The Wisconsin engineer. Volume 17, Number 5 February 1913

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I

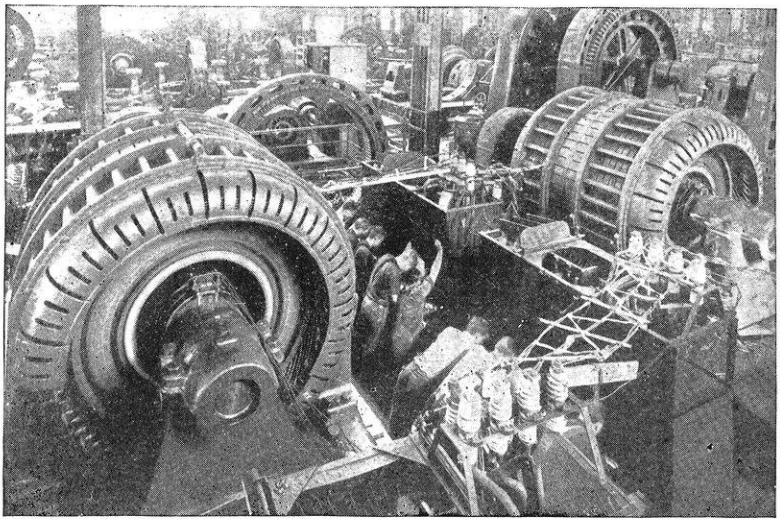
The Wisconsin Engineer

FEBRUARY, 1913

Volume 17 Number 5

$1.00 a Year 20c a Copy

WISCONSIN ENGINEERING JOURNAL ASSOCIATION



Volume 17 Founded 1896 Number 4

The Wisconsin Engineer

$1.00 a Year 20c a Copy

Entered as second-class matter Sept. 26, 1910, at the postoffice at Madison Wis., under the Act of March 3, 1879.

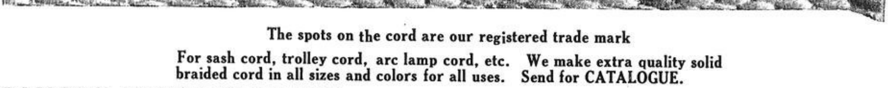
CONTENTS

FEBRUARY, 1913

Published monthly from October to May, inclusive, by the
WISCONSIN ENGINEERING JOURNAL ASSOCIATION,
Engineering Bldg., Madison, Wis.

Address all communications to The Wisconsin Engineer.

Subscription price $1.00 a year if paid before February 1; $1.25 a year after that date. Canadian subscriptions, $1.25 a year. Foreign subscriptions, $1.50 a year.



The Wisconsin Engineer

VOL. XVII FEBRUARY, 1913 NO. 5

COMMERCIAL ENGINEERING OPPORTUNITIES IN THE SOUTH

By D. H. BRAYMER, A. B., E. E., (Cornell)
Editor Southern Electrician

It is now generally recognized that the South, once a land stricken with poverty is now teeming with industry and progress in every line. The facilities for manufacturing, agriculture, and every other business interest connected therewith, are attracting capital from all directions and while the past few years have created a record of marked progress in all these lines the potentialities for further development are not yet realized and all that has been accomplished has only been a beginning and a reflection of the possibilities.

An index to the trend of commercial development is found in the increased population of the South to something more than thirty million or one-half the population of the United States in 1890 and in the increase in the value of manufacturing enterprises of the South to nearly three and a half billion dollars producing products valued at something more than this figure, while the total value of manufactured and agricultural products is twice this amount, and also twice what it was ten years ago. The capital invested in factories in cities having more than 25,000 population has in the last ten years increased over 140 per cent while the value of the products of these factories has increased over 100 per cent showing that while the number and size have increased, the output also has increased favorably in proportion.

Any mention of Southern products must of necessity include cotton, the crop of which for the year ending August 1912, totaled 16,138,426 bales. This was one of the largest cotton crops and it is important to note that 50 per cent of it has been handled in Southern mills and turned into a finished product.

This astonishing development in population and manufacturing can be traced to several important causes, principal among which are proximity to raw materials, transportation facilities, abundance of labor, and the presence of cheap electrical power.

Of the twelve and a quarter million cotton spindles in operation in the South, over 60 per cent are located in those states and towns reached by the transmission lines of the Southern Power Company the pioneer in the distribution of electrical power over long distance in the South.

It is the writer's purpose to consider the promising features of the electrical development of the South.

This development has been brief, in fact it barely covers ten years, for the Southern Power Company, was organized in 1905, and the first plant permitting operation on a large scale [the plant constructed on the Catawba River of 10,000 H. P. and taken over by this company] was not completed until the spring of 1904. However, even with a beginning in the distribution of electrical energy and the use of it to drive the mills and factories of the Southern states, some eight or ten years ago, there is at the present time represented in North and South Carolina by the load curve of the above company a power demand from 160 cotton mills, six street railway systems and the light and power load of forty-five towns and villages. This company alone has a plant capacity of over 125,000 H. P. with plants contemplated that will increase this figure three times. The success of the connected systems of the Southern Power Company, and its activity for industrial loads, has given confidence to other investors in public service corporations and now there is in progress in various parts of the South an electrical development that rivals that of any other section of the country, either in size or importance.

During the last year, hydro-electric enterprises alone have been organized representing a capitalization of considerably over $200,000,000 and having in view the development of upwards of 1,500,000 horsepower. This activity is not confined to any particular section of the South, but is generally distributed among those sections where power possibilities are found through the development of water power. There has recently been organized through financial interests in London, a company with a capitalization of $50,000,000 to develop the water powers of Alabama. This development contemplates the production of 400,000 H. P. to be used in lighting towns and villages, operating street railway systems, and industrial plants.

A large part of the existing developments and those under way have been confined to the Piedmont region of the South. The important plants now in operation and soon to be completed include the following: Those of the Southern Power Company, in North and South Carolina with a capacity of 125,000 H. P., and a transmission system of 1300 miles and those of the Georgia Railway & Power Co., in Georgia with a development under way that will produce 90,000 H. P. and cost approximately $10,000,000 to form a part of a system which will ultimately develop 350,000 H. P. and operate 500 miles of transmission lines. In Tennessee there is nearing completion the Hales Bar Development of the Chattanooga and Tennessee River Power Company, where 60,000 H. P. will be available. A system is planned and partly completed by the Tennessee Power Company, which will aggregate 170,000 H. P., 54,000 H. P. of which is partially completed.

The contemplated plants include those of the Tennessee Hydro-Electric Company, with plans for the development of 400,000 H. P. through the construction of five dams in the states of Tennessee and Virginia; the extensive system of the Aluminum Company of America which, through a chain of five dams on the Little Tennessee River and tributaries, will harness 400,000 H. P. by water power development within a radius of 100 miles in eastern Tennessee and western North Carolina. Neglecting the many other plants of less than 10,000 H. P. there is represented in the developments mentioned, a possibility of one and a half million of electrical horsepower being available in the next three years in addition to that now developed in the South, for exploiting the industries now already formed and creating others for which the section is excellently suited.

The creating of a development sufficient to produce fifty to sixty thousand horsepower in the South, causes little surprise and only casual mention. Yet it is within the memory range of a large majority that Southern hydro-electric development in large capacity was born. In fact as already mentioned the plants are yet very young. Those of a capacity of over 15,000 H. P. being not more than five years old, and seventeen years ago marking the beginning of any elertrical transmission in the South, that being at the moderate voltage of 5,500. Today sees one of the largest transmission systems operating within this territory and well toward the top notch of present transmitting voltages with the possibilities of the field for equally extensive systems just opening. As previously stated the cheapness of water power already developed has in a large measure been responsible for the remarkable industrial development of the South thus far, and this progress has now reached the point where it is reacting to stimulate the control of Southern water powers and the transmission of that power through electrical energy to the remotest towns and cities where the possibilities are yet lying dormant. This reaction has been assisted by a peculiar chain of political circumstances, important among which is the checking of the western section of the country through the so-called conservation movement. The capital therefore naturally invested in water power projects has been diverted to the Southern states where conservation is best interpreted by making developments instead of preventing them. This advantage will remain with the South until federal authorities decide upon terms for reopening of western lands on a basis that will attract capital.

The fields open to the young engineer are in the main, three, manufacturing, operation and construction, and commercial work. Thus far, these fields have attracted the product of our technical schools in the order named, the first perhaps getting the largest share, and for good reasons. The man who desires the best possible foundation upon which to build a successful engineering career can in the writer's opinion secure no more profitable position than one on the apprenticeship courses now open to him through the large manufacturing companies. The large plant that has practical instruction courses open to young graduates is an important school for the technical man who desires a real and tangible knowledge of engineering and a fertile field to place his absorption of fundamentals where it will grow to maturity and be pruned and trained by the laws that govern design, manufacture, construction and erection not found in text books and of which he has now only a mental picture. With sufficient training in this school, the young engineer can then decide what phases of engineering he does not desire to follow and is in the profession of an engineer many times better equipped than his seemingly more unfortunate brother who has escaped the apparent hardship through other means and has an apparently desirable position.

The average graduate has heard much about the specialist and this advice may seem to him foreign. However, if an investigation is made it will be found that the specialist in electrical engineering today is in fact a generalist and has a good working knowledge of many subjects. Knowing everything about something and something about everything should be a motto from the start. The knowledge gained at the end of an apprenticeship course, combined with the information absorbed during the college course, begins to have value in dollars per week or per month, the engineering career is just opening and with ideals high, much hard work and a capitalization of ability moderate, a good engineer usually will result.

It may be that I am making a rather dangerous statement when I say that the commercial opportunities for a good engineer are most attractive at the present time on account of the fact that the return is quicker and more substantial than that received from following the well laid out and beaten paths for the electrical engineer who takes up strictly engineering pursuits. It is dangerous for the fact that it may give the impression that this is a field recruited from the ranks of the graduates who have absorbed few of the engineering fundamentals and only a smattering of technical problems which make up engineering work, this being gained through a good memory or through the good natured assistance of fellow students who through friendship have had a sympathetic feeling for such unfortunates. For such as these no engineering field is open and few sympathizers will be found as supports upon which to lean for mental assistance. It is in the commercial field that the South offers excellent chances. In fact it is this field that offers the greatest opportunities for a resourceful engineer if it is entered with the proper preparation. A large field for future activity is among central stations where some of the important combined commercial and engineering problems of today are to be solved. In this field in the capacity of a commercial engineer, the greatest leaway for initiative is given, for the investor in the central station field of today must of necessity rely upon those who are capable of giving him the largest returns on his capital and the man therefore who possesses a combination of engineering, commercial and executive ability successfully to bring this about, has a certain basis upon which he can place a material capitalization upon his services and expect to get it. It must not be assumed that this field points any easy road to success for any engineer, for to be successful it is necessary that some time be spent in grasping the purely engineering problems and therefore the young engineer must of necessity spend some of his time gaining a knowledge of the technical details of this large field of endeavor so that they will act as a source of definite information when dealing with the commercial subjects to which his endeavors may later on be entirely confined. It has only been during the past few years that the commercial side of central station work has been given the importance it deserves. At this date however, the larger of central stations are installing what is known as new business departments, at the head of which is usually placed a technical engineer who has charge of securing new business and analyzing the demand so as to be able to connect to the lines of the system the most profitable load and take on those loads which heretofore have been considered least profitable at a rate which will justify their solicitation. It is through the recent study made in this direction that certain new and important considerations have been found to exist which have a definite bearing upon the management of a successful public service corporation. The relation of power factor, load factor, and diversity factory are now terms which must be as thoroughly understood in all their relationship by the commercial engineer as the cost of generation or the rates which are made for different services. This development in central station work has created such positions as those of the industrial power engineer, competitive power engineer, illuminating engineer, heating appliance engineer and the decorative sign lighting engineer, all of which positions are recognized by every central station operating in a city of more than 50,000 people.

It is remarkable to note how few graduates enter this field of engineering with all of its possibilities and the question comes up if there is not a link lacking in the curriculum of our technical schools that fails to connect the technical with the commercial end of engineering and the study of the great problems that confront one of our largest industries and one certain to be larger in the future of our country.

It has been the aim of the writer in these remarks to place before the reader of this publication a few pertinent facts that may help to settle the all important question of, "What shall I do and where shall I do it when I graduate?" Having passed through this stage and found little consolation in the advice of others due to a conservatism and a policy of let the young man find his way, it is my earnest hope that those who are about to determine their future in engineering may at least investigate the possibilities mentioned. The policy of allowing the younger recruit to the engineering profession to seek his own way is a policy which does not place the talent available where it will do the greatest good and it is to this end that these remarks have been called forth.

NOTES ON THE TECHNOLOGY OF HYDRO-SILICATES, SILICATES AND BRICKS

The worker in clay, sand and cement has in the last few years commenced to realize the possibilities of application of the actively acid qualities of silica. Although the use of cement dates back two thousand years or more, no real important investigations of the reactions which took place in effecting the hardening of the cement and of concrete were seriously undertaken until by investigations the useful qualities of hydro-silicates in hardening when brought into contact with alkali and metallic oxides had been established. One of the commonest instances of the application of these qualities of the hydro-silicates and of hydro-silicic acids is the manufacture of sand lime brick. Sand lime bricks, when properly made, do not appear to be such negligible materials of construction as some of our partisan and ardent clay workers would have us believe. In many foreign journals and reports from the laboratories of several foreign universities, we find confirmation after confirmation of the success of the application of these foreign sand lime bricks in public buildings, in private houses, and even in the pavements of streets. The industry was born in Germany in the late '80s, and has spread over the whole of Europe in a degree that threatens the life of the clay brick manufacturers. The industry has appeared also in the United States, but without achieving the prestige which has marked its development in Europe. The possible reason for this lies in the disinclination of American manufacturers to employ chemists and experts who would determine for each locality and factory, by experiment, by analysis, aided by considerable common sense and knowledge of the chemistry of silicates, the proportions of lime to be used, the number of hours and the amount of pressure under which it should be steamed, and who would dictate methods of laying and bonding the bricks.

In order that some understanding of the process of manufacture may be obtained, the following digest of methods employed in Dutch factories is given. These may present a general view of European procedure.

These bricks are made by mixing and tempering together quarry sand or ground quartzite with at least 6 per cent slaked lime, moulding under severe pressure and bonding in cylinders under the influence of steam at a pressure of about eight atmospheres for a period of from six to sixteen hours.

Seven factories slake the lime in trommels, in one with a pressure increasing gradually to ten atmospheres. Some sift the lime after slaking. One grinds the slaked lime in a ball mill, digests the mill material in a silo for four days and then screens it. Three works use a silo in which the material lies for eight, fourteen and twenty-four hours respectively. The lime is slaked by hand in three other factories, one of which stores the slaked material for two months in covered sheds. Lime and sand are measured out carefully; generally the proper proportions of charge are thrown into cars divided by a moveable partition. Mixing machines of the screw-worm and pan or edge-runner type are used. Moulding and pressing is done by dry-press machines, or by means of presses with turntables. The bricks are hardened in cylinders under a pressure of eight and one-half, eight, seven and six atmospheres during a period of from eight to sixteen hours (depending on the factory). All firms use saturated steam, but one finishes the hardening by passing superheated steam into the cylinder. The latter, however, uses a wetter charge than is usual. The object in all cases is to effect the formation of an aqueous calcium metasilicate, which is formed at the temperature obtaining in the trommel, namely 500 to 800 deg. C., a temperature about 500 deg. C. lower than the temperature of formation of dry calcium bisilicate in furnace operations.

The chemical reactions which go on during these processes of manufacture are not thoroughly understood, but some undisputed solutions and succeeding chemical combinations have been established.

We know that hydro-silicic acid, $2H_2O\ S_aO_2$, acts on bases and basic rocks just as hydro-sulphuric acid, $H_2O\ SO_3$; for instance, at 200 deg. this acid, $2H_2O\ S_aO_2$, will actively attack bases to form silicates, for instance of lime, which in the dry state, under furnace conditions, with only dry S_iO_2 present as an acid, would not form under 1400 deg. C. The geologist is perfectly acquainted with the activities of hyro-silicic acid in changing the crust of the earth, and does not hesitate to use this factor in solving metamorphic problems in economic geology. There, indeed, seems to be no base, except those of the rare metals, which is proof against this aggressive corrosive agent. Even the more valuable metals, like copper, are attacked and transported by this agency, to be precipitated on reaching any reducing agent or carbolic acid gas.

It is interesting to compare with these geological and chemical changes resulting from the activity of hydro-silicic acid, the processes involved in making sand-lime brick and also in the manufacture, for the sake of comparison, of silica brick. Now, in most studies this process is shortly defined as "the operation of hardening." Most of the lime present combines with a small part of the silica present, as sand, to form a hydro-calcium silicate, which combines the rest of the grains of sand together and knit the brick into a homogeneous mass.

$C_a(OH)_2\ S_iO_2 = C_aS_iO_3H_2O$

$C_aS_iO_3H_2OC_a(OH)_2 = C_{a2}S_iO_4\ H_2O$

$C_a(OH)_2\ 2S_iO_2 = C_aH_2S_{i2}O_6$

As a matter of fact, this does not explain fully all the reactions. By an analysis* of a hardened brick, it was found that the lime was present in three forms: (1) as calcium hydroxide; (2) as calcium metasilicate; (3) as calcium carbonate. The silica was found to be present in three forms: (1) as quartz; (2) as chemically combined silica; (3) as colloidal silica. It was found also that about three-fourths of the lime went into the form of the calcium silicate. Of the rest of the lime, the greater part was combined with carbonic acid. Of the silica, between 4 and 6 per cent is combined with the lime; and a large proportion,—between one-half and one-third of the rest, is found to be in a colloidal condition.

The beginning of the process of hardening takes place when the lime is slaked in the presence of the silica, which in the case of a mixture of 100 parts of sand and 10 parts of lime, is sufficient to raise the temperature 275 deg. C. While now the hydro-silicic acid is actively attacking the hydrate of lime, the bricks are run into the steam cylinder and the process of hardening completed at a temperature of at least 500 deg. C. Immediately carbonic acid combines with the moisture in and about

* Thorundustrie Zeitung, April 25, 1912.

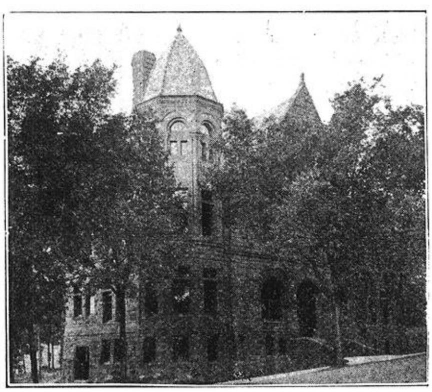
the brick, producing carbonates of lime and resolving part of the silicate into a colloidal condition; and both of these agents, calcium carbonate and colloidal silicate, help in bonding the brick. Furthermore, it is probable that a further reaction may sometimes take place between the metasilicate of lime and calcium hydroxide, as indicated above producing a calcium orthosilicate containing free water, which is similar to the zeolithic minerals of hydrothermic origin, which have the property at high temperatures of giving off their water so that it can never be taken up again. It would be an interesting research to determine in what way the European sand-lime bricks are superior to American, or if the American sand-lime bricks are really more discriminated against than the European.

In the case of the silica firebrick we have no such interesting chemical reactions taking place. We hold splinter ground quartzite and sandstone together by means of 2 per cent of lime, dry it and vitrify it at a temperature which reaches 1650 deg., when the quartz particles are held together by the formation of incipient slag particles of calcium, iron and alumina silicate distributed throughout the mass.

The number of applications of this hardening of hydrosilicates is large and increasing. We have in every day industries the manufacture of artificial stone by means of reactions of soluble silicate of soda with various bases and basic rock materials. Water glass and magnesia, water glass and fireclay, water glass and felspar, and, indeed, most other rock bases, form, when warmed and dried, an extremely hard, and, in the case of the two former, very refractory masses. Still more illuminating is the action of hydro-silicic acid in forming silicates, hard clinkered and durable, such as result in the well known sintering processes in metallurgy when a blast of air is blown through a charge of ore containing sulphur, contained in combination, or carbon added in the form of coke, and heated by a primer of a gasoline torch or a layer of hot ashed under the charge with a positive blast and above the charge with the suction draft. At a temperature much lower than that at which the ordinary slag silicates are formed, this material, if thoroughly moistened, will clinker into and form porous brick..

Very interesting applications occur in the literature from day to day. The most extraordinary of these was the attempt of the German Government to save the shores of Heligoland by a process of fluatising.. When everything, including concrete, had failed to protect the foreshore and the dry rocks, a fluatising solution was sprayed all around the island. The fluatising solutions consist of quartz, fluaspar, and one or the other of the alkali or alkaline earths which are soluble in water. The rocks were first cleaned by streams of water from the German battle ships, and the solution, in this case a solvent consisting of quartz, fluorspar and magnesia, was sprayed on the clean clear places, with the hope that the rock would effect chemical changes with the fluatising salts, resulting in the fixing of the original quartz and fluorspar. Of the results of this experiment it is at present impossible to obtain any information.

In this short article we have simply indicated some of the many processes which are now using the peculiar properties of hydro-silicic acid in manufacture of products which are becoming more numerous from day to day. It is a field in which the geologist, the chemist and the engineer may work with much mutual satisfaction and probable success.



THE PROFESSION OF PATENT LAW

The profession of Patent Law is doubtless so far removed from the pursuits of most alumni of the Engineering College that the editor must have regarded the subject matter of this article as being primarily of interest to the undergraduate who is more or less free to choose his future field of endeavor. A patent lawyer likes to discuss with enthusiasm the magnitude and importance of industries based upon patents. The undergraduate would doubtless, however, be more interested in learning something about the routine work of a patent attorney, about the qualifications necessary to success in that field and about the pecuniary rewards to be expected.

The neophyte will devote his attention to the matter of soliciting patents. If in this he is successful and he becomes admitted to the bar, he will devote his attention largely to the conducting of patent litigation. A patent lawyer who is successful in these branches will inevitably be called upon to handle important contracts and negotiations.

In order to procure a patent, the inventor is required to file in the Patent Office a drawing illustrating his invention, a specification describing its construction and mode of operation, and a set of patent claims, each claim defining in exact but comprehensive language the feature "covered" by the patent. In order to be effective, the claim must be broad enough in its descriptive terms to include all feasible variations of the invention. On the other hand, the claim will be invalid if so broad in its descriptive terms as to describe anything which may have preceded the invention to be patented.

In order to be a successful solicitor of patents, therefore, a man must have a quick and active imagination; otherwise he will fail to foresee the variations which may be made in carrying out an inventive idea. If the solicitor fails to foresee the possible variations, he is not likely to draw claims of a scope broad enough to cover effectively his client's invention. For example, it was essential that the solicitor of the Bell telephone patent claims should recognize that Bell's fundamental idea lay in varying the strength of an electric current in conformity with the sound vibrations to be transmitted. The particular form of the apparatus for bringing about this result was comparatively unimportant, as demonstrated by the thousands of detail patents subsequently taken out upon every conceivable form of telephone transmitter, receiver, switchboard, etc.

One would suppose that inventors themselves would be able to point out to their patent solicitors the essential features of their inventions and to distinguish these essential features from the unimportant details. Some inventors have that faculty of analysis, but a complete lack of it is more nearly the rule. It devolves upon the patent solicitor, therefore, to see into and through the inventions submitted for his consideration and to pin his claims to the essentials.

For the most part, the more important modern inventions involve the application of highly scientific principles and theories, and, other things being equal, the patent solicitor who is best informed upon the scientific principles upon which engineering practice is based, will best succeed in drawing specifications and claims adequate to cover his client's invention. Years ago patents were solicited by general lawyers who occasionally were called upon to strive as best they could with an occasional invention. Nowadays, however, it is the exception rather than the rule to find in the patent practice, young men who have not had the advantage of an engineering education.

A large majority of the young men who enter the profession of the patent law do so through the avenue afforded by the Patent Office itself. The government conducts civil service examinations, as a result of which the Patent Office Examiners are appointed. It is the business of the examining corps of the Patent Office to consider the claims filed by patent solicitors and to compare those claims with the devices of the so-called, "prior art." If the examiner finds that the claims are so broad as to describe something that antedates the invention in question, he rejects the claims with a statement of the reasons for his rejection. The work of the Patent Office Examiner familiarizes him with the jargon of patent specifications and claims and it gives him a thoroughgoing familiarity with the particular art or arts to which he may be assigned. The Patent Examiner's compensation at the outset will be $1,500 per year, and he may reasonably look forward to an increase of about $100 per year.

There are several good law schools in Washington, and the class hours are arranged in such manner that the Patent Office employes may attend. It is the custom for ambitious assistant examiners, therefore, to take the law course while in the government employ. Admission to the bar of the District of Columbia will admit to practice in nearly all of the states. To my mind the opportunity to attend a good law school is the most important advantage offered through a position on the examining corps of the Patent Office. If an engineering graduate had an opportunity to study law and to become admitted to the bar without entering the Patent Office, I should advise him to do so, particularly if he could meanwhile spend part of his time in the office of an active firm of patent attorneys. I know that many patent attorneys would not second this advice, but in my opinion the experience gained in a law office, particularly in the matter of meeting and dealing with clients, will more than offset the value of the Patent Office training. The bulk of the patent work is handled in large cities, and most of the large cities are provided with law schools available to the man who starts in as a draftsman or specification writer in a patent law office.

A man's success as a solicitor of patents will depend not only upon his fund of information upon scientific and engineering subjects, but upon his powers of analysis. An ability to write fluent and intelligible English is an almost necessary requisite, and finally his ability to draw any considerable income will depend largely upon his ability to attract and hold clients. The ability and habit of doing first class work are, of course, the most potent means of establishing a clientele, but the ability to "meet people," and to inspire confidence in them is an asset of no small value.

No man who gets into the patent practice will be satisfied to devote himself always to the work of soliciting patents. He will wish to identify himself with the trial of patent suits involving questions of patent infringement. There may have been an old-fashioned idea that the most successful lawyer was the most gushing fountain of perfervid oratory. This idea is so far removed from the fact that I doubt if it exists nowadays even among laymen. Certainly, lawyers themselves know that the man who is most diligent in his search for evidence and in the production of that evidence is almost bound to win against the lawyer who depends upon his oratorical flights alone. As a matter of fact, patent cases are almost invariably tried and decided by judges,—almost never by juries. Judges listen to arguments day in and day out, and they are prone to fall asleep long before the modern Patrick Henry reaches his peroration. The most persuasive patent advocate is the one who can merely *talk* to the judge about machinery in such a way that the judge can understand what he is talking about. The engineer who aspires to success in the profession of patent law will find it unnecessary, therefore, to take long courses in elocution and dramatics.

Any man who is reasonably well qualified, will find the practice of patent law an extremely interesting if not indeed an engrossing pursuit. If he succeeds in establishing a good clientele, he will find that he is working with the men who are not only abreast, but ahead of the times in their respective lines. The patent attorney is occupied necessarily with *new* things. He is procuring patents upon inventions—ideas which have never been conceved of in the past history of the world. The fact that it is only new things which are the subject matter of patents and patent suits, makes it impossible for the patent attorney to devote himself to routine work in the sense that he must do the same thing over and over again. Every piece of work which he undertakes is bound to be new and different from anything which he may have handled before. There is a fascination about this everchanging variety which has a strong appeal. It is a source of considerable satisfaction to be right up in the forefront of a progressive age. It is a source of satisfaction to have procured a patent which a rival will find it impossible to circumvent. It is a satisfaction to succeed in maintaining an inventor's rightful monopoly in the face of the would-be infringements of competitors. I know of no experienced patent attorney who does not proclaim enthusiastically the charm with which his profession holds him.

It would, of course, be futile for any man to select his business or profession with reference only to the pecuniary returns to be expected. It will, however, be of interest to the engineering undergraduate who contemplates the patent law as a possible vocation to know something about the income to which he may look forward. In a general way, the patent attorney's income is likely to be less during the early years of his career than in other and more common branches of engineering. On the other hand, the income of the average patent attorney is probably somewhat higher in the later years of his life than that of the average engineer engaged in more strictly engineering work.

A graduate engineer with no experience whatever in patent work will find it difficult to get a position of any kind with a patent law firm. He must make up his mind to regard the getting of a position of any kind as of primary importance, the matter of salary being wholly secondary. It not infrequently happens in the east that young men will pay their employers for an opportunity to work in their law offices. In the middle west, it is customary to pay something even to a beginner. I am willing to cite my own case, in which the aspirant for legal training and experience was paid seven dollars per week at the beginning of his career in a patent law office. A thoroughly ambitious man might hope to increase his income at the rate of about a thousand dollars per year during the first few years of his career. First-class patent attorneys in the middle west generally receive fifty dollars per day for their time. His clerical and office expenses will eat up about one-third of his charges to clients. To a certain extent, a patent attorney can increase his income above the limits thus set, by employing assistants, but it is impossible to extend a purely professional business indefinitely. Clients generally want the head of the business to be in close touch with their own affairs and there is a limit to the amount of detail which any man can follow thus closely.

Patent attorneys become closely identified with new enterprises and find themselves in a good position to judge the merits of new enterprises. This gives them an opportunity to make speculative investments which may prove highly profitable.

SIGNAL ENGINEERING AS A FIELD FOR ENGINEERING GRADUATES

M. H. Hovey
Wisconsin Railroad Commission

The development and advancement in railway signaling during the last few years has been so rapid that it has been difficult for even those engaged in the business to keep pace with the development of the art, this being particularly true of the development in alternating current apparatus.

The early development of railway signaling was confined almost entirely along mechanical engineering lines, but the last fifteen years has witnessed a marked change and today the well balanced signal engineer must be prepared not only to solve mechanical problems, but also pneumatic and electric problems.

The first signaling consisted of mechanical interlocking plants for the protection of railway crossings, junctions and drawbridges. As traffic grew heavier, the need of a block signal system was felt and the natural development was a system that would make use of the equipment and men available, namely, the train order signals and telegraph operators. This system is known as the manual block system and it has given and is still giving a very useful and satisfactory service, but with the changes in train operation, with faster schedules and more frequent train service, the need of a block system giving a higher degree of protection than could be secured from a simple manual block system became necessary.

This condition was met by the development of the automatic block system. The first electrically operated automatic block signals were of the enclosed banner or disk type, operated by an electro magnet and provided protection against open switches as well as against trains in the block. The earlier installation of automatic block signals was operated by track instruments or levers, so located outside of the track rail on special ties as to be engaged by the portion of the car wheel which projects outside of the head of the rail. These levers opened and closed electric contacts which operated the signals. This system of operation was not found entirely satisfactory and the track instruments were soon replaced by the track circuit, which was found to be so satisfactory that it is now used almost universally for the control of automatic block signals. The track circuit gives protection against broken rails and guards against the possibility of a part of a train being left in a block. The energy for the track circuits was supplied from gravity cells, two or more cells of the battery being used for each circuit, the maximum rarely exceeding four cells. The energy for the operation of the block signals was also secured from gravity cells, the number of cells varying from six to twenty, depending upon the local conditions such as length of block, resistance of circuit, etc. With the development of the storage battery their use was adopted for track circuits as well as for the signal circuits. Both the portable and stationary sets are used, the portable sets being more commonly used on single track lines and the stationary sets on lines having two or more tracks.

The signals used in connection with the earlier interlocking plants were almost universally of the semaphore type operating in two positions in the lower quadrant. With the extension of the automatic block system it became necessary to include the interlocking signals as a part of the block system. This made necessary the development of slotting devices so designed as to allow the interlocking signals to be cleared manually and return to the normal position automatically upon the block becoming occupied.

On account of the comparatively limited distance that it is possible to operate signals and switches mechanically, the need of power operated interlocking became apparent, resulting in the development of the electro pneumatic system. In this system air pressure is supplied at about eighty pounds to the cylinders operating the switches or signals. The valves admitting the air to the cylinders are controlled by electro magnets. The interlocking machine is made up of a frame holding the levers together with the controllers which they operate. The interlocking between the levers is similar to that of the mechanical interlocking machines and in addition there is provided indicating devices operated by electro magnets for checking the operation of the switches and signals.

Following the development of the electro pneumatic came the pneumatic or "straight air" system in which the entire system including the indicating devices and valves as well as the switches and signals are operated by air pressure. The next interlocking system to be developed was the all electric. In this system energy is supplied from storage battery at 110 volts, the switches and signals being operated by electric motors, the motors being controlled directly from the interlocking machine, the interlocking machine being somewhat similar to the electro pneumatic interlocking machine.

Following the adoption of the automatic system and its extension through the interlocking plants, came the development of the semaphore automatic block signals. The operating mechanism consisted of an electric motor with necessary gearing, circuit controllers and holding devices, the signal being cleared by the operation of a motor and held clear by electro magnetic holding devices. With the development of the automatic semaphore signal, it became possible to use the same type of signals for both block signaling and interlocking.

With the adoption of high and medium speed track turnouts came the necessity of giving the engine runners additional information over that required at interlocking plants controlling simpler track layouts, this being particularly true where the interlocking plants were located in automatic block territory. It became necessary in some cases to provide signals having as high as five arms working in two positions each. This condition led to the possibility of confusion on the part of engine runners and also made necessary the use of very complicated apparatus and operating mechanism. As a result of these conditions came the adoption of signals operating in three positions and at the same time the change was made working the arms in the upper quadrant instead of in the lower. The change from the lower quadrant to the upper quadrant was a decided improvement as it did away with the liability of signals failing to return to the horizontal position due to accumulations of snow and ice on the signal arms. By adopting the three position signals the number of arms required under the most complicated conditions was reduced to three and a considerable saving in cost was effected.

With the development of electric roads and electrification of steam roads came the demand for interlocking and block signals for these lines. The system of steam road interlocking could in many cases be used with but minor changes. In the matter of automatic block signaling the conditions were more difficult to meet on account of the fact that the rails are in most cases used for the return propulsion current. To meet this condition the use of alternating current was adopted for both track circuits and signal control circuits. Where the track circuit is used it is necessary to insulate the track rails at the ends of the track circuit and a path of return must be maintained for the return propulsion current. To accomplish this impedence bonds are provided which allow the propulsion current to flow without interruption. Where direct current propulsion is used the impedence bonds must be of comparatively large carrying capacity on account of the quantity of return current to be taken care of, while with high voltage alternating current propulsion the bonds may be smaller. Where alternating current propulsion is used a current of different cycle is used for the signal and track circuits. In the case of a twenty-five cycle propulsion line a sixty cycle current is used for signaling and the relays are designed to respond to the sixty cycle current only.

Alternating current signaling is also being adopted for steam road signaling, it having many advantages over the direct current system, mong the more important being the lower cost of maintenance and operation, and the saving in cost of power. The energy secured from primary batteries as used in signaling costs several dollars per kilowatt as against a few cents per kilowatt for alternating current power. Where alternating current is used for steam road signaling it is customary to provide a special pole line for the transmission of the power and this same line can also carry the necessary wires for the control of the block signals. The power is transmitted at either 2200 volts or 4400 volts and the signals are operated on either 110 volts or 55 volts. The track circuits operate on from four to twelve volts depending upon the length of the section, drainage, ballast and ties. With the alternating current system much longer track circuits may be operated than with the direct current system. In the direct current system the average track circuit section is from 3500 feet to 4500 feet in length, while in the alternating current system the track circuit sections may be several thousand feet in length. There is also the additional advantage in the alternating current system in that the power transmission line may be used for the lighting of depots, operation of pumping and coaling stations and for other purposes.

Signaling has not been confined to the surface roads, but has been extended to the elevated and subway roads. For subway work a signal was developed having lights only and the arrangement proved so satisfactory that the light type of signal has gradually extended first to the slowest speed surface loads and more recently to the high speed interurban roads. On account of the location of pole lines near the track on electric roads it is difficult to secure a background which will permit of readily seeing a semaphore arm. Where the light signals are used hoods are provided for the signal lenses and with this type of signal the question of background is not of vital importance. This type of signal is being used extensively at the present time on the electric lines.

Signaling on electric roads may still be considered as being in the experimental stage and a marked development may be looked for in this line of signaling within the next few years.

At the present time considerable attention is being given to the question of automatic train control. This question is one upon which inventors have worked for many years. A system using mechanically operated trips located on the track ties so as to engage a valve on the motor cars has been in successful operation for some time on the elevated roads and subways. On account of accumulation of snow and ice this class of stop has not been adopted by the surface roads.

Extensive tests have been made under the supervision of the federal government and the results would indicate that there are several systems of automatic train control which are sufficiently reliable to justify their use. Automatic train control systems may be divided into the following types: mechanical trip type, third rail contact type, insulated engine part type, inductive type, hertzian wave type.

At the present time several steam roads are putting in trial installations of one or more of the above types.

The preceding, while necessarily only a condensed outline of the development of railway signaling, will give the reader a general idea of the development of signaling and will be sufficient to indicate that the signal engineer of the future must be a man of technical training. One of the signal manufacturing companies has an apprenticeship course and each year they take into their service a number of engineering graduates. The other signal manufacturing companies do not have a regular apprenticeship course, but do take into their service each year a number of men with technical training. It is also the practice of a number of the railroad companies to place one or more technical graduates with their signal engineers' staff each year.

THE UNIVERSITY OF WISCONSIN GAS ENGINE EXPOSITION

On February 27 and 28, 1913, an exposition of gas engines was held in the stock pavilion—the first of its kind in the state of Wisconsin and probably in the United States. The idea originated with Dr. H. C. Bumpus, general manager of the university and Professor J. G. D. Mack, then acting dean of the Engineering College. Professor C. C. Thomas of the department of steam egnineering and Professor C. A. Ocock of the department of agricultural engineering completed the committee which developed the idea. The matter was presented to the student's section of the A. S. M. E., who enthusiastically agreed to give their support and in a few days the regents gave their permission to hold the exposition. The writer was given charge of the exposition as a whole and Mr. F. M. White and H. W. Vroman represented the agricultural engineering department.

The purpose of the exposition was the education of the general public on the uses of the gas engine. The importance of the gas engine is just beginning to be realized in this country. It has already done wonders in its half century of commercial life. The automobile has come to stay as a necessity—not as a luxury, and the automobile was made possible by the gas engine.

The residents of cities wonder how life could be possible without electric lights, water works and other conveniences—and now the gas engine is bringing all these city conveniences to the farms in the country. The labor problem on the farm has been successfully solved by that humble hired man—the gas engine.

Large cities are now lighted by the gases from the steel and iron industries, which used to be wasted, but due to the gas engine are now utilized. And soon we may be traveling over the country in air ships—driven by the gas engine.

The gas engine is to be the chief source of power in the future and it is a matter of importance that every man and woman should understand how it operates and the uses to which it can be put.

In order to present the wide field of usefulness of the gas engine, manufacturers and dealers in farm machinery, automobiles, motor cycles, motor boats, and accessories were invited to make exhibits. A small charge for floor space was made to defray incidental expenses and all were given to understand that the exposition would be purely educational and that exhibitors must refrain from soliciting purchasers. The response from the manufacturers was immediate and enthusiastic, all the floor space being engaged within a few days after the first announcement. Furthermore all the exhibitors entered into the project with the determination to make their exhibit the best of which they were capable. It was this fact as much as any other that made the exposition the success it was.

For the exposition must be called an unqualified success. The farmer could see huge farm tractors, electric lighting plants, pumping engines and engines applied to all purposes about the home and farm. There was a fine display of marine motors and motor boats which interested all. The motor cycle enthusiasts had ample opportunity to study the various makes. The automobile exhibits were particularly interestng as most of the exhibitors showed a stripped chassis with cut out engine and glass covered gear case. The exhibits of accessories were very attractive and educational. The ladies besides being interested in all these things were delighted with the vacuum cleaner, washing machine, etc., driven by gas engines. Band concerts by the University of Wisconsin band and an illustrated lecture by Mr. R. M. Olney added to the general enjoyment of the 2500 visitors.

Perhaps the best indication of the popularity of the exposition was the fact that almost every exhibitor expressed his satisfaction and asked that he be alloted the same space next year. So it seems that the University of Wisconsin Gas Engine Exposition will become an annual affair and will have a great future.

W. C. Rowse.

THE WORK OF THE UNITED STATES RECLAMATION SERVICE

D. P. Dale
U. W., 1911

Approximately thirty per cent of the area of the United States receives less than the 20″ annual precipitation required for successful agriculture. However, vast areas of desert and arid districts heretofore visited only by the sheepherder, the hunter or the prospector, are found to be capable of conversion into agricultural districts of great productiveness by the application of water. These areas, many of them, are of exceptional latent fertility, and receive much sunshine. The temperature range, in northern districts, is from —25° F. to 100° F., in southern districts it is 20° to 120°, the range being about 100° in each case. However, the sensible variation is considerably less, due to the drier atmosphere. The arid climates are healthful, and are more agreeable than those of the Mississippi valley and the coasts. Extremes of temperature are exceptional; average conditions prevail for long periods.

The object of the United States Reclamation Service is to increase the amount of available water supply in these districts. In general, the problem is to control the run off; over vast areas the amount of rainfall is sufficient for agricultural purposes if it is properly applied. The dean of the Engineering College of the University of Montana states that enough water is flowing to waste out of Montana to irrigate all the tillable land of the state. The rivers in the arid regions are erratic in regime; they are subject to sudden and excessive floods, and to long periods of low water flow. The drainage slopes are steep, rocky, and have little or no vegetation. The floods pass too soon to be utilized, and they cause damage by inundating and washing away land, destroying dams, headworks, canals and houses. At present the irrigating capacity of the streams is dependent on the flow at low water periods, and disastrous loss of crops due to insufficient water is almost certain. The whole problem is to control these rivers so as to prevent floods, and to provide a regular and sufficient flow for irrigation. This is possible only by establishing storage reservoirs near the head waters and winter flow and provide a regular, controllable supply, capable of irrigating with certainty known areas. The necessary works are dams, tunnels, canals, aqueducts and levees. The works are of two general classes, those built primarily for irrigation, and those designed primarily for regulating flood flows. The work cannot be done by private capital on account of (1) the vast cost (some $145,000,000 are necessary for the completion of the projects now undertaken or completed), and (2) the interference between public and private rights in water and land.

PLAN ON WHICH THE WORK IS BEING EXECUTED.

In 1902 congress enacted a law providing that the money derived from the sale of land in sixteen states of the arid region go into a reclamation fund to be used in investigational work, and the construction and maintenance of works for the collection, storage and diversion of waters for the purpose of reclaiming arid or semi-arid lands. These lands were to be sold under the homestead laws (modified to meet the condition) in tracts of 40 to 160 acres. This plan properly carried out has the advantages of enabling settlers to buy land from the government at cost, and of securing the sale of land to bona fide settlers only. The government pays the first cost, and recoups by sale of the land. The cost of the works fixes the selling price of the land. Moneys returned to the reclamation fund go to other projects as yet uncompleted, and thus the system is self-perpetuating. The government makes conditions as favorable as possible for the settler. Payments for land extend over ten years. Thereafter the annual cost of water rights is the cost of maintenance and necessary improvements, no profit added. Demonstration farms are maintained in places, and experienced farmers are provided to instruct the uninitiated.

GEOGRAPHICAL DIVISION AND OFFICERING.

For purposes of facilitating management, the total region is divided into geographical divisions, viz., the Southern (Ariz.,

N. M., Tex., Ut., Cal.) the Pacific (Cal., Ore., Nev.), the Northern (Mont., N. D., Wyo.), the Central (Colo., Kan., Okla., S. D., Neb., Wyo.), the Idaho (Idaho, Ore., Wyo.), and the Washington (Wash.). There are three to ten projects in each division. Each project is in charge of a project engineer; over each division there is a supervising engineer with his examiners, clerks and agents. In the general offices at Washington are law officers, consulting engineers, chief engineer A. P. Davis and director of the reclamation service, F. H. Newell. Highest in position, but lowest in point of utility to the service, is the Secretary of the Interior.

An official journal is published by the United States Reclamation Service. "The Reclamation Record" is a monthly pamphlet printed at Washington for free distribution at the field offices and to libraries. It issues service orders and statements, gives a classified list of employes with a record of recent transfers, promotions and separations, and reports in some detail the progress on the various projects.

SPECIAL FEATURES AND DESIGNS.

Roosevelt Dam, Salt River Project, Arizona.—This dam is built of rubble masonry; it is 284′ high, 1080′ long on top and 235′ long on the base. When the great gates are closed, the rising flood will form a lake twenty-five miles long, the capacity of which is 1,3000,000 acre-feet of water, or fifteen times that of the great Croton Reservoir in New York. This is about seven times the capacity of Lake Mendota. As needed, the water will be allowed to flow through the dam, and forty miles down the regular channel of the river where it is diverted by canals to irrigate some 200,000 acres near Phoenix and Mesa. Power developed by the fall at the dam is to be transmitted electrically ninety miles down the valley, to be used for pumping water from underground sources to irrigate some 50,000 acres in the Gila Indian Reservation.

North Platte, in Wyoming.—The great Pathfinder Dam is 215′ high, and provides a storage of 1,000,000 acre-feet of water. In the past floods have destroyed millions of property in this valley. This dam is able to restrain a flood equal to the greatest known. Water, as needed for irrigation, flows down the river 150 miles, and then 140 miles through the Interstate canal, to irrigate some 400,000 acres in Nebraska and Wyoming. In this rough country several concrete viaducts are built. To avoid losses by seepage, most of the canals are cement lined.

Shoshone Dam, in Wyoming.—In a narrow of Shoshone Canyon in northern Wyoming is built the famous Shoshone Dam. It is 328′ bedrock to parapet walls, almost exactly twice the height of Niagara Falls, and is the highest structure of the kind in the world. Twelve miles farther down the stream a diversion dam turns the course of the river into a tunnel three and one-fourth miles long, which leads it to the head of a great canal system by which the water is spread over the broad level acres.

Belle Fourche Dam, in South Dakota.—At the foot of the Black Hills in South Dakota, in the valley of the Belle Fourche river, the Reclamation Service is building one of the largest earthen embankments ever constructed by man. It is 115′ high, has a 20′ roadway on top, and is over a mile long. It is built in a depression between two hills, not directly in the path of the stream, and will receive the flow of the river through a canal six and one-half miles long. The storage reservoir afforded is nine square miles in area, and holds 2000,000 acre-feet. One great advantage in the construction is the non-interference of the stream during building.

Yuma Project, Arizona and California.—Twelve miles above Yuma on the Colorado river, which here divides California from Arizona, there is being built a dam which is unique in the history of American engineering. The control of this mighty stream is exceptionally difficult on account of the volume and uncertainty of the flow, the shifting and unstable banks, the yearly recurring inundations, and the immense amount of silt carried. With these conditions fully known, and with no bedrock for a foundation, the engineers set about to build a dam across the river on the sands and silt of the bed. The Laguna dam is of the India weir type, 19′ high, 260′ wide up and down stream, 4,780 feet long. The distributing system consists of nineteen miles of main canal and 138 miles of laterals. In order to prevent overflow, above the dam there are seventy-three miles of levees alongside the stream, with the necessary pumping systems to remove water from low lying areas.

Gunnison Tunnel, Colorado.—Perhaps the most difficult of all the projects is the undertaking to irrigate the valley of the Uncompahgre river with the waters of the Gunnison river. The Gunnison flows through Gunnison Gorge, twenty miles from the valley. One of the most remarkable engineering feats on record is the location of the tunnel route through the rock wall which separates the river from the valley, and the excavation of six miles of tunnel connecting to the largest irrigation canal in the world. The Gunnison river is in Black Canyon, 1,000 to 3,000 feet deep with almost perpendicular walls, approaching to within fifty feet of each other in places. In spite of the fact that no white man had ever explored the gorge and returned alive, an expedition was ordered to locate the route. It descended into the upper gorge, but came after a few miles to a point where boats could no longer be used. They retraced their steps, climbing out of the canyon in places so steep that ropes had to be used to make ascent. Two undiscouraged engineers, Torrence and Fellows, however, made a final attempt. They followed the path of the first expedition as far as boats could be used, and then by climbing, wading, swimming, they proceeded. In one place they were obliged to swim a waterfall twenty feet high, and were hurled by rushing torrents against rock ledges and boulders, suffering greatly from bruises, wounds, hunger, darkness and cold. For only two or three hours each day was it light enough in the depths of the canyon to make measurements. However, they succeeded in keeping the instruments unharmed, and made enough measurements to locate the gorge end of the tunnel, which they called River Portal. A road was built to the proposed entrance, itself a task of no mean proportions. A contracting firm began the excavation, but soon gave up the work as impossible. The Reclamation Service took direct charge, and after six years completed it. Many and serious difficulties were encountered. In the western section, a dynamite blast opened the channel of an underground stream of water which poured into the opening and compelled the men to flee for their lives. Borings were made, its extent determined, and conduits were built to drain it. Again, the subterranean passage was filled with carbonic acid gas. A compressed air outfit was installed to prevent it suffocating the workmen. When excavation had proceeded two or three miles into the earth, the heat became so intense that a ventilating system had to be installed. This took three months of time during which the work of excavation had to be suspended. In one place a bed of shells and sand was encountered, necessitating extensive shoring and propping. There occurred the most serious accident, a collapse of falsework confining thirty-two men. Fortunately the air pipe was not injured, so that when rescue was effected three days later, all were saved except six who had been killed by masses of falling rock. The difficulty of keeping a working force of men together under these circumstances can be inferred.

The Gunnison tunnel is the third largest in the United States, two railroad tunnels exceeding it. Its diameter is twelve feet and it carries 1,300 cubic-feet per second, enough to irrigate 200 square miles, or 128,000 acres. Most of the distributing canals are cement lined. This project exemplifies perhaps the most complete irrigation system in the United States. The soil produces four or five crops of alfalfa a year, also fruits, vegetables and wheat of high grade.

METHOD OF ACCOUNTING.

Costs are the fundamental data of engineering estimates. Cost data is important in making estimates on proposed works, but no adequate system has as yet been devised for keeping them. The United States Reclamation Service has an elaborate system of unit-cost accounting, some features of which will be described briefly.

Costs are distributed under eight heads, viz., interest investment, preparatory expenses, plant depreciation, materials, supplies, executive, labor, and engineering. (1) Interest investment includes insurance, bond premium, interest on cash and borrowed capital. (2) Preparatory expenses include construction of roads, construction and drainage of camps, delivery and installation of plant, and all expenses before actual construction begins. (3) To the head of plant depreciation are charged all expenses for repairs, and an estimated decrease in value of tools, machinery, buildings, etc. (4) The materials account is debited with all charges (including freight) for expendable property entering into the structure and remaining a peramnent part thereof. (5) "Supplies" is the account responsible for all charges (including freight) for expendable property used in building work and wholly consumed therein. (6) "Executive" includes salaries of superintendents, foremen, timekeepers, clerks, watchmen, and general administrative expenses. (7) The labor account is charged for the compensation of all skilled and common labor not included in executive, and also hire of teams. (8) Against "Engineering" are debited the salaries of engineers and inspectors. For proper distribution, costs are debited to the particular contracts to which they apply: in case of indetermination or common use they are pro-rated. Collection of data is by a time distribution system. There is a daily time book, with one page for each separate contract item. Entries are made under the heads of engineering, executive, and labor. Similarly in the daily material book, which serves also as a monthly book, debits are entered under the heads plant, materials, supplies. This information is carried forward at the end of each month to a ledger in which entries of monthly progress are made from an estimate book or sheet. In this ledger accounts correspond with each item of the contract, secondary charges being made under heads as aforesaid. Charges on interest and investment and preparatory expenses are carried forward en masse until the completion of the contract, and then distributed among the items of the contract.

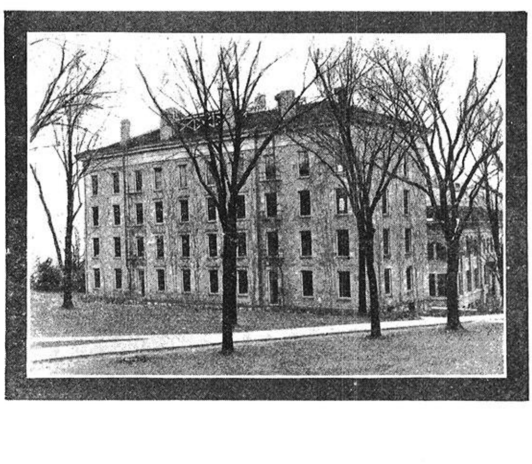
Other elements of cost are also noted. Entries are made by the timekeeper as to character of machinery, condition of labor, geography of the work, topography of site, and proximity of the materials of construction.

PRESENT STATUS OF THE WORK AND RECOMMENDATIONS OF THE BOARD OF ARMY ENGINEERS.

By act of congress of June 25, 1910, a loan of $20,000,000 to the reclamation fund was authorized, provided, that the project should be examined and reported upon by a board of

U. S. Army Engineers, and subsequently approved by the president. On January 5th the president reported favorably to congress. The report of the board and the president's message may be purchased from the superintendent of documents. Twenty-five projects have been undertaken, which involve the irrigation of some 3,000,000 acres of land at a cost of about $145,000,000. About $60,000,000 have been expended to date, and 600,000 acres are receiving water. The Salt River project, where the Roosevelt Dam is located, has a present net investment of $8,430,000, heading the list. The North Platte and Cunnison projects come next with four and a half and four millions respectively.

The board makes a recommended allotment of the $20,000,000 among the various projects, discusses the economic features, criticizes the engineering design and construction, describes the various projects, and gives statistics as to cost, estimated, total to date and probable total. In a few cases it appears that the lands will not be sufficiently benefited in productiveness to enable them to pay back the amount expended in their behalf. Actual costs have nearly always exceeded the estimated costs, being in some cases two or three times as much. The report as a whole is favorable.



THE MANUFACTURE OF WOOD PIPE

E. F. Week
M. E. Seminary

The use of wood pipe began before any other form of pipe was known except lead. The old form of wood pipe was used in London more than two centuries ago, and at a much earlier period in some European cities.

The Romans used lead pipe for distributing water to their Thermae baths, fountains and reservoirs. They were even familiar with the use of the inverted syphon. They were made of hewn stone or lead, sometimes serving under heads as great as two hundred feet, and up to eighteen inches in diameter. The introduction of wood pipe in comparatively modern times marks the first move toward sanitary development. In the seventeenth century some of London's water supply was distributed through wood pipes. It was in 1800 that a great advance was made, one London company alone having nearly 400 miles of pipe. As many as ten lines were laid side by side to form a single main.

In 1865 public water supplies were generally introduced and in the last forty-five years all civilized countries have developed a general system of water supply. Wood pipe was used in the United States as early as 1755. In 1800 Philadelphia installed wood pipes which are dug up today wonderfully well preserved.

Later cast iron pipe came into favor and it was not until the last fifteen to twenty years that its popularity was interrupted.

Butte, Montana, and Seattle, Washington, are two of the largest cities now receiving their water supply through wood pipe. The latter city has recently paralleled its original main with a new one.

Portland, Oregon, after receiving its supply through a steel main for twenty-five years finds it almost destroyed by rust and is planning to replace it with a new main constructed of wood.

Wood pipe, like everything else, has its limitations of usefulness, but these limitations are wide. Three hundred feet of head is about the highest head under which it should be used. Extensive use is being made of wood pipe to supply power water for generating plants; supply systems carrying the water long distances; distribution of such supplies in mains, laterals and feeders; for irrigation and as inverted syphons.

For diameters from eighteen inches to ten feet or greater the so-called continuous stave type is used. It is constructed of selected and carefully milled staves, generally of Douglas Fir. The staves are so milled that when they are assembled a pipe is formed of the desired size. Staves of various lengths are laid side by side so that all the joints are staggered. Each stave as laid is butted against the one immediately preceding it, while saw kerfs or slits at the ends receive a thin metal tongue, thus making the stave continuous and without any joint in the pipe. This construction gives a very smooth interior to the pipe which increases the carrying capacity.

The staves are held firmly in place by steel rods or hoops solidly drawn up until every stave is firmly seated. The pressure under which the pipe is to serve determines the diameter and spacing of the rods.

The wire wound type is usually made in convenient lengths of eight to sixteen feet. Each joint is a butt joint, enclosed in a sleeve or coupling made to a high pressure fit. This pipe is made in sizes up to twenty-four inches. This pipe is manufactured at the factory of selected, kiln dried Douglas fir. The staves are milled to mathematically true radial lines for each individual size. The staves are then assembled in forms and clamped. The pipe thus formed is placed in the winding machine which is a development of the lathe, the pipe is rotated drawing the wire over a friction disc which regulates the tension. The wire and friction disc is carried on a carriage which is propelled the length of the pipe by means of a feeding screw. As the pipe is wound the temporary clamps are removed. From this machine the pipe goes to the "heading machine" where the ends are shaped to suit the kind of coupling or connection end desired by means of revolving heads holding knives mechanically arranged and adjusted.

From the heading machine the pipe goes to the dipping vat, where the entire length is dipped, on the outside only. The tenon ends are protected, by means of paper, from the coating. After being dipped the pipe is rolled down an incline covered with sawdust which adheres to the dip.

The spacing of the wire is governed by the size of wire, size of pipe and the head under which it is to serve.

Wood pipe will never prove a success, regardless of its good qualities, unless it is properly laid. Great care must be exercised in making the joints close and snug, the pipes must be properly supported so as to prevent sagging and consequent strains, the back fill must be of good fresh earth and well tamped. The mistake is often made of filling in with roots and sod which later decays and has a most injurious effect on the pipe.

Mr. J. D. Schuyler, M. Am. Soc. C. E. Vol. XXXI Proceedings of the American Society of Civil Engineering says as to the economical use of wood pipe: "At a moderate estimate the saving affected the Citizens Water Company by use of wood pipe for their main conduits has been no less than $1,100,000 of the cost of cast iron pipe of the same capacity. The interest on this amount at 6 per cent would renew the mains every five or six years or duplicate them as often as necessary. With such a showing as this, the correctness of which cannot be challenged, there can be no doubt of the soundness and wisdom of the judgment which governed the selection of wood as the material for the main conduits of this company. If this be admitted, why may not the experience be repeated anywhere, with equally favorable results?"

It has been proven that the length of life of wood pipe is second only to that of cast iron pipe.

Wood when kept continuously saturated with water is practically indestructable. The confidence of engineers in this fact may be shown by recalling that the Brooklyn pier of the East River Suspension Bridge rests on yellow pine piers which are placed below the water level. A great many of Chicago's big buildings have wood piling foundations which are below the water level. London used wood pipes continuously in its supply system for 218 years.

Turner and Russell on page 571 in their book on Public Water Supply say: "It was noted in the introduction that the use of wood for water mains was quite universal in the early days of water works and that this material was subsequently displaced by cast iron. The use of wooden pipe under certain conditions has now again reached considerable proportions in certain parts of the country."

And on page 572: The expense of cast iron in the west developed the efficiency of the wood stave pipe. Mr. J. T. Fanning built such a pipe at Manchester in 1874. This pipe is still in service and the superintendent of the works recently said: "We know nothing of its condition, as it was laid six feet below the surface and we have had no occasion to disturb it." The chief development of this type of construction has been in the west since 1883, at which time stave pipe was used extensively at Denver.

It is quite clear that if the wood pipe is left continuously saturated its life is not measured by the wood but by the life of the metal wrapping or bands.

In metal pipe the metal serves two purposes, that of forming a water tight shell and providing strength to resist water pressure. If the metal fails, due to corrosion, in either particular the pipe become useless. It is notable that metal pipe does not fail because of reduction of strength, but due to pitting causing leaks. The metal banding on stave pipes is for the purpose of strength only; and while steel pipe would have to be discarded when only 5 per cent of the strength is destroyed by corrosion, stave pipe would continue tight and the bands would not be strained beyond their limit until 75 per cent of the metal wasted away. The shell of metal pipe is only half as thick as the wire used in winding stave pipe hence corrosion would have to penetrate twice as far through the wire or band. Also metal pipe is subject to corrosion from both sides while wood pipe is only subject to outside corrosion and the bands are double galvanized to protect against this.

Wood pipe does not burst when frozen. The reason is that the expansion is taken up by the wood staves, the wire imbedding itself slightly more in the wood.

Planed surfaces of wood, under the action of water, constantly tend to become smoother with time and use. As a result wood pipe has a greater carrying capacity than any other form of pipe.

The Wisconsin Engineer.

R. D. Hughes, '13, *Editor* **J. W. Young, '14,** *Manager*

STAFF

E. C. Noyes, '13, *Ass't Editor*
W. P. Bloecher, '14, *Dep't Editor.*
J. V. McKinney, '15, *Alumni Ed.*
C. M. Osterheld, '14, *Campus Ed.*
D. R. Hughes, '15, *Circ. Manager*
J. D. Basey, '15, *Ass't Circ. Mgr.*
J. F. Harper, '16, *Ass't. Ad. Mgr.*
J. B. Mann, '14, *Publishing Editor.*

ALUMNI REPRESENTATIVES

J. G. Wray, '93, Chief Engineer Chicago Telephone Co., Chicago, Ill.

A. C. Scott, '02, Professor of Electrical Engineering, University of Texas, Austin, Texas.

A. J. Quigley, '03, Sales Manager, Agutter-Griswold Co., Seattle, Wash.

R. T. Herdegen, '06, A. O. Smith Co., Milwaukee, Wis.

Frank E. Fisher, '06, Electrical Engineer, Diehl Mfg. Co., Elizabethport, N. J.

R. H. Ford, '06, '09, Electrical Engineer, General Electric Co., Lynn Mass.

J. E. Kaulfuss, '08, Instructor of Civil Engineering, University of Maine, Orono, Maine.

M. D. Cooper, '08, Electrical Engineer, National Electric Lamp Association, Cleveland, Ohio.

Hale H. Hunner, '09, Civil Engineer, Oliver Iron Mining Co., Hibbing, Minn.

F. E. Bates, '09, '10, Civil Engineer, Drafting Dept., Kansas City Terminal Ry. Co., Kansas City, Mo.

F. C. Ruhloff, '12, Mechanical Engineer, The Bucyrus Co., So. Milwaukee, Wis.

EDITORIAL

This issue comes to our readers considerably later than its scheduled time of publication. For this tardiness we wish to make an apology and also an explanation.

Most of our subscribers have had, at some time or other, a more or less intimate connection with the publishing of this magazine, and will, therefore, appreciate the difficulties connected with it. Of these, the worst have been the entirely new personnel of the undergraduate staff each college year, and the fact that the authority and responsibility of getting out the magazine have not been vested in any one man. Realizing the disadvantages of the old arrangement, our faculty advisory committee has perfected a plan which we believe will greatly facilitate the publishing of the magazine in the future.

This issue is the first under the new regime. We realize that on account of the late date of publication, our start is far from auspicious. But we can promise this to our readers: we are going to make up all the lost time before the end of the present volume. All we ask is a chance to make good.

We also desire at this time to say that we are glad to receive criticisms and suggestions from our subscribers. While we believe that the general character of the Wisconsin Engineer places us in the front rank of the college technical publications, we realize that we are far from perfect. If, Mr. Subscriber, you have an idea that may benefit us, let us hear it. If you can write an article that you think is of general interest, send it in. Above all, let us know what you are doing. In each issue we run an "Alumni Section," devoted to short notices concerning the whereabouts and employment of the alumni of our Engineering College. The value of that section depends upon the number of communications which we receive from our alumni subscribers. So let us hear from you, and don't be ashamed to hurry.

* * *

The recent Gas Engine Exhibition, which is more fully described in another part of this number, was a great success, both as regards the character of the exhibits, and the large attendance. We congratulate heartily the men who were responsible for the exhibition. The benefits from it are obvious. Not only was the show valuable from an educational standpoint, but it also helped to cement the good feeling between the colleges of Agriculture and Engineering. We hope that the success this year will induce the faculties of the two colleges, to make the show an annual event.

* * *

The following poem, which was sent in to the editor by one of our alumni, was written by Mr. Berton Braley, of Leland Stanford University, and published by a western daily paper.

We are taking the liberty of publishing it, and wish to express our obligation to the author.

TODAY'S MAN.

When the sages say, "It can't be done at all,
  It will only prove a failure and a mess,"
Comes a fellow with a quiet sort of gall,
  Just remarking, "We can put it through I guess!"
There's an old and battered briar in his face,
  And his eyes are calmly humorous and clear,
For there seems to be an easy sort of grace
  And power in the civil engineer!

He will tunnel through the quick-sand and the muck,
  He will bridge whatever gulf you want to span,
He has Vision, he has Energy and Pluck
  If you want a Working Dreamer, he's your Man,
In the Jungle, fighting fever and the damp,
  In the desert where the torrid sun's aglare,
In the bleak and frozen North he pitches camp,
  If you show him where the job is—he'll be there!

He has turned the wildest fiction into truth,
  He has made the maddest fancies into steel,
He is alive, he is Daring, he is Youth
  Crushing Doubt and all Disaster under heel!
He's Efficiency—that always finds a way!
  He is Faith, which conquers Unbelief and Fear,
If you're seeking for the Spirit of Today
  You will find it in the Civil Engineer.

—Berton Braley.

CAMPUS NOTES

Wisconsin has again won the western basketball championship. While our team did not quite repeat last year's hundred per cent record, it ended the season far ahead of all competitors. We wish heartily to congratulate the team and Coach Meanwell for the spirit which they have shown throughout the season, and for the success which attended their labor.

* * *

The lower campus has undergone several changes within the last few years; but the most desirable, from the standpoint of the hockey lover, is the little skating rink at its lower end. ''Ehler Lake,'' however, will probably call forth anything but blessings from the freshmen that have to drill on the lower campus next spring.

* * *

Captain Ball's vacancy has been filled by 1st Lieut. P. G. Wrightson. Commandant Wrightson is rapidly getting well acquainted, and no hitch in the routine work of the department, occurred from the change of officers during the school year.

* * *

During the foot ball season our efforts are willingly put forth to see that the upholders of Wisconsin's honor do justice to their school work. Now that the noise of battle is over, and the dust of the arena has settled, we forget this laborious but necessary effort of keeping our athletes eligible. Next year, unless we are fortunate, we will see many of our athletes on the side lines as the result of a ''con'' acquired with a dose of spring fever. Now is the time to do something while our men are still eligible. Many of our winter-sport teams have been weakened by loss of men, due to failure to keep up their work. Oure baseball team has also been a victim of this plague.

* * *

A very instructive talk on the Minneapolis government dam was recently given by Mr. Meyer, an engineer in charge of the work. Mr. Meyer is also a member of an international water power board.

Our engineering clubs are still alive. Recently the C. E. Society challenged the U. W. Club to a debate. We have not been informed of the nature of the subject, but understand that the question will be proposed by the challenging team.

* * *

The prom is now a matter of history—since so much documentary evidence already exists we wish to state that we have only this additional information to give: its all over but paying the bills, that's dad's share.

* * *

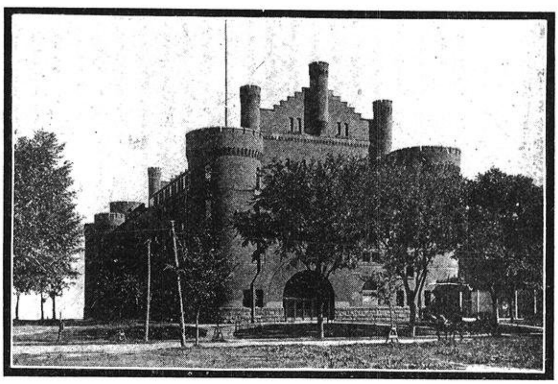
The much-talked-of Senior-Junior Smoker has just been held. The Seniors are to be credited with much of the work that constituted to its success. We are so loaded down with "fifths" that we take too little time for the cultivation of our classmate's acquaintance, hence any affairs of this kind are to be heartily recommended.

* * *

About this time each year considerable interest is taken in our Senior elections. Especially is this true of the election of a senior president. Tradition holds that a Senior class president has to be a leader in forensics, since most of his duties are of an oratorical nature. For this reason our presidents have been "Hill" men—old joint debaters that have come before their classmates as debaters and orators, and who perhaps have little ability in any other line. This year our elections will be of unusual interest to the engineers, for we have a candidate that will make any "Hill" men hustle. "King" Livingston is well known on the Hill for his ability as a speaker, and down in the Engineering College (where deeds not words are weighed), he is known as a "good engineer." Whether or not an engineer will be elected this year or not cannot be prophesied, but, if we can interpret indications correctly, our chances are good.

* * *

Shortly before the holidays the senior engineers held a smoker at the Union. Talks were given by Acting-Dean Mack, Business Manager Bumpus, and Prof. Havard. The object of the smoker was to get the seniors together for a good time, and also to provide a means for their better acquaintance. The smoker was so successful that some agitation is afloat to hold one with the juniors. Many seniors do not know their classmates who are taking different courses; even though the classes are held in the same building. This is a condition of affairs that should not exist, and a "smoker" affords a quick and effective remedy.



ALUMNI NOTES

H. Schwendener, E. E., '04, now holds the position of Chief Engineer of the McKinley Power Plant, Peoria, Ill.

Max W. King, C. E., '05, is a construction superintendent with the Southern Dredging Co., Mobile, Ala.

A. R. Johnson, Ch. E., '06, has taken a professorship in the chemistry department of Ames College, Ames, Iowa.

L. F. Harza, C. E., '06, has formed the L. F. Harza Company, Consulting Engineers, Portland, Oregon.

Charles W. Green, E. E., '04, holds an instructorship in the electrical department of the Massachusetts Institute of Technology, Clifton, Mass.

E. C. Greisen, M. E., '07, is at the head of the gas plant drafting department of the Power and Mining Machinery Company, Sturgeon Bay, Wis.

Dwight F. Henderson, E. E., '07, is the assistant superintendent of the Washington Water Power Company's Light and Power System, Spokane, Wash.

Charles R. Higson, M. E., '07, is in the Power Station Department of the Utah Light and Railway Co., Salt Lake City, Utah.

Harold E. Ketchum, Gen. E., '08, is employed by the Graff Construction Co. in the capacity of Superintendent of Construction, Seattle, Wis.

Arthur W. Horfman, Ch. E., '08, has been promoted to Assistant Superintendent of the Dillingham Manufacturing Co., Sheboygan, Wis.

M. E. Halliday, M. E., '08, has left the engineering profession and is now in the insurance business in Chicago, Ill.

Fred E. Hale, C. E., '09, is a draftsman in the Designing Department of the Alabama Interstate Power Company, Birmingham, Ala.

Frank A. Hitchcock, C. E., '10, is an instructor in Structural Engineering in the College of Civil Engineering at Cornell University, Ithaca, N. Y.

Paul V. Hodgers, Gen. E., '09, now holds the position of City Engineer in Monroe, Wis.

Robert Iakisch, C. E., '10, has affiliated himself with the U. S. Engineering Corps and is now a Junior Engineer in the service. He is stationed at Dubuque, Iowa.

E. L. Hain, C. E., '10, is also with the Government Engineers. He is an Assistant Topographer with the U. S. Geological Survey and has his headquarters at Washington, D. C.

Walter A. Hatch, C. E., '11, is an instrument man with the U. S. Engineering Corps stationed at Rock Island, Ill.

Edward H. Handy, E. E., '11, is the Western Representative for the Bergandahl, Bass Engineering and Construction Co. with headquarters at Chicago, Ill.

Earl V. Miller, E. E., '11, has recently taken the position of Master Mechanic of the Black Hawk Coal Co. at Black Hawk, Utah.

Kenneth R. Hare, E. E., '11, is the Chief Electrician of the Northern Pacific Railroad Co. at St. Paul, Minn.

Walter Hathaward, M. E., '12, is with the Beaver Dam Malleable Iron Co., Beaver Dam, Wis.

Ray W. Hart is with the U. S. Engineering Corps at Rock Island, Ill.

Loren L. Hebberd, is the Illinois Steel Co. Steel Expert at South Chicago, Ill.

William Greve, Jr., has taken an instructorship in Hydraulics at Purdue University, Lafayette, Ind.

R. H. Kellogg is with the Leathem and Smith T. and W. Co., Sturgeon Bay, Wis.

Williard F. Hines a Gas Engineer with the Public Service Commission of the First District, New York City.

ADVERTISERS INDEX

PROFESSIONAL CARDS

TO ENGINEERING STUDENTS

We have special student rates for subscriptions to the following technical publications.

Engineering Record **Electrical World**
Engineering and Contracting **Electric Railway Journal**
Practical Engineering

Your subscriptions will be promptly attended to

The Wisconsin Engineer