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THE FOREST PRODUCTS LABORATORY—ITS WORK AND EQUIPMENT

BY MCGARVEY CLINE, Director

America is distinctly a wood-using country; her per capita consumption of forest products being much greater than that of any other civilized nation. In 1907 the production of forest products reached a climax; during that year not less than twenty billion cubic feet of wood was used, with a total value at the point of production of, approximately, $1,280,-000,000. The kinds of material making up this enormous quantity, and the relative values and amount of each form consumed are shown in Table I:

Table I

Annual Wood Consumption in the United States

	Millions of Cu. Ft. of Forest Material Required	Value at Point of Production.
Lumber, lath, and shingles......	7,000	750,000,000
Firewood	9,200	$250,000,000
Poles, posts, and rails...........	1,000	100,000,000
Hewed cross-ties...............	1,450	60,000,000
Cooperage stock................	350	35,000,000
Pulpwood	350	20,000,000
Round mine timbers............	200	10,000,000

The manufacture of all the materials mentioned in Table I, with the possible exception of firewood, is associated with enormous waste, much of which is unavoidable under existing economic conditions. Some idea of the magnitude of this waste may be had from the consideration of that associated with the manufacture of lumber.

It is estimated, from the results of experiments made by Forest Service, that 25 per cent of the volume of trees cut for lumber is left in the woods in the form of tops, stumps, and culled logs. Of the logs that reach the sawmill 22 per cent is lost in the form of slabs, trimmings, edgings, etc.; 14 per cent in the form of sawdust; and 13 per cent in bark.

The production of lumber in 1907, was, approximately, 40 billion board feet or 3355 million cubic feet of sawed product. Applying the percentages given above we obtain the following estimate; the items in the estimate are expressed both in millions of cubic feet and in per cent of the total amount of wood cut for the production of lumber:

	Million cu. ft.	Per cent.
1. Total wood cut for lumber	8,800	100.0
2. Tops, stumps, culled logs	2,200	25.0
3. Saw logs	6,600	75.0
4 Lumber	3,355	38.2
5. Slabs, trimmings, etc	1,450	16.5
6. Sawdust	925	10.5
7. Bark	860	9.8

Items 2, 5, 6, and 7, aggregating, approximately, 60 per cent of the total wood cut may be termed waste. It is to be remembered, of course, that some of item 2 is used for firewood and that a considerable part of items 5, 6, and 7 is used for fuel in milling operations and for other minor purposes. But even allowing for such utilization it is estimated that, in 1907, four hundred and fifty million cubic feet of slabs and trimmings and 92 million cubic feet of sawdust, as well as enormous quantities of bark, tops and stumps were absolutely wasted.

After the products of the forest are put into commercial use they are subjected to great waste due principally to the ravages of decay, fire, insects, and marine borers. It is estimated that these agencies destroy, approximately, 740 million cubic feet of wood per annum. Further wastes of considerable magnitude are encountered in seasoning and in manufacturing lumber into the numerous articles with which we are already familiar.

This review, although brief and inadequate, indicates a condition of affairs which immediately suggests the following problems:

1. Can wood substances now being wasted be profitably utilized?
2. Can the present methods of seasoning and handling forest products, now being used by the great wood-using industries, be improved so as to involve less waste?
3. Can the serviceable life of the timber in use be lengthened?
4. Are there satisfactory substitutes among American woods for those now becoming scarce?
5. To what extent can other materials be advantageously substituted for wood?

The purpose of the Forest Products Laboratory is to study these problems and to co-operate with the lumbering and wood-using industries in every way possible to bring about greater economy in the use of wood.

The Forest Products Laboratory is run by the Forest Service in co-operation with the University of Wisconsin; the university furnishing, without cost to the Service, the buildings and yard space needed; also the heat, light, water, gas and power, both steam and electric, required for the satisfactory operation of the laboratory. The Forest Service employs the entire staff, furnishes all equipment, and bears all other operating expenses.

The laboratory staff will also present, from time to time, lectures on forestry and the use of forest products, but, aside from such lectures, the staff will take no part in the academic work of the university.

For the purpose of administration, the work of the laboratory is divided into projects. A project may be defined as a series of tests or experiments conducted:

a. For the purpose of investigating problems in experimental research;

b. To verify experimental results on a commercial scale;

c. To assist outside parties in the application of principles and processes of recognized commercial value with which the Service is thoroughly familiar.

Practically all of the work conducted in the laboratory is of the first class, but an important part of the work consists of projects of the last two classes. These latter projects are usually conducted at some commercial plant in co-operation with the company interested in the work; the expenses of the work being largely borne by the co-operating company. The Service has done much in this way to stimulate commercial interests in efforts to secure economy in the use of forest products. It has been found that this plan not only widens the public usefulness of the laboratory staff, but offers an excellent opportunity for the members of the staff to come in intimate contact with the commercial problems upon which they are working. This contact is also secured by inspection trips made by members of the staff for the purpose of studying conditions affecting the commercial utilization of wood.

The technical work of the laboratory is divided into the following sections:

1. Timber Physics.
2. Timber Tests.
3. Wood Preservation.
4. Wood Distillation.
5. Wood Pulp.
6. Chemistry.

Timber Physics

The Section of Timber Physics studies the structure and physical properties of wood, and how these properties are affected by different methods of drying and handling. The principal lines of work at present under way are:

a. The microscopic examination of American woods for the purpose of developing a key to their identification based solely upon the structure of the wood.

b. Experiments to determine the heat conductivity and other heat constants for the principal commercial timbers: In the kiln-drying of lumber and in the treatment of woods with preservatives, it is often important to know how much heat is required, and how long it takes to heat wood to a given temperature.

c. Experimental study of different methods of drying wood.

This laboratory will be equipped with:

1. Microscopes, microtomes, and other apparatus required for the most careful microscopic work;
2. Apparatus for taking micro-photographs;
3. A cylinder especially designed for the study of the different methods of drying wood, and an experimental dry-kiln;
4. Balances, ovens, calorimeters, and other miscellaneous equipment.

Timber Tests

In this section the strength, stiffness, hardness, and other mechanical properties of commercial woods are studied. Tests are also made on woods treated with preservatives and other substances to determine what effect the treatments have on the mechanical properties of the natural wood. The most important lines of work which will be considered in the immediate future are:

a. Tests on the different commercial woods to determine their relative strength, toughness, hardness, etc.: This work is primarily to assist wood users in finding substitutes for woods now becoming scarce;

b. Tests to determine the influence of knots, checks, and other defects used in grading structural timbers on their strength and other mechanical properties: These results are of service to architects, engineers, and lumbermen in forming specifications and grading rules for structural timber;

c. Tests to determine the strength of wood under dead, impact, or repetitive loading: Such tests will assist in the logical determination of the proper working stresses to be used in timber structures;

d. The mechanical properties of wood impregnated with creosote, zinc-chloride, and other preservatives will also be determined.

The timber testing laboratory will contain the following equipment:

1. One 200,000-pound, extension-base Reihle testing machine;
2. One 150,000-pound, extension-base Olsen testing machine;
3. Three 30,000-pound Olsen universal testing machines;
4. One 60,000-inch-pound Reihle torsion machine;
5. One Dory abrasion machine;
6. One impact-testing machine;
7. Deflectometers, and other instruments used in testing structural materials.

Wood Preservation

The impregnation of wood with substances to retard decay and ward off the attack of insects and marine borers has already received much attention. Many processes have been devised, some of which have proved more or less successful and wood preservation is now an industry of considerable importance.

The Section of Wood Preservation studies the problems confronting this industry; these problems may be broadly classified into:

a. Those dealing with the preservatives themselves;

b. Those dealing with the methods of getting the preservatives into the wood.

To study the first class of problems the laboratory will be provided with a fungus pit which will contain chambers thoroughly inoculated with various wood-destroying fungi. The humidity and temperature will be so regulated that conditions in the pit will be most favorable to the growth of the fungi. Woods will be treated with different preservatives and placed in the pit. The efficiency of the preservative will be judged by its ability to ward off the attack of fungi. These experiments, as well as others of a more refined character, will be carried on.

The second class of problems are primarily problems of mechanical engineering, dealing largely with the design and operation of machinery for forcing the required amount of various preservatives into different species and forms of wood to study these problems the laboratory will be equipped with:

1. One treating cylinder $3\frac{1}{2}$ feet in diameter, and 12 feet long, designed to withstand a working pressure of 300 pounds per square inch;
2. One treating cylinder $1\frac{1}{2}$ feet in diameter and 3 feet long, designed to withstand a working pressure of 600 pounds per square inch.
3. Open tanks for treating butts of posts and poles.

This apparatus will be connected with a system of tanks, force, air, and vacuum pumps for handling and storing the preservatives and for forcing them into the wood.

Wood Distillation

The practicability of securing by-products of commercial value from various forms of wood waste is the basic problem of the Section of Wood Distillation. The work naturally divides intc:

a. Experiments to determine what products and how much of them can be secured from different woods: Alcohol, turpentine, wood creosote, and acetates are the products at present of the greatest commercial importance;

b. The design and operation of machinery best adapted to the production of those products having the greatest value;

c. The refining of the crude products.

The species which will be first studied are southern pine, Douglas fir, Norway pine, and other resinous woods. It is already known what products can be secured from these woods, but there is great room for improvement in the methods of producing and refining them. The distillation of different hardwoods will also be studied.

This work offers interesting possibilities for the utilization of slabs, sawdust, stumps, and other forms of mill and forest wastes.

The wood distillation laboratory will be equipped with:

1. One steam distillation and extraction retort;
2. One oil-jacketed destructive distillation retort;
3. One three product continuous refining still and accessary apparatus.

Wood Pulp

The Section of Wood Pulp is concerned chiefly with the problems of the pulp and paper industry. It will also investigate the practicability of using mill and forest wastes in the manufacture ot fiber products.

This laboratory will be a miniature pulp and paper mill equipped as follows:

1. One 30-pound sulphite digester;
2. One 30-pound soda digester;
3. An acid-making system;
4. Experimental grinder for the manufacture of ground-wood pulp;
5. One beating engine;
6. One 6-plate screen;
7. Knuckle-joint power press;
8. Froudrinier paper machine which manufactures a continuous sheet of paper 15 inches wide.
9. Drums, washers, agitators, tanks, and other accessory apparatus for testing pulp and paper.

The problems which will be first studied are:

a. Methods of making ground-wood pulp for the purpose of determining whether or not commercial pulp can be made from species other than spruce;

b. The practicability of treating different woods with the sulphite and soda processes;

c. The quality of paper which can be made from different grades of the various sulphite, soda, and groundwood fibers;

d. The practicability of using different forms of wood waste for the manufacture of paper pulp and other fiber products.

Chemistry

The Section of Chemistry studies the chemical properties of wood and the products secured from them; also the properties of preservatives and other materials used in the treatment of wood. The purposes of the work are:

1. To find uses for products at present having little or no commercial value;
2. To secure data upon which to base commercial specifications for wood products, wood preservatives, and other chemicals used in the treatment of wood;
3. To study chemical problems that come up in connection with the work of the other sections.

The principal lines of investigation at present under way are:

a. The analysis and grading of commercial creosotes;

b. The analysis and grading of wood turpentines;

c. Methods of analyzing treated wood to determine the kind and quantity of preservative in it.

Wood Working and Machine Shops

In addition to the equipment already listed the laboratory will be provided with a wood-working shop and a small machine shop.

The wood-working shop will be equipped with:

1. One short-log sawmill and edger capable of handling logs 24 inches in diameter and 10 feet long;
2. One 8-inch by 24-inch single surfacer;
3. One 24-inch jointer;

4. One 36-Inch band saw;
5. One swing cut-off saw with a 36-inch blade and a 16-foot roller table;
6. One universal circular saw;
7. One trimmer;
8. One 36-inch grindstone and a full equipment of carpenter's tools.

This equipment will be used in the preparation of specimens of various kinds.

The machine shop will contain:

1. One 14-inch engine lathe;
2. One Garvin universal milling machine;
3. One 21-inch drill press;
4. One bench drill;
5. One blacksmith's forge and anvil;
6. One 12-inch emery grinder and a complete equipment of small tools, pipe and bolt threading tools and milling machine cutters.

This equipment will be used in the construction and modification of experimental apparatus.

It is expected that all of the equipment will be installed and the laboratory ready for operation about May 1, 1910. The apparatus will then be available to the students and to the university faculty for investigative work of an advanced character; provided that such use of it does not interfere with the routine work of the laboratory.

TESTS ON THE PERMEABILITY OF CONCRETE

F. M. McCullough

I. INTRODUCTION

In this article will be given in condensed form a report of a series of permeability tests made in the laboratory for testing materials at the University of Wisconsin during the summer and fall of 1908. A detailed account of these tests will be found in University Bulletin No. 1, Vol. 6, Engineering Series. The object of the tests was to determine the efficiency of some of the commercial compounds used for the waterproofing of concrete.

Tests were made on fourteen compounds, each compound being subjected ordinarily to pressures of approximately 20 lbs / in^2 and 40 lbs / in^2. The duration of the test was usually three days, and a record was kept of the amount of water entering the concrete.

In order to ascertain the effect on the strength of concrete of the compounds which are added to the body of the concrete, compression specimens were made. Three of the compounds were tested in this manner, the specimens being broken at the ages of 1, 2 and 10 months.

II. DESCRIPTION OF APPARATUS AND MATERIAL

Apparatus:—The apparatus which was designed for these tests consists essentially of eight six-inch pipes filled with concrete and a pipe system connected with air and water reservoirs. Fig. 2 shows in detail the mold and attached casting and Fig. 1 is a general drawing of the pipe system for four specimens, the apparatus for the remaining four specimens being the same as shown.

The molds shown in elevation in Fig. 1 and in section in Fig. 2 were six-inch wrought iron pipe, $12\frac{1}{2}$ inches long, with a cast-iron flange screwed to the upper end. In order to

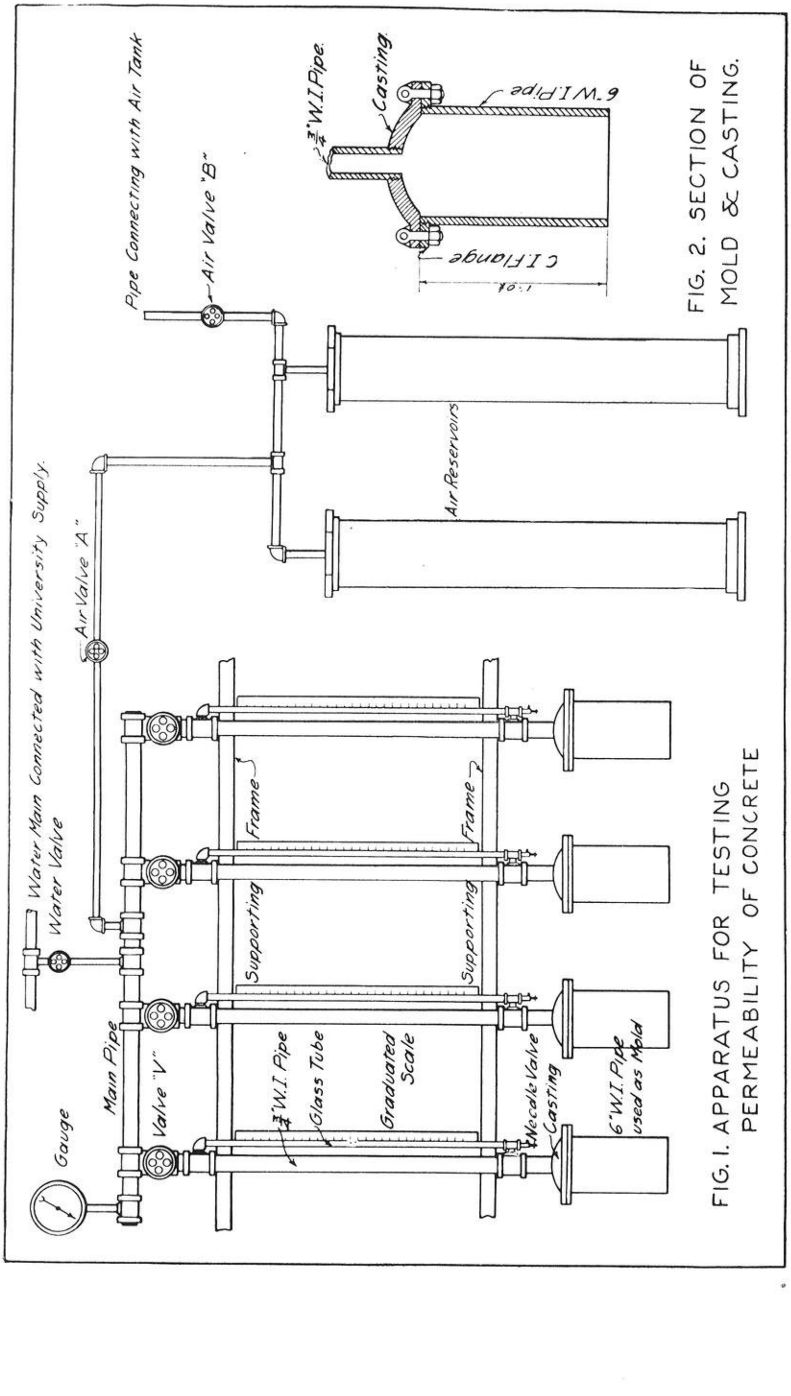


FIG. I. APPARATUS FOR TESTING PERMEABILITY OF CONCRETE

FIG. 2. SECTION OF MOLD & CASTING.

prevent the passage of water between the pipe and the cement lining ten or twelve V-shaped grooves were cut in each pipe, each groove extending around the inner surface of the pipe.

This flanged pipe was attached to the casting by means of six eye-bolts. A $\frac{3}{4}$-inch pipe, 4 feet 6 inches long, was screwed into this casting. Each of these $\frac{3}{4}$-inch pipes was joined to the main pipe, which in turn connected with the water main and with the air reservoirs. The shut-off globe valves for water and air are shown on the pipes connecting the main pipe with the water main and with the air reservoirs. Two cast-iron cylinders, $6\frac{1}{2}$ inches in diameter and 4 feet 8 inches long, formed the air-reservoirs. They were connected with a large air-tank, not shown, by means of the pipe shown in Fig. 1, a shut-off globe valve being placed between the air-tank and air-reservoirs.

A glass tube and attached scale graduated to hundredths of feet, were fastened to each $\frac{3}{4}$-inch pipe in order to obtain the water level in the pipe. The globe valve "V" was used to disconnect any specimen proving defective. The $\frac{3}{4}$-inch pipe and glass tube were drained by means of the needle valve. A gage registered the air pressure.

Concrete:—The proportions by volume of the concrete were 1 : 3 : 5, the required amount of the materials being weighed on a scale. No attempt was made to secure a waterproof concrete by proper proportioning. On the contrary, a lean mixture was desirable in order to bring out the waterproofing qualities of the compounds.

Stone and Sand:—Local stone and sand and Atlas cement were used. The stone was a rather sandy lime-stone while the sand was of the fine bank variety.

Waterproofing Compounds:—The compounds tested, which were all secured through local dealers in order to obtain the ordinary commercial product, were Century Cement Fluid, Dehydratine No. 4, Des Moines Elaterite No. 60, Hydrex Waterproof Felt and Compound, Limate, Medusa Waterproof Compound, Siastex Waterproofing Fabric No. 2 and

Pitch, Universal Damp-Proof Compound, Aquabar, Antihydro, Antihydrine, Wunner's Bitumen-Emulsion, Coatine, and Flexible Compound. In nearly all cases the manufacturers, at our request, gave special instructions in regard to methods of waterproofing against the pressures used, such instructions being usually followed in the tests. As the name indicates, Universal Damp-Proof Compound is used for damp proofing and not for waterproofing.

III. METHOD OF MAKING THE SPECIMENS AND OF PERFORMING THE TESTS

Making the Specimens:—Materials sufficient for two specimens were weighed out and thoroughly mixed by hand. The consistency of the concrete was such that it flowed readily from a pile on the floor. A quantity of neat cement was mixed with sufficient water to make a thick paste.

The six-inch pipe was now lined with this neat cement paste to a thickness, varying from $\frac{6}{10}$ to $\frac{7}{10}$ inches and then filled with a concrete core. The cement lining and the grooves, previously mentioned, were required to prevent water from seeping along the surface of the pipe and were very effective.

A set of 8 specimens was usually made for each kind of waterproofing, 4 of the specimens being tested at a pressure of 40 lbs / in^2 and 4 at a pressure of 20 lbs / in^2. All specimens were first tested at 40 lbs / in^2, and, if satisfactory, no other specimens were made. The duration of the tests was about 3 days, although the time was extended to 7 or 10 days in a few cases. In order to prevent shrinkage cracks, the specimens were covered with damp cloths for a few days after being made. The specimens were stored in air and were 35 days old when tested. The pressure was at all times applied to the upper or waterproofed surface of the concrete.

Performing the Tests:—The specimens were securely bolted to the castings, an Eclipse rubber gasket being used between the finished faces of flange and casting. With the air valve "A" closed and the air valve "B" opened, air was admitted to the reservoirs until sufficient pressure was obtained. The water-valve was opened and water was allowed to fill the $\frac{3}{4}$-inch tubes. Care was taken that the pressure did not exceed that used in the test, this being regulated by opening the needle valves. Air-valve "B" was closed and air-valve "A" connecting with the air reservoirs was opened, thus subjecting the specimens to pressure. Usually it was necessary to drain the $\frac{3}{4}$-inch pipes through the needle valves until the water level was visible in the glass tubes.

The rate of flow of the water through the concrete was obtained by noting the scale readings and the time. Pressures were also noted, but they showed very little decrease as the volume of the air-reservoirs was very large compared to the volume of the $\frac{3}{4}$-inch pipes. No readings were taken for five minutes after the pressure was on. As the rate of flow rapidly decreased readings were taken at intervals of 10 or 15 minutes for the first few hours and then at intervals gradually increasing from 2 to 8 hours. The bottoms of the specimens were frequently examined and any dampness noted.

IV. RESULTS OF EXPERIMENTS

The compounds that were tested may be classified as follows according to the manner in which they were used:

(1) Compounds that were applied to the surface of the concrete. These may be sub-divided into three classes: (a) Compounds which were applied as surface paints, as Century Cement Fluid, Des Moines Elaterite No. 60, Universal Damp-Proof Compound, Antihydrine, and Flexible Compound. (b) Compounds which were applied in layers of felt, burlap, or tarred paper with a cementing material, as Hydrex Waterproof Felt and Compound, Siastex Waterproofing Fabric No. 2 and Pitch, and Dehydratine No. 4 and common tarred roofing paper. (c) Coatine which is a surface coating used in the form of a thick layer.

(2) Foreign ingredients that were added to the body of the concrete as Limate, Medusa Waterproof Compound, and Aquabar.

(3) Foreign ingredients that were added to a mortar coating as Medusa Waterproof Compound, Aquabar, Antihydro and Wunner's Bitumen-Emulsion.

A set of specimens was made using for waterproofing an ordinary mortar coating and a neat cement wash, this method of waterproofing being frequently made use of in reservoirs under a low head. In order to determine the effectiveness of

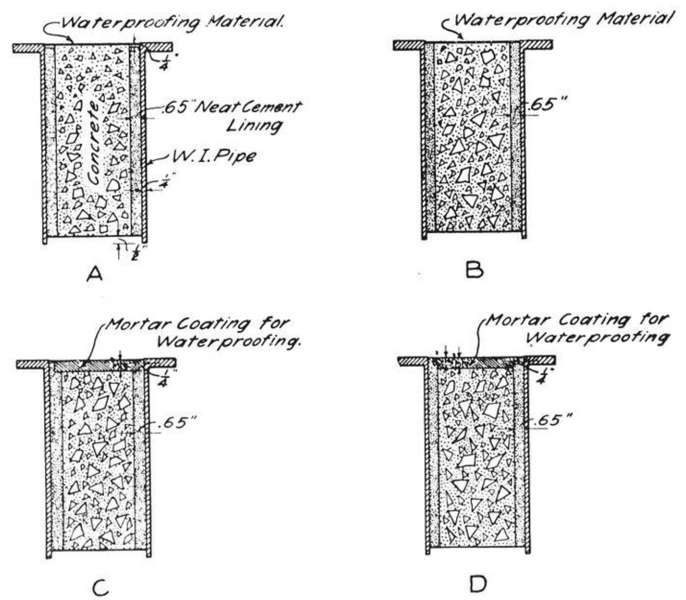


FIG. 3. SHOWING METHOD OF FINISHING UPPER SURFACE OF CONCRETE.

waterproofing materials in general, a set of specimens was made in which the concrete was not waterproofed.

Different methods, as illustrated in Fig. 3, were used in finishing the upper surface of the specimens, depending upon the kind of waterproofing compound used. As shown at A and B in Fig. 3, the concrete was finished flush with the top of the pipe, the upper surface of the concrete being well troweled. Before troweling, the specimens were allowed to stand a half hour in order that the free water on the concrete might be absorbed. The cement lining extends to the top of the concrete in B, while in A it is cut off $\frac{1}{4}$ inch below. In the specimens that were coated with mortar (see C and D of Fig. 3) the surface of the concrete was $\frac{3}{4}$ of an inch below the top of the pipe. After the concrete had absorbed the standing water the mortar top was added, the surface of the concrete and the mortar being thoroughly troweled.

The experiments will be discussed in the same order in which the waterproofing compounds have been considered. In applying all surface preparations care was taken to secure a dry, clean surface and to have the preparation well brushed in.

Century Cement Fluid:—This is a gray substance resembling caked putty, which was thinned with benzine to the consistency of a thick cream before being used. It is sold by the Century Cement Fluid Co., Madisonville, Ohio. The compound was applied in three coats with a brush at the ages of 14, 24, and 30 days. Only four specimens of the type shown at B in Fig. 3 were made because of a lack of time. These were subjected to a pressure of approximately 20 lbs / in^2 for 263 hours and no appreciable flow was noted.

Des Moines Elaterite No. 60:—This is a black tar-like liquid furnished by The Elaterite Paint and Manufacturing Co., Des Moines, Iowa. It is of the consistency of linseed oil and was applied cold. Eight specimens were made similar to that shown at B in Fig. 3. Three coats of the compound were applied at the age of 15, 23 and 31 days for the specimens tested at 20 lbs / in^2 and at the age of 10, 17 and 23 days, for those at 40 lbs / in^2. The specimens subjected to a pressure of 20 lbs / in^2 showed no measurable flow during the 72 hours that they were under pressure. The flow of the specimens subjected to a pressure of 40 lbs / in^2 was quite variable. The duration of the test was 68 hours. Specimen No. 53 was practically impermeable, the flow of

No. 54 and No. 52 was moderate but No. 51 showed excessive flow. While considerable leakage was noted at the flanged joint of No. 51 and No. 52, this leakage would not account for the increased flow of No. 51. Furthermore, while the bottoms of No. 53 and No. 54 were dry at the end of the test, the bottom of No. 51 was wet and that of No. 52 was damp.

Universal Damp-Proof Compound:—This is a heavy tar-like paint which was secured from the Universal Compound Co., No. 88 Maiden Lane, New York City. The 8 specimens were of the type sketched at B in Fig. 3. The compound was applied at the age of 15, 23 and 30 days for the pressure of 21 lbs / in^2, and at the age of 10, 16 and 26 days for the high pressure specimens. The result at the 20 lbs / in^2 pressure for a period of 251.5 hours were satisfactory, but extremely variable. Specimens No. 127 and No. 130 were practically impermeable, while specimens No. 128 and No. 129 showed moderate flow. Three of the four specimens that were tested at a pressure varying from 35 lbs / in^2 to 37 lbs / in^2 showed excessive flow, while considerable water entered the fourth specimen. Moisture was noted on the bottom of No. 57 within 6 hours after the pressure was on, while No. 58 and No. 56 were wet within 16 hours. Specimen No. 59 remained dry on the bottom during the test which continued for 69 hours. This compound was unsatisfactory at this high pressure.

Antihydrine:—This compound is manufactured by The Antihydrine Company, New Haven, Conn. It is thin tar-like liquid which is applied cold. Because of a lack of time only 4 specimens of the type shown at B in Fig. 3 were made. Three coats of Antihydrine were applied at the age of 15, 23 and 31 days. Under a pressure of $20\frac{1}{2}$ lbs / in^2 one of the specimens was impermeable, while the flow for the remaining three was moderate. All the specimens were dry on the bottom at the end of the test, which lasted about 168 hours. These specimens were removed from the apparatus and stored for 26 days, when they were tested at a pressure of 40 lbs / in^2 for 79 hours, the flow for each of the specimens being very small.

Flexible Compound:—This material, which resembles linseed oil in color and consistency, was secured from S. P. Holmes & Co., Chicago, Ill. Before applying the compound it was mixed with white lead, the proportions being 25 pounds of lead to one gallon of the compound, the mixture being of a creamy consistency. A set of specimens was made similar to that shown in Fig. 3 at B. Three coats of the waterproofing were used, applied at the age of 15, 23 and 30 days for the low and at 10, 16 and 26 days for the high pressure specimens. The results at each pressure were very satisfactory, the flow being small and uniform. The first set of specimens was tested at a pressure of approximately 21 lbs / in^2 for 251.5 hours, and the second set at a pressure varying from 35 lbs / in^2 to 37 lbs / in^2 for 69 hours.

Hydrex Waterproof Felt amd Compound:—These materials were purchased from the Hydrex Felt and Engineering Co., New York City. Four specimens, similar to those shown in Fig. 3 at A, were treated with these compounds at the age of 19 days. The compound was heated so that it ran readily from a stick and was then quickly applied with a swab in an even layer to the upper surface of the concrete. A sheet of felt was now placed on the compound and well smoothed with a brush. Alternate layers of compound and felt were applied until the specimen was covered with three thicknesses of felt and four layers of the compound. The sheets of felt were of sufficient size to extend outside of the flange. This waterproofing gave excellent results, the specimens showing no flow whatever when subjected to a pressure of 40 lbs / in^2 for 163 hours.

Siastex Waterproofing Fabric No. 2 and Pitch:—These materials were obtained from the Sicilian Asphalt Paving Co., New York City. The form of specimen used and the manner of applying the waterproofing were exactly the same as for Hydrex Waterproofing Felt and Compound. The specimens were treated at the age of 11 days. The test continued for 68 hours at a pressure 39 lbs / in² and the specimens showed no permeability whatever.

Dehydratine No. 4 and Tarred Roofing Paper:—Dehydratine No. 4 is manufactured by the A. C. Horn Co., New York City. It is a black, tar-like liquid of medium consistency which was applied cold. Tarred roofing paper similar to that found in ordinary building construction was used with this compound. The four specimens were of the type sketched at A in Fig. 3, and the materials were applied in the same manner as was the Hydrex Felt and Compound with this exception. Two coats of Dehydratine were applied to the surface of the specimens and to the upper sheet of roofing paper, the first coat being quite dry when the second coat was added. The flow at a pressure of 40 lbs / in² was practically zero for the 66 hours that the test continued.

Coatine:—This is a gray fibrous material resembling soft putty and was obtained from H. B. Morgan Co., Grand Crossing, Chicago. It does not appear to harden and was still quite plastic 35 days after applying. Eight specimens were made of the form shown at D in Fig. 3 but with Coatine used in place of mortar. In order to secure adhesion between the Coatine and the concrete and cement lining, the surface of the latter was roughened with a trowel and allowed to set thoroughly before the Coatine was applied. The layer of Coatine was placed on the specimens at the age of 5 days, care being taken to secure a good joint by proper troweling. The three specimens were subjected to a pressure of 20 lbs / in² for 74 hours. Specimen No. 193 was impermeable while No. 192 and No. 195 gave a very slight flow. The results for the specimens tested at an average pressure of 38 lbs / in² for 145 hours were also satisfactory. Specimen No. 200 was impermeable, No. 202 practically so, while No. 203 showed a slight flow and 201 a moderate flow. However, the needle valve of No. 201 leaked throughout the test, and this will account in part for the increased flow of the specimen.

Antihydro:—This is a thin liquid, greasy in consistency and containing a brown sediment. It was secured from the F. M. Hausling Co., New York City. Eight specimens were made of the type shown at D in Fig. 3. After the concrete had absorbed the water standing on its surface, the mortar coating was applied in three parts, the total thickness being $\frac{3}{4}$ of an inch. The concrete was first covered with a slush coat or grout of neat cement to a thickness of $\frac{1}{8}$ of an inch. This was followed by a scratch coat of mortar $\frac{1}{4}$ to $\frac{3}{8}$ of an inch thick, the proportions being one part of cement to two parts of sand. After the initial setting of the scratch coat, the finish coat of mortar was applied, its thickness being $\frac{1}{4}$ to $\frac{3}{8}$ of an inch and the proportions one part of cement to one part of sand. Each coating was gaged with a mixture of water and Antihydro, the proportions by volume being one part of Antihydro to 10 parts of water. Care was taken to thoroughly trowel each coating. The results at a pressure of 40 lbs / in^2 were quite satisfactory, the test continuing for 67 hours. The flow was small and uniform for the different specimens. With the exception of specimen No. 190, which showed leakage at the flange joint, the specimens were practically impermeable for a pressure of 20 lbs / in^2 when continued for 141 hours.

Plain Mortar:—Eight specimens were made similar to that sketched at C in Fig. 3. A $\frac{3}{4}$-inch mortar coat of the proportions, 1 part cement to $1\frac{1}{2}$ parts sand, was applied to the concrete, the mortar being well troweled. At the age of 14 and 23 days the surface of each specimen was painted with a coating of neat cement of a creamy consistency. The cement and mixing water were not treated with any waterproofing compounds. Three of the specimens that were tested at a pressure of 39 lbs / in^2 for 68 hours gave satisfactory results. Specimen No. 66 showed excessive flow, dampness being noted on the bottom 24 hours after pressure was applied. The flow was moderate during the 93 hours that the three specimens were subjected to a pressure of $19\frac{1}{2}$lbs / in^2. Owing to defective apparatus it was not possible to test specimen No. 135.

Tests at pressures of 40 lbs / in^2 and 20 lbs / in^2 were also made on Medusa Water-Proof Compound, Limate, Aquabar, Wunner's Bitumen-Emulsion and plain concrete, but the results obtained were conflicting. Additional tests on these materials are desirable.

However, these two facts were brought out:

1. That when Medusa Water-Proof Compound, Limate and Aquabar were added to the body of the concrete and not in the form of a mortar coating, unsatisfactory results were obtained in 45 out of 48 specimens.

2. That all specimens of plain concrete were wet on the bottom either before or at the end of 3 days, thus showing the effectiveness of some of the waterproofings discussed in this bulletin.

V. COMPRESSION TESTS ON CONCRETE

Concrete:—The proportions by volume of the concrete were 1 : 3 : 5. The cement, sand, and stone used were the same that were described under the permeability tests. The concrete, which was of a wet consistency, was machine-mixed, ordinary methods being followed except in the case of Medusa Waterproof Compound.

Waterproofing Compounds:—The compounds tested were Limate, Medusa Waterproof Compound, and Aquabar.

Making of Specimens:—The specimens were of a cylindrical form, 6 inches in diameter and 18 inches high, cast iron molds being used. Cylinders treated with each of the waterproofing compounds were made with 6 in each set, and 8 cylinders of plain concrete were made.

Performing the Tests:—The specimens which were stored in the laboratory were broken in a Richlé Universal testing-machine at the ages of 35, 62, and 292 days.

Results of Experiments :—In Table I are given the results of tests which will now be considered.

(a) *Plain Concrete:*—For some unexplained reason the strength ofthe plain concrete specimens, marked P, was about 6 per cent. less at 292 days than at 62 days.

(b) *Limate:*—This material is a hydrated lime obtained from the Western Lime and Cement Co., Milwaukee, Wis., Four sets of specimens were made, the ratio by weight of Limate to the cement for the different cylinders being 10 per cent., 14 per cent., 18 per cent., and 22 per cent., respectively. In each case the Limate replaced an equal weight of the cement. The Limate and cement were first thoroughly mixed dry by hand. This mixture with the sand was then thrown into the mixer and the mixing process carried on in the ordinary manner. The specimens marked L10, L14, etc., (see Table I) indicate those in which the Limate was equal to 10 per cent., 14 per cent, etc., of the weight of the cement. As shown in this table, the use of Limate usually increased the strength of the concrete, this effect being especially marked with the L10 and L14 specimens.

(c) *Medusa Water-Proof Compound:*—This is a dry powder furnished by the Sandusky Portland Cement Co., of Sandusky, Ohio. A quantity of the compound equal to 2 per cent. of the weight of the cement was thoroughly mixed dry with the cement. Water was slowly added to this mixture while at the same time it was well troweled. The addition of water and the troweling were continued until the mixture was of a damp consistency. It was now thrown into the mixer with the sand, and the mixing then completed. By referring to Table I it will be seen that the cylinders (mark M) treated with this compound were stronger than those of plain concrete at corresponding ages. Furthermore, there was a decided increase in strength with age.

(d) *Aquabar:*—This compound was obtained from the Aquabar Co., Philadelphia, Pa. This is a material in gelatine form which, when properly diluted, is used to temper the mortar or concrete. The compound was thoroughly mixed with water in the proportions of 2 gallons of the compound to 48 gallons of water. The concrete for these cylinders was mixed as usual but with this exception, that the Aquabar solution instead of water was used to temper the mortar and the concrete. The results (see Table I) were very unsatisfactory, the Aquabar specimens (mark Aq) showing from 46 to 64 per cent. of the strength of plain concrete at corresponding ages.

TABLE I

EFFECT OF WATERPROOFING COMPOUNDS ON THE COMPRESSIVE STRENGTH OF 1 : 3 : 5 CONCRETE

Specimens	Ultimate Compressive Strength in Lbs / in²					
	Age, 35 days		Age, 62 days		Age, 292 days	
		Average		Average		Average
P	940	....	1110	....	1330	
P	780	....	1160	....	880	
P	....	....	....	....	930	
P	....	860	....	1135	1140	1070
Aq.	570	....	480	....	620	
Aq.	530	550	570	525	....	620
L10	1110	....	1200	....	1240	
L10	960	1035	1180	1190	1210	1225
L14	1130	....	1270	....	1130	
L14	1050	1090	1320	1295	1300	1215
L18	1040	....	1000	....	1040	
L18	860	950	1190	1095	1020	1030
L22	1000	....	1250	....	1340	
L22	750	875	1000	1140	1140	1240
M	970	....	1090	....	*1270	
M	890	930	1160	1125	1220	1245

* This specimen was broken by mistake at the age of 224 days.

VI. CONCLUSIONS

The following conclusions are drawn as the result of the experiments:

1. Unless extreme care is taken in proportioning, it is necessary that some form of waterproofing be used for a 1 : 3 : 5 concrete for pressures from 20 lbs / in² to 40 lbs / in².

2. For nearly all specimens the rate of flow decreased rap-

idly with time. This was especially marked in the case of the mortar coatings and was due in part to their dry condition.

3. All of the surface paints were quite satisfactory at pressures of 20 lbs / in^2. When subjected to pressures of 40 lbs / in^2, Des Moines Elaterite No. 60 and Universal Damp-Proof Compound proved unreliable. The mixture of Flexible Compound and white lead gave good results at both pressures. Century Cement Fluid was not tested at the high pressure, and while Antihydrine gave only a small flow at 40 lbs / in^2, the results can not be compared with those of the other compounds because the test was carried on under different conditions.

4. Waterproofing materials composed of layers of felt, burlap, or tarred paper, cemented together with a compound, gave excellent results at the high pressure. Not one of the specimens treated with Hydrex Felt and Compound, Siastex Fabric No. 2 and Pitch, and Dehydratine No. 4 and tarred roofing paper showed any appreciable flow.

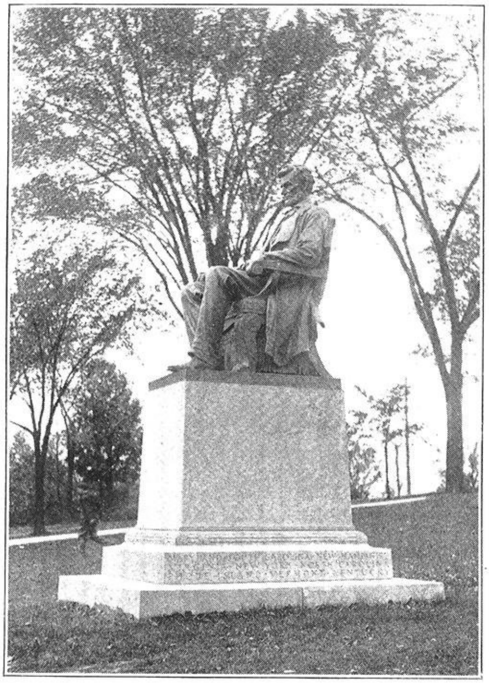
5. Coatine was practically impermeable at the two pressures.

6. The mortar coatings in the case of Antihydro gave good results at both pressures, there being practically no flow after the first 24 hours. It is possible, however, that its effectiveness was due partly to the method of applying the mortar. For waterproofing used in this manner, it would seem desirable to apply the mortar in two layers after first covering the concrete with a neat cement slush coat. The plain mortar with a neat cement wash was effective at a pressure of 20 lbs / in^2 but proved unreliable at 40 lbs / in^2. No doubt a plain mortar coating would prove satisfactory in waterproofing concrete at high pressures, providing it be applied as just described.

7. Waterproofing compounds that are added to the body of the concrete are worthless at pressures from 20 lbs / in^2 to 40 lbs / in^2 unless great care be used in proportioning.

8. Limate, when replacing 10 per cent. to 22 per cent. of the weight of cement, and Medusa Waterproof Compound

equal to 2 per cent. of the weight of the cement, do not impair the compressive strength of 1 : 3 : 5 concrete. On the other hand, Aquabar equal to $4\frac{1}{6}$ per cent. of the mixing water reduces the strength of 1 : 3 : 5 concrete by percentages varying from 36 per cent. to 54 per cent.



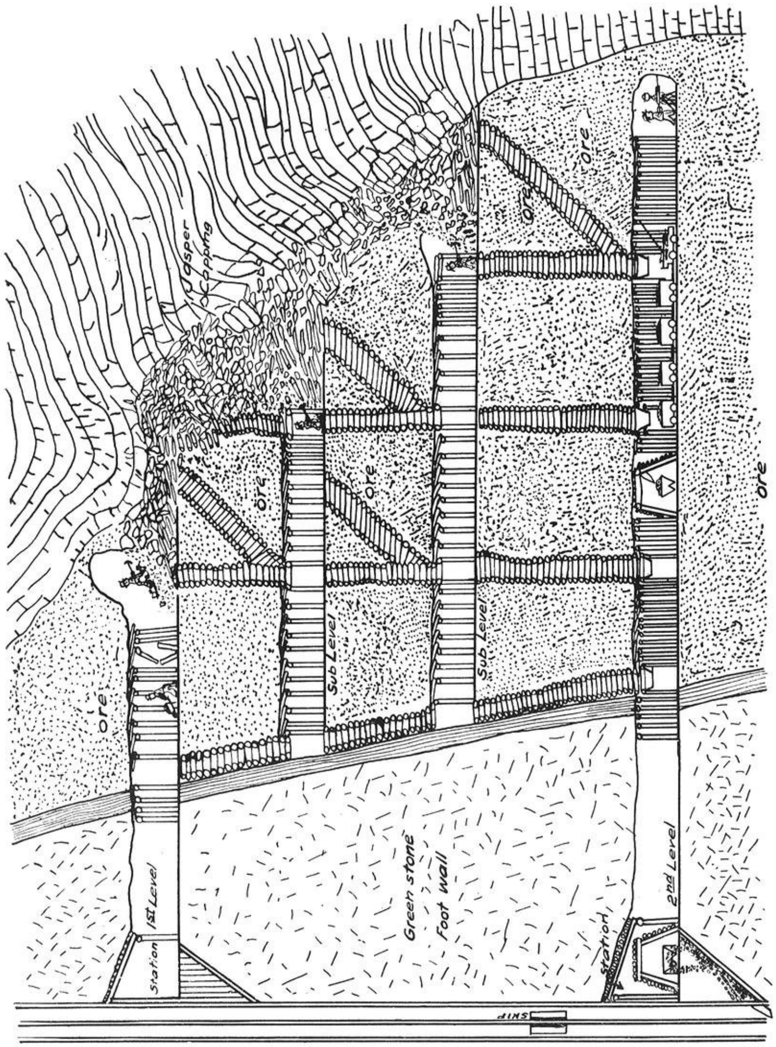
CAVING SYSTEM IN ELY DISTRICT

FRANK KENNEDY

The caving system is used in the Ely District except in those places in the mines where only pockets of ore occur. These pockets are sliced out by the usual methods, and wheeled to the nearest raise. The ore body is many hundreds of feet in depth, confined between two walls and over-capped with jasper. The walls are nearly vertical and are composed of altered Diorite, (commonly called Green Stone), and jasper. The Diorite is so much changed in places that it looks like legnite. The upper part of the ore body is soft, very blue, and is called by the miners "Blue Rubbly Ore." It grades from the soft ore on top to a very hard ore deeper down. The ore on the 14th level of the Pioneer Mine is as hard as any ore on Soudan or Gogebic Iron Ranges. Yet this ore caves as readily as the softer ores when properly handled.

All shafts are sunk in either the foot wall or hanging wall, so that no part of the shaft is nearer the ore body than 150 feet or more. This is done in order to mine out all possible ore and keep the shaft from moving while the ore is being mined. If there is any movement of the earth very near the shaft, it is sure to move with the ground.

The 1st Level is run in 100 feet below the top of the ore body and is divided into pillars of approximately 70 feet square. As soon as the 1st level becomes fairly well developed, the subs above are started. The main levels are 100 feet apart, so it is possible to place two sub-levels between the main levels $33\frac{1}{3}$ feet apart. Raises are run every 25 or 30 feet from the 1st level to the 2nd sub-level. Pole sets are then put in over each raise. The sub-drifts are put on directly over those below so that the raises from the main level come up in the side of the drift of the sub; and it is usual to have a raise in the center of the drift wherever two drifts cross each other. (The accompanying cross-section shows the relative position of the sub-levels to the main levels.)



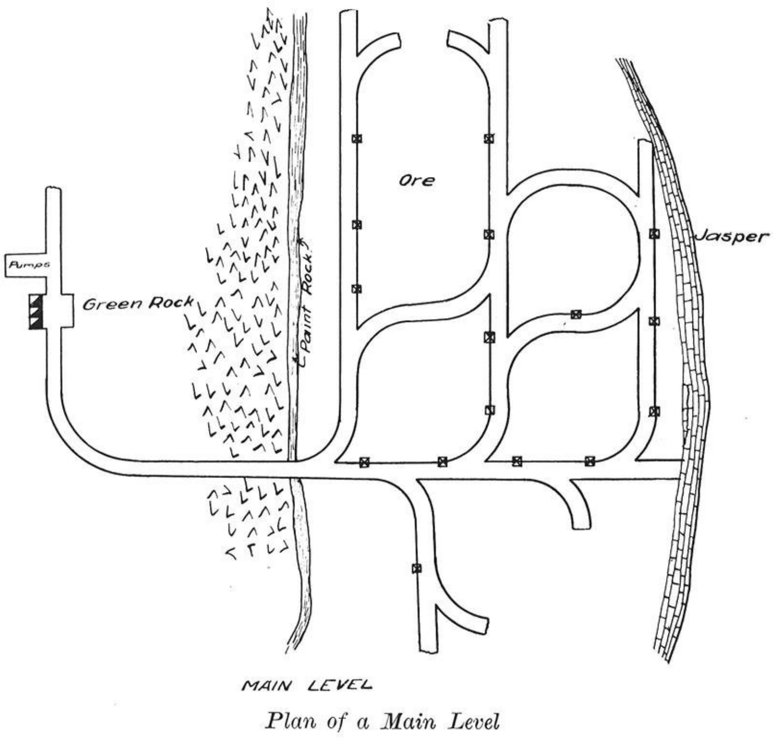
Cross-section Through the Mine

Work is now begun on the first sub. Inclined raises are run from here to the second sub, so each vertical raise from below has from two to three raises running into it. The second sub at this stage is supposed to have been cut up into pillars 70 feet square. The pillars are cut still smaller. They are now too small to hold the great weight of ore and surface above. The timbers begin to crush and lining sets are put in to hold them up still longer until the crushing is more nearly complete. A vertical section now of the second sub looks like a honey comb. This part of the mine is now in a good condition to cave.

The miners begin to mine in the ends of the ore body, when the ore pinches out between the foot and hanging walls. It is here that it is often necessary to do a great amount of wheel-barrow work, for it is almost impossible to get raises to every part of the mine. But as soon as the ore is mined to where the raise is located, the wheel-barrow is discarded and the caving system begun. A small cave is blasted in above and to one side of a raise. This cave fills up with the crushed ore and runs with little effort into the chute. As soon as the jasper capping begins to run with the ore, the cave is stopped up with old timber. A cave is now started on the other side of the raise, and the same process is gone through with again. The boulders of jasper are stopped by cross pieces over the raise and thrown in a drift that is mined out to the rock. The pieces over the raise also keep anyone from falling into the chute. The miners call each cave a "chance," and there are two or three chances to every raise. When the "chances" are gone, the drift is allowed to crush down. It can easily be seen that there will be a layer of timber between the ore and jasper capping as the mining is carried arther down.

Caves hang up now and then so that the back is nearly 30 or 40 feet high, and is often necessary to blast heavily before the cave is filled. A poor cave is one which will not fill up readily, and in order to run well it should be nearly full all the time. When the ore in the back is "dropping well," it runs a stream of 6″ or 8″ diameter into the chute; and it will run two or three days with an output of 200 or 300 cars. The writer has known a cave to run 250 cars per day.

The development of the main level is carried on in advance of the subs above. The ore is hard and the development is slow. In some cases it takes two weeks to raise from one sub to another by the use of air drills. Drifts are driven on



Plan of a Main Level

the 14th level, Pioneer Mine, at the rate of 25 feet per month with a Rand drill.

By the time the last level and subs are mined out, the subs below are being developed. They are not cut up into small pillars as above, unless the ground is very stable.

The main level is caved down somewhat differently than the subs. The subs can only be caved into chutes, while on the level a temporary chute, called a "slab chute," can be put in at any place where it is possible to get a tram car. A quarter pan is not put in but the ore is held back by the use of a short plank.

One thing is noticeable about the caving system and that is the large amount of timber that lies between the ore and jasper capping. The first indications that a miner gets that his cave is going to play out, is the appearance of timber in the cave. The timber is piled in an old drift, and the ore allowed to run until the jasper comes down.

Drift sets on the subs are 7′ x 8′, and the main level 8′ posts and 10′ caps. The center posts are large at all turns, sometimes as much as 3′ in diameter. All raises are well cribbed and most of them are retimbered before the caving is complete.

There is perhaps no method of mining where as many tons per man can be gotten out as in this system. The Sibley Mine averaged 11 tons per man per day for several months. The Chandler Mine in its last stages mined ore as low as $0.39 per ton. The Pioneer and Zenith Mines average from 6 to 8 tons per man per day. However, the tons per man depend a great deal on the amount of development work that is going on.

The loss of life is low, although it has been but of late years that the necessary precautions have been taken to prevent ordinary mining accidents. The method used in the Pioneer Mire to prevent collisions between their trains is used in many mines on the Mesabi. The mine is lighted entirely by electricity and red globes are used on the most important turns leading to the Shaft or Station. The light is close to the cap, and is operated altogether with a switch. When the switch is turned to allow one train into the station, the red light shows any approaching train that there is already one train ahead, and waits until the empty train pulls out. A large amount of blasting is done on the sub-levels which endangers the men at work in the caves and at the chutes on the main level. Speaking tubes are put in between the main level and subs; so there is a speaking tube station under or near every part of the mine that is being caved. A large gong is placed at the station and an electric switch which controls numerous red lights on the sub level above. When the red lights on the sub-level above are on there is no blasting done, and the men are free to work in the caves. When a miner in a cave wishes to blast he speaks through the tube to the nearest station on the main level, who immediately turns out the red lights and sounds the gong. As soon as the men on the main level hear the gong and those in the subs see that the red lights are extinguished, they go to a place of safety.

All raises not in use are covered so as to keep any one from falling down them, and a fence is built around those in use. The ladder ways have but openings large enough to allow a man to get through. These are usually inclined and never more than 35 feet in length.

FIELD LOCATION OF CANALS FOR IRRIGATION

L. R. Balch, '05

The canals of an irrigation project may, in general, be classified as:

(*a*) The Main Canal which carries the water from the source of supply to the irrigable area.

(*b*) The Lateral Canals, which serve to convey the water from the Main Canal to the various farm units. The lateral canals are collectively designated as the Distributing System.

With modification, the same methods of location apply to both systems, and since the surveys for the main canals are the more elaborate, a discussion of the latter will only be attempted.

The location of a canal differs from that of a railway in that the gradient must fall continuously from the source to the extreme end and also much sharper curves may be used on the canal.

The location will depend on several conditions among which may be mentioned, the situation of the land to be irrigated, with respect to the water supply, the amount of land which can be watered with the available supply, and the amount of land which can be economically watered.

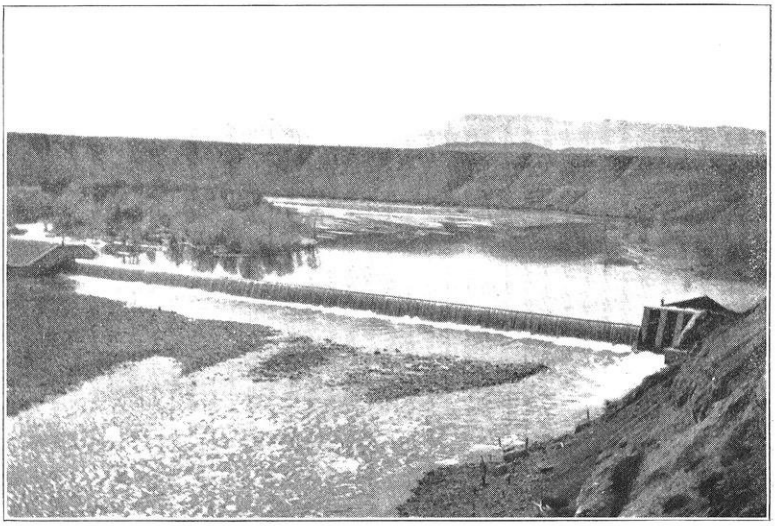
The simplest case and the one most often met is that in which the land to be irrigated is a portion of the valley of the stream furnishing the water. In order to get the water from the stream to a sufficient elevation above the land it becomes necessary to:

(*a*) Locate the headworks a distance up the stream and bring it to the land by means of canals at a flatter gradient than that of the stream, or

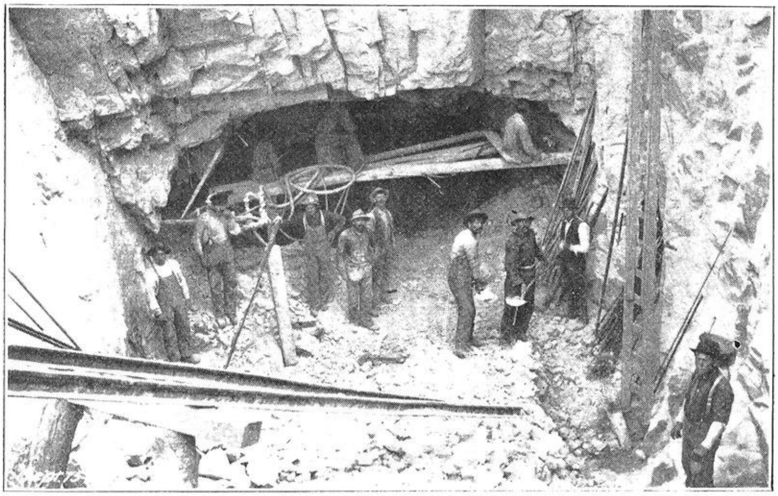
(*b*) Raise the stream surface elevation by a dam, or

(*c*) Raise the water by pumping.

The surveys for the location of a canal may be classified under three heads: Reconnaissance Survey, Preliminary Sur-



Diversion Dam, Shoshone Project, U. S. R. S.



Construction of Tunnel for Spillway, Shoshone, Wyo.

vey, and Final Location. The purpose of the reconnaisance is to determine the probable location of the line from which is found the area that can be economically irrigated and consequently the amount of water required. Of course if the water supply is limited, the area which can be irrigated is limited, and this will largely determine the location. Many irrigation projects have been partial failures, due to the extension of the scheme further than warranted by the available water supply.

If the topographic survey has been completed, the reconnaissance becomes a tolerably simple matter. The proposed line may be approximately plotted on the topography sheets according to elevation, and from this the irrigable area may be closely estimated. By the typography sheets mentioned is meant a precise topographic map of the project, not the sheets made by the United States Geological Survey. The latter are of too small scale and too great contour interval to be of use in any but very rough approximations. If no topographic sheets are available, and they generally are not, it is necessary to go over the ground quite carefully. Ordinarily a line consisting of a series of tangents is run on an assumed grade, setting stakes three to five hundred feet apart. It is sometimes advisable to begin this line at some controlling point and back it up to a favorable position for the headworks. The field notes taken should be very complete and contain descriptions of all obstacles, the quality of the soil, and in fact, anything which will in any way affect the design or construction of the work. Ties to land subdivision corners should be made wherever possible.

The line so run may be platted on a map which should show all the physical features of the country as closely as may be.

A good knowledge of the area to be irrigated is essential and no pains should be spared to gain information concerning it. This information should include quality and depth of soil at various points. Position on the map of the physical features such as drainage courses, lakes, marshes, hills, flats, etc., and non-irrigable areas. The general slope of the land both in amount and direction. The probable courses of the larger laterals especially, but a general idea of the layout of the whole distributing system should be had. With these points in mind, the map may be intelligently studied with a view to ascertaining the irrigable areas, the canal capacities, and the points of change in capacity which are generally made at the points of turnout to a lateral canal of ten second feet or more.

The Preliminary Location

For the most satisfactory results, the canal sections should be known before the field work is begun on this portion of the survey. The sections used will depend upon the capacity gradient, the material in which it is to be built, and the transverse ground slope.

Heavy gravel or rock will stand high velocities and gravelly soil will stand a much higher velocity in the canals than will lighter soil. Side hill canals are generally of the one bank type, that is the embankment is constructed on the lower side only except when a structure or other special condition necessitate two banks. Canals on level ground must be provided with two banks. Wide, shallow canals are uneconomical considering the amount of excavation, while narrow, deep canals are costly to construct because of the height to which the material must be carried to build the banks. When the canal sections have been determined the economic cut, or center cut for which the excavation is sufficient to just build the bank, should be computed for the following cases:

(*a*) Level section—two banks.

(*b*) Various side slopes—one bank.

A convenient method for doing the latter is given by the following (see fig. 1):

Let b=base BC.
e=bank width DE.
h=height from ditch bottom to bank top.

x=distance from the center line of canal to the mid-point of level cutting for one bank represented by LM.

c=economic cut for level section one bank.

B=angle of transverse ground slope with the horizontal.

Let the ditch be of the one bank type with the outer slope of the bank equal to the upper slope of the ditch. Let LM represent the level cutting, at a distance C, above the base, for which the cut LBCK will just make the fill KDEM. Through H, the middle point of LM, pass AF representing the side hill surface.

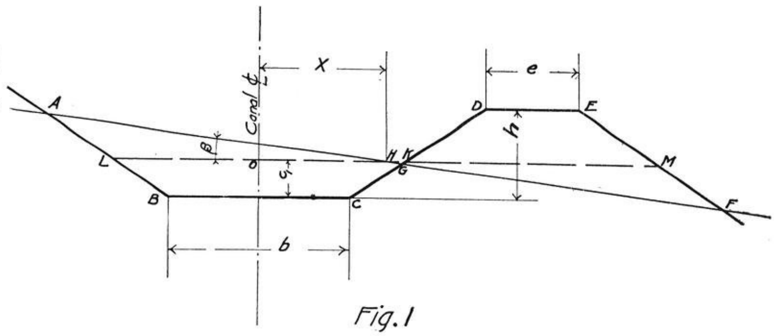


Fig. 1

By construction LBCK=KDEM; ΔALH = ΔFHM since LH = HM and AL and FM are parallel.

Then LBCK + ALH = KDEM + MFH. Area of excavation = ABCG = LBCK + ALH − HKG. Area of embankment = DEFG = KDEM + MFH − HKG. Therefore ABCG = DEFG.

For side slopes $1\frac{1}{2}:1$

$$\text{Area LBCK} = \frac{(2b+3c_1)c_1}{2}$$

$$\text{Area KDEM} = \left[\frac{2e + 3(h - c_1)}{2}\right](h-c_1)$$

Equating and solving for c_1 we have

$$c_1 = \frac{h(e+1\frac{1}{2}h)}{b+e+3h}$$

The distance x may be readily calculated for any given canal section

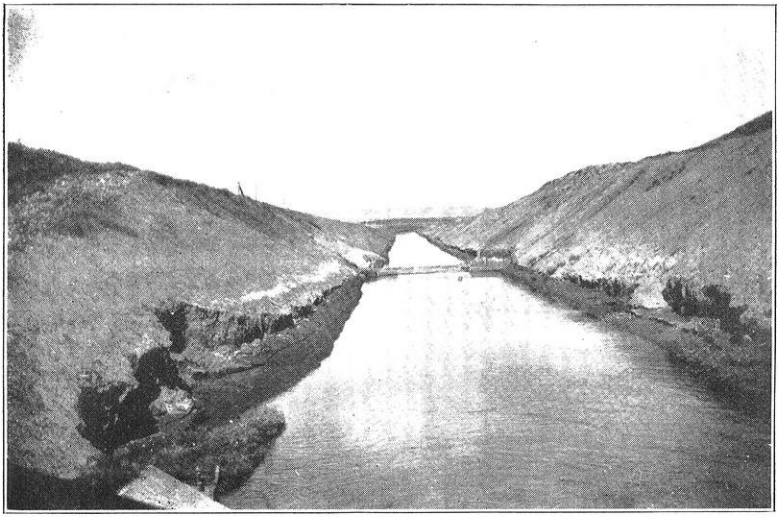
$$x = LH - LO$$

$$LH = \frac{LM}{2} = \frac{b + 3c_1 + e + 3(h - c_1)}{2}$$

$$LO = \frac{LK}{2} = \frac{b + 3c_1}{2}$$

From this $x = \frac{e + 3h - 3c_1}{2}$

It is readily seen that, having found the economic cut for a level section, the economic cut for any slope of the ground



Main Canal, Huntley Irrigation Project, U. S. R. S., and Wier used in testing Pumping Plant.

surface is equal to $c_1 + x \tan \beta$. Formulas for computing c_2, the economic level cut for two banks, are very cumbersome and the value can be more easily computed by trial and error. The value of c_1 is of great assistance in estimating for the first trial.

The preliminary line is run, setting stakes at each station by means of the level so that the ground elevator at the stake is equal to the elevation of the canal grade plus the economic cut for that section and transverse slope. They may also be set on the level economic cut and afterward moved up the hill a distance x. The line of stakes so set is followed by a transit traverse to which each stake is tied by offset or otherwise.

Care must be taken to provide for cross drainage by means of flumes or culverts, and for other structures as wasteways, etc. The line may then be platted preferably to a rather large scale, 100 feet to the inch is satisfactory, and the position of each stake shown as accurately as possible. A paper location which will follow the preliminary line very closely with a practical alignment may be made on the plat. It should show the approximate length of tangents, the degree of curves, and frequent ties to stakes of the preliminary line. The last are of especial value in the field work of the final location.

The Final Location

It will be found that the paper location made as described can be followed very closely. The tangents may be established by means of pickets set up as shown by the ties to the stakes of the prelininary line. Then after setting the point of intersection of tangents and measuring the angle of intersection, the tangent distance for the proper curve may be laid off and the curve run in.

On steep side hills it is of advantage to allow some excess cut on the points of the hill, especially on the sharper curves, as this makes a heavier bank and also allows a larger area of natural ground to resist the wearing action of the water which is thrown to the outside of the curve.

Distributing System Canals

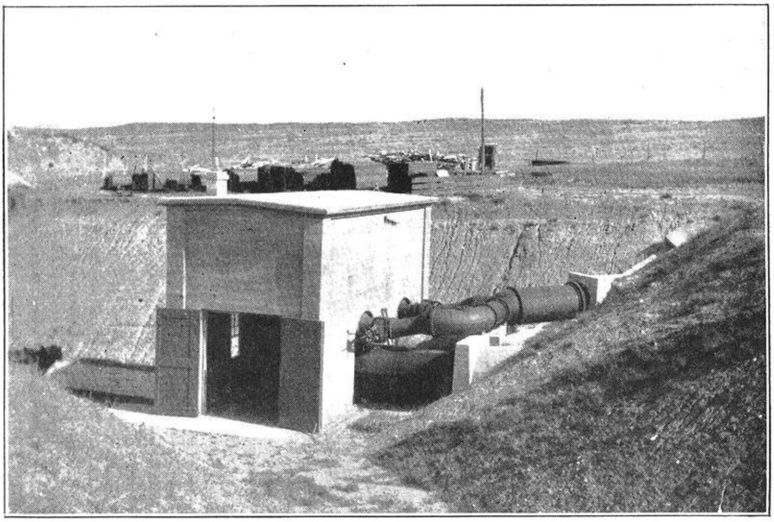
In most cases it may be said that the topographic map is a necessity. The map should be made on a scale not smaller than 1000 feet to the inch with contour interval not more than 5 feet. An accurate map of this sort serves as the reconnaissance survey for the numerous ditches of the distributing system, it shows the proper position for the turnouts to the various farms, and from it the irrigable area in each farm may be ascertained.

Ordinarily it is not customary to run curves on these ditches, it being generally sufficient to ease them around by eye.

Care should be taken not to cut up a farmer's land more than absolutely necessary, and it is a good plan to follow boundary lines where possible.

After these ditch lines have been located and profiled, the grades may be adjusted to give the necessary cut for the sections used.

The methods given in the foregoing are modified to suit the local conditions as no one mode of procedure will suit all cases. The proposition must be carefully studied in detail, as it is only by consideration of all elements that an economical location will be achieved.



Pumping Plant, Huntley Irrigation Project, U. S. R. S.

THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION

By W. D. Pence,* Professor of Railway Engineering

It has been suggested that a brief account of the work and history of the American Railway Engineering and Maintenance of Way Association would be of considerable interest at the present time, owing to the great activity of this association along lines which vitally affect important features of civil engineering practice, quite beyond the field of railway engineering proper.

The Maintenance of Way Association, as it is commonly known, was organized in 1897–1898 at the suggestion of several prominent railway men who recognized the need of a general association of engineering and maintenance of way officials along lines suggested by other special railway organizations, such as the Master Mechanics' Association, the Master Car Builders' Association and the Association of Superintendents of Bridges and Buildings. An older organization of track maintenance men, known as the Roadmasters' Association of America, had included in its membership a fair number of maintenance of way engineers, although it was made up for the most part of men who had risen from the ranks. These so-called "practical trackmen" naturally enough dominated the policies of the older organization, and this fact may have had some part in suggesting the need of a new association which should not merely be free from the narrow limitations of the older organization, but should actually occupy the full sweep of those branches of railway technology which are customarily administered by men having a civil engineering training. Indeed, so broad was the original conception of the newly formed organization that there was for a time real danger of seriously overdoing the matter, even to the extent of top-heaviness and of threatened

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failure. After a few years of persistent effort, however, under the guidance of some of the ablest railway engineers of the country, the Association finally "found itself," and reached a basis of highly efficient work, with the result that this organization has now come to be regarded as a most vigorous and efficient agency in crystallizing and promoting high standards of professional practice. These standards primarily pertain to railway civil engineering, but reach out into many related channels of professional activity.

From the very outset the Association adopted the plan of doing its work through standing committees, along the general lines which had been shown to be so efficient in the earlier work of the Association of Superintendents of Bridges and Buildings under the guidance of the late W. G. Berg. Mr. Berg's efforts were also early enlisted on behalf of the Maintenance of Way Association, and at the time of his death in May, 1908, he had become its president.

The object of the Association, as set forth in the constitution, is the "advancement of knowledge pertaining to the scientific and economical location, construction and maintenance of railroads."

Perhaps no better idea of the scope of the Association's activities can be gained than by reviewing the accompanying list of standing committees, as organized for the current year (1909–1910).

List of Standing Committees, 1909–1910, with Membership

	Title of Committee	*No. of Members*
I.	Roadway	19
II.	Ballast	19
III.	Ties	13
IV.	Rail	21
V.	Track	22
VI.	Buildings	12
VII.	Wooden Bridges and Trestles	15
VIII.	Masonry	20
IX.	Signs, Fences and Crossings	13
X.	Signals and Interlocking	23

XI.	Records and Accounts	23
XII.	Rules and Organization..................	11
XIII.	Water Service..........................	11
XIV.	Yards and Terminals....................	20
XV.	Iron and Steel Structures	13
XVI.	Economics of Railway Construction.......	16
XVII.	Wood Preservation......................	19
XVIII.	Electricity............................	10

In addition to these standing committees there are special committees, as follows: (1) On Uniform General Contract Forms (10 members); (2) On Brine Drippings from Refrigerator Cars (3 members); (3) Co-operating with National Conservation Commission (8 members); (4) Co-operating with National Advisory Board on Fuels and Structural Material (3 members); (5) On Standard Specifications for Cement (3 members). In previous years special committees have been appointed on various other matters, such as the classification of track with relation to traffic, the relationship between wheel flanges and the clearance of guard rails, etc.

The representative character of the membership assigned by the Board of Direction to the more important committees may be illustrated by the membership of the Committee on Rail, which consists of the following:

Railroad president..............................	1
Railroad vice-president.........................	1
Consulting engineers............................	3
Chief engineers and engineers of maintenance.......	15
Rail expert.....................................	1
Total..	21

Through co-operative or concurrent action with other associations along related lines, the work of all these organizations has been materially strengthened. A notable instance of this is found in the Committee on Signals and Interlocking. Practically all of the members of this committee are also active committeemen in the Railway Signal Association.

The membership of the Maintenance of Way Association, numbering approximately 800, including railway officials ranging from president, vice-president, general manager, and chief engineer on down to assistant engineers, besides consulting engineers, scientists, professors of engineering and others engaged in professional work related more or less directly to railway engineering. The constitution provides that an active member of the Association shall be a civil, mechanical or electrical engineer, or an architect, "who has had not less than five years' actual experience in the location, construction or maintenance of railroads, and who at the time of application for membership, is actively engaged in railroad service, in a responsible position, in charge of work connected with construction or maintenance of way and structures; or a professor of engineering in a college of recognized standing; or any railroad official who is responsible for or has supervision of railroad construction or maintenance of way and structures."

The mileage represented by the association in 1909 was 267,067 miles, covering some 188 different railways. Included in the list of railroads represented in the membership are the following foreign roads:

Name of Railroad	*Mileage*
Argentine Republic Railways	6,654
Assam–Bengal Railway	775
Bolivia Railway	800
Burma Railways of India	1,340
Canton–Hankow Railway	1,000
Government Railways of Victoria	3,319
Guantanamo Railway	48
Imperial Railways of Japan	4,445
Seoul–Fusan Railroad	638
Transandine Railway of Chili	44

The roads having the largest number of members in the Association's list are the following:

Name of Railroad	*Members*
Atchison, Topeka & Santa Fe	14
Baltimore & Ohio	42
Canadian Pacific	12
Chicago & Northwestern	7
Chicago, Burlington & Quincy	13
Chicago, Rock Island & Pacific	12
Cleveland, Cincinnati, Chicago & St. Louis	11
Erie	24
Grand Trunk	8
Great Northern	7
Illinois Central	21
Imperial Government Railways of Japan	8
Lake Shore and Michigan Southern	11
Lehigh Valley	7
Louisville & Nashville	8
Michigan Central	9
Missouri Pacific	23
National Railways of Mexico	9
New York Central & Hudson River	13
New York, Chicago & St. Louis	8
Northern Pacific	8
Pennsylvania Lines	11
Pennsylvania Railroad	6
Pittsburg & Lake Erie	6
Seaboard Air Line	7
Southern Pacific	7
Southern Railway	7
Union Pacific	9

In the case of other roads the membership usually ranges from 1 to 5. These memberships are individual or personal, that is, the action of the Association is not in any way binding upon the railroads having employees or officers in the membership list.

It has not been the policy of the Association, in general, to carry on research work, although considerable work of this kind has been inspired indirectly through the liberal policy of assigning engineering professors to active committee work. The bulletins and proceedings of the Association have been a means for the publication of the results of important investigations made privately for the benefit of various railroads and bridge companies, many of which contributions would no doubt never have been given out in the absence of such stimulus.

The first actual research work undertaken formally by the Association was a series of important field studies with reference to impact effects on railroad bridges. These experiments grew out of a heated discussion both in the Committee on Iron and Steel Structures, and on the floor of the convention, touching the impact allowance to be provided for in the standard bridge specifications submitted for approval by the Association. On account of the lack of agreement in opinion and practice of recognized authorities, it was resolved to undertake an elaborate series of field tests, provided financial support by the railroads could be secured. A prompt and liberal response to the call for funds made it possible to begin active operations in 1907. The field tests and reductions of data have now been in progress for a period of three successive seasons. These impact tests are of particular interest to Wisconsin men for the reason that the work has from the first been under the personal direction of Dean F. E. Turneaure, of the College of Engineering, whose earlier experiments and publications on impact effects in railroad bridges provided a definite basis for taking up this work on a more extensive scale. In this investigation active assistance has also been rendered by W. S. Kinne and E. E. Parker, of the Structural Department teaching staff. Progress reports have been made to the Association, and the final report of the sub-committee is awaited with the greatest interest both by the Association members and by the profession in general.

The Association issues monthly bulletins usually of about 100 pages each. These bulletins contain committee reports, individual papers and written discussions. These, together with the verbatim report of discussions at the annual convention, supply the material for the annual reports or proceedings. Some notion of the capacity of the Association to produce technical literature may be had from the following figures covering technical matter contained in the ten annual reports thus far issued.

Summary of Annual Proceedings

Volume	*Year*	*Pages*
1	1900	173
2	1901	481
3	1902	426
4	1903	464
5	1904	747
6	1905	782
7	1906	725
8	1907	634
9	1908	798
10	1909	1549
	Total	6779

The annual reports are purchased in considerable numbers by many of the leading railroads of the United States and Canada and supplied to employes of the maintenance depart-department for purposes of reference.

As already stated, the Association had a hard struggle during the earlier years in finding out just how to make good use of its talents. The turning point came, apparently, in connection with the adoption of a plan proposed by Mr. Berg, looking towards the publication of a "Manual of Recommended Practice," in which are brought together in crystallized form the results of the committee work and the deliberations at the annual convention. Two editions of this manual have already appeared, and a third will probably be issued during the present year. This manual has been of great value in that it makes material available to the members of the Association as rapidly as the same can be brought into fairly definite form.

The work of the various committees is carried on under instructions issued by the Board of Direction immediately following the annual convention, which is held in Chicago in March. The nature and extent of these instructions is indicated by the following extract from the outline of work to be done during the current year by the Committee on Iron and Steel Structures:

"Observe General Rules for the Preparation of Committee Reports. Subjects are given in the order of their importance. It is not desired that all subjects be reported upon this year. The number to be reported upon should be determined after careful estimate of the length of the report and the time required by the convention for its consideration.

"1. Consider Revision of Manual; if no changes are recommended, make statement accordingly.

"2. Continue investigation of effect of impact on bridges.

"3. Continue investigation of injuries to bridges and structures caused by flat spots on car wheels, conferring with committees of other associations.

"4. Recommend Specifications for Bridge Erection.

"5. Report on the care of existing bridges, methods of field work, inspection and work of inspection.

"6. Report to what extent steel bridge construction for the main girders of bridges carrying heavy loads under high speeds is preferable to reinforced concrete construction.

7. "Submit review of the development of metal bridge building in America."

In developing a plan for working material through the convention on a methodical basis, it was found advantageous to consider committee reports in one of the following ways:

(a) Reading by title.

(b) Reading, discussing and acting upon each conclusion separately.

(c) By majority vote, with discussion on each item. Clauses not objected to when read are considered as voted upon and adopted.

Formal vote or action by the convention on committee reports is taken in one of the ways indicated below, after discussion is closed:

(a) Receiving as information.

(b) Receiving as a progress report and referring back to committee.

(c) Adoption of a portion and referring remainder back to committee.

(d) Adoption as amended.

(e) Adopted as submitted.

The list of Association presidents, with their official titles at the time of election, is given below.

J. F. Wallace, Chief Engineer, Illinois Central R. R.

G. W. Kittredge, Chief Engineer, Cleveland, Cincinnati, Chicago & St. Louis Ry.

Hunter McDonald, Chief Engineer, Nashville, Chattanooga & St. Louis Ry.

H. G. Kelley, Chief Engineer, Minneapolis & St. Louis Ry.

A. W. Johnston, General Manager, New York, Chicago & St. Louis R. R.

W. G. Berg, Chief Engineer, Lehigh Valley R. R.

William McNab, Principal Assistant Engineer, Grand Trunk Ry.

In attempting to account for the results accomplished by the Maintenance of Way Association within so short a period of time, one naturally turns to the records of work done by the individual members themselves. It would probably be difficult to bring together anywhere in the world of industrial activity an abler body of men than those who have chiefly inspired and directed the work of this Association.

TO JAPAN WITH THE BALL TEAM

OSWALD LUPINSKI, C. E., '10

With the approval of the faculty and the energetic efforts of Genkwan Shibata the Japan Ball Trip became a reality in place of a mere possibility.

On the evening of the 21st of August, 1909, a bunch of Wisconsin spirit congregated at the Merchants' Hotel in St. Paul, Minn. In the party were the following:

Dr. Charles McCarthy, G. Shibata, '09; E. Barlow, '09; R. Fellows, '11; D. Flanagan, '11; N. Jones, '08; A. Kleinpell, '11; D. Knight, '09; J. Messmer, '09; R. Mucklestone, '09; C. Nash, '10; A. Pergande, '10; H. Rogers, '09; J. Simpson, '10; W. Timbers, '11, and the writer.

It was a jolly bunch and all seemed to be in the best spirits. Happy they might be for on the morrow they would start for Japan, on what was destined to be the longest trip ever undertaken by an athletic team of any sort. The morning of the 22d awoke with a stillness which goes to accompany most Sabbaths, and at 11:00 A. M. the Wisconsin Baseball Team boarded the "Oriental Limited" of the Great Northern Railroad en route to Seattle. After a trip across the plains which carried us through Minnesota, North Dakota and into Montana, the foothills of the Rockies came into view. Spokane, Washington, was reached at 7:00 A. M. on the 24th, and after a brief stop we were once more under way. For the next ten hours we were treated to a bit of scenic Washington, such sights as the wheat country of the eastern part of the state, the famous fruit country of the Wenachee Valley, the Cascade Tunnel and the Valley of the Columbia River taking up most of our time. It was 8:15 P. M. when we arrived at Seattle. We were surprised to be welcomed with a "U Rah, Rah, Wisconsin," given in true Varsity style, as we entered the manificent depot, situated 1,830 miles from Madison. It was an example of never die

Wisconsin spirit, with which our Western Alumnus is filled to overflowing.

At Seattle we were quartered at the Washington Annex Hotel and made our first attempt at practice. Games were played with some semi-professional teams at Seattle. We made a side trip to Tacoma and Port Ludlow, where games were played with the respective teams. Our stay at the west· rn metropolis was of a week's duration and very enjoy-

Aboard the Steamer "Aki Maru"

able. During this time we had the opportunity of visiting the A. Y. P. Exposition, the U. S. men-of-war and many other scenes of interest. The free and open-hearted hospitality of the western people was met with on all sides, and various club houses were thrown open to us.

Ten o'clock on the morning of the 31st found all the members of the party on the upper deck of the steamer "Aki Maru" of the Nippon Yusen Kaisha Line. It was here that we watched with interest the final loading of an ocean steamship preparatory to its trip across the Pacific. Excitement was intense everywhere. Luggage was being hurriedly hoisted aboard and dropped in a large pile on the lower deck.

Commands were given, hatches battened down, and amid the most awful chattering (in Japanese tongue), the hawser was raised and the boys from the Badger state were off for the Orient. After a few hasty farewells and a rousing Wisconsin yell, the boys entered the cabin to examine the apartments which were to be their homes for a few weeks to come.

Any one that is familiar with ocean travel knows how the fascination of the salt water wears away after a few days and life aboard ship becomes somewhat monotonous. And it was no different on board the "Aki," as the boys soon called her. The "Aki" is a spacious steamer about 462 feet long, 55 feet wide, and carries a crew of about 85 men. It is a Jap Liner, and the crew consists mostly of Japanese, intermingled with a few other types of orientals, the Chinese predominating. The passenger list included, besides our party, a few Americans headed for the East in quest of missionary work, and about ninety Japanese. Eighty of these Japs were seal poachers who had been captured in American waters near Alaska. They were being returned to their native land after eight months imprisonment under United States supervision. Among this number were a few Ainu, called by many the aborigines of Japan. In all probability the Ainu were in Japan long before the present race of Japanese. They are of medium height and of sturdy build, and are said to be the hairiest race in the whole world. On account of the variety of types of people on board ship, we were given an opportunity to study different personalities, and this was an education in itself.

When the waves were running twenty to forty feet high, most of us became somewhat seasick. Naturally things didn't taste quite right to us, and it was then that we went to "Shibby" (Shibata), and told him that we could never go chop suey and those oriental dishes, which were set before us three times a day. He explained to us that they were regular French meals, and that "pottage" was soup, and "yaki imo," simple sweet potatoes. Oh, how we did tire of those French meals (a la Japanese), and that dining room which some of us would leave in a rather sudden manner at certain times to hunt for the lee rail! After a hurried meal we would congregate in some one's stateroom, swap stories, and yearn for those dear old dog wagon lunches, which were now but a fair reminiscence. To pass away the time we would play games of all kinds, and some of them stopped rather abruptly when the cry of "There she blows," came to our ears. It was then that we all rushed for the deck in order to obtain a view of either a fin or a hump-backed whale.

On the way over we all had the unique experience of retiring for the night on Tuesday, and being awakened after a nine hour's sleep on Thursday morning. This was due to the fact that our position of longitude was changing every day. When the 180° meridan was reached this change had become great enough (reckoning from Greenwich) to make a difference of one day. On the return trip we encountered two successive Wednesdays for a similar reason. Two hundred and eighty-eight miles was an average daily run, and sixteen days of ocean travel brought us to Tokio Bay.

On the morning of September 16th, land was in plain view on both the starboard and port sides and we didn't take our eyes away from it very long. Old M. N. Fuji (sacred mountain of Japan), towered up to the sky, apparently a few miles distant, when in reality it was about fifty miles away. Farther up the bay we passed numerous fishing smacks, manned by a crew of two or three swarthy orientals. These crafts are on the style of a Chinese junk; and are rigged with square sails, the mast being set back about two-thirds of the way from the bow. In place of a rudder a long sweep-like oar is used to guide the boat.

Along the shores of the bay could be seen low one-story frame structures, which seem to disappear among the green vegetation in the background. About two miles below Yokohama, the channel is obstructed by some forts, three in number, which resemble the Merrimac (of U. S. fame), in general appearance and outline. Passing these the "Aki" dropped anchor just outside the breakwater where the government inspectors boarded the ship. We were all lined up on the rear deck, to prepare for inspection. The ordeal was not a very trying one. A sweet smile was all that was requested of us, and we were passed with flying colors. Newspaper men now demanded our attention, and for the next ten minutes we were the prey of the camera fiends.

Among the first to bid us welcome to fair Nippon, was our old friend Sakagami, now secretary to the mayor of Yoko-

Arriving at Yokohama

hama. By the time all of the ceremony was over, the "Aki" had steamed up to the dock and we were met by a Wisconsin yell. Luggage was gathered and in a few minutes we were on the good old *terra firma* once more. It was only the wooden wharf at Yokohama, but everyone felt good enough to get down and embrace it. The Keio boys met us. After passing inspection at the custom house, we stepped into jinrickshaws and were treated to our first ride. The jinricky men whirled us through narrow streets lined with fancy looking shops and stores, past native gatherings of women and children, finally depositing us at the railroad depot. From here we travelled in a private car to Tokio, twenty miles away. At Tokio we were met by a body of five hundred

Keio students who welcomed us with a rousing reception. Rickshaws were again in order, and in a few minutes the Wisconsin caravan was again under way. Our boys didn't know what to make of it. Our heads were continually bobbing from side to side, to make sure that none of the strange sights would be overlooked. The carts suddenly turned a sharp corner and we were told to disembark at the foot of a steep hill. A climb of eighty-six steps brought up to the top of Atago Hill, upon which the Tokio Hotel is situated. It was a tired and worn out crowd that entered the hotel and stepped up to the desk to register. Everyone wore a blank, astonished look upon his face ana this is about what it expressed: "What in the world has happened to us?" So much had occurred in a few hours, that none of us actually realized where we were or what had happened. Tiffin (the noon meal) was served shortly after. Land-sickness generally follows a long sea voyage, but there was none of it in our party, and every one did full justice to the finest (in his estimation) meal we had ever been favored with. That afternoon we had our first practice. Considering the fact that we had just left the Pacific, our showing was remarkable, as all of the boys played in old league style. We were given an ovation as we left the field to make room for the Keio team. Our good efforts soon faded away as they made us look like amateurs, displaying a very fine exhibition of inside baseball. Our first game was played with Keio on September 22d. On our way to the grounds we were surprised not to meet very many natives going to the baseball game, and we remarked to one another that to all appearances we would have a slim crowd. Imagine our surprise when entering upon the field to see an audience of ten to twelve thousand people gathered in the huge amphitheater, which served as a ball park. The spectators had been waiting for some time, and some had evidently walked six or eight miles to see the Wisconsin–Keio match. The average price of admission is about 20 cents in our money. The games played by the Wisconsin team in Japan and the results are as follows:

Sept. 22, '09. Keio University, 3; Wisconsin, 2 (11 innings.)

Sept. 26, '09. Keio University, 2; Wisconsin, 1 (19 innings.)

Sept. 28, '09. Tokio Americans, 0; Wisconsin, 10.

Sept. 29, '09. Tokio Japanese, 7; Wisconsin, 8.

Oct. 2, '09. Waseda University, 4; Wisconsin, 7.

Oct. 4, '09. Keio University, 5; Wisconsin, 4.

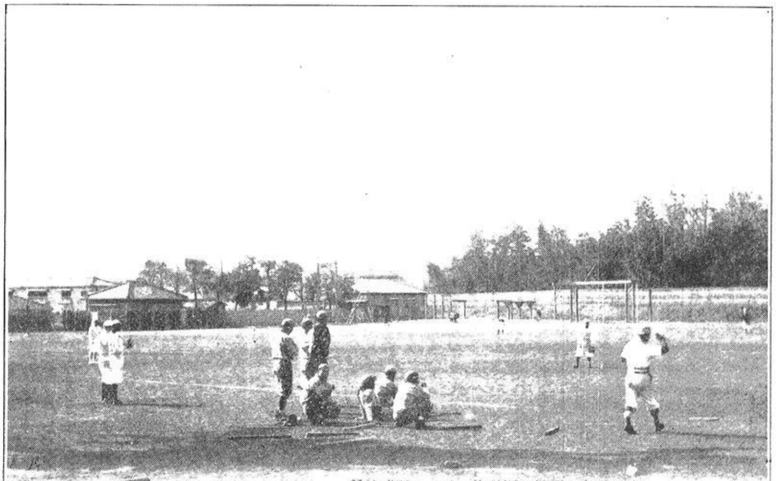
Oct. 7, '09. Waseda University, 0; Wisconsin, 5.

Oct. 9, 09. Waseda University, 3; Wisconsin, 0.

Oct. 12, '09. Keio University, 0; Wisconsin, 8.

The Keio University has a very strong team, being the champions of Japan. From the above results it will be seen that Keio beat us three out of four games. It was generally conceeded that the first two games, which were very close and went extra innings, would have been Wisconsin victories but for the misinterpretation of the rules by Umpire Nakano, a fact which he openly avowed at the close of the series. The fact that our boys took their medicine like men, and no matter whether the decision went against us or not, always played the national game in a sportsmanlike manner, won for us the admiration of the thousands who witnessed the games, making our visit more successful than if it had been crowned with a string of victories. The Japs are a bit weak with the bat, but play a fielding game which can hardly be improved upon. They are dangerous men on bases, and when a runner reaches first he generally goes all the way around to home. They use the squeeze play and the bunting game extensively. Often a base runner goes from first to third on a bunt.

The Wisconsin boys naturally played baseball in true American style. When they talked to one another while in the field or at bat, some Japs and the Englishmen (of whom there were quite a number), in the audience would hiss and try and let them know that, while the game was in progress, noise was not wanted. After the first game the English newspapers commented on the noise and banter of the Wisconsin team, and hinted at its discontinuation. We talked to the Japs about our style of play and tried to convince them that it was the customary one, and also that the English, being accustomed to the tame game of cricket, naturally did not appreciate our American game. We continued our noise, and before the close of the international series our opponents were making just as much, and perhaps more noise than we were.



The Play ground of Keio Gijiku 慶應義塾綱町運動場ニ於ケル野球練習

Too much cannot be said of the hospitality and courtesy of the Keio boys and the Japanese public as a whole. We were invited to the homes of the natives, and always came away loaded with gifts of every description. Theater parties, tea parties, banquets and receptions, both public and private were given in our honor.

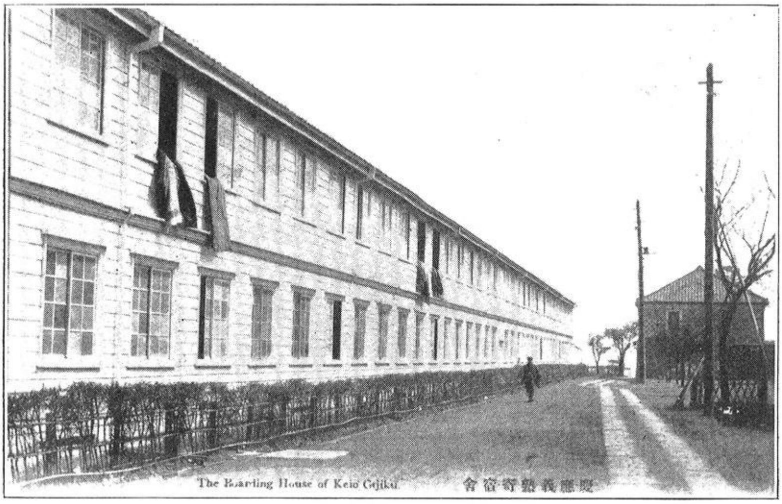
One of the most unique of social affairs arranged for us was the banquet given by the Yokohama miteci at the Chitose Ro (the finest tea house in Yokohama), on the evening of October 6th. It was a typical Japanese affair. Luncheon consisted of soup, chestnuts, yaki imo (sweet potatoes), noodles, baked fish, rice and various fruits; chop sticks were used instead of knives and forks, and at first we had some difficulty in making them work to advantage. One would imagine that he had some food started for his mouth, only to find that he had lost it en route. But then it was some consolation to notice that some one across the way was having the same difficulty. After the first course had been served, the red and white curtain rose, and the most beautiful geisha girls of the part appeared on the stage, at the farther end of the dining hall. After several courses had been served, Mr. Iwashita, a distinguished graduate of Keio university, delivered a speech of welcome in behalf of the Keio alumni in Yokohama. Mr. Witsahashi, the mayor of Yokohama, was the next speaker. He said in part: "We thank you for coming to play baseball in our country, for showing us how to improve our own play, for your hearty good fellowship, but perhaps above all we keenly appreciate the thoroughly gentlemanly manner in which you accept the decisions of the umpire. This is indeed a lesson which most baseball players need to learn, which you yourselves seem to have learned most thoroughly, and in which we desire to follow your example. It is indeed to be regretted that baseball matches in both our countries are frequently spoiled by exhibitions of bad temper and ill-feeling against the umpire. These features are indeed regretted by all true lovers of clean sport, and in some respects it may even be doubted whether one can be a true gentleman and yet a baseball player. You have come, and by your example taught us that this is not only possible, but that it really forms the highest, best kind of sport, for a man to be as keen as mustard at the game, and yet have such excellent control over his own feelings as to submit without question to the decision of the umpire."

Sakagami, known as Saki among old Wisconsin men, was the next speaker, and was followed by Dr. McCarthy, who responded to these speeches, and told of the benefits the young Americans with him were receiving from their visit, and the contact with the younger element of the Japanese.

Tokio now contains nearly two million people, and covers about twenty-three square miles of territory. In some parts of the city, European and American ideas are in evidence, while in the outskirts examples of old Japan are seen upon all sides. The modes of travel have changed considerably in the last twenty years, and the street car, railroad, jinrickshaws, the bicycle and the automobile have come into use. At present the jinrickshaw (man-power-carriage), is most used. This is a two-wheeled small gig pulled by one or more men. The fee for a jinrickshaw ride averages about 10 or 12 sen ($\frac{1}{2}$ cent) for $2\frac{1}{2}$ miles, or about 10 to 20 sen per hour. The jinrickshaw men develop speed and endurance, and often make a trip of $5\frac{1}{2}$ miles with one passenger in 50 minutes. It is estimated that there are two hundred thousand jinrickshaws in Tokio. Long journeys are now being made by railroad, of which there are about five thousand miles on the island at present. Coaches and locomotives are patterned after the English style. The gauge is narrower than the American standard, being 3 feet 6 inches, and the coaches and locomotives are built accordingly. The rate of fare is 1 sen ($\frac{1}{2}$ cent) per mile for third class, 2 sen (1 cent) for second class, and 3 sen ($1\frac{1}{2}$ cents) for first class. The rate of speed rarely exceeds 20 or 25 miles per hour, except in case of the express trains, which run about 35 miles per hour. This is plenty fast enough to satisfy the Japanese.

When entering Japan for the first time, a foreigner is charmed, and one of the first curiosities to attract his attention is a Japanese shop or retail store. The building is a small, low frame structure crowded among similar ones along a narrow street. The floor is raised a foot or so above ground and is usually covered with a thick matting. Spread out upon the floor or on little wooden shelves are the goods for sale. The shopkeeper or merchant sits on his feet upon the floor and greets you with a bow and words of welcome, but makes no attempt to effect a sale, until you ask for some article. He will politely display anything you want to see, and whether you purchase anything or not, is just as courteous when you depart as when you arrived. After visiting a few stores you soon become affected with what might be termed a case of shopping fever, and as a rule will find yourself strolling down the Broadway (known as the Ginza), of Tokio, in the evening.

Wages and incomes around Tokio are insignificant. Ordinary mechanics earn on an average fifty sen (25c.) a day; skilled mechanics about one yen (50c.), carpenters sixty-five sen ($32\frac{1}{2}$c.) a day. Street car conductors and motormen receive about twelve yen ($6.00) per month, and other



The Boarding House of Keio Gijiku 慶應義塾寄宿舎

workmen of the common class about the same amount. From this it can be seen that the cost of living is proportionately lower. With rice, barley, sweet potatoes, fish, vegetables, eggs, and tea in abundance the Japanese can subsist on very little and very cheap.

The average Japanese is about five feet in height and weighs only about one hundred and twenty-five pounds. Their homes are light frame structures, with a thatched or tile roof. The doors and windows are solid and slide in grooves. The floors are covered with thick mats, and as they must serve to eat, sleep, work and sit upon, it is necessary to keep them very clean. To meet this end all foreigners are requested to remove their shoes or boots before entering a Japanese house.

As you enter, the host or hostess greets you and makes a profound bow, a half dozen or more times. You are then shown into a room which is comparatively bare and plain and contains no chairs or tables. You sit on your feet on the floor, and at meal time a small lacquer tray is placed before you. Chop sticks take the place of knives, forks and spoons, and it is not considered bad form to make a loud smacking noise while eating and drinking. Soup, rice, vegetables, and fish generally constitute the meal, while the principal beverages are tea and sake. This latter is an alcoholic liquor, brewed from rice, and taken hot. Tea is served without sugar or cream, not only at meals, but just about all the time.

October 10th and11th were spent in visiting Nikko (meaning sunny splendor) which among the Japanese is considered to be incomparable. This city is situated among the hills, about sixty miles inland from Tokio. This trip into the interior was of great educational value, and enabled us to gain an insight into Japanese country and village life, which could never have been received in Tokio. Nikko is reached by railroad after a slow, tedious trip. Running parallel to the railroad bed for a distance of two miles outside of Nikko, is the famous Avenue of Pines. This is a wonderful sight and must be seen to be appreciated. Both sides of the narrow roadway are lined with magnificent pine trees, rising upward straight as an arrow for a distance of one hundred and seventy-five feet. This roadway leads through the heart of the village, passes the famous sacred bridge of Nikko, and takes one up to the spacious temples. The entrance to the site of the temples is made over a massive stone stairway. To the left of the entrance can be seen a five-story pagoda, about one hundred feet high, with its sloping, gilded roofs, its quaint and beautiful carvings, and its large gold images. The sacred buildings are a very fine example of old Japanese architecture, and involve a large expenditure of money. On the hill back of the main buildings can be seen the graves of two of the Shoguns (former rulers).


Road, Nikko.
日光街道

Our return trip to Nikko was made without mishap, and on the evening of October 12th, a big farewell banquet was given in our honor by the Keio alumni at the Kojunsha Club in Tokio. Two hundred and fifty plates were laid, and besides the Keio team and our party, there were present the Waseda team, a number of Tokio business men, and some newspaper representatives. Following the banquet, President Kamada, of the Keio university, presided, and delivered a farewell address in English, which was responded to by Dr. McCarthy. Prof. Takasuzi spoke in behalf of the Waseda university, and Umpire Nakano thanked the members of the three teams for the courtesies shown him by the respective members.

On our departure from Yokohama, October 13th, we were given a rousing send-off. The Keio team, the Waseda team, officials of both universities, Umpire Nakano, and a score of newspaper representatives gathered to bid us farewell. Each member of the Keio team carried a huge wreath of flowers, which was presented to some member of the Wisconsin team as a token of their esteem. As the steamer "Tango Maru" moved away from the dock, we gave nine 'rahs for Japan, Keio and Waseda. Then amid the exchange of final farewells our dear Japanese friends began to grow smaller and smaller in the distance, and with the 'varsity toast on our lips, we turned our heads toward the good old Badger state, seven thousand miles away.

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EDITORIALS

SENIOR ENGINEERS ATTENTION

To the senior students of the colleges, universities and technical schools of the United States who will graduate in 1910, the J. G. Brill Co., of Philadelphia, manufacturers of cars and trucks, offers $500 for theses on the subject "Design of an Electric Railway Car for City Service." This sum will be divided between the authors of the three best theses in the proportion of: $250 for the first best, $150 for second best and $100 for the third best. The Brill thesis contest was inaugurated in 1908. Charles T. Ripley, University of Illinois, was awarded first prize and the Brill gold medal last year. Why shouldn't Wisconsin be represented in this contest?

MINSTREL SHOW

Encouraged by the successs of the minstrel show of the last year, the senior engineers are making preparations for a minstrel show which will eclipse all that have gone before, and to keep up with the past record every loyal engineer will have to work.

The minstrel show idea started with the class of '03, who staged the first one of its kind at the university. So thoroughly did it meet the approval of the students that the class of '04 gave another the following year. No show was given by the seniors in 1905 as it was not thought best to attempt to run in opposition with the university circus which is given every two years, but the class of '06 showed that the minstrel idea was still alive and staged a very clever production in Library Hall. For the next two years sufficient enthusiasm could not be awakened to give a minstrel show although the class of '08 got as far as the appointing of the committees. The class of '09, however, started in early and rounded up so much good material for a minstrel show that it was determined to stage it in the Fuller opera house. This was a long step but, knowing the limitations of the stage and seating capacity of Library Hall, they determined to take the increased responsibility on themselves. This performance is remembered by the present students as a very clever show and a decided minstrel hit. The hopes of the committee were realized and the Fuller opera house management stated that with one exception the seat sale for the minstrel show was the largest in the history of the theatre.

The benefits derived from work of this nature cannot be estimated. The engineers are naturally a jolly set, who like a good joke or song, and are therefore the logical class to appear in a minstrel show. Let every engineer who can sing, or who has a good act, boost the minstrel show and help make it just a little bit better than the previous one.

A committee consisting of Messrs. Traxler, Osthoff, Cowan, Andrews, Witt, Slidell and Pergande, have been appointed to make the necessary arrangements. Mr. Cowan was elected musical director, Mr. Osthoff, business manager and Mr. Traxler, stage manager.

OUTSIDE LECTURES

On January 14, a lecture was given by Dean W. F. Goss, of the University of Illinois, on "The Locomotive as a Power Plant." Mr. Goss gave a brief summary of the difficulties to be met in the construction and the development of the modern locomotive. He emphasized the rather startling fact that the locomotive has reached the highest point in its development that is obtainable until a new means of stoking is available. The power of an engine depends upon the amount of coal it can burn and the amount of coal consumed depends upon the area of the grate surface and upon the ability of the fireman to shovel coal.

The locomotive is as complete a power plant as any stationary plant but, instead of spreading over several hundreds or even thousands of square feet of floor space, as the later may do, the locomotive is confined to a very limited space. Its width is limited by the clearance required of obstacles along the way; its height, by overhead construction; and its length by such equipments as turntables, round houses, etc., which it must use. The locomotive builder will sacrifice efficiency for more power. The most important question to him is not how economical the engine can be run but how much power it can develop. As the grate surface is limited by conditions over which the builder has no control, the problem is to increase the coal consumption per square foot of grate in order to increase the power. Instead of burning from 2 to 20 pounds of coal per hour per square foot of grate surface, as in the case of the stationary, the locomotive consumption has been increased, to over 100 pounds of coal per hour per square foot of grate surface, by means of the forced draft.

NEW ENGINEERING SOCIETY

The Senior Mechanical Engineers of the University have recently organized a student section under the rules set down by the American Society of Mechanical Engineers. The name of the organization is the Wisconsin University Student Section of the American Society of Mechanical Engineers. The Section was organized in the early part of December, of the year 1909, and all men in the University interested in engineering are eligible for membership. The Journal of the Society is supplied to all student members at a nominal cost. The purpose of the Section is to review articles published in the Journal and to obtain prominent engineers to speak before members as often as possible. The meeting of the Section is the third Thursday in the month. Prof. C. C. Thomas was elected Honorary Chairman, and the following are the student officers: R. N. Trane, Chairman; E. L. Kastler, Vice-Chairman; G. A. Glick, Secretary; J. S. Langwill, Assistant Secretary; R. A. Reudebusch, Treasurer. The Section had its first regular meeting, Thursday, January 13th, when it was addressed by Dean Gross, of Purdue University. The Section enjoys a membership of 38 students besides several members of the A. S. M. E., who are honorary members. Everything at present looks as if the Section will have a very successful career at the University of Wisconsin.

CAMPUS NOTES

James R. Garfield, former Secretary of the Interior, spoke in Assembly Hall, Dec. 6th, on "The Conservation of Natural Resources."

George Blanchard, L., '10; Robert Iakisch, C. E., '10; Harry Culver, L. S., '10; and Peter Murphy, L., '10, were elected to Iron Cross at the annual fall election.

Chancellor Frank Strong, of Kansas University, addressed the All-University Convocation in the gymnasium, Dec. 10th.

Bernard Shaw's "You Never Can Tell," was creditably staged by the Edwin Booth Dramatic Club, Dec. 11th. Leo Tiefenthaler appeared in the leading role, and was ably supported by Miss Fanny Brown, John D. Jones, John D. Brewer, Karl K. Borsack, Harry Meissner, Martin G. Glaeser, Hazel B. Clarke and Winifred Webster. Prof. A. H. Johnstone, of the public speaking department, directed the play.

The faculty committee on dramatics recently ruled that students will be allowed to take part in only one play a semester.

The faculty athletic council passed with their approval the plan of the athletic board to build a field house at Camp Randall, to contain shower baths, locker rooms and dressing rooms for the exclusive use of the varsity teams. The funds for its erection will be taken from the surplus of the athletic proceeds. A permit from the Board of Regents allowing the erection of the house upon university ground, is necessary before the building can be started.

The first attempt at soccer football in Wisconsin was made early in December, when J. F. Sugden, a soccer player of international reputation, was secured by Dr. Hutchins to take charge of candidates for the soccer team. A large number of enthusiasts turned out until cold weather hampered the work and caused it to be abandoned until spring.

Earl G. Lake, '12, was elected assistant football manager, and Angus McArthur, '11, vice-commodore of the crew, by the Athletic Board at its December session.

"In Hospital," a play of one act, by Prof. Dickinson, of the English department, has been accepted by the New Theatre of New York, and will be used by them as a curtain raiser. The New Theatre is the protege of a group of wealthy men who present upon its stage only plays which they deem to be of exceptionally high artistic merit. For this reason the honor to Prof. Dickinson is doubled.

The Wisconsin glee, mandolin and banjo clubs gave a joint concert with similar clubs from the University of Michigan, in the Pabst theater at Milwaukee, Dec. 27. The Wisconsin clubs then took their annual Christmas tour, playing at Oshkosh, Green Bay, Appleton, and Grand Rapids.

Philomathia won the thirty-ninth annual joint debate December 17.

Wisconsin debating teams lost to Illinois and Minnesota in the Central Debating League, Dec. 10th, and dropped from first to fourth place.

The announcement was made Dec. 1st, that Kenneth F. Burgess, '09, had won the annual Junior play contest. The play is a four act comedy entitled, "Three Queens and a Joker," and deals with college life in satire. Herbert Stothart is directing the play with Ben. Jelineck, '11, as business manager. The first call for try-outs for places in the cast of fourteen brought forth over a hundred aspirants. The play offers a good vehicle for talent. and with such a large number of candidates working under the tutorage of Mr. Stothart, it will undoubtedly excell all previous class performances. The date for its production is Feb. 19th.

The cast selected is as follows:

Marjorie Brown, proprietress of the Hotel Brown, Middleton—Fleurette Hartwig.

Mrs. Wilkins, of Oshkosh, Carlton's mother—Alice B. B. Smith.

Mrs. Martin, chaperone of Kappa Phi—Margaret Curtis.

Hazel Humphrey, from the effete east via Oshkosh—Betty Tucker.

Margaret Morgan, the fair rushee—Phoebe Twining.

Helen, president of Kappa Phi—Gladys Scribner.

Gertrude, Kappa Phi—Irma Hellberg.

Alice, Kappa Phi—Olga E. Hoff.

Mary, Kappa Phi—Norma Roehm.

Mabel, Kappa Phi—Helen Connor.

Count von Wurtz, of Germany, student of social problems —Manfred S. Gross.

Carlton W. Wilkins, the retiring senior—Chester Rohn or Donald Holmes.

Jimmy Blakely, his room-mate—William H. Ellis.

John, the man of all work at Hotel Brown—H. D. White.

Hank—F. C. Meyer.

Bert—Donald Holmes or Chester Rohn.

Chuck—A. H. Noyes.

"Jimmy" Dean, '11, right-end and All-Conference choice for end by many critics, was elected captain of next year's varsity football team. Dean was a Madison high school player before entering the university, and has played two years on the varsity. He is a brother of Dr. Joseph Dean, of Madison, who was a star end during his college career.

With funds provided by the Board of Regents, and under the direction of the faculty committee on hygiene, semi-annual inspections of the boarding, rooming and fraternity houses occupied by students in the city will be made for the purpose of determining what hygienic provisions exist, and what may be done to safeguard students against possible epidemics. A trained nurse will be engaged to make the investigation and report to the committee, which will take in hand any matters discovered to be radically unsanitary and assist in their remedy. A certified list of inspected places will be published in pamphlet form.

As a further safeguard to the health of the students, the Regents have secured Dr. Joseph Evans, of Philadelphia, as professor of clinical medicine, and to act as medical adviser to all students. His duties as adviser will be to see that all students have proper medical care in case of illness, and to keep a record of all student illnesses. He will commence his work the second semester.

Resolutions regretting the dismissal of Gifford Pinchot from the office of Chief Forester have been presented to all of the various student organizations and have received the signatures of practically all the members. These resolutions will be forwarded to President Taft and a copy will be sent to Mr. Pinchot.

The recommendation of the student conference committee for a seven-game football schedule was presented to the faculty at their meeting, January 17, and was referred by them to the athletic council for further consideration. This action leaves the proposition open and the students are hopeful that the ultimate decision will be in favor of the longer schedule.

The action of the faculty in accepting the proposition made by the student conference for a student court, to act in all cases of student discipline except those relating to dishonesty in class work, has a most important bearing on student self-government at Wisconsin. The court will consist of six seniors and three juniors elected by popular vote from the university at-large. Nominations will be made by the student conference, two men being nominated for each one to be elected. The court will have original jurisdiction and the evidence of their findings will be transmitted to the faculty discipline committee with recommendations as to the disposition of the case. The discipline committee may then, if it approves the findings of the court, suspend the student pending action by the faculty.

The student whose suspension is recommended by the court may appeal the case to the faculty upon the ground that there is evidence bearing upon the case that was not brought out in the trial. If this appeal is sustained, the faculty has the right to remand the case to the court for another hearing.

Louis B. Lochner, '09, Alumni Fellow in Journalism and editor of The Alumni Magazine, has been selected as editor of the official magazine of the affiliated international clubs and of the International School of Peace founded by Edwin Ginn of Ginn and Co., publishers. Mr. Ginn has given an endowment of a million dollars towards the support of the school of peace and the magazine. The journal which will be known as "The International Students' Magazine"' will be edited here but published in New York by Ginn & Co.

Realizing the importance and the need of a trainer for all varsity teams, the Athletic Council recently created such a position, and has engaged I. Bernstein, of Chicago, for the place. Bernstein has entered upon his duties by taking in charge the physical welfare of the basket ball, track and baseball teams. The trainer is responsible for the condition of the men on the various teams, and is also in charge of their equipment.

The book and lyrics for the annual Haresfoot play have been written by George Hill, '08, and "Ted" Stempfel, '09, and have been adapted to music by Herbert Stothart. The play is a two-act comedy, as yet unnamed. The scene is laid in the Alps of Switzerland, and the opera will be resplendent with Swiss costumes and Alpine scenery. Besides the work of the joint authors, Horatio Winslow, '05, author of The Dancing Doll, the Haresfoot success of last year; Ralph Birchard, '10; and Walter Buchen, '11, have contributed lyrics and songs. Hugo Hering, '10, has been elected musical director, and C. D. Baird, '11, business manager.

The Athletic council at their December session, voted down the recommendation of the Athletic Board for a seven game football schedule for next season. Student sentiment was strongly in favor of the longer schedule, and the council's action was unfavorably received. Efforts are being made to have the question reconsidered. The Athletic Board has brought the matter to the attention of the faculty, and has recommended that the student conference do likewise.

The Badger basketball team has started in with a rush, and has clearly outclassed its opponents in the first four games of the season. Beloit met the Badger five at Madison, December 15th, and was defeated 24 to 9. The second game was with Ripon, December 17th, the Badgers winning 32 to 5. On January 8th, Northwestern came here to play the first game after the holidays. Again the Badgers showed splendid form and won 55 to 9. The Evanston five was able to secure but one field goal. The first game having a critical bearing on the conference championship, was with Illinois, January 15th. The Illinois took the lead, but were unable to hold it, and the first half ended 10 to 8 in Wisconsin's favor, with the final result of 28 to 16.

The Wisconsin line-up has been as follows:

Right forward, Birch and Schwalbe.

Left forward, Scoville and Stangel.

Center, Slidell and Fenn.

Right guard, Witt (Captain) and Mahoney.

Left guard, Harper and Bickelhaupt.

The remainder of the schedule is as follows:

Jan. 21, Illinois at Champaign.
Jan. 22, Purdue at Lafayette.
Jan. 28, Chicago at Chicago.
Jan. 29, Indiana at Bloomington.
Feb. 5, Minnesota at Madison.
Feb. 25, Minnesota at Minneapolis.
Feb. 26, Northwestern at Evanston.
March 5, Chicago at Madison.
March 7, Indiana at Madison.
March 12, Purdue at Madison.

The resignation of Dr. C. P. Hutchins, as athletic director, to take effect January 1st, was announced just before the holidays. Dr. Hutchins has become extensively interested in the Bitterroot Valley country, and has entered the employ of a realty firm of that section. His successor has not been appointed.

President A. Lawrence Lowell, of Harvard, spoke at convocation held in the gymnasium, January 5th. Dr. Lowell was in attendance at the convention of The Association of American University Presidents.

In an effort to make the Junior Prom an all-university affair, the Prom committee has adopted several innovations in the way of information bureaus to assist those who desire to attend, but who are not attached to fraternity parties, to arrange independent parties. In order to make the Prom as democratic as possible, a general box has been arranged for those who do not come in fraternity or independent parties. The date of the Prom is Feb. 18. The personnel of the committees is as follows:

Finance—H. H. Veerhusen, chairman, G. H. Nickell, J. S. Slade, A. B. Doe, J. M. Firth.

Floor—C. F. McConnell, chairman, C. F. Grunert, E. F. Week, W. Ellis, L. A. Wood.

Program—O. F. Bradley, chairman, R. L. Schuetter, E. C. Wilson, H. M. Anderly, R. C. Phipps.

Decoration—C. E. Terry, chairman, R. C. Phipps, C. F. Grunert, A. M. Bleyer, R. D. Green.

Reception—C. L. McMillen, chairman, H. H. Veerhusen, E. F. Week, F. P. Hutchinson, C. A. Rossbach.

Advertising—A. B. Doe, chairman, O. F. Bradley, W. V. Bickelhaupt, K. Mann, J. M. Firth.

Music—F. A. Hecht, chairman, K. F. Dickinson, C. L. Hill, G. W. Esau, W. Ellis.

Refreshments—R. L. Schuetter, chairman, W. T. Hover, T. W. Conron, C. F. McConnell, C. L. McMillen.

NOTES AND PERSONALS

The second annual meeting of the Engineering Society of Wisconsin will be held in Milwaukee, Feb. 23-25, inclusive.

E. E. Bandli, '09, stopped off a couple of days here in December, to see some of his old friends. Mr. Bandli has been in the employ of the U. S. G. S. service in Alabama, and was on his way to Washington, D. C., where he will be stationed during the winter.

L. M. Larson, '09, has left the government and accepted a position in the designing department with the Wm. B. Hough Co., designers of reinforced concrete construction and agents for concrete machinery and reinforcing rods.

J. F. Klug, '07, was drowned New Year's day while skating. Mr. Klug had, but recently, resigned his position with the Knoxville Gas Co., and accepted a position wlth the Pueblo Gas & Light Co., and the news of his death comes as an unexpected blow to his friends.

R. G. Saxton, '09, spent a few days with us in January. Mr. Saxton is in the employ of the Chicago and Northwestern Railway, in the construction department on the Dakota extension, but owing to the deep snow and extremely cold weather the company was forced to suspend construction for some time.

In July, 1909, occurred the marriage of Carl Winger, '05, and Maude Boorman, of Madison. Mr. Winger is employed by the Locomobile Co. of Chicago.

W. J. Gibson and F. K. Langraf, both of the class of '98, are in the employ of the Flannery Bolt Co., Bridgeville, Penn.

On Jan. 20, B. Bateman, of the United States Forestry Service gave a lecture on "Methods of analysis for determination of the absorbtion and penetration of metallic salts in preserved woods."

Prof. Edward Burr Van Vleck of the University of Wisconsin, has been awarded an honorary degree in mathematics by Clark University.

The recent meeting of the American Society of Mechanical Engineers, at New York, was addressed by Prof. Carl C. Thomas, of the University of Wisconsin, who spoke on "An Electric Gas Meter." In his paper he described a meter developed in the university laboratories which is now employed commercially to measure large quantities of gas, air, or steam.

The technical education of employees, and the direct value of such training to the efficiency of the plant was discussed at the annual convention of the Wisconsin Electrical Association, at Milwaukee, Jan. 19–20, by Prof. C. M. Jansky, of the Electrical Engineering Department of the University of Wisconsin.

L. B. Orr, a graduate in Electrical Engineering in the class of '09, has returned to the university, and has entered the short course of the College of Agriculture. Mr. Orr evidently intends to make use of his engineering training in scientific farming.

ALUMNI NEWS.

H. J. Hirshheimer, '91, resides at 131 South 15th street, La Crosse, Wis. He holds the position of Vice-President of the La Crosse Plow Co.

James F. Simpson, '08, is a mining engineer. Address, 6157 Crescent Road, Chicago.

Vernon Edwards is in in the U. S. Reclamation Service at Powell, Wyoming.

P. A. Bertrand is manager of the Jefferson City Light, Heat and Power Co., Jefferson City, Mo.

Edward Schildhauer, '97, is an electrical and mechanical engineer with the Isthmian Canal Commission at Culebra, Panama.

Alfred S. Diehl, '07, is with the Oliver Mining Co., at Coleraine, Minn.

Ernest B. Miller, '06, is an engineer with the Davidson Chemical Co., located at 601 Keyser Bldg., Baltimore, Md.

A. J. Quigley, '03, is sales manager of the Agutter, Griswold Co., Seattle, Wash.

A. B. Whitney, '08, is an assistant engineer with the Chicago and Alton R. R., with headquarters at 319 S. Eastern Ave., Joliet, Ill.

J. C. Conway, Seattle Elec. Co., Seattle, Wash.

Frederick A. DeLay, '02, is professor of electrical engineering, Colorado State College, Fort Collins, Colo.

R. V. Herdegen, '06, is sales-engineer with the Allis-Chalmers Co., with residence at 650 Marshall street, Milwaukee, Wis.

J. E. Kaulfuss, '04, can be addressed Pray, Jackson Co., Wis.

A. V. Larson, '09, is in the stoker department of the American Ship Windlass Co., with address 233 Medway street, Providence, R. I.

E. S. Hirschberg, '07, is partner in the Hirschberg-Williams-Washburn Co., Civil Engineers, Milwaukee, Wis.

Charles P. Barker, '07, is partner in the Barker Auto Co., of Chippewa Falls, Wis.

R. H. Ford, '06 and '09, is an electrical engineer with the Dayton Electrical Mfg. Co., of Dayton, Ohio. Address, 539 Y. M. C. A. Bldg.

Sigurd G. Lunde, '08, is junior topographer, U. S. G. S., located at 2400 K street, Sacramento, Cal. On November 6th, at Sacramento, occurred the marriage of Mr. Lunde to Ellen Dorothy Hanson, of Stoughton, Wis.

L. D. Rowell, '01, holds the position of assistant professor in electrical engineering, Case School of Applied Science, Cleveland, Ohio. Residence, 1492 East 118th street.

A. C. Scott, Ph. D., '02, is professor of electrical engineering in the University of Texas at Austin, Texas.

E. A. Loew, '06, instructor in electrical engineering at University of Washington, resides at 4128 Brooklyn avenue, Seattle, Wash.

W. H. Williams, '96, is sales manager of the Hart-Parr Co., Charles City, Iowa.

Frank J. Petura, '04, is with Henry L. Doherty and Co., 60 Wall street, New York.

Joseph R. S. Blaine, '05, engineer, residence 653 Park avenue, Beloit, Wis.

W. E. Bates, '06, is an engineer with the Oliver Iron Mining Co., at Virginia, Minn.

Emil A. Ekern, '03, and Alvin Meyers, '01, are engaged in power plant design and installation at Tacoma, Wash. Address, 1406 North 6th street.

Fred E. Paesler, '08, is district traffic chief, American T. and T. Co., of Iowa. Residence, 5918 Washington Blvd., Chicago.

Gana G. Ryder, '07, is manager of the Twin City Electric Co., electrical contractors, Minneapolis, Minn.

George G. Thorp, '91, vice-president Illinois Steel Co., Commercial National Bank Bldg., Chicago.

D. E. Foster, '06, is instructor in mechanism and descriptive geometry at University of Michigan. Address, 223 S. Ingalls street, Ann Arbor, Mich.

George C. Daniels, '08, is instructor of engineering, State Industrial School, Ellendale, N. Dak.

Frank E. Fisher, '06, is an electrical engineer residing at 315 Morris avenue, Elizabeth, N. J.

J. F. Hahn, '03, is engaged in structural engineering, 807 E. Kearsley street, Flint, Mich.

W. H. Winslow may be reached at 1518 Tower avenue, Superior, Wis.

Ernest B. Nelson resides at 720 Biddle street, Baltimore, Md.

L. A. Larsen is located at 1325 Mission street, San Francisco, Cal.

Jesse M. Boorse, '95, is proprietor of the Miles City Auto Co., and a member of the Olsen-Boorse Realty Co., Miles City, Mont.

Frank B. Rowley, '05, is instructor in drawing and descriptive geometry, University of Minnesota, 414 Oak street, S. E., Minneapolis, Minn.

John Berg '05 is located at 524 W. 162d street, New York.

W. G. Gibson, '08, is draftsman with Flannery Bolt Co., Bridgeville, Pa.

F. K. Landgraf, '98, is superintendent Flannery Bolt Co., Bridgeville, Pa.

A. J. Kohn, '06, is a telephone engineer at Rochester, N. Y. Residence, 193 Park avenue.

W. A. Hoyt is consulting engineer, Chamber of Commerce Bldg., Chicago, Ill.

George H. Zeisler, '08, is with W. J. Longeor, building contractor, New Masonic Temple, Marshalltown, Ia.

Carl Zapffee, '07, is a mining geologist with offices at Brainerd, Minn.

J. G. Wray, '93, is chief engineer, Chicago Telephone Co., 203 Washington street, Chicago.

William Burk is engaged as mine inspector at Pikeville, Ky.

A. W. Bechlem, '08, is in U. S. Reclamation Service at Minidoka, Idaho.

G. W. Wekansen, has removed from La Crosse to 618 Chapel street, Schenectady, N. Y.

F. H. Ford, '93, is sales manager of the Mechanical Appliance Co., Milwaukee, Wis.

C. H. Shepherd, '08, is now chief operator at Fisk Street Station, Chicago.

H. Lutzie, '08, has resigned his position with the operating department of the Commonwealth Edison Co., Chicago. He has not given out what he intends doing next.

Frank Krusie, '08, is now in the fuel testing department of the Commonwealth Edison Co., Chicago.

W. H. Beasley, '08, resigned his position with the operating department, of Commonwealth Edison Co., Dec. 30, 09, and is now with the North Shore Electric Co., Chicago.

THE APRIL ENGINEER

will contain live, practical, and authoritative articles on engineering subjects. You can't afford to miss it.

"RIVER GAUGING WITH ROD FLOATS" by George W. Brown, B. S. '86, C. E. '90. This is recognized as an authority and is used as a reference in the second semester course of sophmore surveying. All sophmore civils should possess it.

"FREIGHT YARD CONSTRUCTION" by C. L. Van Auken, '10. An interesting treatise on track problems that every engineer will find valuable.

GEORGE F. BLANKENHORN of the Allis-Chalmers Co. will tell of the apprentice system now generally adopted by the larger manufacturing firms.

J. E. KAULFUSS, '04, and others engaged in practical engineering will be contributors to The Engineer.

IF YOU HAVEN'T SUBSCRIBED, IT'S NOT TOO LATE.