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# The Wisconsin Engineer

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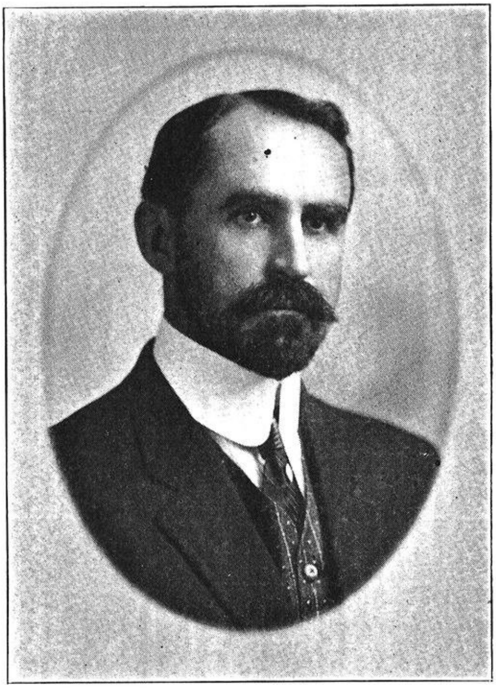
# WISCONSIN'S PIONEER PART IN THE DEVELOPMENT OF THE MOTOR VEHICLE AND FARM TRACTOR

By John S. Donald
*Secretary of State*

If fifty years ago the true history of the world's marvelous achievements in the creation, development, and use of the automobile could have been written, it would have rivaled the "Arabian Nights" or "Twenty Thousand Leagues under the Sea," in the field of imaginative literature. No one today attempts to give statistics for the world; statistics of one's own country are sufficiently baffling. In numbers the phenomenal rise has been from the first successful motor vehicle invented to 3,000,000 in the United States alone. At $1,000 each, the investment is three billions of dollars for cars alone on the part of purchasers, and the manufacturing and sales industries have developed captains of industry rivaling all precedent. Wisconsin's early effort to encourage the "invention and production of a machine propelled by steam or other motive agent which shall be a cheap and practical substitute for the horse and other animals on the highways and farm" is not fully realized and in fact but little known. In 1875, the State offered $10,000 to any resident who would invent and construct a "steam wagon" to accomplish these purposes. Records and reports in the office of the Secretary of State, at Madison, and also in the Historical Library, set forth the effort made in this contest. Some of the reports from participants and their accounts of early trials are of especial interest.

Although attempts have been made to apply steam power to road or light draft vehicles from the time it was first used as a motive force, undoubtedly the nearest approach to a successful horseless carriage was that built and christened the "Spark" in 1871 by Doctor J. W. Carhart of Racine, Wisconsin. From letters written by Doctor Carhart in 1914, we learn of his efforts and partial success which undoubtedly constituted a great stimulus to the State's interest, and had much to do with the legislature offering a reward. Doctor Carhart died at San Antonio, Texas, in 1915.



*John S. Donald*

"In 1871 I was a resident of Racine, Wisconsin," wrote Doctor Carhart, "and suffered from a long siege of fever. When I began to convalesce I thought much about the steam buggy matter, and for amusement during my long enforced leisure I sketched the outlines; and as my brother, Professor H. S. Carhart, now emeritus professor of physics in the University of Michigan, was stopping with me for a time, and being skilled in mechanical drawing, he made the working drawings of my engines and some other parts of the mechanism.

"A wealthy citizen of Racine, seeing the drawings, offered to furnish the money to build the vehicle; and accordingly the patterns and many of the parts were made in the shops of the well known J. I. Case Threshing Machine Company of that city. The principal part of the vehicle was built in our own shop, our lathes being operated by a pony tread power. The steam boiler was made by the Button Steam Fire Engine Factory in Waterford, N. Y., after special design, the drawings of which I still have."

Describing the "Spark," Doctor Carhart says: "There were two reciprocating engines attached to the boiler, which was upright and in the rear of the seat, each engine independently propelling a drive wheel, thus doing away with differential gears. The steering was done by lever and chains, attached to the front axle which turned on a fifth wheel, buggy-fashion.

"As liquid fuel was then unknown, I used hard coal for fuel, and I carried it under the seat, having a chute from the front into the door of the boiler fire box. With a jointed poker it was easy to fire the machine. Water was carried in tanks appropriately located. The boiler was furnished with whistle, steam-gauge, and safety valve and was capable of carrying a pressure of 300 pounds to the square inch, although I generally ran with about 120 pounds.

"The whole affair weighed 1,100 pounds. Other heavier twenty horsepower machines had been tried in England 100 years before, but mine was the first light self-propelled road vehicle in the United States and probably in the world. My first appearance on the streets of Racine was fantastic and exciting. My engines exhausted their steam directly into the smoke stack, and the exhaust not being rhythmical, the noise was hideous and the steam and smoke from the stack really alarming. No need for traffic police, for man or beast.

"At the next session of the legislature of Wisconsin," continued Doctor Carhart, "such was the interest created, that a premium of $10,000 was offered to the party building a self-propelled road vehicle that would run 200 miles, nearly north and south in the state, and which would be able to run backwards and to turn out of the road for other vehicles.

"Wisconsin was probably the first and only government in the world to pay money as a premium for the development of the auto and tractor industry.

"Machines were built two or three years after mine, and one, the 'Oshkosh,' built by my friend, Anson Farrand, went through from Green Bay to Madison and took the premium.

"Six years ago I was invited to visit the International Automobile Exhibition in Paris, France, and in a sense to become a part of the show. This invitation I accepted, and I received, indeed, many attentions and favors, not the least of which was a purse of several hundred dollars in bills on the Bank of France.

"At that exhibit was an 'old machine department,' and not a machine there was over sixteen years old. Mine would have been nearly forty years old at that time had it still been in existence. America and Europe have therefore established my claim to being 'The father of automobiles.' Whether it is a blessing or otherwise to the world I will let others decide."

The following odd bit of legislation by the Badger State to encourage the motor car will doubtless be of interest:

Laws of Wisconsin, Chapter 134, published March 5, 1875.

An act to encourage the invention and successful use of steam or other mechanical agents on highways.

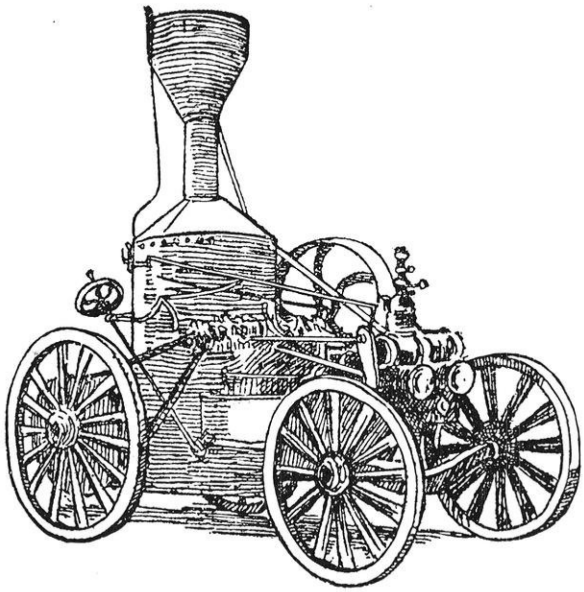
Section 1. There is hereby appropriated the sum of ten thousand dollars—to be used as a bounty and to be paid to any citizen of Wisconsin, who shall invent, and after five years' continued trial and use, shall produce a machine propelled by steam or other motive agent, which shall be a cheap and practical substitute for the use of horses and other animals on the highway and farm.

Section 2. Any machine or locomotive entering the list to compete for the prize or bounty, shall perform a journey of at least two hundred miles, on a common road or roads, in a continuous line north and south in this state, and propelled by its own internal power, at the average rate of at least five miles per hour, working time.

Section 3. The said locomotive must be of such construction and width as to conform with or run in the ordinary track of the common wagon or buggy, now in use, and be able to run backward or turn out of the road to accommodate other vehicles in passing, and to be able to ascend or descend a grade of at least two hundred feet to the mile.

Approved by the Governor, March 2, 1875.

This bill was introduced and fathered by Honorable G. M. Marshall, who represented Adams and Wood counties in the legislature. Mr. Marshall was a mechanic and had experimented considerably in such matters. He wrote a very interesting letter from Kilbourn, Wisconsin, May 29th, 1914, concerning his



*The Pioneer Motor Car*

work and the part he took as chairman of the commissioners who judged in the contest between the competitors for the prize offered by the state.

In part, he says: "The little engine that came through without a breakdown, was made in Oshkosh for threshing machine power and work only. The commission reported that they found nothing of sufficient value to the people of Wisconsin to justify the reward of $10,000, or even a part, and that it was not a 'cheap and practical substitute for horses or other animals on the highway and farm,' and so reported to the Governor.

"Undoubtedly the automobile is now a success, but it is not the invention of any one man. The perfection of the gas engine for general use as a motive power for all purposes and the rubber pneumatic tire invented for the bicycle, combined, are in effect, the foundation of the automobile of today. The bounty and the law were failures as such, but the 'stimulus' and suggested soul or spirit of these, immediately started a new enterprise. Men and means were at hand, success was in sight, and now the automobile is spreading all over the civilized world.''

During the interim between the legislative sessions of '75 and '77 the prize offered attracted a great deal of attention. Many inventors were busy building machines to enter the contest, and it was found necessary to have some system to the affair. Accordingly, in 1877, the legislature amended its previous act by providing for a commission to have charge of the contest and to lay down rules to govern it. It was also provided that each contestant must file a notice that he would be in the competition. Reports on file reveal seven contestants in the field. The commission of three, the law provided, should include two experienced farmers, and must file a report with the secretary of state, who upon the approval of the commission was authorized to issue a warrant on the state treasurer for the prize money. Governor Smith named as the three commissioners, John M. Smith, of Green Bay; G. M. Marshall, of Big Springs; and Mr. Olin, of Jefferson County. The commissioners were to accompany the contestants in carriages.

It had been announced that six competing machines would be on the ground. For some unexplained reason only two of these started—those of E. P. Cowles, of Scott, and Shomer and Farrand, of Oshkosh. The Cowles machine was called the ''Green Bay'' and the other the ''Oshkosh,'' and from newspaper accounts, it is evident there was much rivalry. There were many amusing incidents during the trial from Green Bay to Madison, which attracted wide interest throughout the state. One witness said, ''Talk about your excitement: Barnum's circus was no greater attraction and horses could not be kept anywhere near the highway when it came along.'' Mr. J. H. Optenberg, of Sheboygan, who participated in the building and operating of the successful ''Oshkosh,'' has recently furnished the following account of the event:

''From the time the State Legislature of Wisconsin passed a bill in 1875 offering a $10,000 bonus to the inventor of a successful self-propelled vehicle adapted for agricultural purposes or a road wagon, the writer is thoroughly familiar with the history surrounding what may be termed 'the first successful self-propelling road vehicle.' The writer was one of the mechanics employed to build the engine which was named 'Hog,' and which won the prize. Afterwards it was purchased by the writer and used for a portable threshing engine for a considerable number of years.

"As above stated, immediately after a bill was passed awarding a $10,000 bonus, several gentlemen of Oshkosh with means decided to form a co-partnership to build an engine suitable to take this reward. As near as the writer's memory serves him, he will give the names: M. T. Battis, by whom the writer was employed; J. F. Morris, owning and operating a machine shop which he purchased from Bequitt-Davis Co., and where the writer was occasionally employed as a machinist and boiler maker; Isaac Gallagher, Frank Shoemar, and Anson Farrant. Anson Farrant, J. F. Morse, Herman Dohman and the writer were the four men employed to design and build the road wagon. This consisted of a vertical boiler containing 150, 1¾-inch tubes with a box heater rounding at the bottom, and which was horizontally attached to the side of the boiler. The king bolt casting was attached to the front and was provided with a coil spring and a standard steel axle stationary into one.

"Two engine cylinders 5 x 8, with link motion, were attached on top of the heater with the cylinders at the front end and the crank shaft near the boiler. The propelling device was a sprocket pinion on the crankshaft with an approximately 30-inch diameter sprocket wheel on the rear axle, which passed across the rear of the boiler. The center portion of the large sprocket wheel is where the differential gears were attached. The driving chain used at that time was of similar construction to those used on the automobile trucks of today. The steering gear was of a cone-taper roller construction attached to the front of the boiler at a height on the level with the front axle. Two chains were attached from this roller to this axle and were attached close back of the wheel hubs on each side, the chain in question wrapping around the roller several turns to allow winding on one side and unwinding on the other. The end of the roller shaft was provided with a worm gear, and to move this a worm gear pinion was attached to the end of the steering shaft,—a construction similar to that used on modern automobiles.

"The exhaust pipe from the engines was led over the boiler and there entered the side of conical chamber, or smoke-box, above the boiler. In the stack opening at the vertex of the cone a four-way exhaust nozzle was provided for the purpose of creating a good artificial draft.

"All wheels were made of wood. The front wheels had a 4-inch wide tire, whereas the rear was 6-inches wide with an extra tire beside the original tire, binding the wheel. This tire was fastened to wheel by means of bolts through a feller provided with a snake form of mud cork to prevent slipping.

"While the road wagon was under construction the state authorities were notified of our intentions to enter the contest. Legal steps were immediately taken to promote advertising and the Governor appoint three commissioners as judges while the road trial and test were undertaken. One of those selected was a man by the name of Smith, a mechanic from Green Bay. The other two gentlemen the writer cannot recall, but both were experienced agricultural men.

"Immediately Green Bay, Racine and some other cities reported that similar road wagons were under construction to be entered in the contest for this reward. In the Spring of 1877 or '78 the entry was made. The only two engines that made the entry to undergo this trial were the Oshkosh and Green Bay road wagons, for all other road wagons had dropped out. The Green Bay road wagon was of a horizontal fire box boiler type. The mechanism was very complicated, having a considerable number of gears. However, some credit must be given the Green Bay road wagon designers for their construction of a front axle steering knuckle similar to the ones which exist on the automobiles today. The writer had no knowledge of this being in use before that time.

"When the time came for the trial, the Oshkosh road wagon was shipped to Green Bay on flat-cars, for it was from here that the trip started. It so happened that the Green Bay wagon reached Oshkosh first, where a test was made on the old fair grounds, both in racing and pulling freight. The Green Bay road wagon with its gearing having a mechanism whereby various speeds could be maintained therefore had the advantage of higher speed on the road and lower speed for hauling freight, whereas the Oshkosh road wagon had but one speed for pulling freight around the city. This freight, incidentally, consisted of several heavy trucks laden with water logged lumber.

"It was found that the pulling capacity of the two road wagons was about equal, but when it came to racing on the fair grounds race track, the Oshkosh road wagon could not compare with the speed of the Green Bay wagon. However, when the Green Bay wagon had gone half way around, it came to a sudden stop owing to difficulties in the journals and gears, and the Oshkosh wagon passed, making the circuit at an average of eight miles an hour.

"The next day the 200 mile road trip was continued, the Green Bay wagon taking the lead by several miles until about half way between Oshkosh and Fond du Lac, when the Green Bay wagon stopped for repairs along the side of the roadway. The Oshkosh wagon then continued the trip. All went well until within two miles of Fond du Lac, when it was noticed that one of the front wheels was running tight on the axle. After spending about half an hour in repairs, the trip was continued. The Green Bay wagon was then far out of sight in the rear. Orders were then received from the commissioners to continue our trip to either West Bend or Janesville, when a halt was made to allow the Green Bay road wagon to be loaded on cars at Fond du Lac and shipped to either of these cities. Repairs were made and both were again ordered to start. This time the owners of the Green Bay wagon deemed it advisable not to use the fastest gear and to use the next speed slower. This speed made the Green Bay somewhat slower than the Oshkosh wagon. On reaching some point ten or fifteen miles out of Madison, we were again requested to halt until further orders from the commissioners. The next day the Oshkosh wagon received orders to proceed to Madison, where they arrived without difficulty with a record averaging six miles an hour during the whole trip, or one mile better than specified. The Green Bay wagon did not reach Madison at all and on the contrary was shipped back to Green Bay.

"Immediately after the test was made, the commissioners or judges met and disagreed on the awarding of the prize. It was then decided to refer the whole matter to the next legislature for final action. During the next session of the legislature it was decided and voted that $5,000 should go to the Oshkosh road wagon, which was duly paid and divided among the four owners.

"From the foregoing history it can be seen that Doctor J. W. Carhart and the gentlemen from Oshkosh deserve the distinction of being the first inventors of the self-propelling road vehicles in a crude form. No doubt some of the readers recall to their memory the above facts as near as the writer can remember them. If not correct I stand to be corrected."

*The Weekly Northwestern* of August 1st, 1878, reported the contest, giving the whole distance as 201 miles and covered in thirty-three hours and twenty-seven minutes, including stops for wood and water. The last comment was, "We left Janesville at 2:30 P. M. and arrived at Madison at 10:30. No runaways or broken bridges were left to tell the tale, and six hours and thirty-three minutes ahead of time."

The schedule was as follows:

| | Miles | "Oshkosh" | "Green Bay" |
|---|---|---|---|
| Green Bay to Appleton | 29 | 6:05 | .... |
| Appleton to Oshkosh | 20 | 3:30 | .... |
| Oshkosh to Waupaca | 36 | 6:25 | 4:30 |
| Waupaca to Watertown | 32 | 4:30 | 4:40 |
| Watertown to Ft. Atkinson | 22 | 2:10 | 3:10 |
| Ft. Atkinson to Janesville | 22 | 3:17 | 4:15 |
| Janesville to Madison | 40 | 7:27 | .... |
| | 201 | 33:27 | |

Could judges and others who in 1878 witnessed the trial of the two machines and saw the "Oshkosh" arrive alone at Madison, have seen the farm tractor demonstration recently held, with its hundreds of machines, and also the thousands of motor vehicles on the streets, not only from all parts of Wisconsin but from other states, it would have seemed like a dream come true. The tractor is now successfully operating on many farms, and this season will witness more than 112,000 motor vehicles upon the highways in the state of Wisconsin, where in 1875, the legislature was offering $10,000 to the citizen who might produce one.

# THE INSTALLATION OF A SUBMARINE CABLE ACROSS THE GOLDEN GATE *

By S. J. Lisburger, E. E. '03

One of the latest engineering feats of the Pacific Gas and Electric Company of San Francisco has been the completion of a circle of electric transmission from the mountain power plants direct to San Francisco by means of the recent installation of a submarine cable system across the Golden Gate. This work has demanded considerable skill and ingenuity on the part of its constructors, and the description of the encountered difficulties and the work involved is brought forth in the following article.—Editor.

In May, 1915, it was finally decided to carry out this project that had laid dormant so many years. To accomplish this, it was necessary—

First—To extend the 60,000 volt Cordelia-San Rafael steel tower line from San Rafael to Sausalito, and to erect at that point a step-down sub-station.

Second—To build a pole line 4,500 feet long from the sub-station across the government reservation on the Marin shore to the cable landing at Yellow Bluff.

Third—To lay two submarine cables across the Golden Gate, a distance of approximately 13,000 feet.

Fourth—To erect a cable terminal house on the Presidio shore in San Francisco and to extend four underground cables to sub-station "F," a distance of about 6,500 feet. This installation was designed to deliver into San Francisco 18,000 H. P. of hydro-electric energy.

As the voltage of the San Francisco distributing system was 11,000 volts, it was desired to make the cable installation 11,000 volts to conform with this. It was advisable and, incidentally, necessary to cross within the forbidden anchorage area between the Presidio shore and the Fort Baker shore in Marin. Considering the water conditions and shore landings and also the fact that it was the shortest distance between the high-tension station on the Marin shore and sub-station "F" on the San Francisco side, this was selected as the best route.

* Reprinted from the *Pacific Service Magazine* of the above-mentioned company.

### METHOD OF INSTALLATION

In considering the installation it was known that the cable of the size required could not be made in one continuous length and that it would be necessary to make at least ten splices for the completed cable. Furthermore, the problem of how to reduce splice and joint tension in the laying of the cable became a most important problem. This is due to the fact that experience has well demonstrated that it is impossible to lay successfully a cable which has been spliced on shore and mounted on a reel because the tension in the joints invariably results in electric failure of the splice. Not only this, for in making this installation consideration had to be given to the six-knot tide which prevailed in this channel, to the depth of the water, which exceeded 200 feet, and to the possibility of ships' anchors fouling the cable in the event of having to drop anchor in the vicinity. The question of repairing the cable should failure at any time occur, was also important, since the strain in lifting it from a two hundred foot bottom would be excessive.

It was, therefore, determined to use the messenger method of installation which had been used and successfully developed by Mr. A. J. Pahl of San Francisco. In this system a steel rope, known as the messenger, is first laid from shore to shore and anchored securely at both ends. This rope can be laid quickly when tide conditions are favorable and serves as a guide line for laying the power cable. When ready to lay this cable, the messenger is picked up at the shore end and is laid across a barge on which are mounted the reels for the power cable and an ordinary grip such as were formerly used on street railway cable cars. The messenger cable passes over sheaves and through the grip, which is operated by one man. At his will the messenger is allowed to slide through or to be clamped in the grip, and thus the operator absolutely controls the movement of the barge while it is being towed across the water by a launch. It should be understood, of course, that the messenger cable must be of sufficient size to withstand all strains imposed upon it and that the power of the launch towing the barge must not be in excess of the holding power of the grip.

With the messenger laid over the barge, the launch proceeds to tow at a rate determined by the man at the grip. As the power cable is paid out, it is attached to the messenger until a whole length of cable has been sunk. At this point the barge is anchored fast to the messenger, a splice is made at sea, and the towing proceeds. This operation is continued until the barge (which in this case held four reels of cable, approximately 5,000 feet in length) is empty. The free end of the cable is then sealed with a special lead sealing cap, securely attached to the messenger, and lowered into the water, after which process the barge returns to shore, underrunning the messenger to receive another load of cable. When ready to start laying again, the messenger is picked up at the free shore end, laid across the barge, and underrun until the free end of the cable comes up, when the splicing and laying is repeated as before. In this manner, the messenger takes all the strain and relieves the cable and all joints of tension.

### THE MESSENGER AND ANCHORS

The messenger in this case was a thirty-seven wire galvanized steel strand one and three-eighths inches in diameter, in one continuous length of 14,000 feet, having a breaking strength of ninety tons and weighing about four and one-half pounds per foot, so that the total weight of each messenger on the reel was approximately thirty tons.

Since there is no beach on the Marin shore and since the bluff rises in almost perpendicular fashion for over 120 feet, the landing at Yellow Bluff was by no means ideal. In order to anchor the messengers at the base of this bluff and just above the water's edge, short heading tunnels were driven into the rock about fifteen feet, and in these the anchor sheaves were located and held in place by concrete enclosure. The two tunnels, one for each cable, were located about 100 feet apart. The anchorage on the San Francisco shore was constructed on a sandy beach about 100 feet from the water's edge. On this account, the design was somewhat different from the others, although the iron structure in all the anchorages was the same.

To hold the messenger in the anchorage, a series of three bolt and single bolt clamps were used and over these, a mass of melted zinc was poured in order to assist the clamps. The bridge socket type of anchor was not used, for the reason that it might be desirable to change the tension in the messenger at some later date.

The anchorages were designed to withstand a tension equal to the maximum strength of the messengers.

### THE POWER CABLE

The submarine cables were three-conductor, 250,000 C. M. copper, each conductor having an insulation of 6/32-inch thirty per cent. Para rubber, over which was placed a 4/64-inch layer of varnish cambric. These three conductors were laid together in circular form with a jute filler, and over all a 10/64-inch varnish cambric belt was applied. The enclosing sheath was 5/32-inch layer of pure lead, over which two 1/8-inch layers of jute were applied. The latter substance was used in order to form a cushion for the wire armor, consisting of forty-two wires of No. 4 B. W. G. extra galvanized iron wires. Over all was placed a ⅛-inch layer of jute with a layer of sand and asphaltum for mechanical protection. The shore ends were of the same specifications as the main submarine cables, except that the conductors were 350,000 C. M.

Each cable contains a twisted pair of telephone wires, of No. 13 B. & S. copper, insulated with varnish cambric 2/32-inch thick, cotton braided and laid in the jute filler between the conductors and the outer belt of varnish cambric in the cable. In order that no ground be introduced into the cable, the telephone wires were protected at both ends by means of telephone insulating transformers. The shore ends were each 800 feet long, the main power cables being manufactured in lengths of 1,275 feet to the reel. The length of each completed cable was 13,250 feet.

The specifications required a test pressure of 30,000 volts for thirty minutes at sixty cycles, between conductors and between conductors and ground. This test was to be applied at the factory before leading and the same test after leading, except that the pressure was to be 25,000 volts under the latter condition. The telephone conductors were required to withstand a test pressure of 4,500 volts between conductors and between conductors and ground. The cables withstood all tests and on the final breakdown test required 100,000 volts to puncture between the conductors of the main cable and 46,000 volts to puncture between the conductors of the telephone cable. The 250,000 C. M. cable was four inches in diameter and weighed nineteen pounds per foot, whereas the shore end was four and one-quarter inches in diameter and weighed approximately twenty-two pounds per foot. The weight of the cable and the reel was approximately fifteen tons and the combined weights of the messenger cables, power cables and the reels approximated 380 tons. Incidentally it required fifteen flat cars to transport the entire shipment from the factory.

### CABLE TERMINALS AND ANCHORAGES

For a distance of thirty feet from the Marin shore the power cable was not attached to the messenger but was conducted through a channel which had been dug through the rock. From this position, moreover, the cable was housed in an iron pipe and completely embedded in the water at the shore line to protect it from wave action. As mentioned heretofore, the bluff on this shore is very steep, and it was on this account necessary to erect along the face of the bluff a series of concrete pillars approximately every ten feet. To these piers a channel iron was fastened, and to this were clamped the cable and a cover of heavy galvanized iron. At the top of the bluff the cable was laid in a concrete trench beneath the ground line. Although no attempt was made to anchor the main cable at the base of the bluff, it was found quite necessary to use cable anchors at the top. These anchors were of special design suited to this purpose. The submarine cables were terminated on separate riser poles, 25,000 volt Davis open air terminals being used for potheads for protection of the cable ends. On these riser poles, telephone insulating transformers were placed.

On the San Francisco shore the cable anchors were attached to the same concrete foundation as that used for the messenger, the type of cable anchor being the same as that used on the Marin side. As the beach is sandy, the cables were embedded beneath the water line, approaching the terminal house through a short concrete tunnel.

All metal used in the anchorages and protecting the cable at the shore ends was given a thorough coat of rust proof material, and all ducts and trenches were built in such a way as to insure the free circulation of air around the shore end cables. In this manner a minimum temperature was secured.

TESTING EQUIPMENT

In order that the cable be tested as the work proceeded a testing station was erected in a temporary shed built on the Marin shore and a 2,200 volt line extended from Sausalito to the cable landing. This station had a capacity of 200 k. w. at 22,000 volts and was equipped with a suitable water rheostat for voltage regulation. Each length of cable laid was tested with a megger, and when three lengths were spliced they were subjected to a two minute test from the testing station at a minimum pressure of 20,000 volts between conductors and between conductors and ground. When one complete cable had been laid it was subjected to a test pressure of 22,000 volts for three and one-half minutes between conductors as well as between conductors and ground.

CABLE LAYING EQUIPMENT

The barge used in the laying of the cable was of 125 tons capacity, seventy feet long with a beam of thirty feet, and when loaded had a freeboard of about 5 feet. When laying the messenger the axis of the reel was parallel to the short axis of the barge, and a 100 horsepower launch was used for towing. The same barge was used when laying the cable, but the cable reels were mounted with their axis parallel to the long axis of the barge; in this way the barge was least affected by the prevailing action of the tide and the waves in the channel. The tow for the cable-laying equipment was a 50 horsepower launch. However, during very heavy tide run, two launches were necessary for towing the equipment.

On both sides of the barge grooved cast iron sheaves, 40 inches in diameter, were securely fastened to the deck, a rigging being provided to prevent the messenger cable from leaving the sheave no matter what position the barge might take. The cable was fed from the reels around rolls through the serving machine together with the messenger cable, the two being tied together by the machine in question.

This serving machine, which was driven by a gasoline engine, consisted of two circular iron rings mounted in an iron frame, the rings being made to revolve by a friction drive so arranged that the machine could be stopped or started by the movement of a handle. Removable jaws in the cast iron rings were provided so the machine could be slipped over the cable and the messenger. Two spools of No. 6 galvanized iron wire were held between the rings and the outer edges. In this way when the cable and the messenger were allowed to travel through the serving machine, the rings were made to revolve and the machine would wind around the cable and the messenger a serving of the two wires. Every twenty feet the movement of the barge was stopped by means of the grip and a considerable number of turns wound around the cable and the messenger at one point. This was done to secure the attachment of the cable to the messenger at least every twenty feet in the event of the breaking of the serving wires between these wraps. Formerly the work of serving was done by hand entirely and was a slow and tedious process. However, with the development of the serving machine for this installation the work was greatly facilitated and much better performed. The speed of cable laying was about eight feet per minute.

THE JOINT

After a length of cable had been laid out, the messenger was made fast in the grip on one side of the barge, while on the other side the messenger and the cable were lashed to the sheave. To make the joint mechanically strong, it was necessary to lap the armor for fifteen feet; and in order to get sufficient armor for this lap it became necessary to cut off fifteen feet of cable from that end which projected from the water. This armor was then folded back and held in place and shape by means of holding rings, it being necessary to maintain the original shape of the armor to obtain a good fit when laying it back in final position.

The copper conductors were sweated together; four layers of pure rubber tape were applied over each conductor; and over this alternate layers of forty per cent. and thirty per cent. Para rubber tape were wrapped until the insulation on each conductor was approximately fifty per cent. greater than the original rubber insulation. Over the rubber tape seven layers of high grade varnish cambric tape were applied. The telephone conductors were then spliced and treated with varnish cambric for insulation. In order to lessen the induction in the telephone system, the twisted pair was transposed at every joint, so that in the completed cable the telephone pair lay first between legs 1—2, then 2—3, and then 3—1. Varnish cambric spacers were now inserted between the power conductors and the whole joint made ready for the lead sleeve. Following this process, a single lead sleeve, $4\frac{1}{2}$ inches in inside diameter by 5/16 inches thick and 24 inches long was wiped to the main sheath. Immediately afterwards, the joint was filled with ozite, poured at a temperature of 460° F. This size of the sleeve insured a belt of approximately one-half inch of compound around the joint between the insulation and the sleeve. The temperature at which the compound was poured served not only to fill every crevice but to vulcanize the rubber tapes on the conductors in such a way as to form a homogeneous mass equal almost in quality to the original insulation. After this was done, the joint was sealed and wrapped with burlap dipped in hot insulating compound over the splice, care being taken to fill the space at the point of wiping in order that there appear no humps between the cable proper and the splice. This was necessary owing to the fact that any unevenness at this point made the replacing of armor and the serving wires quite difficult.

The armor wires were then brought back into place and the serving machine was again brought into action as before, except that the serving wires were now fed through slotted bars attached to one side of the circular revolving cast iron rings. Since the barge was held fast to the messenger, the serving machine was mounted on rollers, and as the serving wires were laid over the joint, the machine forced itself along. Every twelve inches the serving wires were soldered together to protect against the wire unwrapping for any distance in case of its breaking. Here again the serving machine accomplished in one hour the work that was formerly done in eight hours by hand. After the joint had been served it was carefully paid overboard, every effort being used to protect it against undue strains. The cable was not attached to the messenger for a distance of about eight feet on each side of the splice, and thus the splice was allowed freedom of movement independent of the messenger. With prevailing wind and tide conditions it required on an average twenty-four hours to pay out one length and to make a splice. There were eleven splices for each completed cable.

LAYING THE LAST LENGTH

Cable laying was continued in the manner described until within approximately 800 feet of the shore, at which point the cable was sealed, attached to the messenger, and dropped overboard. The barge was then towed to shore and turned around, after which the messenger was again picked up and the shore end pulled into the beach. After the shore end was made fast cable laying was resumed, the shore end being paid out until the end that was dropped overboard appeared. At this point, the final splice was made; the cable and the messenger were then underrun to a point midway between the two splices, hoisted over the reels and then gradually lowered to the bottom by means of ropes. This method was pursued, since it was the easiest way by which the shore end could be handled. Furthermore, there was no difficulty in handling this because enough slack had been left near the shore to allow hoisting overboard as above described.

PROGRESS OF THE WORK

As the prevailing trade winds and fogs are at their worst during the summer months, and as the winter storms usually commence early in December, it was necessary to prosecute the cable laying during the months of September and October. All equipment being provided and having consulted all tide tables, the first messenger was laid on the morning of September 18. Laying of the power cable was commenced September 26 and was finished on the afternoon of October 7. The work on the second cable was started October 16 and completed and tested on October 30. Extremely heavy tide runs occasioned considerable trouble, the force of the tide being strong enough to cause the messenger to slip in the temporary anchors while the barge was near the center of the channel. This indicated that the force of the tide was sufficient to move the messenger cable, which between bar and shore amounted to a weight of twelve tons, in addition to the friction of the cable on the sandy bottom and the holding power of the temporary clamps. In the meantime work on the terminal house and the land cable connections was being rushed, and the tie-in between sub-station "F" and the submarine cables was completed and the voltage applied from the San Francisco on November 5.

It would be amiss at this time not to mention that the work of laying the cables was let by contract to Mr. A. J. Pahl, to whose experience and efforts much of the success of this work is due. The construction of the anchorages and the terminal houses was under the charge of our civil engineer, Mr. H. C. Vansano. To Messrs. Jollyman, Thompson, and those engineers of our staff who assisted in this difficult undertaking, the thanks of the writer are given.

# DEVELOPMENT OF ENGINEERING SHOP COURSES AT WISCONSIN

A. L. GODDARD
*Superintendent of Shops*

Thirty years ago there were required nine hundred and forty hours of shop-work in the mechanical engineering course. This included the design and construction of a "senior model," which at times, was rather a pretentious undertaking. Some of the more elaborate of these models were a steam hammer which is still giving good service, a gas engine with slide valve torch ignition, a vertical straight line engine with balanced slide valves, a compound pumping engine which was the principal unit of University pumping engine for eighteen years, and a twelve inch stroke, Whitworth quick-return shaper.

Twenty-five years ago the shop-work requirements had been reduced to seven hundred and twenty hours. The electrical engineering course had been established, and the time formerly devoted to shop-work had been used to provide opportunity for broader education in other engineering subjects.

This policy of transferring time to other subjects has progressed until at present we have three hundred and sixty hours of work required in the University. In addition, however, there are required not less than seven weeks of commercial industrial practice.

With this lessening of the time given to shop-work has come the necessity for more intensive instruction. At first the more advanced courses were dropped or shortened, while elementary courses were continued with little change; but with continued study of the subject, what seems to be a fair balance has been secured. Moreover much study has been given to the improvement in methods of instruction and in conditions under which instruction is given. Formerly, a large amount of individual instruction was given, and in consequence, less ground was covered. At present, in all elementary courses the same work is required of all members of the class, and the instruction is given by a demonstration lecture calculated, when possible, to provide instruction in work which shall require from one to one and one-half hours. Follow-up instruction to correct misunderstandings and mistakes is generally individual in character but if there seems to be general trouble with any one feature, a group or the whole class may be assembled again for further instruction. The demonstration lectures are given by each instructor for his classes.

The general purposes of the courses in shop-work are: First, as an essential mechanical engineering subject, to acquaint the student with the principles and the elements of the methods of metal manufacture; second, as a subject correlated to machine-design, to provide the knowledge of constructional methods necessary to intelligent machine design; third, as an educational principle, to provide a manual training course. It is neither considered possible nor important that skill be acquired, but progressive excellence of workmanship is expected and generally secured.

Thirty-eight credits, including military drill and physical training, are required in the first year. Of these, four credits are shop-work, requiring two hours per week or about one hundred and twenty hours for the year. In the second year, three credits, or about ninety hours; in the third year, two credits for about sixty hours, and in the fourth year, three credits again are required.

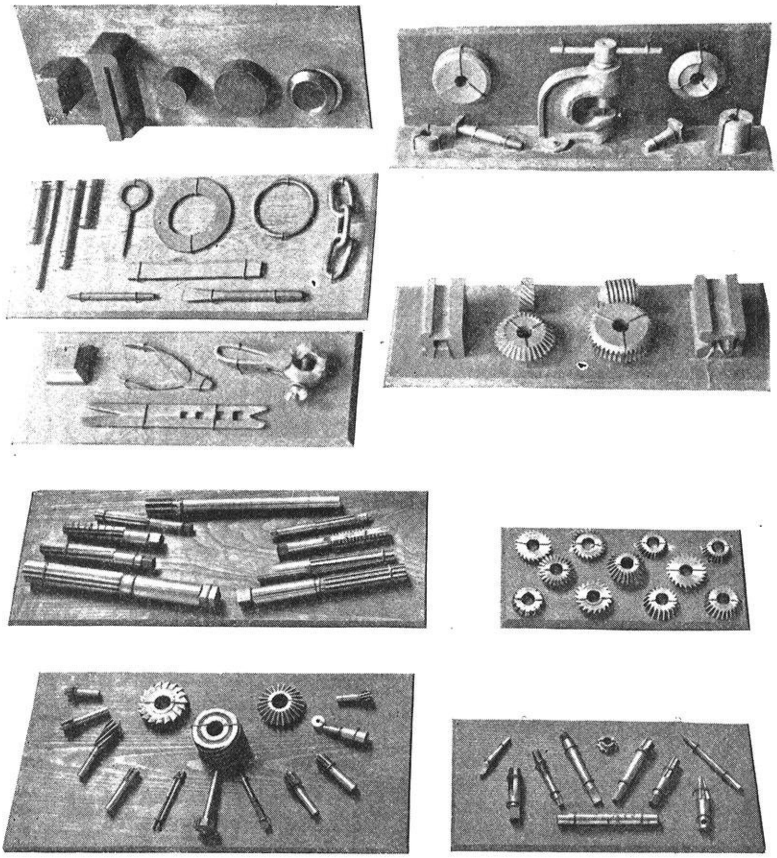
The courses in the first year, first semester, are: elementary pattern making, one credit, forging, one-half credit, and bench work in iron and steel, one-half credit. The pattern-making does not begin with any exercises in the use of tools, but takes up the subjects of draft, finish, and shrink at once. By the use of baked sand and linseed oil molds, cut in section, the uses of the pattern are shown, while in a molding tub kept in the lecture room for this purpose a mold is made so that the student need not lack for a clear understanding of the function of a pattern. Some elementary instruction in mechanical drawing must be included in the first few lectures, until the regular classes in mechanical drawing have passed the lettering stages and have taken up projection, since in the pattern shop, the student works from sketches which he copies from the blackboard into his note-book.

Since the aim is to develop an understanding of the subject, rather than skill in performance, the student uses bench tools for only a part of his work. He uses both the band-saw and disc-grinder to gain the contrast in methods and in order to cover a larger variety of work. About the middle of the semester he finishes his bench problems and goes to the foundry to mold them. This often develops the necessity of correcting his patterns for draft and smooth finish. After this he takes up several lathe problems, including a two piece pattern to be turned with a tenon and recess. He also finishes several cylindrical or disc-shaped patterns on the disc-grinder and in this way learns the advantages of this method over the lathe. The student also molds up these patterns in the foundry. Whenever possible during the semester several heats are taken off in this foundry, and most of the students have opportunity to watch this work. The advanced pattern making and foundry course, which comes in the fourth year, will be described later.

The course in forge work includes all the standard processes, but owing to the fact that this course uses only about fifteen hours, there are fewer exercises than were formerly included. In welding, one ring weld, one two-piece weld and three chain links are made. In tool steel forging, a chipping chisel, a cape chisel, and a prick punch are forged and tempered. In brazing, a ring joint is brazed. This course was reduced from forty-five hours to fifteen in order that the other thirty hours might be available in the fourth year for a course in heat treatment of steel.

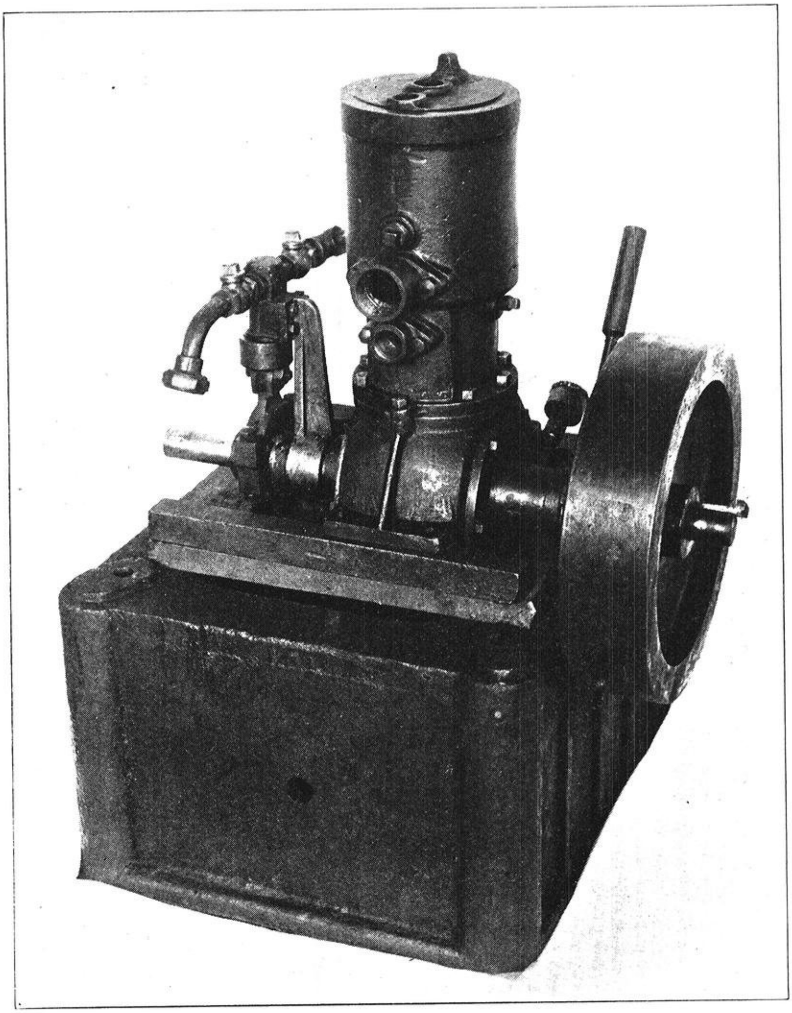
The course in bench work, also of fifteen hours, includes chipping, filing, polishing, drilling, tapping, thread cutting with dies, and bending and fitting thin metal. Part of the surfacing is done on the disc-grinder to contrast hand surfacing, the oldest and most expensive method, with disc-grinding which is the latest and by far the cheapest method.

In the second semester of the first year elementary machine work is taken up. About thirty hours is given to lathe work and as much to planing, milling, and gear cutting. The lathe work includes the manufacture of planer bolts, a hand screw-punch with cast iron spindle, and gear blanks. This includes almost every standard lathe operation, and in this, a moderate degree of accuracy is always required. The planer bolts are made in pairs, a short one and a longer one, and usually the one threaded first is not usable. Satisfactory performance is generally secured with the second bolt. Gear blanks may be under size; this is allowed for in cutting the teeth, and the emphasis



*Second Year Shop Work*

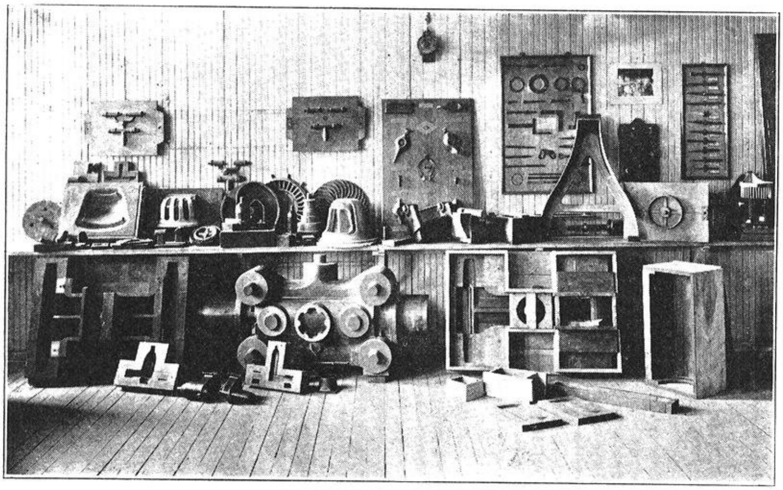
is thus given to the fact that the pitch diameter is the important dimension of a gear. The gears cut are, a "spiral" (or helical) gear, a bevel gear and a worm gear. The spur gear has been omitted for lack of time, as all the principles involved are included in the others. To hasten this work, the students work in pairs when cutting gears, and the time saved in setting up the machines, as well as their discussions of the points involved, generally results in a better understanding of the work. All gears are finished completely and are tested on fixtures prepared for that purpose. In all of this work the students grind their lathe and planer tools, but not their milling cutters.



*Third Year Shop Work*

Inasmuch as many of the students seek employment in machine shops during their summer vacations, there is an advantage in giving instruction in machine work during the first year. The students have greater confidence in soliciting employment and often secure a better class of work. Moreover they are able to understand far more of what is going on in the shops during their employment.

In the first semester of the second year sixty hours are given to tool making. This includes the making of a tap, a reamer, a punch, and die, a mandrel, and one or more milling cutters. Greater accuracy is required in this work. The hardening and tempering is of a more delicate character than that done in the first year forge work. The cutting edges produced on these



*Senior Pattern Work*

tools are different from those which were produced on the lathe and planer tools. The operation of the universal grinder and the grinding of reamers and milling cutters imparts a keen impression of accuracy of measurements, although nothing like the accuracy involved in fine gauge making and work of that character is attempted. During this semester also, thirty hours is given to foundry work. Bench molding, core making, machine molding, and cupola practice are taken up.

In the first semester of the third year sixty hours have been applied to individual work in machine construction. Those students who have desired to make any particular piece of work have been given instruction in such work. A number of students have made small launch motors, in which case they purchased their own material. This has required electing additional shop work. But the outcome has frequently been such that the pressure of other work has resulted in neglecting the work on the motor, and this would be sold in an unfinished condition to some other student.

Beginning this year, this third year shop-work course will be, not a problem in machine construction, but a problem in manufacturing a single cylinder row-boat motor. Manufac-

*Ready to Pour in the Foundry*

turing problems have been taken up in the past, for a wood-turning lathe was manufactured here for several years. However, the objection was made to entering the commercial field on this basis, so this work was dropped. In the manufacture of the row-boat motor, a number of motors equal in number to the students in the class, will be carried through to completion. Each student will perform his assigned tasks on all the motors. With this division of labor, and with properly developed methods, the motors should be completed and tested out in the allotted time. Each student of the class may become the owner of one of the motors by paying for the materials. No accumulation of finished motors in stock is anticipated.

The time study, cost accounting, inspection and shop engineering of the above course will constitute a problem in shop management for the fourth year students. This will involve the division of these activities among the students of the class. Reports on articles in current technical periodicals and in treatises on these subjects will be taken up in seminar. Reports on the progress of the work in the shops will be taken up in the same manner, the object being to develop interest in the problems of shop management and in the literature of the subject, rather than advocating or practicing any particular type of management.

In the second semester of the fourth year thirty hours are given to advanced pattern making and foundry practice, and a like amount of time is given to heat treatment of steel. In the pattern and foundry course the students work in groups of three or four, and each group selects one of the various problems offered. These have been in the past a Corliss engine cylinder, core-boxes for same, patterns for a one-million gallon centrifugal pump, a frame for a key-seating machine, or skeleton patterns for pipe els. Problems particularly adapted to plaster of paris patterns are always included, since this offers a wide field for fruitful development, large patterns with surfaces of revolution being often finished in less time than would be required to prepare and glue up the material for a wood pattern. Sweep molding and further instruction in cupola practice is taken up also, and all the problems undertaken are discussed from time to time by the whole class. The students have by this time finished their courses in machine design, and the fact that constructional problems in machine design are shop problems is kept in mind and emphasized in this work.

The course in heat treatment involves the operation of oil-, gas- and electric-furnaces and the uses of base metal thermocouple pyrometers and optical pyrometers. The study of the thermal critical points in tool steel is also taken up. The effects of both good and bad heat treatment is investigated by means of the scleroscope and ball test. Carbonizing of mild steel, both in the box and in the cyanide bath, is performed and various heat treatments subsequent to carbonizing are practiced with investigation and discussion of the results.

Hardening, tempering, and annealing under various conditions are performed, and careful records of temperatures and treatments are made for comparison of results. The students work in groups of three taking turns as recorder, observer and operator. A first report is turned in for the group at the close of the experiment, and after being checked it is returned and final reports with charts are required of each.

There are required for graduation 14 hours of shop, and in addition to this, all courses in engineering require some summer work. That of the mechanical engineering course termed commercial industrial practice, is not less than seven weeks of constructional work, performed preferably with some establishment having a well developed system of discipline and methods, the principal object sought here being to acquaint the student with commercial conditions and to give him experience in securing employment. Civil and mining engineering students formerly took wood-working and forge work, but now are not required to take shop-work. Chemical engineering students take the first year's work of four credits or about one hundred twenty hours. Electrical engineering students take the first year's work and the tool-making course of the second year, making a total of about one hundred eighty hours or six credits.

# THE NEW RESERVOIR FOR THE HYDRAULICS LABORATORY *

By Charles I. Corp
*Associate Professor of Hydraulic Engineering*

One of the needs of the Hydraulics Laboratory of the University of Wisconsin has been a good supply of water under a moderate but very steady head. This need has now been met by the completion of the new concrete reservoir located on the bluffs rising just shoreward from the laboratories. At the selected site, the ground elevation is approximately seventy feet above the level of Lake Mendota, giving a head of over fifty feet in the laboratory.

The reservoir, circular in form, has a capacity of 220,000 gallons. The inside diameter is fifty feet and when filled to maximum capacity, the water is fifteen feet in depth. Figure 1 is a photograph of the reservoir as one views it from the campus, looking toward the lake. As can be seen, it is covered by a flat reinforced concrete roof, surrounded by a parapet wall thirty inches in height. As the ground is sloping, the top of the parapet wall on the lower side is six or eight feet above the surface, but just level with it on the upper side. Along this side, for about one-sixth of the circumference, steps are substituted for the wall, and thus one is enabled to descend directly onto the reservoir roof. An excellent view of Lake Mendota can be had from here, and the addition of seats other than the wall would make it an even more popular resting place and observation point.

## CONSTRUCTION

Before excavating was begun, it was expected that the earth would be firm enough to be used as the outside form for the concrete wall, but a very fine sand was encountered three or four feet below the surface, making it necessary to erect both an inner and outer form for the wall. In constructing, reinforcements were put in place and the forms carried up to the top of the main reservoir wall. Wooden spacing blocks were used to

* J. Roherty, contractor.

separate the forms, the tension in the binding wires being sufficient to hold them in position. As the concrete was poured, these blocks were knocked loose by a heavy weight on the end of a rope and thus removed. For all purposes, a wet mixture of 1 : 2 : 4 concrete was used.

This construction was done in the middle of winter, and to prevent freezing a tent was erected over the reservoir and the whole tent kept warm by fires in salamanders placed in the bottom of the pit. All materials were heated before mixing. After

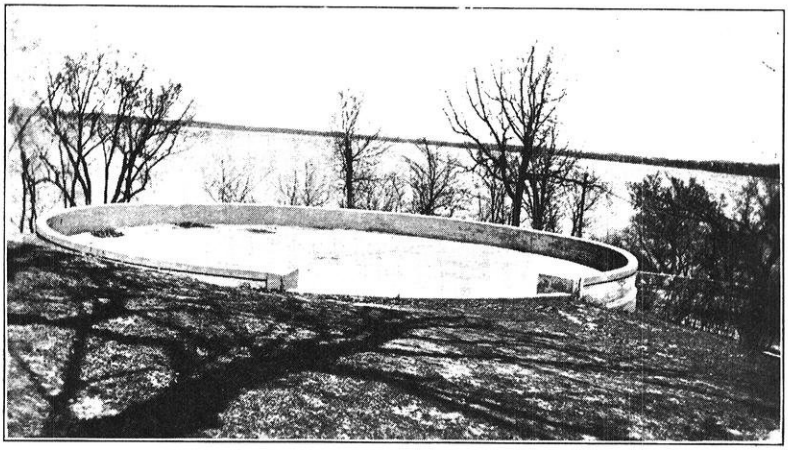


FIG. 1

the outer cylindrical wall was poured, forms were built in for the columns to support the roof and for the roof itself. The parapet wall was built up at the same time, whereas the floor or the bottom of the reservoir was poured last. Reinforcing rods had been left extending from the wall at the bottom in order to take care of the tendency of the floor to break away at the juncture of floor and wall.

When the forms were removed after two or three weeks, the interior appearance was very good, and except for one or two small patches, the materials appeared well mixed. When completed and tested, a leakage of fifty cubic feet per hour through the walls was found. The greater part of this, however, was through the one or two defective places evident when the forms were removed. These were mended and the reservoir made practically water tight by two coatings of 1 : 1 cement and sand mixed to a thin consistency and thrown on with a brush.

RESERVOIR DETAILS

Figure 3 is a drawing which shows the various details of the reservoir. As may be seen the vertical wall is eighteen inches thick at the bottom, tapering to twelve inches at the top. It is reinforced by both longitudinal and vertical bars, but some dependence is also placed on the earth work that surrounds the reservoir. The flat slab roof is designed to carry a live load of 150 pounds per square foot. It is supported in reinforced concrete girders which rest upon columns.

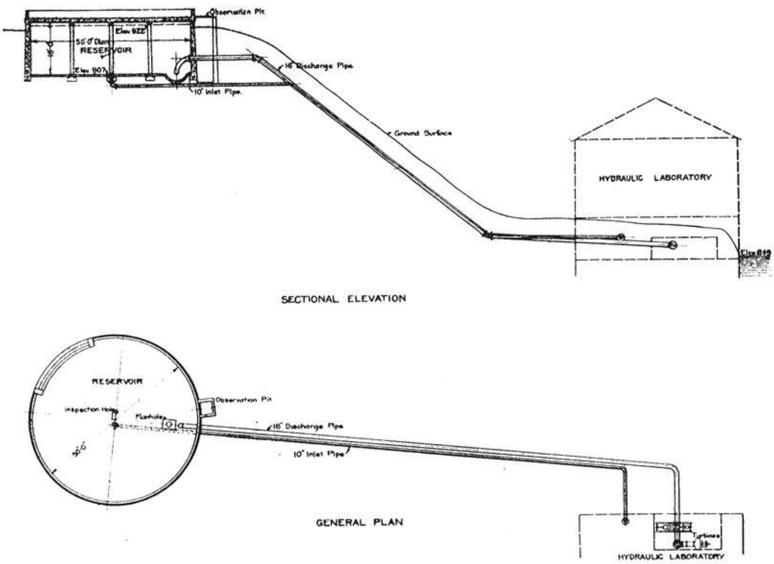



FIG. 2.—*General Elevation*

The supply pipe, which is ten inches in diameter, passes beneath the floor of the reservoir, turning up through it at the center of the tank. It is surrounded at this point by a rectangular block of concrete to prevent leakage. The discharge or delivery line, which is sixteen inches in diameter, enters the reservoir four feet above the floor. Two pipe flanges are attached to it and are embedded in the body of the wall through which the pipe passes to insure a permanent water-tight joint. This pipe terminates in the interior with a long sweep elbow whose lower end is just level with the floor line. At this point a sump has been made in the floor. This sump is provided with a drain which terminates in a valve at the bottom of the observation pit.

This observation pit is constructed just to one side of the point where the delivery line passes out of the reservoir. It is four

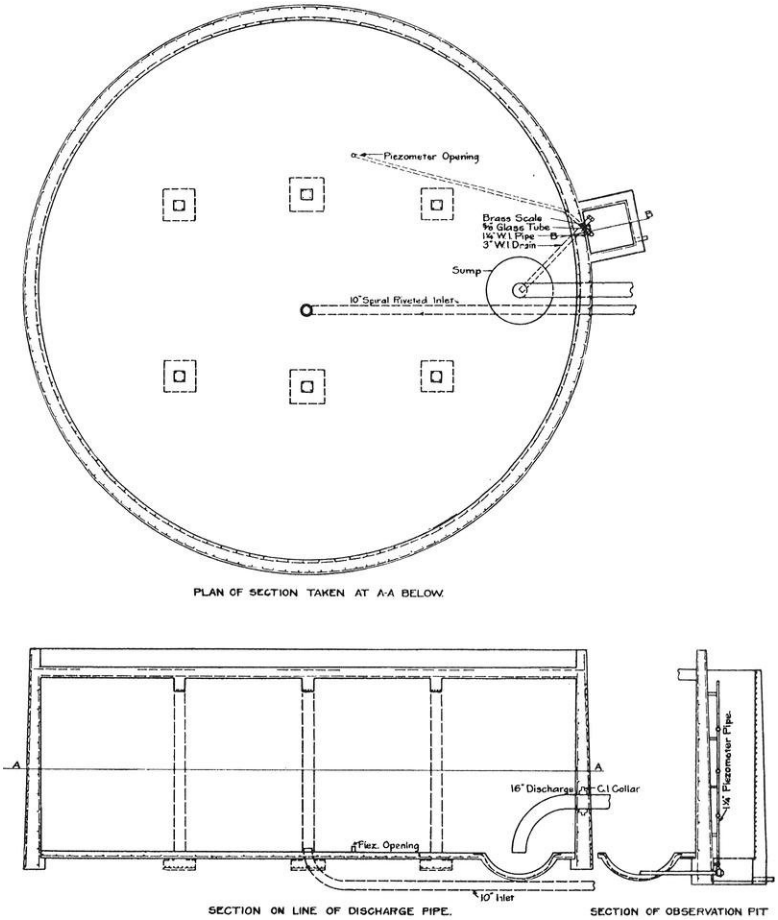



FIG. 3.—*Reservoir Details*

feet by four feet on the interior and extends from the top of the reservoir wall to a depth somewhat below the level of the floor line. In the bottom is a tile drain to carry off any water which may escape into it. Leading from this pit, through the reservoir wall and beneath its floor, there extends an inch and a quarter pipe which turns up through the reservoir floor about twenty-five feet from the pit and twelve to fifteen feet from the reservoir supply line. Attached to this pipe in the observation pit is a riser to which are fastened gauge glasses at various elevations. A single brass scale, reading to hundredths of a foot, extends from a point opposite the floor level to the top of the pit, and is so located with reference to the gauge glasses that by means of a vernier, the elevation of the water in the reservoir may be read to the nearest one thousandth of a foot.

A piezometer connection leads from the observation pit to a point on the delivery pipe about fifteen feet from the reservoir. Furthermore there are at present four openings into the reservoir blanked off. These are intended for future gauge connections to make possible the investigation of pipe entrance losses.

CONNECTIONS TO THE LABORATORY

Two pipe lines connect the reservoir with the laboratory, one a ten-inch supply and the other a sixteen-inch delivery. These are both asphalt covered, spiral riveted pipe. In the laboratory, the ten-inch line terminates in a twelve-inch line into which water may be pumped either from the University pumping plant or from the pumps of the laboratory. The sixteen-inch delivery pipe leads to two turbine water wheels in the laboratory and is also arranged so that other connections may be made to it. A gate valve is placed in the line about fifteen feet from the laboratory, by means of which any head from zero to the available maximum can be maintained in testing. To make it possible to observe the water level from the laboratory when both the supply and delivery lines are being used, a one-inch pipe laid in the same trench with the larger pipes, leads from the observation pit to a gauge within.

CALIBRATION

The reservoir has been carefully calibrated so that the amount of water discharged from it between any two gauge readings may be accurately determined. This was done by first filling it and permitting the water to flow in small increments into a calibrated tank in the laboratory. The latter tank was calibrated by pouring into it weighed quantities of water. In this way the quantities of water for every one-tenth to two-tenths drop in the reservoir water surface were obtained.

ADDITIONAL ADVANTAGES

Previous to the completion of the reservoir, it was very difficult to calibrate the larger weirs and usually necessary to resort to indirect methods. With the present reservoir a weir located at any point in the laboratory can be readily and accurately calibrated.

The question has arisen as to the accuracy with which laws between the head, discharge, power, etc., of turbines may be applied when comparing their performances with different heads. Using the reservoir as the supply, tests are now being run in the laboratory to obtain experimental data on this point.

As indicated above the reservoir supplies a steady head for routine class work and makes it possible to conduct accurate experiments on entrance losses into pipes, on pitot tubes, and numerous other practical hydraulic problems on which information is needed.

# ALUMNI LETTERS

## TEN YEARS OUT

E. T. Howson
*Editor, Railway Maintenance Engineer*

### AN ENGINEER IN EDITORIAL WORK

Within recent years, the experience of engineering graduates in fields other than those which are strictly engineering has widened materially. For this reason the experience of the writer since graduation may be of interest to engineering students now in the field, as indicating a possible line of activity for them.

Having my work in advance of graduation requirements I left the University on May 1, 1906, to take a position as resident engineer in charge of twenty miles of heavy reconstruction work on the Chicago, Burlington & Quincy in Central Illinois, returning for graduation to secure my degree. During the next three years I was in charge of several construction and maintenance of way projects for the same road in various parts of Illinois. On August 1, 1910, I was appointed division engineer of the La Crosse division, extending from Savannah, Illinois, to Minneapolis. I was in charge of maintenance of way work and of the construction of second track which was then being started. This construction involved the building of the large freight terminals in Savannah, Illinois, and at La Crosse, Wisconsin, and the building of about fifty miles of second track, including a considerable amount of realignment.

On February 1, I left direct railway service to become engineering editor of the *Railway Age Gazette,* in charge of the engineering department of the weekly section, and the contemplated monthly Maintenance of Way Section, which was started four months later. On June 1 of this year, this Maintenance of Way Section was transferred into the Railway Maintenance Engineer under my direction as editor. In the five years of editorial work opportunity has been offered to visit the important construction and maintenance of way work in all parts of the United States and Canada and to become familiar with the important engineering developments. In writing on subjects of this character one has also been required to study into them more deeply and to investigate many problems which otherwise would be passed by.

## NINE YEARS OUT

R. B. Anthony
*General Manager, E. A. Wilcox Co., Chicago*

ENGINEERING AS A GOOD TRAINING FOR MANY KINDS OF WORK

On graduating I aspired to take an apprentice course with one of the large electrical manufacturing companies, but on account of the existing business depression these concerns were not adding to their forces. From what I have learned since, the apprentice course gives much to the company and little to the young engineer.

My first and only job was that of sales engineer for a company manufacturing recording instruments for industrial- and power-plants. This work took me to Pittsburg, which probably has more engineers to the square inch than any other district in the country.

The primary object of most of us these days is to earn an honest living and to lay by something for the future, as well as to get as much joy out of life as possible at the same time. It seems to me that the engineer is the most poorly paid of all professional men. Fortunately, however, an engineering education fits one quite well for other kinds of work and unless a man has unusual ability, he will do well to get away from it quickly. Chances for rapid advancement, I believe, are much better with smaller companies where the officials are able to know you and what you are accomplishing. In manufacturing, the managing and the sales department lead to the best position. The by-product coke industry is rapidly developing in this country and offers, I believe, greatest opportunities at the present time for the young engineer.

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## EIGHT YEARS OUT

Gordon Fox
*Process Engineer, Mark Manufacturing Co., Chicago, Illinois*

A FEW SUGGESTIONS AND PERSONAL OPINIONS FOR THE RECENT GRADUATE

Practical information on the job and familiarity with his working tools, electrical apparatus and accessories are the things which the recent electrical graduate lacks and which he must acquire to attain more than mediocrity. Excellent opportunities are now offered in the manufacturers' training courses for the graduate to acquire rapidly a wide range of information which will greatly aid him in future years. The writer is a firm believer in these courses.

Next to the actual contact with the apparatus at the factory, the best way to learn its whys and wherefores and to keep in touch with its progress is the technical press. No better investment can be made than a membership in the A. I. E. E. and a continuous subscription to the *Electric Journal,* the *General Electric Review,* and perhaps one or two other magazines representing one's special field of endeavor. These magazines need not be read from cover to cover as they arrive, but should be bound and filed with their indices in such a way that all available information on any specific subject may be readily found. In reading it is then best to read by subjects or to concentrate on one piece of apparatus at a time, rather than to read articles as they appear.

The writer has found an interesting, beneficial and fairly lucrative field in writing of the experiences incidental to the day's work for the technical press. No better way to master a point can be found, for writing undoubtedly clears and reviews a subject. In this way transient experiences are made permanent records. Moreover many of the trade journals are glad to receive contributions of this nature.

At present I am looking after the electrical end of a new steel mill which the Mark Manufacturing Company is now erecting at Indiana Harbor, Indiana. We hope to have a model mill and at some future date to be able to invite the engineers to visit our plant in connection with their inspection trip.

## SEVEN YEARS OUT

C. A. JONES
*Sales Engineer, General Electric Company*

### THE NEED OF THE BOOSTING SPIRIT IN WISCONSIN

You ask me to write "no more than two hundred words" and to cover such portions of our alumni life as might be interesting to the students and the other alumni. This fact comes to me red hot; it is a real issue. Since leaving school, I have covered a good part of the New England states. I have been in Chicago for a year and in St. Louis four years, and during my wanderings I have found that the University of Wisconsin was rather an unknown quantity in various New England centers where there were Wisconsin men. Generally speaking, the men of Wisconsin do not bunch together for their own good; there are no live Alumni Associations and no meetings; the men are unacquainted and are woefully weak in the advertising value that they could give themselves and their school. Illinois and Cornell are up and doing, their associations have meetings, and the news of their doings gets into the newspapers.

We entered a team in the Intercollegiate Bowling League here last winter and were champions. That is the first real pull-together proposition that I can recall. Wouldn't a circular letter directed to, say, a half a dozen men in each city where the alumni are numerous, inquiring of association conditions and boosting a concerted action, regular meetings and stunts be of some value?

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## SIX YEARS OUT

Lewis M. Hammond

*Assistant Engineer, United States Reclamation Service, Provo, Utah*

SUBJECT: HAS A WIFE, A FORD, AND A DAUGHTER

I came to Provo, Utah, in August, 1910 as the result of a civil service examination taken in Madison six months before, and I have been here ever since. I spent the first three and a half years in the various construction camps of the Strawberry Valley Project of the U. S. Reclamation Service and the past two and one-half years in the Project office here in Provo. On September 30, 1914, I was married to Anna A. Dobler, and our oldest daughter, Katherine Merrick, was born August 4, 1916. I have found time outside of my office work to do considerable work in one of the lodges in Provo. My one extravagance is a Ford roadster, purchased a year and a half ago, which has enabled us to see a great deal of the surrounding country and has paid for itself many times over in health and happiness, if not in dollars and cents. (This is not an ad.)

# FIVE YEARS OUT

C. O. Bickelhaupt
*Commercial Engineer, American Telephone and Telegraph Co., New York City*

## WORDS AND THE ENGINEER

The engineer, it has been said, is a man of deeds. However, this is a far from accurate statement of the case. The engineer, while concerned with deeds, is fundamentally a man of words. The possessor of the most brilliant engineering mind, the highest type of constructive genius, could accomplish but little if unable to convey his thoughts and ideas to others. He might conceive a structure in all its details; but to make it an actuality, he would be forced to construct it with his own hands unless he could tell others how to build it. He must be a man of words, a master of exact and logical statement, not only to enable him to function, but, what is equally important, to provide a market for his constructive ability—to sell his services.

The engineer is constantly forced to put his ideas and visions into words. Starting with a mental plan, he must build in words, that others may grasp his vision, may properly interpret it in materials, may accomplish his will, and finally that he may secure to himself the recognition due its conception. His task is to tell others.

Thus it is essential that the engineer, while perfecting himself in the technique of his profession, should devote much time and effort towards obtaining ease in expressing his thoughts. He must learn to write,—to write so that his words exactly, concisely and completely convey what he intends them to convey, no more, no less. To learn to write good engineering exposition is no mean task to be lightly approached. It is a work worthy of the highest endeavor. In proportion as an engineer is brilliant and capable will he feel the need for the ability of expression. No engineer will reach the high position to which his talents entitle him unless he can properly express himself. The pages of current engineering magazines show many examples of brilliant thought poorly presented, ambiguously stated, in some cases even successfully concealed, for want of a little care and effort on the part of the writer.

Employers have found through experience that technical graduates are not particularly apt in expressing themselves in writing. This is true also of graduates of non-technical institutions and is not the fault of the graduate, but of the educational system. There is a definite lack of attention to training in written expression that is apparent throughout the entire modern school system. My own experience, in connection with the employment of college men for engineering positions, has been that extensive and intensive training in report writing is necessary before they are fitted for responsible work. Learning to write is nine-tenths of the battle. This, I believe, is not clearly recognized by the majority of students, yet it is vitally important that it be recognized.

You asked me for a few words as to my experience since graduation and as to my personal ideas. I have given you both. My experience has been mainly in writing and trying to learn to do it properly; my personal ideas are that it is immensely important and that the engineer should early realize that he must be a master of words. Old J. Caesar built a bridge. If I remember rightly he built it with words—several pages of them. It was the lowly legionary, however, that hewed the logs, that toiled and heaved and sweated until it stood, a monument to a master mind. Who gets the credit today?

## FOUR YEARS OUT

JOHN FRASER, JR.
*Engineer, The Fraser Company, Milwaukee, Wisconsin*

THE OPPORTUNITIES THAT AN ENGINEERING COLLEGE OFFERS FOR COMRADESHIP OF MEN

In the winter of 1912, five senior mechanicals—Ward, Bennet, Prochaska, Richter, and Fraser—selected "Appreciation of Music" for a one-fifth elective course. When the remaining twenty-eight members of this notable class discovered the fact, they termed the course "Depreciation of Music." Naturally, "depreciation" was a very large word for some of them to use, but they had heard Professors Thorkelson and Mack use it and so believed themselves licensed to do the same.

Now were I to write a letter of advice or were I to tell of my experiences, I am sure that some of my fellow members of the class of 1912 or others even less interested would have the right to accuse me of being the accomplice to the "Depreciation of Letter Writing."

As a matter of fact that course in music came as close to solving some of my later problems as many others of the courses that we were required to take.

I can always remember that practically every instructor and professor of our classes kept pounding away at the word "foundation." "You are getting merely a foundation," they would say. And foundation it was, and one of the most important parts of that foundation was the association of all the different types of men.

One of the greatest advantages that our University affords is the comradeship of men, and there is no place like the engineering building to acquire this. Unless you hide yourself or continually and completely exclude yourself from the others, it is there waiting for you.

We shall talk this over at the reunion next June, and I only hope that others are looking forward to that time as much as the writer.

* * *

## THREE YEARS OUT

ROGER BUETELL

*Engineer, Crowell-Lundoff-Little Company, Cleveland, Ohio*

### THE NEED OF PRACTICAL EXPERIENCE FOR THE ENGINEER

With the exception of the six months spent in Chicago on the Soo Freight Terminal job, I have been in Cleveland since my graduation, learning how buildings are built. If I were to write this letter ten years from now, I should still be using the word "learning."

My experience has been that an engineer has to have three separate and distinct kinds of training, only one of which, his theoretical training, he gets from an engineering course. The other two, his practical training and his business training, he must acquire after he leaves school. Contrary to the beliefs of many senior engineers (my own case was no exception), an engineering degree means that its possessor is about one-third equipped to handle all the problems that an engineer may be called upon to solve.

By practical training I mean actual training in construction methods. This training is indispensable as an adjunct to the engineer's theoretical training. If I were not limited to two hundred words I would tell you why; I know that I personally have just enough practical training to make me wish I had a great deal more. I think that you will agree with me also, that the engineer of today must be a business man at the same time that he is an engineer. Without knowledge of business practice, of contract law, and of the relations of the engineer to his client and to the contractor, he would find his field limited to a much greater extent than he might be willing to believe.

I am writing, of course, from my own experience in a particular field of work, but I believe that if all the engineers of 1913 were to be consulted, most of them would agree with me.

## TWO YEARS OUT

CLAUDE BRODERS
*Engineer, French Battery Company, Madison, Wisconsin*

### TECHNICAL TRAINING AND PRACTICAL EXPERIENCE

The engineer who keeps his job possesses a wide practical and theoretical knowledge. Neither will suffice alone. A purely theoretical knowledge may give a man a good position; it may make him feel that he has an easy job, but it will not win him the esteem of the men who lead in engineering pursuits. It is impossible to cite an ideal case, but better still are examples, first of men of too little theoretical knowledge, and secondly of men of too little practical knowledge.

The chief operator and construction boss of a large power company gave detailed directions for paralleling the armature windings of a direct current booster. Instead of having jumpers placed at the commutator end, he caused the adjoining rear ends of the bars to be permanently soldered. He did not possess the theoretical ability to trace the connections from a wiring diagram. The work was done as specified, the machine was started and was ruined in the course of a few seconds. An able college graduate has stepped into the place of the former engineer.

The rotating cylinder on an ore dryer burst the rivets on several of the seams. A man of college training but of very little practical experience suggested that the metal be cleaned at the seams and that iron cement be applied to remedy the fracture. Can any one estimate the life of such a repair job? Possibly it might last long enough for the drum to become hot enough to give the forces of expansion to act. What esteem would such a college man gain among real engineers?

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## ONE YEAR OUT

E. T. LONG Loring

*Engineer, Dravo Construction Company, Pittsburg, Pennsylvania*

### TECHNICAL EDUCATION

In complying with your request asking for a few lines regarding my alumni life, I am pleased to say that although I am still rather young in practical experience, I can not help realizing more and more, as the time goes on, the great value of the technical training that one receives at the University of Wisconsin.

Immediately upon leaving the University, after one has completed an engineering course, he is apt to question the value of such an education, especially if the value of the dollar is known to him, but a few short months of practical experience with the association of other college men will make apparent the great worth of such an education. The ease with which the technically trained mind can grasp and analyze, not only engineering questions but questions of a widely different nature, as has become apparent to me through my association with men trained in this way, has certainly expelled from my mind any doubt which may have existed there as to the great value of a technical training. I am positive that as the time goes on I shall become more and more proud of the fact that I am an engineering graduate of this school.

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## EDITORIAL

One often hears the remark that it pays to go into engineering because of the abundant opportunities for rapid accumulation of money. This is a false idea that a majority of the men entertain when they undertake any specialized course. They choose a profession which offers the largest pecuniary inducements, whereas they should enter the field because they feel a natural adaptation to it, or, because of peculiar fitness they will be of greater service in that vocation than in any other. There is great danger of analyzing the wheat of a calling by the appearance of the husks and not by the quality of the kernel; and a prospective candidate for any profession could do well to examine closely to see whether there is not more than a legitimate amount of husks.

The alumni and the upperclassman recall many of the things that disillusioned them in their rosy estimate of the profession they have entered. We do not wish to discourage you, Beginners, in the pursuit of your chosen work, but we want to warn you of the necessity of having a reason for choosing it. If you have gone over the ground carefully and know that you will like it and that your biggest opportunities lie there, stick to it by all means and accept our welcome. If, however, you are only going into this occupation because some friend has told you that great financial gain will result—get out of it!

The big end in education is to fit us to make a LIFE. The little end is to help us make a living. If, Freshmen, you have come to an engineering college with these thoughts in mind we welcome you gladly and hope that all success may be yours. But remember, you will be expected as Wisconsin men to be broad engineers; so plan your course accordingly. Take the subjects that make for efficiency and service, in order that in after life the world may look upon you and say, "THERE GOES A MAN."

Alumni, we hope that you will find this year's volume of THE ENGINEER is up to your expectation. You are the men that make THE ENGINEER a paper that Wisconsin men will have reason to be proud of—for most of the technical articles deal with the work of the graduates. In the past your success in practice has given this school an enviable reputation. Will you not add to this by making our technical magazine the best in the country? As Moses had his followers hold up his hands so that the Red Sea would not drown them so we ask you that we may not be overwhelmed by a flood of mistakes. As we start out this new volume, we can not help but feel that you are with us, and we extend you the hearty greetings of THE ENGINEER.

At the beginning of the college year two classes of students are readily distinguishable in the campus population, the old student returning to renew his work and the new student who is here to begin his college course. The old student knows about what to expect and falls in line with ease and as a matter of course. He needs little direction and wastes little time in finding his place. A few are a bit too sure of themselves and need a word of caution. The new student is navigating unfamiliar waters and needs time to get his bearings. If diligent he will soon become used to his surroundings and find himself well started on his college journey. If he is careless and postpones the beginning of regular serious study he is apt to find himself adrift and flowing down stream, and a big effort will be necessary for him to recover the lost ground. Industry and common sense need to be applied to the situation.

The engineering faculty, through THE WISCONSIN ENGINEER, extends a warm welcome both to old and new students and hopes that the work of the coming year will be both enjoyable and profitable.

F. E. TURNEAURE.

* * *

There are several positions open on THE WISCONSIN ENGINEERING staff for those of our engineers who are willing to work hard and to work without being continually prodded along by the manager to see if the work has been done. What we want is a man who is a real engineer, a man who can do things. WE WANT A COUPLE OF MEN UPON WHOM WE CAN DEPEND FOR THEIR COOPERATION AND ASSISTANCE, MEN WHO WILL DO WHAT THEY SAY THEY WILL AND MEN WHO WILL TACKLE THE ORDINARY PROBLEM WITH ENERGY AND WITHOUT AID. Have you any realization of the scarcity of this kind of a man in this or in other universities? Strange as it may seem, there are but very, very few. We are depending on you for your support in maintaining and enhancing the reputation THE WISCONSIN ENGINEER has already established.

# CAMPUS NOTES

Professor Holden of Mining and Metallurgy is now on a two-year leave of absence to do mining work in Cuba.

Cuthbert Conrad c '15, who has been studying for his Master's degree in hydraulic engineering, will take the place of H. L. Garner, who has just resigned his position as instructor in hydraulics.

There are to be three changes in the chemical engineering faculty, the most important of which is our loss of Dr. Charles A. Mann, Assistant Professor of Electrical Engineering. Charles Hecker, who was an instructor at the University of Illinois last year, is to fill the vacancy created by Dr. Mann's resignation. We understand that Dr. Mann has accepted an associate professorship at Iowa State College, Ames, Iowa. The other changes are the substitution of Messrs. H. D. Valentine and E. C. Bain for Messrs. W. P. Pritz and C. W. Armstrong, respectively.

In the Mechanical Engineering department also there are several changes. We understand that Mr. A. E. Berggren is to return this fall to teach in his old place as instructor in Steam and Gas. A. O. Schmidt of Logansport, Indiana, is to fill the vacancy of W. J. Sansom, our former instructor in Mechanical Practice. Mr. Sansom has resigned to work in Freeport, Illinois, as a superintendent in a large manufacturing plant.

The other change is that of our old friend George Zurian, who leaves Mr. C. F. Peters of Pepin, Wisconsin, to take his place.

Since our last issue, two members of the Engineering faculty have been married. We extend our heartiest congratulations to Professor Phillips, who was recently married to a Miss Anna Moore of Madison, and to Mr. Hyland, who married Miss Celestine Sheridan last August.

In order to accept a better position with the Wisconsin State Railroad Commission, Mr. B. E. Miller recently has resigned his position as instructor in Electrical Engineering.

With the drowning of Huber Chapin, junior Chemical, Wisconsin has lost one of her most promising young engineers. The accident occurred a few days before the close of the summer session, while Chapin with several other University men, were sailing near Maple Bluff.

It is with considerable regret that we record the untimely death of Mrs. F. E. Turneaure, wife of Dean Turneaure.

Probably one of the best additions to the university equipment has been the construction of the new Physics Economics building on Charter street It is to be a simple classic structure, following the general order of design of the Wisconsin High School. For the present the central feature of the building is to be constructed with one wing, which will extend back parallel with the chemical laboratories. When finished it will stand four stories in height with a high basement, a beautiful building of brick with stone-terracotta trimmings. On the first three floors are physics laboratories, laboratories for research, physics seminaries, recitation rooms, libraries and offices, as well as an auditorium capable of seating 370. On the third and fourth floors are to be the lecture and recitation rooms, the accounting laboratories and the reading rooms of the economics department. With this great improvement that we have needed so long, the additional space thus acquired will conform admirably with our present needs and will undoubtedly increase the efficiency of the departments affected.