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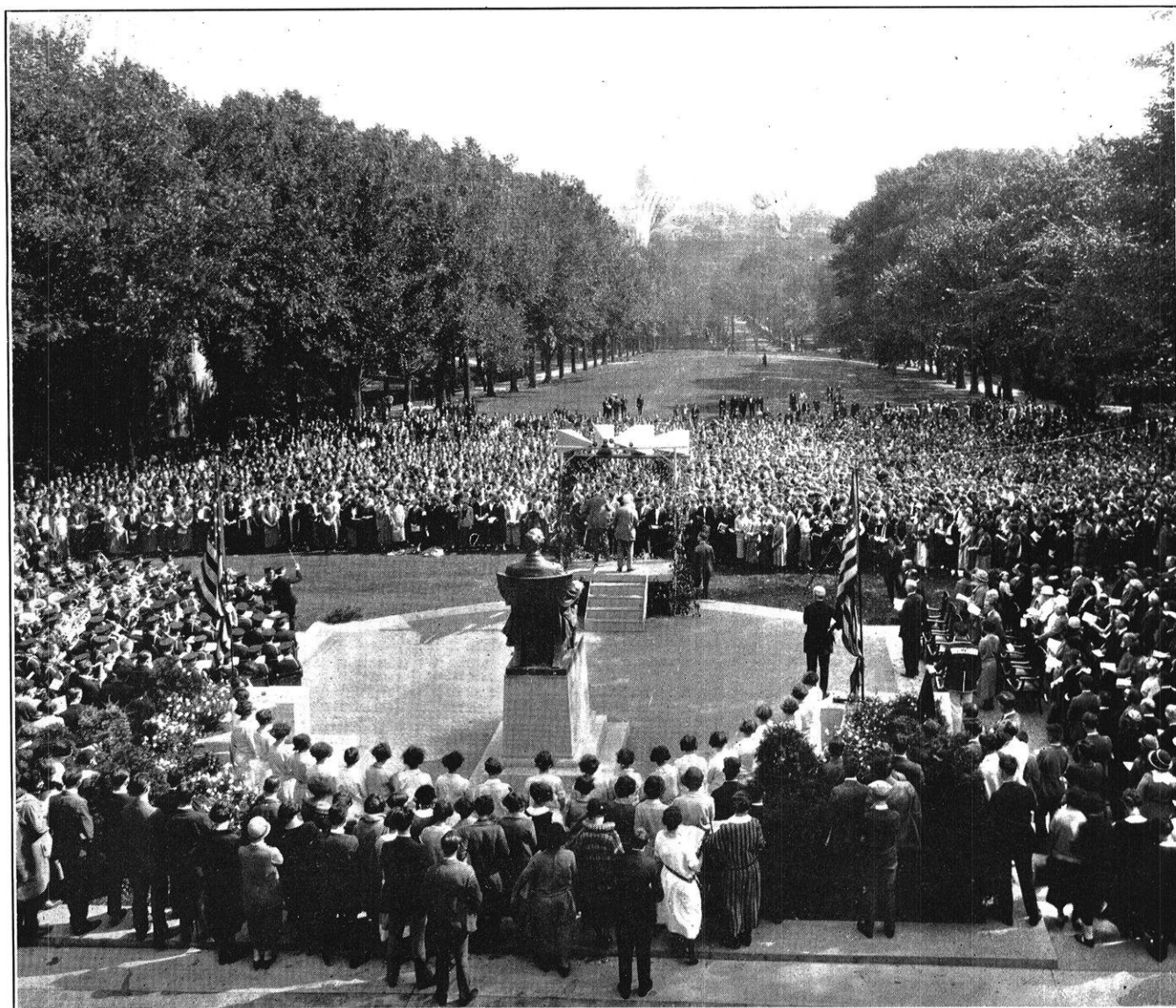
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ENGINEER**

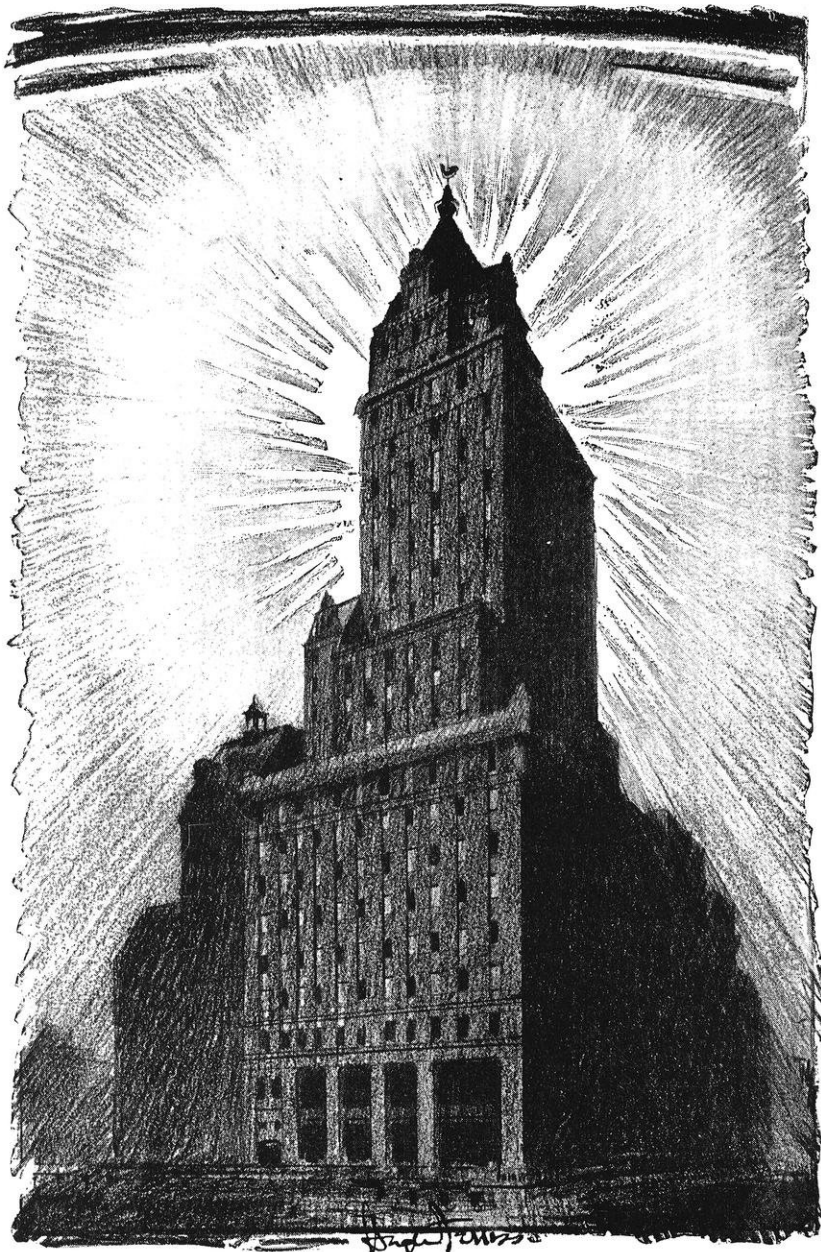
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**THE UNIVERSITY OF WISCONSIN**

VOL. XXIX

MADISON, WISCONSIN, OCTOBER, 1924  
*Member Engineering College Magazines, Associated*

NO. 1





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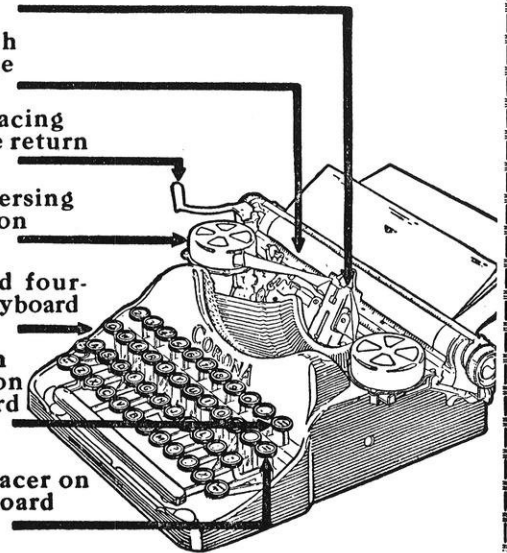
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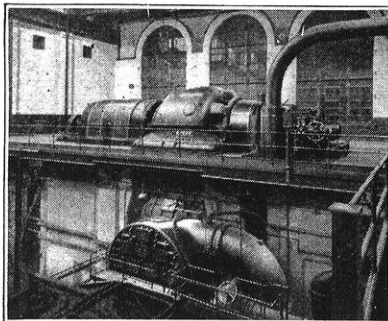
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If your fingers love the feel of a pencil, why not obey that impulse and come out for the publications? You can serve Alma Mater and yourself better as a first-class editor than a third-class halfback.

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THIS development of the United Hudson Electric Corporation, near Kingston, N. Y., utilizes water power from Walkill Creek. The dam is about 700 feet long and 110 feet high. The power house is about 50 feet by 100 feet, and the present installation will consist of three vertical wheels, each with a 6000 H. P. generator. Construction involved the operation of a quarry, crushing plant, and a railway from the quarry. Materials, other than stone, had to be trucked in, but in spite of this handicap and a severe winter, construction was carried on by The Foundation Company, as general contractor, without interruption.

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# WISCONSIN ENGINEER

UNIVERSITY OF WISCONSIN

VOL. XXIX No. 1

MADISON, WIS.

OCTOBER, 1924

## DESIGN, CONSTRUCTION, AND OPERATION PROBLEMS OF A 132,000 VOLT TRANSMISSION LINE

By RALPH E. MOODY, E'13

Research Engineer, T. M. E. R. & L. Co.

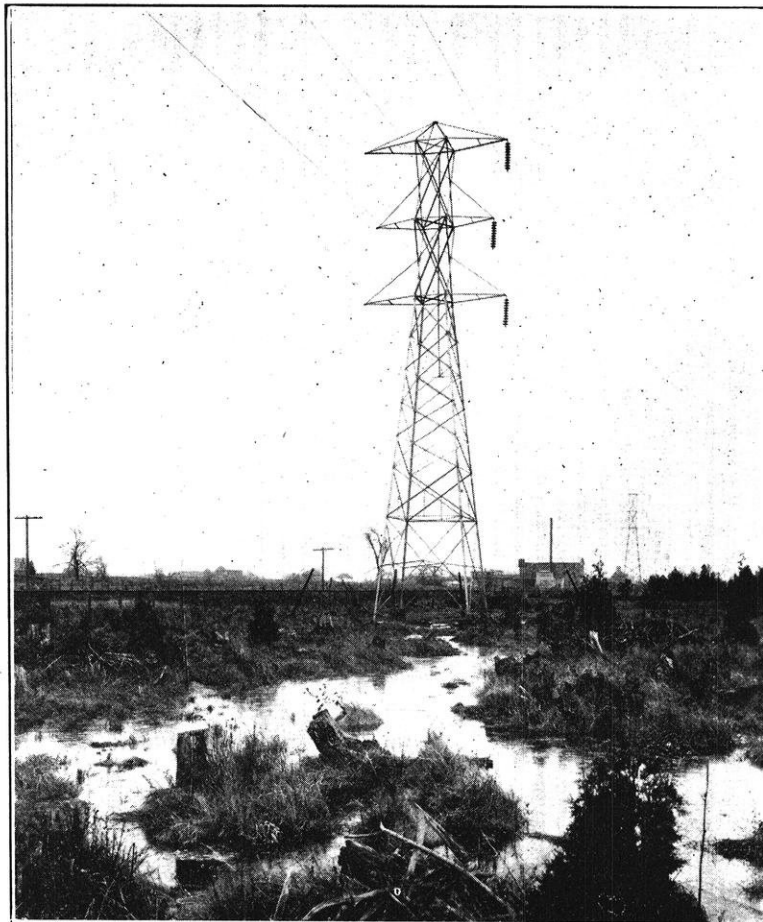
THE development of the electrical industry in Wisconsin is reflected by the marvelous progress from the 160 volt system which lighted the 16 candlepower lamps of the more affluent citizens of Appleton, back in 1882, where on September 30th of that year the first hydro-electric plant in the world began to operate, to the 132,000-volt steel tower transmission line which will soon carry electric energy to and through the same community. Forty years in few other industries have seen such progress. Electric light is now sold for about one-twentieth of the cost in 1882; electricity has developed from a dangerous luxury to a vital necessity, and as for the contrast in voltages, it is much as static sparks from a cat's back compared to a bolt of lightning.

The new steel tower transmission line from North Milwaukee to Plymouth is the first 132,000 volt line in the State of Wisconsin. It was designed and built in

Milwaukee and to furnish energy to the Wisconsin Gas and Electric Company at Random Lake, and the Wisconsin Light and Power Company at Plymouth. Steel towers averaging 78 feet in height and providing for two circuits carry the No. 3/0 steel-reinforced aluminum

conductors. The line runs 43.9 miles almost due north from the Granville substation, about two miles northwest of North Milwaukee, to the Plymouth substation, one-half mile southwest of Plymouth.

The company also has under construction 132,000 volt steel tower lines from Lakeside, its famous pulverized fuel power plant, to Racine, to Whitewater, and a loop around the city of Milwaukee to North Milwaukee. In the near future, an extension of the line from Plymouth north to connect with the Wisconsin Traction, Light, Heat and Power Company's property near Appleton, serving that community and beyond with energy from



STRAIGHT LINE TOWER CONSTRUCTION — Showing Method of Guying in Swamps.

1923 by The Milwaukee Electric Railway and Light Company to serve an increasing business north of

Lakeside, will complete the cycle described in the opening paragraph. Each of these lines, however, will

be very similar in all respects to the Plymouth line, and since the latter is the first one in operation it has been made the subject of the discussion below, in which the writer attempts to outline some of the more interesting features of high voltage transmission.

#### *Choice of Voltage*

The voltage, 132,000, may seem high for the present transmitting distance, but it was determined by the consideration of other factors. The future extensions of territory can be conveniently made without changing the transmission voltage of 132,000 volts which is also desirable, because it is a multiple of the generating voltage, 13,200, and of the company's standard transmission voltage, 26,400. This facilitates the design of the necessary transforming equipment.

But perhaps the most important determining factor is the proposed policy of interconnecting large generating systems throughout the Great Lakes region as outlined by the Power Survey Committee of the National Electric Light Association. The economic aspects of interconnection have caused serious consideration to be given this matter by nearly all the larger utilities. Because the maximum interconnecting distance was expected to be about 150 miles, the transmission voltage of 132,000 was considered the best. Other utilities in Ohio, Indiana, and Northern Illinois have already adopted it.

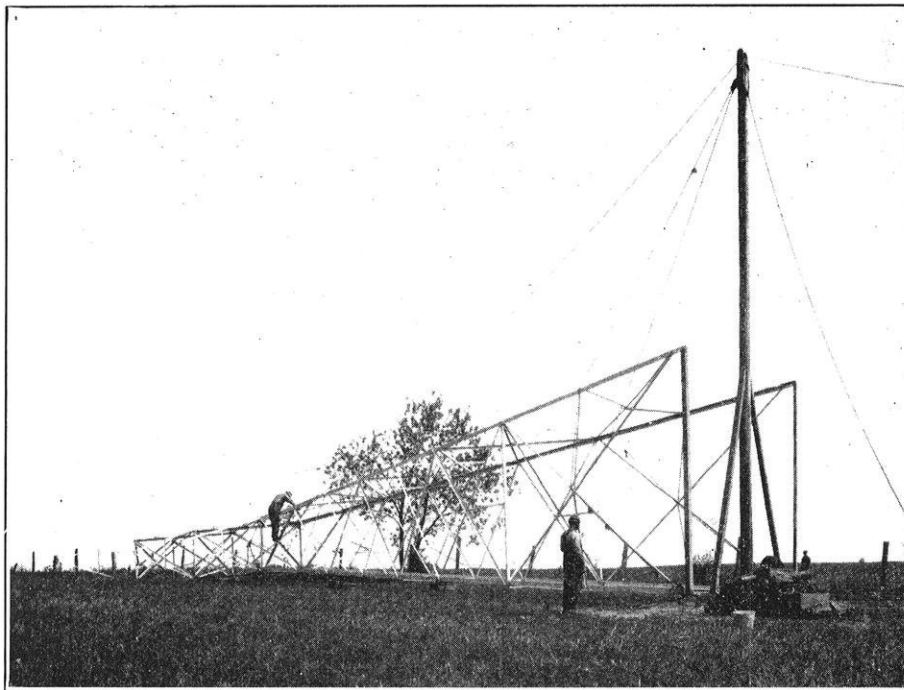
#### *Right-Of-Way Features*

The right-of-way for the tower line to Plymouth is about 80 feet wide, and it follows lot and section lines wherever possible in order to reduce the inconvenience to farmers. For a large part of the distance the route parallels a railroad and is comparatively near it at most other points. This enabled the construction material to be readily and economically transported. Some difficulty was experienced in securing easements from property owners; in some unavoidable cases the property had to be condemned and purchased. The right-of-way passes through land where in many places

considerable clearing was necessary. Arrangements were made wherever possible to have the farmers clear their land at the company's expense, but for the most part the company had to do its own clearing. Certain parts of the right-of-way crossed tamarack swamps where difficulties both in clearing and later in laying foundations were encountered.

#### *Specifications of Towers*

The loading specifications for the towers are given in



STRAIGHT LINE TOWER ABOUT TO BE RAISED—*Note Use of Gin Poles, Hinges, and Strengthening Members.*

considerable detail below, because it is thought they may be of interest to students of design. They have been developed by previous experience with steel towers on other of the company's lines, and with consideration to all known weather conditions in the vicinity of the tower line. Failure of a two-circuit tower would be serious, and it was decided to provide an ample factor of safety.

The towers are spaced approximately 650 feet apart, and with the exceptions noted below are set in ordinary earth. Towers are to withstand an inch-thick coating of solid ice on the conductors of both circuits. The towers should also withstand a wind which would impress 8 pounds per square foot on the projected area of the ice-coated conductors and 13 pounds per square foot on one and one-half times the exposed area of one face of the tower.

All towers other than corner ones should withstand the following:-

- (1) A vertical load at each conductor support, including ground wire support, of 1230 pounds. Total, 8610 pounds.
- (2) A horizontal load transverse to the line of 900 pounds per conductor including the ground wire. Total, 6300 pounds.
- (3) A horizontal load in the direction of the line of 3500 pounds at any conductor support. A load of 3500 pounds applied at the end of any two crossarms in the direction of the conductors on the same side of the tower. Total load, 7000 pounds.

*(Continued on page 16)*

# THE PURPOSE OF THE ENGINEERING COURSES OF STUDY

By EDWARD BENNETT  
*Professor of Electrical Engineering*

**A**T a conference of the deans and representatives of the Middle West Engineering Colleges held two years ago, a resolution was adopted which contained the following statements:

"In order to meet the constantly enlarging responsibilities of the engineering profession, we favor an advance in engineering education at this time that shall provide five years of collegiate training for those engineering students whose aim is to become qualified to take positions among the creative leaders in the profession, and that such advance shall be made in substantial accordance with the following plan:

1. Remodel the present four year engineering curricula by substituting a substantial proportion of humanistic and fundamental subjects in place of an equivalent amount of advanced technical work. 2. Add a fifth year of advanced work, mostly or wholly technical, and specialized to such an extent as desired. 3. The first four years of work shall lead to a bachelor's degree and the fifth year to an advanced degree in engineering."

The four year engineering courses at Wisconsin have for many years contained elective credits, the expectation being that these credits would be used to pursue studies in fields other than engineering. The fact that these elective credits were listed mainly in the senior year has militated against their use to the intended purpose.

In conformity with the resolution quoted above, the electrical engineering course has been modified by the requirement that, in addition to pursuing the non-professional studies directly specified in the curriculum, the student shall elect non-professional studies to the extent of at least three credits per semester in a continuous band extending throughout the last three years of the course. The subjects elected in this non-professional band must be non-professional in the sense that they are not prerequisite to the more technical phases of engineering work, — subjects such as the languages, literature, history, political and social science, economics, and the like.

To furnish an explanation of why this band of non-professional electives is required, and as a guide to students and advisers in the selection of non-professional electives, the following statement of the purpose of the engineering courses of study has been prepared.

The function of an educational system is to assist the individual in developing himself for the duties and privileges of citizenship in the state which has evolved the educational system.

The present-day mode of life is made possible by intense specialization on the part of individual workers, accompanied by a high degree of organization and co-operation between the groups of specialized workers. The engineering achievements of the age, in particular, are to be attributed as much to the development of a co-operative spirit between groups as to the development of highly trained specialists.

If the advance of civilization is to be continued, or if the present stage is to be maintained, it is imperative that the engineering courses of study (as well as all others) shall not only provide the foundation for the technical work of specialists, but that they shall also impart the beginning of an appreciation of and respect for the contributions, and aims of other groups of workers. Accordingly, the engineering courses of study should afford a training for the prospective engineer and citizen along the following lines:

- I. For the highly specialized duties of the engineer in directing the forces of nature to the service of mankind.
- II. For the duties of citizenship; that is, for the duties arising from the co-operative relations of citizenship.
- III. For the recreational privileges of citizenship.

On this basis, the studies which are required of the engineering student and those which may be elected by him may be classified in the following manner under three main headings.

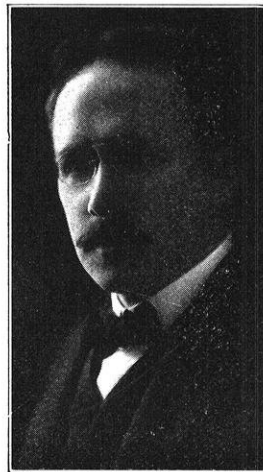
### I. Non-professional Studies Prerequisite to Professional Studies

(Pursued jointly for their social value and as a prerequisite to professional work)

While the following introductory studies are prerequisites to the professional engineering studies, they are so essentially a part of any liberal education that they are classed with the non-professional group of studies.

Because of the fact that the engineering group will make professional application of the work in mathematics, physics and chemistry, the treatment of such subjects for engineering students should place more emphasis on the acquirement of the details and the technique of the subject than is desirable for student groups pursuing these non-professional subjects with no professional application in view.

Elementary Mathematical Analysis	-----	Year.
Chemistry	-----	Year.
English	-----	Year.



PROFESSOR  
 EDWARD BENNETT

Physics ----- Year.

Elements of Economics ----- Semester.

II. *The Professional Studies* (pertaining to the training of the man as an engineering specialist).

1. *The Pure Sciences* (so-called, concerned primarily with the development of fundamental principles and relations.)

- A Descriptive geometry
- B Calculus and advanced mathematics
- C Advanced mechanics
- D Advanced hydraulics
- E Advanced thermodynamics
- F Advanced electrical theory
- G Advanced chemistry
- H Advanced geology and mineralogy
- I Advanced electrical theory
- J Advanced branches of physics

2. *The Engineering Technique Group of Subjects*  
 A. The professional information group. (furnishing illustrations of the engineering *applications* of the fundamental principles).

These studies treat of engineering methods and practices, and of the properties and the costs of engineering materials and appliances in fields such as the following: machine design, mechanics of materials, fuel analysis, electric machinery, steam and gas machinery, electric railways, telephony, water power engineering, metallurgy, bridge design, power generation and distribution, heating and ventilating, contracts and specifications, etc.

B. The manipulative skill group (pursued with a two-fold object); namely —

- a. The acquirement of a certain degree of manipulative skill in the use of tools, instruments, and machines.
- b. The acquirement of a knowledge of what constitutes the skillful use of tools, instruments, and machines.

To this end there are offered certain features of

- Laboratory exercises
- Drawing
- Shop exercises
- Surveying

III. *Non-professional Studies Not Prerequisite to Technical Engineering.* (Pertaining to the co-operative aspects of citizenship: pursued for their recreational value).

The "non-professional electives" specified in the engineering courses are to be elected in fields such as the following, —

- Economics and Sociology*
- Elements of Economics
- Value and Valuation
- Socialism and Capitalism

(Continued on page 13)

## FACULTY CHANGES

By H. C. WOLFE

### *Chemical Engineering Department*

W. T. Ennor has left the department to take a position with the Aluminum Company of America, at East Pittsburgh, Pennsylvania. He was formerly an instructor in metallurgy.

John Krombholz, who received a degree in chemical engineering with the class of '24, is taking Mr. Ennor's place.

### *Electrical Engineering Department*

H. H. Fuller has resigned his position as instructor to join the United Electric Light and Power Company in New York City.

Kenneth Scott, former instructor, is now the manager of a cafeteria in Peoria, Ill.

W. R. Lyon has left the department to become a testing engineer for the Pennsylvania Power and Light Company. His address is Hazelton, Pennsylvania.

H. L. Rusch has taken a position with the A. C. Nielson Company of Chicago. He is engaged in obtaining operating data and preparing reports on engineering equipment. Mr. Rusch held a fellowship last year. His address is 4509 N. Ashland Avenue, Chicago.

The new instructors in the department are G. D. Clark and R. E. Johnson.

Mr. Clark, who graduated from Ohio State in 1922 with the degrees of B. A. and B. E. E., has spent the last two years with the Westinghouse Company engaged in research work. He is now an instructor in the laboratories and is also taking work for a Masters degree. He is married and lives at 2603 Stevens Avenue.

Mr. Johnson, who will also instruct in the laboratories, is a graduate of Wisconsin of the class of '23. Last year he held a Wisconsin Utilities Fellowship, and carried on research work in this department.

### *Highway Engineering Department*

W. G. Bonawitz, c'25, has resigned his position as assistant to Professor Smith in order to devote all of his time to his studies.

L. C. Alk, c'25, is taking Bonawitz's place.

### *Machine Design Department*

Assistant Professor Neff has resigned his position. Mr. Puerner is taking his class in Machine Design 5.

Mr. King, an assistant instructor last year and a member of the class of '24, is now working on power plant design with a firm in New York City.

A. O. Dahlberg has returned to the department as an instructor. He was formerly an assistant instructor. Leo Kincamon is the new assistant instructor.

### *Machine Shops*

Mr. Goude, former instructor in foundry work, died suddenly this summer while on his vacation. His death occurred at Markesan, Wisconsin.

A. Wald, who was a student assistant last year, has resigned.

Assistant Professor J. M. Dorrans is the new super-

(Concluded on page 13)

## WHAT THE CLASS OF 1924 IS DOING

By E. E. ELLICOTT

*Sophomore Mechanical*

The members of the class of '24 have been out in a proverbially cold and cruel world for three months, and from the reports that have come in we can see that the '24 Plumbers are making good. Nearly all of them are now actively engaged in engineering work of one kind or another. This very effectively shows that the engineering courses at Wisconsin enable a man to really enter the technical world very shortly after graduation.

### CHEMICALS

**Baehr, William B.**, is a student at the Harvard Graduate School of Business Administration. His address is 1582 Massachusetts Ave., Cambridge, Mass.

**Bellew, Edgar T.**, is with the Spruce Falls Co., Ltd., of Kapuskasing, Ont., Canada. His home address is 407 State St., Appleton, Wis.

**Breitenbach, W. C.**, is employed in the sulphite mill of the Marathon Paper Mills Co., Rothschild, Wis. His permanent address is 1010 Rutledge St., Madison, Wisconsin.

**Chyle, John J.**, has returned to Madison and is a graduate student at the University. He may be reached in care of the Steward at the University Club, Madison, Wisconsin.

**Corliss, Allen G.**, is employed as a cadet engineer with the Western Electric Co., Chicago. His home address is 21 Brewster St., LaGrange, Illinois.

**Fulkerson, R. P.**, is cadet engineer in the oil deodorizing department of the Proctor and Gamble Co., Ivorydale, Ohio.

**Greene, Ernest W.**, is with the French Battery Co., Madison, Wisconsin.

**Harris, Mace V.**, is employed with the Weyerheueser Wood Products Co., Cloquet, Minn. His permanent address is 125 Alcott Avenue, W. Fergus Falls, Minn.

**Harris, Robert E.**, is an assistant to Nissen and Crane, patent attorneys of Chicago. He is living at 3618 Franklin Blvd., Chicago, Ill.

**Hart, Lyman H.**, is now in the field with the Wisconsin Geological Survey. His home address is 1220 Sherman Ave., Madison, Wisconsin.

**Hirth, Carl W.**, is employed in the engineering department of the Wisconsin Telephone Co., and his address is 1620 Fifteenth St., Milwaukee, Wis.

**Kroesche, H. J.**, is a chemist with the Pittsburg Plate Glass Co. His present address is 1099 Fourth St., Milwaukee, Wis. Home address: German Valley, Illinois.

**Kuenzli, Walter A.**, is with the Western Electric Co., of Chicago. His home address is 151 Warren Ave., Wauwatosa, Wisconsin.

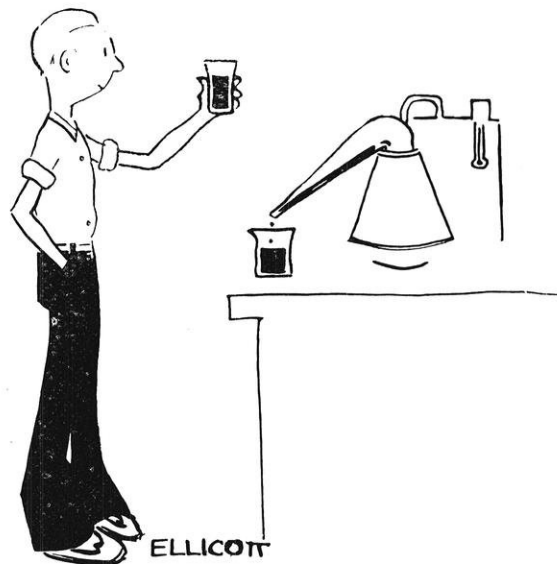
**Kuhe, David**, is employed as a chemist by the Continental Paper and Bag Mills Corp., of Rumford, Maine. Mail addressed in care of the Rumford Institute, Rumford, Maine, will reach him. Permanent address: 1623 Jefferson St., Madison, Wisconsin.

**Nelson, Edwin R.**, is a cadet engineer with the Milwaukee Coke and Gas Co., Milwaukee, Wis. His home address is 450 W. Second St., Superior, Wisconsin.

**Nichol, Paul A.**, is doing operation work for the Proctor and Gamble Co. He may be reached at 747 E. Epworth Ave., Cincinnati, Ohio. Permanent address: 229 W. Gilman St., Madison, Wis.

**Ouweneel, William E.**, is employed by the Commercial Solvents Corporation, Terre Haute, Ind. His address is 1437 So. Center St., Terre Haute. He writes as follows: "So far I have admired this town quite a bit. If the rest of the state is the same, it surely is all right. After living in the North for so many years one thinks he sees just a little of Dixie even here. I am shift chemist and also somewhat of a foreman in the derivatives department. This company controls all patents for making acetone and butyl alcohol from corn by the Weizmann process.

"I am anxiously awaiting the first number of the ENGINEER to see what the old class is doing and also to get



Ouweneel Sampling His Product

just a whiff of that wonderful campus atmosphere, — from that in the basement of the Chem. Engineering Building to that amongst the trees on the Hill."

**Silver, C. Albert**, is a chemical engineer at the C. F. Burgess Laboratories, Madison. His address is 218 N. Mills St., Madison, Wis.

**Soll, Roland H.**, is with the Singer Steel Casting Co., Milwaukee, Wis. His home address is 1118-26th St., Milwaukee, Wisconsin.

**Thomas, Walter E.**, is a cadet engineer with the Wisconsin Power and Light Co., Fond du Lac, Wisconsin.

**Weimer, Bernard A.**, is employed as a chemical engineer with the Marinette and Menominee Paper Co. He is living at 1507 Newberry Ave., Marinette, Wisconsin.

**Whelan, Richard A.**, is employed as plant operator with the American Tar Products Co., and is living at 650 Linus St., Milwaukee, Wisconsin.

The present addresses of the following Chemicals are not definitely known; the addresses given below being the best available:

**Fiedler, Stewart O.**, 809 Clymer Place, Madison, Wis.

**Kelly, Pennell C.**, Fort Atkinson, Wis.

**Manthey, R. H.**, Ablemans, Wis.

**Rutherford, John A.**, 1818 N. Charles St., Baltimore, Md.

**Walton, J. L.**, Moorestown, N. J.

### CIVILS

**Becker, Elmer W.**, is junior engineer with the Water Works Department, City Engineer's Office, Milwaukee, Wis.

**Breimeister, Harry**, is employed with the City Planning Department, Milwaukee. He is living at 565 Muskego Ave., Milwaukee, Wisconsin.

**Breivogel, Milton W.**, is Assistant Engineer with the Public Land Commission, Milwaukee, Wisconsin.

**Collins, Wm. A.**, is working in the city engineer's office, Beloit, Wisconsin. He was married to Edna May Young on September 2nd. His address is 805 Euclid Ave., Beloit, Wisconsin.

**Desmond, John T.**, is employed with Older, Consoer and Quinlan of Chicago.

**Donohue, Edward B.**, is working for the Montana Highway Commission. His address is 1009 N. Warren St., Helena, Montana.

**Farwell, Knight D.**, is an instrument man on location with the Chicago, North Shore & Northern R. R. He is living at 6117 Kimbark Ave., Chicago, Illinois.

**Ihling, Herbert M.**, is a junior engineer at the Riverside Pumping Station in Milwaukee. His address is 606 Wentworth Ave., Milwaukee, Wisconsin.

**Kent, Hugh Jr.**, is engaged in engineering work with Older, Consoer and Quinlan, Chicago, Illinois.

**Mac Leod, Wm. S.**, is married and living at 310 Norris Ct., Madison, Wisconsin.

**Mohs, Carl E.**, is surveying for J. C. McKenna. His home address is 834 E. Gorham St., Madison, Wisconsin. Mohs was married on September 10 to Doris Baldwin, Wisconsin '24, of Madison.

**Otis, Edward N.**, is a junior engineering assistant of the Sanitary District of Chicago. His address is 244 Washington Blvd., Chicago, Illinois. Permanent address: 1822 Chadbourne Ave., Madison, Wisconsin.

**Robb, Carroll E.**, is a safety engineer of the Public Safety Division of the National Safety Council, at 168 N. Michigan Ave., Chicago, Illinois.

**Schudt, Joseph A.**, is an inspector for the Sewerage Commission of Milwaukee. His address is 381-29th St., Milwaukee, Wisconsin.

**Schuman, Everett C.**, is an instructor in Mechanics at Wisconsin, and is living at 12 N. Broom St., Madison, Wis. Permanent address: 1074 Maryland Ave., Milwaukee, Wisconsin. He writes as follows: "I spent the summer

and many unusual sections were found. The rather heavy members that were used lead me to believe that the building had been designed to withstand heavy wind stresses which sometimes occur down there. Several 60 mile gales blew while I was there.

"My greatest interest was directed to the men. I learned, that nowhere can one find a harder working gang of men than the 'bridgemen' or iron workers. They are 'working fools' and there is no such thing as soldiering or taking a 'fiver' (five minutes rest). My opinion of iron workers never had been very high until I mingled with them and worked as one of them. Now all I can say for them, in general, is praise for their conscientious efforts to earn an honest living.

"Did anyone ask about the temperature? One day we took a thermometer up on top 'where the work is' and it registered only 120° F. Officially it was 97° in the shade, — and no shade."

**Sogard, Lawrence T.**, is a construction engineer with the Henkel Construction Co., of Mason City, Ia. He can be reached in care of Henkel Const. Co., Woodson, Ill. Permanent address: 1521 Wisconsin St., Racine, Wis.

**Stebbins, Lawrence L.**, is working in the engineering department of the New York Telephone Co., at 104 Broad St., New York City. His permanent address is 136 Weaver Ave., Bloomfield, N. J.

The present addresses of the following Civils are not definitely known; the addresses given below being the best available:

**Amundson, Helmer, C.**, in care of Henry Amundson, Rio, Wisconsin.

**Bandelman, Oliver J.**, 522 W. 1st Ave., Mitchell, S. D.

**Foxon, Roy D.**, 207 Bridge St., Northampton, Mass.

**Haddorff, Irving R.**, 1532 State St., Rockford, Illinois.

**Hammann, Wm.**, 1057 Fifth St., Milwaukee, Wisconsin.

**Hirsch, Edmund**, 2710 Wright St., Milwaukee, Wisconsin.

**Holden, Chas. E.**, in care of C. E. Holden, Burkhardt, Wis.

**McCullough, Herbert D.**, 21 Fifth St., Fond du Lac, Wis.

**Mathy, Anton**, Brussels, Wisconsin.

**Minshall, Neal E.**, Viroqua, Wisconsin.

**Schneider, Alfred W.**, 740-17th St., Milwaukee, Wis.

**White, Emil**, 1701 Hamilton St., Racine, Wisconsin.

#### ELECTRICALS

**Alfrey, Henry F.**, is working for Dwight P. Robinson and Co. of New York. His home address is 1813 Center St., Milwaukee, Wisconsin.

**Aultman, Dwight E.**, is with the General Electric Co., at Schenectady. His home address is Fort Benjamin Harrison, Indiana.

**Barker, Herman H.**, can be reached in care of Wisconsin Telephone Co. at Milwaukee. His home address is Noblesville, Indiana, Route 3.

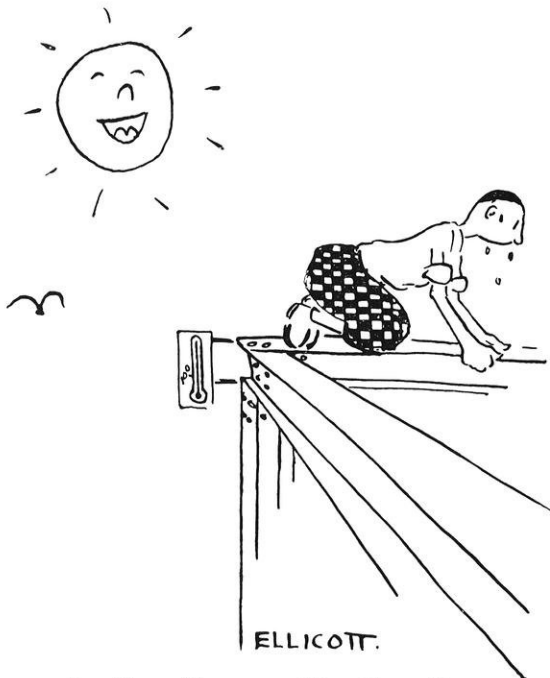
**Baxandall, Frank M.**, is a Junior Engineer with the Commonwealth Power Corp. of Jackson, Mich. His address is 765 W. Michigan Ave., Jackson, Mich. Permanent address: in care of Commonwealth Power Corp., Engineering Department, Jackson, Michigan.

**Bean, Geo. E.**, is with B. M. Tanner Concrete Construction Co. His address is Blackfoot, Idaho, Route 2.

**Berg, Leo F.**, is an equipment engineer for the Automatic Electric Co., and is living at 2129 W. Washington Blvd., Chicago, Ill. His home address is Lima Center, Wis.

**Blanch, Fred D.**, is a student engineer with the General Electric Co. at Schenectady. His address is 632 Brandywine Ave., Schenectady, N. Y. Permanent address: Claremont, Minnesota.

**Bopf, Edward C.**, is employed by the Automatic Electric Co. as a patent engineer. His address is Oak Park Y. M. C. A., Oak Park, Ill. Permanent address: Wausau, Wis.



ITS THE RISK, — NOT THE HEAT

in St. Louis working on an 11 story structural steel building. Throughout the building the construction was heavy,

**Branovan, Leo I.**, is working for the General Electric Co. at Fort Wayne, Indiana. His home address is 548-6th St., Milwaukee, Wis. He is now living at 1121 Fulton St., Fort Wayne, Indiana.

**Buerk, Fred C.**, is a student engineer with the Illinois Bell Telephone Co., and is living at 514 Park Ave., Rockford, Illinois.

**Coates, Royal E.**, is a student engineer with the General Electrical Co. His home address is 509 E. Wisconsin St., Prairie du Chien, Wisconsin.

**Coe, Simeon M.**, is manager of the Emergency Engineering Corp., and is living at 1305 W. 3rd St., Sterling, Ill. He says that he expects to move into Wisconsin soon, but is not sure.

**Finkle, Geo. H.**, is a meter engineer with the Wisconsin Power and Light Co. His address is Berlin, Wisconsin.

**Gartner, Irl C.**, is an electrical engineer with the Commonwealth Power Corp., of Jackson, Mich. His address is 315 W. Van Buren St., Jackson, Mich. Permanent address: Linneus, Mo. At present he is employed at building a 40 mile 140,000 volt tower transmission line in the eastern central part of Michigan.

**Goshaw, Irl R.**, is studying law at the University of Wisconsin.

**Gregg, Hendrick J.**, is a junior engineer of the Public Service Co. of Colorado, and is living at 1475 Race St., Denver, Colo. His home address is 412 N. Murray St., Madison, Wisconsin.

**Herring, Reuben E.**, is employed with the Wisconsin Telephone Co., Milwaukee, Wisconsin.

**Hume, Lloyd E.**, is with the Bell Telephone Co. of Milwaukee. He is living at 2519 Cedar St., Milwaukee, Wis. Permanent address: Endeavor, Wis.

**Johnson, Edwin E.**, is working for the Consumers Power Co. of Jackson, Mich. His home address is Dollar Bay, Mich.

**Johnson, Floyd D.**, is taking the students training course at Westinghouse. He is living at 7939 Susquehanna Ave., Pittsburg, Pa.

**Johnson, Royce E.**, is an instructor in the electrical engineering department, and is living at 909 Oakland Ave., Madison, Wis. "R. E." spent the summer with the Marinette and Menominee Light and Traction Co.

**Kelhofer, Leon M.**, is an electrical engineer with the Commonwealth Power Corp. and is living at 711-4th St., Jackson, Mich. Permanent address: 1315 Randall Ct., Madison, Wis. "We are here from Wisconsin ten strong. What we need badly is to have you send a winning football team to Ann Arbor on October 25th."

**King, Timothy P.**, is employed by the Wisconsin Public Utility Corp. of Green Bay. His address is Niagara, Wis.

**Krohn, Howard G.**, is working in the engineering department of the Automatic Electric Co. His address is 2129 W. Washington Blvd., Chicago, Ill. Permanent address 1014 Janesville St., Whitewater, Wisconsin.

**Landkamer, Othmar F.**, is employed in the engineering department of the Consumers Power Co. His address is 216-1st St., Jackson, Michigan.

**Lessing, Otto**, is a Second Lieutenant in the Marines stationed at Philadelphia. His address is Williamstown, Massachusetts.

**Lilja, Edgar D.**, our former editor, is an estimator for the Wisconsin Public Service Corp., and is living at 1273 Cherry St., Green Bay, Wis. Permanent address: 121 London Ave., Rockford, Ill. He is teaching electrical engineering at a vocational school as a sideline.

**Lynn, Delmur C.**, is with the General Electrical Co. at Schenectady. His home address is Cornell, Wisconsin.

**Manke, Arthur G.**, is with the Automatic Electric Co., 4406 Jackson Blvd., Chicago, Ill. Permanent address: Norwalk, Wisconsin.

**Masters, Dean B.**, is with the Consumers Power Co., Jackson, Mich. His home address is Canton, Minnesota.

**McMurrin, Marshall J.**, is now in Oregon with Utah Power Co. Home address: 1106 W. Johnson St., Madison, Wisconsin.

**Miyasaki, Masao**, is taking graduate work at the University of Wisconsin.

**Michael, John H.**, may be reached in care of Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin.

**Miller, Thomas F.**, is with the Wisconsin Telephone Co. at Milwaukee, Wisconsin.

**Naab, Milton P.**, is working in the plant department of the Wisconsin Telephone Co. at Milwaukee. His home address is 341 Division St., West Bend, Wisconsin.

**Nelson, Erik N.**, is a cadet engineer with the H. L. Doherty & Co. of Denver, Colo. His home address is 330 W. Irvington Pl., Denver, Colorado.

**Nelson, Floyd E.**, is working for the Commonwealth Edison Co. of Chicago. His permanent address is 521 Prairie Ave., Kenosha, Wisconsin.

**Nemetz, Victor W.**, is with the Consumers Power Co. of Jackson, Mich. Permanent address: Kewaunee, Wisconsin.

**Peterman, Paul H.**, is working in the railway department of the Menominee and Marinette Light and Traction Co., of Menominee, Mich. Home address: 1702 Loomis St., La Crosse, Wisconsin.

**Peterson, Harold A.**, is with the Wisconsin Telephone Co. at Milwaukee. His home address is Box 273, Phelps, Wis.

**Plettner, Earl M.**, is working for a Master's Degree at Wisconsin this year. His address is 201 N. Park Ave., Madison, Wis. Permanent address: Algoma, Wisconsin.

**Porter, Frank M.**, is with the Northern Indiana Gas and Electric Co. of Hammond, Ind. Permanent address: Elkhorn, Wisconsin.

**Purucker, Ralph E.**, was working for the Dwight P. Robinson Co., but has returned to school this fall. His home address is Jefferson, Wisconsin.

**Rahr, Fred A., Jr.**, is living at 702 So. Monroe Ave., Green Bay, Wisconsin.

**Ratliff, Horace H.**, is with the Westinghouse Electric and Mfg. Co. at E. Pittsburg, Pa. Home address: 10 W. Gorham St., Madison Wisconsin.

**Rian, John**, is working for the Northern Indiana Gas and Electric Co., of Hammond, Ind. His home address is Box 183, Buhl, Minnesota.

**Roller, August F.**, is a student engineer with the Illinois Bell Telephone Co. He married Frances Stoeckel, of Chicago, on Sept. 9th and is now living at 2011 N. Kedzie Ave. Chicago, Illinois.

**Schoenoff, Waldemar, P.**, is working for the Public Service Co. as a construction engineer. His address is 1636 Oak St., Chicago Heights, Illinois.

**Scholes, Robert H.**, is employed by the Public Service Co. of Northern Illinois at Waukegan. Home address: Endeavor, Wisconsin.

**Stewart, Sturtevant**, 993 N. Main St., Rockford, Illinois.

**Thomas, Everett J.**, is a student engineer with the General Electric Co. His home address is Ipswich, S. D. He is now living at 226 E. Washington Blvd., Fort Wayne, Indiana.

**Thomas, Geo. H.**, is employed in the traffic department of the Wisconsin Telephone Co. He is living at 605-68th Ave., West Allis, Wisconsin.

**Timmons, James S.**, is now in the design school of the Westinghouse Graduate Student Course. His address is 913 Ross Ave., Wilkinsburg, Pa.

**Vornholt, Karl E.** is with the Consumers Power Co. of Jackson, Mich. His home address is 26 N. Park St., Madison, Wisconsin.

(Continued on page 14)



# EDITORIALS

## DEAN'S WELCOME

TO the engineering students and subscribers of *The Wisconsin Engineer*, we extend our greetings at the opening of another college year.

To those of us who have seen several generations of students pass through the University, including many sons of former members of our own classes, it is difficult to appreciate the pleasure of anticipation which must be present in the minds of those who are here for the first time as they look forward to the years they hope to spend at the University. And yet it is to be doubted if you fully appreciate what really wonderful opportunities are offered to the multitude of young people at the present day by the various universities scattered over the country. For you it is really "an opportunity of a lifetime", and, if well utilized, the time spent in college is likely to be looked upon in later years as the most enjoyable period of your lives. But keen enjoyment comes from achievement, and not from having an easy time. A fisherman would get no sport or pleasure in catching trout in a fish hatchery, or a hunter in shooting deer in a fenced-in park. The pleasure of a sportsman comes from getting his game by fighting with nature. He must start before daybreak, tramp through swamps and brush, sleep under a blanket, get cold and wet, come home dog-tired, and sleep for eighteen hours, in order to be really satisfied with his sport. It is much the same with college life. It shouldn't be easy, and we do not expect that it will be, but hope that every student will take it as a great opportunity to secure the education and self-development necessary to prepare him for his future career.

F. E. Turneaure

### A NEW ERA OF PROGRESS

Nearly every year past experience suggests some changes in the engineering curriculum. The present year, however, will be a memorable one from a consideration of the much needed reforms that are now being made. For several years, the more broad minded educators have made an earnest plea for a change of the engineer's viewpoint of a college education. The realization of the changes that go into effect during the present school year is even more than a gratification. When the engineering student is finally convinced that there are other things in the University that are just as important as technical engineering knowledge, he will certainly be crossing the threshold of a new era of progress.

The actual changes in the curriculum are given in an article by Prof. Edward Bennett elsewhere in this issue. The faculty of the Electrical Engineering Department have done their best to offer the student just what he needs most. The question is: Can the casual single track mind be convinced of the inestimable value of cultural and non-technical subjects? The student who needs culture the most is generally the last one to avail himself of an opportunity when it is presented. Some of the more narrow minded engineering students consider the "hill" courses as a joke. In truth, their attitude of mirth is nothing short of a tragedy to themselves. Some see the true value of a broader education at a later period in their life; others are destined to stay in one narrow rut forever.

There is no better time than the present to reform some of our moss-covered ideas. *Don't take the course that fits your schedule; take the course that fits your needs.* Snap courses have no place in any college curriculum. If the only ambition of the student is to obtain a diploma, he might just as well frame a piece of drawing paper and leave the University at once. No sheepskin is worth any more than the earnest effort that was expended toward its possession.

Character, personality, and a broad education are the three foremost qualities that an engineer should possess. The first two, each of which is equally as important as the third, are not to be found in engineering text books. These qualities cannot be acquired without an effort or without at least a manifestation of seriousness of purpose, but they can be developed if opportunities are realized and not ignored.

*There is no method by which we can either be relieved of the results of our own folly or be guaranteed a successful life. There is an inescapable personal responsibility for the development of character, of industry, of thrift, and of self-control.*

—Calvin Coolidge.

*Is it not strange that it is not written in history that at least one of the great men of the past attained his greatness through trickery, deceit and double-crossing his business associates? —Napoleon Hill.*

# EXTENSION NOTES

Professor Ben G. Elliott of the Department of Mechanical Engineering attended the annual meeting of The Society for The Promotion of Engineering Education held at the University of Colorado in June. A. A. Potter, Dean of Engineering and Director of Engineering Extension at Purdue University, was elected President of the Society for the coming year.

The third edition of "The Gasoline Automobile" by Hobbs, Elliott, and Consoliver has recently been published by the McGraw-Hill Book Co. One hundred thousand copies of this text have been distributed by the publishers. It is used as a text in 60 Universities and Colleges.

Three new courses on the Manufacture of Paper have been announced by the University Extension Division. The courses are offered with the co-operation of The United States Forest Products Laboratory.

During the biennial period July 1, 1922, to June 30, 1924, there were 2645 active students doing correspondence work in Mechanical Engineering subjects. During this same period 1003 students completed their courses.

Mr. V. C. George, formerly Assistant Professor of Mechanical Engineering, is now in the College of Engineering at the University of California. In addition to his work in the College of Engineering, Mr. George is doing some Engineering Extension work in California.

An extensive series of field classes will be offered during the coming winter by the Mechanical Engineering Department. The work in Steam Engineering at the Port Edwards Mill of the Nekoosa-Edwards Paper Co. will be continued, and several new classes in this subject will be organized in the Fox River Valley.

Mr. M. S. Douglas, a 1922 Wisconsin graduate in civil engineering, has been appointed Instructor in the Department of Civil and Structural Engineering. Mr. Douglas has had two years of practical experience in the contracting field as Superintendent of Construction.

The Milwaukee headquarters of the University Extension Division have been moved to 137 Second Street. The new location is very convenient and accessible, being within a few blocks of the business center of the city.

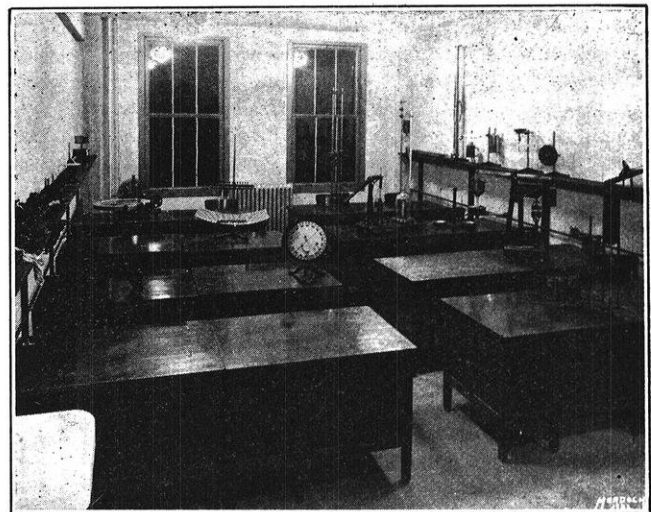
Mr. J. E. Kammermeyer, Extension Student in Engineering, is Superintendent of Transportation for the Yellowstone Park Transportation Co. In a recent letter to the Extension Division he comments upon his work as follows:

"We handled nearly 150,000 tourists this season, and I supervise six garages and 322 busses and trucks with all the grief that goes with it; so you can readily understand that I could not give study any concentrated thought—much less the time—as I put in about 18 hours a day trying to keep up with problems.

"Your letter, however, comes at a most opportune time as our season closes September 20th, and I just began to assemble my lessons to start on a good period this winter. I expect to send in lessons regularly for the next nine months."

Mr. L. M. Hoffman, Instructor in the Civil and Structural Engineering Department, has resigned to accept a civil engineering position in Porto Rico.

The interest of paper mill employees in electrical engineering is disclosed by the successful completion of a course in Direct-Current Machinery by the following employees of the Nekoosa-Edwards Paper Company: Marvin Presser, Robert Lee, W. J. McGrogan, Carl Olson, Edward Moulton, Jack Brennan, Vincent E. Bliss, and Chester Bridgmen.



PHYSICS LABORATORY—Milwaukee Branch, University Extension Division.

The 700 correspondence students in the Department of Civil and Structural Engineering include men from 46 states other than Wisconsin and from 9 foreign countries.

# ALUMNI NOTES

## CIVILS

**Raymond S. Collins**, c ex'22, announces the arrival of a son, Raymond junior, on July the sixth. Mrs. Collins was Miss Alma Terry of Reedsburg, Wisconsin. Mr. Collins has been engaged upon the construction of a pipe line from Tea Pot Dome, Wyoming, to Freeman, Missouri, for the Sinclair Pipe Line Company. His present address is 510 East Main Street, Reedsburg, Wisconsin.

**David L. Fairchild**, c '90, writes that he is now located at 1312 Douglas Avenue, Minneapolis, Minnesota.

**John E. Noran**, c '23 was married on August the twenty-first to Miss Mabel A. Schroeder at the home of the bride in Superior, Wisconsin. The couple are living in West Vanity, Ohio.

**Lewis R. Sherburne**, c '20, employed with the Sewerage Commission of the City of Milwaukee, was married on July the thirtieth to Miss Mary Rebholtz of Troy, Ohio. The couple are making their home at 2227 Clark Street, Milwaukee.

**L. C. Tschudy**, c '23, is working with the City of San Francisco on the Hetch Hetchy Water Supply Project. He writes as follows: "The city let us off on the fourth, fifth, and sixth, and a party of us, five in all, took a hiking trip into the mountains. We were trout fishing half of the time and were really successful. I got sixteen nice ones from six to ten inches long. We hiked along one of the government ranger trails to Lake Eleanor. Here the city has built a multiple arch dam. The water from this lake will be used for a large power house when the project is completed. I imagine the lake covers fifteen hundred acres. From Lake Eleanor we hiked to the Hetch Hetchy Reservoir or O'Shaughnessy Dam Site. The O'Shaughnessy Dam is 340 feet high from bottom of foundation to the crest and 600 feet in length. It is a gravity type dam and holds 360,000 cubic yards of concrete. It is one of the most beautiful structures I have ever seen. The reservoir and the dam, with the steep cliffs on the sides, make a sight that is beautiful beyond description. If any of your friends see Yosemite National Park, they should see Hetch Hetchy Reservoir since the two are not far apart. Stages make connection with the Hetch Hetchy Railroad. In all we hiked about thirty miles over rough trails. We had no trouble sleeping that night.

The Hetch Hetchy Project, at present, is rather doubtful, as it will not be continued unless the September bond issue is successful. Naturally the work is not going in full sway at present. However, from all indications, there is hardly a doubt but that the bond issue will go through and the project completed. This should be especially true as California has had its lowest water year that records show; and consequently the city is suffering for water.

At camp here, we have finished driving the tunnel and are putting all our time into constructing the dam. We have had very much work during the construction of the spillway floor, walls, gates, and piers. We had only one-fourth of an inch clearance between piers for the gates on the spillway. As you know the carpenter work must be very close to prevent a larger error. We were up there with level, transit, and chain most of the time. We expect to pour the rest of the dam soon. The foundation is already placed."

**Eugene F. Bepalow**, c '21, sends his check for \$1.50. He has resigned his position with the Bureau of Public Roads and is now with the Shearman Concrete Pipe Company, promoting the sale of concrete pipe in the State of Florida. His address is, care of the Shearman Concrete Pipe Company, Station A, Jacksonville, Florida.

## CHEMICALS

**R. Perry Fulkerson**, ch '24, is employed in the edible oils plant of the Procter and Gamble Company of Ivorydale, Ohio.

**Howard E. Morey**, ch '23, was married to Miss Pearl I. Damon on the twentieth of September at the home of the bride in Chicago. Mr. Morey is employed by the Roth Motors Company of Chicago. The couple will make their home at 6900 Osceola Avenue, Chicago.

**Elton K. Morice**, ch '20, was married on September the tenth to Miss Ruth Wilt at Elkins, West Virginia. The bride graduated from West Virginia University in '23. Mr. Morice is employed with the Rubber Production Corporation of Morgantown, West Virginia.

**R. L. Rundorff**, ch '23, M. S. '24, is with the Wisconsin-Minnesota Light and Power Company, Minneapolis, Minn.

**K. M. Watson**, ch '23, is with the Western Electric Company, Chicago, Illinois.

**Donald Grenfel**, ch '14, was in Madison for Commencement. He is in charge of the lithopone plant of the Mineral Point Zinc Co., at De Pue, Illinois.

## ELECTRICALS

**Richard W. Brewer**, e '21, gives his address as Room 455 McCormick Building, 332 South Michigan Avenue, Chicago, Illinois.

**Donald S. Dewire**, e '22, announces his marriage to Ethel M. Lemmer, '22, on September 16, 1924. The couple is now at home at La Grange, Illinois. Mr. Dewire is in the employ of the Western Electric Company at Chicago.

**Harry I. Miller**, e, '21, visited his Alma Mater on Wednesday, October first. He is employed with the Menominee and Marinette Light and Traction Company, and he gives his permanent address as 419 Spies Avenue, Menominee, Michigan.

**Charles A. Rau**, e '17, is now living at 619 South Twelfth Street, Pekin, Illinois.

**Edward Schildauer**, e '97, EE '11, announces his affiliation with the Allied Chemical and Dye Corporation of New York. Mr. Schildauer was formerly Consulting Engineer for the American Investigations Corporation of Washington. He gives his new address at 61 Broadway, New York City.

**Hugo L. Rusch**, e '23, who was instructor in electrical engineering last year, is with the A. C. Nielsen Co. of Chicago, engaged in preparing reports on the performance of power plant and industrial equipment. Address: 337 West Madison St., Chicago, Illinois.

## MECHANICALS

**Richard E. Baus**, m '00, announces a change in address. He has moved from 3415 Seminole Avenue, Detroit, to 17435 Hamilton Boulevard, Detroit.

# ATHLETICS

G. H. ABENDROTH

Although football is occupying the limelight at present with cross country running a close second, coaches in basketball, gym, and swimming are getting their men in action ready to take their place on the athletic stage when football and cross country have had their "fling."

Meanwell has his charges working on the gym basketball floor. The little coach, who has placed Wisconsin on the basketball map and has turned out many conference champion teams, will have the job of filling the shoes left vacant by the graduation of Farwell and Gibson and the retirement of Ken Elsom. George Levis, the former Badger star, who is now coaching the frosh, should have some stars for Meanwell from last year's frosh squad.

With Marshall Diebold, all conference guard and captain of this year's varsity, playing his old reliable game, and Spooner, Varney, and Wackman making the sensational shots and plays which placed us at the top of the conference heap last year, Meanwell should have the nucleus of a real team. By issuing his call for men at the beginning of the year, Meanwell has his newcomers trained to his style of play, the short pass, long before the season actually opens.

## FOOTBALL

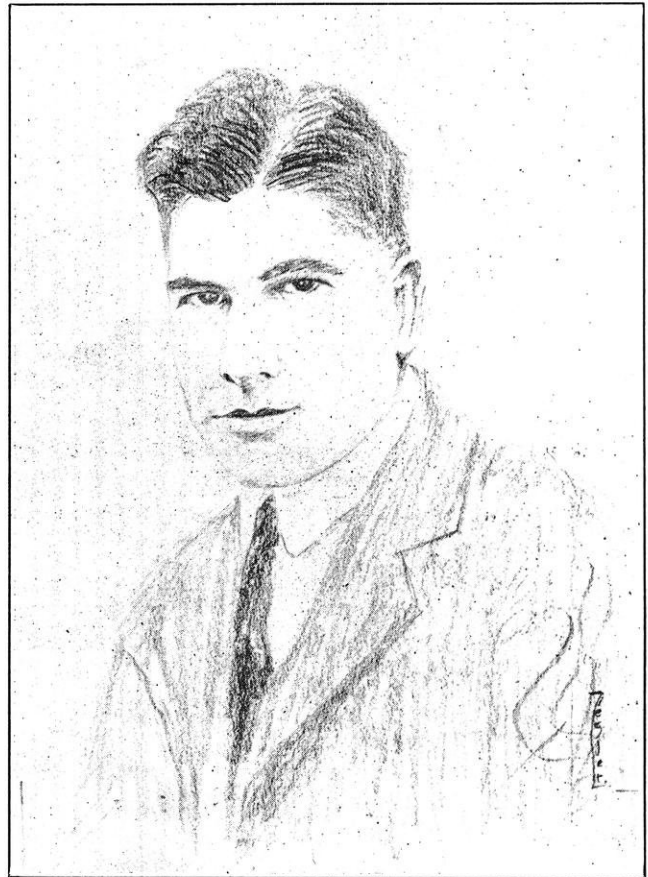
Coach Ryan's second year at Wisconsin should be more successful than his first. Last year, with only a few veterans back to work with, he produced a team which battled Minnesota to a tie and which almost beat Michigan and Eckersall or "Eckie" as his friends at Wisconsin call him.

Wisconsin, this year, has a real schedule, and should Ryan produce a winner, as it seems he has, he will have done something to boast about. With Notre Dame, Minnesota, and Iowa coming to Madison, the students have some good football to look forward to.

According to the opinions of several football experts, Wisconsin's 1924 team was doomed to certain failure. The men were said to be listless and pepless. The first game with North Dakota proved this statement to be false and showed the spectators that Wisconsin has a team which might be heard from.

On a muddy field and in a drizzling rain, the Cardinal players, and especially the backfield, plowed through North Dakota at will. North Dakota had as much chance of scoring or of holding the eager Wisconsin backs as the lawyers have of beating the engineers in the annual snowball fight. Rain or no rain,

Doyle Harmon ripped off run after run in a fashion which made it appear easy. The game demonstrated that everything said about the Harmon brothers was true. Doyle gained 268 yards against the Flickertails, and it didn't take him all afternoon to do it by any



"TECK" — Varsity Center.

means. He was a team all by himself, according to appearances, and should make Red Grange of Illinois hop for the honors of the best ground gainer in the states.

Besides Doyle Harmon, the backfield is made up of Harris, Williams, Leo Harmon, McAndrews, and Stangel. Harris played his reliable, hard hitting game and can always be depended upon when a few yards are needed to make a down. McAndrews found it hard to get started on the muddy field and consequently could not use his speed to any advantage. With a dry field Mac should make quite a few yards before the opposition discovers where the lightning has struck.

(Concluded on page 13)

# CAMPUS NOTES

## REGISTRATION DATA

Registration in the college this semester is only a trifle under that of last year. For the statistics hound, we publish the following data about the freshman class, which is usually indicative of the enrollment in the entire college. At the close of the last day of registration, 280 freshmen engineers had signed their name on the dotted line. The corresponding number for last year is 286. The maximum enrollment during the first semester of last year was 304. So far this year, 291 have enrolled. The freshmen engineers are distributed as follows: electrical, 116; mechanical, 72; civils, 64; chemicals, 41; miners, 8.

## EVENTUALITIES

The famous Bachelor's Club of the electrical engineering faculty suffered a serious setback this summer when J. E. Wise and L. C. Larson, erstwhile members in good standing, deserted to the ranks of the benedicts.

Wise was married August 20 to Miss Glenn Miller of LaValle, Wisconsin. Mrs. Wise is a graduate of Milwaukee Downer, and she took her M. A. degree at Wisconsin in '19. Before her marriage she served as University Statistician. They are now "at home" at 1615 Summit Avenue.

The marriage of Mr. Larson and Miss Harriet D. Bracher was performed at the home of the bride, Red Wing, Minnesota, on August 21. After an extended motor trip through northern Minnesota and Wisconsin the couple returned to Madison and have made their home at 225 Clifford Court.

## PAINTERS vs. FACULTY

The painters are with us again, and it looks as if they were going to be with us for some time to come. By fair means, or foul, the brush slingers induced Mr. Stivers to leave his happy home and establish temporary headquarters in the office of The Wisconsin Engineer for a few days. Mr. Stivers, however, was not alone in his misery; Professors Watson, Meyers, Rood, and Owen have also become intimately acquainted with turpentine and linseed oil, and it is more than likely that other comfortable inhabitants of E. B. offices will be forced to retreat before the "Save the Surface" brigade.

After six years of fruitless effort, Prof. Van Hagan has finally induced the construction syndicate to place new blackboards in room 305. They are the latest type of super-halation, air-cooled blackboards, and are expected to be an inspiration to all of the students.

## JUNIOR ENGINEERS VISIT WESTERN MINES

Twelve Junior and Senior mining engineers left on June 15 for the required six weeks inspection tour of western states. The party stopped at Lead, South Dakota, where the first mine inspection was made. Many other states were visited by the knowledge seekers. The trip broke up at Spokane, Washington. The miners who made the trip are Fred Sunday, Jack Servatius, E. D. MacNeil, C. C. Gladson, D. C. Roscoe, O. W. Herring, J. F. Zapata, H. Erlinger, Oscar Fritsche, and Wild Bill Tietjen. (A more detailed account of the trip will be given in a later issue of the Engineer).

W. Fabera, m'25, is part owner of the floating tin-ware that appeared at the foot of Lake Street a few days ago. According to the inventors, the purpose was to design a ford that would never be a sinking proposition. With this end in view, a large canvas was placed under the entire machine. The paddles on the real wheels induced the contraption to pursue a forward course for a short distance. The attempt was not entirely successful, however, because the engine did not raise enough stink to keep the water from going up the exhaust pipe.

During the summer the mechanics department added a ragged patch to their over-crowded department. The addition takes the shape of a small one-story structure in the rear of the Engineering Building. As the lack of floor and storage space was keenly felt by the mechanics department, this temporary building was erected by the University and the State Highway Commission. It contains bins for sand and cement, and a moisture room for testing concrete specimens.

The U. S. Bureau of Mines rescue car, in charge of W. H. Carrick, district engineer, has been spotted on the siding near the Forest Products Laboratory. Mr. Carrick instructed all seniors in the art of mine rescue work while his assistant, Mr. M. B. Orfold, instructed the junior miners in first aid.

## ONE COULD TAKE SOUNDINGS THAT WAY

Mr. Stivers tells the story of the student who, when asked in a quiz how he would go about determining the height of a building with an aneroid barometer, wrote thus: "I would go to the top of the building, tie a string to the barometer and lower it to the ground, and then measure the length of the string. This would give me the height of the building."

**ATHLETICS***(Concluded from page 11)*

Teckemeyer, a senior mechanical engineer, is again playing his game at center. Teck is a reliable passer and should hold his position against all comers. Besides being center on the varsity football squad, Teck is captain of this year's crew. Herb Opitz played for a few minutes in the North Dakota game but did not get an opportunity to show his stuff. Herb is also a senior mechanical and should show off his wares to better advantage if used in the next few games.

When Ames came up from Iowa, the state that doesn't give a damn for the 47 other states, the students were all prepared to see the walk-away victory over North Dakota repeated. But Roberts who can throw a football with more speed and accuracy than most of us throw a base ball, put a real scare into the hearts of Wisconsin rooters by heaving passes to all parts of the gridiron and into the arms of waiting Iowans. The first half left many of us in doubt as to the final outcome even though Wisconsin led by the slim margin of 3-0.

In the Ames game, a lack of good interference prevented our backfield from making the scintillating runs which featured the North Dakota game. Nevertheless the Badgers came out with the long end of a 17-0 score.

**FACULTY CHANGES***(Concluded from page 4)*

intendant of the shops. He comes from Janesville, Wisconsin, where he was the director of the Vocational School.

N. F. Hollander is taking Mr. Payton's place as instructor in pattern making. Mr. Payton now has charge of the foundry.

William A. Trefz, of Rockford, Illinois, will be student assistant in Wald's place.

Mr. Hitchcock has been appointed general foreman of the shop.

*Mechanics Department*

A. M. Simons has resigned his position as instructor in mechanics, and is now an instructor in engineering at Northwestern University.

Herbert Glaetli has resigned to take a position with the Prairie Pipe Line Company. His address is Independence, Kansas.

The new instructors in the department are Warren A. Mason and E. C. Schuman, both of the class of '24.

*Steam and Gas Engineering Department*

Assistant Professor Aagaard has resigned to become the chief engineer of the Aagaard Laundry, Chicago, which is controlled by his father. His address is 6647 Perry Avenue, Chicago.

R. A. Trotter has also resigned. He is now a city engineer in the Power Plant Division of the city of Virginia, Minnesota.

Associate Professor L. A. Wilson is filling the vacancy left by Professor Aagaard. Professor Wilson is a graduate of Cornell with the bachelor's and master's degrees in mechanical engineering. For five years following his graduation he was an instructor in Sibley College, Cornell University. In 1914 he went to the University of Illinois where he became first assistant in the Engineering Experiment Station. While there he carried on original investigations. During the war, Professor Wilson was in charge of the Engine Department, U. S. A. School of Military Aeronautics, at Urbana, Illinois. He was commissioned First Lieutenant, Air Service. After the war he returned to Illinois, first as research Associate in the Experiment Station, and later as instructor in Steam Engineering. In 1920 Mr. Wilson went to the University of Cincinnati to become Assistant Professor of Mechanical Engineering. In the years 1921-23 he was professor of Mechanical Engineering at Oklahoma Agricultural and Mechanical College. Last year he was professor of Mechanical Engineering at the University of Arkansas.

W. I. Senger, m'23, is taking Mr. Trotter's place as instructor. Last year Mr. Senger was a Fellow at Yale, where he received his Master's degree this spring.

*Structural Engineering Department*

D. M. Wilson, formerly an instructor, has resigned. He is now an engineer on a sugar plantation in Porto Rico.

Ora C. Rabbitt, c'23, is the new instructor. Last year Mr. Rabbitt was with the American Bridge Company at Gary, Indiana.

*Topographical Engineering Department*

William A. Collins, c'24, who was student assistant last year, is now Assistant City Engineer at Beloit, Wisconsin.

C. T. Mickle, c'26, is taking the position left vacant by Mr. Collins.

**THE PURPOSE OF THE ENGINEERING COURSES OF STUDY***(Continued from page 4)*

Money and Banking

Social Problems

Labor Problems

Economic Institutions

*Political Science*

Government and Politics in the U. S.

General Political Science

History of Political Thought

Municipal Government

*Biological Science*

General Botany

General Zoology

Animal Biology

*Philosophy and Psychology*

Introductory Psychology

Elementary Logic

Introduction to Philosophy

Ethics

*Legal*

Contracts  
 Commercial Law  
 Property  
 Torts  
 Agency

*History*

Ancient History  
 Medieval History  
 English History  
 History of the U. S.  
 Modern European History  
 History of the West

*English*

Sophomore composition  
 General Survey of English Literature  
 Introduction to English Literature  
 Technical composition  
 American Literature

*Geology*

Engineering geology  
 Paleontology

*Classics*

Latin language and literature  
 Greek language and literature

*Modern Languages*

German language and literature  
 French language and literature  
 Spanish language and literature  
 Norse language and literature

*Medical Studies*

Physiology  
 Bacteriology

*Comparative Literature**The Fine Arts**Education*

Educational Psychology

*Speech*

Elements of public speaking  
 Argumentation

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**WHAT THE CLASS OF 1924 IS DOING**

(Continued from page 7)

**Whitworth, Wm. E.**, is a telegraph equipment engineer of the Western Electric Co. He is living at 229 W. 4th St., New York. Permanent address: 7 Rockwood Ave., Ansonia, Conn.

**Wing, Orlando H.**, is with the General Electric Co. at Schenectady. Home address: 1233 S. River St., Eau Claire, Wisconsin.

The present addresses of the following Electricals are not definitely known; the addresses given being the best available:

**Averill, Robert L.**, Batavia, Ill.  
**Barker, Carleton J.**, Troy Center, Wisconsin.  
**Blaisdell, Chas. O.**, Darlington, Wisconsin.  
**Boruzak, Nathan**, 604 Galena St., Milwaukee, Wisconsin.  
**Kietzmann, Edward H.**, Westfield, Wisconsin.  
**Larson, Arthur J.**, Evanston, Illinois.  
**Marx, Carl H.**, 502 Ashland Ave., Aurora, Illinois.  
**Murphy, Dennis J.**, Buhl, Minnesota.  
**Osius, Edgar F.**, Plymouth, Wisconsin.

**Pedley, Howard L.**, 979 S. Sheridan Rd., Kenosha, Wis.  
**Pokras, Adolph**, in care of Mrs. A. Vinorsky, 1253-40th St., Milwaukee, Wis., or 402 N. Murray St., Madison, Wis.  
**Schacht, Delbert H.**, Augusta, Wisconsin.  
**Sobey, James J.**, Dodgeville, Wisconsin.  
**Sun, Kwan-Faung Henry**, 48 Ave. Dubail, Shanghai, China.  
**Tjoffat, Gerald B.**, Ettrick, Wisconsin.  
**Vaclavik, Frank J.**, 1820-19th St., Two Rivers Wis.  
**Wilcox, Clarendon W.**, in care of Wisconsin Telephone Co., Milwaukee, Wisconsin.  
**Zia, Yussuf**, Constantinople, Turkey.

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**MECHANICALS**

**Addington, Harold**, is employed at designing vapor heating systems by the Trane Co., and is living at the Y. M. C. A., La Crosse, Wis. Permanent address: Willow River, Minnesota.

**Anthony, Herman R. C.**, is working in the engineering department of the French Battery and Carbon Co. He is living at 1014 Drake St., Madison, Wisconsin.

**Bauer, Chas. A.**, is engaged in research work on pulp machinery for the Bauer Bros. Co. His address is 1735 Crescent Drive, Springfield, Ohio.

**Bowers, A. F.**, is taking the student training course at the Schenectady works of the General Electric Co. His address is 706 South Ave., Schenectady, N. Y. Home address: 706 Oak St., Hudson, Wisconsin.

**Breed, B. K.**, is testing acetylene generators and similar equipment for the Underwriters' Laboratories, 207 E. Ohio St., Chicago, Illinois.

**Caldwell, Earl L.**, is with the Illinois Bell Telephone Co., at Chicago. His home address is 41 Soencer Ave., Indianapolis, Ind.

**Carlson, George A.**, is taking a student course with the Bucyrus Co., of South Milwaukee. His home address is 4944 W. Erie St., Chicago.

**Chambers, Chas. J.**, is working in the mechanical department of Graham, Anderson, Probst and White, — Architects of Chicago. His present address: 1019 S. Denver St., El Dorado, Kansas.

**Czerwonky, Hugo E.**, is employed by the Chain Belt Co., of Milwaukee. His address is 764 Hubbard St., Milwaukee, Wisconsin.

**Drissen, Wallace W.**, is with the Allis-Chalmers Co., Milwaukee. His home address is Port Washington, Wis.

**Dudley, D. E.**, is engaged in the design of milk bottle filling and capping machinery. He may be reached at 145 N. Park Ave., Waukegan, Illinois.

**Fitze, Maurice E.**, is a junior engineer with the Milwaukee Electric Railway and Light Co. His address is 439-31st Ave., Milwaukee, Wis. He writes as follows: "My first two weeks I was classed as turbine room helper in the Lakeside Plant, — in other words, general all around flunky. The first job I did of any note was to help a bunch of jibbering "hunkies" mop up the turbine room. The next day I received my first promotion; I was put in charge of another gang and told to mop up the auxiliaries room down below. The only trouble with that job was that there was only one man in the crew — myself."

**Gray, John E.**, is a sales engineer for the Armstrong Cork and Insulation Co., and is located at 202 S. Graham St., Pittsburg, Pa. His home address is Mineral Point, Wis.

**Greeley, Wm. F.**, is a draftsman in the hydraulic department of the H. M. Bylesby Engineering and Management Corp. He is living at 3157 Washington Blvd., Chicago, Ill. Permanent address: Lake Delevan, Wisconsin.

**Greiling, David J.**, asks if his title, which is "Automatic Ice Cream Cabinet Engineer," is imposing enough. He is

working for the Lipman Refrigeration Co., and is living at 624 Whitman Heights, Beloit, Wis. Home address: R. R. 5, Green Bay, Wisconsin.

**Hildreth, Lane W.**, is working for the Lansing Fuel and Gas Co., Lansing, Mich. His permanent address is 115 N. Bassett St., Madison, Wisconsin.

**Hurbesky, George F.**, is a coal tester for the Wisconsin Public Service Corp. His address is 1510 New York Ave., Manitowoc, Wis. Permanent address: 314 Naymut St., Menasha, Wisconsin.

**King, Kenneth J.**, is employed at power plant designing by the Dwight P. Robinson Co. His address is 209 W. 97th St., New York City. Permanent address: 1318 John Ave., Superior, Wisconsin.

**Koskinan, C. J.**, is testing domestic oil burners and fire extinguishers for the Underwriters' Laboratories, Chicago. His home address is 100-9th St., Fond du Lac, Wisconsin.

**Leonard, John B.**, is with the American Blower Co., Detroit, Mich. His home address is 126 S. Bell St., Fond du Lac, Wisconsin.

**Madell, Frank J.**, is with the Wisconsin Public Service Co., Manitowoc, Wisconsin. Permanent address: Oshkosh, Wisconsin.

**Mason, Warren A.**, is an instructor in the Mechanics department at Wisconsin. He is living at 207 W. Washington Ave., Madison, Wis.

**Maurer, Harold J.**, is an assistant superintendent of knitting with the Holeproof Hosiery Co., of Milwaukee. His address is 762 Washington St., Milwaukee, Wis.

**Mollerus, Fred J.**, is taking the student training course at the General Electric Co. His address is 117 Nott Terrace, Schenectady, N. Y. He says that his main work has been testing motor-generator sets, turbine exciters and converters of about 350 to 500 kilowatt capacity.

**Nichols, Thomas C.**, is selling oil burners in Detroit. His address is 71 Medbury Ave., Detroit, Mich.

**Olson, Edward E.**, is taking a six months apprentice course with the Newport Co. His address is 171 Allen St., Milwaukee, Wisconsin.

**Ouweneel, Wm. A.**, is a heating and ventilating sales engineer with Warren Webster and Co., of Milwaukee. His address is 717 Sixteenth St., Milwaukee, Wisconsin.

**Purvis, Adrian A.**, is employed in the construction department of the Public Service Co., of Northern Illinois. His address is 301 N. Humphrey Ave., Oak Park, Ill. Permanent address: 1513 Vine St., Scranton, Pa.

**Quammen, Delbert J.**, is with the General Electric Co. at Schenectady. His home address is 324 E. Mifflin St., Madison, Wisconsin.

**Risteen, Horace W.**, is a Professor of engineering subjects in charge of the basic engineering course at Mt. St. Charles College. His address is in care of Mt. St. Charles College, Helena, Montana.

**Ritchie, Wm. E.**, is employed at box making by the Ritchie Corp. of Chicago. His address is 27-3rd St., Hinsdale, Illinois.

**Rosecky, J.**, is with the Allis-Chalmers Co. His address is 901 Becher St., Milwaukee, Wisconsin.

**Schaefer, Carl E.**, is a student engineer with the Windes and Marsh Co. His address is 327 N. St. Johns Ave., Highland Pk., Illinois.

**Sibbe, Carl F.**, is in the patent office at Washington, D. C. His address is 1307 Clifton St., Washington D. C.

**Spoodis, Anthony**, is a heating and ventilation engineer and is employed by the Herman Nelson Corp. He married Gertrude Jacobinas, of Superior, on June 17th and is now living at 1610-12th St., Moline, Illinois.

**Trotter, Richard A.**, is living at 227 Second St., S., Virginia, Minn. He is employed by the city in engineering work.

**Stumpf, Walter P.**, is a student engineer with the Illinois Bell Telephone Co., and is living at 2011 N. Kedzie Ave., Chicago, Ill. Permanent address: 1136 E. Dayton St., Madison, Wisconsin.

**Sullivan, John F., Jr.**, is with the General Electric Co. at Schenectady. His home address is Hurley, Wisconsin.

**Thessin, P. G.**, is with the Sivyer Steel Casting Co. His address is 554 Madison St., Milwaukee, Wisconsin.

**Von Kaas, Herman K.**, is employed as a student engineer by the Milwaukee Dairy Supply Co. His address is 940-23rd St., Milwaukee, Wisconsin.

**Wandschneider, Fritz W.**, is taking a training course with the Chicago Central Station Institute and is living at 311 N. Central Ave., Chicago, Ill. Permanent address: 19 E. Milwaukee Ave., Ft. Atkinson, Wisconsin.

**Zamzow, Geo. L.**, is taking student training at the General Electric Co. of Schenectady. His home address is 309-5th St., Baraboo, Wisconsin.

The present locations of the following Mechanicals is not definitely known; the addresses given here are the best available:

**Alberts, Harry C.**, 727-8th St., Milwaukee, Wisconsin.

**Bond, Jerome S.**, 639 Wentworth Ave., Milwaukee, Wis.

**Chase, Sherman**, 123 N. Orchard St., Madison, Wisconsin.

**Donnelly, Daniel**, 847 Clark St., Appleton, Wis.

**Feirn, Wm. H.**, 451 Pearl St., Janesville, Wisconsin.

**Friedman, A. S.**, Racine, Wisconsin.

**Hartwell, Henry T.**, Hildreth, Nebraska.

**Haugen, Edmund H.**, Brookings, S. D.

**Karnath, Geo. P.**, Fountain City, Wisconsin.

**Koch, Norman F.**, 2311 Grand Ave., Milwaukee, Wis.

**Mariotte, Walter W.**, Elroy, Wisconsin.

**Mogg, J. Owen**, is with the Chicago Motor Coach Co.

**Mulholland, Clifford A.**, 4645 Arco Ave., St. Louis, Mo.

**Plummer, Richard T.**, Marble, Minnesota.

**Schjolberg, Eiler R. K.**, Kristiania, Norway.

**Smongeski, Paul P.**, 2220 Jefferson St., Two Rivers, Wis.

**Towle, Wilbur T.**, 631 Langdon St., Madison, Wisconsin.

**Young, Ruby R.**, 816 Riverside Dr., Fort Atkinson, Wis.

#### MINERS

**Azcon, Ernesto**, is with the Elm Orlu Mining Co., at Butte, Montana. Azcon is engaged in the development of standard practice in mining methods for the company's operations. He may be reached in care of the Y. M. C. A., Butte, Montana.

**Gladson, C. C.**, is employed as instructor of mathematics at the New Mexico Military Institute, Roswell, N. M. Gladson's position carries with it a commission as Captain on the Governor's Staff.

**Lcrig, Clarence**, was awarded the Stowell Fellowship in metallurgy. His address is Mining Laboratory, University of Wisconsin, Madison.

**Lynch, Henry A.**, is employed as mining engineer with the American Smelting and Refining Co., at the York mines, Leadville, Colo. His address is 206 E. Eighth St., Leadville, Colorado.

**Murphy, John M.**, is taking graduate work at Harvard. His home address is 1512 Sixteenth St., Superior, Wisconsin.

**Nelson, F. A.**, is employed as metallurgist by the Taylor-Wharton Co., Highbridge, N. J. Address: in care of Charles Emery, Highbridge, N. J.

**Wagner, Gilbert W.**, is a metallurgist with the International Smelting and Refining Co. of Tooele, Utah.

The present addresses of the following Miners are not definitely known. The addresses below are the best available.

**Field, Walter S.**, Somers, Conn., or 313 W. Wilson St., Madison, Wisconsin.

**Linden, John F.**, Hayward, Wisconsin.

**Zapata, Jose**, 719 University Ave., Madison, Wisconsin.



**DESIGN, CONSTRUCTION, AND OPERATION PROBLEMS OF A 132,000 VOLT TRANSMISSION LINE**

*(Continued from page 2)*

- (4) Wind on tower amounting to 13 pounds per square foot on one and one-half times the exposed area.
- (5) Dead weight of tower.

Straight line towers are guyed on one side where the angle in the line is less than 15°, and on all four sides in swamps. Transposition towers (where the relative positions of the conductors are interchanged) have a slightly different crossarm construction than that of the straight line tower because the transpositions are made by means of jumpers, — a construction which eliminates the crossing of conductors in a span. These towers are spaced approximately 5 miles apart.

Where the line bends more than 15° corner towers must be used. These towers are specified to withstand loads as follows:-

- (1) A vertical load at each conductor support, including the ground wire support, of 1230 pounds. Total, 8610 pounds.
- (2) A horizontal load in a direction bisecting the angle made in the line conductors of 5000 pounds at each conductor support, including the ground wire. Total, 35000 pounds.
- (3) A horizontal load in the direction of the line on each side of the tower of 35000 pounds at each conductor support, including the ground wire. Towers must withstand 3500 pounds applied at the end of any two crossarms in the direction of the conductors on the same side of the tower. Total, 7000 pounds.
- (4) Wind on tower amounting to 13 pounds per square foot on one and one-half times the exposed area of one face of tower.
- (5) Dead weight of tower.

All loads are to be considered simultaneous loads.

*Dimensions of Towers*

The height of a standard tower is 50 feet from the ground to the lowest crossarm. At points where clearance is desired, extensions of 10 or 20 feet are provided. At the ground level the base is 15 feet square. The middle conductor is out of the plane of the upper two. The vertical distance between crossarms is 12 feet, and the width may be tabulated as follows:-

WIDTH IN FEET OF STEEL TOWER CROSSARMS			
TYPE OF TOWER	UPPER CROSSARM	MIDDLE CROSSARM	LOWER CROSSARM
Straight Line	23	19	23
Corner	21	17	21
Transposition	27	15	27

*Tower Foundations*

The four footings of each tower are made of structural steel parts. Each footing consists of four pieces of channel iron bolted to form a plate against three pieces of channel iron formed in a triangle. Three pieces of angle iron rise from the corners of the tri-

angle in the shape of a tripod, one of which is longer than the rest and is placed so as to point toward the center of the tower foundation. This is buried in the earth to an approximate depth of 8 feet. Where the character of the soil would permit, a posthole-digging machine was used. This machine is equipped with a special 42 inch auger, and all equipment is mounted on a heavy truck. Where there are rocks and gravel or where the truck can find no traction, excavation is made by hand, a hole four feet square being necessary.

Anchors for towers erected in swamps are set in concrete, and considerable difficulty was encountered in excavating for such foundations on the Plymouth line. The excavation consists of four trenches which make up a square, with sheeting or cribbing and pumping necessary in the majority of cases. When the excavation is completed, the footings are placed at the corners of the square and the template is attached to the projecting angle irons. The trench is then filled with concrete to a depth of two feet, after which the remaining space is filled by removing the shoring after concrete has set and allowing the walls to cave in. The removed dirt is backfilled in any spaces of the trench that may remain.

*Method of Erecting Towers*

The towers are assembled on the ground in such a position that two of the tower legs line up with two of the foundation legs. After assembling the tower, the insulators are attached and the pole is ready to be raised. A hinge is bolted, one side to the tower leg, the other to the foundation leg on the two sides which are in alignment. A 35 foot "gin pole", fastened and braced to a log about which the tower pivots, is placed in a vertical position at the base of the tower. Two vertical angle irons are bolted to the upper and lower legs of the tower, one on each side. This serves to keep the tower base rigid and distributes the stresses encountered in the course of erection. The legs of the foundation are similarly braced to make them rigid. A tow line, pulled by a two-ton tractor, is attached to the tower just below the bottom crossarm and run over the pulley at the top of the gin pole. The gin pole serves to change the horizontal pull to a turning moment about the axis of the hinges, and thus the tower is raised into a vertical position, steadied meanwhile by back and side guys. When the tower is upright the bracing angle irons are removed and the legs opposite the hinges are bolted to the foundation. Putting a strain on the tow rope will take the weight from the hinges so that the latter can then be removed. The legs of the tower are fastened to the foundation and the erection is completed.

*Description of Conductors and Method of Stringing*

The conductor used is a No. 3/0 aluminum cable reinforced with a steel wire. An illustration of a few of the economic considerations which determine this choice may be of interest. The cable selected is equivalent in conductivity to a No. 1/0 A. G. W. hard-drawn



## What Makes Defense "Air-Tight"?

A team with fast, hard-tackling ends and a weak line can no more stop a straight attack, than heavy guards and tackles can break up open plays, when the ends are weak. An "air-tight" defense must stop plays both through the line and from the ends; it must withstand attack from every quarter, just as a good bearing must withstand all loads.

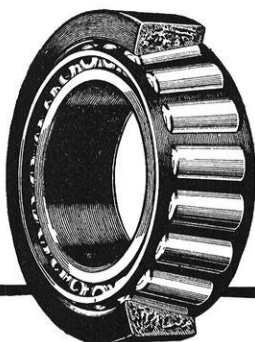
The bearings in the wheels of a motor car, for instance, have a vertical load upon them, represented by the weight of the car. This is termed "radial load". It corresponds in effect to a straight charge by backs upon a football line.

When the car sways, however, or when its course is sharply changed,

a part of the weight of the car is thrown sidewise against the bearings in the wheels. This load is called "end thrust". It corresponds in effect to a diagonal attack upon a football line.

In actual operation, a wheel bearing must meet continuously both "radial load" and "end thrust"—must as it were, withstand attack through center, off tackle, or from the ends. Because of its *tapered* principle, a Timken Tapered Roller Bearing withstands, in one bearing, all these loads. It is upon this principle that the unquestioned leadership of Timken Bearings is founded—a leadership extending beyond the automotive field throughout industry generally.

The Timken Roller Bearing Company  
CANTON, OHIO



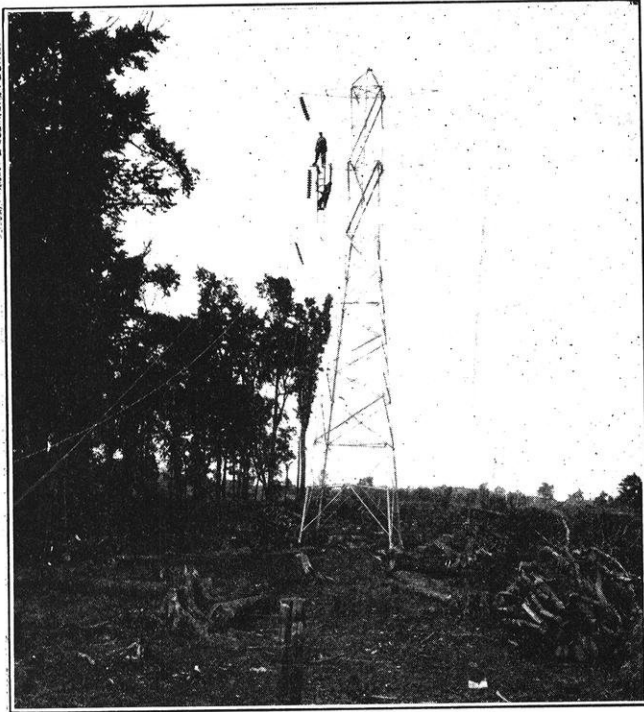
**TIMKEN**  
*Tapered*  
**ROLLER BEARINGS**

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Kindly mention *The Wisconsin Engineer* when you write.

copper conductor, which would be too small for use with 132,000 volts because of the excessive corona loss. The latter on a 100 mile line would amount to approximately 1,500 kilowatts in fair weather and 3,800 kilowatts in stormy weather, no inconsiderable item. Such loss on a No. 3/0 aluminum cable only amounts to about 50 kilowatts in fair weather and 1,500 kilowatts in stormy weather. A conductor with equivalent corona loss in a hard-drawn copper cable would require No. 4/0, but a single circuit of this size conductor would cost about \$1,200 per mile more than the No. 3/0 aluminum conductors such as were used on the Plymouth line.

The stringing operation is quite interesting. Three reels of cable are run out on the ground by tractors and carried up the towers by linemen. The wire is pulled three at a time in lengths of approximately one mile through sheave blocks attached to the crossarms. The sagging crew follows and takes the wire out of the sheave blocks, clipping the conductor to insulators.



SAGGING CREW "CLIPPING IN" THE MIDDLE CONDUCTOR.

This operation requires particular skill on the part of the lineman. The insulators, of special design, are as tall as a man, and are connected ten in series at each suspension. To reach the bottom insulator the lineman must use a ladder hung from a crossarm. The amount of sag is predetermined by the use of sagging curves and measured by means of a marked line attached to the top conductor in the middle of a span. When the top conductor is the proper distance from the ground the markers on the measuring line indicate the proper 12 foot spacings for the middle and lower conductor.

#### *Cost of Completed Line*

The tower line whose construction has been described above was built at an average unit cost of close to

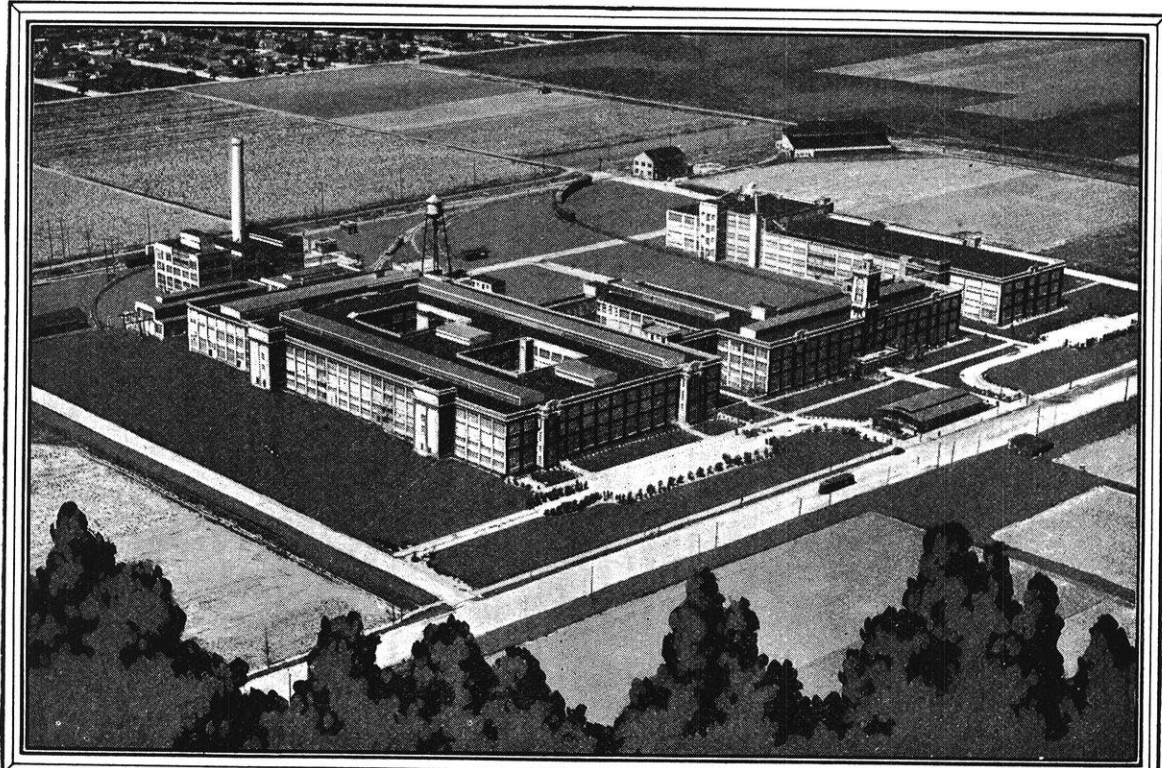
\$9,000 per mi.e. Among the larger items of expense, the cost of towers in place amounted to about 39 per cent of the total cost; conductors, insulators, hardware and stringing, 22 per cent; right-of-way easements and clearing, 18 per cent; foundations and footings, 17 per cent; hauling, unloading and engineering, and superintendence, 4 per cent. The proportion of these costs which labor alone represents may be of interest. Labor constitutes 17 per cent of right-of-way costs, 16 per cent of tower construction and erection, 91 per cent of foundation and footings, and 8 per cent of the cost of wires, insulators and stringing.

At Random Lake, where the company furnishes energy to the Wisconsin Gas and Electric Company, there is an outdoor substation stepping the voltage down to 26,400 volts. Here there are four 1000 kva oil-cooled transformers with the necessary switching and protective equipment. The cost of such a substation runs around \$47,000. Of this amount, land and structures constitute about 10 per cent, equipment 77 per cent, and labor and sundries, 13 per cent. Transformers represent 58 per cent of the equipment cost.

#### *Operating Problems*

The operation of a high voltage line involves some complex problems. The large charging current which is inherent in high voltage lines has a marked tendency to raise the voltage at the end of the line under light load conditions, a tendency increasing with the length of line. Synchronous condensers are used to regulate the voltage at the ends of lines where this difficulty is encountered. It was not found necessary to use this expedient on the Plymouth line, but the effect of the charging current is very noticeable, amounting to about 0.4 amperes per mile. On a hundred mile line the charging current would thus be 40 amperes or about 9,100 kva. A 10,000 kva transformer on such a line would be just about fully loaded with the charging current alone. As a load comes on the line the reactive charging current is counterbalanced by the lagging current of the load and the resultant current may actually decrease. Any large variation in load at the end of the line would have to be accompanied by an adjustment of the generator voltage. It is, therefore, desirable and necessary that the load be kept as nearly constant as possible.

In conclusion, readers of the Wisconsin Engineer will be interested to know that the first installation at this transmission voltage in the state has been accomplished, appropriately enough, under the supervision of two Wisconsin graduates, G. W. Van Derzee, e'08, Assistant General Manager, and G. G. Post, e'04, Electrical Engineer. The Plymouth line is now in successful operation, and with the completion of the similar lines now under construction referred to above, the Milwaukee Electric Railway and Light Company will have contributed a great deal to the advancement of power transmission in the State of Wisconsin, and will have done its share in the promotion of the proposed system of interconnection, a matter of national importance.



PLANT OF THE GOODYEAR TIRE & RUBBER COMPANY OF CALIFORNIA, LOCATED AT LOS ANGELES. GENERAL CONTRACTORS: HUNKIN CONKEY CO., CLEVELAND. PLUMBING CONTRACTORS: ARTHUR HESS, LOS ANGELES, AND H. E. TRYDAY, LOS ANGELES

## THE ARTERIES OF A MODERN FACTORY

In tunnels, behind walls, beneath floors in every American factory, complex systems of piping inter-connect the various departments. Delivering water, steam, compressed air, oil and gas to every point where they are needed, these pipe-lines enable each department of the institution to specialize in its particular function.

They make possible the centralizing of the production of power, heat and gas at efficient

large-capacity plants. They allow the isolation of fire hazards and obnoxious processes.

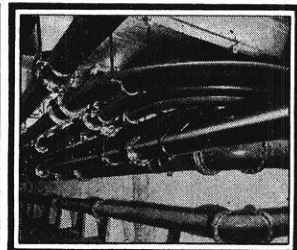
Should one of them fail, however, production might be crippled, even stopped. That is why it is so important to get uniform quality in every part of a piping installation; why the Crane name, the assurance of dependable quality on products that cover all piping needs, means so much to architects, engineers and owners.

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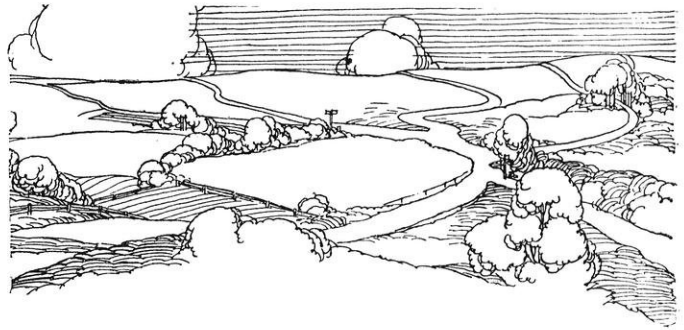
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Today, a nation's progress is indicated by the character and extent of its roads. Good roads are an essential of modern civilization. They facilitate the transportation of people and the interchange of commodities, and bind the nation into a homogeneous whole.

Where hand labor quarried the stone, dug the roadways and spanned the valleys in ancient times, explosives now perform this work a hundred times better, easier, quicker and cheaper. The modern engineer finds explosives power necessary to economical highway construction.

Du Pont explosives, because of their wide variety, are particularly adapted to road construction: This work includes boulder-blasting, drainage, grade reduction, subgrade and surface work, upkeep of roads, and digging post and pole holes. The du Pont explosives recommended for road construction and maintenance are: Red Cross Extra Dynamite, Dumorite (Pacific Stumping in the Northwest), du Pont Gelatin and du Pont Straight Nitroglycerin Dynamite.

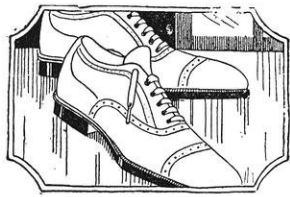
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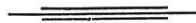
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As thousands of our industrial plants are operating to-day with poor lighting and in some cases with extremely bad facilities, it would seem that the importance of the subject of lighting has not been given the serious consideration by those responsible for such conditions.

Poor lighting is one of the most serious handicaps under which a manufacturing establishment can operate. First of all, poor lighting is the cause of a large number of accidents in industrial plants; and it is singular that accident reports do not yet properly classify the hazards of poor lighting, which in many cases is the primary cause of an accident attributed to what is really a secondary cause. Safety engineers and other officials who make accident reports should always consider the condition of the lighting when working up a report of accident causes, for it plays an important part in a great many casualties and is apt to be overlooked. All accidents due to poor lighting are accidents of neglect, and are preventable. The poor lighting accident hazard is clearly chargeable to management and not men. It is a difficult matter to make such progress with Safety First in a plant which has neglected to provide one of the fundamental requirements of accident prevention—good lighting.

Probably no one single factor connected with the equipment of a plant so directly affects the efficiency and inefficiency as the quality and quantity of the lighting. The curtailment of production of all working under the disadvantage of poor lighting represents a big loss each day; the poorer the lighting the less able is the working force to function efficiently. Quality and quantity both suffer, representing a preventable loss wholly removable by improving the lighting.

Under poor lighting condition, we cannot expect and rarely do we find an orderly, clean factory. Darkened places encourage careless habits and workers are often led to deposit discarded articles or material which should be deposited elsewhere. The eyesight of those who attempt to use their eyes continually in insufficient light, below nature's demands, is often affected. Too much light, such as is furnished by bright, unprotected lights, is as harmful as too little illumination; both are fundamentally wrong. Nature's own illuminant, daylight, is unequalled for our requirements of lighting.

The eye is best suited to daylight in the proper quantity. Sun glare should be avoided, and in the darkened hours proper artificial illumination provided. Daylight should be utilized to the fullest extent. It is supplied free in abundant quantity for our use. Modern invention has supplied a means whereby the interior of buildings can be lighted by daylight, and all the advantages secured which is furnished by good lighting at the smallest cost.

Industrial buildings should have as much wall space as possible devoted to windows fitted with Factrolite Glass, which insures the maximum amount of daylight and which prevents the direct rays of the sun from passing through as it properly diffuses the light.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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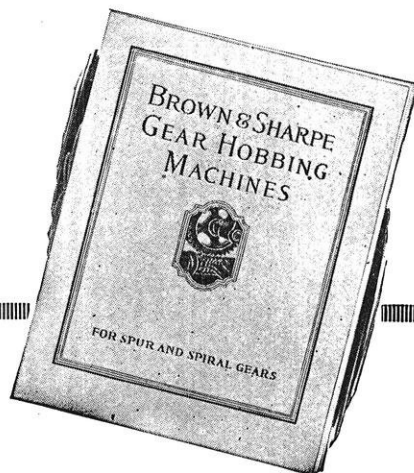
220 Fifth Avenue,

St. Louis.

New York.

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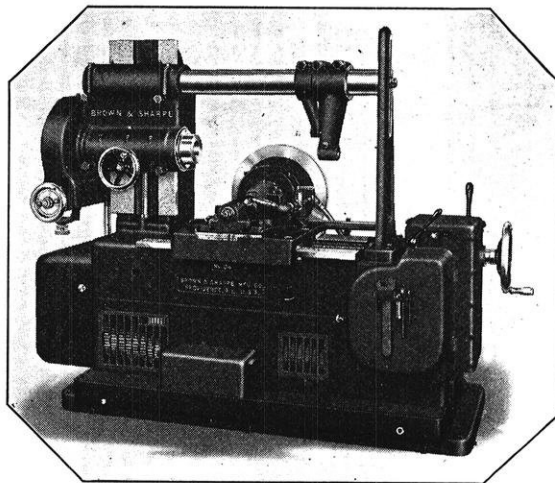
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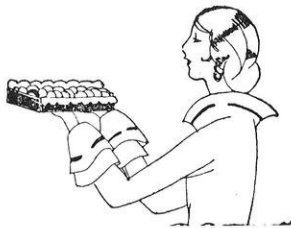
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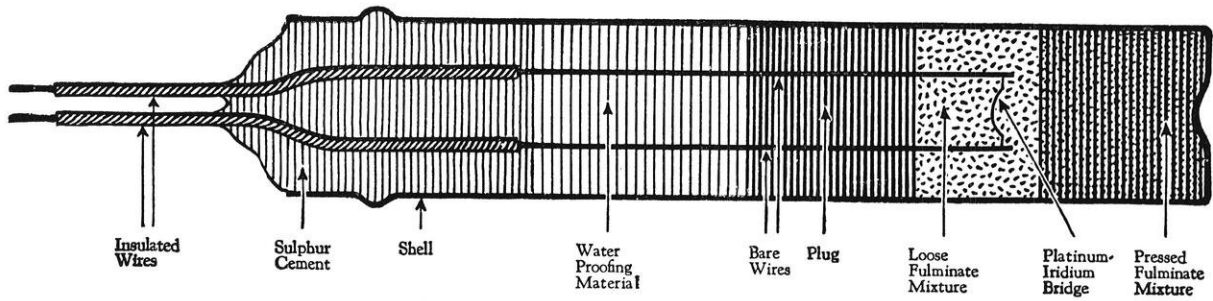
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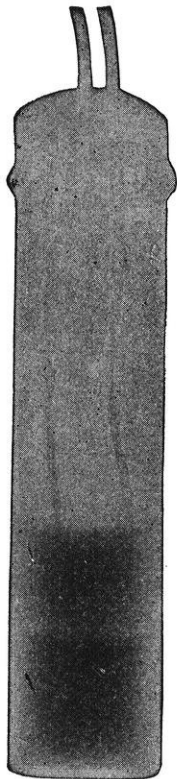
## The Economy of Care

ALL Hercules blasting caps and electric blasting caps are manufactured under careful supervision and inspection. This takes many forms, ranging from simple visual examinations by inspectors responsible for various steps in the process, to complicated laboratory checks under the direction of skilled chemists.

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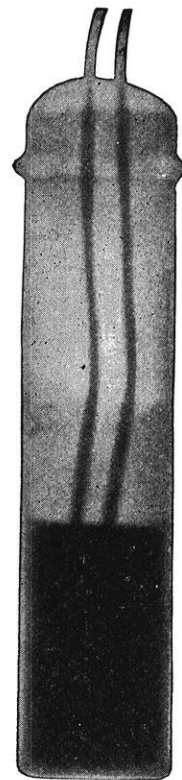
The X-Ray shows clearly whether the internal mechanism of an electric blasting cap is accurately adjusted; and at frequent intervals we place samples under its searching eye. Descriptions under the accompanying illustrations indicate the value of this precaution.

The elaborate series of checks to which we subject our products, protects us as well as our customers. It is economy for us to take every reasonable precaution that science can devise to prevent mistakes, which are always costly. It is economy for you to purchase blasting caps or electric blasting caps on which so much care is expended to insure unvarying success in your blasting.



IMPORTANT CHECK WITH X-RAY

A long exposure is required to penetrate through the copper shell and the charge, to reveal the bridge wire (little more than one-thousandth of an inch in diameter) which is lost in this printed reproduction. But accurate adjustment of this tiny filament is essential to proper detonation.



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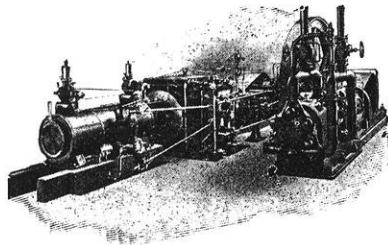
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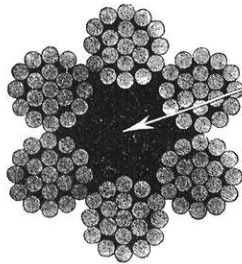
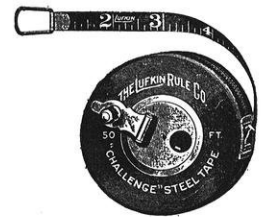
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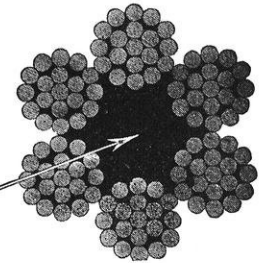
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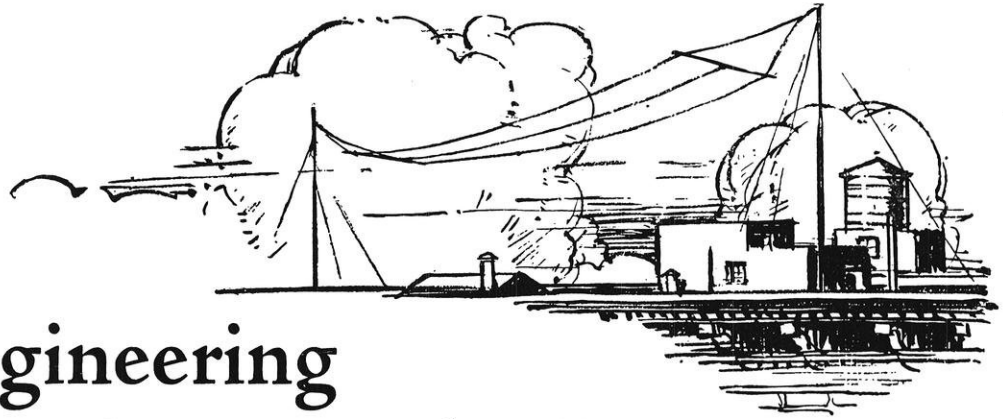


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# What Engineering Owes to the Imagination

From An Argument Over  
Watches Came KDKA



**B**ACK in the days when wireless was just beginning to spread, Frank Conrad (now Assistant Chief Engineer of the Westinghouse Electric & Manufacturing Company) and another official, happened to compare watches, to see if it was time to go back to work. Their watches differed.

Unable to convince his friend that his watch was right, Mr. Conrad suddenly remembered that the naval station at Arlington, Va., had just inaugurated a system for sending out daily time signals by radio. Just the thing to prove his point!

So he built a simple set of receiving apparatus, erected an aerial, and—you can imagine what happened! He was badly bitten by the radio bug. After proving to his satisfaction the accuracy of his watch, he started experimenting with the transmission of music by radio, with good success.

He began sending out phonograph music from his home, and attracted the attention of some of the big department stores, that had installed radio departments. They in turn, started advertising Mr. Conrad's "musical evenings."

Then, one day, upon arriving at his desk, he was summoned to the office of Harry Phillips Davis, Vice President of the company.

"Frank," said Mr. Davis, "I'm going to close your radio station." His attention had been attracted the night before to a simple note in a full-page advertisement, which read, "Mr. Conrad will send out phonograph music this evening."

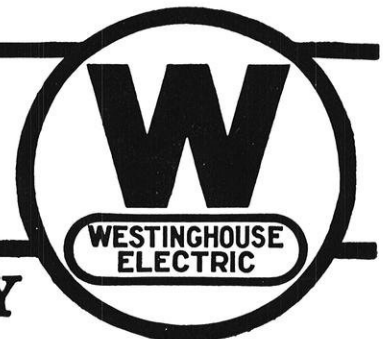
You know the rest. In November, 1920, "KDKA" was formally opened to send out election returns. It had received the first license issued by Uncle Sam. Today over 500 broadcasting stations entertain and educate millions of people each night, a wonderful result from so insignificant an argument as one over watches.



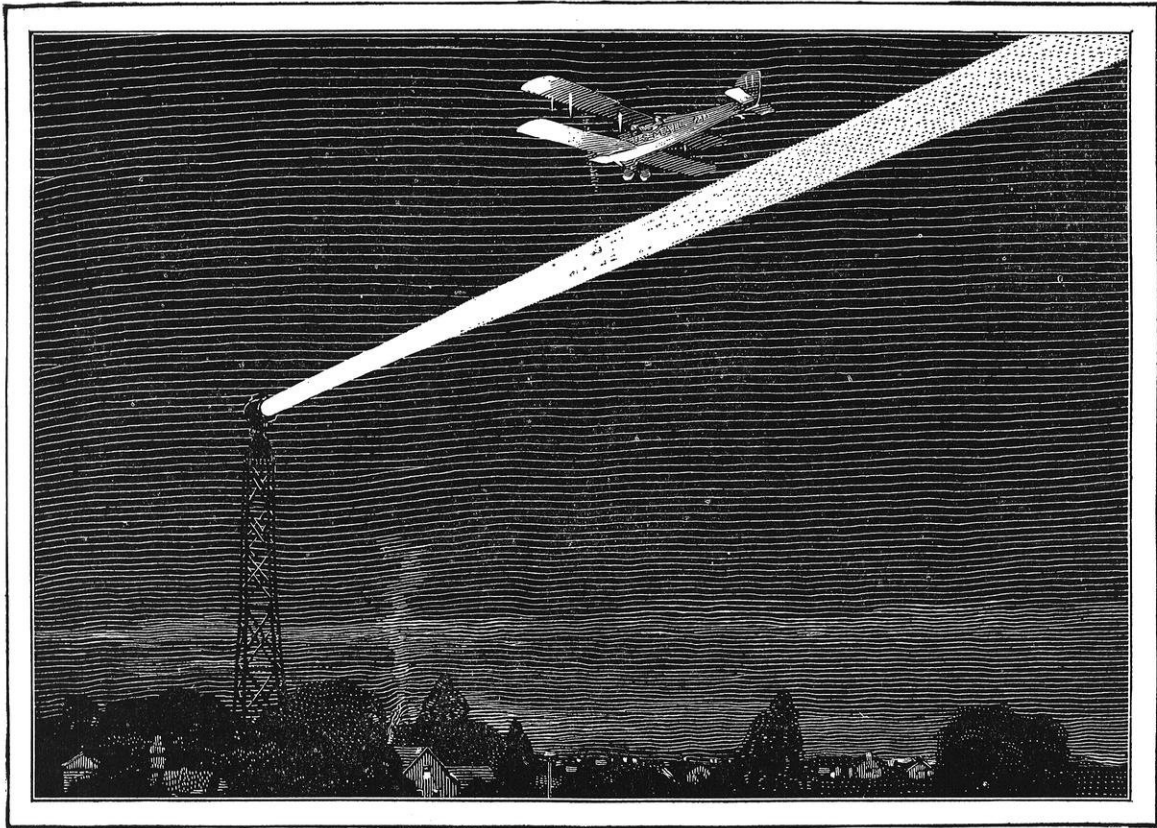
Broadcasting Studio at Station KDKA, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

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This achievement has been made possible by engineers of the Illuminating Engineering Laboratories of the General Electric Company, working with officials of the Post Office Department. A startling achievement now will be a commonplace of life in the *new* America which you will inherit.

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