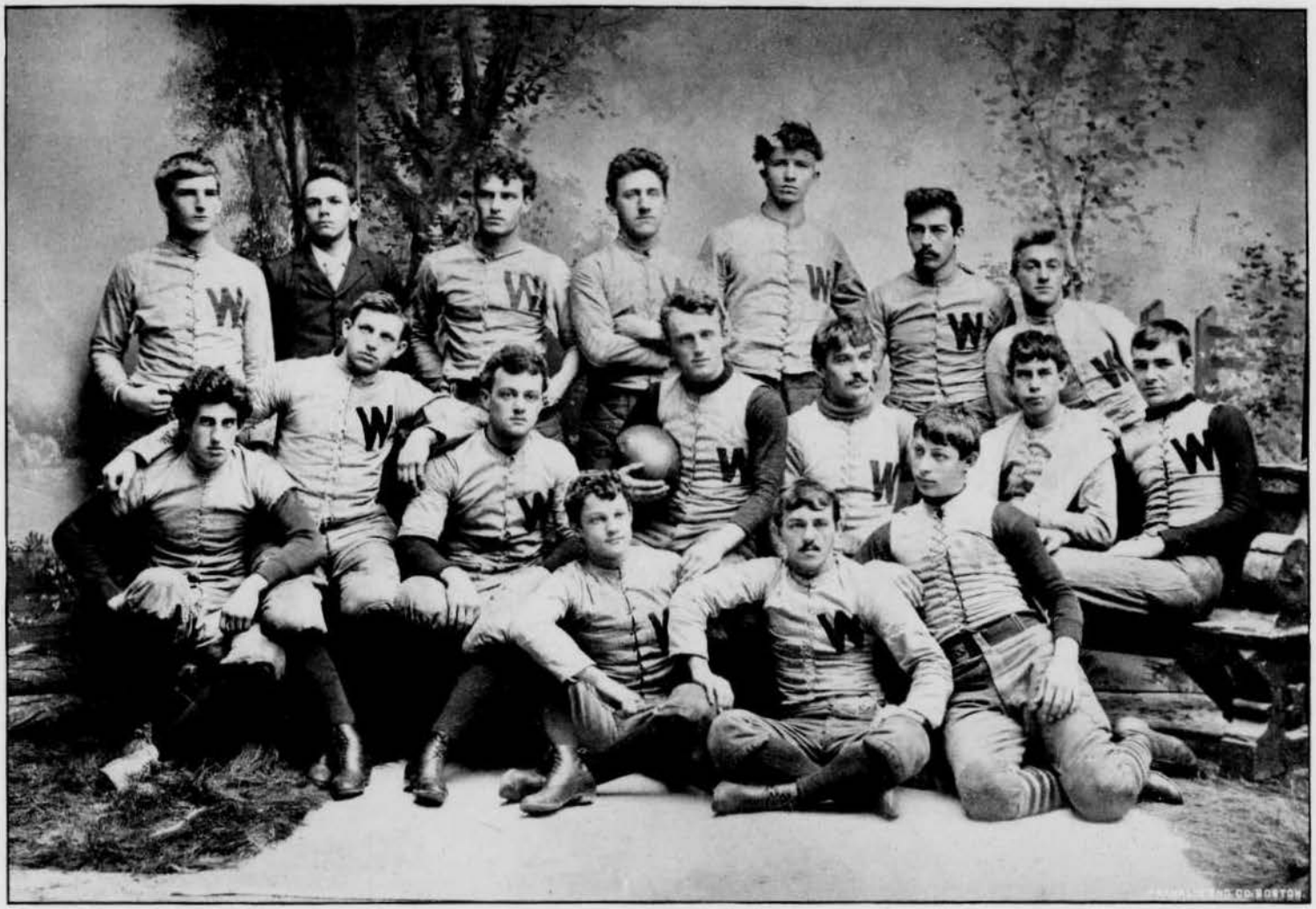
The Tech.

Vol. VIII. Thursday, November 24, 1892. No. 12

CONTENTS.

WORCESTER, MASS.

THE WORCESTER POLYTECHNIC INSTITUTE.



GOODRICH, '93. PHILLIPS, '93, MGR. BROOKS, '94. ROGERS, '93. BRIGHAM, '95. BUTTERFIELD, '93. WARE, '95.
STONE, F. L., '95. SMITH, '95. DAVIS, '95. ALLEN, '94, CAPT. SOUTHGATE, ELEC. HARRIS, '94. LINCOLN, '93.
CHASE, '94. ANDREWS, '93. STONE, F. H., '93.

W. P. I. FOOT-BALL TEAM. '92.

THE W P I

Vol. VIII. WORCESTER, NOVEMBER 24, 1892. No. 12

THE W P I.

Published on alternate weeks, during the School Year, and devoted to the interests of the Worcester Polytechnic Institute.

BOARD OF EDITORS.

A. C. COMINS, '93, *Editor-in-Chief.*
E. W. DAVENPORT, '94, *Assistant Editor.*
LOUIS W. RAWSON, '93, *Business Manager.*

NORMAN M. PAULL, '93. | HARRY L. COBB, '94.
NATHAN HEARD, '93, | J. M. GALLAGHER, '94.
ALFRED D. FLINN, '93. | HENRY S. FAVOR, '95.
NED C. THRASHER, '95.

ARTHUR L. CLARK, '94, *Assistant Business Manager.*

Terms: One Year, $1.50. Single Copies, 10 Cents.

☞ *Remittances and advertising matter should be sent to the Business Manager. Exchanges should be addressed: The W P I, Worcester Polytechnic Institute, Worcester, Mass. All other communications should be addressed to the Editor-in-Chief.*

CHAS. HAMILTON, PRINTER, 311 MAIN ST., WORCESTER, MASS.

It was a very pleasant thing which our new professor did a few days ago when he told the Seniors that hereafter he and his wife would hold open house on Tuesday evenings to those students who would like to call. Undoubtedly a student caller at the house of any professor would be welcome, but from invitations extended in the class-room, he would never know it. Tradition says that occasionally vague and general invitations have been given out in this way, but like most vague and general invitations, they mean but little. The invitation referred to however, is definite, and it is probable that a large number of men from the upper class will avail themselves of the opportunity thus offered for becoming better acquainted with their instructor. Such things as this tend to make students realize that they are learners and not victims, and that they have some interests in common with the Faculty, and not antagonistic.

WHAT TO DO WITH YOUR INVENTION.

I have been asked by the Editors of the W P I to give a little advice in the columns of this paper to the Tech students in regard to what steps they should take, and how they should proceed in order to protect themselves in any inventions which they might make.

I am very glad to comply with this request, and I hope that what I may say will be of value and of interest to the Techs, who, as a body, should become, and in all probability will become, prominent in the fields which so attractively lie before the inventive genius.

In common law, an inventor has no property in his invention. The only way a man gets any protection or property in his invention in this country is by letters-patent.

The foundation of the system by which letters-patent are granted in this country is, that only one patent shall be granted for one invention, and this is carried out, except where the office makes mistake, or under a certain state of facts, which will hereafter be explained.

Of course, it is easy to understand, that if a man makes an invention, and that he adequately covers the same by letters-patent, and no one else sets up a claim that the patentee is not the inventor, then the patentee will hold absolute and clear title to his property or to his invention; but it is sometimes the case, and especially the more so if the invention is of value, that rival claimants appear in the field, each claiming to be the inventor.

In anticipation of these disputes, and to provide a court in which they could be settled in the first instance, Congress has enacted laws by which, when two men appear before the Patent Office with applications, each claiming the same patentable invention, then a trial will be had, and the patent will be granted to the one, who, upon the evidence, appears to be the inventor.

These proceedings are called interference proceedings; and the decision of the Patent Office in these matters is final, so far as the granting of the patent is concerned, although the decision made by the Commissioner, under certain circumstances, may be reviewed in Court.

It would be a hard and unjust rule, if the fact that a man had already obtained a patent before

another person who was in reality the inventor, should file his application in the Office, if the latter would not be heard. So the fact that one man has obtained a patent will not prevent an interference; for although the Commissioner has no power or jurisdiction whatever to cancel a patent, he may grant another patent for the same invention to a person who proves to be the prior inventor.

Thus, there can arise a state of affairs by which two patents may exist upon the country for the same invention; although, of course, the second one would by the record be the dominating patent, and the second patentee would, under the practice of most of the Equity Courts, be enabled to get an injunction to prevent infringement by the first patentee, without further procedure.

Thus, it will be seen that contests arise, and are very often of great importance by which two men claim the same invention, and it is the purpose of this article to give some points to the future Tech inventors, by which they will be in a position to better make their proofs, should they be unfortunate enough to get involved in one of these proceedings.

The question, who is the inventor of a disputed device, may be said to be a mixed question of law and fact. The mere fact that one man was the first to conceive does not, in the eye of the law, make him the inventor. The Patent Office requires a statement called the "preliminary statement," and evidence upon the following points: first, the date of the original conception of the invention; second, the date upon which a drawing of the invention was made; third, the date upon which a model of the invention was made; fourth, the date upon which the invention was first disclosed to others; fifth, the date of the reduction to practice of the invention; and sixth, a statement showing the extent of use of the invention.

The general rule followed in these cases is, that if he, who is the first to conceive, uses reasonable diligence in reducing to practice, he will be considered the inventor, although another person, who is subsequent to conceive, first reduces to practice.

The important points, therefore, in a contest of this character are the original conception, and the reduction to practice. The exact date and time of the conception of an invention is generally pretty hard to prove, as it is an act of mind, which is supposed to be intuitive, and it would be difficult to conceive how a man could show what particular act his brain performed at a certain time. So the making of a drawing, the making of a model, and the disclosure to others, are considered as evidence tending to prove the fact of conception; but if a man conceives an invention, makes a drawing of the same, discloses it to others, and makes a model, he has not yet done enough to protect himself so that he can be considered the inventor. He must reduce the invention to practice.

This reduction to practice may be in two ways: first, it may be a material reduction to practice, which is the making of a practical machine, or practically exploiting the invention; or this reduction to practice may be constructive, and a constructive reduction to practice is the filing in the Patent Office of an application for a patent, in proper form.

Before the reduction to practice, the invention may be said to be embryonic, and not fully developed; but after the reduction to practice, it is considered as completed, and that the man who so reduces the invention to practice is the inventor.

I recently had come under my consideration, a very interesting case, in which two men proved that they conceived an invention within one month of each other, that they made working drawings of the invention within one month of each other, and that their machines were started almost on the same day. But one man filed his application six days earlier than the other, and, as the other could not clearly show conception of the invention prior to the time in which the first applicant proved that he conceived his invention, the first applicant was held to be entitled to the patent, although the other man's machine was first completed, and placed on the market. The first applicant's reduction to practice was first and therefore he prevailed.

Therefore, a few words of advice to prospective inventors, would be as follows:—

If the invention seems to be of value, and one in which the inventor would like to obtain property, he should, to prove the conception, make a drawing, and this drawing should be made as full and complete as possible.

This drawing he should have witnessed and dated. He should explain the operation of his invention from the drawing to a number of persons, whom he thinks he can trust.

Then, if the invention is a simple one, and easily admits of practical demonstration by a model, he should make a model, although this latter is not very important. He should, also, write a careful description of the invention, together with the drawing, and have the same witnessed, as before suggested. Generally this will go to show clearly the fact of conception.

Now that the inventor has conceived the invention, and has fixed his proofs in this respect, he should use due diligence to reduce the same to practice. The easiest and simplest way to

do this, if the invention is complete, and it is not desired further to perfect the same, is to file an application for a patent.

This, as before stated, constitutes a reduction to practice; and if it is not desired at once to take out the patent, by proper handling, the application can be kept alive in the office, almost any length of time.

Further, if the invention is such that it is not desired to apply for letters-patent until the same is fully perfected, the inventor should take such steps as lie within his means to make a practical machine, or to put the invention into operation; and then when it is perfected, he should apply for letters-patent.

An inventor should not, in any case, after he has conceived of the invention, made his drawing, disclosed the same to others, lie on his oars and wait until some future time before he develops the invention, or files his application for a patent; for, if he does not diligently go to work, and reduce the invention to practice, a person who subsequently conceives the invention, but first reduces to practice, provided the first conceiver has not been duly diligent, prevails.

Of course, in stating these rules, they can be only laid down in a general way, as the facts and circumstances must govern in each case, but, if an inventor will follow the above suggestions, he cannot be very far wrong.

The law in deciding these peculiar contests is founded upon reason, and upon the presumption that a grant of letters-patent is somewhat in the nature of a contract between the inventor and the government.

The inventor agrees with the government that he will disclose a new and valuable invention, and will contribute something to the sum of human happiness and comfort, which is not known: and that after seventeen years he agrees that the same shall be public property.

The government, on the other hand, agrees with the inventor, that in view of this disclosure, it will allow the inventor an exclusive monopoly in his invention for the term of seventeen years, as a reward of merit. The government officers, being the ones to decide these contests, naturally lean towards taking the side of the government, and favoring that inventor, who is, all things considered, the first to make this contribution.

The question of "reasonable diligence" as before presented, is a very interesting one, and is one which varies with the circumstances of the case. Thus, for instance, if a poor inventor conceives the invention, and has not the means and has to borrow money, and can go but slowly in developing his invention, he will be considered as having used reasonable diligence, if he does all that he reasonably could, which lies within his power.

On the other hand, suppose a wealthy concern or corporation to be interested in an invention, and, as soon as the same is conceived to put every available machine or means in the way of the inventor so that this person could reduce the invention to practice much easier and earlier then the poor inventor. Then the mere fact that the rich inventor arrives at the successful goal first, is not conclusive. They both have used reasonable diligence, and the question must then be decided upon the other circumstances and facts of the case.

Therefore, in fine, my advice to the prospective inventor is to protect his date of conception so that he can easily and fully and adequately prove the same, and then to use reasonable diligence to bring the invention down to completion either by embodying it in practical form, or by filing an application for a patent.

I hope, however, and should advise in every case, if possible, to avoid any of these contests for they are apt to be tedious and expensive, but, as before stated, if a man has a valuable invention, he will have to protect it from inroads on all sides; and one of the first things that is very apt to arise is for some one else to say, "I invented that a long time ago, and am going to prove it."

It is very easy for a man, after he has seen another man's invention to see how close he has come to the mark, but the maxim in all these cases is that the law favors the diligent and not the sluggish, inventor.

LOUIS W. SOUTHGATE.

CONTINUOUS WRAP MANILA ROPE POWER TRANSMISSION.

One Case of Failure and the Remedy. Paper Read before the W. M. E. Society by W. L. Chase, '77.

In 1889, the Knowles Loom Works built a new plant on Grand and Tainter streets, in this city. Partly perhaps because it was believed that the transmission of main power by manila rope was good and a coming practice, but more because the use of ropes seemed to fit the somewhat peculiar conditions of the situation, the new plant was equipped with eight rope transmissions. Four of these were main drives off the same engine wheel, and the others were secondary drives, two in the main building, one in the foundry and forge shop building, and one from the second floor of the main shop, through a tunnel under Grand street to the saw-mill building in the yard. In fitting up these eight transmissions, nothing was intended to be spared to make them as perfect and complete as possible, though it will appear that some of the materials employed and perhaps that some of the engineering that proportioned the material was of rather a crude character. The number and size of the ropes used was determined by the home office of the Dodge

Manufacturing Co. at Mishawaka, Ind. The ropes, pulleys, tension carriages, etc., all the machinery used, except the engine wheel which was grooved to the Dodge company's specifications, the tension carriage tracks and the winder wheel shafts and hangers, were furnished by them. The work was put in by home talent, but in consultation with the Dodge agents, who pronounced it as thorough and satisfactory an installation of their system as they had seen.

Referring to Fig. 1, which is made from a blue print which shows three of the four main drives off the engine wheel, and the two secondary drives in the main shop, and is the same as one furnished to the Dodge company for their figures on the rope plant. In explanation: The engine wheel E, set close to the wall of a short or cross wing on the basement floor of the main building, is 72″ in diameter and is speeded at 166 rpm. The two shafting lines A and B on the second or wood shop floor were driven from the engine wheel over 36″ idlers to 50″ pulleys at a speed of 240 rpm. For the drive EA which was required to transmit a maximum of 45 HP., six wraps of ⅝″ rope were employed, and for EB. 60 HP., eight wraps. Shafting lines C and D extend the length of the long wings of the main shop on Tainter street, and the B. and A. R.R., were driven respectively from lines A and B with 48″ pulleys and at the same speed, 240 rpm. For the drive AC which called for 25 HP., four wraps of ⅝″ rope were employed, and for BD, 40 HP., six wraps. The basement shaft G extending the length of the R.R. wing and about 85′ distant from the engine wheel, was driven directly off the engine over 30″ idlers carrying the ropes over a doorway, to a 50″ wheel at 240 rpm. For this drive, 30 HP., four wraps of ⅝″ rope were used. The fourth drive off the engine wheel, EN which is not shown in Fig. 1, was taken off nearly parallel to EG, over idlers near the doorway shown, to a 50″ pulley on a line shaft which extends the length of the engine room wing, and which runs 240 rpm. For this drive, 15 HP., two wraps of ⅝″ rope were used.

Each of the engine drives had a rope speed of 3140 fpm., and as proportioned each of the twenty wraps was required to transmit at the maximum 7½ HP. The Dodge company in their published descriptions of rope transmissions, gave in 1889 the following method of calculating strain on the rope. Considering the drive EA:

$\frac{33000 \times 45}{3140}$ equals 472.5 lbs. plus 144 lbs., half the weight acting on the tension carriage equals 615.5 lbs., total tension on the drive. This divided by 6, the number of wraps, equals 102.75 lbs., the tension on each wrap, which is two-and-a-half per cent. of the ultimate strength of 4000 lbs. claimed by the Dodge company for their ⅝″ firmus rope. This has a robust look. A factor of safety of 40 ought to carry security with its use. But let us examine this calculation. If this is the method used in figuring rope transmissions in Mishawaka, I think we may feel that we have located the spot at which the crude engineering began in this case.

The diagram Fig. 2 may be taken to represent the drive EA, though the driver is placed on the same level with the driven instead of two stories below.

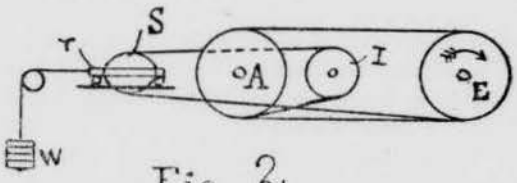


Fig. 2

The drive is strung in the following manner: beginning with the nearest wrap on the wheel E, the rope is delivered from the lower side past the near face of driven wheel A to wheel S, mounted on the travelling tension carriage r, on a shaft so inclined that the rope is delivered past the farther face of wheel A to idle wheel I, which is mounted on a fixed shaft so inclined as to deliver the rope to the farther groove of wheel A, which is then wound successively around wheels E and A, completing the six pulling wraps direct on the draft side from A to E, which brings us to the starting point of the stringing.

For this drive EA, the 472.5 lbs. appear to be correct for the net or effective tension required to do the work, which is equivalent to a tension of 78.75 lbs. on each wrap to transmit its 7.5 HP. Consider now the drive as in motion, but doing no work; the tension weight, which was in this case 288 lbs., acts in the bight of the wrap which is delivered to it and which passes thence to idler I, imparting to each side of the bight a tension of 144 lbs. When the entire length of the rope has passed the tension wheel the whole system will be subject to a tension of 144 lbs., which is independent of any strain that may be put upon the rope by the load, and which should not be divided by the number of wraps. Making the usual allowance for the tension on the slack side to be 20 per cent. of that on the working side the total tension due to the load becomes 94.5 lbs. Adding this to the initial tension due to the tension weight we have a

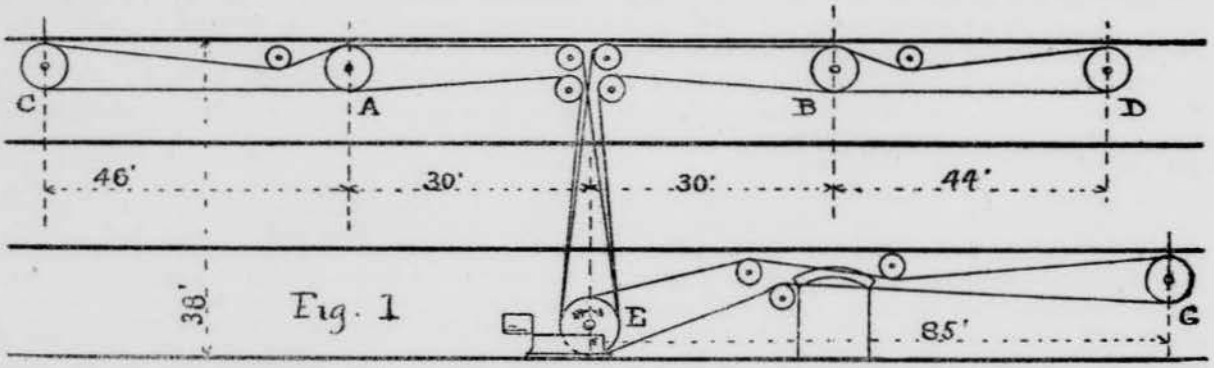


Fig. 1

tension of 238.5 lbs. on each wrap. To this should be added the tension due to centrifugal force which is represented by the formula

$$\frac{W \quad v^2}{g}$$

in which I have taken W to be the weight of one foot in length of the rope. and v the velocity in feet per second. Substituting we have,

$$\frac{.166 \ (52.3)^2}{32.2}$$

or 13.4 lbs., which added to the 238.5 lbs. gives a total tension of 251.9 lbs.

There is still another addition which, it seems to me, may be made to this tension under some circumstances. Suppose the drive to be running under a minimum load, and that a load like starting a heavy belt elevator is suddenly thrown on; the slack caused by the increased load is promptly taken up on one wrap, that which delivers to the tension carriage, while the effect on all the other wraps is to cause sag on the slack side until each succeeding wrap has had time to travel the circuit to the point of delivery to the tension wheel. One natural result of the sudden increase in load and sag in the slack side, is a waving or whipping motion of the ropes which may easily result in more or less slipping of the sagging wraps, while the first wrap being drawn taut by the action of the tension weight hugs the pulleys and takes more than its proper share of the work in consequence.

The total tension which we have reduced to figures, 251.9 lbs., is nearly 6.3 per cent. of the ultimate strength of $\frac{3}{4}''$ firmus rope claimed by the Dodge company, 4000 lbs. This represents a factor of safety of about 16. Some makers place the ultimate strength of $\frac{3}{4}''$ manilla rope as low as 3000 lbs. The figure most commonly used, perhaps, is 3250 lbs. of which our tension is $7\frac{3}{4}$ per cent. or which represents a factor of safety of nearly 13.

Our 7.5 HP. is largely in excess of the safe load as given by E. D. Leavitt's table, which for a $\frac{3}{4}''$ hemp rope is, at 3000 fpm. 5.5 HP., and as given by the C. W. Hunt Co. for their "Stevedore" transmission rope, which is for $\frac{3}{4}''$ rope at 3000 fpm. 4.2 HP.

The tension weight was, I suppose considerably above what it ought to have been, but it was no more than we found to be necessary to prevent dangerous sag and whipping.

Another cause of trouble was the unequal wear in the wood rim wheels, which is particularly emphasized by the increasing frequency of the breaks which occurred the longer the ropes were run. It required but a few months to change all the grooves from V shape to half round, and it was noticeable that the grooves on the driven wheels which received the tension wheel wraps were worn deeper than the others. I accounted for this fact by the creep of the rope in the groove induced by the action of the tension weight on that wrap, but, however accounted for, the existence of the fact and the consequent unequal tension in different parts of the rope is evident cause for much mischief to the ropes, and a sufficient reason for condemning the pulleys to our list of "crude" materials.

Let us now glance at the record of the performance of these seven drives I have mentioned. They were in service about one year. In that time there occurred forty-four breaks in the ropes, which stopped the whole or a part of the works for periods ranging from five minutes to the rest of the day, and in twenty-six cases inspection revealed weakening splices which were respliced before a break occurred. The longest run made by any of the seven ropes without resplicing was about four months, and the average run was a trifle over one month. The greatest number of splices made in a single drive was sixteen in EA and the smallest number was five in AC. All the ropes were renewed within the year, some of them several times, and some of them replaced by $\frac{3}{4}''$ ropes. Short, long, home made and old sailor splices, expert splices by the Plymouth Cordage Co., and by the Dodge Co., and various rope dressings were tried to no avail, and in spite of repeated and urgent appeals to the Dodge people to come over and prop up their reputation in Worcester, six of these rope drives were finally replaced by leather belts.

With the belts two direct transmissions are taken off the engine. Referring to Fig. 1: One 7″ double belt takes 60 HP. diagonally to shaft A on the second floor, and 15 HP. is returned to the basement to drive the lines formerly driven by the two-wrap engine rope EN, through a 3″ quarter-turn belt from shaft A to shaft N. The four-wrap counter AC is replaced by a 4″ double belt. A 10″ double belt takes 90 HP. from the engine diagonally to shaft B. 70 HP. is carried from shaft B to shaft D by an 8″ double belt replacing the six-wrap rope BD, and also transmitting the 30 HP. formerly delivered directly from the engine to shaft G, which is returned to the basement by a 5″ double belt from shaft D to shaft G. The belts are all endless and supplied with tighteners on one end and idlers to increase the wrap on the pulleys at the other, as recommended by Mr. Nathaniel Hill of Lowell, who was consulted in the design of the belt plant. With the exception of the belt BD jumping from its pulleys a few times when it was new and stiff, there has not been a minute's delay or interruption owing to the belts since they were started a year and a half ago.

With the ropes the power consumed on shaft G and in the cross or engine-room wing was taken directly from the engine wheel to the points of service. With the belts the 45 HP. transmitted to those points is carried from the engine to the second floor above, and brought down again to the basement floor, 15 HP. by the 3″ quarter-turn, and 30 HP. through the horizontal belt BD and thence down by belt DG, as already stated. The average dead load with the ropes, as shown by the indicator, was about 80 HP. With the belts and with nothing else changed it was about 70 HP., a betterment of $12\frac{1}{2}$ per cent.

The cost of the rope driving plant, installed, exclusive of the ropes, I estimate to be about equal to the cost of the belt plant exclusive of belts. While the cost of the belts for the six drives mentioned was about two and a half times the cost of one equipment of ropes for the same, the cost of the original ropes together with what was required to replace worn out ones within a single year, was more than the cost of the belts.

Without going into the difference in coal consumption represented by the difference in dead load, or into the losses chargeable to the forty-four stoppages of power in working time, and without making any account of the loss of temper and general amiability of disposition involved, the inference from this experience would seem to be strongly in favor of sticking to the old belt for reliable power transmission.

There are, however, some situations in which owing to positions vertically, distances, angles, and restricted space, the use of belts is practically inadmissible, and in which the continuous wrap system of rope transmission is of great utility. A good illustration of such a situation is furnished by the seventh drive

I have mentioned, and which is still running, that under Grand St. to the lumber yard. This drive while it is apparently working under harder conditions in position, distances, and in variability of the load, than those imposed upon any of the displaced transmissions, has proved the least troublesome of any of them, except possibly the eighth drive mentioned, a small one in the forge shop, which is also still running. Both these transmissions are two-wrap, and both are strung double, that is, the two-wraps are both run over the tension wheel. I believe this to be one of the important conditions of success in continuous wrap transmission, and that it is better economy to increase the size of the ropes to get the required capacity than to add a number of wraps independent of the tension wheel. Above reasonable limits in this direction I think now that I should hunt for conditions that would allow the use of belts or shafting, or if necessary employ independent engines. I believe also that success in rope transmission demands the use of iron sheaves, and a perhaps ridiculous factor of safety of 20 to 40, according to circumstances and conditions. I suppose if it were not for the weakness of the splice a much smaller factor might safely be used, though it is claimed that the splice can be made as strong as the body of the rope as laid. I have never seen a record of tests to determine this point.

Why is it not an interesting field for some one who has an opportunity to practice in the laboratory to collect samples of spliced ropes from the several makers of rope and transmission machinery, and give us a paper on the conditions and results of a series of tests?

WM. L. CHASE.

GOOD FOOT-BALL.

"Tech—Four—Brown—Nothing."

After cancelling one game, Brown condescended to meet our eleven at the Oval, Saturday, November 12th. The team had almost no practice during the week, but put up a good game, playing well together and with lots of snap. The grounds were not in first-class condition but the weather was not bad for foot-ball.

The teams lined up as follows:

TECH.		BROWN.
Ware,	l. end r.	Drawbridge (Denny)
Butterfield,	l. tackle r.	J. L. Casey
Brigham,	l. guard r.	Lancey
Rogers,	centre	Smith
Brooks,	r. guard l.	Call
Goodrich,	r. tackle l.	Nott
Smith,	r. end l.	E. N. Casey
Chase,	quarter back	Matteson
Allen,	l. half back r.	Green
Andrews,	r. half back l.	Robinson
Lincoln,	full back	Straight

At a little after three o'clock Brown opened the game with a V. By hard work they were able to reach our five-yard line but lost the ball on a fumble and were pushed back again. Almost no end plays were made during the half. First one side would make short gains and then lose the ball on four downs, then the other side would do the same. Although the ball stayed near Tech goal most of the time, Brown was held with comparative ease and just before the end of the first half, was pushed back from Techs' goal. Time was called with the ball on Brown's twenty-five-yard line and the score, 0—0.

Techs opened the second half with the regulation V, and within five minutes scored the first and only touchdown. Allen missed the goal by barely a foot. Tech soon had the ball again and pushed it to within a yard of Brown's line. In the next scrimmage the ball was pushed over but the referee heard someone say "Down," as he thought before the ball was over, so the touchdown was not allowed. Brown then did some very good defensive work, holding for four downs, twice, when the ball was almost over their line. Darkness began to interfere some by this time. Brown had the ball and made some short gains when Umpire Rice gave it to Tech for holding in the line. The decision was perfectly fair as warnings had been given several times previously.

Brown then did a very childish thing in withdrawing from the field, the score being Tech 4, Brown 0.

Perhaps after all it was policy for her to withdraw, as her team seemed to be all tired out and the ball was Techs' on Brown's fifteen-yard line, which meant almost surely another touchdown.

The playing in this game shows what kind of material we have in the Institute. To outplay in every way a team which has played tie games with M. I. T. and Trinity, and beaten Wesleyan, speaks very well for an eleven which has been handicapped as ours, by poor facilities for practice.

Brown felt pretty sore over her defeat and almost immediately on the return of the team to Providence, wrote asking for another game. As we are allowed only two games a season out of town, and one of these had been played and arrangements made for the other, of course this was impossible.

A STRONG FINISH.

Tech Holds Harvard Freshmen Down to a Small Score.

The Tech foot-ball team played Harvard, '96, on Jarvis Field, Nov. 16, at 3.30. There had been a heavy rain for some hours previous, and in consequence, the ground was very slippery, and the ball becoming heavy made sure goal kicking impossible. 150 people saw the game, among them a number of W. P. I. alumni.

Ninety-six had beaten Amherst Aggie 52 to 12 the Saturday before, consequently, it took more optimism than most of the Techs possess, to believe it possible for us to win, and the showing

made is highly creditable, when we consider that for two weeks the team had practiced only one night.

The teams lined up as follows:—

TECH.		HARVARD, '96.
Ware,	l. end r.	Brown
Butterfield,	l. tackle r.	Clark
Brigham,	l. guard r.	Rice
Rogers,	centre	Russell
Brooks,	r. guard l.	Worden
Goodrich,	r. tackle l.	Lewis
Smith,	r. end l.	Richardson
Chase,	quarter back	Borden (Capt.)
Allen (Capt.),	l. half-back r.	Gould
Andrews,	r. half-back l.	Hamlin (Bullard)
Lincoln,	full-back	Fennessy

Mr. Cabot of Harvard was umpire and Mr. Southgate, W. P. I., referee, for the first half. They changed places in the second.

Tech had the kick-off and played against the wind. A V gained 8 yards. Then Goodrich, Allen, Andrews, Smith and Lincoln carried the ball steadily forward and in 8 minutes Allen had made a touchdown, from which he kicked goal.

This was good work, and the hopes of the few Techs in the crowd took a bound. Harvard opened with a V and then lost to Tech on a fumble. Andrews, Brigham, Goodrich, and Allen carried the ball 15 yards, when it was held for three downs. Lincoln tried to punt, but the ball struck the line and 10 yards were lost. Harvard took the ball, and by long runs gained a touchdown in 8 minutes. No goal.

Andrews gained 8 yards from a V. Ball held for three downs, the Tech line appearing to go to pieces. Lincoln punted. Fennessy caught the ball and made a long run. Then Hamlin made 15 yards more. Chase broke through and tackled in the next play and Cabot called a foul tackle, giving Harvard 25 yards. This was a hard one, and really inexcusable. Again Harvard rushed the ball over. Time of touchdown 5 minutes. No goal.

Allen gained 10 yards from a V, then the ball was held for three downs. Another V was tried and failed to work. Harvard then gained 60 yards by runs. Worcester braced, laid hold for 4 downs. Allen, Andrews, and a criss-cross between Allen and Chase gained a small distance. Lincoln punted into touch and Harvard took the ball, but Worcester soon secured it for holding in the line. The Allen-Chase criss-cross followed, then Allen gained 5 yards and was pushed outside. Rogers touched the ball down and ran 5 yards. Chase, Allen, and Goodrich made gains, and the ball went to Harvard on four downs. Andrews broke through on first play and Harvard lost 5 yards. Fennessy punted and a Harvard man fell on the ball just as time was called. The half was 30 minutes.

Score, H. U., '96, 8; W. P. I., 6.

The second half opened with a new ball on Harvard's kick-off. A V gained 8 yards, Fennessy ran 30, and Hamlin gained 8 more. Lincoln broke through and spoiled the next play. On the next Harvard made a forward pass and Tech took the ball. Chase and Allen advanced the ball 10 yards and here it was held for what was called four downs. Cabot claimed in the last play the ball went outside but it did not. Touchdown was made by Worden in 10 minutes. Tech opened with a V and gained 20 yards. Lost the ball on 4 downs, but received it for holding. No gains resulted from runs so a punt into touch was tried, Harvard securing the ball. Runs and then a punt was tried. Allen caught and tried to run but made no gain. Four downs without gain gave Harvard the ball, and another touchdown was made in 10 minutes more. Again no goal. After an advance of 20 yards by Tech, Harvard secured the ball and after a long run made the touchdown and here goal was kicked. Tech could not advance more than 25 yards, so Harvard took the ball and after another long run, time was called with Tech's ball on Harvard's 20-yard line.

Harvard Crimson, Nov. 17th, "Worcester put up a much better game than that put up by Amherst Aggie."

"The coaches should have credit for one thing, that they have taught the team *to play with snap and readiness. The backs are quick to start and generally support one another well.*" We ought to improve in this next year.

Worcester Gazette, Nov. 17th, says that the score might have been more even had the referee not favored Harvard, but on the other hand Harvard would have scored more had goals been kicked. But we wish to observe that had Mr. Cabot been at all impartial one or two touchdowns would clearly have not been made.

NOTES BY ENTROPY.

MR. EDITOR:—

My friend of whom I spoke a few weeks ago as having changed his tactics on drawing since leaving the Institute, has become a little wrathy because of my comments. One reason why he changed his ideas was the following: The shop where he officiates as draughtsman, is so unfortunate as not to have a Tech graduate for a foreman. The one they do have does not know much about making a drawing but he has his own ideas of what he wants to use in the shop. He does not see the beauty of heavy shadelines. "All well enough to do it for drawings to show to customers," he says, "but if you have any time to use that way, I wish you would cross-hatch your sections instead of paint-

ing them. Your coloring is all right in detail drawings, but even there the fewer sections you make the better; but when you make a blue-print, particularly from a general drawing of a machine, your method is almost useless. All colors print alike so far as a shop hand can see by gas light, and there is nothing to show which parts of the drawing are of the same piece in the machine. There is no universal standard for the colors to represent different metals unless in the case of brass, which everyone, by a strange coincidence, represents by yellow. You might just as well write on the drawing of what you wish the piece made as to try to make any distinction in the sectioning." This is the foreman's idea. It may be all right, but I must confess one dislikes to start in at drawing section lines by the hour.

Necessity is said to be the mother of invention. However, the necessity of a good, general rule for calculating the diameters of cone or step pulleys has failed to bring out anything entirely satisfactory. There is no lack of rules. Rankine gives one which is all right if the pulleys are infinitely far apart. It will do if they are a good ways apart compared to the diameters of the pulleys. It fails entirely if they are near. Far apart and near together are not very accurate terms. When my class went through the mill, I think the first example we did under this formula had for part of the data given, diameter of large pulley on one, 20 in., diameter of corresponding step on the other, 10 in., distance of centres, 40 in.! The pulleys were never made.

The next things to pulleys generally are belts. They are much-tested articles. If you, Mr. Editor, should be so fortunate as to secure a thesis on the belt-testing machine, and should also desire to get some good results which will make your reputation, just revolve the whole machine through 90°, into H, in fact. It is well known, both theoretically and practically, that a vertical belt never gives results at all satisfactory as compared with a horizontal belt. The difference is due to the weight of the belt acting to decrease the pressure on the lower pulley.

Entropy.

NOTICES.

Nov. 27. At U. C. ME. 3.00 P. M. Concert and Lecture on "Seven Wonders of Worcester." 7.00 P. M. Concert and Stereopticon Entertainment.

Nov. 27. 7.00 P. M. Stereopticon Sermon at Salem Square Baptist Church.

Nov. 28. 7.30 P. M. Entertainment at Pilgrim Church by the Little Ones, "The Dozen Bootblacks.

Nov. 28. 7.30 P. M. Military Drill and Dance, U. C. ME.

Nov. 30. Matinee, 3.00 and Entertainment at 7.00 P. M., U. C. ME.

Dec. 1. 8.00 P. M. Third Concert in Y. M. C. A. Course, Boston Ideal Banjo Club and Judge William B. Green, Reader.

Dec. 3. Same as Nov. 30.

Dec. 4. Same as for Nov. 27.

Dec. 5. 7.00 P. M. Banquet at Pilgrim Church, Ladies' Night of the Gentlemen's Association.

Dec. 6. 7.30 P. M. Sale and Supper of the Ladies' Society at Central Church, both afternoon and evening.

Dec. 6. 7.30 P. M. Lecture by Dr. Gunnison at First Univ. Church on "Rome and its Environs."

Dec. 6. 8.00 P. M. Dance at the U. C. ME.

Dec. 6. 6.00 P. M. Old Fashioned Boiled Dinner and Entertainment at Old South Church.

Dec. 7. Same as Nov. 30.

Dec. 7, 8. Annual Fair of the Ladies' Circle at the First Univ. Church.

EFFECTS OF HEAT ON STEEL.

The Engineering and Mining Journal for Nov. 5th, has a brief review of the paper read by Mr. H. W. Wyman, '81, before the W. M. E. Society at its meeting last month. Among other things it says:—"To say, however, that the effects of heat upon steel are due mainly to changes in the condition of the carbon is to lose sight of the possible alterations of chemical and physical structure due to changes in the other ingredients. We are not yet in a position to say that the change in carbon alone produces that result which for lack of a better term we call 'hardening.'

"The fact is, we know very little about the ultimate condition of any of the ingredients of steel, whether in their chemical or in their special relations. It is not safe to assume that because our present methods of analysis enable us to observe the changes in the carbon more readily than in the sulphur, the silicon, and the phosphorus, yes, even in the iron, therefore these others are of minor importance. It may be, and evidence is not lacking in support of the view, that elements other than carbon likewise suffer changes, *pari passu*, with this, when under stress, be the source of the stress what it may. We see the effect of certain reagents upon steel, as in hardening, but we cannot yet say that it is due to the change from cement to hardening carbon at a low yellow heat. If by cement carbon is meant the tertiary form of carbon, first definitely observed by Rinmann, as distinct from graphitic and combined carbon, it is to be remarked that our knowledge of it is at present unsatisfactory."

THE CAMERA CLUB.

The fourth Annual Exhibition of photographic prints and lantern slides will take place in the Salisbury Laboratories on the afternoon and evening of Saturday, December 10th. The arrangements are now in the hands of the committee, and

although not fully completed there promises to be a very interesting display of the products of the photographic art. All the work of each man will be shown together, and prizes worth striving for will probably be offered to the men having the best exhibits. The exhibition will include some very fine work by members whose results are known by previous exhibitions, as well as the work of new members, and possibly some views taken abroad last summer.

The lantern slide exhibition in the evening will be a distinct feature this year. The four or five men who will exhibit will each describe his views in a short lecture.

The exhibition is primarily for Techs and their friends, and will not be advertised outside to any extent. It is to be hoped that every member of the Institute with his friends will avail himself of the opportunity of spending a very pleasant evening. A souvenir card similar to the one last year will be issued. The tickets, which will appear soon, will be sold for fifteen cents.

Any member of the Institute who wishes to avail himself of the privileges of the Club should join now.

Y. M. C. A.

Rev. F. B. Vrooman, of Salem Street Cong. Church, spoke before the Y. M. C. A., Wednesday noon, Nov. 9th. Mr. Vrooman is a graduate of both Harvard University, and Oxford University, England, and his remarks upon the laws governing both material and spiritual things were listened to with much interest.

On Sunday afternoon, Nov. 13th, a meeting of the Association was held in Boynton Hall. Reports of the Pittsfield Convention were given by Edward W. Vaill, Jr., '93, who outlined the work taken up by the convention and spoke of what took place at the various meetings; by C. E. Goodrich, '93, who spoke on the matter of Bible Study as brought forward during the session; and by Nathan Heard, '93, who spoke upon the College Conference and the plans and methods suggested by the delegates present from the various colleges, and by Mr. J. R. Mott, College Secretary of the International Committee.

An address was delivered by Rev. Daniel Merriman, D.D., of Central Church. Dr. Merriman made a deep impression upon all present by the clear and forcible way with which he outlined the need of practical, scientific, Christian men in the world.

ALUMNI ASSOCIATION.

Meeting of the Executive Committee.

Ed. W P I.

The following may be considered a report of a recent meeting of the Executive Committee, which was held with a full local board at Pres. Washburn's law office. The first business considered was the proposition introduced at the annual meeting last June, to hold a meeting of the Association in Chicago, in 1893, which after discussion, was referred to the Executive Committee with power to act. So far as known to the committee, the project has assumed three principal phases; 1st, To hold the regular Annual Meeting in Chicago in June; 2d, To hold a Special Meeting and have a dinner in Chicago, either shortly before or shortly after the Annual Meeting in Worcester, or at some other time if it seems preferable; 3d, To maintain for a specified period, a sort of reception committee or Tech rendezvous at some hotel or other convenient place in Chicago.

The committee was unanimously of the opinion that whatever happens in Chicago, the regular Annual Meeting must be held here. Of course we must have a dinner, and if we can have a continuous reception before and after the dinner, or a grand excursion from Worcester to Chicago following the Annual Meeting and Commencement here—the committee shouts, good! The committee, however, feels that the arrangements, whatever they may be, for dinner or reception in Chicago, cannot be advantageously handled from here, and inasmuch as the committee is made up, with one exception in the present board, of local residents, it seems desirable in every way that the committee find some means of shifting the "power to act," received from the Association, to some combination of our Alumni, resident in or near Chicago. It happens that the Association has in the West two vigorous off shoots, organized and prepared for business. One of these is at Cleveland, of which Mr. Frank Aborn is President, and Mr. Jang Landsing, Secretary; and the other at Chicago, of which Mr. T. Edward Wilder is President, and Mr. Edwin F. Simonds, Secretary. To these organizations the committee has turned with the following vote: "That it is inexpedient to hold the 1893 Annual Meeting in Chicago, but that the committee heartily approves the scheme of holding a Western meeting of the Alumni during the World's Fair, and suggests that the two organized Western Associations, if they consider the plan feasible, arrange to hold such a meeting under their auspices, and that the Secretary be hereby directed to correspond with the Western Associations to ascertain their dispositions in the matter."

The Secretary has done as directed and now has his ear to the ground awaiting results. Mean while let every Tech who has ideas, wants, or aspirations on the subject make them known directly to the W P I or to whichever of the

secretaries he chooses, and let us try and get sufficient volume to our noise to let the World's Fair know "where we are at."

To resume the committee meeting. The disposition of the Thompson Memorial Fund was not considered. If the fund was large enough to found or even to materially assist a scholarship that plan would be strongly in favor, but the small amount of the fund precludes that use. It could be invested and allowed to accumulate to proportions which would make it available for scholarships or proportionally large purposes, but nobody on the committee leaned that way and after discussing the question in all lights the following vote was unanimously passed:

"That the Secretary, in accordance with one of the provisions of the fund, insert in the call for the next annual meeting, a statement that the Executive Committee will recommend that action be taken by the Association to devote the income from the Thompson Memorial Fund to the enlargement of the Institute Library."

The condition of the Alumni exchequer was then heard proclaiming the necessity for levying an assessment. This state of things is evidently owing directly to the force of habit, which a large proportion of the members of the Alumni have acquired, of being deaf to the gentle calls of the Treasurer. It was voted "That the Treasurer be hereby directed to levy and collect an assessment of $1.00 per member to meet current expenses of the Association; and that in issuing the call for this assessment the Treasurer invite the attention of those who have failed to pay the last assessment to this fact."

Adjourned.

WM. L. CHASE, *Sec'y.*

Worcester, Nov., 1892.

CLEVELAND ALUMNI.

The second semi-annual meeting of the Cleveland Alumni Association of the W. P. I. (Cleveland, Ohio) is to be held sometime during the Christmas holidays, and it is hoped that all graduates and members of the Institute who happen to be in that vicinity, will endeavor to attend. The Secretary is Jang Landsing, 1253 Curtis Ave.

ALUMNI NOTES.

'75. In the *Engineering News* of Oct. 27, it is stated that C. C. Chandler has resigned his position as Chief Engineer of the O. & M. R. R.

'80. Chas. E. Wells' address at present is, Care McArthur Bros., Contractors, Brink Haven, Ohio.

'87. The New Hampshire Experiment Station of which Fred W. Morse is a chemist, has been removed from Hanover to Durham. Mr. Morse expects to have its new chemical laboratory equipped within a month.

'88. George Francis Myers has opened an engineer's office in Pittsburg, Pa. He is a member of the American Society of Mechanical Engineers, American Institute of Mining Engineers, and American Institute of Electrical Engineers.

'89. A. J. Bean's address is Box 183, La Grange, Ill.

'90. Francis W. Treadway has opened an office as attorney-at-law, No. 635 Society for Savings Building, Cleveland, Ohio.

'90. The Impervious Package Co., of Keene, N. H., with which C. H. Faulkner is connected, are manufacturers of *turned and coopered* and not *tinned and coppered* cans as the printers translated the manuscript a fortnight ago. Mr. Faulkner writes, "The company's special claim is that their wooden packages are superior to metal."

'90. Chas. H. Jenness was married Nov. 9th, at Grafton, to May I. Wood. His present residence is Springfield St., Chicopee, Mass.

'90. Loring N. Farnum is a partner in the firm of E. Worthington & Co., Civil Engineers, with offices at 673 Exchange Building, 53 State St., Boston, Mass., and Insurance Building, Dedham, Mass. The company was formed Nov. 1st, and has a general office in Boston with draughting rooms at Dedham. Mr. Farnum's private address is "The Rexford," Bowdoin St., Boston.

'91. Harrison P. Eddy, who since graduation has been Superintendent of the Sewage Purification Works in this city, was last week elected by the City Council, Chief of the Sewer Department.

'92. R. H. Thompson is with the Brockton Last Co., of Brockton, Mass.

'92. C. A. Tucker is a partner in the firm of Aaron F. Emory & Co., manufacturers of boots and shoes, Marlboro' and Boston.

'94, S. A. W. Dimick has left the Mason Machine Works, Taunton, and is now draughting for the Atlantic Mills, Lawrence Mass.

LIBRARY ADDITIONS.

Since September there have been added to the libraries in the various departments of the school, something like 250 volumes. By far the greater part are in the departments of History and Political Science, and Language. Besides bound volumes of various magazines, there are as recent acquisitions, Marshall's Economics, Fiske's Poli-

tical Ideas, Hadley's Railroad Transportation, Müller's Political History, various histories of England and the U. S., Dunbar's Banking, Davis's Outline of International Law, Crosby & Bell's Electric Railway, D. K. Clark's Steam Engine, Smith's, Ricardo's and Mills' works on Political Economy.

The Department of Language receives Meiklejohn's English Language, Taine's History of English Literature, 7 volumes Morley's English Men of Letters, Scott's complete works, Shakespeare's complete works, Bacon's Essays and Poems of Coleridge, Keats, Burns, Milton, Goldsmith, Gray, Scott, Chaucer, Byron, Spencer, Wordsworth, and Dryden.

MEETING OF THE W. M. E.

The Physics Lecture Room was two-thirds filled last Monday evening when Pres. Paull called the meeting of the Washburn Mechanical Engineering Society to order. Besides a good attendance of students, there were present among others, Pres. Fuller and Professors Alden, Sinclair and Higgins of the Faculty, and of the Alumni, Messrs. Chase, '77; Miller, '79; Hill, '71; Parker and Powell, '79; Wyman, '82; Edwards and Cole, '83; Rice and Gibson, '91; Fish, '92, besides several visitors from the city.

The first paper read was that by W. T. Chase, '77, upon "Continuous Wrap Manila Rope Power Transmission," which we publish in full in another column. At its conclusion, quite a little discussion followed. Mr. Wyman inquired if more than one kind of rope had been used and was answered in the negative. The only rope used was what the Dodge Co. call the "Firmus Manila." Mr. Miller then spoke for several minutes upon the subject of rope transmission. He said that the Dodge Mfg. Co. originally made smooth, split wood pulleys, but by development came finally to making these same pulleys with V grooves, that they had set up many in different plants of the country which he had afterwards visited. He found that when of equal size and linked without idlers these pulleys worked very satisfactorily, but only under such conditions. When the wheels are of unequal diameter, the tendency is for the rope to wear out the bottom of the V grooves and make them take its own shape. This fact alone is enough to condemn wooden sheaves. It had been claimed that wood was inferior because its co-efficient of friction is less than that of iron. This is absurd, because, such being the case, the fault could easily be remedied by making the groove pitch greater. There is an advantage in designing with a technical education behind it.

Prof. Alden suggested that the students present would like a direct answer to the question, which is better—rope or belt transmission. Mr. Miller in reply said that as a general thing for direct short connection, belting is better, but for long connections especially between non-parallel shafts, rope is preferable. He said that a western firm is now having great success with a rawhide rope. As a general thing a grooved pulley costs about twice as much as a smooth one. Mr. Hill, '71, said that in engine fly-wheels, his firm charged about 15 cents per linear foot extra for grooving for 1 in. rope; 20 cents. for 1½ in. rope. Mr. Fish asked Mr. Miller if, when he needed more power, he would increase the size of the rope or the number of wraps, and was told that it depended almost entirely upon circumstances,—size of hangers and the like.

A. C. Higgins, '93, then explained the model of the steam loop for conveying back condensed steam, below the level of the boiler.

After a slight intermission, T. Spencer Miller, '79, Manager of the Cableway Dept., Lidgewood Mfg. Co., New York, gave a very interesting talk upon transportation in mines and quarries by travellers upon a single cable. He had a large number of lantern slides, reproductions of photographs and sketches, by which he illustrated his remarks. As he spoke without MS. and in reference to his pictures, his short lecture cannot here be reproduced.

The meeting, which by the way, was one of the most successful held as yet, adjourned about 10:30 P. M.

TECHNICALITIES.

Brigham went by *that Ayer* Line as he missed the 10.50 over the B. and A.

Prof. MacD. says that certain things have recently been *strik*ingly illustrated at Homestead.

As a topic for investigation in Political Economy, we would suggest for C. W. D. D.—"A Wife from the Economic Standpoint."

Dr. Fuller gave a lecture on the "Relation of Geology to Agriculture" in the Natural History course at Sterling, Thursday, Nov. 17th.

A recent Junior English composition contained a reference to a girl with a *pail* face. The writer evidently thought her seasick.

In Descript.—"S—rs, you may name the kinds of surfaces with which we have to deal.

S—rs, confidently.—"Plane and solid."

Junior: [to Senior stroking his upper lip.] "Is it a case of mus-tache?"

Senior: "No, it's a case of must-ache."

A new incident in the life of Whittier has been revealed by a certain Junior, who wrote recently the following: "at this time, he pub-

lished one of his best poems and three of his sisters."

It is officially announced that Prof. ——— has resigned his position as policeman and can no longer be seen moving about the lecture room, flourishing his club and shouting "Come, come! Move on! Get out of this!"

N. M. Paull, '93, has been chosen a member from Ward 2, of the Executive Committee of the Young Men's Republican Club. Evidently our esteemed W P I man intends to enter Paull-itics.

John Jernberg says, that in Sweden during the winter, the runner tracks in the roads are so smooth and hard that bicycling is very common. A smaller runner is substituted for the rear wheel, sliding over the snow, while the forward wheel still serves as a means of propulsion.

Prof. Encyclopædia.—"These ores are invariably found either with or without soda."

Mid.—"Well, I think that is rather queer."

Prof. E.—"It does seem so. But if you think it over I think you'll see it. The class will please make a note of my statement."

The following is taken from the last number of the *American Journal of Folk-Lore*: "At the annual meeting of the American Society for the Advancement of Science held at Rochester, N. Y., an exceptionally valuable paper on 'Primitive Numbers' was read by Professor Levi L. Conant of Worcester, Mass. The paper will appear as a chapter of a book by Professor Conant."

Senior.—Professor, do you think that Political Economy is a science?

Prof. Practical.—What is a science?

Senior.—Classified knowledge.

Prof. P.—Well, Political Economy is classified ignorance. Can it be a science then?

Senior.—Must labor maintain its standard of efficiency?

Prof. P.—That depends;—not if the laborer gets free-trade wages; and that's what you will probably get after next June.

A few days ago, New England newspapers contained accounts of the sale of the Pratt and Whitney Co.'s well-known establishment to an English syndicate for $2,500,000. A letter of inquiry sent to the Company at Hartford, Conn., brought a reply from President Pratt denying the truth of the statement. It reads: "* * * A reorganization of the Company may take place by which it is expected that we shall increase our facilities to enable us to manufacture our goods to better advantage. It is expected that the old officers will retain their places with the Company, in fact no reorganization could be effected did they not agree to do so. The Company will continue to do business at the old stand."