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As all those outside of the Tech who take part in the Burlesque are to tender their services free of charge, it is hoped that the students will appreciate their efforts and acknowledge the same by giving them a hearty reception at their appearance on the stage.

It may seem to the students that some of the accounts in the W P I , of occurrences which take place right here in our midst are rather old. If an issue of the paper appears on a Thursday afternoon and on the next Monday evening, perhaps, there is something of considerable importance takes place, a full account in a paper published nearly two weeks afterwards must seem decidedly old to those who have known most of the particulars for that length of time. The aim of the W P I is, however, not entirely to be a model newspaper but to faithfully portray what is occupying the time and minds of the Tech students so that an alumnus who has no other way of learning what is going on here, than through our columns can keep posted; and to so arrange it that a file of the paper will be an accurate history of Tech life.

Those who were present at the meeting of the W. M. E. Society last Monday evening could not help being immensely benefited by it. Both of the papers were very interesting and both led to valuable discussions. As was said after Mr. Powell's paper was read, every one at all interested in practical mechanics should read and thoroughly digest every part of this article. Although it is on a subject not taught here at the Institute it is a subject which directly concerns nearly every graduate.
a profit to his employers; this lack is, perhaps, owing to the fact that most college Professors are not closely allied, or conversant, with practical business methods; while they may thoroughly understand political economy and civil government, they have but little if any idea of that business economy, which is so absolutely necessary to a successful business career. It would seem that there was a field for lectures on business economy in connection with the economics as now given in the Institute course. In these days of close competition, successes and failures depend wholly upon the annual balance sheet. No matter how successful the year may have been in a professional sense, no matter how satisfied you may have been in what you have conceived and accomplished, the balance sheet tells the whole story. Your financial manager cannot make a satisfactory showing to his associates unless the shop manager keeps his end up and makes a profit in his department. Some method of keeping the cost of the work passing through the shops is therefore of vital importance, and it becomes the duty of each shop manager or foreman to study such systems of economical management, as tend to reduce the cost of production. These methods vary throughout the country almost as widely as do the different products made; from the small shop where the cost is simply a matter of guess work, to those having elaborate systems where at an hour’s notice the actual cost of any part of a machine in process can be accurately determined. All this can be attained at no great expense of red tape or extra help.

It is my intention in this paper to show a simple method that answers very well for the average shop, and which can be elaborated or cut down in such manner as the case demands.

Passing directly to the subject in hand, we will first consider the drafting-room, as it is here the machine is conceived, plans made and finally adopted, orders issued, and general oversight of the entire works is had. It is here the closest management is necessary, as it is possible by means of mistakes, carelessness, etc., to use up a great portion of the profits on manufactured work. Here we should have a chief who should be the designer, who should be held responsible for the work of his associates, taking his orders from the superintendent or manager. A uniformity of drawings is indispensable; a size not over 22 x 30 is, in my judgment, sufficient; drawings should be drawn to scale quarter and eighth size; there is no necessity of making drawings of full size except, possibly in cases where we wish to show an intricate or irregular shaped piece, or for the convenience of the pattern-makers and blacksmith, of which I will speak later on; this sheet may be divided into two sheets 15 x 22 for detail, to be mounted on cardboard for shop use. Each sheet should be numbered serially, also by sheet number and case number. The pattern letter or symbol should be on each sheet; a simple title (the less the better, as the serial number and pattern letter inform us which machine it has reference to), should be placed at the top or upper right-hand corner of the sheet; it is well to have the drawing-case number and pattern letter in the lower right-hand corner and the upper left-hand corner so as to always present the letter and the number at the right-hand corner of the drawer or case when looking for a sheet. A uniform system of showing parts, sections, details, dimensions, should be adopted and closely followed. The use of bond paper is preferable for making original drawings from which blue prints can be taken without making tracings. I use No. 22 or No. 25 Crane bond paper, unlaid. Drawings can be shaded and colored on this as well as on Whatman paper, and the blue prints taken from them give clear lines and gradation of shade and color. In order to designate the material in section, I have adopted the technical colors for sections. Of course, it is obvious in the blue print all sections would show a plain shade; perhaps there would be enough gradation in the shades to convey to workmen the material of which each part was made, but I take the plain shade for cast iron; for steel, plain shade hatched with same color; brass, plain shade with little dots; babbitt, plain shade hatched with short dashes, all of same color as material section. These print very readily through on the blue print, and can be easily distinguished by the workman; it is well to put on parts where there may be danger of making mistakes, the plain word "steel," "cast iron," "brass" as the case may be; this obviates any danger of mistakes. Changes can easily be made with bond paper by simply stretching another sheet of bond paper over the drawing which we wish to change, and draw through and make alterations, giving the new sheet its serial number, marking across the first drawing "Superseded by serial No.——" or other words to that effect, then filing the first drawing in the same case as our new drawing so as to be easy of access for reference, should occasion require. Original drawings should not be handled by everyone; the chief, or whom he may designate, will show them, and under no consideration should the original drawings be taken into the works. Blue prints should be made directly a drawing is completed and approved, and it is best to have no less than two, sometimes more, of each sheet. It is well to keep one complete set in the drawing-
room on file to show in place of originals which
would quickly become soiled with handling, also
for use of salesmen and travelling men to take
with them on selling trips. A case enclosed in
a fire-proof vault is very desirable, and if possi-
ble, should be provided, to contain drawings.
These cases should have drawers of perhaps 2'!-
margin outside the size of drawing, and be about
2" in depth; it is not best to have more than 50
drawings in each case. Blue prints should be
kept in a case (lettered and numbered same as
original drawing case in the fire-proof vault) in
the outer drawing-room to be easy of access
when occasion requires. Each drawer in the
drawing case should have a number, also a let-
ter and other symbols to conform to the letters
and case number on our drawings; and each
drawing should be filed in its proper place.
A record book is indispensable, and this should
be a complete history of each drawing made, what
changes made, its serial number, case number,
shipped number, pattern letter or symbol, and a
reference or remark column, in which may be
noted changes and other data which may come
up. A record book of complete sets of draw-
ings for each machine is useful and saves time
in looking up information, however, it is not
absolutely necessary. There should be a record
book showing how many blue prints have been
made of each sheet, when made, when delivered
to the shop, whom delivered, and when re-
turned; and it should be seen that this book is
carefully kept. I have but outlined a system
of drawing-room management and drawings,
which answers very well for an ordinary ma-
chine shop. Of course, experience would show
wherein changes might be made to improve the
management of that particular department.

After the drawings have been carefully looked
over and approved, the next step towards the com-
pleted machine is to the pattern room, where the
necessary patterns are to be made. But while
we are on the subject of drawings, and in con-
nection with pattern room, will say that oftten-
times it is wise to furnish pencil drawings full
size clearly showing such parts as may be
obscure or irregular on the working drawings,
for the pattern maker's use; I make it a point to
have everything as clear as possible for the pat-
tern-makers so as to obviate the necessity of
their studying over the sketches and making
pencil sketches of drawings themselves. The
pattern room is a problem that should be care-
fully studied. Here the profits of an otherwise
successful business can be more than used up
by indifference and bad management. There
should be a foreman of this department who
should have charge of the men under him, and
be held responsible for the work his men turn
out. If you are the manager or superintendent,
do not interfere with the men; if you have
anything to say about the work, good or bad,
say it to your foreman; this applies to any and
all departments throughout the works. Do not
be niggardly with materials and supplies;
"economy is not parsimony." Have what is
needed on hand; do not let your men wait for
work. Hold your foreman up to having his
work laid out ahead of his men. Great discre-
tion should be made between patterns to be used
perhaps once or twice and then discarded, and
those which are in every day use. It does not
always pay to put lots of labor and the best
material in all patterns. In fact, if one has a
great many castings to be made from one
pattern, it is wise to have a metal pattern made.
Every pattern before being taken into the found-
ry should be carefully measured and compared
with the drawing, and discrepancy in the
dimensions or finish should be corrected at once;
we can more easily cut and patch in here than
after the castings have been made, brought into
the shop and partially finished up. Keep
everything picked up around your pattern room;
do not let the scrap heap accumulate; better
send it to the boiler room. Men do not like
to haul over the scrap heap, and it takes more
time to do this than it saves in stock. If you
have the right man at the head, or if your own
eyes are sharp, this scrap heap will never
accumulate or contain pieces of much value.
Keep your benches, tools, and machines clean
and in order. Nothing so discourages a work-
man as a dirty, slip-shod place to work in.
Each pattern should be designated by some
symbol and number which should be plainly
stamped thereon, or put on with raised letters
and figures which may be cast on the casting;
each machine should have a designating number
and letter which should be on every pattern
belonging to that machine, together with serial
pattern number. A record should be kept of
each pattern together with its letter or number,
s serial number, the number which were
required for each machine, its casting weight,
name of the foundry where the casting is to be
made, when sent, when returned for repairs, its
cost if it has been kept, and a column for
remarks. This book should be kept by the
foreman of the pattern room. The patterns are
now ready for the foundry; we will presume
that we have no foundry connected with the
works; if we had, the system would be sub-
stantially the same except possibly more rigid.
We train some bright young man to know each
pattern's name, what it is for, and where it is
kept. Orders for the castings come through the
heads of different departments in the works,
in the form of requisitions for supplies and materials, stating what castings are required and for what lot or machine. These requisitions should be looked over by the general foreman or superintendent, and orders issued from drawing room or stock room to the foundry the same as for all other supplies. These orders should state the number wanted, the pattern letter and number, the name of the pattern to aid in picking it out, number furnished and number received. After due time has been given them for completion of this order, duplicate slips should be made out, stating what is short to complete order, and the young man takes this to the foundry to see why the order has not been filled, making such notes on this slip of the condition and expectation so that he can intelligently convey same to the foreman upon his return, that he in turn may make calculations to arrange his work accordingly. Patterns should be removed from the sand as quickly as possible and put in their proper places on the shelves or rack in the pattern house. They should be carefully looked over, and any needed repairs made at once. Patterns in the foundry are usually handled like cord wood; you may provide plenty of rap and draw holes and hooks to fit the same, but the average moulder will drive pointed irons and screw hooks in the finely finished pattern rather than use those provided for him; result, repairs necessary. Now, all this may be obviated by proper management; there is no more use of things running riot in the foundry than in your machine shop. It has always seemed as if it were necessary to have great heaps of refuse, sand flasks, dinginess and confusion in the foundry in order to make the men feel at home. I suppose that if they should drop into one of the modern foundries where all is bright and clean as a modern machine shop, that they would become homesick and long for the old shop. This slackness in the foundry is just as fatal to good results as a ship-shod, dirty, unsystematic machine shop, and you can rest assured that where you find this to be the case, the quality of work turned out by either is indifferent. Upon delivery of the castings at the stock room, they should be carefully weighed, and a slip pasted on them stating when and to what lot or machine they are to be charged, and a notice to the workman to charge his time to that lot or machine. When the casting is delivered into the shop, a slip should be made out, stating that — pounds of castings, costing — has been delivered to a certain lot or machine. This same system is followed out on every piece of steel, iron, brass or supplies; these slips or tickets are taken up by the clerk in the office daily, and are charged directly to the lot or machine in question. The stock room should be separated from the machine shop, and in charge of a competent man who will see that everything is charged and delivered to its proper place; he should allow nothing to be taken from his room without an order to that effect, and a record made of its delivery. Strips of wood or metal of correct length (for gauges) marked as to what material and size of same should be furnished, to assist stockman in cutting off shafts, etc. When the shaft is cut off, straightened and centred, it should be stamped or marked with a number of lot or machine to enable the workman to charge his time correctly.

The arrangement of tools in the machine shop should be made so as to give best results, rather than for symmetry; we must try to arrange them so that as our work progresses it moves in a circle from the stock-room through the planers to the boring-mills, lathes, drills, finishing benches, erecting floor, lastly, the shipping-room, where it is to be loaded on the cars. Having the necessary tools in each of the departments to do its own individual work without extra handling, it is wise (and it is absolutely indispensable where you are duplicating work) to divide the work into departments, each department having a head or under foreman, who should at the same time be a working foreman; he should have oversight over his men, and should be held responsible to the general foreman for the work turned out in his department. The general foreman should have general oversight over the entire shop; should hire and discharge the help; approve of the requisitions for supplies, and see that no delay or confusion results in any of the departments. He only is responsible to his superior, the shop manager, for every performance of his subordinates. Orders should be issued by the shop manager to the general foreman, and he in turn to the under foreman, who lays out the work for every man. Special shop tools should be provided whenever necessary for the rapid reproduction of work, and the best machine tools should be purchased for all the departments, as they pay in the long run.

A tool-room should be provided, fitted with only such tools as are necessary to make shop tools and do the needed repairs on those in use. This room should be in charge of a competent man, who should be a good tool maker; it is his business to see that the tools are in proper condition, jigs made, and that they are delivered promptly to the workman requiring same. A check system should be adopted, giving each man, say ten checks, and when a tool is delivered taking a check in place of same, which
is to be returned to workman on the return of the tool. There should be a place provided, either on the shelves or in the drawers, for every tool in the shop; a rack for dogs, boring bars, arbors, etc. My preference is, to have all the tools in drawers, as there is less accumulation of dust and usually we can have plenty of room about them; it is well, perhaps, to have the reamers, drills and arbors on a shelf in plain view, where at a glance the tool-man can tell where a certain tool is, that is missing from the rack. I arrange to have the boring tool, chuck-mill or reamer, the reamer twist drill, the hand reamer and the arbor for each size together. It is well to have cases made to hand out with the reamers and possibly the twist drills, but especially the reamers, as they are so liable to be nicked; I prefer pine boxes which are square, with a hole bored in one end the size of the reamer, and when reamer is given out we give the box with it. All the forged tools, lathe tools, planer tools, drills, boring-mill tools, slitter tools, etc., after being forged in the smith-shop, are returned to the tool-room for distribution. It is preferable to have all the tools ground on a tool grinder in the tool-room or in a room adjoining; in small shops this would be an added expense and unnecessary; however, it is absolutely necessary for economical management that twist drills, etc., should be ground by the tool maker himself, or an able assistant, and that strict orders should be issued that no drills should be ground outside the tool-room. It should be the business of the tool maker, or overseer of the tool-room, to look after the delivery of the shop supplies, and he must use great discretion in their distribution; he must be economical, but he must not be niggardly. Files, waste, oil and emery cloth are four items of shop supplies in which there is more waste and carelessness in using than in anything else, and it becomes the duty of each under foreman to co-operate with the tool maker in seeing that there is no unnecessary waste of supplies in their department. My advice is to get the best; it does not pay to buy cheap oils for use in screw cutting and lubrication; it does not pay to buy cheap files, or old, worn-out, recut files; it does not pay to buy "seconds" emery cloth and sandpaper, as their life is so much shorter, that, in the end they cost more than the best. Get the best in every instance, and see that it is properly used and not wasted. In a machine shop, conveniences for the rapid handling of work should be furnished. Machine tools should be so arranged as to give best results. Oftentimes a judicious transposing of tools already placed, means fewer names on the pay-roll and greater production at less cost. The main line and countershafts should be often inspected and tested as to alignment, and should never be allowed to run until lined up. Many dollars disappear in extra coal burned to produce power lost in friction. One man should look after the shafting and see that it is in good shape and properly oiled. Each workman should keep his tools in order, and report any repairs which may be necessary, that the same may be fixed at once. It is wise to take a week during the summer, at such time as business is liable to be a little quiet, for a vacation, both for the men, and to give you an opportunity to clean up and thoroughly repair any and all machines in the works; it pays in added life to the tool, and the rested condition of your help. Material should be on hand before it is actually needed; it saves delay, and also has a good effect on the help by enabling them to see the work piled up ahead of them. Make one department crowd the other. If you can institute a friendly spirit of rivalry between your different departments, so much the better. Use any effort to produce the best in the quickest possible time. Find fault freely, not for the sake of finding fault, but for a means of improving the quality of work produced. The question of day-work and piece-work depends on the kind of work you are doing. There are places where one is more economical than the other. A thorough discussion of this subject would in itself require more time than is possible to take this evening, and could very properly be made the subject of another paper at some future time. In the engine-room and boiler-house, there should be a man in charge who thoroughly understands his business. It does not pay to hire some cheap man to look after this department; he can waste and burn up more than the difference between his wages and those of a good man. Keep your engine and engine-room clean and in good order. Take indicator cards occasionally to see that your engine is working with economy. Use good oil; keep your fires clean; ashes raked up, and a general order of neatness about your place; weigh your coal, measure your oil, and keep an account from day to day as to what is actually used, for sake of comparison; try every means to make each pound of coal produce more work. In fact let the desire to reduce expenses and cost of production in the machine shop enter as well into your steam plant. In regard to time-keeping, there are many systems; clocks, checks, slips, etc.; many are good; many cost more than they save. My judgment is, to use the most simple method possible and attain your end. I have a time-keeper who goes about every morning and takes up the time of each
man for the previous day. The gang foremen or heads of departments take the time of each man under them, and what they work on, in a book furnished them for that purpose, which the time-keeper copies into his time-book. This time-book is arranged with a page for each man, giving total time for each day, and divided time on different lots or parts he may have worked on; these are added by the first of each month, and are charged directly to the lot or machine, together with the material and running expenses. As each lot or machine is completed, we get its actual cost, thus being able to tell whether a profit has been made or not. The relative cost which running expenses bears to stock and expenses, we find in this manner:—we divide the whole labor into producing and non-producing labor; producing-labor is wages paid for labor charged directly to the lot or machine; the non-producing labor is salaries, clerk-hire, foreman, draughtsmen, pattern-makers, engineers, blacksmith, strikers, stock-man, laborers and casting cleaners; this latter labor constitutes shop expense. Running expense includes rent, taxes, insurance, interest, coal, water, oil, waste, advertising, travelling and all items of supplies. We averace this per month, or in other words, divide the total running expense for the year at so much per month, (or perhaps take it every six months if there may have been a variation in the general expenses), and charge this to expense. We find that in our shop, for every dollar we pay for producing-labor, we must add $1.17 for expense to produce that labor. This of course would vary in different shops, according to the amount of business done and help employed, etc. The main thing is to have it on the right side and not to make it appear better than it really is; it is much better to err on the safe side. A successful management depends upon the care and pains taken to keep this expense cost as low as possible, and the efforts made by foremen in getting the most work out of the help.

In conclusion, let me say a few words in relation to the help. The workman is worthy of his hire. He is a man, and should be treated like a man. It is a great blunder to treat your men other than with courtesy and consideration. There is certainly no one influence bearing more forcibly on economical production of work than kindly and considerate treatment of your help, both by yourself and those under you. Harshness, even if not unjust at times, results in resentment and dissatisfaction, while perhaps not openly displayed will show in the quality of work turned out. Words of commendation go a great way with your men, and do not cost you anything in even your self-esteem. Do not let your men feel that all there is in life for them is pay-day Saturday night. A feeling of unrest goes with the men to their homes, and often times their homes are not as pleasant as they should be, they wander off to the saloon and drown their troubles in drink. Morrow comes, and your men, if not out, are in such a condition that it would be much better for you if they were. While, on the other hand, if you and your subordinates have always a pleasant word and occasional praise for a man, his home-coming would bring a ray of sunshine into a cloudy home. I can assure you that the home-coming of the bread winner with his spirits buoyed up or depressed affects in a like manner his family as well. Put yourself in his place. Treat him as you would wish to be treated were the tables turned. If this policy were followed out, labor agitators would have but little show of breeding dissatisfaction among your men. Even if there were any cause for complaint, your men would not believe there is. The warfare between capital and labor which has raged and is raging to-day, in which both sides are hurt and neither benefited, would in my opinion never have existed if there had been right good feeling between master and man. The workman's labor is just as necessary to the master as the master's gold is to the workman in payment for that labor. It is the workman's divine right to sell his labor for the highest price, but it is also the master's right to insist that he gets full equivalent in work for the money he pays, and this can be done without incurring the enmity of your men.

ARMOR PLATE.

A Paper read before the W. M. E. Society.

The United States Navy has been developed so fast in the two or three years past, that in connection with it, both through the daily press and the scientific literature, the public has constantly had its attention called to the armor that is being used in the construction thereof.

It is my purpose in this paper to briefly bring forth some of the conditions required, and the methods used to meet them in the past and to also describe somewhat more in detail the manufacture and treatment of the armor plates now accepted by this government.

In years gone past, when battle-ships had little or no protection in the shape of plate covering, the guns used were of comparatively small calibre and could only be fired so as to give a low initial velocity. Then the manufacturers of naval guns began to increase the size of calibre and somewhat the velocity. It will be seen at once that a large projectile moving at
a slow velocity would, should it come in contact with a war ship, greatly shatter it. Soon began the first moves towards protecting the ship against such attacks by means of metal covering. Practice has shown that for this purpose the softer the plate in consistency the better, and so soft iron was used. A change suddenly took place in the methods of naval warfare and the guns were built to withstand a much stronger initial pressure. On this line have the guns been developed until we now have guns of 13" caliber capable of throwing a 500-lb. projectile with an initial velocity of 1,406 feet per second. This new era of things brought the following problem forward to be solved in the making of protecting armor, and it has been with the idea of solving this that so much time and expense have been spent in trying to accomplish the same in so many countries. How can the most efficient armor plate be produced, that will withstand the effect of both classes of guns, i.e., shattering and piercing?

The English were the first to get anything like satisfactory results and these they got by means of the laminated plate. This plate consisted of a soft iron back welded on to a steel front, similar to the making up of composite dies in these days. This was of necessity a very expensive piece of work and at the same time not very satisfactory for it is next to an impossibility to weld a surface of 8' by 6' without having some flaws. The steel used for the surface was a crucible steel of high enough carbon to harden in oil. These plates, after being made, were heated to a cherry red and then plunged into an oil bath. The iron not being susceptible of temper remained soft while the front was very hard. When these plates were put to the ballistic tests they proved unsuccessful in this way, where a plate was hit with a projectile of slow velocity it would be shattered on the steel, and parts of the face would peel from the back. Then it was a very easy matter to pierce the iron with a high velocity projectile, thus rendering the plate useless. The next tests were made with steel of varying analyses and plate tempered and the back drawn. Some of these plates stood exceptionally well, but at times it was impossible to temper these large masses evenly; they experienced the trouble that always is found in tempering large masses, i.e., when the mass of metal comes in contact with the liquid in cooling there is immediately formed an envelope of the vaporized liquid on the surface which keeps the liquid from contact with the metal and thus allows it to cool unevenly.

About three years ago, almost simultaneously, there were presented to the Government for consideration two processes for treating armor plate, the one English and the other American. Tests of both showed that they superseded any results that had been arrived at before, and it required a very long and careful series of experiments for the Navy department to arrive at a conclusion as to which to adopt. I will now describe somewhat in detail these two processes. I would pass over entirely the English process as it has been rejected by the United States were it not that I think it brings out one or two points in regard to the manipulation of steel in hardening, that are of great value in actual work of manufacturing extra large and heavy tools and dies in the shop to-day.

First the Brown-Tressider process, as employed at the Atlas Steel works, Sheffield, Eng. This patent was granted to Capt. Tressider for a process by which he could harden the surface of a large plate and have it homogeneous.

We will now examine Fig. 1 in order to more fully understand this process. We have a large pan (b) large enough and arranged on foundations solid enough to carry a plate of 8' by 6' and 14" thick. In this pan are series of supports (a) arranged so that their tops are on a level about 3" below the top of the pan (b). On a plane parallel to the pan and at about 2 feet above is a series of piping so arranged that when water is thrown, the direction of the jets of water will be downward upon the pan. The pressure of water used in this douche is about 80 pounds.

Now the plate is heated in a furnace to a tempering heat. Then placed upon the supports (a). The water is now turned on at the above pressure. This cold water playing on the surface tends to harden the same while the back will cool much slower and thus be soft. The cooling of a plate on one surface like this of necessity distorts it. So in making armor plate by this process, the plate must be dished an amount so that the contraction of the plate in cooling will bring it back to a level position. The dotted lines E represent the plate before being treated. This process is also modified for curved plates by using the curved douche, and to harden both surfaces by using the double douche.
It will be seen that by this process the water striking the surface at so high a pressure will dispel the steam film that will be generated, so the surface will be kept in contact with water at all times and so be hardened quite evenly.

The process adopted by the United States is that known as the Harvey process and is used in connection with Ni. steel made by the open hearth process. This system consists in taking a steel of 10 to 35c. and 34% Ni. and treating the surface so as to raise its carbon to any point desirable and to any depth wished. This plate when hardened would have the hard surface to resist penetrating and bulging, with the soft back to resist shattering. Now let us follow a plate through from the ingot to its final acceptance by the Government.

We will take one of the smaller plates that are used. One 8' by 6' by 10 3/4". This plate will weigh finished 9.55 tons. The Government requires that the ingot from which a plate is made shall weigh at least twice the finished plate. So first we must pour an ingot of Ni. steel O. H. process of at least 19 tons in weight. Next the Government specifies that not less than 30% by weight of the ingot shall be cut from the top end and scrapped.

Taking away this 30% of scrap will leave some 2½ tons to be sheared from the plate when finished. And this shearing cannot be done until the plate has been reduced to its finished thickness. This precaution is taken so as to ensure against any cracks starting in from the edges as is quite often the case in reducing stock either under the hammer or through rolls. If we are making this plate at the Bethlehem Iron Co. at Bethlehem, Pa., we could reduce it under the hammer to its finished thickness, but if we are at C. P. & Co., Homestead, we will finish it to size in heavy rolls. The two are the only firms in the United States making armor plate. After the plate is trimmed to its required size, the edges are all machined so as to make the lap joint on the ship. The holes are drilled and tapped in the back for stay bolts. The holes are now plugged up and the plate is ready to be treated or as is called Harveyized.

---

Fig. 2 is a cross-section of a furnace used in the Harvey process. This furnace has the wall C and C stationary with the cover B, an arc made of the best silica fire-brick to be obtained. Underneath the furnace floor is the fire-box. The flame from the fire-box passes up and around the spans (f) on both sides and out of the flues in the ends of the furnace.

In the middle of this furnace is a section which is about 10' long and 8' wide and some 24" deep, built of fire-brick. In this section the plate is placed for treatment. On the bottom of this section are supports (a) at intervals of about 12'". These are generally made of railroad iron. For treatment, the plate is placed on the supports (a) in the matter shown. Now all the open space around the plate up to a point, say 3' from the top, is thoroughly filled and tamped with the best Si. sand. Upon this is then put about 8' of some carbonizing substance, generally bone-black and powdered charcoal as used in case-hardening. Then about 2' or 3' of sand on this. Lastly this is thoroughly covered with fire-brick. These are laid loosely upon the sand so that their weight constantly causes a pressure on the surface of the plate.

One of the claims made by Harvey is that when steel is brought in contact with a carbonizing substance under heat, the steel will absorb almost directly in proportion to the pressure applied.

After the plate is packed then the fires are built and the bricks are heated, the furnace is slowly heated through, then the fires are forced until the furnace is up to the heat of melting cast-iron.

To carbonize this plate to a depth of 3" and up to 1% in this furnace would require, first the bringing the temperature of the furnace up to a point equal to the melting point of cast iron. This would take about 48 hours. Then the furnace must be held at this temperature for about 120 hours. At the end of this time the fires are drawn and when the plate has cooled to the point of cherry red it is withdrawn from the furnace and hardened.

This is done by either spraying on H₂O at a great pressure or else by plunging into a bath of H₂O or NaCl water which is constantly being agitated. When cooled and cleaned the plate is ready for the ballistic test of the government.

I should say in practice that in making a set of plate, an extra plate is carried through. The government inspector chooses any plate from the set to test. If it stands, then the government must pay for this plate as well as the entire set. This plate is sent to the proving ground at Indian Head. It is placed in a vertical position and is bolted to a solid oak backing 36 inches
AN UP-HILL GAME.

The second base ball game of the season took place with the Amherst Aggies at Agricultural Park, April 29th. The game was not as well played as the first one on account of the unevenness of the ground.

Waite officiated in the pitcher's box and pitched a good game with the exception of the first two innings. In the first inning, two bases on balls, three hits and two errors enabled the Aggies to score five runs. In the second, a hit, a base on balls and two errors scored another run and then the Tech boys began to wake up.

The Aggies scored no more until the eighth inning, but at that time the Techs had the game well in hand. In the third, two singles, a double by Zaeder and a neat steal home by Gordon, earned three runs for Tech. When the Techs went to bat in the sixth inning the Aggies were still in the lead, 6 to 5. Then four singles, two bases on balls and stolen bases too numerous to mention netted five runs, and from this time the result was not in doubt. Zaeder, Gordon and the Curleys were the best at the bat, while Philpot and G. F. Curley took the honors in the field.

W. P. I.

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Totals, | 35 14 11 13 3 27 15 9 |

Amherst Aggies.

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Totals, | 40 8 11 12 0 24 17 7 |

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WESLEYAN 8, W. P. I. 4.

On May 1st, the Tech team went to Middletown and surprised the natives by giving the Wesleyans a hard rub. The latter anticipated an easy victory. As the game progressed, however, it was evident that the Techs were the equals of the Wesleyans, and lost only through hard luck and the favoritism of the umpire. The latter materially aided the Wesleyan pitcher in striking out our men, although his decisions on bases were satisfactory to both sides. Tech scored in the first inning—Philpot was given his base on...
bats, stole second, took third on an error by the catcher and scored on Zaeder's sacrifice to left field. Wesleyan did not score till the third inning when Beeman got his base on balls, stole second, and scored on Smith's two-base hit. Wesleyan was especially lucky in making their hits when men had been given their bases on balls. Waite, however, is recovering rapidly from this fault, and with practice will soon be able to place the ball wherever he wants it.

Captain Gordon was unable to accompany the team on account of an injury, sustained by sliding in the Amherst game. Zaeder fulfilled the duties of captain for the day. The details of the game follow:

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Totals, 31 4 5 5 1 27 9 5

*WESLEYAN.*

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Innings, 1 2 3 4 5 6 7 8 9

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**A CLOSE GAME.**

The Tech team played its second home game of the season at Agricultural Park last Saturday afternoon, and was beaten by a team supposed to represent the College of the City of New York, the score being 8 to 6.

Some of the New York (?) men did not know the names of the members of their own team, thus making coaching difficult. The game, however, was close and interesting. There were between thirty and forty people present who paid admission, making the gate receipts less than $10. The guarantee paid the New York men was $90. Figure it out for yourselves, students of the Institute, how long will the team exist with such support? The Tech was never so well represented in base-ball as this year, and to go to the other extreme never were home games so poorly attended as this season. The Tech team out-batted and out-fielded the visitors, and earned all the runs credited to them, but several close decisions at critical times were decided in favor of New York, thus ruining Tech's chances of winning. The features of the game were the batting of Gordon and Perkins, the fielding of Waite, and the catching of Mooney.

The game opened with a base hit by E. McSorley. Quinn followed with another. Mooney was hit and went to first, filling the bases. Salmon knocked a grounder to Waite, who threw E. McSorley out at the plate. Sutorius did the same thing, forcing Quinn. Waite gave McSorley a base on balls, forcing in a score. Leonard hit a grounder to Waite, and was thrown out at first. In the second half Knowles struck out. In the first half of the ninth inning the score was 6 to 6, with New York at bat. With Salmon on third and Sutorius on second Leonard sent a ground ball to center field, bringing in two scores. In the second half Knowles struck out. Perkins made a hit, but was put out while trying to steal second. Lincoln made a hit and stole to second and third. Waite reached first on an error and stole second. With two men out, two men on bases, and two runs needed to tie the score, Gallagher knocked a grounder to Sutors, and was called out at first on a close decision.

The score:

**NEW YORK.**

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Totals, 39 8 11 13 0 27 19 4

**TECH.**

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A SHORT VACATION FOR PRESIDENT FULLER.

Dr. and Mrs. Fuller started last Friday on a trip through some of the southern states. The object is partly for research in several directions and partly for the benefit of Mrs. Fuller’s health.

The plan is to be gone at least three weeks and visit the Drexel Institute at Philadelphia, Washington, the University of Virginia at Charlottesville, either Natural Bridge or White Sulphur Springs, Cincinnati, Louisville, Nashville, the iron and steel works at Birmingham, Al., New Orleans and San Antonio, Texas. Dr. Fuller’s plans were not made when he left here as to the route after leaving San Antonio. It is hoped by all that this trip will prove a successful and enjoyable one in every way.

THE W. M. E. SOCIETY MEETING.

The regular meeting of this society took place last Monday evening in the mechanical model room at the Laboratories. In the absence of the president, Mr. N. M. Paul, Mr. Nathan Heard, vice-president, occupied the chair. There were about fifty present, nearly half of them being undergraduates. After the routine business was finished Mr. G. E. Camp, ’88, read a paper on “ vou· Armor Plate” which called forth some discussion. This was followed by a paper by Mr. A. M. Powell, ’79, President of the Powell Planer Company, on “Economics of Shop Management.” The next regular meeting will be held on the afternoon of Commencement day, so that many of the alumni who come to the alumni meeting in the evening may be present. Papers will be presented at that time by William R. Billings, ’71, Treasurer of the Taunton Locomotive Works, and John M. Goodell, ’88, Assistant Editor of the Engineering Record.

THE EVENT OF THE SEASON.

The Burlesque which is to be presented Friday and Saturday evenings promises to be a success in every way. All of the finishing touches have been put on, and although the management has had to work up hill a part of the time everything now is ready.

The Amazonian March which is to be given during the evening by Messrs. Edgerly and Benton of the Boston Cadets was first presented by them at the Tremont Theatre in Boston in 1891. They are assisted by F. F. Brown, also of the Cadets.

The costumes for the entertainment are from George P. Raymond, and the wigs and make-ups from Charles H. Garey & Co., Boston.
Mr. Harry Doe will take J. C. Abbot's place in the clown dance.

There still remain many desirable seats in the Balcony and Orchestra Circle for each evening. The following men have been selected for the Fairy Chorus:


ALUMNI NOTES.

"88. George E. Camp closed his connection with the Spaulding, Jennings & Co. Steel Works on the first of May. He has accepted the position of superintendent of the Hunt Conveyor Company of New York.

"91. George W. Booth, who, until recently, has been assistant in civil engineering at the W. P. I., has accepted a position with E. Worthington, Jr. & Co., Civil Engineers, 52 State Street, Boston.

Ex. "93. Walter U. Gutmann sailed May 6th on the "City of New York" from Southampton. He has been abroad for twenty-two months studying in a textile school at Aix la Chapelle.

Charles T. Tatman has recently published a very interesting and instructive little pamphlet on the study of numismatics.

TECHNICALITIES.

The preps would like to learn a practical way to remove red paint from a marble sidewalk.

At a meeting last Monday noon of those who intend to enter the intercollegiate sports this spring, E. B. Whipple, '94, was chosen captain of the team.

Miss Adelle Poore, stenographer at the Washburn Shops, gave up her position last Saturday, to accept a similar one with the Heywood Boot & Shoe Co. Miss Warden is her successor.

G. W. Bishop attended the conference of presidents of college Y. M. C. A.'s which was recently held at Harvard College. Twenty-four out of twenty-eight associations were represented.

"Did you ever see such a lot of fat Dutchmen?" asked Dobbs as they came suddenly upon a lot of street musicians.

"No," said Hobbs, "it must be one of those obesity bands you read about in the papers."

The Lakeside Boat Club is making great preparations for a grand good time on the evening of May 24th. The Amherst College Glee Club is to give a concert in Mechanics Hall from quarter of eight until quarter of ten, when the floor is to be cleared and a reception and dance will follow.

On Saturday evening, April 29th, Dr. Fuller gave a reception to the Senior Class at his home on Boynton street. The evening was spent very pleasantly in a social manner. Dr. Fuller has, in years past, given this reception in June, but on account of the trip which he is at present enjoying it was held earlier this year than usual.

At a meeting of the Y. M. C. A. of the Institute, held March 29th, the following officers were elected for the ensuing year: George W. Bishop, '94, president; Frank J. Bryant, '95, vice-president; J. Warren Thayer, '95, corresponding secretary; James B. Mayo, '96, recording secretary; Warren A. Scott, '94, treasurer.

Bowdoin College is to have a new scientific building. Mr. Edward F. Searles offered to the college about a year ago the funds for a building which he said must exceed any other of its kind in the country. Three of the professors have made an extended trip throughout the United States, visiting different institutions and gathering ideas, and now plans are all made and the contract will be let immediately.

Clarence W. Eastman, class of '94, and one of the editors of the W P I., has received from Congressman J. H. Walker the appointment as cadet at West Point. He took the examination with fifteen others and received a per cent. considerably higher than any of the others. There is an examination still to be taken at West Point and if this is successfully passed, of which there is little doubt, Mr. Eastman will enter in June, 1894. Alba H. Warren, '95, received the appointment as alternate.

On Thursday, May 2nd, the W. P. I. Banjo Club and Mandolin Club made their first appearance in public at a concert held in Association Hall. The home clubs were ably assisted by the M. I. T. Glee Club. Every number on the programme was excellently rendered. The audience was large and apprecia-
tive, and nearly every selection was encored. The ushers were, C. H. Dwinnell, '94; M. B. Chase, '94; G. W. Heald, '94; H. P. Linnell, '94; C. A. Burt, '94; C. A. Harrington, '95, and F. W. Gay, '95.

**TRACK ATHLETICS.**

If appearances are to be considered as affording any means of forming an opinion, there is every indication that the intercollegiate meeting will be the best athletic event seen in the city for years. From all the colleges prominent in athletics, come reports of steady effort and earnest training by candidates for their teams. About thirty men have handed in their names to Manager Rawson, but owing to the unfavorable weather which seldom permits more than three days of training a week, the team has not been able to make much headway yet. The time required for the trip to and from the Oval has doubtless deterred a few men from training, but the majority seem to have realized the fact that some difficulties must be expected, and that only by faithful training can anything be accomplished for self or Institute. The men will have the assistance of Mr. Donovan, the W. A. C. trainer, and will not be obliged to blunder along as in previous years without any aid except of anyone who might happen along to help in rubbing after exercising. In regard to the matter of rubbing, five men are needed every night, and any men who wish to show their loyalty to the athletic interests of the Institute, will doubtless be given an opportunity if they hand their names to Mr. Rawson.

The Worcester Athletic Club is also putting forth its best efforts to make the meet an unqualified success.

In order that all may obtain seats, the W. A. C. will erect a temporary stand at the beginning of the stretch north of the covered grand stand. Admittance to the grounds will be twenty-five cents, and the price of reserved seats will be fifty cents in the covered grand stand, and twenty-five in the smaller ones. Seats will also be placed on the club house which will probably be disposed of to private parties at one dollar a seat. It has also been proposed to allow carriages upon the earth tennis courts beyond the back stretch if it is found that it can be done without injury to the courts.

The Oval has a well-deserved reputation as the finest athletic field in New England, and the W. A. C. will spare no pains to have the track in the best possible condition. Even if it should rain on May 24th there would be no slipping as on an earth track, for the cinder absorbs rain nearly as fast as it falls, and offers a firm, hard track for the runners.

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**WARREN—BOSWORTH.**

Mr. Herbert Anson Warren, a graduate of the Institute in '91, and now engaged in business at St. Albans, Vt., was united in marriage at 3.30 o'clock last Saturday afternoon to Miss Maud S. Bosworth.

The ceremony was performed by Rev. Austin S. Garver of the First Unitarian Church, at the house of the bride’s uncle, Mr. Ezra Churchill, at No. 47 Wellington Street.

The best man was Mr. Frank R. Batchelder, and the bridesmaid was Miss Mabel C. Streeter. The maids of honor were two little girls, Miss Margaret Reed of this city and Miss Marguerite Seales of Millbury. Messrs. Fred B. Stuart of Lawrence, Harrison P. Wires of Boston, Thaddeus C. Warren, Bradford A. Gibson, and Master John P. Warren of Worcester acted as ushers.

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**A LONG WAIT.**

At four o’clock Friday afternoon the man who wanted most, his first choice of seats for the Burlesque took his place before the ticket-office at Leland’s music store. As soon as the news spread that the line had begun to form more came, and by six o’clock there were ten in line, and at eight o’clock there were twenty-five. Nearly every one was a member of a combination, generally consisting of four or five men, who relieved each other at intervals of a few hours. The longest relay lasted for one man from 10 P. M. Friday until Saturday noon. The furniture for seats was anything from a peach crate to an arm chair. Early Saturday morning a short shower came up but the line proved insoluble, it was not dissolved. At a little after seven Saturday morning the line filed through Leland’s store and took up its station in the rear. Playing cards was the chief occupation during Saturday forenoon. Promptly at 2 P. M. the door to the ticket-office was opened and the first two men in line were admitted. Each man required on an average about six minutes to make his choice, and nearly every man took the full number of tickets, fifteen for each night. The boxes and about all of the orchestra, besides a large number of balcony and orchestra circle seats were disposed of at this time. The management has been criticised to some extent for not selling the seats at auction, but it was decided after due consideration that the way decided on was best.

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**THE Y. M. C. A. GYMNASIUM BANQUET.**

The third annual banquet for gymnasium members took place at the Y. M. C. A. Thursday
evening, April 27th. Three tables stretched the entire length of the gymnasium, with one smaller table for the speakers and officers of the association. A considerable number of Techs are present members of the gym and a majority of them were present, two being on the programme to respond to toasts. Derby, '98, spoke of "Our Athletes," showing the value of gymnasium training. Higgins, '96, gave an extemporeaneous address on the "Y. M. C. A. Wheelmen." An admirable address was given by Rev. A. Z. Conrad, D.D., entitled "The Man at the Top." The musical part of the programme was furnished by E. P. Crierie, whom the audience never tired of hearing.

**COLLEGE NOTES.**

The U. of P. is raising money to erect a Y. M. C. A. building to cost $150,000.

One hundred and two members of the House of Representatives are college graduates.

Williams college is arranging for an expedition to Labrador, during the summer vacation.

A $1,000 silver cup will be the prize competed for at the international athletic contests in Chicago August 11th and 12th.

The Harvard Hasty Pudding Club realized over a thousand dollars at its performance of "Hamlet" in New York, April 27th.

The University of Michigan has almost twice as many living alumni as any other American educational institution. Harvard is second and Yale third.

Two hundred and fifty men at Cornell have subscribed their names to a pledge to form an organization for the suppression of fraud in college examinations.

The University of Chicago has decided to open its dormitories for the accommodation of the educational public, during the World's Fair. Many institutions are planning to make the University their headquarters.

Samson, the strong man read about, was the first to advertise. He took two solid columns to demonstrate his strength, when several thousand people tumbled to his scheme, and he brought the house down.—Ex.

The faculty of the University of Pennsylvania has adopted a rule excusing from a part of the English composition work of Junior and Senior year those who have been chosen to an editorial position on a periodical of the University.

The number of unexcused absences allowed at Princeton will be reduced as follows:—Seniors and Juniors will have fourteen instead of twenty cuts, and Sophomores, Freshmen and Specials, twelve. This rule will not go into effect until next September.

The fourth annual spring meeting of the Harvard University Cycling Association is to take place on Holmes field track, Saturday, June 10th. There are seven events with gold, silver and bronze medals as prizes for each. Entries close June 1st, at noon.

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