.

There are a few fine bridges, mostly railroad bridges, across some of the larger streams. The Menam has not yet been bridged at Bankok, so that the Southern Railway does not enter Bankok, but ends across the river. The river is deep, wide, and it is a long way to bedrock, so that it will be a good job for some engineer to construct that bridge. And the extension of the railways in Northern Siam will make necessary the construction of many bridges.

Some work is being done on rivers and harbors. Most of the coast towns have poor harbors, but many could be made good with a little dredging, such as those at Singora, Puket, and Trang. Bankok is a river harbor which can be entered by moderate-sized ocean vessels; dredging the bar at the mouth would make possible the entry of the largest Pacific steamers. The present mooring and docking facilities are barely adequate at Bankok now and with increasing trade more docks will necessarily be built.

Industries in Siam

Irrigation is necessary in raising rice. The Siamese have constructed intricate systems of irrigation, built piecemeal without any particular design. Some



work is now being done, building better and more permanent systems.

The greater part of the engineering work so far described is government work. Siamese railroads are government-owned, and their construction has been pushed as rapidly as funds permit. The Siamese government is progressive.

Mining is an important industry in Southern Siam. Most of the mining is tin placer mining, that is, mining of tin ore found in sand and gravel. The mining is by gravel pump, by dredging, by hydraulicking, or by Chinese. All of these require engineers of greater or less capacity. Recently electric driven dredges have been installed, and their use makes necessary the development of water power. Most of Siam is hilly, and there are many rivers, so that there are large amounts of water power, but the demand for power is so limited that there has been little development along this line.

Anyone interested in the people and in the temples of Siam should read "Hunting the Chaulmoogra Tree," by J. F. Rock, National Geographic Magazine of March, 1922.

NOT ENOUGH ON

"She dances with abandon," remarked the advance agent for the Salome act.

"Then no permit in this town," retorted the chief of police. "We require more covering than that."
—Louisville Courier-Journal.

Minnesota Techno-Log
UNDER NEW MANAGEMENT
Starting June 10th

The Policy of the new Managing Editor will be made public in the June issue.

Seniors are urged to renew their subscriptions before graduation to assure a contract with their Alma Mater.

Undergraduates line up now as TECHNO-LOG boosters—subscribe.

BETTY J. SULLIVAN
Editor, June Issue

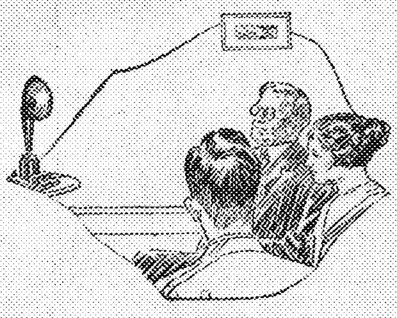
THE CALIPH WINS

(Continued from Page 9)

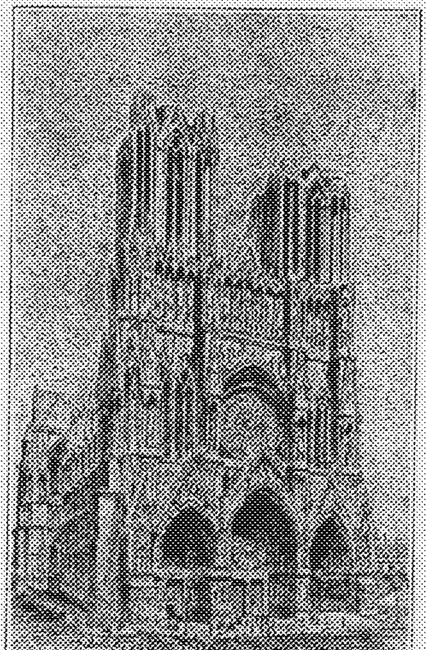
were successfully made on burlap, this material through its natural dullness harmonizing the chalk colors so as to set off the brighter hued costumes.

The mechanical achievement though, if not as artistic in color scheme, was the great arch stretching gracefully over the stage and half the length of the Armory. The Armory through this piece of work became transformed into a theater. Some idea of the immensity of the effect may be garnered from the accompanying flashlight. The rich colorings of the paper lattice work although contrasted too much in the picture, are indicative of the amount of work expended. As a whole the mechanical work of the production was of an excellence never equalled on the campus. The artistically executed scenery, enhanced by this truly decorative arch spanning the enlarged stage offered a setting never to be forgotten by the audiences.

A financial success, too, assures to the University productions by the Arabs from time to time in the future. The proffers of overtown theater managers for the staging of the production for more general view was a gratifying acknowledge of ability to the new organization. The support of the Engineering College faculty and student body was whole-hearted and commendable, the untiring efforts of three score Arabs, an inspiration. The whole University looks forward to the next dramatic offer of the Arabs Club. Arabs, you are to be congratulated on the establishment of a new and worthy tradition of the Engineering College.



MINNESOTA TECHNO-LOG



THE RHIEMS CATHEDRAL

JUNE 1922

PUBLISHED MONTHLY DURING THE SCHOOL YEAR BY THE STUDENTS OF THE COLLEGE OF ENGINEERING AND ARCHITECTURE AND THE SCHOOL OF CHEMISTRY.

VOL. II UNIVERSITY OF MINNESOTA NO. 8

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

The Great Rajasamand Dam

The ruler of Rajputana, in the heart of India, began the great dam "Rajasamand" in 1661. This vast pile of white polished marble, hidden so well in the Aravalli Mountains, has remained almost unknown for generations. It is a colossal monument to these early engineers.

Twenty years were consumed in building the dam; hammers and chisels were used for cutting the rocks; large sharp hoes for excavating earth. Workmen, commandeered by the Rajah, moved "in that leisurely but regular procession peculiar to the East, where time is not and obedience is law".

It is doubtful whether modern engineers can build a better structure; but today they must also consider costs. Explosives have made possible the building of dams larger than Rajasamand and equally as enduring, with much less labor and in less than one-tenth the time; but even explosives—one of man's greatest cost-reducing inventions—must now be carefully compared and chosen.

For reducing blasting costs, we have for several years recommended Hercules Special No. 1. This dynamite contains nothing but the highest grade of standard materials and by wide use has proved its dependability. Special No. 1 replaces 35% and 40% cartridge for cartridge, but, because of its higher cartridge-count, costs less per cartridge than 15% dynamite. No high explosive on the market is more economical than Hercules Special No. 1.

If you are interested in the elimination of waste, write to our advertising department, 942 King Street, Wilmington, Delaware, for our booklet, Volume vs. Weight—A Lesson in Explosives Economy.

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Koehring Heavy Duty Construction matches the operating speed of the Koehring paver—the fastest paving unit.
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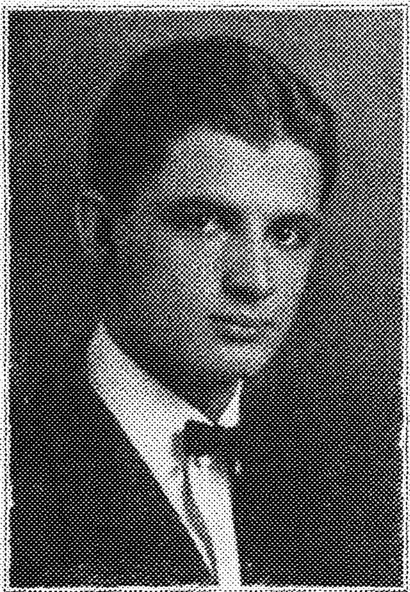
IN THE MONTHS NEWS



STEPHEN F. DARLING, C '22

To Mr. Darling belongs the distinction of being honored four times on Cap and Gown Day. Membership in Sigma Xi, honorary scientific society which requires noteworthy research, and Phi Lambda Upsilon, honorary chemical fraternity were his in addition a Sigma Xi prize and the St. Paul Institute medal for work in natural science.

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DONALD T. GRAF, A '22

Following the annual competition among the Senior Architects for the A. Moorman Traveling Scholarship in Architecture, Mr. Graf was picked as having the best solution to the problem, "A Community Building." The prize is in the form of a trip in the East where opportunity will be given for viewing the work of the best American architects.

MINNESOTA TECHNO-LOG

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VOLUME II JUNE, 1922 NUMBER 8

TRANSPORTATION PROBLEMS

As Applied to Local Street Railways

By Delos F. Wilcox, Ph. D.

Mr. Wilcox, a Consulting Franchise and Public Utilities Expert, is now engaged in making an evaluation of the street railway for the City of Minneapolis with a view toward solving the present street car fare controversy.

CERTAIN aspects of the electric railway problem appear simple, but a close examination of the causes that have contributed to the present financial embarrassment of the electric railway industry, and a consideration of the consequences to the industry and to the country likely to follow upon the application of particular remedies, reveal the fact that the problem as a whole is not simple, but extremely complicated and baffling.

The most important facts with respect to which there was little or no dispute among the witnesses before the Federal Electric Railways Commission may be summarized as follows:

The electric railway industry at present is a factor of vast importance in the urban life and, to a less extent, in the interurban relations of the country.

Electric railways as common carriers, primarily used for local passenger transportation, have been, are, and will continue to be a public utility, subject to public control as to the extent and character of the service they render and as to the rates they charge for such service. This is true whether or not the policy of private ownership and operation is continued.

Until very recently public control as to the rates of fare charged for electric railway service has almost universally in this country taken the form of a fixed, uniform unit fare of five cents prescribed either by statute or by local franchise ordinances or contracts.

Trend of Economic Forces

As a result of the trend of economic forces through a period of about twenty years prior to the outbreak of the World War, a gradual increase had been taking place in the unit prices of labor and materials entering into the construction, maintenance, and operation of electric railways. This gradual increase was wholly or in part overcome by improvements in the electric railway art. Following the outbreaks of the World War, however, and particularly since 1916, an enormous increase in electric railway unit prices has taken place which, at least for the time being, has quite outstripped the economies due to the progress of the art and the growth of revenues due to the increase of traffic.

For several years prior to the war, and to an increasing extent throughout the war period and up to the present time, the automobile has proven to be a serious competitor of the electric railways in rendering local transportation service. Jitneys and automobile buses operating as common carriers have been able in many cases, through the absence of sufficient public regulation, to engage in unfair and destructive competition with the electric railways for the most profitable part of urban passenger traffic. The direct results of this competition and the doubt as to the extent of its future development have even raised a query in the public mind as to whether or not the electric railway can survive as the principal means of local transportation, and this doubt has seriously affected the credit of the industry.

Were Not Conservative

Electric railways, as a general rule, were not conservatively financed in their early years and have not since made good their over-capitalization, except to a limited extent, otherwise than through the process of bankruptcy and reorganization. Also, they have not reduced their capital on account of the accruing depreciation of their physical property and have not spent in the maintenance of their property or set aside as a depreciation reserve enough money to maintain the integrity of the investment at 100 per cent.

The destruction of capital incident to the World War, the unprecedented demands of the Government for loans during the war period, the great increase in the burden of taxation growing out of the war, and the general sense of increasing insecurity of invested capital have resulted in an increase in the cost of new money needed in the electric railway as well as in all other industries.

The net income of the electric railways has been greatly diminished and their credit so impaired that they cannot readily refund their outstanding obligations, and cannot, without great difficulty, if at all, secure new capital for extensions, additions, and improvements.

The electric railways generally have reached a condition where the margin of income available for return upon investment must be enlarged or else the entire capital foundation of the industry must be changed.

While the immediate occasion of the present evil plight of the electric railway industry is the economic changes that have been incident to the war period, the condition of the industry even prior to the war, particularly in its public relations, was unsatisfactory and unsound.

The wages of street railway labor prior to the war were generally insufficient from the point of view of "the living wage," and the increases in wages that have taken place since the beginning of the war period have not been greater, on the average, than the increase in the cost of living.

From a consideration of the foregoing points the following general conclusions appear to be obvious:

1. Unless the usefulness of the electric railway as a public utility is to be sacrificed, public control must be flexible enough to enable the electric railways to secure, in one way or another, sufficient revenues to pay the entire cost of the service rendered, including the necessary cost of both capital and labor.

2. Where the cost of service has greatly increased as a result of conditions over which the electric railways have no control, a corresponding increase in the rates charged for the service is the remedy that first suggests itself as in line with the remedies applied in other industries under similar circumstances.

Essential Nature of Service

3. In view of the essential nature of the service rendered by the electric railways and the extent of their use, it is a matter of the highest public importance that both the total cost of the service and the cost to the individuals who use it shall be kept as low as possible without injustice to those who take part in producing it.

4. Economies in operation that do not involve a harmful lowering of the standard of service or an injustice to those who take part in rendering it are preferable to an increase in fares as a means of meeting the increased prices which enter into the cost of service.

5. Economy in the use of capital to the extent that such economy does not impair the service rendered is preferable to fare increases as a means of meeting the increase in the cost of capital.

6. Savings in the cost of capital through financial reorganization and the adoption of more advantageous and economical methods of financing are preferable to rate increases as a means of meeting the increase in the market rates of interest.

7. Wherever unequal or excessive public burdens have been laid upon the electric railways on the theory that the community, as the grantor of the franchise for operation, is entitled to a share in the profits of the industry, the removal of these burdens is preferable to fare increases.

8. The restoration and development of electric railway traffic and revenues through the removal of unfair, irresistable, and destructive jitney competition, and through the recognition and encouragement of the principle of monopoly within reasonable limits as applied to electric railway service under adequate public regulation, are preferable to fare increases.

9. If economies in operation, economy in the use of capital, savings in the cost of capital the removal of excessive and unequal public burdens and the elimination of unfair competition cannot be made to afford sufficient succor to enable the electric railways to pay the entire cost of service out of the revenues derived from the electric railway rate schedules which the public has been accustomed to pay, then the remaining deficiencies may properly be made up by an adjustment of the fare schedules, subject to the limitation that in no case should the fares be so greatly increased as seriously to impair the usefulness of the electric railway as a public utility. A comparative analysis of street railway traffic figures shows that as fares go up the number of car-riders goes down. On electric railway lines where the fares were unchanged, the average increase in traffic from 1917 to 1919 was 15 per cent, but where the fares were increased more than 25 per cent, traffic showed an actual average decrease of 7.5 per cent.

Under Private Ownership

10. In communities where considerations of public policy require that electric railway fares shall be maintained at a fixed level or below a fixed maximum, then deficiencies in the earnings of the electric railways must be made up through other sources than passenger revenues to whatever extent may be required to meet the full cost of electric railway service. These deficiencies may be made up through the levy of special taxes upon property benefited, through the loan of public credit, or through direct subsidies from general taxation, but these methods of relief are everywhere subject to a proper consideration of sound public policies whether or not such policies are, in a particular case, embodied in constitutional or statutory restrictions.

11. If under private ownership and operation, with such degree of freedom from regulation or such degree of public assistance as may be practicable and the community may approve, the electric railways are unable to continue to render the essential service now being rendered by them, and to expand their facilities in proportion to the reasonable increase in the public demand for their service, then the assumption by the community of direct responsibility for the performance of the function of local transportation is a logical necessity.

The salient points outlined above are, I think, supported by the overwhelming weight of testimony presented to the Federal Electric Railways Commission. The conclusions which I personally reached from the Commission's investigation as well as from previous study and experience, go somewhat further.

The author's personal conclusions are:

1. Local transportation service, coming as it does within the accepted definition of a public utility, is affected by a public interest. It has for its

(Continued on Page 16)

CHEMISTS MAKE TRIP

Industrial Plants Inspected During Vacation

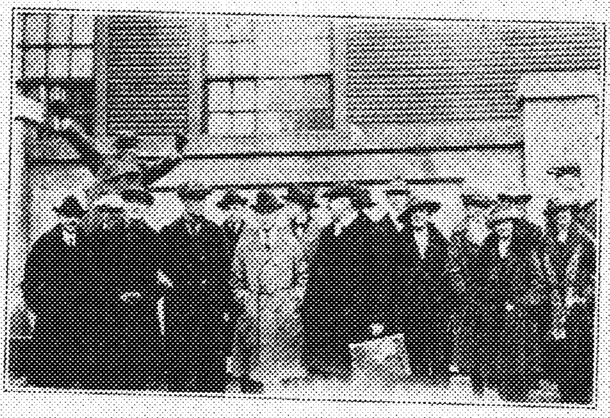
By Ruth W. Tappan and Betty Sullivan, C. '22

DURING spring vacation Dr. Charles A. Mann conducted the Senior Chemical Engineers on their annual inspection trip through the larger factories and plants of Milwaukee, Chicago, and the outlying districts. Despite the fact that it is not so pleasant to listen to explanations of plant processes under drippy pipes and chimneys, (Chicago celebrated our visit with continuous showers), and that getting up at six in the morning is a rather wearisome task, the trip, although strenuous, proved to be interesting and instructive. Indeed, in our opinion, an engineer or a chemist will learn as much in two weeks on an inspection trip of this sort as he would learn in a year of ordinary school work. Since a complete description of any plant, including its equipment and the processes used, would fill many pages, it is obvious that only a brief summary of the processes of a few of the plants can be given here.

Our first tour was through the Pfister-Vogel plant of Milwaukee which is the mother plant of the Pfister-Vogel Leather Company,—$15,000,000 corporation. Here we saw leather of all grades being developed from cow and horse hides. The material is first received in the hide house where it is trimmed (the trimmings are used for glue and gelatine). The hides are soaked for twenty-four hours and washed. After the preservative, salt, has been soaked from the sun-dried hides, the hair is loosened in lime sulphide baths and the hides defleshed and dehaired by machine. Then the smooth skins are defleshed, plumped with lactic acid and bran, and tanned with basic chromesulphate. This is added gradually to drums containing the hides, and after twelve hours, sodium bicarbonate or sodium hyposulphate is added to reduce the acidity and form basic chrome hydrate, the actual tanning agent. The water is pressed out by passing the hides through rolls and the leather is finished by dyeing, (aniline dyes are generally used) shaving, and buffing. The final treatment of the leather, of course, depends upon the grade, the poorer in quality requiring buffing and sandpapering before polishing. The best leather is glazed by passing it between glass rolls. An interesting feature of the process was a measuring machine which quickly and accurately measured the size of the tanned skins. Practically every part of the hide is used—the clipping utilized in the manufacture of glue, the hair for plaster and upholstering, and the uneven parts of the skin left after splitting, for gloves. Although nearly all of the work of the Pfister-Vogel plant is accomplished by the use of modern machinery, its greatest pride is its chemistry laboratory—the most modern one we visited—it even had chainomatic balances and a Minnesota bacteriologist.

After we had finished our tour of the Pfister-Vogel Company, we followed the hide clippings to the U. S. Glue Company where not only glue but gelatine is manufactured. Skins of animals alone are used, as no bone glue is produced here. The clippings are washed free from mucin and the hair loosened in lime water baths where the clippings are soaked for eight to ten weeks, then removed, treated with sulphurous acid, the hair washed out, and the skins cooked and extracted seven times by allowing steam to pass through. The glue liquors are drawn off in the cookers and concentrated in double effect evaporators until they are of the right consistency. The jelly-like mass is allowed to set in molds of galvanized iron, sliced by passing through wires and dried in hot air tunnels. The finished product looks like sheets of hardtack. These sheets are broken up and the glue barrelled.

Gelatine is made from selected calf skins in the new two million dollar gelatine plant of this company, just as glue was made from the clippings. The



whole process, however, is carried out under much more sanitary conditions. The gelatinous liquors are handled in glass-lined pipes and evaporators. The process varies a little in accordance with the use to which the gelatine is to be put—for instance edible gelatine is not at all like photographic gelatine.

At Carrollville, Wisconsin, is located the Newport Chemical Company which was started during the war. Of the four hundred to five hundred dyes made in this country, one hundred and fifty have been made here, but only about thirty dyes are produced regularly, since it is the policy of the company to manufacture a few dyes but make these better than anybody else has made them. The laboratories for both research and analytical work were especially well equipped with all the conveniences of a modern dye laboratory in addition to having an exceptionally fine bookkeeping system for all research problems. Besides a research laboratory (which is made up of various divisions, each having a chief chemist who works on a definite set of dyes and is independent of the other divisions) the Newport

Company has a semi-plant laboratory where all processes are tried before they are actually used for large scale production. One of the black dyes we saw being made was Zambesi black, used by the Phoenix Hosiery Company for dying silk and cotton together. A series of new pyrazolone dyes was also being investigated. The convenient arrangement of the plant whereby the intermediates were dissolved on the top floor and coupled on the floor below, and the equipment of chemical machinery, especially autoclaves, glass plate stirrers, nitrators and sulfonators were noteworthy features of this plant.

Paints and Pigments

At the Patton Paint Company of Milwaukee and the Sherwin Williams Company of Chicago we got our first glimpse of the paint and pigment industry. White lead was being made at Sherwin Williams by both the Old Dutch and the Carter or quick process. In the Old Dutch process the corrosion is effected in earthenware pots, each with a shelf. On the shelves of these pots are placed several lead buckles made from lead of high purity, and acetic acid is added to the bottom of the pot. The floor is covered with a layer of spent tanbark, the pots put on top of the tanbark, and wooden beams arranged on top of these. On the beams are placed some more tanbark and pots. This series of tanbark, pots, and beams reaches a height of thirty to forty feet and covers an area of about five thousand square feet. Carbon dioxide is produced by the fermentation of the tanbark, heat (170 degrees F.) is generated, and the acetic acid vapors in the bottom of the pot attack the lead forming basic lead acetate. The reaction is allowed to continue for ninety days when about eighty per cent of the lead is converted. The corroded buckles which are now grayish white in color, are put through rolls and then screened so that any uncorroded lead which is present will be flattened out in going through the rolls and will not pass through the screen. Finally the white lead is wet ground.

In the Carter or quick process the corrosion of the lead is accomplished in fifteen days. Superheated steam in a jet is blown against a fine stream of melted lead forming atomized lead. This is put in a large rotary drum, acetic acid sprayed in, and carbon dioxide gas under slight pressure admitted through the center of the head. The white lead formed is identical in every respect to the Old Dutch lead. Litharge and Red lead are made from the waste lead by oxidation. Lithopone, another important pigment, is manufactured by the precipitation of zinc sulfate together with barium sulfide. Intermediates, such as paranitroaniline and beta-napthol were also being made.

The Patton Paint Company of Milwaukee, is divided into three distinct parts, the dry color, enamel, and varnish plants. In the dry color plant, green, red, blue, and yellow colors as well as insecticide powders were being made. The varnish plant is the newest and most modern part of the Patton Paint Company. Here the fossil gums, such as Congo and Kumar, are put in kettles and heated to a temperature of five hundred to six hundred degrees C., which makes them soluble, oil added, and then the gums taken up by the solvents which may be either turpentine, benzene, or the light naphthas. The mixture is stirred by hand until the resin is all dissolved, when the varnish is allowed to settle, then centrifuged to remove foreign material, and allowed finally to age for five weeks to six months.

Portland Cement is made at the Universal plant, Buffington, Illinois, principally from limestone and blast furnace slag from the steel mills. The limestone is crushed, first of all in a huge gyratory crusher, then dried in a kiln which is heated internally by powdered coal. The dried limestone is then further ground and mixed with the slag in the proper proportions, these proportions being dependent upon the chemical analysis of both the limestone and the slag. The mixture is fed in the end of the cement burner which is rotated and the material discharged as clinker. Gypsum is added at this point to retard the setting. The clinker is ground, allowed to weather and becomes cement. It is ground in the last stage in a tube mill so that 78 per cent passes a 200-mesh screen and the cement is sacked in a patented bag.

Standard Oil Headquarters

At Whiting, Ind., is situated the Standard Oil Co.'s plant which consists of several units, the refinery, paraffin, grease, acid, and mechanical works in addition to two laboratories, one for research and the other for control and specification tests. The plant itself has a capacity of 40,000 barrels of crude per day which comes to the plant in tank cars or through the wonderful pipe-line system. The crude is first stripped of its lighter oils by heating in either a horizontal direct fired still or steam stills which are safer. The condensate which is principally gasoline and kerosene, goes to the tail house where it is separated by gravity. The oil remaining in the still is distilled down to coke and the latter part of the distillate is used for lubrication oils. All the oils contain sulphur and resins and, in order to get rid of these, the oils are agitated, after distillation, with sulphuric acid. The acid sludge, after settling, carries down with it the tarry and resinous material. This process is called sweetening. The oil is then treated with sodium plumbite to precipitate the sulphur, and the acid is recovered by concentration of the sludge. The heavier lubricating fraction is filtered through Fullers Earth which gives it the lighter color which the trade demands but which does not add anything to its lubricating value. In the paraffin works the lighter naphthas and water are pressed out of the wax and the wax poured into molds to make candles. Some of the oils are made into various kinds of greases, principally axle greases. What impressed us particularly in this plant more than in any other, was the efficient and economical way every operation was conducted with the least possible loss of time. This was typified in the crude oil stills where, after the stills had cooled a little by blowing in live steam, men were sent at a temperature of 400 degrees centigrade to chip out the coke. The company found it more profitable to do this than to lose the time and heat in waiting for the stills to cool to a lower temperature.

At Argo, Illinois, corn is converted into dextrose, corn starch, syrups, cattle feed, and corn oil. The corn is cleaned, heated to 170 degrees F. with a .38 of one per cent solution of sulphurous acid for thirty-six hours to loosen the germ. The corn is then ground in a squirrel-cage disintegrator, and by water

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GETTING A POSITION

Business Man Makes Suggestions

By William L. Fletcher

Mr. Fletcher as President of William L. Fletcher, Inc., is one of the ablest men in the country to give students advice on how to obtain a position. As head of one of the most unique concerns in the country, he has a very deep insight into a student's troubles in seeking a position.

MR. SENIOR, have you got your life's job yet? If not, are you directing your energies toward that end according to any system, or are you merely being directed by your intuition and your sense of propriety? You would not consider passing a final examination by your intuition and why go after the greatest thing in life, your life's job, in a less systematic way than you go after a mere final exam? There are a very few principles which may guide you in your search for a job and you cannot afford to be without them. A mere cognizance of them will place you head and shoulders above the man who is seeking his job blindly.

When you start hunting for a position you will probably feel like a marble sliding around and around on a polished surface unable to stop or to control your destiny in the slightest degree. This is a natural feeling so it won't help any to worry about it. The way to get over this feeling is to appreciate that getting a job is a sales problem and start work as a salesman to sell your own services.

The most important thing in the world to you is "you" and the most important thing to your employer is "himself." The man who hires you will do so because of what he thinks you can do for him. To get a job you must find out exactly what your prospect must think before he will hire you and then lead him to think those thoughts. This is getting over on to the prospect's side of the fence is called getting the "you" attitude.

Seek Opportunity For Service

Do not waste any time and money hunting for the ideal job or some kind employer who is going to push you ahead in business. The thing to hunt for is an opportunity to render a service. All any good man needs is one foot inside of the door—just one opportunity to demonstrate his value to an employer. Money comes as a reward for service rendered. Looking at a job in this light means to an employer that you have the right mental attitude.

If you will remember this and act upon it, you will avoid one of the greatest misfortunes which can happen to any man starting in business—having his heart broken by an unscrupulous employer. Some companies have a policy of trying to get their work done by young men for very little money. These companies go to the college men upon graduation with beautiful word pictures of the things which come to their faithful employees. As the graduate sees the situation after the officer of one of these companies has talked to him, he has only to take the job offered to find his life work and be happy ever after. The man who takes one of these jobs finds himself at the end of two or three years in an undesirable position. If he is single and has money in the bank he faces the necessity of quitting his job and starting all over again with some other company. If he is married and has been unable to save any money, he cannot gamble with a new job. His life is ruined. You probably know men in this position. The least said about them, the better. They are the fellows who never show up at their class re-unions or commencement. The way to avoid being one of them is to disregard whatever an employer tells you about your future with his company. No employer can guarantee your future and if he could there is no reason why he should.

Plan Your Campaign

In looking for a position you should proceed in a constantly widening circle. Approach first your nearest neighbor. Tell him exactly what you want so far as you know. Do not ask him if he knows of any such job but if he will help you find one. Get him to thinking about your problems, and working for you. Ask all your friends to help you. Get them at work on your problem. Then scour the following list of sources of prospects to find prospects for your services:

1. Cooperation of friends and business acquaintances.
2. Help wanted advertisements in newspapers and trade journals.
3. News items, magazine articles, and general advertisements.
4. Directories and mailing lists.
5. Schools, colleges, clubs, and business associations.
6. New corporations and companies being organized.
7. Situations-wanted, advertisements in newspapers and trade papers.
8. Employment agencies.

If you find it hard to think of prospects among your friends and acquaintances, go over old scrap books, address books, correspondence files, family albums—everything you have. You will find many prospects in this way. Of the sources of prospects which I have given, three, outside of friends and acquaintances, are particularly worthwhile. These are "Help-Wanted" advertisements in newspapers, and trade papers; "Situations-Wanted" advertisements in the same papers, and direct mail campaign.

If you were an officer in your class or a member of the football team or a good debater or an active fraternity man, this means that in some ways at least, you are above the average man. In trying to get a position you should always use as a sales argument everything you did in college which tends to prove that you have ability as a leader of men.

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ALUMNI NEWS

By W. T. Townes, '24

MECHANICALS ORGANIZE

ALUMNI of the Mechanical Engineering Department held an enthusiastic meeting lately, in the banquet room of the Minneapolis Y. M. C. A., at which a permanent organization was perfected. Speeches were given by Mr. Donald Westbrook, M. E., '10, and Mr. Dwight Bell, M. E., '07. Professor Flather set forth the needs of the Mechanical Engineering Department. He showed that the present space provided was absolutely inadequate and that there was only about half the space ordinarily allowed per student in the principal universities of the Mid-west, including Illinois, Michigan, Purdue, Ohio, Nebraska, and others.

The new organization elected as president, Mr. George du Toit, M. E., '10; as vice-president, Mr. Harold Morton, M. E., '12; and as secretary, Mr. John E. Morris, M. E., '08. A building committee was appointed, consisting of Mr. H. E. Herrick, M. E., '05, as chairman, Mr. Alfred Buenger, M. E., '08, Mr. D. McD. Wesbrook, M. E., '10, Mr. C. W. Hirleman, M. E., '13, and Mr. Geo. D. Andrews, M. E., '87.

Mr. Gilman W. Smith, C. E., '80, who was a major in the construction division and real estate service of the quartermaster's corps during the war, is prominently connected with the central organization in New York of the American Society of Civil Engineers. He is practicing at 3420 13th St. N. W., Washington, D. C.

Arch Robison, E. E., 09, who for the past year has been chief construction engineer in Florida for the Southern Utilities Company, a subsidiary of the J. G. White Engineering Corporation of 13 Exchange Place, New York, has returned to the head office of the company.

J. R. Wessalie, E. E., '21, is in business with his brother at Waconia, Minn., in the manufacture of sorghum syrup.

Jay Vincent, E. E., '03, has recently resigned his position as assistant chief engineer with the Twin City Rapid Transit Company to become Electrical Engineer for the City of Minneapolis. Mr. Vincent is actively engaged in studying the electrical utilization of the High Dam that the power may be received by the Municipal Corporation.

John Newman, E. E., '22, who has been through a serious illness at the University Hospital, is now convalescing in the Northern Minnesota woods.

Percy S. Saunders, M. E., '92, is with the Canadian Holt Company, Ltd., manufacturing Holt Caterpillar tractors. The company moved its offices recently from Calgary, Alta., to 608 Pacific Building, Vancouver, B. C. It has worked in the past year to perfect a caterpillar tractor for use in logging operations, and with such success that the members of the company have moved out to Vancouver to be in the center of the logging industry. Mr. Saunders finds, from his general observations, that business conditions on the coast are better than they are inland.

E. C. Melby, E. E., '17, is in business at 21 East 40th Street, New York City, as an importer of paper and pulp. It is reported that he is building up a fine business in this line.

Prof. C. M. Jansky of the Electrical Engineering Department, has recently returned from a month's absence at Washington, D. C., in connection with the conference on radio of which he is a member. He succeeded in securing for universities and other governmental broadcasting stations the exclusive right to use certain wave-lengths, which will greatly increase the value of the radio broadcast.

At the Cap and Gown convocation, Henry C. Forbes, E. E., '22, was announced as having been elected to Sigma Xi, in recognition of his research work in radio. It is understood that some other undergraduate engineer may be elected at the next meeting of Sigma Xi.

After serving four years as chief engineer of the St. Joseph Structural Steel Company at St. Joseph, Mo., J. C. Holland, C. E., '04, is now engaged as reinforced concrete and steel designer for Berlin, Sivern, and Randall, architects and engineers, at 19 South LaSalle Street, Chicago. Mr. Holland's home address is 1455 Cuyler Ave., Apartment 3, Chicago, Ill.

Glen B. Ransom, E. E., '21, is with the Long Lines Department of the American Telephone and Telegraph Company. He is at present with the Minneapolis office, but will soon be transferred to Chicago.

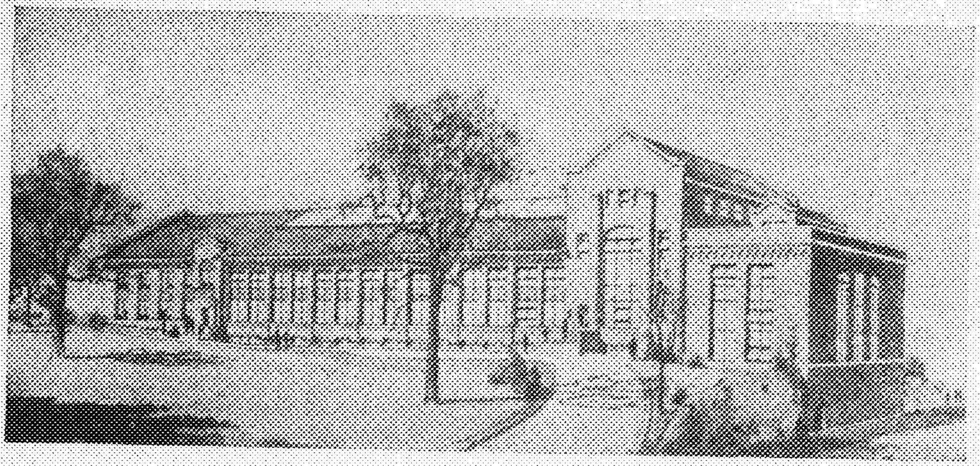
Basil Maine, E. E., '21, and R. R. Sweet, E. E., '21, who have been with the General Electric Company at Schenectady since graduation, are opening a place in the Midway district in St. Paul to manufacture and deal in radio apparatus.

(Additional News Page 11)

THE NEW MINES BUILDING

Work Started on Experimental Station

By Paul E. Nystrom, '24



MEMBERS of the University, particularly those preparing for the practice of law, have had to contend with the noise of construction in the offing. Pleadings and arguments have been interrupted by the snorting steam engines and the rattle of concrete in the mixer. Students of the fairer sex in the College of Education have pouted as black smoke has rolled over the tennis court adjacent to piles of material.

But to the engineering students of the University this hum of industry has been indicative of the start of the latest and most modern addition to the campus. Construction work on the new Mines Experimental building is now well under way and one more building is added to the number that will compose the future Minnesota Institute of Technology.

Development of methods of handling mining operations and the reducing of ores is one of the greatest industries of the state, and as the University has always been a center of experiment and research, the value of a building of this nature, modern in its equipment and available for research and experiment, is obvious.

Three Main Groups

The building which is now under erection will cover a ground area of 17,080 square feet, its dimensions being 280 feet by 61 feet. The layout of the building may be divided into three general groups. The first group will contain the executive departmental offices, a chemical laboratory, and an assaying laboratory of the staff of the School of Mines, and also of the Federal Bureau of Mines. The second division will include extensive experimental laboratories, two stories in height, equipped with traveling cranes to facilitate the handling of various materials. This laboratory will be completely equipped for the reduction of ores.

At one end there is a high tower in which there are a series of steel bins. One is brought in and placed at the top by elevators, and dumped into the bins, from which it goes through crushing machines, after which any disposition of the material may be made. It is now taken to the reducing machines where experiments are to be made. According to Professor James H. Forsythe, the modern equipment of the laboratory marks a new departure in work of this nature for it secures the greatest elasticity in the handling of material.

Fuel Testing

At the north end of the building, there is a large furnace room 56 by 34 feet. It is three stories in height and is to be used to carry out experiments in fuel testing and the reduction of ores in furnaces. This room will have a regular moulding floor. A huge gas main will supply the furnaces, which are connected directly to the bin tower so that material may be brought directly from the crusher to the furnaces.

The building will be equipped with three traveling cranes; one with a capacity of ten tons, and two with a capacity of five tons each. When complete the building will cost about $360,000.00, including the contract price of $300,000.00 and about $60,000.00 for equipment. The exterior is of brick with a slate roof. The design is of a modified Renaissance style of architecture.

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This issue compiled and edited by
BETTY SULLIVAN

LOOKING TOWARD NEXT YEAR

Following the custom of all incoming administrations, we will let the breathless multitude in on the plans of the Techno-Log staff for next year's volume.

The book will embody several new sections in addition to the present ones. A full page of humor, a second page of athletics, three more of alumni and also pages for the various departments of the college. Architectural, Chemical, Civil, Electrical and Mechanical interests will each have a page for their own news. Instead of the single page Alumni News, the Grads will have from four to six pages each month to extol their glories.

The general reading matter will not be the old text-book style appearing heretofore. There will be in each issue one authoritative article on some current and interesting topic. The rest of the articles will be those of interest to engineers but not necessarily on engineering subjects. More cuts and illustrations will be used each month.

Our new cover will be used again next year but inside the makeup of the magazine will be more varied than before which will aid in making the TECHNO-LOG more interesting.

The question probably arises in the reader's mind however, as how all these additions may be made in the present twenty-four page magazine. That is easily solved for it is the purpose of the new staff to publish a thirty-two page issue next month. This will make the TECHNO-LOG the same size as the SKI-U-MAH.

Unfortunately there is a big IF connected with these plans. Unless we get the solid backing of the whole school, or in other words 1,000 paid up subscriptions, the plans will be impossible of fulfillment. It will take a total of 2,000 from students, faculty and alumni to put this across. The seniors will be asked to subscribe before they leave school this June and the undergraduates MUST come across with the necessary dough when the membership campaign of the Association of Engineering Students opens next fall. The TECHNO-LOG will be given to each member of the Association next year.

This is the plan prepared by the new staff, in consultation with the officers of the Association, for YOUR magazine. IT IS UP TO YOU. If you support the magazine properly—you will have the best technical magazine printed, placed in your hands each month.

ON THE FRONT COVER

The attention of our readers is directed to the lithograph pencil rendering of Rheims Cathedral on the front cover. The work was done by John A. Walquist, '23, while preparing architectural history research notes for Prof. F. M. Mann. Mr. Walquist also supplied The Campanile for the April cover.

A GOOD YEAR—WITHAL

The school year is almost over. In a little less than a week we shall say farewell to our Seniors. We shall see them begin a journey and before it is finished they will have scattered over the face of the earth. Shortly thereafter we ourselves shall leave to travel ways which will bring, some of us at least, back to Minnesota's beautiful campus next fall.

To most of us the past year has been eventful. The students on the campus have passed through an even greater press of activities and movements than ever before. We have read of these new things in the Daily, the Ski-U-Mah and the Techno-Log. Another Gopher has made its appearance recording upon its pages the march of progress.

In athletics we have had a checkered career but a change has come and we find ourselves with a completely reorganized and augmented staff to direct Gopher sports during the coming year. Within our own college we find that classes have not been as large as during the two preceding years, yet the spirit of interest and cooperation is even greater than before. These facts were reflected in a somewhat smaller but fine St. Patrick's Day parade and the organization of what proved to be one of the big events of the year, the Arab's musical comedy.

It is with such a background as this that we go forth to work, to study, to travel, to rest,—whichever is to be our lot the coming summer. We intend that the arrival of autumn shall find that our time has been well spent. May we return to our Minnesota better men and women, physically prepared for the strain of another year, determined that the new year shall be more active, more genuinely profitable and productive than any other year has been in the previous history of the University.

ADDITIONAL ALUMNI NEWS

DEVER WINS HONOR

FRANCIS A. DEVER, C. E., '20, of Duluth, has just been notified of his appointment to the Strathcona Memorial Fellowship in Transportation in the Graduate School of Yale University for next year. This Fellowship was established by the late Lord Strathcona, president of the Canadian Pacific Railway, and the proceeds are, by the terms of the bequest, to be used for study "in civil and mechanical engineering, with special reference to the construction, equipment, and operation of transportation of passengers and freight whether by land or water and the financial and legislative questions involved." In making the appointment the trustees of Yale are directed to give preference to men who "have been for at least two years creditably connected in some manner with railway companies."

The conditions imposed, together with the money available, make this Fellowship one of the most desirable offered by any institution in the country, and the person winning this appointment is consequently brought into very close contact with all the big problems of operation and management. Mr. Dever made a very unusual record as a student in the College of Engineering and Architecture, having maintained a grade of A in nearly all his courses throughout his entire four years. He was employed in the Engineering Department of the Duluth, Missabe & Northern R. R. under Mr. W. H. Hoyt, C. E., '90, Chief Engineer, during his summer vacations and has been with the same company continuously since graduation. He was active in all matters connected with student affairs. Mr. Dever, as well as the College of Engineering and Architecture, is to be congratulated upon his appointment to the position.

Professor Shepardson was recently engaged as an expert in a case of interference between power and telephone lines near Crookston, involving a number of intricate and highly technical problems.

Thomas Granfield, E. E., '14, is connected with the Northwestern Bell Telephone Company, with headquarters at Omaha. He is in charge of "Foreign Wire Relations."

Professor W. T. Ryan, E. E., '05, is assisting the Minnesota Tax Commission in the valuation of hydro-electric properties.

H. V. Kruse, C. E., '14, formerly assistant in experimental engineering and civil summer surveying camp, is now civil and mechanical engineer for the United Verde Extension Mining Company, at Clemenceau, Arizona. Mr. Kruse with his wife and daughter Margaret, visited in Minneapolis recently while on the way to New York for a hearing on an engineering experiment.

Appointment of A. C. Godward, C. E. '10, as city planning engineer was recently approved by the unanimous vote of the city council. Mr. Godward is at present park board engineer and will assume his new work for Minneapolis on Sept. 1st.

ALPHA ALPHA GAMMA

DELTA Phi, the architectural sorority organized at Minnesota year before last has entered the national Architectural-Interior Decorating—Landscape Gardening Sorority, Alpha Alpha Gamma as the Beta Chapter. Delegates from the eight chapters of Alpha Alpha Gamma will hold a convention in Saint Louis this month, the local representatives being Gladys Brouillard and Tressa Snure.

CHI SIGMA TAU

CHI SIGMA TAU, local engineering fraternity, was granted a charter of Triangle fraternity at a national meeting held recently at Madison, Wis. Installation of the local fraternity as a chapter of the national will be held early in the fall of 1923.

Chi Sigma Tau was organized at Minnesota last October. Progress has been rapid, the present active membership totalling 21, with two honorary members, Prof. R. W. Siler and Prof. H. B. Wilcox.

At present there are seven active chapters of Triangle, located at Illinois, Purdue, Ohio State, Wisconsin, Kentucky, Cincinnati and Iowa. The Minnesota Chapter will be eighth. Triangle was founded in 1907 at the University of Illinois. Membership is restricted to the College of Engineering and Architecture, and the School of Mines, the Engineering branch including candidates for degrees in chemical engineering.

Active members of the local chapter are Carl I. Aslackson, Edward V. Brossard, Floyd E. Copeland, Orville H. Hosmer, Sheldon S. Hibbard, Harold E. Peckham, Vernon M. Babcock, S. Peter Berg, Donald E. Thorne, Clarence R. Zimmerschied, James P. Johnson, Walter L. Maiser, Harold W. Fischer, Roy N. Williams, Edwin T. Bergquist, Philip L. Bergquist, Maurice W. Hart, Archibald T. Miller, Philip Richardson, John Schlenk and Russel Harrington.

NEW STAFF NAMED

Samuel J. Sutherland, Managing Editor-Elect for the 1922-23 Techno-Log has made public the following members of his staff. Harold E. Peckham and Horace W. Tousley will serve as Associate Editors and Charles M. Burrill as News Editor.

Working in conjunction with these men will be the following department heads: Architectural Editor, Glanville Smith; Chemical Editor, Lloyd Hatch; Civil Editor, Paul H. Swanson; Electrical Editor, James P. Johnson; Mechanical Editor, Sheldon S. Hibbard; Exchange Editor, Olive Prescott; Alumni Editor, William T. Townes; Athletic Editor, Hibbert M. Hill; Art Editor, Edward O. Holien; and Editorial Writers, Elving L. Johnson and Rudolph M. Kuhlman.

Otto C. Person heads the business staff of the new volume as Business Manager. George Patchin will be Assistant Business Manager; Irvin S. MacGowan, Advertising Manager; and F. O. Elfstrum, Circulation Manager.

Sophomores and freshmen will elect reportorial representatives next fall. The editors want all men, particularly freshmen and sophomores, to try out for the reportorial positions still open. There are also several positions open on the advertising staff which pay 10 per cent commission. Men interested should communicate with Mr. Person, the business manager, P. O. 1086, for appointment.

ATHLETICS

By Hibbert M. Hill, '23

TRADITION says that it is difficult for an engineer to take part in athletics and keep up in his studies, yet engineers have this year made an unusual record in Varsity sports. The Engineering College contributed six first string men to the football team when the call went out last fall. Three Engineers scintillated on the basketball floor, two more splashed their way to fame on Minnesota's championship tank team, two men represented us on the hockey squad, the rest of the Engineer's hockey team being ineligible; the track team is doing fairly well with only two Engineers, the golf bugs are waking under Engineering guidance, a whole flock of slide rule artists performed for us on the bars and flying rings in the gym, three wrestlers mixed calculus and neck twisting, two Engineers are putting Minnesota on the baseball map 50 per cent of the tennis team is composed of Engineers and any number more of St. Pat's men have done their part in trying for the teams that their more fortunate brethern have made.

The roll of the Varsity Captains sounds like an Engineering Class book. Every Varsity captain but three were engineers. The Honor Roll follows:

Football . . . . Larry Teberg
Basketball . . . . Dusty Kearney
Baseball . . . . Harry Brown
Swimming . . . . Murray Lanpher
Hockey . . . . Chet Bros
Tennis . . . . Chet Bros
Gym . . . . Ernie Carlson
Golf . . . . Paul Swanson

Our 50 per cent of the tennis team batted 500 in the recent win over Wisconsin, Bros dropping his match, and Kuhlman coming through with a nice win. The ping-pong players weren't so successful against Chicago, where they received a neat trimming.

GOLF VARSITY SPORT

Paul Swanson is making noble efforts to get the Scotch pastime under way as a Varsity sport. The Senate has recognized the golfers and with several good matches and a number of trips in prospect, it ought to be easy to gather in a creditable gang of pill swatters. Paul will welcome any crooked stick artists with open arms.

Schwedes and Brown were easily the class of the Minnesota gang in the recent riot with Wisconsin. A little more support for that pair and we'll have a team that can beat someone besides Northwestern. The game was enlivened for those spectators near the players' bench in watching the deep anguish it caused Doc Cooke each time he had to part with a new ball.

Anyone who doesn't believe the new athletic administration is making good ought to visit Northrop field some afternoon. There hasn't been so much activity there since the year of the big frost. The innocent visitor is pretty sure to be run down by a football player or spiked by Anderson as he practices hurdling the goal posts. If he escapes this fate he will have to dodge right smart to keep away from the various baseballs, discus', hammers, and javelins, to say nothing of the epithets, that are hurled through the air. If it wasn't for the fact that no football man cares for his life it wouldn't be possible to get as many athletes on the field at one time.

REDS vs. WHITES

Speaking of football, did you see that little soiree put on by Bill Spaulding and his proteges one afternoon not so long ago? Considering the fact that the Reds and Whites were for the most part battling their first game on Northrop it looks as though there would be a different tale to tell when we rehash next season about the time the Thanksgiving turkey is nothing but a pile of whitening bones.

INTRA-MURAL SPORT

Under the Captaincy of Hugo Hanft, former Shattuck star, the Engineers, May 6, came through with a close win in the intra-mural swim meet. The steady increase in interest that has characterized these meets in the last few years was evidenced in the times of the different events. Hanft swam the 40-yard dash in 19:4, a new intra-mural record, and as fast time as the Varsity has made during the year. The relay, won by the S. L. A., was 1:22:2, the same time as that which won the conference relay for Minnesota in 1921. Hanft was high man for the Engineers with 9 points, followed by Jenkins, 6; Witt, 5; Spencer, 3. The final score was close, Engineers, 48; S. L. A., 46; and Dents, 3.

Intramural baseball is under way in the care of Chet Bros. Everything points to another championship for the Engineers, who seem to have a wealth of material. However, the usual tough opposition can be expected from the Dent and S. L. A. tribes.

In the first inter-class games the Juniors won from the Frosh, 8-5, and the Seniors took a tough one from the Sophs, 2-0. Thompson and DeFreece starred for the Juniors, and were credited with a homer apiece, DeFreece cleaning the bases at a tight place.

CHEMISTRY RESEARCH

STUDENTS AND FACULTY ARE ACTIVE

By Stephen F. Darling, '22.

SINCE the founding of the separate School of Chemistry at Minnesota investigation has been in progress in every department of the college. Students as well as faculty are doing research because of the requirement of an original thesis for the degree of Bachelor of Science in Chemistry and Chemical Engineer, and also because of the utmost importance of original research in the training of Chemists. The subjects of investigation are of both practical and theoretical value. The results are published in the current Chemical Journals, among the most important of which are the Journal of the American Chemical Society and the Journal of Industrial and Engineering Chemistry. The School of Chemistry is well equipped for research, having many private laboratories as well as a senior research laboratory on the first floor of the new edition, and an especially equipped graduate laboratory on the third floor. The work is carried out under the direction of members of the faculty and departmental heads, but the work is entirely that of the different students. The problems that are now in progress or are being completed this spring are as follows:

The department of organic chemistry—under the direction of Dr. W. H. Hunter, Dr. Lee Irwin Smith and Dr. George Bell Frankforter. Dr. Hunter is working on the oxidation of tribromaniline, the preparation of 2-6, dichlor quinone, the structure of a potassium salt of tribrom guaicol, the constitution of some oxonium compounds, and is directing the following problems under various graduate students:

- A. H. Kohlhase, hexabromdiphenyldi sulphide.
- Arthur Levine—Oxidation of trimethoxybenzoic acid.
- L. C. Humphrey—Preparation of nitroso carbazole.
- Miss Minerva Morse—Oxidation of trichlorphenol.
- Merrill Seymour—Triphenylpropylene.
- A. C. Beckel—Oxidation of tribrommonomethyl aniline.
- Arthur N. Parrett—Mechanism of reaction of the halogenation of certain phenols.
- Mrs. Lucille Kranz Heisig—Hydroxamic acids.
- Stephen Darling—The preparation of a new dye base from carbazole.
- Dr. Lee I. Smith is investigating some new reactions and compounds of duro-quinone and under him is working Frank J. Dobrovolny on the same problem.

Dr. G. B. Frankforter is working on an entirely different field, that of the terpenes, as well as some other investigations on dyes and explosives. Under him are Edwin M. Nygard, working on some new condensation reactions of aldyhydes on hydrocarbons with aluminum chloride; Elwyn Harris—some new condensation reactions of bromal and phenetol with aluminum chloride; Miss Betty Sullivan, investigating the Polymers of Pinene.

Under the direction of Dr. M. Cannon Sneed, L. J. Weber is investigating some new perselenides. Miss Katherine Hammond is testing some new methods of separating the third group in qualitative analysis.

Dr. P. H. M-P. Brinton and Professor C. F. Sidener, direct the research in the department of analytical chemistry. Dr. Brinton is working on the separation of molybdenum and tantalum and the ignition temperature of WO_3. Under his direction are R. E. Ellestad, on the separation of beryllium and uranium and L. A. Sarver on the solubitity of the rare earth oxalate. A. E. Stoppel is separating the rare earth oxalates. A. E. Stoppel is separating Dr. C. F. Sidener.

Dr. Charles A. Mann of the department of chemical engineering directs the theses required for the degree of Chemical Engineer. Dr. Mann, with Mr. Robert Ernst, is working on the electroplating of a bi-metallic thermo-element with brass for corrosion resistance to be used in steam traps. He has also finished the preparation of a newer and cheaper glue for making Compo board. The following students are working under the direction of Dr. Mann:

- Sam Aronovsky—The use of vacuum in making sulphite paper pulp.
- R. W. Cornell—Titanium nitride.
- Jarvin Fulmer—Some new chemical products from flaxshives.
- Melville R. Lee—Reducing the sulphur content of coking coals.
- M. A. Peterson—Inter-influence of metals on plating alloys.
- Frederick Riddington—Effect of constituents in molasses on the decolorizing properties of carbon.
- W. J. Roberts—Properties of metals and alloys for chemical equipment.
- Oscar C. Schermer—Composition of corn cob tar.
- W. J. Wolf—Synthetic rubber.

Dr. E. P. Harding directs R. E. Brewer in his research on the recovery of petroleum from oil shales; P. J. Riley on the separation of methyl from ethyl alcohols, and Miss Ruth Tappan on an investigation of the variability of the mineral constituents in flour.

In the department of physical chemistry Dr. Ryerson and Max Latshaw are investigating the absorbtion properties of cocoanut charcoal. Dr. Henderson and F. C. Kracek are experimenting in the field of radio activity and the new method of obtaining radium for carnotite. Under the direction of Dr. F. H. MacDougall, Carleton H. Smith has been studying the hydrolysis of lead chloride, using conductivity methods. Mrs. E. J. Lund also is studying the ionization of lead chloride working with lead cells. Dr. MacDougall and Paul Sharp have just published a paper in the Journal of the American Chemical Society on "A Simple Electrometic Titration Method for Acidimetry and Alkinimetry."

COLLEGE NEWS

By Chas. M. Burrill, '23

A. I. E. E.

THE Electricals were afforded an exceptional opportunity at the meeting of the A. I. E. E., May 3, 1922, in the Engineering Auditorium, of hearing Mr. Whiton of the Northern States Power Co., who told many interesting facts concerning that system, the largest electrical enterprise in Minnesota.

They have an installed capacity of 156,300 KW (a KW is about 1⅓ H. P.), and a record peak load of 83,000 KW. The large difference is because much of the former is water power which cannot be depended on, especially in winter, when the load is the heaviest. This is a growth of 500 per cent in ten years. The largest single source of power is the Riverside Station in Minneapolis, which has a capacity of 77,000 KW, all steam, where nearly 200,000 tons of coal are burned yearly, an average of nine carloads per day. To insure an uninterrupted supply, an average of 46,000 tons are kept in storage. In 1920, by improvement in thermal efficiency coal was saved to the extent of $80,000. The storage battery at Riverside has a 5,000 ampere hour capacity, but it would be able to carry the full load of the station for less than five minutes. These figures will suggest that there are many difficult and interesting engineering problems in the operation of the system.

Of special interest to engineering students are the approaching weddings of two of their popular profs. Dr. E. P. Harding of the School of Chemistry, and Prof. James H. Forsythe of the Department of Architecture, are the benedicts who were recently entertained by fellow members of the faculty at the Campus Club.

Miss Jeanette Kirchner, daughter of Prof. and Mrs. William Kirchner, will become the bride of Prof. Forsythe on June 21.

Dr. Harding will motor west at the close of school and meet Miss Bertha Fornfiel of Deer Park, Washington. They will be married the latter part of July.

Ray Holmes of the Electrical Department, left school May 31 to take charge of his father's business at Sherwood, N. D.

A comedy, "Seeds Sown in the Spring," written by our Architectural Editor, Glanville Smith, for Pi Epsilon Delta, honorary dramatic fraternity, and produced by the players under the direction of Bernice Marsolais, was awarded the Daily Star Cup. This cup is conferred annually for the best production of a play written by an under-graduate.

CHEMIST'S ACTIVITIES

LAST Thursday the Sophomores landed the Kittenball series which they were playing with the Freshmen by a margin of two games to one. The scores were 20 to 1, 2 to 3, 3 to 1. The last two games were close and well played. One of the features of the game was the fanning of two men with one out and bases full by Pitcher Jewett of the Sophomores.

The School of Chemistry tennis tournament has entered its second round. The second frame must be played off by Saturday, May 28, according to Charles Johnston who has charge of the tournament.

Junior chemists are planning a picnic and outing at Wildwood. If the party lives up to the Junior's standard or to one-half of the advance press agents' reports it will be a regular one.

School of Chemistry Seniors entertained at a luncheon at Candleglow Inn on June 7. Drs. Mann and Hunter were the faculty guests.

The officers who will have charge of the Student Branch of the A. I. E. E. next year were elected May 25, 1922: Chairman, Roy H. Olson; Secretary, Clifford L. Sampson; Treasurer, Robert H. Tunell. During the past year, the most successful of its career, the branch has held two programs bv its members, has heard three distinguished speakers at other meetings. The A. I. E. E. also sponsored the most successful First Annual Get-together Banquet of the Electrical Department, and the first and only Engineering "Sunlight."

The Leamington Hotel was the scene of Sophomore festivities, May 26, 1922, when the last class party of the year took place. The affair was a complete success in spite of the many serious demands on the students' time as the quarter comes all too rapidly to a close.

Saturday, May 27th, the A. S. M. E. election was held and officers for the coming year were named and the future discussed. The winners were President, C. Floyd Olmstead; Vice President, Ray C. Ascher; Secretary, H. R. Lagman; and Treasurer, Glen Larson.

At the A. S. C. E. meeting held May 29th an announcement was made relative to the adoption by the national body of an emblem for the student branches. It is worthy of note that until recently the A. S. C. E. permitted no student affiliations. The officers to guide the work of this new student work are President, Orville H. Hosmer; Secretary, George Guezmer; and Treasurer, Arthur C. Zimmerman.

GETTING A POSITION

(Continued from Page 7)

If you have managed an athletic team or a musical club or a dramatic club successfully this is always a good point to bring out. If, in analyzing yourself, you find that you have not excelled in any way, use this fact as an argument. Generally speaking, business men are not looking for "boy wonders"; they won't want men to revolutionize their business. What they desire are men of average intelligence, with open alert minds, who have some appreciation of the importance of discipline and are willing to work and study hard to get ahead. The man who has not excelled in college should tell prospective employers that he possesses only average ability but that he can and will accept suggestions and will work hard to get ahead. In other words, turn every objection into an argument when you can possibly do so.

Want Advertisements Pay

Probably more men secure positions by answering "Help-Wanted" advertisements in newspapers or trade journals than in any other one way. It is important, therefore, that you know how to answer an advertisement. The first point to keep in mind in answering an advertisement is that you are not applying for something. A letter of application is a sales letter. You are trying to sell your own services. In your answer to an advertisement you should try to do only one thing—get an interview with the employer. To do this the employer must say to himself when he has read your letter, "This is the kind of man I want." You must lead him to think this thought.

If you are going to run a "Situation-Wanted" advertisement to secure a position, you should place it in the paper or papers which are read by the people you wish to reach. In a large city, the papers which carry the largest amount of advertising are the best mediums. A 15 or 20 line advertisement is much more likely to pull a good job than a small advertisement. Many employers follow "Situations-Wanted" advertisements in newspapers very closely. These men reason that the men who advertise for the positions they desire have more initiative than the men who try to secure positions simply by answering help wanted advertisements. Situation-wanted advertisements in the trade papers are very well worth while because these papers are read by intelligent, progressive employers. If the paper in which you are advertising permits display head lines in its classified columns you will do well to use one. If you start advertising for a position, don't expect results from your first advertisement. Run your advertisement three times during one week and check up the results. If you think it advisable, change your copy and run the new advertisements on the days when your medium has its largest circulation. Advertisements run on holidays, however, are probably not extensively read.

Under normal business conditions, a direct mail (circular letter) campaign to get the job you want is almost certain to produce satisfactory results. All you have to do to get a job is to keep at it until you win. For the man who has a weak personality or who finds it hard to talk to strangers or has some other weakness, direct mail campaigns are worth very careful consideration. Through letters, you can anticipate and overcome objections. If you cannot write a good letter, you can always get a trained advertising man to help you.

Direct Mail Method

The principles which you should observe in running a direct mail campaign are the same as those you follow in answering an advertisement. One good way to run a campaign is to prepare a letter carefully and then send out ten copies. When your answers are received, you will probably be able to determine the value of your letter. If the first ten letters do not pull satisfactory results, have an advertising man check up your letter to see if it is a good one. Don't mail letters so that they will be received by prospects on Saturday or Monday. Letters received by business men on these days do not receive the consideration given to letters received in the middle of the week. The days just before and after holidays are also bad days to have your letter reach prospects. Telegrams and night letters can sometimes be used instead of letters. They always get attention. You create this thought in his mind by doing five things: giving in your letter all the information asked for in the advertisement; making your letter clear, concise, correct, and courteous; using strong first and last paragraphs; keeping the employer's interest in mind all the time you are writing to him; giving definite information (facts not generalities) about what you have done, can do, and want to do. The first and last paragraphs of your letter are particularly important. Do not begin your letter with a statement to the effect that you have seen his advertisement and are convinced that you are exactly the man he needs. The employer knows this without your telling him. If this were not true you would not answer his advertisement. Don't "tune up in the presence of the audience." Start right in to tell him why you are the man he wants. If you find it hard to do this, write your letter as you naturally would write it—and then throw the first paragraph away. Always end the last sentence with a period. A simple statement such as "You can reach me by telephoning Main 4000" is a good ending. Don't try to force the employer into taking action.

In writing a letter you should never use any expressions which you would not use if you were talking to your prospect. This means that you must eliminate all such hackneyed expressions as "Beg to remain." Don't use the words "beg," "state," or any of those other expressions which are so common in business letters but mean so little. The stationery which you use is very important. The quality of paper and envelope should be as good as you can afford. Do not under any circumstances write a letter applying for a position on ladies' note paper. Use a sheet 8½x11 or gentlemen's note paper, which should measure not less than 6½x9 inches. The envelopes for this size are 4¾x6¾. In reading answers to advertisements nine employers out of ten will select and read first the letters which come in the best-looking envelopes. Unless an employer states in his advertisement that he desires all answers written with a pen, your letter should be typewritten. See that the type is clean and that the letter has a neat appearance.

TRANSPORTATION PROBLEMS

(Continued from Page 4)

primary purpose the rendering of a public service. The electric railways are constructed, maintained, and operated not primarily for the purpose of enabling capital to find profitable investment; not primarily for the purpose of enabling labor to earn a living; not primarily for the purpose of enabling management to win the rewards of administrative ability, but primarily for the purpose of rendering an essential service to the community. This fact distinguishes the electric railway industry from any and every purely private business, and makes the public interest in the quantity, quality, and continuity of the service rendered, and in the charges made for such service, paramount.

2. Heretofore, under the policy of private ownership and operation, capital has assumed the management. Capital engaged in a public service such as local transportation enjoys the special guarantees which the Federal constitution and many of the state constitutions throw about property interests. It is entitled to a fair return, subject to the limitation that in no case must the rates charged to the public represent more than the service is reasonably worth. The right of capital to earn a fair return has, in many respects, been limited by the effect of restrictive contracts voluntarily entered into with the communities within which public service is being rendered. In case these contractual restrictions are all removed, capital demands not merely the assurance of a fair return upon the investment, but, so long as it assumes the management, demands something more—a speculative chance of profit, or a special reward for efficiency. If it were divorced from management, capital would ask for nothing save security and a fair return, which, under those circumstances, would be the minimum rate of interest required to attract capital to a secure investment.

Labor's Part in Problem

3. The cost of labor as an element in the cost of electric railway service has hitherto been determined primarily by the law of supply and demand, subject to such adjustments as the employees could enforce through negotiation with the management representing capital, or through the power of the strike. As yet labor has no guaranty of "the living wage" corresponding to capital's limited constitutional guaranty of "the fair return," but at the present time labor is properly demanding that, in the permanent settlement of the electric railway problem, the living wage shall receive practical recognition coordinate with or even precedent to the fair return guaranteed to capital. Labor does not, to an appreciable extent, control or participate in management, and, therefore, while existing relations continue, it cannot demand more than the fair or living wage, except under conditions where the law of supply and demand makes the payment of a higher wage necessary. But if labor should assume the management, or any effective share in the management, it would then logically and necessarily claim the opportunity to earn, as a reward for efficiency, something more than the living wage, just as capital now claims, upon the same basis, the chance to earn something more than the fair return.

4. The public has so fundamental an interest in electric railway service that it cannot permit itself to be the victim of the vicissitudes of an unregulated struggle between capital and labor, and it cannot permit itself to be forced into the position of signing a blank check to cover the cost of service at whatever figure capital and labor may, by joint agreement, fix it. Therefore, it is necessary that a direct relation between the public and labor as fundamental and effective as the direct relation between the public and capital, be established, to the end that labor may receive adequate public guaranties and in turn acknowledge and assume adequate public responsibilities in connection with the production of transportation service.

Public Interest Paramount

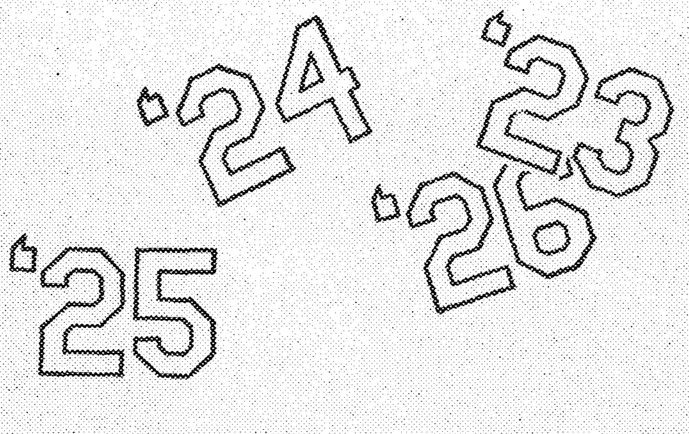
5. With the establishment of direct relations between the public and labor, the responsibility of capital for management is undermined and its motive for efficiency in management weakened if not destroyed. That the public interest is paramount is proven by the constantly increasing scope of the public encroachments upon management. With the assumption of direct public responsibility for wages, hours, and conditions of work, and for the enforcement of continuity of service, the next step, which is both logical and necessary, is the assumption by the public of complete responsibility for management and the limitation of capital to its true function of supplying funds in aid of public credit for a fixed return determined by the security it enjoys.

6. The problem of credit can most effectively be solved by public ownership, undertaken through the acquisition of the existing electric railway properties at a fair price based upon the actual cost of existing and useful property, with due regard to its present condition and with fair consideration of the equitable claims of invested capital with respect to losses not resulting from bad management or imprudent contracts. Upon this basis capital will retire from the management and will assume the same subordinate but useful position that it already occupies in relation to municipal improvements generally. The cost of capital will be reduced to a minimum and the credit necessary for inducing new capital to flow into the industry will be forthcoming on the basis of the security offered. This security will be increased and the cost of capital will be reduced in proportion to the conservatism of the financial policies adopted by the community. Ample depreciation reserves, the prompt amortization of dead capital, and the gradual amortization of the entire capital out of earnings or out of taxes will effectively maintain public credit for electric railway expansion.

Management or Ownership?

7. The assumption of management by the public will involve the definite public recognition and guaranty of the rights of labor to a living wage, reasonable hours and just conditions of work, and will, at the same time, place electric railway employes in the position of civil servants with the advantages and responsibilities which are implied in that relationship. Labor is different from capital. It is a living thing, not inert. Its full cooperation, even under public management, can hardly be secured merely by civil service rules and a guaranty of the living wage. No doubt one of the principal jobs of public management will be to work out a

(Continued on Page 24)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TECHNICALITIES

CULTURE IN THE CORRIDORS
(Swiped from the Tech. Voo-Doo)

" . . . . " and I says, "Funny," I says, "Yeh, funny as hell making me come dam near spilling the whole quart of . . . ."

" . . . . lissen, I'll tellya wacha gotta do. You f'gotta divi' by two afta ya got this valya here, see. Thishere's double the quann'ty you wanna get, see. Ya gotta divi' by two, you wanna get the right annser, see. What ya got's alwri' downta here, but then ya shoulda divi' by two, you wanna get the right annser, see. It wouldda been awri', you just divi' . . . ."

" . . . . so I didn't let on what Ed had told me about her, and after a little while she came downstairs, and I didn't say anything, but she kept hanging around, so after a little while, I says to her, I says . . . ."

" . . . . now lookit. Y' taka paira compasses and settum equalta fi' timza lengtha AB, see, and then y' take ya point X as a centa, and where the arc cuts MN, thatsa poinicha want, see? Sure! that's ri', whatha helya think I'm tryina do, kijja? Lissen, thas what Luoie did, and he got the right annsa. All'ya do, y'taka paira compasses . . . ."

" . . . . and it seems that there was a newly married couple. So . . . . and next morning the bride says to her mother, 'Mother . . . .'"

"You know, he thinks he's as sarcastic as hell, that guy. Some day I'm going to get sore and bust him one in the jaw, that's what I'll do. I went into his office the other day, and I says to him, 'Lissen, Mr. ———, I think you've got a lot of crust to give me thirty-five on a paper like this.' And what tha hell do think he says. He says, 'Mr. Snork, if I changed your mark to anything, I'd change it to thirty,' that's what he said. He thinks he's as sarcastic as hell, he does."

—E. F. H.

A. S. M. E. BANQUET?

She—"Did you ever in your life see such a translucent yet iridescent wine?"

He—"S'funny, it tastes all right to me."

Ladies' Tailor—"Do you want a belt in the waist?"

Customer (angrily)—"Do you want a crack in the jaw?"

"How did you get that cut in the head?"

"Hic—musta—hic—bit myself."

"Gwan. How could you bite yourself up there?"

"Mushta stood on a chair."

"SHE DONE AM WENT"

A salesman, bringing his bride south for their honeymoon, visited a hotel where he boasted of the fine honey.

"Sambo," he asked the colored waiter, "where's my honey?"

"Ah don't know, boss," replied Sambo, "she don't wuk here no mo'."

He (to make conversation): "I've just bought a new slide-rule."

She (a dumb S. L. & A. co-ed): "Oh, if you'll take it out of the garage I'll love to take a ride in it."

Hydraulics, Number 12345zz

One day, as I chanced to pass,
A beaver was damming a river,
And a man who had run out of gas,
Was doing the same to his flivver.

—Awgwan.

Oh, These Interior Decorators

"We girls have to be so careful these days."

"How's that?"

"If a man tries to tell us a risque joke and we stop him too soon, he knows we've heard it before."

—Jack-o-Lantern.

We would suggest a painful, but in all somewhat lingering death—boiling in oil, perhaps—for the s. y. t. who, while passing along Church street, wanted to know what kind of Engineering "Main Engineering" was.

NEW YEAR BOOK FORM

THE Architectural Society Year Book, discontinued since 1916, when war conditions made its publication impossible, is to appear again this year. Twenty-six designs are to be presented, including work done in the free-hand drawing classes and several problems in interior decoration. The loose-leaf portfolio arrangement of this year's volume not only makes it useful for further filing, but allows the price to remain so low as two dollars. An interesting feature of the present year-book is the entire absence of advertising, thus making it both more distinguished in appearance and more compact in size.

The book will be of real architectural value since it contains the best designs for the year produced in one of the country's best architectural schools.

CHEMISTS MAKE TRIP

(Continued from Page 6)

flotation the germ is removed from the starch and gluten. The gluten is separated from the suspension in settling tanks and is used for cattle feed. From the germ, by drying and pressing, corn oil is obtained. The starch is dried in a current of warm air, pulverized and bolted. Dextrose is obtained from the starch by the hydrolysis with acid.

At the Illinois Steel Company of South Chicago, ore is refined by either the Bessemer, open hearth, or electric furnace processes. The electric furnace although requiring much more power, is more easily controlled and is often used after preliminary treatment of the ore by the Bessemer or open hearth methods. The material is sampled every fifteen minutes and analyzed for sulphur, phosphorus, silica, and carbon, much to the envy of those of us who take weeks to make the same determinations. The most impressive scene in the plant was the rolling out of the red hot bars to the right thickness between water-cooled rollers. The sheets of iron roll back and forth between the cylinders like a red hot wave, and hiss and explode violently when salt is added to remove the scale.

In addition to the plants mentioned in the above story the Senior Chemical Engineers also visited the Milwaukee Solvay Coke and Gas Company, and The Goodrich Linseed Oil Company Mills in Milwaukee, the Graselli Chemical Company, the U. S. Lead Refinery Company, Swift and Company, Libby, McNeil and Libby, The Barrett Company, The Chicago Heights Bottle Works, and the American Steel and Wire Company plants in Chicago and vicinity; the establishments of the American Refractories Company at Joliet, and the Western Clock Company at Rockdale. At each of the plants the Minnesota chemists were extended every courtesy.

MAY DESIGN AWARDS

THREE Freshmen designs were judged this month: two sketch problems and a long problem. In one sketch-problem, "A Grille in a Library Window," Gilman Holien was awarded an A; in the other, "A Grille in an Arched Entrance-way," Hugh Eaton won first place, receiving a B plus. Homer Tatham, E. W. Krafft and Dorothy Brink received the high awards in the judgment of "A Pavilion in a Park," the Freshman long problem.

Two mentions were awarded in the Junior long problem "A Jewelry-Store Interior," to Eunice Nielson and I. W. Silverman.

In the Interior Decoration long problem, "A Masonic Throne-Room," mentions were awarded Faith Nixon and Gladys Brouillard. Both designs were in the Egyptian manner.

High awards in the Freshman problem, "A Window and Balcony," were received by Gilman Holien, Delphine Moreau, and R. V. McCann.

In the Sophomore's long problem, "An Entrance to an Athletic Field," Mentions were won by Wayne Hunt, Paul E. Nystrom, Walter A. Kendall, Frank R. Root, Herman J. Wenker, and Wallace C. Bonsall.

Faith Nixon received Mention in the interior decorator's problem, "A Study in Mantel-pieces," while the high award in the Junior's short problem, "An Open Air Pulpit," went to M. J. Markusson.

PI TAU SIGMA

GAMMA chapter of Pi Tau Sigma, honorary mechanical engineering fraternity, was installed at the university Tuesday, May 16, 1922, by a delegation from the University of Wisconsin chapter. Professor G. L. Larson, supreme secretary-treasurer of the fraternity, E. A. Longenecker, T. G. Glenn and W. D. O'Conner conducted the ceremonies. A banquet at the Leamington Hotel followed the installation.

Pi Tau Sigma elects its members from the Junior and Senior classes in mechanical engineering. Active membership is based upon sound engineering ability, scholarship, and personality. Honorary members are chosen from the list of successful professors in the mechanical engineering department.

Pi Tau Sigma has chapters at the University of Illinois, Wisconsin, Purdue, and Minnesota. Charters are granted only to groups of mechanical engineering students who are highly recommended by the faculty of first class engineering colleges and approved by the supreme council of Pi Tau Sigma. Members of the local chapter are:

Seniors

C. Floyd Olmstead, Ernest F. Carlson, Clayton E. Hemsey, Ernest Nordstrom.

Juniors

Lee L. Amidon, Sidney H. Acker, Raymond C. Ascher, Grant Bergsland, Shelden S. Hibbard, Karl W. Keiser, Rudolf H. Kuhlman, Chester R. Marshall, Harold E. Peckham.

Honorary Members

Prof. J. H. Rowen and Prof. J. V. Martenis.

TRANSPORTATION PROBLEMS

(Continued from Page 16)

more effective and democratic relationship with labor than has hitherto characterized the electric railway industry under either private or public operation.

8. The imperative need of the present time is the acceptance of public ownership and operation of local transportation systems as a policy, and the adoption as rapidly as possible of those measures which are required to clear away the obstacles to the realization of such a policy, and to make it successful in the highest practicable degree when realized. Any temporary relief granted to the electric railways and any temporary readjustment of their public relations under private ownership and management, such as the working out of a more complete and unrestricted system of state regulation or the adoption of a service-at-cost plan, ought to be consistent with and preparatory for the early and effective consummation of public ownership and operation as the ultimate policy.

I think I have a proper realization of the dangers and difficulties inherent in the policy which I have proposed, but I am confident that these dangers and difficulties can readily be overcome if public opinion can be crystallized in favor of a serious effort to overcome them. If public ownership and operation are either inherently desirable or, in the course of events, inevitable, it is of the utmost importance that the community should set its house in order and prepare to assume in an orderly and effective way the responsibility that it cannot ultimately escape.

INDUSTRIAL BUILDINGS SHOULD BE WELL LIGHTED.

From the employer's viewpoint, the big difference between men who work out of doors and those who perform tasks inside the building, is the factor of light. Daylight furnishes sufficient illumination outside during the daytime working hours for men to pursue their tasks efficiently and safely. But the proposition of getting enough daylight into the interior of industrial buildings, requires some thought.

It is not a difficult problem by any means, and any employer can take advantage of daylight and utilize it for lighting his building during the daytime, if he desires. It is an excellent light, especially suitable for the eyes, reducing eye strain and eye weariness to a minimum, and has the great economic advantage of costing nothing.

To utilize daylight to the utmost, we must first provide means for allowing daylight rays to enter the interior of buildings in sufficient quantity—namely, proper and adequate windows and skylights. Many excellent instances of buildings designed with a due regard to the importance of daylight lighting can now be seen in many of our industrial cities. Such buildings present the appearance of being practically all windows—"window walled," as they are termed—and this type of daylight construction is coming rapidly into favor, because it constitutes a more healthy building for large numbers of employes, both from the lighting and ventilation standpoints.

Among those who have constructed this type of modern industrial building may be mentioned: The Shredded Wheat Co., Gillette Safety Razor Co., Lyon & Healy Piano Co., H. J. Heinz Co., Corona Typewriter Co., Skinners Macaroni Co., Grape Juice Co., Dodge Bros., Nelson Valve Co., Piston Ring Co., Remington Arms Co., and a great many others.

The Larkin Co., Philadelphia, has erected a building almost entirely glass, 85% being windows, and the Loomis Breaker, operated by the D. L. & W. R. R. Co., Nanticoke, Pa., is literally a glass house, being 93.5% of glass. The new buildings of the Winchester Repeating Arms Co. have an average glass area of 58%.

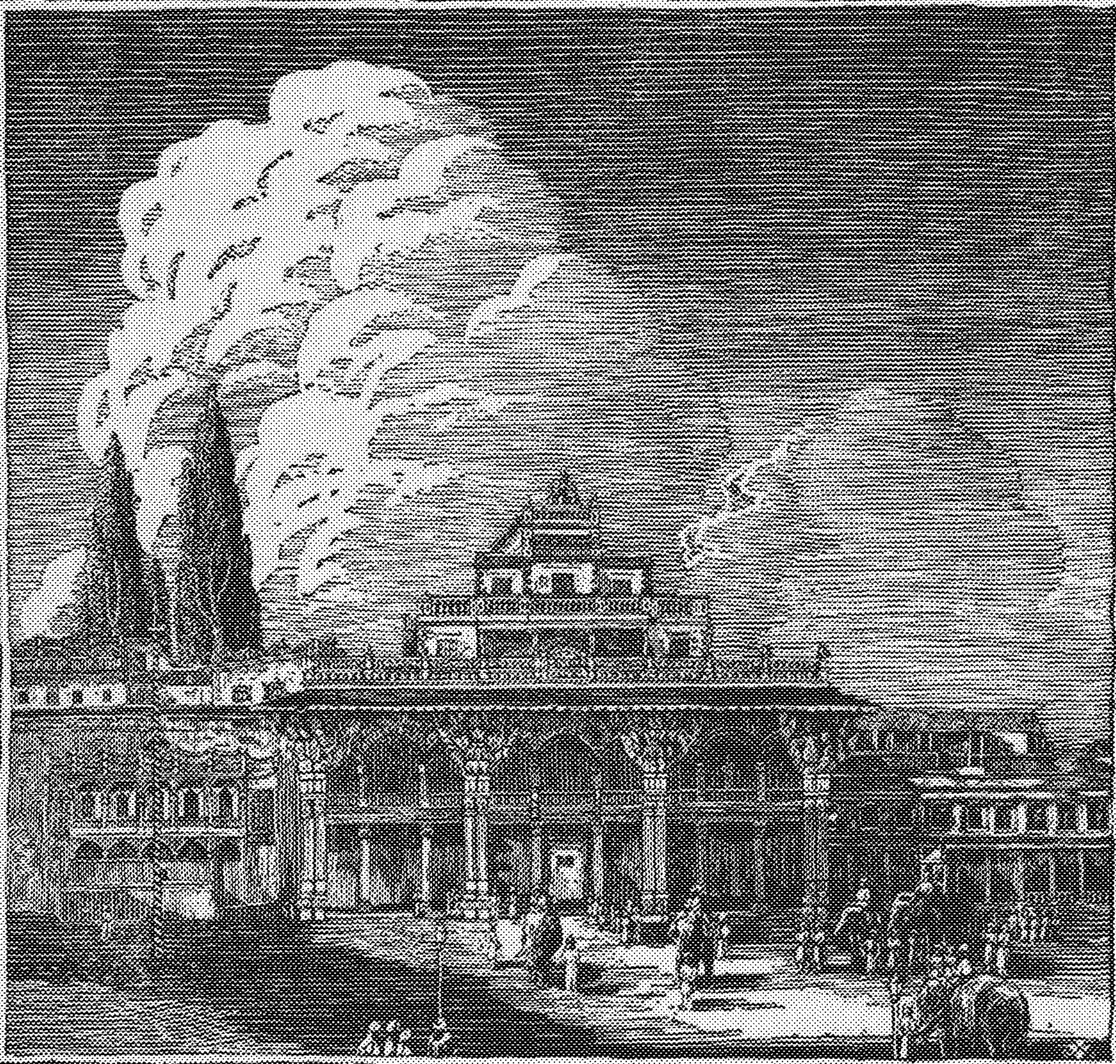
An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 57.5%.

These figures indicate how important the subject of lighting is now considered by employers of industrial labor, and how well the idea has been carried out by the architects and engineers, in order that all parts of a building may receive sufficient daylight. But, in addition to providing ample window space, there is another factor which is equally important, and that is, equipping the windows with the proper glass.

The bright direct rays of the sun should not be permitted to strike the eye, and we must provide a means for reducing the glare to rays which will not be too bright. This is accomplished by glass especially manufactured for industrial windows, known as Factrolite. This glass possesses the property of breaking up the intense rays of the sun and diffusing the light into the interior of the building in proper portions, solving the problem of sun glare.

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

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.
No. 4.




GENERATION
AIR PURIFICATION
HEADQUARTERS
GENERAL ELECTRIC COMPANY
SCHENECTADY N.Y.
TRANSMISSION
LIGHT
TRANSPORTATION
HEAT
A Gateway to Progress
There it stands—a simple forty-foot gateway but unlike any other in the entire world. Through it have come many of the engineering ideas that have made this an electrical America.
The story of electrical development begins in the Research Laboratories. Here the ruling spirit is one of knowledge—truth—rather than immediate practical results. In this manner are established new theories—tools for future use—which sooner or later find ready application.
The great industries that cluster around Niagara Falls, the electrically driven battleships, the trolley cars and electrified railways that carry millions, the lamps that glow in homes and streets, the household conveniences that have relieved women of drudgery, the labor-saving electrical tools of factories, all owe their existence, partly at least, to the co-ordinated efforts of the thousands who daily stream through this gateway.
General Electric Company
General Office
Schenectady, N. Y.
MARINE ELECTRIFICATION
MATERIAL HANDLING
FARM ELECTRIFICATION
HOME CONVENIENCES