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The Wisconsin Engineer

VOLUME 35, NO. 5 FEBRUARY, 1931

A Review Concerning

Human Relations in Industry

By Jack H. Lacher, ch'31

BEFORE the beginning of the Industrial Age, the human relations between the apprentice and journeymen were very satisfactory. To be sure, the hours were long and the working conditions could be rarely classed as excellent, yet in most cases the apprentice was made to feel more as a member of the journeyman's family than as a workman or laborer. The advent of the Industrial Age brought about great changes in the relation of workman to owner. The workman became a slave and the owner a capitalist. The first capitalists were primarily interested in quantity production, and in amassing fortunes; and it apparently mattered little what happened to the laborer, as to his working conditions, to living conditions, or to actual existence just as long as he did exist and was available. Labor unions came next with the express purpose of protecting the human rights of the workingman. There were many bitter struggles and in certain industries, today, these battles are just as bitter as they ever were. At present, for the most part, there has come an understanding between the labor parties and the capitalists. This is not at all obvious, however, as there are yet a number of books which treat the matter very pessimistically. That this understanding should develop was only to be expected; labor and capital are inter-related. The one can not exist without the other. With the gradual expansion of this knowledge, the actual value of the labor unions has waned; and there are now a number of industries employing thousands of workers who do not belong to unions.

Jack H. Lacher,

LaGrange, Illinois

This paper is a departure from the usual technical subjects which engineers are apt to encounter in the *Wisconsin Engineer*. We are too often forgetful of the human element in our profession.

Jack Lacher elected a five year course, which contained many subjects in the college of Letters and Science. During his junior year Jack was president of the local chapter of A. I. Ch. E. and Polygon. He is a member of Alpha Tau Sigma, Alpha Chi Sigma, and Sigma Phi Epsilon.

There are two distinct arguments in the matter: that of the employer and that of the employee. There are at least six essential factors which company officials must consider in regard to their human relations with their employees; to ignore them would result in lower production, higher costs, lower dividends, and possibly failure.

First in importance from the employer's viewpoint is increased efficiency; i. e., conservation of time, and of energy. In comparison with foreign countries in this regard, America is far ahead. The higher the wage scale, and the greater the output, the more essential are the time studies. Time costs money.

Second, an improvement in the quality and quantity of work done. Sales success depends directly upon those two factors.

Third, the loyalty and confidence on the part of the employee. The best advertising medium in existence is a satisfied employee; consequently we find a number of railroads engaged in promoting activities for their employees.

Fourth, is industrial peace. Strikes are costly. Aside from the sums spent by both sides for publicity, legal counsel, and the like, the workers lose their wages, employers lose their profits, and society loses the production. In some industries the worst cost is not valued in dollars and cents, but in the sacrifice, deprivation, and suffering experienced by the families of the strikers.

Fifth, is the cost of labor turnover. A satisfied employee has no desire to leave a company. The cost of hiring a man has been estimated at between $10 and $300, depend-

ing upon the class of work. This cost is not only in the employment department but due to the expense of training, spoilage, smaller output, and less effective use of machinery and equipment.

Sixth and last, is the interest of the worker in his work and fellowmen. It is obvious that a man interested in what he is doing turns out better work. An interest in his fellowmen is companionship, cooperation, and citizenship. The idea of teamwork in a football game is well known; the use of team work among industrial workers is just as effective.

The employees, on the other hand, list eight items which they want: higher wages and shorter working hours, steady work, better personal relations with their superiors, improved working conditions, health protection, a square deal, a chance to better their position, and provision for old age. The industry which satisfies its employees in those points is in a very enviable position, while if but one or two of the desires are not properly fulfilled, the industry finds its labor situation in an unstable position. What various organizations have done to improve their relations with their labor are indeed interesting as they are exact answers to the wants of the workingman.

Wages are higher, in general, in this country than any other place in the world, and yet this is partly due to the higher standard of living and higher cost of living. Unskilled labor is still what could be considered underpaid, as witness the wages of section men on railroads, and day laborers of construction companies. Skilled labor wages are higher than ever before, some would say that the workers in the building trades are over-paid. Some criticize the wages paid in large industrial concerns as being on a single man basis, and for that reason married workers suffer considerably from inability to live on a decent standard of living. The shorter working day has been granted almost universally and is in most cases protected by law. Many large firms do not pay large wages, yet they furnish other ways for their workers to save money. The A. T. & T. system enable employees to purchase stock by small weekly payments, at a price far below the market price. Some companies, also, give full dividends on partially paid-for stock owned by their employees. Profit sharing has possibilities although it has not proved highly successful. Some firms fail to make profits regularly and extra compensation in this form fails to offer much incentive to the worker. Likewise any reward which comes to the unworthy comes as well as to the worthy. The U. S. Steel Corporation has a profit sharing system, which is based on merit alone, for the unusual man who through dint of his brain has done something to ensure or enlarge the profits for the company. This offers the necessary incentive. Other companies furnish their employees with homes, or the opportunity to buy or rent them very reasonaby, for example, Kohler of Kohler. The sub-station operators of the C. M. St. P. & P. electrified, are furnished homes, heat and light.

Many industries are seasonal or at least have seasonal rushes when they need many more workers than in the slack period. The Dennison Manufacturing Company makes paper boxes, tags, crepe paper, etc., have seasonal rushes at Hallowe'en and Christmas. They formerly had to take on many people for short periods to handle the rush, but in 1919 they started to build up additional work through the slack periods, encouraging advance orders, and stocking up during the light season. This eliminated the fluctuating demand for workers, and resulted also in increased good will and lowered turnover. Likewise in the fruit packing industry, research in the cold storage of fruits enabled the concentrated seasonal work to be spread out over long periods, again resulting in an increased year-round staff, and greater profits. Unemployment insurance is another means which is being regarded as effective in relieving the burden of faulty industrial organizations.

One of the first ways to start employees is to treat them as friends when they are employed. The now highly developed personnel departments do much in making the new worker pleased with his surroundings. This also holds true in firing employees or letting them go. Some companies make it a practice to go out of their way in telling workers just why it is they can't be used. It eliminates the disgruntled attitude of the worker. Another means is the employee-employer committee for discussing the human factors of sanitation, safety, and also matters concerning production and the business in general. The Hawthorne club of the Western Electric is an example of this. They hold an annual election of officers and members; and throughout the year have charge of directing the recreational activities of the shop and office workers. The T. M. E. R. & L. Co. does a great deal with psychological tests in the way of placing their men in the right kind of work.

Health goes hand in hand with improved conditions, but in addition almost all factories of any size have their own first aid stations or hospitals. Employees are given medical exams before being permitted to work; in order to be certain that their health is suited for the job. Along with health go the safety programs, machine guards, protective screens, goggles, etc. The financial saving in 1918-28 due to reduction of accidents in the U. S. Steel Corporation was over $14,500,000 not including the saving in life and in suffering. Many industries have the hazard of industrial poisoning or occupational disease, such as phosporous poisoning in the match industry, brass poisoning, arsenic poisoning in the glass industry, fumes from dryers in organic processes, carbon monoxide and others. Fortunately a number of these have been greatly lessened by the use of protective masks, screens, fans, etc., but the hazard is still there, and the continued viligance of the worker and employer is necessary in order to keep the industry from social disruption.

Many companies go out of their way to give their employees what could be called a square deal. The American Seating company provides insurance, all costs paid by the company; the amount varies from $300 to $1000, and if the employee desires more insurance it can be purchased subject to a satisfactory physical examination. Other companies furnish the opportunity to buy group insurance at very low rates, and in some cases the company makes part of the payment. The Western Electric furnishes the op-

portunity of a building and loan association; others use different forms of banking. The Hawthorne Club has charge of a number of company stores located all over the plant at which employees can buy clothes, groceries, sport goods, electrical and radio equipment, coal, etc., at prices considerably below the market prices. Through arrangements made with stores and manufacturers all over Chicago, the employees can get practically any article of home use in existence at from 20-50% below regular retail prices. They also run two or three large restaurants in the plant at cost. During the noon hours they furnish programs given by prominent entertainers, and twice a week there is a noon hour dance. During the winter months one night a week was bought out at the Civic Opera, and the tickets were made available to all employees at rates; also tickets are available for at least one good play throughout the winter. A large gymnasium, bigger than possessed by a number of high schools, was recently built to carry on athletic programs; i. e., interdepartmental basketball, bowling, etc., during the winter. For the summer, the playground, of two city blocks area, is utilized in tennis, baseball, track, and other interdepartment competitive sports. These are all as much for the women as well as the men employees. The *Western Electric News*, monthly magazine, is published by the club. An annual photography contest is sponsored. Department picnics are arranged. This is not all that the club does to make it easier for the employees to live. It makes them satisfied with their work, as well as improving the personal relations with their superiors, and it is typical of what a large organization will do. One idea which has not been carried out extensively is the use of music to accompany the workers as they work. It is known that music relieves fatigue, besides producing psychological reactions of other natures, which may be utilized in industrial plants as it is now used in hospitals, large railroad waiting rooms, etc.

The object of time studies is to increase the efficiency of the workers and consequently increase production, or relieve strain and fatigue. It also results to a certain degree in raising the wage rate of the competent workman. This development is because men are picked and paid for fitness and capacity, since when they get started on a piece of work they save indirect costs by doing it quicker without costly supervision, forcing or driving. Processes and machines are analyzed to see if there is a quicker, better way to turn out work; organization methods are developed not to hurry work in the sense of skimping it, but to eliminate the useless time-consuming operations and motions. Not all employees are satisfied with their position, and yet because of their lack of education they are prevented from advancing. Many companies have aided their employees by furnishing the chance to go to night school classes in a variety of subjects, and in some cases technical courses are given on company time during the day. Others employ vocational guidance systems and psychological placement tests, all for the purpose of giving the employee the chance to find something which appeals to him more than his present occupation.

(Continued on page 160)

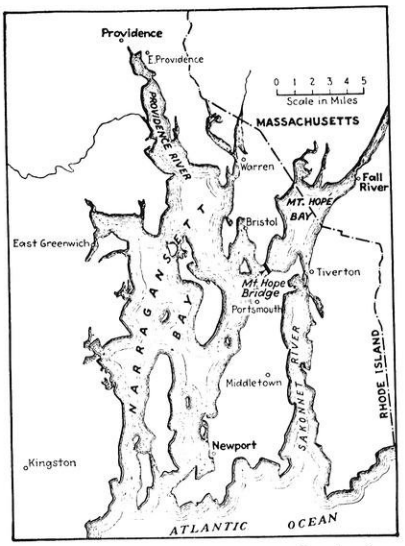
THE FEBRUARY COVER

The Mount Hope Bridge

Editor's Review

TOLL bridges have come to stay. Four months ago, a census of these structures showed that there were nearly 300 of them in the United States. And previous counts showed that there has been a steady increase. On October 1, 1927, there were 233 in operation, and at the present time there are 51 in operation.

Among the recently constructed projects of this nature is the Mount Hope span in Rhode Island. It crosses Mt. Hope Bay which is a branch of Narragansett Bay. In this way, an island containing about thirty square miles with cities Newport (30,000), Portsmouth, and Middletown, is connected with the mainland. This section of the country is especially populated in the summer time by vacationists.



The structure connects an island of a city and two towns with the mainland. This territory is especially populated by summer tourists, and summer colonies.

The project was first taken up by the state legislature when a commission reported that a 1200 ft. cantilever at an approximate cost of six million dollars would be economically sound from the standpoint of traffic. It was turned down. A private company was soon formed which took over the problem. It was financed by $2,850,000 of 6½ per cent first mortgage bonds, $1,300,000 of 25-year sinking fund 7% debenture bonds, $100,000 of 7% cumulative stock and 50,000 shares of no-par common stock.

The main span is 1200-ft. long with small suspended spans of 504-ft. on each side. Approaching these are steel viaducts which total 2,800 feet in length. The piers are sunk off shore in order to reduce the span length of the main suspension. These are founded on clay and gravel which is stiff and compact. Shale is a depth of from 50 to 80 feet below the ground surface. The road at the approach is 30 feet wide and 27 feet wide at the span. Sidewalks 2½ feet wide are provided for pedestrians and to cover the conduits and piers at the same time.

The bridge is similar to many suspension types that have been erected recently over large bodies of water. Among these are the Ambassador Bridge at Detroit, the Hudson River Bridge, and the Philadelphia-Camden structure. The use of toll bridges will probably continue as long as there are difficult and expensive spans to be constructed. The principle of the bridge is the universal slogan of making the man who enjoys the benefit pay for it. It is a good principle, and the construction of such benefits by private interests is not to be looked down upon.

Principles, Characteristics, and Uses of

Copper-Oxide Rectifiers

By JOHN LLOYD JONES, e'31

THE copper-oxide rectifier has received wide recognition in the electrical industry. It is rugged, compact, cheap, and long-lived. It may be readily adapted by series and multiple connections to any voltage or current. The discovery of the rectifying principle is credited to L. O. Grondahl, and was first applied commercially by the Westinghouse Company in 1924. Since that time several manufacturers have placed similar devices on the market, and copper-oxide rectifiers have become standard equipment in many magnetic controls, in radio, and telephony.

A rectifier must have one of two essential characteristics in order to function: it must conduct current more readily in one direction than in the other; or it must reverse any currents not flowing in that direction. The latter is the principle employed in mechanical rectifiers such as commutators and vibrating contacts; and the former is employed in non-mechanical rectifiers such as electrolytic, vacuum-tube, mercury arc, and copper-oxide types. Proper combination of two units of any of these non-mechanical rectifiers will rectify both loops of an alternating current, reversing the backward currents, rather than merely stopping them. This is called full-wave rectification. Mechanical rectifiers are greatly limited as to usable frequency, capacity, and life. Electrolytic rectifiers are bulky, messy, and inefficient. Mercury-arc rectifiers are inflexible and bothersome in small sizes, though the large ones are extremely effective. Vacuum tubes are delicate and require considerable auxiliary equipment. It will be shown that the copper-oxide rectifier is greatly superior to these in many respects.

Mr. Grondahl discovered that the junction plane between a piece of copper and a layer of cuprous oxide formed on its surface, offers a very large resistance to current flowing from the copper to the oxide, and a relatively small resistance to current flowing from the oxide to the copper. Both of these resistances vary widely, but their ratio is of the order of several thousand to one. This phenomenon is obviously an excellent one for use in a rectifier. The current that will pass in the high resistance direction under advantageous conditions is so small that it is negligible as compared to that in the other direction. This resistance rectification takes place automatically with no assistance from heated filaments, special vapors, or reduced pressures.

When copper is heated, first at white heat then at red heat, in the presence of air, there is formed on its surface a strong adhesive layer of brick-red cuprous oxide. For convenience copper washers are regularly used in the making of copper-oxide rectifiers. They are sent through the furnaces mounted on racks in pairs tightly pressed together, so that only one face of each washer is coated with oxide. In order to obtain an efficient electrical contact with the uneven oxide surface, it is customary to rub graphite into it, and to place against it a piece of soft metal, usually lead. One copper washer and one lead washer so assembled and held together by an insulated bolt, are the simplest standard form of copper-oxide rectifier. Several of these copper disks may be mounted in series with their oxide surfaces facing all in the same direction, and then the lead washers are included only at the ends of the stack.

The resistance of a copper-oxide rectifier unit in either direction depends inversely on the surface area of the washers, the pressure applied by the bolt, the voltage across the unit, and its temperature. The reverse resistance changes only slightly with pressure until the point is reached at which the oxide coating crushes, and then it falls rapidly. This occurs at about 3000 pounds per square inch. The forward resistance decreases much more rapidly and steadily under applications of pressure. It has been found that after allowances are made for the strength of the bolt and the expansion of the washers with temperature rise, the most satisfactory pressure is about 800 pounds per square inch.

As indicated by the volt-ampere characteristics of a test unit, the forward resistance changes from 0.5 ohm at one volt impressed, to 0.286 ohm at four volts. With the

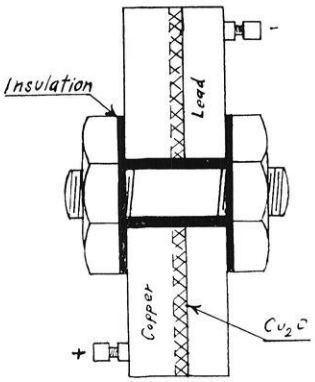
Because of the completely "civilized" staff of the *Wisconsin Engineer*, very few of the articles which have been published in the last year are technically electrical. Most of the editorial matter was general, and could be digested with ease by students of any school.

The use of copper-oxide rectifiers is a subject purely in the scope of the electrical engineers. The author of this article, John Jones, derived his material from actual experience as well as from periodicals. During the summer months he was employed by an eastern electrical company where he came into actual contact with the testing and construction of these devices. There were several graphs which accompanied the paper, but due to lack of space could not be published. Mr. Jones wrote this article primarily for Professor Jansky's course in Electrical Engineering.

The simplicity of the copper-oxide rectifier has made it successful on these controls which are sensitive only to direct current.

same increment in voltage the reverse resistance changes from about 5000 ohms to 2600 ohms. This suggests that there is a definite limit to the value of voltage which may profitably be impressed on the rectifier, for the reverse current presently ceases to be negligibly small. This will be mentioned again in connection with efficiency.

Temperature rise causes a very large decrease in both resistances. A temperature change from 20 to 40 degrees centigrade reduces the reverse resistance of the test unit 50 per cent, and the forward resistance nearly as much. High temperatures are injurious to the rectifier and must be guarded against. More than 90 degrees centigrade permanently destroys the rectifying property, apparently by a chemical break-down of the oxide.



A cross section of the simplest type of copper-oxide rectifier, which is fundamentally the same as the complicated devices on the market.

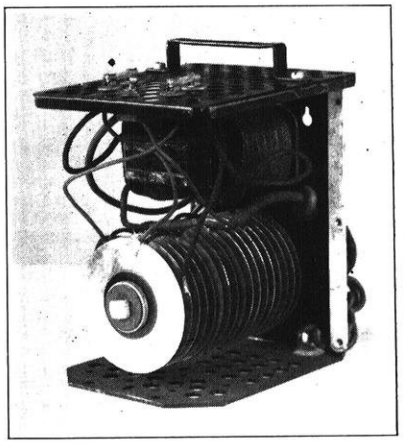
One more factor influences the rectifier resistance: "ageing." For eight or ten months after beginning operation a copper-oxide rectifier increases its resistance slowly until it approaches a final steady-state value some 10 to 15 per cent higher than its initial value. Unless overheated, the rectifier then continues to operate without change for an indefinite length of time. The effect of aging must always be taken into account when specifying copper-oxide rectifiers.

Copper-oxide rectifiers may be used to furnish full-wave rectification on single-phase or polyphase circuits by proper connections of several stacks of washers. The normal single-phase arrangement is the simple bridge, in which each branch or leg consists of a stack of rectifier disks. This hook-up may be readily extended to operate on any number of phases. Care must always be taken to have all the stacks connected in the proper direction. Load currents will flow from the oxide to the copper in each washer, so the positive direction of each stack is that in which the free copper surface of each disk faces. Small standard single-phase rectifiers are often mounted conveniently with all four branches on the same bolt, and terminals brought out for easy connection. For larger current capacity it is only necessary to parallel several stacks in each leg of the rectifier circuit.

The rising temperature-current characteristics, and the fact that heat is generated in proportion to the square of the current, make it essential to provide adequate radiation to prevent overheating. Thus the better the facilities for radiation, the larger will be the current the rectifier can safely carry. For this purpose metal spacers and large, thin fins are frequently mounted with the washers. The standard continuous current rating of a 1.5 inch rectifier is 125 miliamperes. With two inch fins placed after every second washer, this rating is increased to 200 miliamperes. Larger fins further raise the continuous current rating.

Since the mass of metal in the rectifier enables it to absorb a large amount of heat before the temperature gets too high, currents of eight or ten amperes may be drawn for a few seconds. This large thermal capacity is frequently utilized in standard applications.

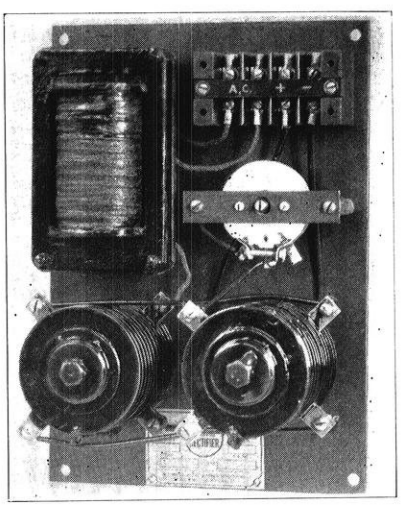
Surprising outputs are obtained from the larger combinations of copper-oxide rectifiers. Compact standard assemblies are made for as much as 3 kilowatts.



A rear view of a commercial rectifier of the copper-oxide principle using a pile of discs.

The efficiency of a copper-oxide rectifier is conservatively quoted at 60 per cent under favorable conditions. In the case of a four-disk bridge-connected rectifier the maximum efficiency is about 70 per cent, and occurs with ten volts impressed, which corresponds to eight volts on the load, when supplying 0.5 amperes. This means that a copper-oxide rectifier at its continuous current rating should sustain a maximum impressed voltage of about 10 volts per washer. Higher voltages result in such large back currents that the efficiency is reduced. The number of rectifier disks in series in every stack is determined by the expected maximum voltage drop across the stack.

Within the limits of its continuous rating, a copper-oxide rectifier maintains a regulation of 3 to 4 per cent. At heavy overloads, however, the load voltage drops very fast. As would be expected, the temperature is an important factor in the exact value of the regulaton, and for high loads rapid heating makes all observations more or less inaccurate.



Another commercial copper-oixde rectifier using two sets of discs instead of one.

Any rectifier causes interesting and peculiar current wave forms which vary with the type of load. A single-phase full-wave copper-oxide rectifier may be considered representative in this respect of all copper-oxide rectifiers. Oscillographic tracings illustrate its characteristic wave forms of input current and voltage and output current. On a pure resistance load the output current is a perfect sine wave with half of the loops inverted. The input current wave is undistorted and in phase with

(Continued on page 156)

The Wisconsin Extension Division Is

Developing Ground School Classes

By CLINTON D. CASE
Assistant Professor of Mechanical Engineering
University of Wisconsin Extension Division

THE University of Wisconsin during the present school year is offering several rather unusual courses in aeronautics in order to serve a type of student not ordinarily in a position to take advantage of the regularly established courses in aeronautical engineering offered by some schools. For a number of years other schools have been developing highly technical courses in aeronautical engineering in which students have enrolled eagerly; all too eagerly, in fact. One of the pioneers in this work made the statement recently that he thought that not more than ten per cent of the graduates in aeronautical engineering from his school this year would find work allied to the aircraft industry.

With the field of aeronautical engineering crowded, the University of Wisconsin has decided not to go intensively into this specialized field. Instead, its College of Engineering offers a well rounded course in mechanical engineering in which may be included enough optional aeronautical subjects to give students a good grounding in the fundamentals. If they desire more specialized work, they may study the more advanced subjects unsupervised; or they may take up graduate work in aeronautics.

This policy is followed by many other universities. They all appreciate the fact that only a few engineering schools are needed to supply trained men for the highly specialized fields of engineering and industry, such as naval architecture, ceramics, or aeronautics. A study of the situation in Wisconsin by the Extension Division of the University of Wisconsin revealed a lack of ground school facilities throughout the state; also an increasing demand by adults for a course of instruction which would prepare them for the written examinations for pilot's licenses given by the Department of Commerce. There are less than half a dozen cities in Wisconsin where commercial ground schools are organized on a permanent basis. In numerous communities throughout the state there are a handful, more or less, of pilots and others interested in aviation who would like to attend schools of this nature if they were more conveniently located. In some air-minded localities there are usually a dozen or more men who have learned to fly, have purchased a plane, and are building up time in the air toward a transport license but are looking forward to the impending examinations with considerable temerity because of the questions on navigation, meteorology, and perhaps some of the other four subjects. The number of such individuals, however, is seldom large enough to warrant a permanent commercial ground school.

Appreciating the above situation, the Extension Division of the University of Wisconsin, in conjunction with the local vocational schools, is serving such localities with ground school classes, held for one semester. Such a plan requires no outlay for housing the class. As all of the equipment is portable, each town may be served as adequately as though it were provided with an elaborate local organization; at the same time there is not the expense that such a system would involve. It has been found that the airports in these cities are always more than willing to turn over their shops and other facilities whenever it is desired to have the classes inspect the planes and engines in operation or when they are being repaired.

For three years classes of this type have been held in Milwaukee. This fall three other cities were added to the instructor's itinerary. There are shown in the table included in this article, together with the enrollment in the various classes.

It is planned to discontinue this type of instruction next fall in Milwaukee as there is now a well established ground

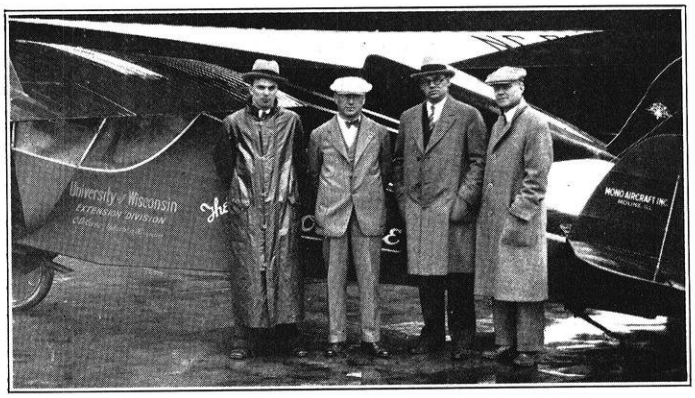
A COURSE IN AVIATION

The importance of aviation is increasing at such a rate that it cannot be disregarded by any school at which engineering is taught. At the present time even though it is yet in its infancy, aviation is growing by leaps and bounds and is taking hold in the desires and ambitions of the younger generation.

Many students are entering the university now wishing to take a course in the theory and principles of areonautics, but they have to be satisfied with a course in mechanical engineering because none is given in the course they wish to pursue. This situation is quite unfortunate and should be remedied. These students have the same desire to learn areonautical engineering that students of not so long ago and even of the present time had and have relative to automotive engineering. And why shouldn't they? They are young and so is aviation and their ambition is to grow up with it and endeavor to make it better, safer, and more practical for the entire human race.

Wisconsin is known for her progressiveness and is proud of this distinction. She should be; but can she continue to remain on this pinnacle of progressiveness if she does not satisfy the desires of her students in this future field of engineering development? Other schools have already passed her in this field. — *Wisconsin Engineer* editorial — November, 1928.

school there conducted by one of the flying services of the city. After the present series of Extension classes in Milwaukee is completed, it is very probable that a series of advanced evening courses in aero-dynamics, stress-analysis, propeller design, engine design, and airport planning will



The University of Wisconsin Extension Division Plane as it appeared at the Wausau Hangar. Prof. Case is standing at the left of the foreground.

be made available to small groups of adult students who have the technical background to enroll profitably in them.

Day	*City*	*Subjects*	*No. of Students*
Mon.	Wausau	Elementary Aeronautics	19
Tue.	Appleton	Meteorology and Air Navigation	5
Wed.	Manitowoc	Elementary Aeronautics	19
Wed.	Manitowoc	Meteorology and Air Navigation	10
Thur.	Milwaukee	Elementary Aeronatutics	22
Fri.	Milwaukee	Aviation Engines	19
		Total	94

Ground school courses will be continued in many of the other cities of the state. Oshkosh and Racine have indicated that they would like to fill in any vacancies in the schedule for the coming semester, in case any of the present classes are omitted.

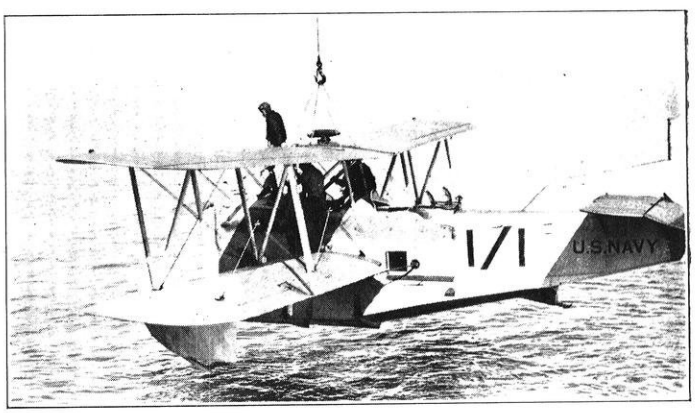
The titles of the three courses offered are largely self-explanatory, but it might be well to at least mention a few of the more important subjects covered. In the course in Elementary Aeronautics are included: theory of flight; aircraft construction, repair, and operation; air traffic rules and air commerce regulations. The last two subjects give sufficient preparation for the written portions of the examination for a student's or private pilot's license. The other subjects are not only of value to the student flier in increasing his understanding of flying, but they prepare him for his limited commercial examinations. This course in Elementary Aeronautics, together with the course in Aviation Engines, completes the preparation for this examination.

Meteorology and Air Navigation has proved the most popular course for those actually engaged in flying. These men believe that their contact with planes and engines will be sufficient to help them through the first four subjects of the transport examination. The other two subjects, however, can seldom be mastered so simply; recourse must be had either to good books on the subjects or to ground schools. The ground school appeals to most men because it stresses the important points in a more effective way than it is usually possible for a text to do; what is probably more important, it requires less initiative to attend regular sessions of a class than to set out haphazardly to read several books from cover to cover.

Under the heading of meteorology are included, a study of the atmosphere, clouds and their meanings, winds, weather maps, and weather forecasting. These are taken up during the first six weeks of the course. The last ten weeks are given over to navigation, which covers the magnetic and earth inductor compasses, aircraft instruments, airway maps, radio aids to navigation, dead reckoning, piloting, and a brief introduction to celestial navigation. All of the courses have proved sufficiently thorough so that only an exceedingly small number of students have had difficulty in passing sample examinations similar to those given by the Department of Commerce.

The lectures and general class procedure are built around the text "Commercial Aeronautics," published by the Junior Air Service of America, Inc. This text consists of fifty pamphlets, which admirably serve the purpose of the courses. The various booklets are grouped conveniently to form material for home study for each of the three classes taught; the complete set forms a very inclusive aeronautical reference library for any student. In addition to the text, appropriate moving pictures and slides are shown from time to time in the various classes; also, a large number of exhibits have been prepared for use with the lectures.

Naturally, there are numerous sections in the state where the number of students desirous of taking such a course is too few to justify the installing of even a temporary ground school. A solution for this problem is offered in the form of two correspondence courses. The first, Elementary Aeronautics, covers all of the material given in the class course of the same name, plus that given in the



Professor Case obtained much of his experience in the navy. This shows one of the navy planes being hoisted aboard the carrier after having taken off.

engine course. The course is based on "The Airplane and Its Engine," by Chatfield and Taylor, together with some specially prepared mimeographed notes. The student's work is blocked into twenty-four assignments, which cost him $15 if he is a resident of Wisconsin.

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The "Board of Inquiry" vs. the "Lecture-Recitation Method of Education

By EDWARD BENNETT
Professor of Electrical Engineering

The Lecture-Recitation Method.

The customary method of aiding students to obtain a grasp of any branch of organized knowledge, such as calculus or physics or electrodynamics, is to conduct classes of the *lecture-recitation* type in that subject.

The typical weekly schedule of classes in any one of these subjects may consist of one or more *lecture periods* and two or more *recitation periods*. The lectures are delivered to the entire group of from 50 to 300 or more students who may be pursuing the subject, but for the recitation periods the group is divided into *sections* of from 18 to 24 students each. In the recitation period the student recites on the work he is doing in the subject and has the opportunity to present his views and to bring about a discussion of obscure or difficult parts of the subject.

In the engineering classes in the fundamental subjects, in which there are excellent textbooks, the more general practice is to dispense with the lectures and to use all the periods allotted to any subject for recitations. The class in any subject is divided into sections of 18 to 24 students each. In a fundamental subject like mathematics, the student will have five recitation periods per week, each 50 minutes in length. Of the 50 minutes available in each recitation period the instructor uses from 10 to 25 minutes in asking questions, calling attention to features of assignments, eliciting or giving explanations, etc., leaving, say, 35 minutes of the time in which the students may have the floor.

Weakness of the Lecture-Recitation Method.

The weak feature of the recitation method of education is that in the typical class of 18 to 24 students, each student may be expected to have the privilege of the floor to exercise and develop his powers of oral expression and exposition in any subject not more than two minutes per recitation, or rarely as much as a total of 30 minutes per week in all the subjects of a full time program of studies.

Edward Bennett
Madison, Wisconsin

Education like engineering is subject to evolution. New methods displace present methods, as new machines are developed to replace antiquated types. Many subjects will never change in the presentation of the subject to the students. Some will change slightly, and others will be radically altered.

The "Board of Inquiry" scheme of instruction is a distinct transition from the usual methods of pedagogy. Its success like the success of a machine depends on experimentation and tests. It will correct many of the evils of the modern "lecture-recitation" presentation.

The most frequently repeated critical comment on the preparation of the engineer grows out of the relatively poor showing which the typical engineer makes when he is called upon to make an off-hand oral presentation of his views or of his position. Now the mathematical and physical sciences do not lend themselves to the same extent as do the historical and social sciences to free discussion and debate based upon the more common notions and experiences of mankind. Consequently a boy who elects to follow the engineering profession, as contrasted with one who elects to prepare for a career in the fields of law, or of economics, or of political or social science, by this very election, shows definite tendencies. He shows that he is predisposed to activities in which he is dealing with the not easily debatable principles of phyiscal and mathematical science, rather than to the activities of the public forum. His studies in mathematical and physical science serve to confirm his natural tendencies, and undoubtedly the recitation method of education used in the engineering colleges is a powerful factor tending to stunt and repress any tendency toward free and ready oral expression.

In view of this situation, it would seem that an educational method should be used in the engineering colleges which will tend to beneficially modify the characteristics and influences sketched above. With this objective in view, a trial is proposed in one or more sections of certain fundamental engineering subjects of a method which will be called the *Board of Inquiry Method* of education. The features of the proposed Board of Inquiry Method are as follows:

The Board of Inquiry Method.

In the Board of Inquiry Method of instruction, the instructor divides his typical section of 18 to 24 students into three sub-groups of 6 to 8 students each. These groups of 6 to 8 students will be called Boards of Inquiry. Each Board of Inquiry has available for its use at the hours

formerly devoted to recitations a small room which is provided with some blackboard space, the necessary chairs, one or more conference tables, and for some purposes with models or demonstration equipment.

Each Board of Inquiry meets in its own room at the customary recitation period and proceeds to conduct an "inquiry" or a "hearing" on the topic from the text previously selected or assigned for that period. For the purpose of conducting the hearing on any topic, such as those suggested in the foot-note *, the Board at a prior meeting has apportioned to its members the following positions for the coming hearing:

Chairman.

Counsel for the Author's presentation or development.

Witnesses and experts for the Author's presentation — 1 or more.

Counsel for the defense against erroneous views.

Witnesses and experts for the defense — 1 or more.

The hearings may be conducted after the manner of the hearings conducted by the examiners of commissions such as the Interstate Commerce Commission, the Federal Radio Commission, or the Patent Office. The functions of the members participating in the hearing are as follows:

Organization of a Board of Inquiry of 6 to 8 Members.

Chairman — Duties of

A. To preside at the hearing and to see that the rules of orderly and considerate procedure are followed.
B. To pass upon questions of relevancy and irrelevancy.
C. At the end of the hearing to render a statement of the facts disclosed by the hearing.

Counsel for the Author's presentation methods, line of development or interpretation.

Duties of Counsel

A. To briefly state what he proposes to establish.
B. To elicit by questioning the Author's witnesses and experts —
   a. the experimental facts relating to the topic,
   b. the interpretation, or the correlating principles,
   c. illustrative examples bringing out the meaning of the principles, or showing their applications.

Counsel for the League of Defense against erroneous or unfounded or hazy views.

Duties of Counsel

A. To briefly state what he proposes to establish.
B. To elicit by the cross-examination of the Author's witnesses and experts, and by the direct examination of his own witnesses and experts, errors, uncertainties, ambiguities, inconsistencies, questionable reasoning, etc., in the case built up by the Counsel for the Author, or by the Author himself, and occasionally to make a case for an alternative and equal or more effective development of the topic.

Witnesses and Experts.

The duties of witnesses and experts will be evident from the statement of the duties of Counsel. A system of knowledge which has been gradually built up for the purpose of enabling men to get about in safety and in comfort amid the experiences of life, is to be mastered. What are these *experiences,* and *what ways of regarding them* have been invented so that experience comes to be comprehensible and predictable as the result of the operation of a few natural laws? This is to be established by the testimony and demonstrations of the witnesses and experts. Witnesses or experts when not on the stand should sit with their counsel to confer with him and to render advice during the examination of the witness who is on the stand.

Reporter.

It is obvious that a record of the "Hearing" is not desired. It will undoubtedly happen, however, that Counsel or Witness will from time to time desire to ask the Chairman that an "exception" to his "ruling" be noted. In this case, the Chairman may find it convenient to designate a *Reporter* to record the "ruling" and the "exception;" this record will be discussed and passed by the Instructor when he joins the group.

The organization of the Board may be changed daily or weekly, but preferably at the conclusion of the two or more hearings on each fairly brief, well-knit topic.

During the regular 50 minute period, the Instructor will have 15 minutes to sit with each board. He may sit with the chairman, or with either counsel, or may take the stand to testify for either counsel.

It will be seen that under this "Board of Inquiry" procedure, the time available for each student in which to exercise and develop his powers of oral expression is from five to ten times as great as in the recitation method. Moreover, the duties of each member of the Board are such that there is an incentive for him to be alert to everything which transpires, and to come to the meeting of the Board with the topic well organized. The incentive arises from the fact that he has the assurance of the opportunity to use and to test his observations and his knowledge.

The Spirit of the Hearings.

On first reading it may appear that the Board has been so constituted that the interests of the parties to the hearing are in conflict and that the "Hearings" may not rise above the low plane of a petty matching of wits, in which the sense of proportion and of common interest and common purpose is lost. On the contrary, it seems reasonable to expect that the holding of the Hearings in the study of the mathematical sciences will give the members, not simply a vision, but a rich experience of the high plane upon which an inquiry may be conducted if the method of science is followed. To this end it must be emphasized that all parties to the hearing have a common objective, but that the attainment of the objective requires that the members play different roles.

The common objective is the appreciation, appraisal and ultimate acquirement of new territory. The roles which

(Continued on page 160)

*The topics set for the hearings will be topics such as "Types of Motion," "Simple Machines," or "Force, Mass, and Acceleration" in Physics, or such as "The Notion of the Derivative," "Maxima and Minima," or "Derivatives of the Circular Functions" in Calculus, or such as "Electric Potential," "Properties of Conductors or "Motional Electromotive Forces" in Electrodynamics.

Campus Notes

ENGINEERS ON PROM STAFF

The annual Junior Prom, as usual, dispelled the gloom and anxiety incidental to final exams, with an extensive program of entertainment. The regular routine of the affair was varied a good deal through the introduction of the Winter Carnival, with ice boat races, an ice carnival dance, and numerous winter sports. The prom chairman, or "king" if you prefer, this year was Bob Basset, who led the Prom with Jane Streich, appropriately called the queen.

Two engineers were selected by Bassett for the committee chairmanships.

Howard H. Darbo, ch'32, holds chairman's position at 1931 Junior Prom.

Howard H. Darbo, junior chemical of Wauwatosa, was chairman of the alumni information concerning the affair through letters and the alumni magazine. A special effort was made this year to have as many as possible of the former prom kings at the affair, where they were special guests of the evening. Darbo is a member of Phi Eta Sigma, monorary freshman fraternity, of Phi Lamba Upsilon, honorary chemical fraternity, and of Triangle fraternity. He is also a member of the gym team.

Robert L. Miller, a junior civil who lives in Milwaukee, acted as chairman of the transportation committee. This committee made all the necessary arrangements for transportation of guests of honor. Bob Miller is a member of Alpha Sigma Phi fraternity.

The music was provided by the inimitable Paul Whiteman and his band for the prom, and the Apex club orchestra played for the ice carnival dance. This ice dance is an idea borrowed from Dartmouth. Heavy Woolen socks are worn over the shoes to keep the feet warm and to reduce the familiar coefficient of friction.

THOMAS DESCRIBES NEW ENGLISH COURSE FOR ENGINEERS

A student interested in the content of the course and an instructor interested in the student are the ideals aimed at in the new course in English for freshmen engineers that is being given this semester for the first time, according to Professor C. W. Thomas who is heading the work and who discussed the progress of the experiment to date before a meeting of the faculty of the College of Engineering at the University Club last fall.

Individual contact between the instructor and the student, Professor Thomas stated, has been increased to a considerable extent over past practice.

The class sections are still quite large—about 26 men; too many for much individual work. The practice, therefore, is to devote one of the three weekly periods to conferences in which the instructor meets much smaller groups of students and gets at the problems of each individual.

The main objective is to train the student, so far as possible, to write clearly. Clarity and effectiveness are stressed rather than the ideas of literary style and gramatical correctness. Good style and correctness will be achieved as by-products if the plan is successful. Drill in such matters as grammar and punctuation, in which experience has shown freshmen to be weak, will be avoided, if possible, by emphasizing the logic and reason that lies behind the rules.

The effort is being made to gain the student's interest in the course by centering the discussions, not upon the style and thought of some writer of a past generation, but upon some of the situations and problems that society is facing today. Stuart Chase's *Men and Machines,* published in 1928, serves as a basis for outside reading. The book is supplemented by a volume of essays selected last summer and furnished to the students in mimeographed form. Class discussions center about the ideas and questions that come out of such readings. Propaganda, which might easily creep into discussions, is to be scrupulously avoided. It has been found that this reading matter, while often over the heads of the freshmen, is stimulating and that the men are much interested. There is abundant material for theme writing. Progress in composition seems to be greater than usual, partly because of this interest in the material and partly because of the closer contact between instructor and student.

The development of vocabulary is receiving more than ordinary attention, largely at the urging of the faculty of the College of Engineering, and the students are responding in a satisfying way. General reading is being encouraged by making readily available to the students a fairly large special library. Each instructor prepares a list of books, and each of his students buys one book at one dollar. These books constitute a section library, the headquarters of which are in the instructor's office. The books are interchanged freely, and at the end of the course each student gets back the book he purchased. The plan has interested the students, but its success as an encourager of general reading is not yet established.

The instructors have been selected because of their interest in engineering and scientific matters and because of their experience and success in teaching enginering students. Professor Thomas, himself, holds an engineering degree. It is realized that the success of this experiment depends not only upon the content and methods of the course, but largely upon the character and interests of the instructors.

It has been possible to handle only 230 of the 300 or more engineering freshmen in these special sections last semester, according to Prof. Thomas.

There will be a section for new men entering at mid-year, and next year it is the plan to handle all freshmen engineers in the special course.

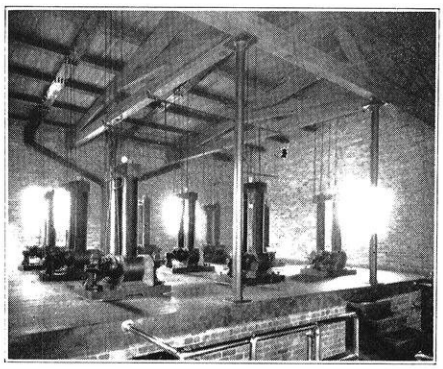
LIEUTENANT ROOP TELLS OF U. S. MODEL BASIN

Lieutenant W. P. Roop, of the construction corps of the United States Navy, presented information to prospective graduates in engineering concerning the work of the United States Experimental Model Basin at the Navy Yard in Washington, D. C. He also told of the conditions for appointment in this and other activities of the Federal Service. The lecture, which was given in the Engineering Auditorium on February 3, was accompanied with moving pictures illustrating the talk. The lieutenant told of engineering research on hydrodynamic and elastic lines as applied to the design of ships and aircraft.

EDISON GENERATOR MAY BE IN FORD MUSEUM

Probably every engineer who, at some time or other, has taken an electrical course has noticed the old generator with exaggerated field poles which is now resting comfortably in the electrical laboratory. Possibly he has at some time hung his coat on the machine, since the high electromagnets lend themselves very conveniently to the purpose.

The machine is unique in that it marks one of the first developments in the history of electrical engineering. Up



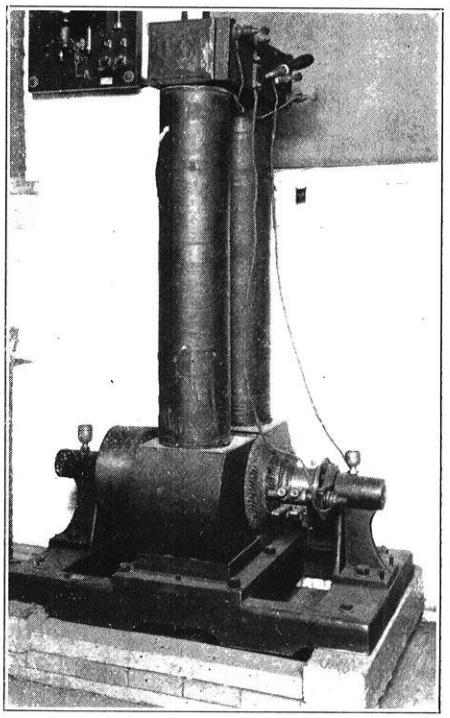
An interior of a plant made up of generators ilke the antque in the Electrical Engineering Laboratory.

until the period of the construction of this machine, electricity had been considered a rather mysterious plaything, useful in communication, and having a good deal of attraction for scientific men who investigated its peculiarities without much regard for the value of their discoveries in a commercial sense.

Edison was faced with two problems in his attempt to make possible electric lighting by means of the incandescent lamp. One of these was to construct a lamp which would have a long enough life, and the other was to make a dynamo of such efficiency as to make the idea of electrical lighting practical to compete commercially with gas illumination. The generators which had been built previously had never exceeded an efficiency of 38 percent. Edison, by investigating the design, and principally by using a low resistance armature, succeded in constructing a machine which had, or at least was said to have, an efficiency of 90 percent. It is one of these first "90 percent efficient" generators which is now in the laboratory. The first was constructed in 1879, and strangely enough, found its first use on a ship making a trip around the Horn. It seems rather peculiar that the electrical lighting system, which was barely past the state of development of working tolerably well, should be used on a ship which would be out of contact with any means for repairs to the generator, and had no means of renewing the supply of incandescent lamps, which, at the time, were very fragile. However, strange as it may seem, the electric generator received its first real commercial use on the steamship "Columbia" in 1879.

The generator now in the laboratory is very similar to the generator which was installed on the "Columbia". The one from the Columbia, and the one now in the laboratory are the only ones remaining of the original Edison generators. The history of the travels of the machine now owned by the university is rather vague. Just how it came to be a part of the laboratory equipment no one seems to know definitely. It seems, however, that the generator was used in the Menlo Park power station along with fourteen others in 1880. Electric lighting proved to be so popular that larger generators were subsequently installed, and this generator was sent to the Edison Lamp Works at Harrison, New Jersey, where it was reduced to the status of a motor in the pump room. It was here, most likely, that the winding of the machine was changed to smaller size wire to permit shunt field operation, for those in the Menlo Park station had all their fields connected in series, and used heavy wire. The machine was later taken to the World's Fair in Chicago in 1893 by the General Electric Company, where it was placed on exhibition. The machine then somehow or other changed hands, was obtained by the university, and installed in Science Hall.

At the present time, Henry Ford is desirous of securing the machine for



The Edison Generator which has been resting innocently in the laboratory may soon be sent to the Henry Ford Museum.

the remarkable museum he is organizing at Dearborn, Michigan. This museum is to include the Menlo Park laboratory of Edison, with as much of the original equipment as can be secured. The museum is proposed to give a history, in a visual way, of the development of the industrial era, and is to have in it either originals or replicas of all the inventions which have been important in the growth of the machine age. The laboratory of Steinmetz on the bank of the Mohawk river has been transported bodily to the Dearborn museum with as much adherance to the original environment as possible in the new location.

The Menlo Park power station of 1880 is to be duplicated, but Mr. Ford is desirous of securing originals in his collection, and since the university generator is one of the original machines of the fifteen in the Menlo Park installation, arrangements are being made through James W. Bishop, of the Edison Institute of Technology, to

(Continued on page 159)

Editorials

"I THOUGHT YOU WERE A GENTLEMAN"

Herbert Hoover, when crossing the ocean, was asked by an extremely cultured woman: "Just what is your business, your profession?" To which he replied that he was an engineer. "Oh my," returned the lady with mild surprise, "I thought you were a gentleman." All of which serves to recall the fact we engineers are frequently taken for a ride on the subject of our behavior and dress.

We don't question the attack on our manners. A good many of us are unnecessarily boorish and unrefined. No man is called on by his profession to be rude and disgusting. but a question arises when insinuations and innuendoes are thrust at us concerning our clothes. When we picked engineering as a profession, we didn't expect to spend our lives with our noses buried in ledgers figuring the net profit for the month of January last; nor did we expect to sit behind large oak desks in handsomely furnished offices cajoling recalcitrant buyers into handing over good money for something for which they find no use or desire. We expected to spend our time wading through swamps to inaccessible spots, proceeding to make those spots accessible; or to spend our time dominating a mill which would dearly love to see us highly embarrassed. We expected to lead a life which has no particular spot for lace cuffs or silk handkerchiefs.

Clothes, like manners, should never be such as to offend, but, we ask, are corduroy pants, high-cut boots with their inevitable flash of colored sock, and a leather jacket any more offensive to the ordinary, uncultured eye, than are pea green sweaters, multi-colored shoes, eye-searing sox, and plaid bloomers?

"START NOW — MAKE JOBS"

With the inauguration of our new governor, the billboards around the state issued a new command —"Start now — make jobs." This statement, which was rather startling to the reader, was decidedly vague in its purport. Just what should be started, and wherein that would create jobs was a source of wonderment to the public confronted by the red, white, and blue signs. Apparently, however, our new governor knew what he meant, for no sooner had he been inaugurated than he issued orders to lay plans for the immediate construction of approximately ninety new grade separations throughout the state. Division engineers gasped, took a look at the map, and ordered field parties out to pick out and survey likely sites for grade separations. Grade separations seemed to be in vogue with the people, and the new governor was going to attend to desires of his public. All good politicians do.

Doubtless there are ninety places in the state where grade separations would eliminate hazard to the motorists, but is it probable that with rush orders to construct a given number of structures in the division, the division engineer is going to be able to pick the most necessary separations, and, having picked the sites, make the best choice of the ultimate location? To our plodding and methodical minds, trained to a certain degree of conservatism in engineering matters, it looks like a flashy, but questionable measure to take as a relief to the present unemployment situation.

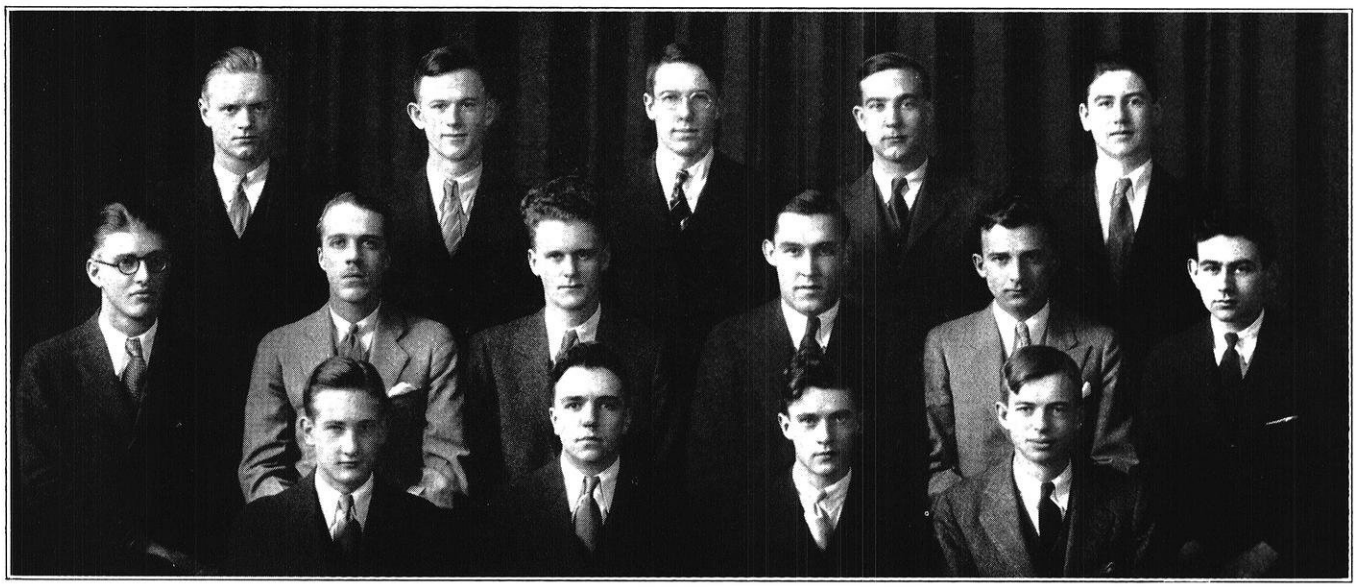
All of us have noticed, from time to time, abandoned pieces of highway with a lonesome looking culvert stuck out in the middle of a pasture. Overhead bridges and underpasses are considerably more expensive structures, and it would indeed be doleful to see an abandoned overhead leading bravely off a bluff and across the tracks with no apparent destination and no approaches. Yet, unless the ninety new structures are placed along the direct interurban routes which future traffic will ultimately travel, we shall be confronted on our Sunday afternoon outings with countless bridges spanning historic railroad crossings only to be left destitute of their highways.

Our worthy executive plans to pay for the added expense by increasing the tax on gasoline to four cents, thus making tourists, not to mention our own taxpayers, shoulder the load. Wisconsin has long been known as the playground of the middle-west, and has basked each summer in the easy revenue offered by tourist trade. A four-cent gas tax is not to be sniffed at when a man measures his summer mileage in thousands, and his gas consumption on the new car in gallons per mile. There lies a possibility that the tourist trade may object to paying for Wisconsin grade separations, and decide to do its summer playing somewhere else. Several industries, notably the Ringling Brothers, have found it advisable to withdraw from their Wisconsin headquarters due to excessive tax, and yet the new governor proposes to test the endurance of the most fickle of them all — the tourist.

The people have decided that the leadership of a successful business man was not to their liking, and have elected in his place the son of a famous father. Ethically it is not our place to criticize this early in the season, but may we offer a suggestion to the emminent "lecturer in law," that some engineers may have some reason for doing part of what they do with a certain amount of conservatism.

ANOTHER GOAL FOR STUDENT ENGINEERS

Can you clothe your ideas in effective English or are you like the freshman who is quoted as saying: "Us engineers don't read no English." The freshman was right without knowing it, says Paul Petty in the *Iowa Engineer* for January. Then he proceeds to give facts



Top Row: Perry (editor), Gorder, Kachel, Matthias (faculty advisor), Derby.
Middle Row: Greiling, Mack, Strand, Martiny, Lacher (manager), Roberts.
Bottom Row: Hulsberg, Weavill, Van Hagan, Bell.

and examples to prove his contention that in the engineering profession today, English is next in importance to ideas.

The *Iowa Engineer* and the other E. C. M. A. exchanges of the *Wisconsin Engineer* may be found in the current magazine files of our engineering library. These student publications contain many interesting and helpful articles like that quoted above. That is why we placed them in the library where they would be accessible to all students. Look them over some time.

CHANGE OF STAFF

It has been customary for the *Wisconsin Engineer* under the control of the Wisconsin Engineering Journal Association, to change its staff with the beginning of the second semester. The election of the new editor and business manager will take place soon after the classes start in February.

In bringing to a close this contact with the students, faculty, alumni, local merchants, and national advertisers, the present editor and business manager take this opportunity of expressing their appreciation of the fine cooperation which has existed throughout the current year — the thirty-fifth year of the *Wisconsin Engineer*. Since the first number of the first volume which came out in June, 1896, the periodical has lived only through this support and interest which the associations of the magazine have willingly fostered.

These thirty-five volumes contain a large amount of engineering literature submitted by prominent engineers of the school and state, edited and managed by students.

The healthful relation between the alumni and the engineering school has been developed extensively by the alumni notes section. The activities in the engineering school which are not given proper publicity in other magazines, are given every attention and consideration by the *Wisconsin Engineer*. In fact, a volume of this section alone, would make a comprehensive history of the school since 1896.

The editorial, engineering review, and the main body of the magazine are instrumental in bringing to the students a practical view of engineering to supplement the theoretical side which is so well developed in the classes.

In order that the magazine may continue to thrive, and to fulfill these worthy purposes to the greatest extent, the editor and business manager request that this cooperation between the *Wisconsin Engineer* and its clientele continue throughout the years to come.

THE ENGINEER AND OBJECTIONABLE NOISES

The most objectionable feature of the machine age is its form of noises. In every town and city in the country there are noises created by the engineer and his machine age, that could be eliminated by correct engineering for removing objectionable noises or sounds.

The larger cities have to cope with a large amount of noises such as the elevated train system, the subway, riveting machines, large boiler works, steel mills, and train systems. These noises may not all be found in one city but they are objectionable enough even in small quantities. The smaller towns have some of those that the larger cities have such as automobiles, trains, street cars, building operations, and radio stores.

Some of the larger cities are attempting to study, and in the end control many of the sounds. New York City is studying the sounds caused by the subways, and they have found that there are about fifty-seven different sounds causing the one roar we hear. These sounds are separated by filters and then amplified and recorded and measured so they now can be studied scientifically. The officials are confident they can control at least some of the sounds thus studied, if not all of them. The engineers of the surface car companies have already eliminated some of the sounds caused by the street cars. The axles have been padded with rubber pads to eliminate some of the noise as the cars

(Continued on page 154)

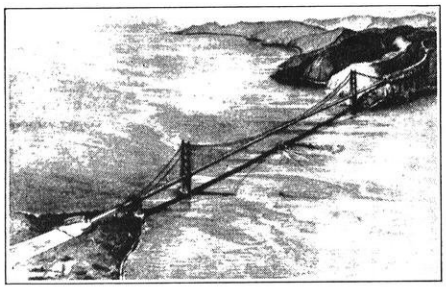
Engineering Review

FIVE YEARS TO BUILD BRIDGE

Golden Gate Bridge Finally Approved of by Popular Vote

Popular approval of a $35,000,000 bond issue has finally permitted the erection of the Golden Gate bridge across the entrance of San Francisco Harbor. It will be one of the longest and largest suspension bridges in the world and its construction will take about five years.

The construction of such a bridge demanded a very concentrated study



The Golden Gate span, no longer an idle dream, will soon transverse the harbor of San Francisco.

of foundation conditions of San Francisco Harbor along the proposed sites of the bridge and this study alone cost in the neighborhood of 30,000 dollars. Borings were made along the suggested bridge sites from Goat Island to Telegraph Hill; from Rincon Hill to the Alameda Mole, and in adjacent territory. The final plans of the bridge were approved Aug. 28, by the board of directors of the Golden Gate Bridge and Highway District.

The bridge really had its beginning in 1919, but it wasn't considered seriously until 1924 when the War Department approved plans for its erection. Now, with the approval of the voters, construction will soon begin.

The center line of the full cable suspension structure will run northwest from Fort Point Lighthouse in San Francisco to Marin county by way of Lime Point. It will have a span of 4200 feet from center to center of the piers, 700 feet longer than the Brooklyn bridge. The plaza to plaza length will be 8943 feet. The clearance height will be 210 feet at the piers, increasing to 220 feet at the center. Towers supporting the cables will be 740 feet high and will have glass enclosed observation rotundas at the top with elevators carrying sightseers up to a 27-mile view.

The bridge will serve to open a rich land to coast residents and tourists. Motorists crossing it will, within a short time, be in the land of redwoods, in a hunter's and fisherman's paradise, or fertile valleys upstate. Sections rich in natural resources and minerals will be opened for development with the opening of the bridge.

The great Redwood highway route, one of the world's most beautiful roadways, will be available to motorists from the south. The same highway is being continued to British Columbia, connecting with the Roosevelt highway in Oregon.

SAFEGUARDS AGAINST REFRIGERATOR GASES

Methyl chloride, leaking from refrigeration systems, has been blamed for the recent poisoning and deaths of several persons in Chicago. These fatalities have excited much apprehension among people wishing automatic refrigeration and owning refrigeration devices of all kinds. To relieve this situation, the U. S. Public Health Bureau, the Bureau of Standards, and Bureau of Mining authorized a statement cleaning up the facts in the case.

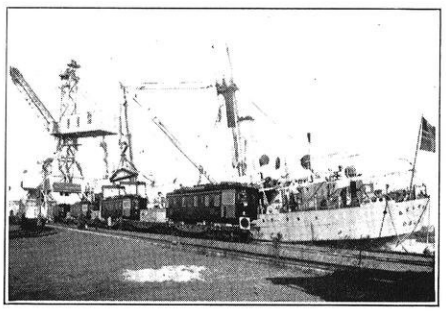
"Neither Methyl chloride, ammonia, or sulfur dioxide," the statement reads, "can be breathed with impunity but none is dangerous when breathed a short time at low concentration." Of the three gases described, Methyl chloride was said to be the least dangerous as to effect but the fact that its odor was so indetectable while the other two gases had so pugent an odor branded it as the most dangerous of the three. Methyl chloride would not warn a sleeping person that there was a leak in the refrigerator while the severe, pungent odors of ammonia and sulfur dioxide in almost all cases would be strong enough to arouse even the heaviest sleepers. The best protection offered was leak-proof systems or a system coupled with a gas having a very bad odor so as to provide warning. The third precaution was to always keep all rooms well ventilated and thus reduce concentration and provide exit for the escaping gases.

ELECTRIC LOCOMOTIVES SAIL FOR CHILE

Four electric locomotives, built on the first order ever received from Chile by telephone, were recently shipped to the only government-owned railroad that is operating at a financial profit.

According to the schedule, the locomotives left December 10, to be loaded on the "Belroy" in Philadelphia December 17. After approximately 30 days on the water, they will reach Chile and be put in service on 110 miles of the main line of the Chilean State Railways system between Santiago and Valparaiso within a few hours after being unloaded.

This line runs through a rough section of country where steep grades of two and one-half percent must be negotiated. It is a wide guage track, five feet six inches between rails, and the locomotives will operate their express-passenger trains on a scheduled speed



Loading the electric locomotives on the transport which will carry them to Chile. They will operate on the only government railway in the world which is profitable.

of 35 miles an hour with a maximum free running speed of 60 miles an hour.

Each of the four new locomotives has six 375 horsepower motors, a total of 2,250 horsepower, and they are essentially duplicates of six other locomotives built for the same system when it began

to electrify its lines in 1921. American equipment is used throughout on the Chilean railway and its substations and the road has been making money since it became electrified.

According to Francisco Sandoval, superintendent of operations and maintenance, who has supervised and inspected the construction of the new locomotives as official representative of the company, it is the only government-owned railway in the world that is operating at a profit.

GLASS AS THE FUTURE BLACKBOARD

Another use for glass has been discovered to add to an almost innumerable number of uses which it already has. Due to a new process of hardening glass by the addition of a mineral called black chromite, which prevents it from wearing smooth and gives it a sufficiently rough surface to facilitate writing with chalk, glass has been proven to be wholly practical and usable as a writing agent in schools. Colored blackboards of porcelain are a recent innovation, along with glass, and only time can tell as to whether or not slate will be replaced in the "little red school house."

NOW THEY'RE IMPORTING ICE FROM THE TROPICS

Belive it or not! It's true! It is a product of carbon monoxide gas found in wells of the Tampico, Mexico, oil fields, flowing to the surface at a pressure of 1000 pounds to the square inch. A new York concern has erected a factory which solidifies the gas into "sub-zero" ice. It has a capacity of 40,000 pounds a day. Vessels with insulated chambers of cork board a foot thick will bring the ice to the U. S.

LINDY MAY SET NEW MARK WITH SPECIAL WINGS

Transcontinental records are expected to be broken when Col. Lindbergh makes a flight from Los Angeles to New York using his plane with a new type of wing and improved type of engine. The ship is to be the same monoplane used by Mr. and Mrs. Lindbergh when they set a non-stop transcontinental flight from Los Angeles to New York last Easter. The ship has been improved by adding more streamline features and the special wings and engine mentioned above.

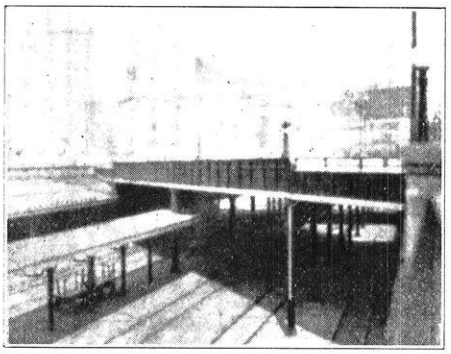
The wing, which the colonel is eager to test, features a retractable landing gear. This gear, when the plane is in the air, is drawn up into the wing, thereby doing away with wind drag and considerably increasing the efficiency of the ship, augmenting its speed approximately 30 miles an hour.

Aviation experts predict that Lindbergh's plane will be the fastest commercial ship in the world, with a top speed of approximately 238 miles an hour.

Following the transcontinental fligh, Linbergh will probably make a coastal aerial tour of South America.

WORKING STRESS OF 1,200 LB. USED FOR 39-FT. CONCRETE SLABS

Limited clearance necessitated a shallow floor system for a viaduct in Seattle. The construction includes the use of several unusual details, including an unspported expansion joint through a 15-in. slab, using steel dowels and a novel method of supporting the slab



A view of the viaduct which will be made up of 39-ft. slabs having a working stress of 1200-lbs. per square inch. This is at Seattle, Washington.

on the lower flange of a plate girder. The viaduct constitutes a part of the recently completed Second Avenue extension, built to provide a traffic outlet from the business district of the city to the residential area to the south. The three-way intersection of the new extension with Jackson Street and Fourth Avenue comprises a triangular area about 300 feet long by 180 feet wide, covering a series of railroad tracks and loading platforms that made viaduct construction necessary. The supporting bents, as shown in the accompanying photograph, extend parallel between the tracks and consist of rolled-steel columns supporting plate girders; the horizontal clearance for these columns was limited to 14 in. As a roadway, slabs were used extending across four spans; the depth was analyzed by the theorem of three moments. The high working stress of 1200 lbs used for the concrete in these slabs is in accordance with the established practice in reinforced-concrete design. The principle of this economic use of the strength known to exist in concrete is based on designing the concrete for a definite strength and assuming loads as close as possible to actual conditions, including high impact allowance. Two expansion joints were provided approximately 60 ft. apart at right angles to the supporting columns. These joints necessitated some means of distributing heavy wheel-loads between the adjacent slabs. The method used consisted in incasing the edges of the slabs in steel channel sections, anchored into the edge of the concrete by means of steel straps, and using heavy steel dowels to transmit the loads across the joint.

The viaduct has been in use for approximately six months, and measurements taken during that period indicate that the expansion joints are functioning according to the design assumptions. It is believed that this joint design has proved satisfactory.

DAMMING THE PAUL BUNYAN GASH

A few of the pioneers who dared the rapids through the canyons of the Colorado river may have visioned a high dam in one of it's gorges but it is unlikely that any of those who contributed to the facinatingly preposterous yarns of Paul Bunyan around the loggers campfires, ever dreamed that man would some day dam the "gash" which the mighty Paul so carelessly scratched with his peavy.

Nevertheless, the U. S. Bureau of Reclamation will open bids on March 4th, at Denver, for the construction of the Hoover Dam, and it is expected to have the mighty Colorado under control by 1938.

The dam is to be 730 feet high,—twice as high as any existing dam in the world. It will contain 4,400,000 cubic yards of concrete — more than the Bureau of Reclamation has placed to date in all of its dams and structures, and will cost $50,000,000.

The plans and specifications which contain a number of interesting and unusual features are well abstracted in the January issue of Western Construction News.

Alumni Notes

Successful Wisconsin Engineers

Donald MacArthur

1880 - 1930

By WM. F. KACHEL, JR.

TO most people a college education is considered an expensive undertaking. To Donald MacArthur, m'04, it was an extremely profitable enterprise. Starting in his freshman year with a total of five dollars capital, he was able to increase his surplus to over $150.00 at the end of his four year course in Mechanical Engineering.

The year of 1880 saw the birth of Donald MacArthur in Glasgow, Scotland. In 1883 he came to this continent with his parents, Mary and Angus MacArthur, who first settled in Collingwood, Ontario, Canada. Later they migrated to Duluth, Minnesota, and then in 1887 they settled on a farm near Superior, Wisconsin. In this vicinity Donald MacArthur grew from a boy into a man. When he was sixteen years of age, he began work with the shipping department of a local mercantile establishment. During the following four years he worked and attented high school at Superior until he was able to enter the University of Wisconsin.

His four years in college were spent in ambitious study and in following the duties of steward of an eating club. His stewardship was the source of income that set him on the road to success for it afforded a means to accumulate a small surplus of ready money.

After graduation, Mr. MacArthur went to work for the Laclede Gas Company of St. Louis. It was only a matter of a short time before he gained the respect of his superiors and was promoted to station superintendent and then to the position of general superintendent.

In the first part of 1916 he left the Laclede Gas Company and became manager of the Seaboard By-Product Coke Company. Mr. MacArthur was connected with that company from that time until his death last July. He became its vice-president in 1928.

Mr. MacArthur became vice-president and director of the Koppers Gas and Coke Company in the first part of 1929. He was also president and director of the Brooklyn Coke and By-Product Corporation; vice-president and director of the Connecticut Coke Company; vice-president, trustee, and a member of the Executive Committee of the Eastern Gas and Fuel Associates; director and member of the Executive Committee of the Kopper's Coal Company; vice-president and director of Kopper's Seaboard Coke Company; director of the Melcroft Coal Company; vice-president and director of the Philadelphia Coke Company; Director of the Upper Marion and Plymouth Railroad; vice-president of the Walloon Realty Company; and Director of the Alan Wood Steel Company, the Rainey Wood Coke Company, and the American Light and Traction Company.

Mr. MacArthur was considered by his colleagues as one of the outstanding engineers and executives in the gas and coke industry. He was especially noted for his ability to select and judge men, and he helped many a young engineer over the rough spots in learning the rules of business procedure.

Besides being a loyal member of the American Society of Mechanical Engineers, he was a member of the New York

(Continued on page 154)

GENERAL

Borchert, Ernst, g'05, is the owner of an orange grove known as "Broad Acres," located south of Anaheim, California.

MECHANICALS

Edwards, A. W., m'25, announces his new address as being 3317 Nash Ave., Cincinnati, Ohio. He has been president of the local Alumni Club of the University of Wisconsin at Cincinnati for the past year.

Haubrich, Alfred F., m'18, is running an automobile sales establishment in Los Angeles, California. He is selling custom-built models of the "Cord" car. Address: 936 South Western Ave., Los Angeles.

Macgregor, Captain Wallace F., m'97, sailed for South America last November. He is spending three months in the southern countries as agent for the J. I. Case Threshing Machine Company.

O'Connor, W. D., m'22, is another man who has invaded the law field after graduating from engineering. He was admitted to the Pennsylvania bar on March 17, 1930. He is now in the firm of Brown and Critchlow, patent attorneys He spent the first six years after his graduation with the Westinghouse Electric and Manufacturing Company. His address is: 6744 Penn Ave., Pittsburgh, Pennsylvania.

MINERS

Uhlig, William F., min'22, is an engineer in the employ of the Senet-Solvay Engineering Corporation, New York City. Address: 31 Newfield St., East Orange, New Jersey.

ELECTRICALS

Herrick, R. H., e'22, has developed many intricate appliances for telephone equipment while in the employ of the Kellogg Switchboard and Supply Company. At present he is working on the development of radio apparatus for aircraft. He has a special 14-passenger Ford plane at his disposal for use as a laboratory.

Kohl, Oliver B., e'02, has been sales manager of the Superior Water, Light and Power Company for the past four years. Before going to Superior, he was in the engineering department of the Minnesota Power and Light Company.

Lucas, Thomas J., e0'7, of Wilmette, Ill., has gone to Russia to engage in work as gas engineer for the Russian Government.

Norton, Paul T., Jr., e'17, former professor in mechanics at Wisconsin and at present a member of the faculty of the Virginia Polytechnic Institute, has been made editor of "Technical Topics," a press bulletin issued by that institution.

Schuchardt, R. F., e'97, EE'11, of the Commonwealth Edison Company of Chicago, acted as chairman of one of the sessions of the Fifth Midwest Power Engineering Conference held at Chicago, February 10 to 13.

CHEMICALS

Gross, James, ch'29, is located at the Du Pont Powder Company plant at Gary, Indiana.

CIVILS

Thomas F. Airis, c'29, dropped into Madison about a month ago and gave his address as 1601 Clark Ave., Detroit, Michigan. He is connected with the U. S. Engineering Office in the capacity of Junior Engineer. His specific duties are in connection with harbor and river improvements along the Saginaw River.

Bambery, James E., c'28, has spent the past two years in charge of a water power survey in Northern Michigan and Wisconsin. He has recently been transferred to the Appleton office of the U. S. Engineering Department in the capacity of field superintendent of construction on all government work on the Lower Fox River.

Brigham, R. H., c'28, is a Junior Engineer of the U. S. Geological Survey, Water Resources branch. He spent a year and one-half on reports in Washington, D. C. He is now located at Lansing, Michigan, where his work consists of stream gaging and maintaining gaging stations on streams in Michigan. He has a wife and one daughter. Address: 1829 Olds Ave., Lansing.

Donohue, E. B., c'24, is a Division Engineer for the Montana Highway Commission. He is located at Kalispell, Montana.

Frazier, Arthur, c'28, writes that he spent most of the past summer obtaining rating curves on the Mississippi River from St. Paul down to Clayton, Iowa. The information obtained will be used by the Army Engineers in drawing up their plans for the new nine foot channel on the Mississippi. He gives his address as: 202 Old State Capitol, Saint Paul, Minn.

Greenman, Ralph N., c'23, is with the Engineering Department of the A. T. & T. Co. at Cleveland, Ohio.

Hain, James C., c'93, is living in California where he is engaged in structural contract work. He is living at 15 Oak Knoll Gardens, Pasadena.

Hanson, S. R., c'08, is the author of an article appearing in the December, 1930, issue of the "Water Works and Sewerage Magazine."

Homewood, Robert T., c'27, visited the college on December 24. He is a sanitary engineer with the State of Virginia with headquarters at the Virginia Polytechnic Institute. The work at present is chiefly a survey of the condition of streams, which are subject to pollution from paper mills and coal mines. Bob is in the field a good deal visiting all parts of the state and reports that Virginian hospitality is all that it has been represented.

Kutzke, William A., c'29, is in the contracting business at Portage, Wisconsin. His work has consisted of paving and sewer contracts. Address: 302 East Cook St., Portage, Wisconsin.

Mackie, J. E., c'23, is connected with the American Lumberman's Association at Washington, D. C.

Older, Clifford, c'00, is president of the firm of Consoer, Older, and Quinlan, Consulting Engineers at Chicago, Illinois. He was the author of an article entitled: "Securing Traffic Safety at Intersections" which appeared in the January 1, 1931, issue of the "Engineering News-Record."

Liddle, George, c'26, National President of the Chi Epsilon Fraternity, is living at 382 Prospect Street, Muskegon, Michigan.

Schustedt, Fred N., c'17, is an outdoor lighting specialist of the General Electric Supply Corporation of Chicago.

Tschudy, Lionel C., c'23, spent the past summer and fall on a hydro-electric development up in Canada. The work consisted of construction of a concrete dam with earth dyke, intake structure, shaft, and tunnel. Because he couldn't spend his money up in the woods, he is now on a trip to California. He left Chicago for New York by airplane on January first. From New York he took a boat and went around through the Panama Canal to California.

Zelonky, Benjamin, c'22, is engaged in the practice of Engineering and Contracting in Milwaukee, Wisconsin. He is particularly proud of the rapid completion of the eight story Buckingham Apartment Building. He claims to have started excavation in the middle of June and the tenants moved in on November first. Address: 2361 North 14th Street, Milwaukee.

Wasson, Joseph H., c'12, is an engineer representative of the Peerless Cement Corporation, at Detroit, Michigan. He was promoted from Lieut.-Col. to Colonel of the 310th engineers reserve corps last December 16.

ALUMNI NOTES

(Continued from page 152)

Athletic Club and the Glen Ridge Country Club. Although his work was his chief recreation, Mr. MacArthur enjoyed a game of golf and could often be seen playing a hand of bridge. He made annual excursions back to Superior, Wisconsin, where he would spend a week or two fishing; usually with a fair amount of luck. Winter evenings were often passed by reading the latest technical books seasoned with a little history and decorated with a book or two of pure fiction. Mr. MacArthur enjoyed good music, but it had to be good.

Mr. MacArthur's interest in his community was readily shown by his interest in the Boy Scouts, being a member of the executive council at Glen Ridge, N. J. He was also president of the Men's Bible Class of the Central Presbyterian Church at Montclaire, New Jersey.

Death ended Mr. MacArthur's active career, at the Mountainside Hospital, Montclair, New Jersey, on Thursday, July 24, 1930. He is survived by his widow, one son, Donald, Jr., a freshman in this college, his father Angus MacArthur of Superior, three brothers, and three sisters. Mrs. MacArthur and her son are now residing in Madison.

EDITORIALS

(Continued from page 149)

go around curves and over bridges. The curves have also been modified so as not to cause such a loud screech as the wheels press on the outer rail. The motors are almost noiseless now, so the main sound is caused by the pressure of the heavy car on the rails.

Riveting machines will slowly go out, we believe, and all joints and connections will be welded to make a stronger joint than can be made with a rivet. This will be noiseless as compared with the riveting machines.

All over the country crusades, some good and many bad, are being waged against the noises of today. The correct way is not to obliterate the cause of the cound, such as the machines, but to improve and correct the machines so they will be less noisy. This is a thing that will confront the engineer for many years to come. In fact a new branch of engineering, noise prevention, will have to spring to the fore.

DEVELOPING GROUND SCHOOL COURSES

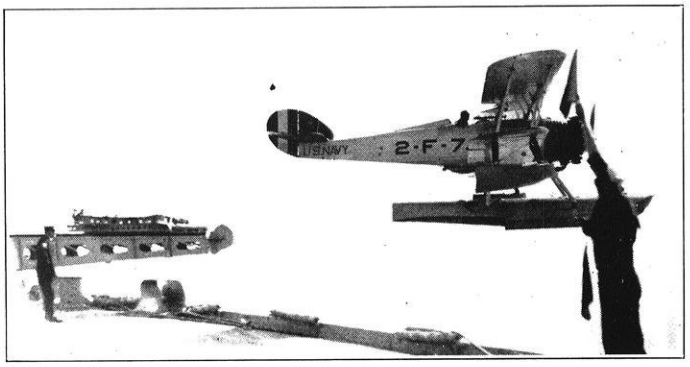
(Continued from page 143)

The second course, Meteorology and Air Navigation, is practically the same as the class course, except that the lectures are supplanted by mimeographed notes. The cost of this course including the fifteen pamphlets from "Commercial Aeronautics" is $15 within the state. The cost of the class course varies with the policies of the vocational schools. These schools ordinarily take care of the enrollment and fees.

The instructor in charge of aeronautics work in the University Extension Division is a graduate in mechanical engineering from the University of Wisconsin. He received his aviation training with the observation squadrons of the Navy and formerly taught aeronautical subjects at

the University of Oklahoma. He holds a transport pilot's license and has had experience in aircraft shop work and engineering.

The interest in the classes of the first semester and the results that have been obtained indicate that the field for this type of education is large and that the next few years will see it develop surprisingly. Without doubt, other state schools will have demands for this rather unusual type of work that the University of Wisconsin has begun, since it seems the only way by which to reach



Taking off from the carrier ship. The navy plane is just leaving the device which gives it enough momentum to keep up out of the water.

communities too small to support permanent ground schools in conjunction with their airports; also, the only way to reach isolated individuals.

The value of a policy such as this in promoting air-mindedness probably cannot be stated accurately at this time. The potentialities of large centers of population as aircraft markets are fairly well understood, and a reasonable development and exploitation of them has been made. However, outlying districts, which have greater need for swift transportation in which sportsmen pilots can use their own backyards or those of their neighbors for landing fields instead of traveling across a large town to reach an airport, have not been proportionately developed. If such development were possible now, what a tonic it would be to the entire aeronautics industry!

It is with this thought in mind, together with the need for answering the demand that has arisen in the state, that the Extension Division of the University of Wisconsin has added these aeronautical courses, taught through class work and correspondence, to its list of industrial subjects.

COPPER OXIDE RECTIFIERS

(Continued from page 141)

the impressed voltage. On a highly inductive load the output current is almost a straight line. The input current is a real square wave with only slightly rounded corners, and is still in phase with the impressed voltage. Any variation between these two extremes can be obtained by different combinations of resistance and inductance. With a resistance load, the effective value of the load voltage is about 80 per cent of the impressed voltage, and the effective value of load current is about 90 per cent of the supply current. But a highly inductive load lowers the output voltage, for the same input current and voltage, and raises the effective load current to some 105 per cent of the input current. That is, under the same supply conditions, an inductive load draws a much higher current at a lower voltage than does a resistance load, and this current may exceed the permissable effective current. A diagram of any set of full-wave connections shows that there is a low-resistance discharge path through the rectifier itself, and that the smoothing effect of the inductive load is accomplished by means of superimposed circulating currents. These, then, are responsible for the lower load voltage and higher current observed in the tests. Since the circulating currents are added to the normal rectifier current, there is more heat developed than with a resistance load. This difference is so small that it is ordinarily neglected.

Copper-oxide rectifiers are quite generally used as trickle chargers for storage batteries. They have been assembled in sets with variable reactor and transformer control, for as much as 1500 volts. In small sizes these chargers have been particularly adapted to radio batteries. Recently they have also been used to supply dynamic-speaker excitation, filament current and plate voltage.

They are becoming standard equipment on all sizes of alternating-current air-break contactors. They eliminate entirely that objectionable hum and rattle so common in alternating-current magnets. An interlock, or mechanical switch, is adjusted to insert a resistance in the supply line

as soon as the contactor is closed. Thus the rectifier furnishes a high initial current so as to pick up the contactor, and then its output is reduced to merely the hold-in current necessary. On several of the best automatic elevator controls, banks of copper-oxide rectifiers supply power for all timing relays, accelerating contactors, magnetic brakes, and safety controls.

Stacks of rectifier discs function excellently as "electric valves." One hook-up for smoothing a pulsating current consists of a series inductance to fill in the low parts of the wave and a parallel rectifier stack to cut off the peaks. Rectifier stacks may be connected in series with each of two small direct-current motors in such a way that two supply wires with a reversing switch some distance away are sufficient to run either motor at will.

Standard metering instruments have been constructed for small alternating currents and voltages, using direct-current meters supplied through copper-oxide rectifiers. It is claimed that these can be made more sensitive at very low ranges than the usual alternating-current meters.

Copper-oxide rectifiers have been applied with considerable success to an experimental automatic starter for squirrel-cage induction motors. The starter uses a saturable-core reactor in series with the line, and the direct current for saturating the core is supplied by copper-oxide rectifiers connected for three-phase rectification to the motor terminals. When the power is first applied, and reaches the motor through the reactor, the terminal potential is practically zero, so the saturating winding carrier no current and maximum reactance is in the starter. As the armature starts to rotate, the terminal voltage builds up, causing the rectifiers to send a direct current through the saturating winding and reduce the series reactance. This then increases in turn the motor current, the motor speed, the terminal voltage, and the saturating current. Ths process is cumulative, until the series reactance is very small, and the motor is thrown directly on the line. By properly choosing the rectifiers the motor may be accelerated by infinitesimal steps in any desired period of time.

In these days of almost universal distribution of alternating-current power, the very simplicity of the copper-oxide rectifier has made it successful in operating those relays and controls which are sufficiently sensitive only on direct current. A little care in choosing these metal rectifiers, so as to avoid overloading and to allow for aging, finds its reward in absolutely trouble-free service such as no other rectifier, as yet, can even approach.

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CAMPUS NOTES

(Continued from page 147)

secure the machine. Professor Edward Bennett, head of the electrical engineering department, expects that the machine will be exchanged for an exact duplicate. The General Electric Company has already made a number of duplicates, so that it appears as though the machine will make another journey, this time to a point nearer home.

During the construction of the duplicates, a rather humorous incident occurred. The machines had been tested after construction, and were sent to be touched up a bit with paint. Through some misunderstanding the machines received a spray of very beautiful modern gray General Electric paint, which took hours to remove. The machine is valuable to the school at the present time to point out errors in design of the early machines, and it is for this reason that an exact duplicate is wanted if the generator is removed. Professor tells amusing stories of how instruments were disturbed on the floor above the machine when it was operated in Science Hall, and proceeds to tell how machines should be constructed to prevent such wholesale distribution of valuable flux. The machine probably will not remain in the laboratory very much longer, so that it might be well to take one last look at the relic to describe its appearance to interested forbears. Incidentally, there is a slight possibility that the electrical inspection trip next year will include the Dearborn museum.

SUBSTITUTE FOR PARADE

Since the abolition of St. Patrick's parade, which formerly menaced the streets of Madison and amused the whimsical minds of a few engineers, there has been very little spirit shown among the undergraduate engineers.

Recently there have been two suggestions that might, if properly carried out, take the place of the antiquated parade. One of these is an engineers' party, and the other is a senior engineers' banquet.

The party would be open to all engineers, both under and upper-classmen. Tentative plans were brought up but no direct action has been taken except to bring the proposition to the attention of the various engineering societies. The spring would naturally be the best time for such a function, and it might even be possible to hold it on St. Patrick's day.

The banquet was designed to be held late in the spring —possibly April or May. It would serve as a farewell affair for the seniors and faculty members who have been more or less segregated in the various schools. A prominent alumnus would deliver a brief address on a subject pertaining to the even. Possibly St. Pat himself could be urged to return to spend an evening among his fellow technitions.

In the beginning of next semester active work will be started by the societies to push either or both of these functions and if possible revive some to the lost spirit in the engineering school.

THE "BOARD OF INQUIRY" vs. THE "LECTURE-RECITATION" METHOD OF EDUCATION

(Continued from page 145)

must be played at the hearings in the attainment of this objective have been separated and assigned to different individuals. But these roles are identical with the roles which each individual must play within himself. He must in turn and in the same general situation act as analyst, advocate, critic, and judge. Education consists in the balanced development of these powers and in the reconciliation of their demands.

The hearings must be conducted in the fine spirit of accommodation which, in the ardor to reach the heart of the matter, passes over the unimportant and the trivial in order to afford the time for valid criticism and real appreciation. For example, it is a triviality when a witness in the course of an explanation slips and says "right member of the equation," when from his actions it is obvious to all that he meant to say "left member." But it is not a triviality when in the course of developing new concepts, such as those of "electric potential" and "electric intensity," a witness uses the wrong name, or uses the name in a way to indicate ideas relative to it.

HUMAN RELATIONS IN INDUSTRY

(Continued from page 139)

In regard to pension systems, many industrial organizations developed pension plans a number of years ago, little realizing what an extensive financial burden it might grow into. Pension plans are a fine idea, but they will certainly result in a teriffic load unless properly financed. To be successful they must be on the order of an insurance company.

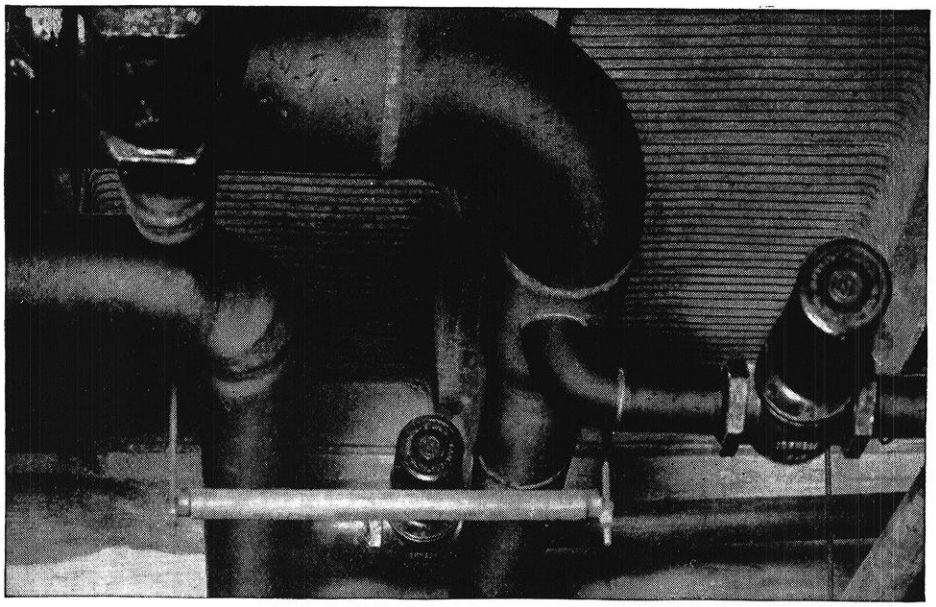
The subject has been covered, but not at all completely, and there are aspects which have not been touched upon, but it is seen that if the employer satisfies the wants of his employees, he in turn will receive the much desired results he wants. The two are inter-related and can help each other as the foregoing examples attempted to illustrate. The problem is not at all as optimistic as pictured; it does not cover anything as to the expense of all these various activities, neither, however, does it say anything about the financial value of the results. The idea of treating employees as humans and equals is well established, and the necessity of intelligent human relations is obvious.

The superintendent had severely criticized the trainmaster for laxity in reporting accidents, impressing upon him the fact that it was very necessary to report by wire immediately anything that appeared to be an accident, no matter how trivial it might seem, without waiting for details.

Only a few days later, the superintendent received the following wire: "Man fell off platform in front of speeding engine." To which the superintendent wired: "Advise details." The trainmaster replied: "No one hurt; engine was backing up."—*Sante Fe Magazine.*

OXWELDING

SIMPLIFIES PIPING DESIGN



THE laying out of a piping system is materially simplified by oxwelding. Where this method of jointing is used, plans are not governed by the availability of standard fittings and the avoidance of specials.

Oxwelding does not change the general design features. Size of pipe, method of suspension, provision for expansion and contraction and location of turns, branch connections, valves and other fittings are the same as for other types of construction. Welded joints and fittings are merely substituted to obtain increased compactness, economy and serviceability.

Under Procedure Control, welded piping construction may be undertaken with the same confidence in a satisfactory result as older methods.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

General Offices · Carbide and Carbon Building, New York

68 Linde Oxygen Plants
51 Prest-O-Lite Acetylene Plants
175 Oxygen Warehouse Stocks

UCC

157 Acetylene Warehouse Stocks
43 Apparatus Warehouse Stocks
252 Union Carbide Warehouse Stocks

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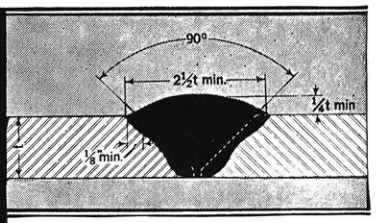

DESIGN STANDARDS FOR OXWELDED PIPING

Any welded piping system, even in its most complicated form, is a combination of a few fundamental welding design details.

WELDED LINE JOINTS

Open Single Vee Butt Weld

Explanation of Design:

The Open Single Vee Butt Weld illustrated is the type of weld most extensively used for jointing steel pipe. When properly made, it develops the full strength of the pipe wall; it is easy to make and of low cost.

Uses:

The Open Single Vee Butt Weld is the standard line joint and is recommended for standard, extra heavy and double extra heavy piping, for all services carrying all pressures to which steel and wrought iron pipe are subjected.

Specification:

When the Open Single Vee Butt Weld is specified the following should be included in the specification:

1. The spacing between pipe ends, before tacking, shall be as given in Table 1, page 11, "Design Standards for Oxwelded Piping."
2. Welds shall be thoroughly fused to the joint edges and shall extend completely to the bottom of the vee.
3. Welds shall have a minimum width of 2½ times the pipe wall thickness and shall be symmetrical with respect to the center line of joint.
4. Welds shall be built up to present a gradual increase in thickness from edge to center.
5. Thickness at the center of the weld shall not be less than 1¼ times the pipe wall thickness.
6. The weld shall be of sound metal free from laps, gas pockets, slag inclusions or other defects.

The above is excerpted from a handbook on fundamental designs, titled, "Design Standards for Oxwelded Steel and Wrought Iron Piping," published by The Linde Air Products Company. A copy of this handbook should be in every architectural drafting room. It is yours for the asking. Just fill in and mail the coupon.

Technical Publicity Dept., 12th Floor
205 East 42nd St., New York, N. Y.

Please send me a copy of your new book, "Design Standards for Oxwelded Steel and Wrought Iron Piping," which also explains procedure control for pipe welding.

Name.....

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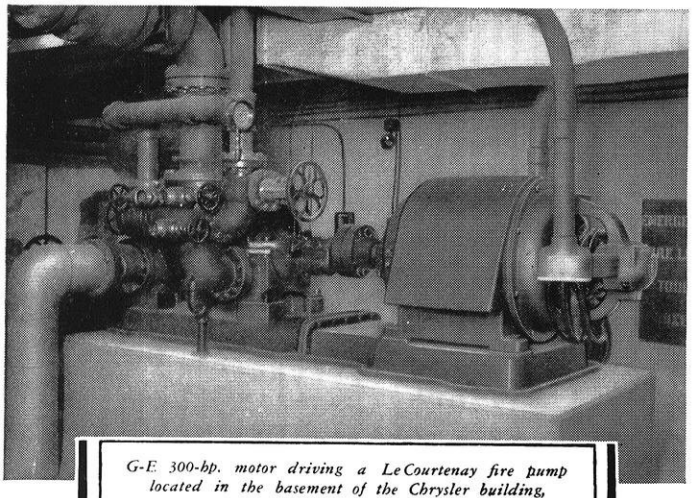
DRIVING A RIVER UP A SKYSCRAPER

SEVEN hundred and fifty gallons of water a minute pouring out from three nozzles over one thousand feet above the busy streets of Manhattan—a small river driven skyward 77 stories—that's the service afforded by the G-E motorized fire pumps of the famous Chrysler building.

During a recent test these pumps developed a pressure of 58 pounds per square inch at the 77th floor, or 422 pounds pressure per square inch at the basement installation—a mighty test for drive and pump alike. A stunt? No! Such protection must be maintained as long as needed—on a second's notice.

Such outstanding performance has won confidence for the hundreds of G-E products. This confidence has been maintained largely through the work of more than three decades of college graduates who are members of the G-E organization.



G-E 300-hp. motor driving a LeCourtenay fire pump located in the basement of the Chrysler building, New York City

95-832DH

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