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THE TECHNIC.

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OUR leading article this month is a very pleasant surprise to ourselves, as well as to our readers. Dr. Mendenhall has been traveling abroad for some time, and early in the fall he promised that he would write us something if he should find time. While we hoped all along that he should be able to write something for us, still we feared we should be asking too much of him.

As a former President of the Institute, Dr. Mendenhall needs no introduction to the older Alumni. It was at his suggestion and under his guidance that THE TECHNIC was established, and he has taken an active interest in its welfare ever since.

The article itself needs no comment, for it will be read with interest by all. It gives one an idea of the alarmingly primitive methods of handling water which are still in use in Egypt to-day.

OUR Alumni article is by Mr. W. A. Peddle, '03. Mr. Peddle, as a former editor of THE TECHNIC, has evidently remembered the difficulties of making both ends meet financially when issues are too big, and has made his article very brief and to the point. We are obliged to Mr. Canfield for the drawings illustrating the article, which he made from sketches furnished by Mr. Peddle.

THE scene of athletic activities has shifted to the base-ball diamond and track, and everyone is wondering how Rose will stand in these branches of athletics. In track work our prospects are of the best. Almost the entire 1905 team is back, and with Captain Turk in good form, we should bring home the I. C. A. L. pennant from Richmond.

There are five of last year's first team base-ball men back, and plenty of new material to make everyone hustle. The schedule is one of the hardest a Rose team has ever played to, and the victories should be all the more appreciated. The schedules of both base-ball and track teams are given under "Athletics."

MR. G. E. HENIKEN, who has held the position of Junior local editor, has been compelled to give up his work at the Institute, on account of ill health. Mr. Heniken takes with him the best wishes of all his friends for a speedy and complete recovery, and we hope to see him back next year. THE TECHNIC appreciates that it has lost the valuable services of a man who has at all times cheerfully labored for the furtherance of its interests.

Mr. Harry D. Baylor has been elected to fill the position left vacant, and the way he has taken hold of the work gives promise of a good, breezy local column.

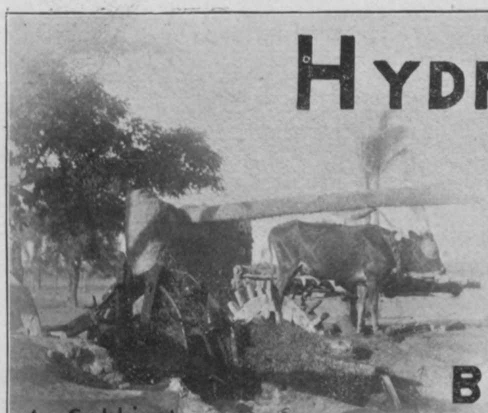
WITHIN a few days the Rose Glee Club is to make its second appearance before the public in comic opera. The success of "Little Red Riding Hood" last year has prompted them to undertake a more elaborate and difficult opera, in the form of "Pinafore." As before, all parts are taken by Poly boys, thus giving an additional feature to the play.

The opera is an old favorite, and one which will never be too old to be enjoyed. The music combines lots of "catchy" airs with some which are almost classical, and the entire opera is one which lends itself readily for such a performance.

The cast and chorus have worked faithfully for some weeks, and all indications point to a very successful entertainment. After the local performance at the Grand the troupe will go to Paris, Ill., and Marshall, Ill., where the same play will be presented. Mrs. Adams has charge of the entire production.

A NUMBER of Senior Mechanicals and Electricals are helping on a series of tests which the Allis-Chalmers Co. is running on the new pumping engine installed by this Company at the Terre Haute Water Works. The tests have been repeatedly delayed by the muddy condition of the river, as it was necessary to pump directly into the pipes in the test.

NEXT month we will present an article by Prof. Howe on "Masonry Arches and the Elastic Theory."



A Sakkiyeh.

HYDRAULIC ENGINEERING IN EGYPT.

BY DR. T. C. MENDENHALL.

ONE of the most interesting things about a voyage on the Nile is the exposition, by actual example, of the history of the science and art of Hydraulic Engineering from the earliest times to the present, — that is, as far as that science is concerned with the transportation and distribution of water. There was a time, doubtless, when water was transported only in such vessels as nature furnished, requiring little modification at the hand of man, as the shell of the cocoa-nut, the skins of animals, etc. The transportation of water in the skin of the goat, and of other animals, is a common practice in Egypt at the present day, and may be found not only on the banks of the Nile but in the most populous cities and towns. In Cairo itself, a city of near a million inhabitants, much of the street sprinkling is done by men who carry these skins upon their backs, manipulating the one unsealed opening with such skill that in uniformity of distribution they rival their most modern competitors, and they are probably not far behind them in economy, when the cheapness of human labor in Egypt is considered. There are few more interesting figures in an Egyptian town than the "waterman," who advertises his coming by the rhythmical "clinking" of two shallow brass bowls carried in one hand, his body bent by the burden of the water in goat skin or earthen jar, from the spout of which he deftly fills these bowls at the request of his thirsty patrons.

The earthen jar is probably typical of the first great advance in domestic hydraulics. Although an invention of primitive times it is still "holding its own"—for to-day the water supply system of nine-tenths, indeed more nearly ninety-nine hundredths, of Egyptian domiciles is represented by an earthen jar. The maintenance of the domestic supply seems to belong to the women of the household, and all along the Nile they may be seen carrying upon their heads large jars filled with water. Usually a ring-shaped pad or cushion is placed upon the head and on this the jar rests, upon its side when empty and upright upon its narrow base when full. This form of calisthenics, almost universal among the women of Egypt, gives them an erect and not ungraceful carriage which is always noticeable.

There being no demand for further improvement in the methods of domestic water supply, the goat skin and earthen jar are still in absolute control of the field, as they were four, five or more thousand years ago. It was the use of water for irrigation purposes that gave rise to the construction of simple machines by means of which the only source of power known to man during thousands of years, namely, the muscles of men, and afterwards the muscles of other animals, could be made more easily available. Every one knows that in Egypt there falls almost no rain. It is one of the few countries of the world in which the weather is not a topic of conversation. Had Egypt depended upon the heavens above for its supply of moisture, it would never have been the granary of the world, as it was for many centuries. Both its inexhaustibly rich soil and the water with which to moisten it, it owes to the Nile, being the "child of the river." And everybody knows that once a year the river voluntarily spreads itself over the long and narrow garden which it has created, the maximum height of the flood occurring in October. After this it withdraws itself to its relatively narrow bed, saying, in effect, "Now if you want more of me, you must get me as you can." And so the great hydraulic problem of Egypt is and has been from the beginning, the lifting of the waters of the river to the level of the long, narrow plain through which it flows and their proper distribution over that plain, so that two or three crops may be gathered annually from every square yard of it.

The vertical lift necessary is not great, varying in time and place from three or four to thirty or forty feet, that is, during the time after the "flood" has practically subsided, when the soil is tilled and the crops planted. The banks are rarely vertical or nearly so, being generally sloping enough to make the construction of a foot path of rather easy grade an affair of little difficulty.

In the earlier days of the cultivation of the Nile valley, irrigation must have been accomplished by, and only by the actual carrying of the water from the river to the top of the bank in skins or jars and often, in the absence of canals, its distribution must have been made from the same.

But some early and, unfortunately, absolutely unknown genius, saw, dimly, perhaps,one of the fundamental principles in the "economy of moving masses," realizing that whenever a man carried a skin or a jar of water to the top of the river bank he carried himself along with it, and that this expenditure of energy might be and surely ought to be avoided. It is tolerably certain that laziness is a close second to necessity in the matter of "mothering inventions," and in this instance the maternity cannot be in doubt.

Human labor has always cost little in Egypt, and especially in ancient times when the rich and productive soil supported a dense population, the larger part of which was in a condition of abject servitude. When Egyptian kings argued, and correctly, that human labor was cheaper than that of animals, it is not likely that any other than a laborer would have given thought to the construction of devices for lessening the hardness of his task. As far as can be ascertained the first application of the principles of mechanical engineering to the problem of irrigation in the Nile valley, and probably one of the first made anywhere, consisted of the extremely simple device of "slinging" a bucket or jar to the middle point of a rope or pair of ropes, the ends of which were held by two men standing some feet apart. Water was raised from one level to another a very little higher by swinging the bucket so that it filled at the lower and emptied at the higher level. This laborious method is still occasionally seen in use; it is only a short step in advance of the method of carrying the jar on the head or shoulder, but it is notable, as involving the new principle referred to above.

Of vastly greater importance was the invention of the "*shadoof*," thousands of which may be seen to-day in active operation by the traveler in the Nile valley. Their origin is prehistoric, and it is highly probable that the construction of these machines is practically identical, even in minor details, with that of their remote ancestors.

The primitive well sweep of the western pioneer, examples of which may still be seen, I fancy, within a day's journey of the Rose Polytechnic Institute, is essentially the *shadoof*. In Egypt, however, its construction indicates a lower state of the mechanic arts than can be imagined, even in the remotest frontier settlement. The scarcity and cost of metals before the setting in of the age of iron and steel compelled the use of rope, cords, pins, etc., to an extent and in a way extremely interesting to the modern engineer. Materials for construction are naturally as scarce in the Nile valley as is rain, yet the shadoof is usually made of the things which the native builder finds available in the immediate neighborhood of the river itself. Two vertical pillars or posts between which the long arm of the sweep moves are first erected. As the structure must always be temporary, parts not easily removable being swept away by the flood of the river, these pillars, which otherwise might be solidly built of brick, are usually made of long stocks of corn or sugar cane. They are thrust into the ground a few inches and when a bundle about six to ten inches in diameter has been formed they are bound together with a rope and the whole is plastered over with a thick coating of Nile mud, increasing in diameter towards the bottom, so as to form a cone-like pillar with a base a couple of feet in diameter. "Nile mud" possesses extraordinary sticking qualities, and when thoroughly sun-dried it forms a strong and tough mass. Indeed a great majority of the buildings of the villages along the banks of the river are made of sun-dried bricks moulded from the soil on the spot. These columns of mud and straw, cornstalks or cane, are easily constructed and possess quite enough strength for the stresses to which they are subjected, but along some stretches of the river where wood appears to be more plentiful stout limbs of trees are occasionally used in their stead.

The "pillars," from four to six feet in height, are placed at a distance apart of from three to six feet, being further separated and stronger when intended to carry two "sweeps" instead of one, as often happens. A horizontal bar of wood joins them, secured by cording on or near the top of the pillars. From the middle of this (if for a single "sweep") is suspended another small and short wooden rod about an inch in diameter, this being the real axis about which the sweep turns. Two bits of rope, eight to twelve inches in length, constitute the "bi-filar" suspension of this axis, which is itself six or eight inches long. It passes through a hole somewhat larger than its own diameter, in the "sweep" and is securely fastened to its rope suspensions so that in action it is practically without rotation, the sweep turning about it. It will be noted that this ingenious suspension gives a number of "degrees of freedom," all of which seem to facilitate the use of the machine.

The "sweep" is usually in two parts spliced together near the middle point, probably to facilitate removal. It may be fifteen to eighteen feet in length, made of wood (generally of limbs of trees—crooked and "gnarled") and varying from two inches in diameter at the smaller end to five or six at the larger. It is suspended in the manner already explained at a point about one-fifth to one-sixth of its length from the larger end. On the shorter arm is placed the counterpoise, usually a large earthenware jar, through the axis of which the short end of the sweep passes, projecting a few inches from the bottom, which is broken for the purpose. The jar is packed with Nile mud and a coating of the same is put on the outside, enough to insure the necessary weight for the counterpoise. To the long end of the sweep a slender pole ten or twelve feet long is attached by a flexible rope joint and to the lower end of this the bucket hangs from a wooden hook.

The bucket is usually made of leather or untanned skin, fastened to a circular wooden ring about two feet in diameter, making a hemispherical leather bowl hanging from the wooden hook. One of the shadoofs is set near the water's edge, so that the bucket dips into a small basin or well in which the water is always at the level of the river, rarely more than a few feet distant. The "lift" of one may be as much as ten or fifteen feet, but that of the first series is usually less than this. Two, three or four of them operate in series, the second taking the water from the level on which it is delivered by the first, and so on—four being generally enough to take it the top of the highest embankment. If the bank of the river is very sloping, canals a hundred feet or more in length may be necessary to carry the water from one shadoof the next in series.

Continued changes in the level of the river necessitate changes in the position of the shadoofs, and to this fact is doubtless due the cheap and "flimsy" character of its construction. The mud and cane supporting pillars are abandoned when a new location is selected, but the remaining parts are readily removed. The counterpoise on the short end of the sweep is always heavy enough to more than balance the bucket when filled with water, so that the operator does his work by a downward pull. The flexible hemispherical bucket seems to be emptied more quickly and easily than one of rigid form, but in a few instances I observed tin buckets in use. Sometimes shadoofs are built two "abreast" as well as three or four in series, in which case, although the two sweeps are swung from the same cross beam (by different bi-filar suspensions) and are worked practically in unison, they are quite independent of each other in movement, so that each operator has entire control of his own machine.

Even in the middle of January, at which time the shadoof is very active, the Egyptian sun is hot* and the "fellahin" who work them find any sort of clothing an uncomfortable encumbrance. The display of their bronze figures, slender and graceful in movement, together with the rhythmic swing of a half dozen sweeps and the far-reaching "creak" of the unsoaped wooden axis about which they turn, makes an appeal to one's "artistic emotions" not soon to be forgotten.

An enormous advance was made when the invention of the *sakkiyeh* made it possible to utilize the muscles of animals as well as men. The somewhat complicated construction of this machine and the continued cheapness of human labor make it tolerably certain that it came into use at a much later period than the shadoof. It seems to have been little, if at all, modified during historic times, and it may be, indeed, a survival of a more extensive and elaborate system of machines available for engineering operations among the ancient Egyptians. The "sakkiyeh" is the direct, though perhaps remote, ancestor of the ordinary "chain pump" which is less frequently seen in America now than it was fifty years ago. The supporting pillars or columns are built, generally of sun-dried bricks. They are usually about four feet by one foot in horizontal section, six or eight feet in height and twenty-five feet distant from each other. Resting upon them is a long wooden beam, usually the trunk of a date-palm. At the middle point of this is pivoted the upper end of a vertical axis, the lower resting upon a crude wooden bearing fixed in the ground or fastened to a stone. This axis carries the horizontal gear wheel which may be from six to ten feet in diameter.

Imagine two "signs of equality" crossing each other at right angles, with the lines slightly curved so as to be convex towards the center and you have a good picture of the ground-work of this wheel. A circular rim with radial spokes or cogs eight or ten inches long is fixed to this frame by rough iron bolts or wooden pins, the whole being of wood very roughly hewn out, but possessing considerable strength. Near enough for its teeth to engage in those of the horizontal gear-wheel is a similar wheel turning in a vertical plane and attached to the end of a horizontal axis long enough to extend to the nearby well; and this must be far enough away to make room for the circular track upon which the "source of power" travels. At the well-end of this axis is another vertical wheel of similar construction which carries the chain of buckets or jars by which the water is lifted. This chain is made o two parallel ropes joined at intervals of a foot or two by cross pieces of wood six or eight inches long and to these the earthen jars are secured. The loop does not turn upon anything at the bottom of the well and may be easily varied in length to suit the circumstances. Although the sakkiyeh is of very crude and rough construction it is much more expensive and elaborate than the shadoof, and is, therefore, usually installed where it will not be injured seriously by the annual floods of the river. The wells from

*I am writing these lines on January 29th in a large garden at Assouan, the old "Syene" of the Greeks, where Eratosthenes, more than two thousand years ago, found the sun shining on the bottom of a deep well, "without shadow" at noon of one day of the year, and on this incident he founded the first rational measure of the earth's diameter. I am sheltered by a Kiosk tent, without which I would be compelled to fly to the agreeable coolness of my room in the hotel near by.

which it raises water are often at a considerable distance from the actual river bed, but they are sunk to a level below the lowest river level, and most of them are continually supplied with water, either by seeping through the porous stratum between well and river or by open canal or covered channel connecting the two. In a few cases I have seen a sakkiyeh raising water from a canal fed by a shadoof. The "working force" is usually an ox, buffalo or camel hitched to the end of a pole fastened to the horizontal gear-wheel and its axis described above. I have never seen men turning these wheels, although in ancient times man power was probably used. Human intelligence is necessary to the working of a shadoof, but the more complicated sakkiyeh needs only "pull"; indeed, as if to prevent the patient beasts from making use of such reasoning power as they may possess they are always blindfolded while doing this work and make their endless rounds in true Egyptian darkness.

One of the most picturesque examples of the sakkiyeh to be found in Egypt is that which raises water from a reservoir fed by springs to fill the "Well of the Virgin" and water the garden in which grows the "Virgin's Tree." A few miles from Cairo are the ruins of the ancient city called "Heliopolis" by the Greeks, the "On" of the Bible. It was the daughter of one of the priests of "On" that Pharoah gave to Joseph for a wife, and for a long period it was the center of Egyptian learning, maintaining a great "University," frequented by students from all lands. Now, there is nothing to mark the spot but a few mounds of earth and a single obelisk, the only one standing on its original base in Northern Egypt. Not far away is the "Land of Goshen" and near by is the much visited sycamore tree under the shade of which, according to tradition, Mary rested with the infant Christ during the flight into Egypt. Almost in the shadow of the tree is the "Virgin's Well," where the garments of the child are said to have been cleansed. The well is now a basin about four feet in diameter, a few feet deep, with smoothly cemented sides, and the water which flows into it is supplied by a groaning sakkiyeh, apparently of no more recent origin than the tree itself.

Thousands of shadoofs and sakkiyeh are seen as one goes along the Nile from one end of Egypt to the other, but they are not the only devices in use for irrigating the soil. In the Delta region, below Cairo, and occasionally elsewhere, other ancient machines may be seen. The most interesting of these is the Screw of Archimedes, scores of which I saw in operation. Indeed, it may have originated in Egypt, for it is known that Archimedes visited the valley of the Nile, and that he was for some time at the great university at "On" or Heliopolis, mentioned above. Since he saw the device in Egypt and afterwards introduced it or described it at Syracuse, its invention may easily have been attributed to him.

There are also wheels of large diameter, turning in a vertical plane and having buckets or jars attached to the circumference. They are turned by men, sometimes in treadmill fashion, and in one of the most reliable books about Egypt it is gravely affirmed that in the Fayoum (an oasis-like region on the west of the Nile, about a hundred miles south of Cairo,) there is in use a water-lifting wheel of peculiar construction, "so contrived as to be moved by the weight of the water itself." I have been, and still am, extremely anxious to see one of these remarkable wheels, feeling confident that I shall find engraved upon it the "cartouche" of the late Mr. Keeley of Philadelphia.

Without diminishing very greatly the number of these ancient devices for lifting water, the last century has added the steam pump, many examples of which are to be seen on the banks of the Nile. Some of the engines and pumps are "on wheels" and are transported from place to place, but there are also a few large pumping stations where water is raised on a large scale to supply irrigation canals of considerable length. The cost of fuel, however, prevents the general adoption of this method, muscle being still successful in its competition with coal.

The real solution of the problem lies in *holding the water up* at flood time and letting it down as needed, rather than in expending energy in lifting it; and this fact was recognized by hydraulic engineers as far back as the time of the "Pharaohs." Canals were dug, but the construction of large storage basins was probably not seriously attempted. During the past seventy-five years modern engineering has had its "whack" at this problem, and after failure at first the final results have been so encouraging that a stupendous system of storage basins and weirs is now in process of development, to the end that agriculture in Egypt shall be independent of the annual inundations of the Nile, and a largely increased area of tillable land will be secured, with a practical certainty of three crops a year instead of two, or sometimes only one, as at present. The beginning of this was in the construction of the "Barrage," about fifteen miles north of Cairo, where the river divides into its two principal "mouths," known as the "Damietta branch" and the "Rosetta branch." Begun nearly three-quarters of a century ago, it was at first a failure; begun again, under a more comprehensive scheme by a French engineer, Mougel, in 1842, its construction was so hurried by the impatience of the then ruler of Egypt, who ordered that so many tons of concrete "should be poured each day into the foundations, whether the river was flowing over them or not," that after a few years of usefulness it began to give way. At last a third attempt was made by officers of the English government about 1883, and in 1891 the dam was sncccessfully completed at a total cost of $12,-000,000. It is about 1,500 feet in length and is capable of holding up a head of thirteen feet of water. Its value to the agriculture of the Delta was quickly demonstrated by a large increase in crops, espccially of cotton, and the construction of other "barrages" was shortly undertaken.

The greatest and most important work of this kind, thus far, is the dam near Assouan, begun in 1899 and finished in 1902. Here, just above the first cataract of the Nile, a splendid granite breastwork has been thrown across the river, a mile and a quarter in length and at some points a hundred feet high. There are one hundred and eighty gates through which the mighty river flows, completely under the control of the superintendent of irrigation.

In the flood season this enormous storage reservoir is filled, to be doled out as desired during subsequent months.

There is also a "barrage" at Assiut, and still others are contemplated. It is estimated that there are 2,000,000 acres of barren land in the valley of the Nile, all capable of being made productive by irrigation. In time the subjugation of these acres will be accomplished by modern methods, but it will be long before the "fellah" ceases to be a drudge and the shadoof and sakkiyeh are seen only in museums.

ALUMNI NOTES.

On account of the ill health of his wife, Cecil A. Howell, '99, was obliged to give up his position with the Wagner Electric Co., in St. Louis, and go to California. They are now located at Los Angeles.

Frederick H. Froelich, '99, has been appointed Electrical and Mechanical Engineer of the Toledo, Ann Arbor & Detroit Railway Co. This company is building an electric line between Toledo and Ann Arbor.

Hubert Parr, '05, is in the Signal Department of the Union Pacific Railway, at Omaha, Neb.

J. Stuart Sharp, '04, is Assistant Engineer, Queen and Crescent Route, Vicksburg, Miss.

Irving Cox, '03, has taken a position with the Eastern Dynamite Co., at Gibbstown, New Jersey. He is foreman of one of the departments of the Acid Works.

The following is taken from a letter bearing the postmark of the Phillipines: "Mr. G. R. Putnam, '90, is engaged on the same duty as for the past five years, in charge of the Coast and Geodetic Survey work in the Phillipine Islands, with the designation of Director of Coast Surveys, Phillipine Islands. The work has now reached a considerable magnitude, five regular surveying vessels being at work, besides other parties with hired launches, and ashore."

We are pleased to note that the Class of 1894 is to have a reunion at Commencement, next June. The plans are being developed and information passed around by means of a class letter, sent out by the Secretary, Mr. J. C. C. Holding.

The Alumni Department would like to suggest that it would be highly profitable to the Alumni in general if THE TECHNIC were included among those to whom this letter (and other class letters) goes. We are sure that it contains information that should be, through this department, shared with the other Alumni, and we beg to be permitted thus to enhance our usefulness.

On March 10th, Mr. T. L. Condron, '90, addressed the school in General Assembly with a very interesting and instructive talk on reinforced concrete and its use in structural work. He presented a great number of illustrations of actual structures by means of lantern slides, but the limited time made it impossible to go into the theory of the subject. He was very enthusiastically received by the students.

A new book has appeared bearing the name of one of the Alumni. It is a small volume on

Shaft Governors, by C. Housum, '02, and W. Trinkle, M. E. It is published as No. 122, in the Van Nostrand Science Series. It is made up of notes and formulæ that were derived for immediate use, by the authors, at different times, and treats only the statics of shaft governors. The theory will be embraced in another volume to be published later.

A STUDY IN SIGNAL LOCATION.*

By W. A. PEDDLE, '03.

IN this article it is proposed to outline rather briefly how the proper spacing of automatic signals provided with automatic stops may be determined in a scientific manner on railroads operated electrically, where train speeds can be calculated closely.

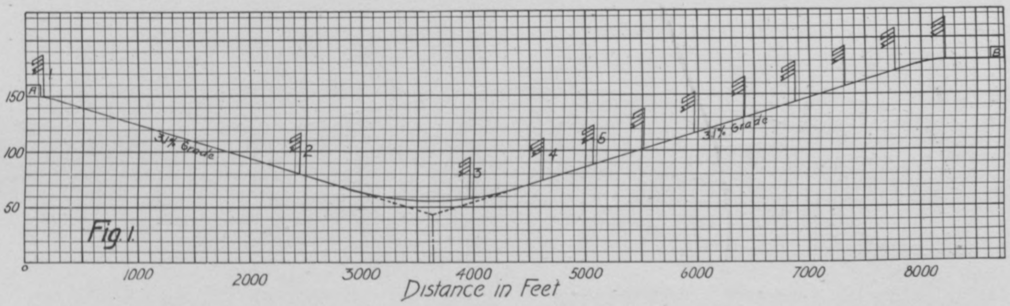
Consider a section of track shown in profile by Fig. 1, over which trains are to be run from A to B at a predetermined speed shown by Fig. 2. Let the signals Nos. 1 and 3 be placed arbitrarily, thus requiring a train to be on the up grade before the following may leave station A. Signal No. 1 should be 200 ft. from station O. The curves can now be used to advantage in determining where signal 2 must be placed so as to give full protection to a train standing just beyond signal No. 3. The track circuit controlling signal No. 1 ends at signal No. 3, and we have what is termed full-overlap control. This control will apply to all signals considered.

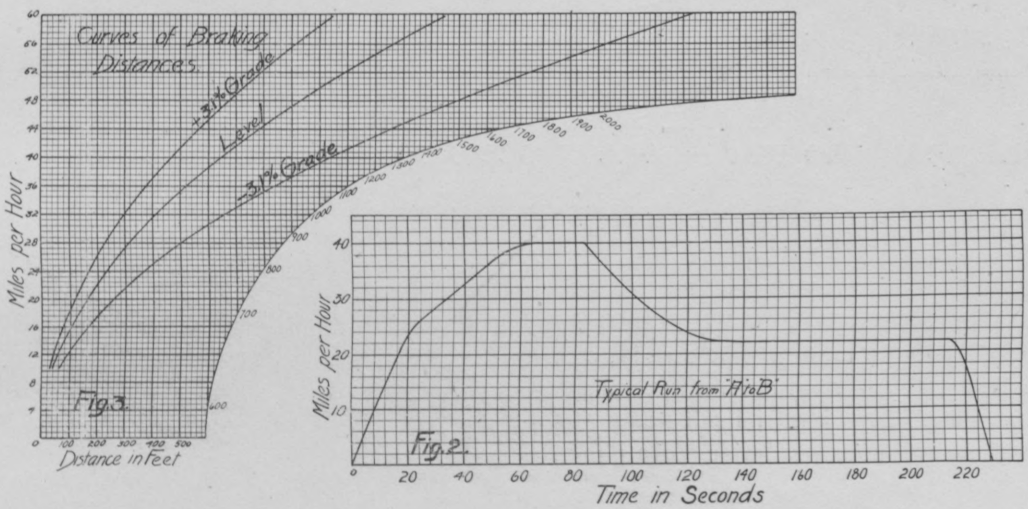
Assume that a margin of safety of 50% is to be allowed over the actual braking distance shown by curves in Fig. 3. Consulting curves Figs. 3 and 4, the correct location for signal No. 2 is readily found to be 2,450 ft. from A. At this point the train has attained a speed of 39.5 M. P. H., at which speed the braking distance plus 50% equals 1,515 ft.

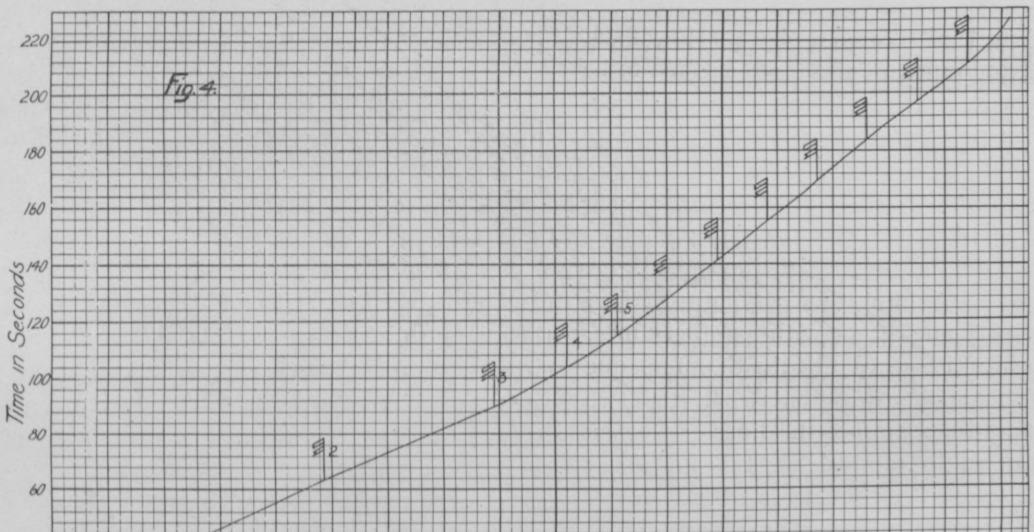
In locating signal No. 4 the train speed is to be noted at signal 3, and braking distance corresponding. Increasing this by 50% gives the distance which signal No. 4 must be placed in advance of signal No. 3. This distance is found to be 653 ft. Repeating the process for determining the location for signal No. 5, and it is found that the train on being tripped (emergency brakes applied by automatic stop) at signal No. 4 in the danger position, would travel only 435 ft. before coming to rest, and a signal could be placed safely this distance in advance of signal No. 4. With trains 400 feet long, however, it is not desirable to have blocks of less than 450 ft., and signal No. 5 will be placed this distance in advance of signal No. 4. The blocking from this point to station B becomes simply the spacing of signals 450 ft. apart.

It will be seen that the time-distance curve, Fig. 2, extended to include the station stops, would give information as to the minimum headway at which it is possible to operate under normal conditions, and this has to be considered in pratical signaling.

* Method originated by George Gibbs, Consulting Engineer.







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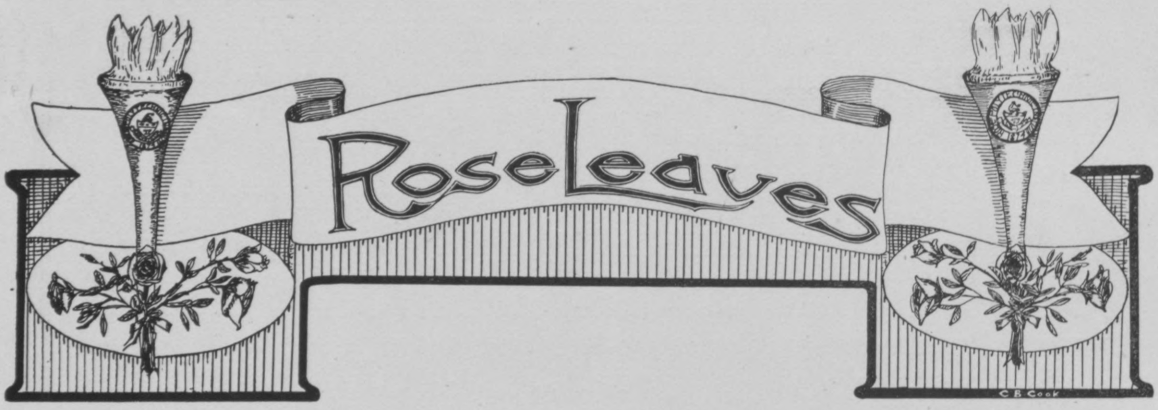


Outline of the Half-Tone Process of Pictorial Printing.

By CARL B. ANDREWS, '08.

WHAT is known as the half-tone process for the production of printing plates had its beginnings about the middle of the last century; the identity of the originator is not certain, as claims are advanced for several different persons. The problem as it first presented itself was that of changing the continuous gradations of a photograph or similar picture into a series of black and white dots, dashes or lines which should fairly represent the original, and yet, being black and white, would permit a raised surface to be made, from which the representation of the picture could be printed on the ordinary printing press.

Omitting a record of the various devices which were tried, aiming at this result, the experimenters finally settled on the use of the screen. A screen is made by ruling two similar pieces of thin, perfectly plane glass with parallel lines, which lines are afterward filled with an opaque composition, in such a way that when the two plates are placed face to face the lines cross each other at right angles, and each set of lines is at an angle of 45° with the edges of the plate. These screens are made in varying fineness from 60 to 300 or more lines to the inch.

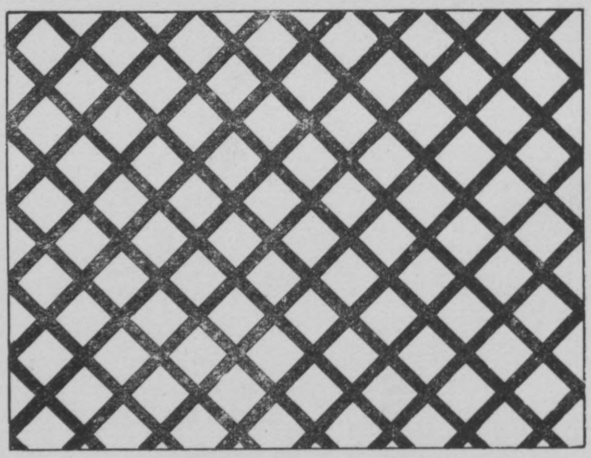


Fig. 1.

The object, or more generally, the picture to be reproduced, is placed before a camera of suitable construction, and the screen is placed in the camera between the lens and the sensitive plate, the screen ruling being perhaps $\frac{3}{16}''$ from the sensitive surface. This screen distance may be varied according to the will of the operator, and it has an important influence on the character of the resulting negative. The general effect of the screen is to record itself on the plate by the shadows of its lines, and if the ruled surface were in contact with the sensitive surface, this would be the only effect, but when the ruled surface is not in contact with the sensitive surface, it is found that each of the minute apertures of the screen acts as a pin-hole lens, reproducing on the sensitive surface the shape and relative size of the aperture of the diaphragm which is used in the camera lens. Also, since the rays of light diverge between the screen and the plate, the greater the screen distance, the larger each of these images of the diaphragm aperture will be.

Suppose that three diaphragms, say F8 (large), F24 (medium), and F64 (small), are at hand, and a negative were made from any given original, using the F64 stop; the resulting negative would correspond to the original in tone values, but would consist only of small areas of negative, separated by transparent lines, the shadows of the screen lines; if F24 stop were used, the result would be the same, except that the small areas of negative would be larger, proportional to the larger stop, the separating lines being narrower. If the F8 stop were used the negative areas would be still larger, and supposing the diaphragm aperture circular, the resulting circular areas on the plate might be large enough to overlap, thus breaking the line caused by the shadow of the screen line. It may be thought that the size of the dot on the negative could not be smaller than the screen opening, but the effect which is actually produced is as though the beam coming through the screen opening is brighter at its middle than around the outside; the resulting dot on the negative is most dense in the center of the circle, the density diminishing toward the edges, and by after processes of intensification and reduction its size may be increased or diminished at will within certain limits.

In practice, three or even more diaphragms are used in making a single exposure; a long exposure is given with the small,a shorter exposure with the medium, and a very short exposure with the large stop. If the transparent dot of the screen were to register the images of the three diaphragms accurately on the plate, the resulting negative would have but three tones; the detail in the shadows would be made up of dots formed by the long exposure with the small diaphragm, varying in intensity according to the tone of the original, but all of the same size. The medium tones would be composed of larger dots formed by the medium exposure, and the high lights would be formed of dots obtained by the short exposure with the large diaphragm.

When the screen and plate are separated, the pin-hole lens of the screen no longer reproduces the shape of the diaphragm in a clear, sharp dot; the dot becomes a fuzzy edged spot which is most dense in the center. Under this condition the dark shadows of the original will reflect only enough light to cause a deposit in the dense central part of the dot, a lighter portion reflecting more light will cause the dot to be comparatively large, and between the two sizes of dots a gradation occurs, corresponding to the amount of light reflected by the original. Between the different sizes of dots caused by the different diaphragms, the same causes produce the same effect of gradation, and if the successive differences of diaphragm aperture are not too great, the gradation is regular and approximately true to the original.

For various reasons the wet collodion plate is used almost exclusively in this work; it is amenable to processes of intensification and reduction which could not be used with a gelatine-coated plate; the result of these operations is to remove the fuzzy edge from the dot, leaving it clear-cut, opaque, with transparent intermediate spaces, the gradation from light to dark (on the negative) being as represented in Fig. 2. The image of

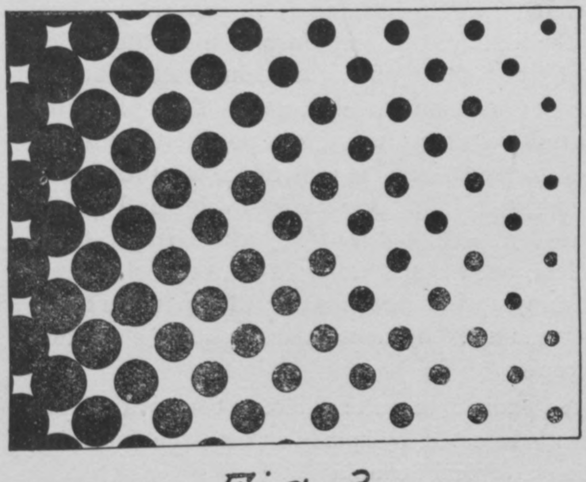


Fig. 2.

the original is now obtained as a series of dots varying in size but not in tone.

The next essential step is the obtaining of a print from the negative on a metal plate, in a substance that will resist the action of the mordant by which the plate is etched. The metal used is usually copper, which is obtained in sheets $\frac{1}{16}''$ thick, highly polished on one side. A piece of requisite size is freed from grease and flowed with a sensitising solution of which the following is a representative formula:

Water,	6 oz.
Le Page's Liquid Glue,	2 oz.
Settled Albumen,	2 oz.
Ammonium Bichromate,	120 grains

The solution is quite fluid, and a thin, even coating on the copper is obtained by clamping the plate horizontally in an apparatus by means of which it can be rapidly whirled in the horizontal plane, warmth being applied at the same time; the greater part of the sensitizer is thrown off from the corners of the plate, leaving a very thin even coating, which is dried by the warmth. The dried plate is placed in contact with the negative in a printing frame especially designed for standing great pressure; the two are squeezed into practically perfect contact, and the plate printed, three minutes in a bright summer sun, or say, seven minutes, twelve inches from a 2000 c. p. arc light. The print is slightly visible on removal from the frame, and is developed by washing in warm water, The exposed portions of the film are rendered insoluble by the action of light on the ammonium bichromate; the unexposed portions wash away. The print becomes invisible during development, and the operator must learn by experience when the work is complete. The print is now dried and gently heated up to about 650°F.; the coating turns yellow, brown, and finally a deep chocolate, and its shiny appearance has earned for it the name of "enamel," by which the sensitizing solution is known.

An enamel of quite different composition has been advocated by some workers, the following being a typical formula:

A	Rock Candy,	400 grains
	Ammonium Bichromate,	160 grains
	Water,	2 oz.
B	Chromic Acid,	80 grains
	Stronger Aq. Ammonia,	½ oz.
	Water,	¾ oz.
C	Settled Albumen,	1 oz.

Add A to B, to C. Mix thoroughly and filter.

The print made with this solution is dusted with powdered sodium carbonate or sodium stannate, which adheres to the unexposed portions, but brushes off from the exposed parts. The print is then heated to say 500° F., the coating becoming light brown; the unexposed parts of the film will now dissolve in water, the exposed parts remaining on the metal. The chemical action is obscure, and the successful use of this method depends so much on proper conditions of humidity that in most localities it is necessary to have an especial dark-room in which the amount of moisture may be controlled by either warming the room when too moist or injecting steam when too dry. This amount of trouble being considered an abomination by the average worker, this solution, though giving a coating superior to that of the glue enamel in its resisting qualities, has not come into general use.

The etching of the plate is theoretically simple; the mordant used is a water solution of ferric chloride; the depth of the etch varies with the mesh of screen used; for a 150-line screen it would be less than the thickness of an ordinary visiting card. The relief thus obtained is sufficient for printing press work. The plate is trimmed and mounted on a block type-high, when it is ready for delivery.

There are several allied processes of which the limits of this article will not permit a description; the zinc line process of reproducing pen drawings, a simpler application of the principles of photographing and etching than that outlined above, and the three-color process, by which pictures of objects are obtained in approximately the original colors, being the principal ones. The three-color process is yet far from perfected, but very acceptable results of its use are common; the theory seems to be all right, and good results ought to be obtained by a proper application of means and materials which will become better known by use.

SCIENTIFIC SOCIETY.

The American Diesel Oil Engine was the subject of a paper read by McComb, '06, before the Scientific Society March 17.

This engine is remarkably efficient thermally, in fact running way above any other internal combustion engine in that respect.

It differs from the common gas or gasoline engine in that the fuel is burned comparatively slowly and at high temperature and not exploded as in a gas engine. The conditions under which the fuel is burned renders it possible to utilize a low grade of combustible, such as crude petroleum, etc.

A feature of interest is that before the engine was built all the thermal equations and calculations were worked out, and later the engine was built to conform as closely to the theory as possible.

ILLUSTRATED LECTURE.

On Saturday, March 10th, Mr. T. L. Condron, '90, gave us a talk on "Reinforced Concrete." Mr. Condron has made this class of work his specialty, and has come to be recognized in engineering circles as an authority on the subject.

The lecture was illustrated by numerous lantern slides, showing photographs of examples of reinforced concrete work as applied to the construction of bridges, dams, retaining walls, etc. While the talk might be expected to appeal more especially to students in the Civil Engineering course, it was presented in such an interesting manner that we all enjoyed it.

It is to be hoped that Mr. Condron will be able to pay us another visit in the near future, to tell us more about this interesting and important subject.

SYMPHONY CLUB CONCERT.

On Thursday, March 15th, the members of the Rose Symphony Club gave their first concert of this season, at the Central Presbyterian Church. The audience was only fairly large, but thoroughly appreciative.

The Orchestra, under the direction of Mr. Hugh McGibeny, played the opening number, and was followed in turn by the Glee Club, under Mrs. Allyn Adams, and the Mandolin Club, directed by Mr. W. G. Brandenburg, Solos were rendered by Kahlert, '06, and Fischer, '08, of the Glee Club; and Wanner, '09, and Worthington, '06, of the Orchestra. In each case the applause was so generous that encores were given.

The program in full was as follows:

ORCHESTRA:

a. Selection from "The Sho-Gun," . . . . Luders
b. Cello Solo: "Gavotte," . . . . Popper
F. K. WANNER' '09.

GLEE CLUB:

a. "Elixir Juventatis," . . . . Stanley
b. "In After Years," . . . .
Solo by FISCHER, '08.

MANDOLIN CLUB:

a. "The Social Lion," . . . . Hildreth
b. "A Day in the Cottonfield," . Smith and Zublin

ORCHESTRA:

a. Flute Solo: "Serenade de Concert," . . . Popp
A. W. WORTHINGTON, '06.
b. "The Dervishes," . . . . Bendix

GLEE CLUB:

"When I Was a Lad," from Pinafore, . . . Sullivan
Solo by Kahlert, '06.

MANDOLIN CLUB:

a. "Lustspiel Overture," . . . . Kelerbela
b. "The Dixie Rube," . . . . Allen

GLEE CLUB:

"A Song of College Cheer," . . . . Adams

THE 1906 TRACK TEAM.

THE candidates for the track team have done considerable indoor work since the middle of February, but owing to the very bad weather and the condition of the ground, very little outdoor work has been done up to the present time. The weather changed, and the men have been out every day now for about a week and everyone is working hard to make up for lost time.

Of last year's team Brannon and Larkins are the only ones who are not here this year, although one or two who were with the team then have not come out this year for practice.

As the state meet is to be held in Richmond this year, we will not be able to send over a large team so it will result in sending only those men who before that time show promise of being able to win one or more pints. This should be an incentive for everyone to do his best from now on.

Arrangements have been made and are being made for number of dual and other meets, including two or three trips. There are several new men who give promise of being point winners, among them Darst, Tyler, Holden and Smith, all '09; Kelso, '08, and Taylor, '07.

For the 100 and 220 yard dashes Turk, Lee, Willien and Reilly will be on hand. For the 440 yard run, Turk, Smith and McCormick.

Quite a number of men arc working on the half and the mile, and we certainly should develope at least one good runner in each event. Those out for those events are McCormick, Holden, Kelso, Tyler, Piper and Smith.

For the low hurdles there are Lee, Modesitt, Taylor and White; and for the high hurdles, Smith, Ryan and Modesitt.

In the high and broad jump, the only new man is Smith; Turk, Wischmeyer and Kelsall being in their old places. Willien and Lee are working hard at the pole vault and promise to hold their own in that event.

For the shot-put, there are Turk, Sharpenberg, and Strecker, and the same men, with the addition of Darst, are working with the hammer.

Turk, Jackson and Boyd will work in the discus throw.

When everything is considered, the prospects of our 1906 team are very bright, and we hope to win the championship.

SCHEDULE OF TRACK MEETS.

If Manager McDaniel's present plans do not fail our team will compete in the following meets:

April 14.	Handicap meet at Y. M. C. A.
May 5.	Dual meet with Kentucky State College, at Louisville.
May 12.	Dual meet with Wabash College, at Terre Haute.
May 19.	I. C. A. L. State meet at Richmond.
May 26.	I. I. A. A. State meet at Lafayette.
May 29.	Dual meet with I. S. N. S., at Parson's field, Terre Haute.

BASKET-BALL ELECTION.

The Athletic Association Directors recently elected Erwin Miner, '07, as basket-ball manager for the 1907 team. The players elected Trueblood, '07, for the next captain.

Trueblood was captain for the 1904 and 1905 teams.

We wish both of them every possible success.

BASE-BALL.

Like the track team, the base-ball team has been greatly hindered in its practice by the exceptionally bad weather during the past month. However, the indoor practice has gone on regularly for more than six weeks, and our batting strength should be greater than that of last year's team.

It is still too early to say much of the line-up up of the team, but the following men may be mentioned as among the more prominent candidates :

Douthett and Freudenreich, pitchers.

Baylor, 3rd.

Miner, c. f.

Mooney, captain, 1st and catch.

Schmidt, catch and pitch.

Piggott, 1st and utility.

Heidinger, s. s.

Frisz, Conley, Whitlock and Crumley, outfield.

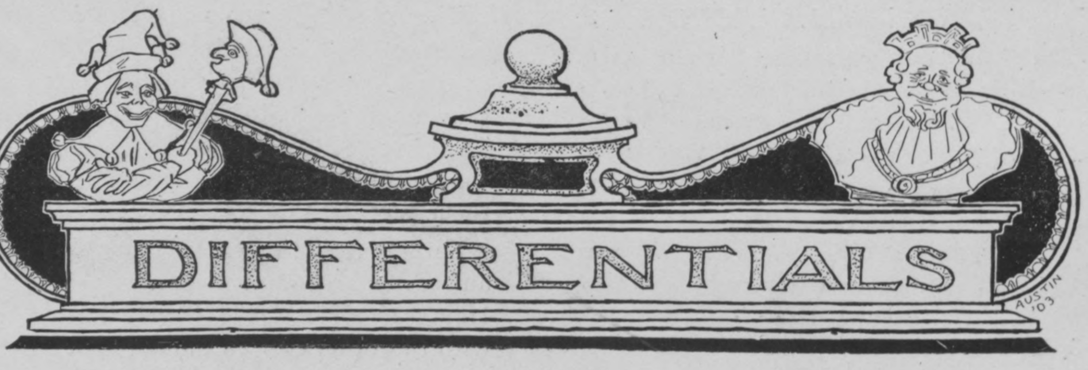
The schedule, as completed to date by Manager Worthington, is given below, and will certainly keep the team playing ball to win out. Cincinnati University, Notre Dame and Armour Tech. are colleges new to Rose schedules, and we are glad to open up base-ball relations with them.

Several of the Big Nine have been scheduled, and a number of practice games with the Terre Haute Leaguers have been arranged, making, with the other college games, about the stiffest schedule that Rose ever handled.

BASE-BALL SCHEDULE.

April	13.	Terre Haute Leaguers, at Ball Park.
"	14.	I. S. N. S., at Ball Park.
"	18.	Purdue, at Lafayette.
"	21.	Indiana University, Poly Campus.
"	28.	Wabash College, Poly Campus.
May	5.	Armour Tech, at Chicago.
"	7.	Notre Dame, at Notre Dame.
"	11.	Cincinnati University, Terre Haute.
"	12.	DePauw University, at Greencastle.
"	19.	Wabash College, at Crawfordsville.
"	23.	I. S. N. S., Parson's Field.
"	30.	DePauw University, Terre Haute.
June	2.	I. S N. S., Poly Campus.

Return games with Purdue and Indiana are yet to be fixed, and Millikin University will probably be scheduled.



"Everybody works but Seniors,
They lay around all day;
Hands deep in their pockets,
Smoking their pipes of clay.
Freshmen take in German,
So do Sophomores too;
Everybody works but Seniors,
Lord what DO they do?"

—[*Ex.*

Shepherd:—"Come in, let's have a students' size."

Cannon:—"No, thank you, I don't smoke."

Hath:—"An independent variable is one which depends upon nothing whatever; we make it anything we please."

Beauchamp, '08:—"I guess my mark in exam must be an independent variable, then."

Senior (in Machine design):—"I wonder if these gears will mate?"

Canfield—"Just get them engaged and they will mate."

Dr. Mees (In last recitation in Mechanics before the mid-term exams):—"God be with you when we meet again."

Mac:—"You Seniors think you're foxy, but I've been here longer than you have, and I'm just a little bit foxier than you."

Wicky:—"Now I'm going to ask the most audacious, unbelievable person in the class what he thinks of this lesson. Mr. Stock, how does it strike you?"

Doc (after explaining the couple as used in Mechanics):—"Now, for an explanation of the other kind of couples you will have to see Mr. Lawrence."

Cece Trueblood is drawing plans of a house. He also says he isn't coming back to school next year. May you live happily ever after.

Jojo (in Physics):—"If the *gentleman* who uses prize-ring slang so fluently will step toward the front, we will be able to hear better." But the fallen champion moved not a muscle, while the referee slowly counted him out.

Tuthill, '09, (trying to sing): "All the world is sad and dreary, everywhere I roam."

Ralston, '09;—"Yes, that's right, Doc."

Freshman (translating): — "*Das ging geschwind.*"

"That's going some."

Uhl, '08:—"Well, Stock, are you ready yet?"

Stock:—"No, I'm Reddy's room-mate."

IN DYNAMO DESIGN.

Thurman:—How many brushes have you?"

McComb:—"Three. A hair-brush, a tooth-brush and a clothes-brush."

Wicky (after Smith has read a paper on liquid air,)—"Well, Mr. Smith, if liquid air fails to become of any practical value, you will make a success if you just go around and lecture about it."

Hunley:—"Say, Mr. Bennett, we're not going to have anything on the subjunctive case on exam, are we?"

Dr. White:—"I think that you will find it to be a fact that we are least familiar with the things with which we are most familiar."

Evans (telling how he fared at Duenweg's dancing lesson):—"When he counted 'one' I slipped back one step, and at 'two' I was two behind."

Wanner, in Chemistry exam, in answer to the question, "Name the most common occurrence of water," gave "In Terre Haute milk."

Kerrick:—"If fellows keep on getting married in Poly, in a couple of years, instead of 'Furnished Rooms' signs, we'll see 'Furnished Flats for Light Housekeeping.'"

Mr. T. L. Condron, '90, gave a lecture before this school on March 10th, during which he showed a view of one of the famous "Pipelines."

Dr. Mees has been talking in Freshman Mechanics about "Plump pungers."

Evans:—"Who was cracking walnuts around Kadel flat last night?"

Robbins:—"That wasn't walnuts you heard, that was Andrews cracking jokes across the street."

Evans:—"Not much it wasn't; jokes don't leave their hulls in a fellow's bed, and besides his jokes are all chestnuts, anyway."

Mr. Bennett explained to the Freshmen that the ability to write well wasn't always a sign of genius, and then he showed them some of his own writing.

Roy W. Hill, '04, was in Terre Haute Sunday, April 8th. He spent the day with his M. E. P. friends, who entertained him at supper at the Terre Haute House.

Arry (expounding theories in foundry):—Now, Mr. Pritchard, pay attention, for this lecture of mine is worth more than any Prof. Wires could give you"

Pritch:—"Hall right, Arry, but if I go to sleep, wake me up."

EXCHANGES.

The reason some men don't succeed is because their wishbone is where their backbone ought to be.—[*Ex*.

Excited lady (at the telephone):—"I want my husband, please, at once."

Telephone Girl (from the exchange):—"Number, please?"

Excited Lady (snappishly):—"How many do you think I've got, you impudent thing?"—*Gold and Blue*.

He put his arm around her waist,
The color left her cheek,
But on the shoulder of his coat
It stayed about a week.
—[*Ex*.

The Trustees of the Northwestern University have decided to abolish intercollegiate foot-ball for a period of five years. The sport hereafter will be confined to interclass games within the university.

Customer (in restaurant):—"Waiter, my cocoa is cold."

Waiter:—"Well, sah, why don't yo' put on yo' hat, sah?"—[*Ex*.

"I have been accused of encouraging opium smoking because I furnish stuff for 'pipe joints.' In explanation I will state that this stuff is Dixon's Pipe Joint Compound and has nothing to do with the opium habit. On the contrary, it is a cure for the habit of inhaling gas from faulty joints."—[*Graphite*.

He who inside his watch lid wears
His sweetheart's pretty face;
Is sure to have a time, for there's
A woman in the case.
—[*Ex*.

French Prof.:—"I do not wish to cockroach upon your time. Ze bell rings. Go, monsieurs."—[*Armour Fulcrum.*

The census embraces seventeen million women. How would you like to be the census?—[*Ex.*

Prof. (to class):—"What is a dry battery?"

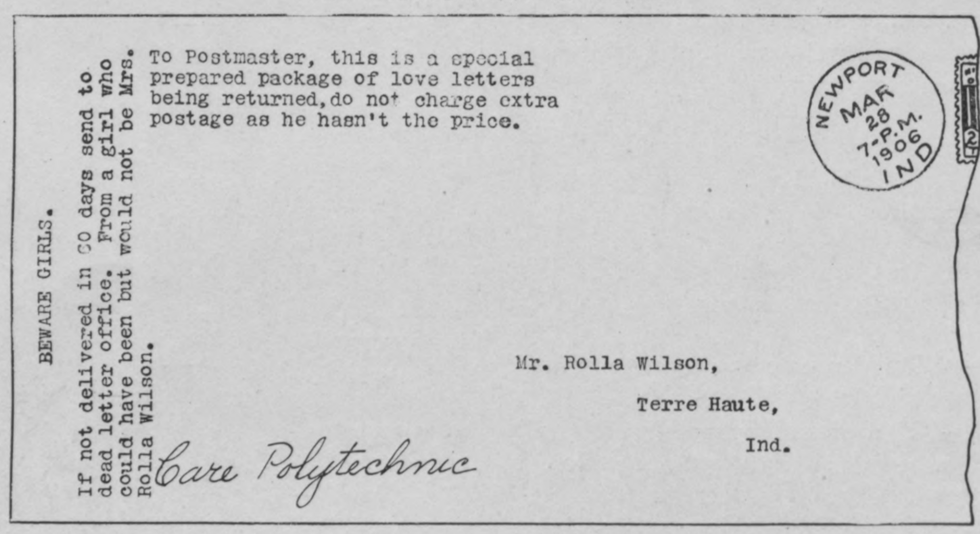
Undertone in the rear:—"A package of dried currents."—[*Georgia Tech.*

A Senior in Electrical Engineering at M. I. T. was killed by contact with live wires. He was enaged in a test of a 575 volt turbo-generator.

THE STUDENT BOARDER.

"Backward, turn backward, oh time, in thy flight, feed me on gruel again just for to-night. I am so weary of sole-leather steak, petrified doughnuts and vulcanized cake; oysters that slept in a watery bath, butter as strong as Goliath of Gath. Weary of paying for what I don't eat, chewing up rubber and calling it meat. Backward, turn backward, for weary I am; give me a whack at my grandmother's jam; let me drink milk that has never been skimmed, let me eat butter whose hair has been trimmed. Let me once more have an old-fashioned pie, and then I'll be ready to turn up and die."—[*Ex.*

SEEN OF THE LETTER BOARD.



BEWARE GIRLS.

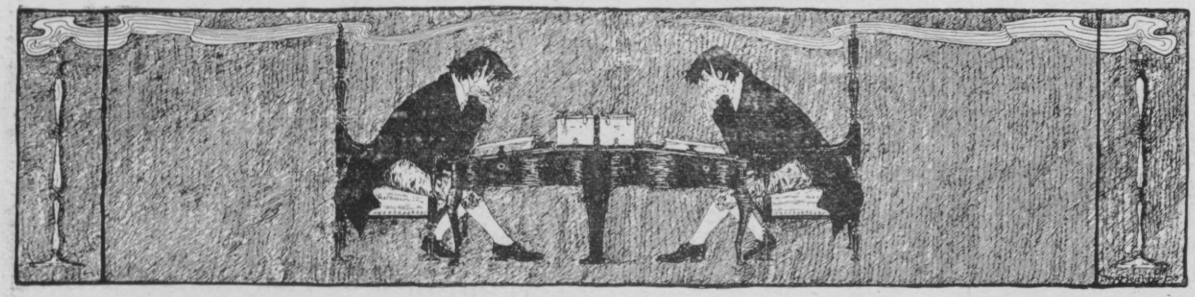
If not delivered in 60 days send to dead letter office. From a girl who could have been but would not be Mrs. Rolla Wilson.

To Postmaster, this is a special prepared package of love letters being returned, do not charge extra postage as he hasn't the price.

NEWPORT MAR 28 7-P.M. 1906 IND

Mr. Rolla Wilson,
Terre Haute,
Ind.

Care Polytechnic



REVIEWS

Single Phase Electric Locomotives.

In a paper read recently before the New York Railroad Club, Mr. B. G. Lamme, Chief Engineer of the Westinghouse Electric Company, has an account of the equipment to be used on the part of the New York, New Haven & Hartford Railroad, which is to be converted into an electric line. The equipment is interesting chiefly because the locomotives are provided with the single phase motors, lately perfected by Mr. Lamme, and because it will be necessary for the locomotive to operate both on single phase alternating current and on direct current.

The power generating end of the equipment consists entirely of turbine driven units, generating 25 cycle alternating current at 11,000 volts. The generators are so designed that either single phase or three phase currents may be drawn from them, and some points in their construction are most unusual. A single armature coil weighs about 600 pounds. The field, which revolves at a speed of 1,500 r. p. m., has only two poles, a design which would have been considered impossible before the advent of the steam turbine. The generators feed directly into the trolley line, giving a trolley potential of 11,000 volts. This high voltage necessitates a very substantial construction, and the catenary system of suspension is therefore used.

The locomotives are not the least remarkable feature of the installation. The mechanical points of the design were taken care of by the Baldwin Locomotive Works, in order that the most advanced information in locomotive construction might be used. The running gear of the locomotive consists of two trucks, each mounted on four 62-inch wheels. Each truck is equipped with two motors of 250 rated h. p. each, giving the locomotive a total power of about 1,000 h. p. The motors are of the gearless type and are wound to operate at a normal full load speed of about 225 r. p. m. on 450 volts alternating or 550 volts direct current. The two on one truck are connected permanently in parallel.

The Westinghouse electro-pneumatic system of multiple unit control is used on these locomotives, making it possible to easily handle a train of any size. It is intended that a single locomotive shall be able to handle a 200-ton train in local service on a schedule of 26 miles per hour, with stops averaging about two miles apart. In order to make this average speed, the maximum speed will be about 45 miles an hour. One locomotive will also be able to handle a 250-ton train on through service schedule.

A Novel Elevator.

"A novel elevator with a rise of 495 ft. has been erected to the summit of the Burgenstock near Lake Lucerne, for sight-seeing purposes. The entrance to the car and space for its operating mechanism are tunneled out of the rock at the base of the cliff and the shaft rises through solid rock to a height of 142 ft., whence it continues in a square steel structure, tied to the face of the cliff at intervals by structural braces. The elevator is electrically operated and provided with safety appliances. Switzerland has been noted for rack railways and inclined planes, but this elevator is a new method for reaching summits."—[*Engineering Record*.

The Smallest Electric Motor.

"What is claimed to be the smallest electric motor in the world is in the possession of a Texas electrician and watchmaker, who made it as a scarf-pin. It weighs one pennyweight and three grains, and is run by current from a small silver chloride battery. The field magnets are made from two very fine pieces of sheet iron scraped down and polished. Instead of copper as a conductor gold is used. The magnets are held together by gold screws and wound with very fine silk-covered wire, and the commutator bars are of gold."—[*American Machinist*.

The Oscilograph.

The recent numbers of many of the electrical journals have given accounts of the oscilograph, lately commercially perfected by the General Electric Company. This interesting instrument performs many such services for the electric circuit as the indicator performs for the steam engine. The fundamental purpose of the oscilograph is to furnish a satisfactory method of observing and recording rapidly fluctuating currents and voltages.

The oscilograph resembles, in some respects, a D'Arsonval galvanometer. The circuit which carries the current is situated in a strong magnetic field. It carries a mirror and is free to move. The instrument is inclosed in a light tight box, and light from some bright source, such as an arc lamp, is brought to a focus on the mirror, by means of lenses and prisms. When current waves of varying amplitude are sent through the current coil, the coil and the mirror attached, move. The movement of the ray of light reflected from the mirror is traced upon a sensitized film, moved before it by clock work. The resulting line on the film is an accurate representation of the wave form of the current and the amplitude of the curve is a measure of the magnitude of the current. In the *Electrical Age* for March several most interesting waves are reproduced. One is given showing the wave forms of a current, before and after being sent through a mercury vapor converter.

This is the first attempt to make a commercial oscilograph, but the idea of having an instrument accomplish what this instrument does accomplish is not new. The cathode ray alternating current wave indicator accomplished the same things, and was dercribed by Prof. Harris J. Ryan, in the *Transactions of the American Institute of Electrical Engineers* for October, 1903. In this instrument, the current is made to deflect a cathode ray and the curve traced was recorded on photographic paper.

A Mechanical Stoker for Locomotives.

The great size and coal consuming capacity of our modern locomotives has given rise to a demand for apparatus which will lighten the labor of the fireman. A recent number of the *Railroad Gazette* gives a detailed description, illustrated with halftones and drawings, of a mechanical stoker for locomotives. The stoker is being tested on a freight locomotive of the Pennsylvania Railroad in regular service. The locomotive is of the "Consolidation" type, and before the installation of the stoker it in no way differed from the Pennsylvania standard.

"The stoker is built by the N. L. Hayden Mfg. Co., of Columbus, Ohio, and it performs all of the functions of taking the coal from the tender, dividing it into small portions and distributing it in the fire-box. First, there is a heavy grating, placed just in front of the coal gates, on the floor of the tender, beneath which the horizontal section of a coal conveyor is made to travel. Coal dropping through this grating is taken by the conveyor and carried up on one side and thence back to the center, where it drops into the tube of a screw conveyor, by which it is carried to a point just back of the boiler head, where it drops into a hopper. The bottom of this hopper is closed by a valve which is capable of turning through half a revolution and receiving a charge of coal when its opening is uppermost.

The half turn drops the coal on a shelf in front of the fire box, whence it is blown by steam jets to the various parts of the fire-box with an even distribution. The rate of feeding can be varied to suit the work and the quality of the coal."

In case the stoker gets out of operating condition, recourse can immediately be had to hand firing. This has been necessary on several occasions during the trial trips, and the change was effected without inconvenience. The stoker demonstrated its ability to keep up a steady steam pressure in the severest service, but one of the advantages hoped for was totally lacking. As a smoke producer it rivals a green fireman. No tests have been made to determine the coal consumption, but the tests seem to show in a general way that the consumption is practically the same as by the old method.

Women as Engineers.

"The American Society of Civil Engineers, through its Board of Direction, has taken a step that both American and foreign professional societies have long debated, by admitting to its membership a woman qualified for one of the lower grades. This young woman is a graduate of the civil engineering school of one of the large universities and has lately been doing good work in the drafting department of a leading bridge company. She is qualified in every respect for admission to the society, under its rules, and the Board very wisely admitted her. There should be no objection to this on the part of the membership. There is considerable work of a technical nature done in all large offices that women can perform very efficiently. It is the general testimony of employers of large numbers of persons on work requiring careful attention to details, that women give better satisfaction than men, so long as the work is not beyond their knowledge. There is every reason to welcome their presence in office positions requiring technical knowledge, as soon as they have that knowledge, and if their education and work justify their admission to technical societies the latter ought to welcome them gracefully or make haste to change their constitutions so as to prevent the dreaded female invasion."—[*Engineering Record.*

Shops of the Louisville & Nashville Railroad.

In view of the fact that the Senior class is to visit Louisville soon, many of the members of the class will find it interesting to read an account, given in the March *Electrical Age*, of the equipment of the Louisville & Nashville Railroad shops, there. These shops have been completed only very recently and are strictly modern in every respect. It is probable that a more perfectly equipped railroad shop is not to be found in this countty. The principal shops are situated in parallel lines on each side of a long aisle, which is traversed by a transfer table operated by electricity. The parts of the plant of particular interest are, the machine shop, erecting shop, power house and forge shop. The noticeable feature about the machine shop is the absence of all belting. All the machines, except the very small ones, are operated by electric motors, geared directly to the machines themselves. The shops are all traversed by electric overhead traveling cranes, there being eleven of these, all told. The power plant is equipped with all the most approved time, labor and money-saving devices. The power equipment consists of three cross compound Buckeye engines, direct connected to 350 K. W. Bullock generators. The power house is equipped with a traveling crane over the dynamo room, and the boiler room is equipped with the Link Belt system for handling coal and ashes. The generator room also contains a balancer set which furnishes multiple voltage current for the machine shop.

The interesting and instructive details of the plant are too numerous to be described here, but it should be worth the while of any Senior Mechanical to go to Louisville, just to inspect this plant.