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THE TECHNIC.

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IN a recent editorial the *Purdue Exponent* takes us to task for what they call a display of rowdyism at the Purdue-Rose basketball game. We believe that their point is fairly well taken, and that we should take this opportunity to advise all Rose men that hissing is entirely out of place at any basketball or other game. Besides being unsportsmanlike, it is offensive for other reasons. When, pray, did you ever see it do any good? Granted that the referee shows that he is an amateur, and has mixed ideas in regard to the rules, it always results that he becomes much worse on receiving an outburst of derision of this kind. In the second place, such a performance injures our reputation, and thus increases the manager's difficulties in supplying us with a good schedule. And this applies not only to basketball but to all games. On each team we have a captain, and it is his duty to see that our representatives get a fair showing. If decisions of the referee show partiality, it is the captain, and the captain only, who is authorized to act. If the captain doesn't act we must blame him.

While we are speaking of this game, however, there is one other matter which we would emphasize. It is a deplorable fact that in such a close game as this proved to be, the official exhibited either an ignorance of the rules or the influence of partiality. We are inclined to believe that the referee of the game referred to was ignorant of rules rather than dishonest. And right here it may be stated that poor officials can do much damage to college athletics. Poor officials cause rowdyism; poor officials decrease the attendance to future games—for people get disgusted to see ignorance on the part of the official.

Finally, we wish to contradict one statement made by the *Purdue Exponent* in their account of the game. They state that their players were threatened. This is entirely untrue. A more sportsmanlike and more gentlemanly team than theirs never played before us, and college men would never allow even outsiders to threaten such opponents.

THE Westinghouse Electric and Manufacturing Company has been the starting point of several of our Alumni. This great concern in their engineering apprenticeship course offers postgraduate opportunities which practically surpass those of any university or technical school in the country. The manufacturing and testing departments of the works provide almost ideal laboratory facilities for the young engineer. Two years ago one hundred and fifty apprentices and engineers of the Electric Company held a meeting and organized what is known as the Electric Club. The chief purpose of the Club was stated to be "social recreation, mutual benefit and improvement, and more particularly for the dissemination of electrical and engineering knowledge among its members." The movement was successful from the start, and there are now over five hundred members. The club rooms consist of a library, an assembly hall, and special smaller meeting rooms. In the assembly hall many practical talks and lectures are given by competent men, and these lectures are always made appropriate for young engineers.

When it was found that these meetings were very successful and beneficial, the Electric Club decided to issue a monthly journal in which the best work of the Club could be put in permanent form. Their first number appears this month, and contains fifty-eight pages of reading matter. The purpose of this *Journal* makes it unique. It is preeminently for young engineers and contains "material suited to their needs and written in a form to meet their education and experience." The privilege of subscribing to this journal is extended to all, and the price, one dollar per year, is very moderate. Any further information concerning the Electric Club or their *Journal* will be gladly furnished by the Alumni Editor of THE TECHNIC.

FOR several years it has been the custom of the Institute to provide a course of lectures and talks by practicing engineers to be delivered before the student body. The first of these, for the present college year, will be given some time during the latter part of this month. Among those who are to speak to us are Mr. H. W. Foltz, '86, and A. W. Layman, '92. The attendance at these lectures in the past has proved that they are enjoyed by all, and we are looking forward with pleasure to their continuation.

"Failure is only endeavor temporarily off the track. How foolish it would be to abandon it in the ditch."

THE above quotation tells us how to treat failure. Although our last football season was by no means a failure, yet the results discouraged us just a little at the end of the season, so that, for a time we thought seriously of abandoning this branch of athletics "in the ditch." Now that the season is passed, however, we look back and begin to discover that we were not so bad after all. In fact careful study will show that we learned several things which have strengthened our standing in other directions. We can now see that the results of another season of discipline, such as Coach Holste inaugurated, might astonish us. In other words, we recognize the fact that our condition in football, during the last few years, has been that of derailed endeavor, and that last season was spent in getting out of the ditch.

Manager Lee is contracting games for next Fall, and, with a competent coach, we expect to leave the ditch far behind, stick to the track, and make things hum.

The Iroquois Fire, Chicago.

By J. T. MONTGOMERY, '98.

THE fire which occurred in the Iroquois Theatre on December 30th, judged from the loss of life, was one of the most disastrous fires recorded in the world's history, and in this particular exceeded the great Chicago fire of 1871 by more than double the number of deaths.

The Iroquois Theatre was opened to the public on Nov. 23rd, 1903. It is of modern construction, embracing the latest principles in fire-proof building. Mr. Benj. H. Marshall was the architect, the general contractors were Messrs. Geo. A. Fuller Company, and the fire-proof construction of the structure proper was furnished by the Roebling Construction Company; all are Chicago concerns. The building was of modern steel construction, using cast iron columns, steel girders and floor beams. The three principal parts of the building, the Grand Foyer or entrance, the Auditorium proper and the Stage, were all separated by heavy masonry walls. The floor construction consisted of reinforced cinder concrete spanning between the floor beams, which were spaced about 5′ to 6′ on centers. The two balconies in the Auditorium were supported by means of large canterlever girders, projecting from the rear wall toward the stage. These girders were carried on Z-bar columns, situated near the rear wall. This arrangement enabled the architect to avoid the use of columns or hangers within the entire seating space of the theatre. These large girders were protected by means of furring and wire lath, plastered and back plastered.

FIG. 1.

The construction of the stage was somewhat different from that of an ordinary building, as the the center part of the stage extended uninterruptedly to the gridiron, a height of 75 feet, forming the scenic tower. To the north of this were two fly galleries, and to the south were six tiers of dressing rooms, with two fly galleries corresponding to those of the other side. These galleries were provided with reinforced cinder concrete floors with cement finish. The dressing rooms were divided from the scenic tower by means of Roebling partition, consisting of light channel iron studs with wire lath applied to one side. This frame work was plastered and was two inches in thickness.

The structure proper had been thoroughly protected by fire-proofing materials, and how well, is shown by the condition of the building to-day. The enormous amount of inflammable material stored on the stage of the Iroquois, which contained at the time of the fire the entire stage setting and drop curtains for "Mr. Bluebeard, Jr.," the largest spectacular play ever produced, together with a car-load of scenery to be used for the "Ben Hur" production, which was shortly to be produced in the theatre, provided the fuel for such a fire as would be difficult to rival in a fire-proof constructed building. The drops used in the theatre were painted with oil paints, and were of a very light and combustible nature. The scenic tower of the Iroquois was completely filled with these curtains hung in such a manner as to provide the best possible facility for a draft and a quick fire. It is not surprising that this fire could not be controlled by the meager fire-fighting facilities in the theatre, which contained only a few tubes of "Kill-fyre," a patent chemical of some merit. That the fire was an extremely hot one is evidenced by the condition of the stage, and the manner in which the steam pipes placed along the wall were twisted and distorted by the heat. A fair idea of this can be seen in Figure 1.

Figure 2 shows the front of the Auditorium. The first several rows of seats have been entirely consumed, as well as the wood flooring. However, the concrete fire-proofing at this point was uninjured and will require no repairing.

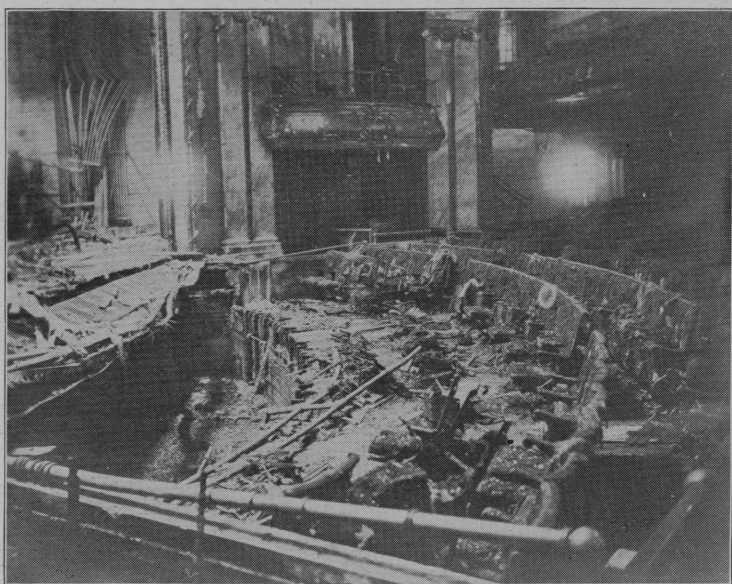


Fig. 2.

Figure 3 shows the partitions at the south end of the stage and at the elevation of the first fly gallery. This partition separated the dressing room on this side of the stage from the scenic tower. It was in a position to receive the full effect of the heat from the burning scenery in the tower, which fire was only a distance of some 8 or 10 feet from the partition. In quenching the fire the water was applied from the scenery door, shown in Figure 1, at the north end of the stage, the fire streams playing directly upon this partition. After being heated to a high temperature, it was suddenly cooled by the application of water applied with considerable force. This partition extended from the first fly gallery to the second, a distance of about 24 feet, and across the full width of the south end of the theatre. With the exception of the one door shown, which was practically entirely consumed, there was no break in the partition and no fire passed through it.

The results of this severe test of the solid plaster partition has caused many architects who have had an opportunity to examine it, to conclude that it forms one of the most perfect barriers to the spreading of fire, and is considered to exceed in effectiveness the old-fashioned tile partition

FIG. 3.

Figure 4 was taken to show the ceiling on the under side of the top balcony and shows the condition of the canterlever girder supporting this balcony. It can be seen that the finishing coat of plaster has in some cases peeled away, but the brown coat and scratch coat remain in perfect condition, and formed complete protection for these girders. The steel was not effected to the slightest extent, and there were no deflections.

The large girder over the proscenium opening, which supported the heavy brick wall extending above the opening to a height of some 60 feet, was protected by the means of cinder concrete enclosed back of furring and wire lath. The concrete protecting the web plates of the girder, which were 5 feet in depth, was about 6″ in thickness ; the concrete on the soffits of the girders was 3″ in thickness. The flames sweeping from the scenic tower into the Auditorium, which were responsible for the enormous loss of life, came directly in contact with this girder with its great load of brick above. That the girder was thoroughly protected is shown by the fact that in no place is the cinder concrete broken or injured, and there is not the slightest deflection to the girder.

The conditions directly responsible for the disaster have been attributed by the various investigating committees to carelessness of management. As has been already mentioned, there were no adequate means of fighting the fire and stopping the same before it could do damage.

The asbestos curtain, which, in case of emergency, was supposed to isolate the stage from the Auditorium, failed to work, and seems to have been entirely destroyed by the conflagration. The large skylight over the stage, which was supposed to have worked automatically in such emergencies and provide a draft to carry away the smoke and heat by means of opening up a space of 21′ x 23′ in the roof, seems not to have been completely equipped, at least, it failed to open. Of the many exits provided for emergency, opening to the fire escapes, etc., practically none was used. This is probably accounted for by the fact that at the moment of the fire all the lights were out to improve the moonlight scene, which was being produced on the stage. When the stampede started the audience only knew of the exits through which they had entered, all moving at once in that direction and leaving the fire escape doors practically unused. Many of them were not opened at any time, as is evidenced by the charred condition of the doors, none of which was locked, but secured by a simple fastening, which could have easily been opened.

The management seems to have had a false sense of security, and knowing that they had a building, which in itself could not burn, did not provide proper means of protection against the burning of the combustible material stored in it, nor did they consider it necessary to provide fire drills for their employees to meet such an emergency. The same sense of security was to some extent felt by the audience, who did not think it possible to have a disastrous fire in such a building and were not as prompt in starting to leave as they might otherwise have been.

The lessons to be learned from this fire are too numerous for us to attempt to even name them, but it will impress on us the importance of an old sentiment: "The price of security is eternal vigilance."

Fig. 4.

The Costs of Medium Size Power Plants.

By ROBERT YORK, B. S., '00.

IT is the intention of the writer, in taking this subject, to consider the various items which go to make up the total cost of a power plant, from the small village plant to a medium size plant of say 750 H.P.

This is not intended to give all data for the costs, but in some instances the way the cost is to be derived. About one of the first things that a graduate engineer has to contend with is this subject of costs from an engineering standpoint, which in a good many ways is identical with the commercial cost.

The cost of an engineering structure or work should be taken as the cost which would be considered most economical for the purpose intended, everything in connection being taken into consideration, and especially the limit of finances, as it is understood that money can be made if you have it to start with. And if more money is invested it can be made to pay interest. It will not be necessary to consider the costs of charters, franchises, and even a bonus for the installation of a plant. These are all entirely a matter which can be considered in connection with the locality, as well as real estate.

The subject of real estate, which is location, embraces the important economical consideration of fuel and water supply. These last two do not always receive the consideration which they deserve, and there are not a few instances in which this has been the difference between a paying and a non-paying plant.

With the exception of the fuel and water supply, it may be said that all other preliminary conditions, etc., are matters which are usually determined upon by the stockholders or directors with out advice from the engineers.

Up to this point, or better before, it is necessary to have the plans and specifications of the plant and a more careful estimate as to the probable cost, as it may be that the plant is to be bonded. To make a bond issue would be a pretty bad mistake if it did not more than cover the actual cost.

We will then consider the first subject:

ENGINEERING.

The cost of this can be reduced at once to a very simple result. The engineer would be either a salaried man, with perhaps some assistants, and he would receive from $100.00 to $250.00 per month to $4,000.00 per annum. In this case it would be necessary to keep the engineer until the completion of the plant, or better for a short time afterward at least, if not continually.

Or, the engineer would be a consulting engineer, who would charge for the complete plans and specifications, and would also supervise the work of construction to some extent, from 3% to 15% of the total cost of the plant, according to his plans and specifications. Also, this percentage would quite probably be based on his estimate. Ordinarily about 5% is the uniform charge which is made by consulting engineers.

Some small companies think it economy to get the engineers of the manufacturers of the equipment they purchase, or are going to purchase their material from, to do their engineering work. Such instances as these may require several practical demonstrations before the right result may be determined.

Before going any further, it is very essential that the plans and specifications are all right and are exactly the thing wanted, because changes are quite expensive, as well as a great waste of of time. Sometimes a franchise or a bonus requires the completion of a plant on or before a specified time.

Just here, after the plans and specifications are complete, bids may be received for the different kinds of equipment, and for the letting of the contracts for construction and installation of the machinery.

Starting now with the general detailed cost of the plant, first,

BUILDING.

The building from the cheaper forms are, frame building, wood skeleton iron clad, steel frame iron clad, up to the best brick structures with iron or composition roofing on wooden or steel trusses.

To start, the ground would have to be cleared off, if needed. This, of course, is again depending on the locality.

Excavation for foundations in different localities would be quite different. Trautwine's Civil Engineer's Pocket Book gives some very valuable figures on this, as well as other costs which are included in the building.

In frame structures the cost of lumber in that locality must be ascertained and the estimate made, and for similar classes of buildings the average cost per thousand feet B.M. will come very close to the proper figure for a building of considerably different size.

The costs of the various kinds of roofing for frame buildings, and also the methods of preservation, require careful consideration.

The construction of wooden roof trusses after they are designed requires an estimate as to the cost of the construction of the same. After one of these costs has been estimated, it is well to know the personal factor involved, which gives the right result for the particular kind of labor used.

Coming now to the better class of power plant buildings for both large and small, we should consider the brick building.

In this, as well as in the previous classes, the cost of windows, doors, etc., with their frames, can be obtained in any city from the dealers of such material. This applies where the company is a small one. It is understood, of course, that large concerns can get such material direct from the manufacturers at wholesale prices.

The largest cost items of a brick structure are the brick, and the laying of same.

The cost of soft brick is from $5.00 to $8.00 per 1,000, hard brick from $6.00 to $14.00 per 1,000, pressed brick for the construction of first-class fronts and fire-brick for lining furnaces are from $20.00 to $24.00 per 1,000.

Generally the best way to get brick laid, especially in the South, is by contract. The prices for this are quite variable, ranging from $2.50 to $5.00 per 1,000 brick actually laid, counting the openings as solid.

The writer has had brick laid for $2.35 per 1,000 on a contract to lay about 600,000. This was an exceptionally close price, as the contractor barely made wages at it. This was partly due to the extremely hot weather at that time.

When the contract is let at the above prices the builder furnishes the lime, water and sand, and the contractor furnishes the scaffolds and the necessary labor.

The prices of sand and lime are easily obtained in any given place.

The power house proper may be said to consist of the boiler room and engine room, but it is necessary sometimes to have a fuel storage room, some kind of a store room is always necessary, and it is sometimes necessary to have offices in the same building.

In connection with the power house would be included the pump house, if the plant supplied its own water. This may be under direct cover of the main building, or it may be a separate little house. If it is a condensing plant, the cooling tower might be built in connection with the main building. This would be a special case.

WATER SUPPLY,

when furnished by a well, is sometimes a pretty bad question to deal with, and also one that every engineer does not have experience with.

A shallow well, which is one that goes only to the first vein of water, which is usually not over 110′ deep, can be put down to supply a plant of 750 H.P. for from $.50 to $1.50 per foot. For putting down what is known as a deep well, which is from 250′ to 1,500′ deep, there is more or less trouble to contend with. The cost of pipe, together with the drilling and sinking, is from $1.50 to $2.50 per foot.

With these wells the water usually comes up near to the surface, and the air lift is used to raise the water from the well to the reservoir. The prices above referred to are by contract.

MOTIVE POWER.

The source of power, which is almost exclusively used for plants of the size here considered, is steam.

Water power is used where it can be obtained, but that is a special case. Just what the developments of the gas engine will bring still remains to be seen. In a number of instances, in the smaller size units, it has been shown that they are more economical than steam, operating expenses considered.

The first thing to be considered with steam as a power is

THE BOILER.

There are three types of boilers which are generally known in power plants: the horizontal tubular or fire tube, the water tube, and the marine type of internally fired boilers, which also includes the special case of the Morrison corrugated furnace boiler.

Rating these boilers on a steam pressure of 125 lbs., which is the general practice, we will make the following brief comparisons :

The horizontal tubular boiler is the cheapest and is of about the same economy as the water tube from a point of evaporation, whereas the repairs are much less than with the water tube. If proper consideration is given the H. T. boiler, the economy obtained is surprising in comparison with the higher-priced boilers.

It is not uncommon in power plants for H. T. boilers to evaporate more water per pound of fuel than the W. T. boiler, although the water tube boiler is a quicker steamer.

The floor space per horse power is greater for the horizontal tubular than with the water tube.

The price of the horizontal tubular is from $6.75 to $8.00 per H.P. at the factory. This price includes all fixtures and fittings, but does not include the breeching and smoke-stack.

The ratio of boiler power to engine power, theoretically, is generally less for power plants equipped with water tube than with tubulars.

The water tube boiler costs from $10.00 to $13.00 per H.P. Both of the above types of boilers require brick setting, the cost of which can easily be ascertained, as the number of each kind of brick for the setting is generally given in the catalogue and the contract price for laying them is from $3.50 to $5.00 per 1,000.

The internally fired boiler does not require a brick setting, while the economy is equal to the above boilers. The price on these boilers is about from $9.00 to $11.00 per H.P.

Boiler feed pumps vary considerably in price from about $.50 to $1.50 per H.P. The prices on pumps can be easily obtained. Duplex pumps and the Manistee and Marsh simplex are generally used.

HEATERS.

Tube heaters cost from about $1.00 per H.P. for heaters of 80 H.P. down to $.50 per H.P. for 350 to 500 H.P.

The prices of open heaters and purifiers range from $1.75 for 75 H.P. heater down to $.75 per H.P. for 750 H.P. heater.

The prices on condensers, together with cooling towers, are somewhat special, although the price of the condenser itself, so far as it is applied to any one given class, is not so variable.

ENGINES.

The prices on engines are about as numerous as the manufacturers. Starting with the plain automatic in sizes from 50 H.P. to 200 H.P. the prices range from $8.00 to $10.00 per H.P. to $5.00 to $7.00 per H.P. respectively.

With the high-grade automatic in the 50 H.P. size the price is from $9.50 to $11.50 per H.P. down to $7.00 to $9.00 per H.P. in sizes of 300 H.P.

The above prices are also for engines with a piston travel of about 600′ per minute.

The prices on Corliss engines are about the same as the high-grade automatic. There are also special two and four valve engines which even cost considerably more than the high-grade automatic.

The cost of compound engines is more than the simple engine, but there is nothing that could be taken as general.

PIPING.

Now that we have considered boilers, engines, heaters and pumps, etc., they have to be piped. This requires a little figuring for the given special condition. There are standard prices on the different kinds of pipe, and on standard black pipe the discount is now from 65% to 67.5% delivered at points near the Mississippi river. Also the pipe fittings have regular standard prices for any one manufacturer's goods, and a regular discount on these prices. These discounts run from 50% to 70%, 10% and 10% generally.

An estimate is very readily made, knowing the correct discounts.

SPECIAL WORK,

Such as painting, wiring, cranes, and a number of other little items, will not be considered here as the cost of such can be ascertained with but little trouble after everything else which requires a rush has been completed. Smoke stacks and chimneys are easily estimated.

GENERATORS.

The prices on these are somewhat similar to the engines, but there are some figures given in different engineering books which are quite valuable along this line.

The price for moderate speed machines is from $13.00 to $18.00 per K. W. in sizes of 50 to 150 K.W., and for slow speed machines from $16.00 to $24.00 per K. W. in sizes of 50 to 200 K. W. The above are for the belt-driven machines. According to the variation in speed in the direct connected machines the prices are also ranging from $20.00 to $26.00 per K. W.

SWITCHBOARDS.

The price of the switchboard is from $50.00 to $150.00 per panel, and the number of panels depends entirely on the given station.

CONCLUSION.

In giving the above brief outline of costs it was the writer's intention to show the importance which may be attached to them. An engineer, who from a purely mechanical standpoint is a good engineer, would be of no value to a capitalist who wished to invest in some kind of an engineering work if he could not give the relative costs of the various items used in its construction as well as their relative economy from an engineering standpoint.

The item of cost may be said to be the connecting link between the capitalist and the engineer, and also the stepping-stone for the engineer to step from his engineering position to an executive position which requires an engineering head.

When an engineer knows that with H.T. boilers and simple non-condensing engines a power plant may be constructed for about $40.00 to $50.00 per H. P., and that the price runs up to $75.00 for a plant equipped with water tube boilers and compound or triple expansion condensing engines, he has the knowledge at his tongue's end which if spoken at once when asked for may be the start of an engineering plant, the value of which would not otherwise have been known.

ROSE LEAVES

Electric Power and Transmission in a Modern Iron and Steel Plant.

By C. E. LEEDY, '05.

IN the Ohio works of the Carnegie Steel Co. at Youngstown, O., are some of the most interesting applications of electricity to labor-saving devices in modern engineering.

The requirement of high efficiency, ease of operation, perfection of control, low cost of maintenance and repairs, and above all, reliability under the worst conditions of hard usage, are all much better fulfilled by electrical apparatus than by steam or hydraulic ones.

Owing to the higher initial cost, it may sometimes appear disputable whether electric machines have an advantage over the steam driven ones, but when, in addition to the advantages named above, we consider the small space required for an electric apparatus to do the same work as a spacious steam machine, the little attention required to keep it in good condition, and the ease with which effects from changes of load, etc., can be overcome, the plant having an electrical equipment will nearly always profit by installing electrically driven machines for special services.

The plant under discussion has in use some of the heaviest applications of electrically driven machinery known to engineers. Yet the trouble from them, the cost of repairs, and time lost from break-downs, have been exceedingly slight, even after a long period of operation.

With few exceptions this plant has been developed entirely by Mr. B. R. Shover, of R. P. I., '90.

The power station, a steel and brick building, 187′ x 55′, resembles closely a street car station, and is a fire-proof building throughout, the apparatus being arranged not only so as to provide thorough attention and access to all parts, but also to present a pleasing appearance to the eye. The engines are kept clean and bright, and are surrounded by highly-polished brass guard-rails. The oiled floors are brushed every day and scrubbed as necessary.

In the station are three McIntosh & Seymour horizontal cross-compound engines of 1400 H.P. maximum each, direct-coupled to three Westinghouse 550 K.W. generators wound for 260 volts. Under a guarantee, these engines can stand a 75% overload for one hour. The space allowed for a fourth engine is at present occupied by a 250 H.P. Buckeye engine driving by belt a 200 K.W. generator. The fourth engine will likely be a gas engine, to be run by gas from the furnaces.

The engines are fitted with magnetic steam cut-offs, which prevent them from running away and allow them to be stopped from several places in the room by simply pressing a button. This same device disconnects the generators from the bus-bars of the switch-board by tripping the circuit breakers.

For lighting, alternating current is used almost exclusively. At one end of the station are two inverted rotary converters of 75 K.W., taking direct current at 250 volts, changing it to two-phase, alternating current at 170 volts. This current is then stepped up to 2000 volts in a static, oil-insulated self-cooling transformer, distributed through the works and transformed down for service.

There are 1500 incandescent and 350 arc lights in use, also a few very powerful search-lights for work on the ore piles.

The two 75 K.W. rotary-converters are 10 pole machines, run at 720 R.P.M., and give 7200 alternations per minute. They are excited by small exciters on the armature shaft, which machines are run below saturation, so as to build up their voltages and prevent running away by increasing the field-excitation. These rotaries have a 5-panel switch-board, which is fitted with all sorts of safety blow-outs and signals for detecting trouble. They also contain feeder regulators for adjusting the alternating voltage, since no manipulation of the machine will do that. These machines throw themselves out of circuit when the generators kick out their circuit-breakers. This action is due to the inertia of the armature operating the rotary as a D. C. generator and endeavoring to supply current for the main D. C. load. One of these machines is constantly in operation.

Two of the 550 K.W. D.C. generators are run night and day from month to month, while the third is cleaned or repaired, as the case may be.

All the switch-boards are black enameled slate, and are fitted with rheostats, ammeters, voltmeters, feeder-regulators, switches, circuit-breakers, and everything necessary to insure safety. Each circuit-breaker is connected to a small magnet, which blows an alarm whistle when the breaker falls out, and in this way no time is lost by the engineer not knowing that a line is dead.

All the wires are in the cellar of the power station and arranged on uprights and cross-arms in such a way that work can be conveniently done on them. Every wire leaving the station is heavy insulated cable, and is run through the mill on steel towers. The amount of wire used in transmission is between 75 and 100 tons.

There is also a 1600 amp.-hr. storage battery in a large brick building separate from the power house. This is so arranged to feed and be fed by the generators, and save fuel at the boilers and wear and tear on the generators and engines, resulting from the extremely variable load, by equalizing the variations. To do this the battery is charged during loads less than the average and discharged when the load exceeds the average.

Adjoining the station is a spacious repair shop, spanned by an electric traveling crane. Here nearly every possible kind of repair work is done, such as rewinding or rebuilding of armatures or fields, and much money in time and labor is saved. In another room is a drafting office, where competent men are constantly designing new, or changes for the old, machinery.

Power is transmitted to motors for various purposes, and amounts to about 7000 H.P. The wire used for mains is restricted to four sizes for simplicity. They are single 0, No. 6, 300,000 cm. and 350,000 cm. cables.

The heaviest motor work is done on the Ore Bridges and Skips (in other terms, Ore-cranes and furnace-elevators.) The Bridges comprise four 160 H.P. motors, and the skips, four 300 H.P. motors.

There is also very heavy motor service for driving the following: four 160 H.P. motors for the Car-Dumper, one 500 and two 160 H.P. motors for two 10 mil. gal. centrifugal pumps.

The enormous work done by the motors on the Bridges can be realized from the weight and speed of the Bridges, which are 1,200,000 lbs. and 100 ft. per min. respectively.

CRAWFORDSVILLE, 20; ROSE, 21.

(By H. M. S.)

FRIDAY noon, Jan. 8, the R. P. I. basketball squad, in charge of Manager Reynolds, left for Crawfordsville for a game there with the Business College team of that place, and one with Wabash College. The Business College game was pulled off first on Friday evening and resulted in a victory for Rose by the score of 21 to 20.

The game was marked by a great deal of unnecessary fouling and rough playing; Shields being the master hand at that sort of work, having no less than ten fouls called on him. Just at the close of the first half Daily was overwhelmed in a mix-up near the Poly goal by three of the college players. They were "roughing it" considerably, and Trueblood, thinking to free his team-mate, gave Shields a push that was misinterpreted by Reiman for a blow. He (Reiman) immediately rushed up and was for having it out then and there. Time was called at this juncture for the first half, and when the next period began, Trueblood and Reiman were conspicuous for their absence, Trueblood giving way to Daily and Johnson taking Daily's place at forward. This change broke up Poly's team work to a great extent, and had this change not been made, the score would no doubt been more to our favor. At the end of the first half the score was 13 to 6 in favor of R. P. I.

Score:

CRAWFORDSVILLE.

	FIRST HALF.			SECOND HALF.		
NAME.	Fouls.	Foul Goals.	Field Goals.	Fouls.	Foul Goals.	Field Goals
Shields, l. f.	6	0	0	4	2	5
Reiman, r. f.	0	3	0	—	—	—
———, r. f.	—	—	—	0	0	0
Fink, c.	0	0	1	0	0	1
Watson, l. g.	0	0	0	0	0	0
Brodseau, r. g.	1	0	0	2	0	0
Given by Referee.	One point for fouling.					
Total	7	3	1	6	2	6

ROSE.

	FIRST HALF.			SECOND HALF.		
NAME.	Fouls.	Foul Goals.	Field Goals.	Fouls.	Foul Goals.	Field Goals
Thurman, l. f.	1	3	1	0	3	1
Daily, r. f.—c.	0	0	2	1	0	1
Johnson, r. f.	—	—	—	0	0	0
Trueblood, c.	2	0	2	—	—	—
Shickel, l. g.	2	0	0	1	0	0
Barbazette, r. g.	2	0	0	1	0	0
Given by Referee.	One point for fouling.					
Total	7	3	5	3	3	2

Final Score—Crawfordsville, 20; Rose, 21.
Referee—McCormick.

WABASH, 34; ROSE, 26.

(By H. M. S.)

The Wabash game was called after a "curtain raiser" by two intermediate Y. M. C. A. teams of Crawfordsville. The college game began with the call to "commence time." It was the policy of Rose from the start to put up a fast game and out-wind their opponents if possible. The plan worked admirably—except for the fact that the Wabash players in all but two or three instances feigned injuries. When called to account for it, one of them said, "Well, what do you do when you're winded?"

The first half was close, too close in fact for comfort to either side. First one side ahead then the other. It ended 14 to 13 in favor of Rose.

In the second half, Lehman, who won for Wabash against Rose last year, went in and did some pretty work. In the last ten minutes of play Wabash ran the score out of immediate danger, and then simply worked to hold it there, although they got a goal just before the timer's whistle blew. Score, 34–26, which the R. P. I. boys are confident of more than reversing when the return game is played.

Score:

WABASH.

	FIRST HALF.			SECOND HALF.		
NAME.	Fouls.	Foul Goals.	Field Goals.	Fouls.	Foul Goals.	Field Goals.
Heintz, l. f.	2	1	1	2	5	1
Burgess, r. f. . . .	0	0	1	—	—	—
Lehman, r. f. . . .	—	—	—	0	0	2
Marshall, c.	0	0	4	0	0	4
Williams, l. g. . . .	1	0	0	1	0	0
Henry, r. g.	0	0	0	0	0	1
	—	—	—	—	—	—
Total	3	1	6	3	5	8

ROSE.

	FIRST HALF.			SECOND HALF.		
NAME.	Fouls.	Foul Goals.	Field Goals.	Fouls.	Foul Goals.	Field Goals.
Thurman, l. f. . . .	0	0	1	1	2	3
Daily, r. f.	0	0	2	1	0	1
Trueblood, c. . . .	1	0	4	1	0	1
Shickel, l. g.	0	0	0	1	0	0
Barbazette, r. g. . .	0	0	0	1	0	0
	—	—	—	—	—	—
Total	1	0	2	7	2	5

Final Score—Wabash, 34; Rose, 26.
Referee—McCormick.
Umpire—Walters.

Y. M. C. A., 21; ROSE, 19.

In a hotly contested game the local Y. M. C. A. basketball team defeated the R. P. I. team on January 13th by the close score of 21 to 19. It was one of the fastest games seen in this section of the country, and to lose to the Y. M. C. A. team, above all others, made the defeat all the harder to bear. Connors played by far the best game for his team, getting five field goals and throwing three foul goals. O'Brien also played a star game, not allowing his man a goal, besides throwing one himself. For the Poly every man played his hardest and deserved to win, but fate, or rather the Y. M. C. A., was against them, and it was not to be. The first half ended with the score of 9 to 5 in favor of Y. M. C. A.

When the play was resumed, the Poly team, aided by the rooters, quickly caught up with and finally passed their rivals, and from that point it was nip and tuck as to who was ahead. But in in the last minute of play, and with the score a tie, Lindeman was given a clear shot for the basket, and it was all over but the shouting.

Summary:

Y. M. C. A.

	FIRST HALF.			SECOND HALF.		
	Fouls.	Foul Goals.	Field Goals.	Fouls.	Foul Goals.	Field Goals.
Brown, l. f.	1	0	0	0	0	0
Lindeman, r. f. . .	2	0	1	2	0	1
Connors, c.	1	3	2	1	0	3
O'Brien, l. g. . . .	2	0	0	1	0	1
Paddock, r. g. . . .	1	0	0	1	0	1
	—	—	—	—	—	—
Total	7	3	3	5	0	6

ROSE.

	FIRST HALF.			SECOND HALF.		
NAME.	Fouls.	Foul Goals.	Field Goals.	Fouls.	Foul Goals.	Field Goals.
Thurman, l. f. . . .	0	1	0	0	5	0
Daily, r. f.	0	0	0	0	0	1
Trueblood, c. . . .	1	2	0	1	0	2
Shickel, l. g. . . .	0	0	1	0	0	0
Barbazette, r. g. . .	2	0	0	0	0	0
Awarded by Referee					3	
	—	—	—	—	—	—
Total	3	3	1	1	8	3

Final Score—Y. M. C. A., 21; R. P. I., 19.
Referee—McCormick.

PURDUE, 19; ROSE, 18.

There are some who say that they cannot see any excitement in basketball, but if those same persons had only taken the trouble to go to the Rose-Purdue game on January 16th, it is a sure thing that they would have changed their minds then and there, and gone home feeling that they had had enough excitement for one night at least. Especially was this so toward the latter part of the game, when, with the score 19 to 13 against her, Rose brought the spectators to their feet by scoring five points in half as many minutes. In fact, only the call of time seemed to save the visitors from defeat.

Both teams played fast, and passed the ball for the most part almost beyond criticism. Both Thurman and Hirsch gained many a point for their teams by their excellent throwing of goals from the foul line.

At the end of the first half the score stood Rose 9, P. U. 6, and if the referee had continued as square in the second half as in the first, Rose would have at least tied the score. Even those who had no interests in either college remarked at many of his decisions and said it looked to them as if the Purdue men had given their official a good talking to between halves. In fact, one of the decisions gave Purdue the game, when Hirsch threw a field goal from out of bounds. Another decision almost as bad was in not allowing a goal made by Thurman, saying that he had blown his whistle. The whole game may be covered by the remark that the referee was not all that could be desired.

One paper states :

"The Polys had the game won in the first half, but in the last half Referee Geyer, a Lafayette man, gave Rose the worst of almost every decision and the Terre Haute boys lost on the finish. Just before time was called Roy Thurman of the Polys was fouled while throwing goal. The rules call for Rose to receive a point on such a play as this, but Geyer, although admitting that he saw the foul, refused to grant the Polys the one point which would have tied the score. In speaking of the game Prof. Kimmell of the State Normal, and Prof. F. A. Dubridge of the Y. M. C. A., both state that Poly was robbed deliberately, and the same opinion is held by others who know the rules well and are accustomed to officiate in contests."

Score :

PURDUE UNIVERSITY.

NAME.	First Half. Fouls.	First Half. Foul Goals.	First Half. Field Goals.	Second Half. Fouls.	Second Half. Foul Goals.	Second Half. Field Goals.
Hirsch, l. f.	4	0	2	1	6	1
Peck, r. f.	0	1	0	0	0	0
Falkner, c.	3	0	0	3	0	2
Miner, l. g.	0	0	0	2	0	0
Caldwell, r. g. . . .	2	0	0	1	0	0
Total	9	1	2	7	6	3

ROSE.

NAME.	First Half. Fouls.	First Half. Foul Goals.	First Half. Field Goals.	Second Half. Fouls.	Second Half. Foul Goals.	Second Half. Field Goals.
Thurman, l. f. . . .	0	6	0	2	2	1
Daily, r. f.	1	0	1	0	0	2
Trueblood, c. . . .	2	0	0	3	0	0
Johnson, l. g. . . .	1	0	0	1	0	0
Barbazette, l. g. . .	0	0	0	1	0	0
Total	4	6	1	7	2	3

In addition to the above results each side was given two points for opponents fouling a man attempting a throw at goal.

Final Score—Purdue, 19; Rose, 18.

Referee—Geyer, Lafayette.

Umpire—Kisner, Terre Haute.

INDIANA, 17 ; ROSE, 22.

Indiana, Rah !
Indiana, Rah, Rah !
Indiana, Gloriana !
Indiana, Rah !

It was a happy crowd that filed out of the Y. M. C. A. on Jan. 30, and they all seemed to wear "the smile that won't come off" for their team had just beaten one of the best college teams in the state, and not only that, but they had beaten them to a standstill.

It was a rough game, and during the first half it looked squally for "Poly," the score standing 13 to 9 in favor of the visitors. The second half opened with a rush. The men seemed to play in their old-time form, passing all around the visitors, and soon ran the score out of all immediate danger and then played simply to keep their opponents from scoring. Johnson, at guard, played a star game for Rose, not allowing his man a goal, while Maxwell did the best individual playing for Indiana, in getting three goals for his team.

Score :

INDIANA.

NAME.	First Half. Fouls.	First Half. Foul Goals.	First Half. Field Goals.	Second Half. Fouls.	Second Half. Foul Goals.	Second Half. Field Goals.
Woody, l. f.	5	0	0	0	0	0
Harmeson, r. f. . .	0	0	1	2	0	1
Maxwell* c.	1	1	2	2	0	1
Kizer, l. g.	0	0	1	1	0	0
Noel, l. g.	—	—	—	1	0	0
Tabor, r. g.	3	0	2	0	0	0
Total	9	1	6	6	0	2

ROSE.

NAME.	First Half. Fouls.	First Half. Foul Goals.	First Half. Field Goals.	Second Half. Fouls.	Second Half. Foul Goals.	Second Half. Field Goals.
Thurman, l. f. . . .	1	4	0	1	3	2
Daily, r. f.	0	0	0	0	0	2
Trueblood* c. . . .	1	0	2	0	0	0
Shickel, l. g.	0	0	0	—	—	—
Barbazette, l. g. . .	—	—	—	0	0	0
Johnson, r. g. . . .	0	0	0	0	0	0
Given by Referee .		1			2	
Total	2	5	2	1	5	4

*Captain.

Final Score—Rose, 22; Indiana, 17.

Referee—Chas. McCormick.

Umpire—Ira Kisner.

BASEBALL PRACTICE.

(By Capt. Daily.)

All those trying for the baseball team must come out regularly for practice in the gymnasium. Every man will be given definite times in which to report for practice and must not come on the floor when others are practicing.

The new candidates must understand that they are on the floor to learn, and not for a good time and that no trifling whatever will be allowed.

Those students who are not trying for the team must stay in the gallery while there is practice, and also keep their roasts and sarcasms strictly to themselves.

BASEBALL SCHEDULE.

Manager Mullett has arranged the following schedule for the baseball team, as completed to date:

April 16—Indiana University, at Bloomington.
April 23—Purdue University, at Lafayette.
May 4—Kentucky State College, at Terre Haute.
May 6-7—Louisville High Schools, at Louisville.
May 14—Washington University, at St. Louis.
May 17—Indiana University, at Terre Haute.

Besides the above, games will probably be arranged with the State Normal, DePauw and Kentucky University, making altogether one of the best schedules ever made for an R. P. I. team to play to.

BASEBALL RECORD FOR 1903.

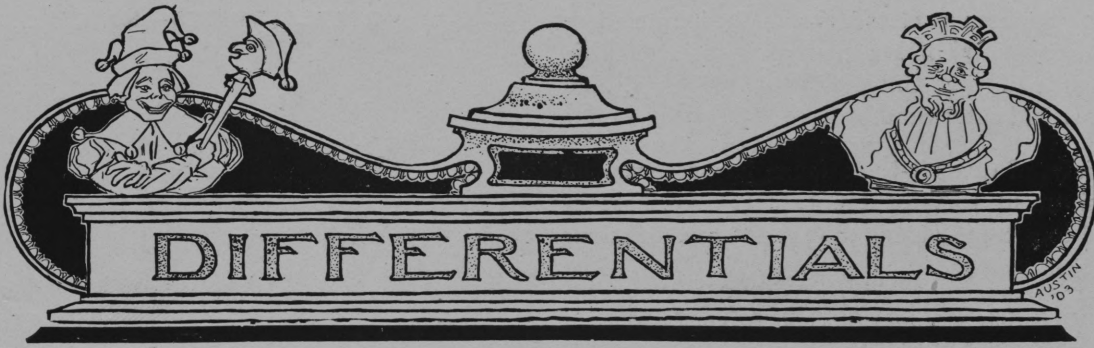
The record made by last year's baseball team is one to be proud of, and ought to be known and remembered by every man in the college. For the benefit of the Freshmen and others who have by any means forgotten it, we print it below:

April 18—Central Normal College, 6; Rose 21.
May 2—Wabash College, 3; Rose, 5.
May 9—Indianapolis Law School, 4; Rose, 3.
May 14—Kentucky University, 8: Rose 2.
May 18—Washington University, 2; Rose 9.
May 26—Indiana State Normal, 0; Rose, 6.
May 30—Wabash College, 1; Rose 0.
June 8—Indiana State Normal, 2; Rose, 4.

CITY CHAMPIONSHIP STANDING.

The standing of the teams in the race for the *Star* trophy cup is as follows:

	Won.	Lost.	Per Cent.
Y. M. C. A.,	3	0	1.000
R. P. I.,	2	1	.667
I. S. N.,	1	2	.333
Co. B.,	0	3	.000



Exams are over.

Some of us are still here.

Some are not.

"What was your term average?"

"Don't know; think it was $\frac{A + C^2}{\sqrt{CB}}$

"What do you think now, Bobby?" remarked the mother as she boxed his ears.

I don't think," replied the boy, "my train of thought has been delayed by a hot-box. [—*Louisville Times*.

Rachel, describing the manufacture of liquid-air:—"The air is first forced into a tank under a pressure of several atmospheres. Then, after it has been pressed for a while, it passes on to the cooling tank."

Prof., in German:—"What is a 'Gymnasium Student?' "

Rotz:—"A Y. M. C. A. member."

Pansy's name has been officially changed to Koochoo.

We have the following from the almost veracious memoirs of a Sophomore:

"I was out camping down South last summer, near a field of pop-corn. One day the sun got so hot that it popped the corn, and a mule that strayed into the field, saw it, thought it was snow, and froze to death."

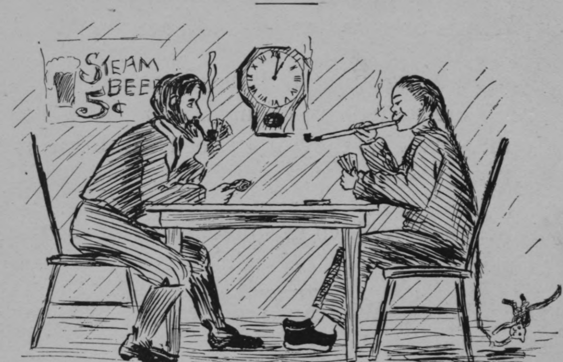
Waggie, to Hahn:—"What is the specific heat of supe—"

Voice from the rear:—"Yes, Noodle soup."

Wise Soph:—"She was standing in a room with a middle door."

Flickinger, '07, has been initiated into the mysteries of the Sigma Nu fraternity.

Say, did you see that I. U. game?



A Chinee whose name was Wun Wun,
Played cards all night with a Hun.
Said the Hun to Wun Wun,
"I'll stake you one one,"
And Wun Wun won one one at one one.

It's as easy to make an E in Jojo's examination as to have a man named Gooligan appointed on the Terre Haute police force.

Klenk, in Physics:—"That's because the angle of innocence equals the angle of deception."

The Sophomore class has sustained quite a loss in the departure of Beattie and Weisel. Beattie will attend the University of Missouri, and Weisel will enter Stanford.

Kiely, of quarter-back fame, has received an appointment to West Point, which he has decided to accept. He is to take the examinations in April.

"What has become of Sam Adams? Wasn't he studying with this class last year?"

"Ah, yes; Adams—poor fellow! A fine student, but absent-minded in the use of chemicals—very. That discoloration on the ceiling—notice it?"

"Yes."

"That's Sammy."—[*C. H. S. Monthly.*

All the students seem delighted with the new system of marking. It's so very definite. Then, too, the new reports are very popular. The only improvements we could suggest would be a mark in deportment and one in neatness, and a space for parent's or guardian's signature.

Professor, lighting a Bunsen burner:—"You may tell me something about flames."

Soph:—"Well, they are used to burn gas with."

Addie says he likes to shovel snow in the winter time.

Dr. White:—We can practically almost decrease it entirely."

A cheerful Soph has an hour-plan tacked up over his desk with the heading, "Coming Attractions."

"Hey, kid, come here!" called an ambulance driver to a small urchin standing near. A certain diminutive, but dignified Sophomore, was just passing and heard the remark.

"I guess that's me," he said, and proceeded to do the man's errand. Soon after Can—I mean the Sophomore—wrote off for circulars on "How to Grow Tall."

NOTABLE SMILES—No. 1.

ADDIE LEE'S SMILE.

Our first smile is one that we have all seen. It occurs chiefly in the vicinity of the gymnasium. The best recipe we know of for obtaining this smile is as follows: Enter the gym on any practice afternoon, and approach the subject with your hand extended. Then mention the fact that you have heard it said that we are soon going to have an indoor meet with the Normals. Watch the result. A quiver will run over the features of our friend, and then, slowly and gently, the smile represented above will burst forth in all its beauty.

Pop:—"Looky here, son, this college education is gettin' pretty expensive."

Sonny:—Well, father, I'm trying to be economical. I study just as little as I can, possibly."—[*Chicago Daily News.*

Addie:—"I'll bet you a nickel. Shucks, that's high bettin', but I'll risk it."

Prof.:—"What does the symbol H stand for!"
Student:—"I don't like to say."

It is said that Biscuits doesn't like the "Prince of Pilsen" because they say so often, "Was you efer in Zinzinneti?"

Junior:—"Mental aberration and spherical aberration are not alike, unless your head is bal(le)d."

Prof.:—"What is an elongated spheroid?"

Freshie:—"That's just a fancy name for Irish potatoes."

Captain Peck, one of the players, and the manager of the Purdue basketball team, visited with their Sigma Nu fraters during the Purdue team's stay here.

Sharp was not able to accept a position with the Vandalia during this vacation, on account of annoyance-pedalian, contracted during the holidays.

Prof., handing Cazin an iron weight:—"Now, what kind of feeling have you?"

Cazin, holding weight out at arm's length:—"That tired feeling."

Veach, translating French: — "Some had wooden legs, others had brass arms."

Freshman:—"In case of danger, presence of mind is good, but absence of body is better."

Dr. Wires shop lectures, a sure cure for insomnia. For testimonial, apply to Douthett, '08.

The officers of the Freshman class for the year are as follows: President, H. M. Shickel; Vice-President, E. D. Kiely; Secretary-Treasurer, D. McDaniel.

ON THE SAFE SIDE.

Soph:—"Have you marked our quiz papers yet, Professor?"

Mr. Nelson:—"No, I think I'll wait until this snow is gone."

Miller, in Mechanics:—"When a bullet is shot out of a rifle, the horizontal velocity is constantly decreasing."

Prof.:—"What is the cause of that?"

Miller:—"Hitting the air."

Prof., having passed out examination papers containing ten questions:—"Answer the first five and any five of the rest."

The meanest man on earth is the man who cut off his dog's tail, fried it, ate the meat, and gave the dog the bones.—[*Ex.*

Randall:—"Shall I use a rheostat?"

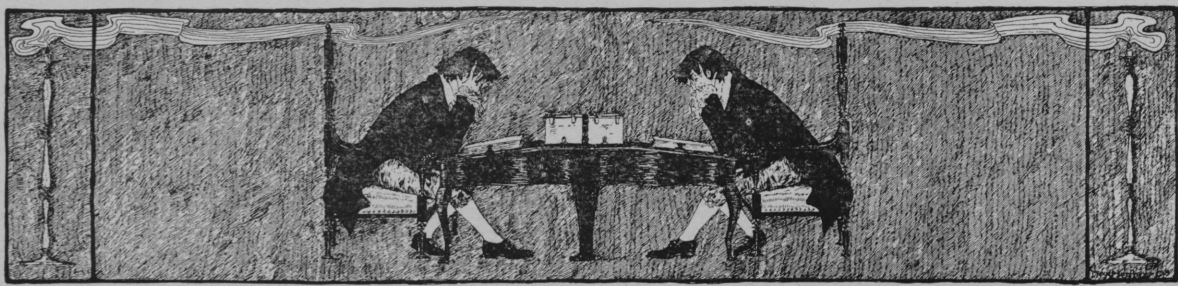
Waggie:—"No, you had better take a bath."

Professor, in Descriptive review:—"Don't be afraid to ask questions. If there's anything you want to know, ask questions."

Soph:—"May I raise a window?"

"It's almost a mile from my hash-house to my room."

"Gee, your supper goes a long way!"



REVIEWS

The Theory of Wireless Telegraphy.

THE theory which Prof. Blondel enunciates, in a most interesting manner, is entirely in accordance with that which we have consistently upheld in these columns, as will be found by reference to the issues for August, 1902, and other dates. That is to say, wireless telegraph waves are essentially semi-Hertzian waves attached to the conducting surface of the earth or sea. All that is known concerning the action and development of free Hertzian waves is immediately applicable to wireless waves, after allowing for the curvature of the conducting earth. In general, therefore, after passing to some distance from the sending antenna, the waves become virtually hemispherical, until their radius of emission reaches a length of fifty miles or so. After this radius has been reached, the hemisphere must reach the conducting strata of rarefied atmosphere, or strata of atmosphere having a degree of rarefaction that produces in vacuum tubes an electrical conductivity equal to, or even greater than, that of sea water. This would have the effect of checking further vertical expansion. Beyond this distance the wave would expand in two dimensions instead of three; or in a layer of non-conducting air, say fifty miles in thickness, with absorption in the conducting liquid ocean beneath, and also in the attenuated gaseous ocean above.

If the sea or land had perfect conductivity, the waves would advance without absorption or penetration, the electric currents at the feet of the waves being confined to a more infinitesimal skin upon the surface; just as very high-frequency alternating currents are confined to a thin skin of copper conductors over which they travel. With imperfect conductivity, however, the waves sink more or less deeply below the surface of land or sea, as they advance, suffering absorption thereby, and producing real accompanying currents of the alternating type in the upper layers of land or water. There would be one alternation of current in the ground for each half wave through the air above. In the salt water of the ocean the current should penetrate less deeply than in the ordinary surface soil of land. Fessenden has stated that this is a fact observed experimentally. Over deeply frozen ground of very feeble electric conductivity, there should be much reduced range of effective wireless telegraph transmission, unless good ground connection can be established at both the sending and receiving antennæ.—[*Electrical World and Engineer*.

An Uncalled-for Electric Machine.

A CURIOUS electrical phenomenon was recently observed in a manufactory of paraffin paper, according to *Cosmos* (June 27.) Says this journal:

"The paper is prepared very easily by passing silk paper through liquid paraffin. To do this on a large scale and continuously, a roll of paper is placed on a revolving bobbin near a bath of paraffin. This paper, unrolling, goes through the bath and then rises to a stretching-cylinder after passing between two drying surfaces that remove the excess of paraffin by friction. Then it moves for some distance horizontally and is finally rolled on a bobbin similar to that from which it started.

"Now since this apparatus has been installed, the workmen who have passed near the band of paraffined paper have felt electric shocks, their hair has risen up on their heads, and they could draw sparks with the finger from the bobbin on which the the paper was rolled.

"It was thus seen that the whole apparatus formed a huge electric machine in which static electricity was developed by the continual rubbing of the drying surfaces on the paraffined faces of the paper. Recently, to do away with the inconveniences of this undesirable production of electricity, a metallic point connected with the base of the machine has been placed where the paper issues from the dryer, and thus the electric fluid has been drawn off."[—*Translation made for The Literary Digest*.

A Method of Photographing Alternating Current Wave Forms.

THE adoption of alternating-current machinery for power transmission, due to the convenience and reliability of the alternating-current transformer, has rendered the study of the wave forms of alternating current very necessary. There are particular cases in which a ripple on the back of an alternating-current wave may play a more important part than the fundamental wave to which it belongs. A great variety of devices have been suggested and employed for detecting, or recording, the wave form of alternating currents. Where the waves have ample power, as in power transmission circuits, there are several forms of instruments in practical laboratory use which accomplish this result. Where, however, the current waves have but little power, as in telegraph circuits of earth and wire, or still more, in wireless telegraph circuits of earth and earth, or earth and upper atmosphere, there is no known apparatus, either for indicating, or for recording the wave form. Moreover, in telephone and wireless telegraph circuits the frequency is very high, often far above the frequency of oscillation of material vibrating systems. The periodic time of an oscillograph mirror is often about 100 microseconds, and any wave or ripple to be recorded should, therefore, have a period of at least several hundred microseconds. But a microsecond is a long dreary waste of time to a wireless telegraph wave, and 250 complete waves of wireless alternating current can comfortably find room within a hundred microseconds, from a hundred-foot mast or sending antenna.

Leaving, however, to the tender mercies of future time the care of the short and delicate wave forms in electric communication, the interest of to-day lies in the methods of recording the forms of waves that each occupy many miles of free space for their development. The Blondel oscillograph is a typical apparatus. A tiny mirror is supported on a loop of wire, the loop being held in a very intense magnetic field, and being traversed by the current to be investigated. The natural period of vibration being so short, the loop and mirror deflect at every ripple in the wave, and throw a tiny ray of light upon the surface of a steadily rotating drum, carrying a strip of sensitive kodak film. In order to obtain sufficient photographic action from so small a ray, moving with great speed over the film, the most intense luminous ray of the arc lamp is employed. In the ordinary oscillographic trace, as photographically developed and printed, the scale of time is given by the fundamental wave, which intersects the zero or middle line at definite intervals, the frequency of which is supposed to be known with a suitable degree of accuracy. —[*Electrical World and Engineer.*

Welding Iron and Steel With the Blowpipe.

UNITED STATES Consul Marshal Halstead writes, quoting the *Birmingham Daily Mail* for his authority, that there is now on view in Birmingham an invention for the seamless welding of iron, steel and other metals by heat produced by the burning of acetylene with oxygen. With a special blowpipe and the mixture mentioned the welding of iron and steel, etc., is done in the same way "as a plumber deals with lead." The acetylene is supplied in cylinders in a state of absorption by acetone, which has the property of dissolving ten volumes of the former for each atmospheric pressure, thus obviating all danger that has hitherto existed in the compression and storage of acetylene. It is stated that the process has been sanctioned by the Home Office after exhaustive experiments. The separate gases are passed through valves, which reduce the initial pressure in the cylinders to about 7 pounds per square inch on the blowpipe. The acetylene when ignited produces an intensely luminous glare, which vividness disappears when mixed with oxygen, there remaining a small, greenish-blue flame which is adjusted to the proper dimensions for producing the greatest amount of heat. The heat zone is practically only about one-eighth of an inch in length, but the temperature is so great that after a very short space of time the metal, wherever it comes in contact therewith, is reduced to a molten state and coalescence follows. Even quartz, it is stated, can be melted as quickly and blown like glass. The representatives of the *Mail* saw several pieces of work done, including the welding, instead of riveting, of a sheet of metal intended to form the body of a foot warmer for railway cars—the joining of two pieces of metal which when rolled out cold into half thickness gave not the slightest indication of a joint. In order to test the strength of joints experiments with compressed gas cylinders have been made; these, about 6 inches in diameter, with longitudinal and circumferential seams at the ends and also a boss welded in the center, withstood a pressure of 2,000 pounds to the square inch. Although the heat produced by the fusion of acetylene and oxygen is so great, operations can be performed with the naked eye. The patentees claim that the invention will be useful in making the construction of framework in the cycle trade stronger, while the apparatus might also be used in filling up corroded places or patching steam boilers. [—*American Machinist.*

WE are in receipt of catalogue 038 on "Industrial Railway," from C. W. Hunt & Co. This catalogue gives complete description, with illustrations, of the various styles of cars, rails, ties, turntables, also made-up tracks and switches which this company manufacture for use in factories, power plants, lumber yards, piers, etc. One special feature in the design of their cars is that they have a flexible wheel base, the axles taking a radial position on a curve, and the outer rail around the curve is of a form for the wheel to run on a flange instead of on the tread, thus making the outside travel faster than the inside, as a cone rolling on a plane surface.

F. B. L.