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NOTICE TO SUBSCRIBERS.

Hereafter we shall follow the general rule regarding subscriptions, and shall continue sending THE TECHNIC to subscribers until notified to discontinue.

MANY of our readers will be surprised and pained to learn of the death of one of '94's leading spirits, David McCulloch, which occurred March 13.

Since graduation Mr. McCulloch's only business connection had been with the Deering Company, of Chicago, in work covering both mechanical and civil engineering practice. In this he made good progress, and endeared himself to his associates there as elsewhere, but the attractions of another field of study grew upon him, and in the fall of '96 he entered upon a course of study in medicine, in Chicago, doing extra work with the expectation of completing the course in less than the usual time. Before the close of the fall term an affection of the lungs developed, and, at Christmas, he left the school, hoping that a few weeks of rest would enable him to return to his studies. Over a year ago he went to San Antonio, Texas, but last October returned to his home, that of Dr. and Mrs. Runnels, in Indianapolis, unimproved in health. There, among those most loved, given every care, he spent his last days.

The lovable qualities in his nature, his interest in all his friends, shone out to the last. His days at Rose were not forgotten; he was glad to meet and hear about his classmates, he read last year's TECHNICS, which by some oversight, had not reached him as issued, and within a month of his death he hunted up his text-book in Calculus, and reviewed the first part of it.

His strong and endearing character contributed in large measure to the life of those with whom he associated during his four years at Rose; his earnest good nature was a welcome element in every manly phase of student life; he was a loyal friend; he excelled in his studies, and was an active and valuable participant in athletics. His form has passed beyond his friends, but the gain imparted to their lives from his and the memory of his good and helpful companionship, will always remain.

WE announce with much regret the continued illness of Judge Mack. He has been very critically ill for several weeks and his condition is little improved. Judge Mack has been a member of the Board of Managers and Vice-president, for years, and has endeared himself to all who have been so fortunate as to make his acquaintance. His deep interest in the Rose

Tech and his long and faithful service as a director has won him the sincerest regard of Alumni and students and we hear of his continued illness with the deepest feeling of sorrow.

NO review or synopsis of Mr. Chaplin's address on the "Ethics of Engineering," delivered to the students of Rose Tech on March 16th, need be given for the benefit of the hearers of the address. We feel sure that the impression left upon them will be so lasting that it need not be freshened by comment or repetition from us. The occasion was, however, so memorable to the students that we feel impelled to revert to it.

Mr. Chaplin has had such a wide and varied experience in the course of his own early education and subsequent career as officer in the army, practicing engineer, teacher of engineering in Japan, as Dean of the Lawrence Scientific School and Chancellor of Washington University, that his opinions in reference to the educational needs of young engineers is entitled to special consideration. In his address the strength and convincing character of his logic was everywhere sustained by his personal experience. His broad views rested upon the sure foundation of reality and could not fail to convince.

His statement that American engineers as a class are among the most highly educated professional men as regards judgment and mental discipline is unquestionably true, as is that criticism that in the affairs of state, of society, and all that concerns the general welfare of mankind they do not exercise an influence commensurate with their mental equipment. Mr. Chaplin traces this to some extent to the lack of attention given to general subjects, foremost to failure in the study of concise, forcible and graceful use of the English language and it seems to us that in this, his ground is well taken. It seems further that this warning is timely, for the tendency is towards narrow professional training—growing out of the clamor of students for the so-called practical branches. The reference to the comparatively small value of much which often appeals to the student was aptly illustrated by an anecdote of a German draughtsman, whose mechanical skill was undoubtedly the result of much practice, was worth only the modest sum of $30 per month. The caution to students that having acquired a sound engineering education if they expect position, influence and wealth to come to them they will be disappointed, may well be weighed. Though opportunity is an important factor, hard aggressive effort and labor is a larger factor in success.

THE March number of the *Sibley Journal of Engineering*, Cornell, in an editorial makes the following statement: "Perhaps it is not generally known among the undergraduates of Sibley college that the *Journal of Engineering* is the only publication of its kind. There are other monthly college engineering publications, but not a one which is controlled and edited by a *student* board of editors."

This sweeping statement is rather hard to understand when we turn to their board of editors and find the names of four of the most prominent professors recorded as associate editors.

If the editor will look over his exchange table closely and examine the boards of management of some of the best of the college engineering journals, he will find several that are edited and managed without the co-operation of the faculty.

EARLY in the present year the faculty considered the advisability of extending the scope of the Institute by the addition of a course of Architecture upon lines, for which there is a growing need in this section of the country. After careful deliberation and investigation the Board of Managers have authorized the establishment of a course of architecture, which will give due prominence to the engineering side as well as a preparation in the aesthetic.

With the growth of the modern office buildings, with their massive steel frames, the duties of the architect have developed from the artistic to the more exacting demands of the engineering profession.

The requirements for large buildings have

made it necessary that those who undertake the planning and erection, should be thoroughly equipped as mechanical engineers and understand the deduction of stresses and strains in girders, roof and floor trusses, the stability of walls, strength and properties of materials, etc. With this in view and realizing the advantages already offered in the civil and mechanical courses with their well equipped laboratories and necessary apparatus for the thorough study of the fundamental principals, as well as provisions for testing structural materials—the course in Architecture was established to follow closely upon the plan already laid out in the Civil Engineering Department.

The instruction in this department is designed to give emphasis to the constructional element in buildings as well as the artistic, comprising the study of construction and materials, the study of building processes and of professional practice as well as that of composition, design and the history of architecture.

The aim of the whole course will be to give the students such a knowledge of the fundamental principles as well as such practice and experience as will thoroughly prepare them to enter upon a professional career with a well laid foundation. Not alone for their years of work as subordinates where accuracy, rapidity and taste in design and art with the knowledge of detail, will be the qualifications, but also the technical knowledge will become important.

The course, as was said before, will follow very closely the Civil course. The more strictly professional work will begin with the study of the five Orders and the history of Architecture, in the Sophmore year. The time devoted to Architecture in the Junior and Senior years will be taken up largely with practical problems of buildings of various types, the study of conditions and materials and the overcoming of difficulties to be met in special designs. At the same time the more technical side will be given due prominence, with instruction and practice in building materials, their use and advantages.

THE sixteenth annual catalogue of the Rose Polytechnic Institution has just been issued. The 1898 catalogue is very much improved, both in the cover and typography. Each year has seen an increase in the size of the catalogue as the number of Alumni continue to grow and the scope of the Institute is broadened until the present volume approaches almost a hundred pages.

The general arrangement is the same as previously, however, several additions and improvements have been made noting changes in the departments and the extention of the courses.

The first change and decided improvement, and one that will be deeply appreciated by the students, especially the coming Freshmen classes, is the calendar which records the days of school in red and the holidays in black.

The course of lectures which were delivered during the past year are given a prominent place, which they well deserve, as they were both interesting and highly instructive. The course of Architecture is the most important addition to the scope of the Institute and promises to become one of the most popular courses offered. The alphabetical list of the Alumni is also a convenient change and improvement over former catalogues.

In the introduction to the catalogue we note the following quotation, which gives the theory and the plan of instruction upon which much of the success of the Alumni of the Rose Tech may be attributed:

"The experience of the last twenty or thirty years in the educational field has conclusively demonstrated that the best results are attained in every case by a judicious introduction of laboratory practice and the study of laboratory methods into courses formerly consisting entirely of purely theoretical and text-book work. The results obtained have appeared so satisfactory that in the last few years there has been a tendency towards an unsystematic and often unintelligent introduction of laboratory work into courses of study. The purely mechanical performance of a number of laboratory experiments with assembled apparatus

according to explicit directions, without intelligent appreciation of the character of the problem and the underlying principle, is of very questionable value. Such exercises, though usually called practical—because they are made use of in practice, are of little educational value. The neglect of the thorough study of principles as underlying good practice, and the lack of appreciation of the importance of a liberal education to the Engineer, is responsible for many errors. The Engineer must be prepared to grapple with new problems not simply to copy or enlarge the scale of previous achievements. The policy of this Institute is to retain a fair balance between laboratory, shop, and field practice and the study of principles, and to so intimately connect these two elements that each aids in the other. The training of the Engineer should be broad and liberal, it should include the study of principles as well as their application in accordance with established practice, and should furnish such special technical and general knowledge as will enable him to successfully attack new problems when they present themselves. He is thus fitted for more rapid advancement on entering his profession, and is saved from the many errors arising out of ignorance of methods ''

FOR the first time in several years the Board of Managers have all of the vacancies filled. At a special meeting held at the Institute, April 8th, Mr. H. I. Miller and Mr. John B. Aikman were elected members. Mr. H. I. Miller is Superintendent of the main line of the Pennsylvania System with headquarters in Terre Haute.

Mr. John B. Aikman is an Alumnus of the Rose Tech, having graduated in the class of 1887. He has been a prominent member of the Alumni Association and secretary and treasurer ever since its organization. For several years he has been a member of the firm of J. R. Duncan & Co., wholesale dealers in paper, stationery, etc., Terre Haute.

AN upper classman of the Rose Tech has been recently appointed instructor to a class of railroad men in this city, who are members of the Correspondence School of Locomotive Engineers and Firemen, of Chicago, and it has been our privilege to be shown and have explained the methods of conducting such organizations. The object of the course is to give the engineers and firemen general instruction in the elementary principles of chemistry and mechanics, dwelling upon such points as will clearly illustrate the scientific principles occuring in the practical experience of every day life.

It is thus that an engineer who has not had the advantages of a technical education, acquires an training that enables him to fill responsible positions, that might not have been obtained otherwise than by the opportunity offered through the Correspondence School. There is no doubt that the advantages offered if carefully and closely followed will be of the utmost value, in giving a better knowledge and more intimate acquaintance with some of the very interesting questions that are met with daily.

In connection with the Correspondence Schools, the instructor must be fully competent in his undertakings, for often in such positions there is lacking the ability to explain comprehensively plain truths and apparently simple problems and this ability may be said to be absolutely necessary where a clear and forcible impression is to be made. However, were all the schools conducted as the one visited, there would soon be shown toward the Correspondence Schools a decided increase in popularity and a true appreciation of their benefits, not only to the men who receive instruction, but also to those who have the management of the roads under control.

Historical Sketch of the Steam Engine.

By PROF. FRANK C. WAGNER.

THE earliest authentic account which we have of the use of steam to perform work is found in the writings of Hero, of Alexandria, a Greek, who flourished about 130 B. C. This author describes several devices for utilizing the expansive force of steam and hot air. One of these is a device for automatically opening the doors of a temple when a fire is kindled upon the altar.

Beneath the altar is an air-tight chamber partially filled with water and communicating by means of a syphon with a large bucket. When a fire is built upon the altar the air in the upper part of the chamber expands and forces the water through the syphon into the bucket. The water in the bucket acting by its weight pulls upon a cord properly arranged and opens the temple doors. When the fire upon the altar is extinguished the air contracts, the water is sucked back into the chamber and a counterweight closes the doors.

The most interesting of Hero's machines is the "Aeolipile," or, as we would call it in these days, the steam turbine, which may fairly claim the honor of being the first steam engine. The principle is that of the reaction turbine.

Of course these devices had no commercial value except perhaps to excite a superstitious dread in the temple worshippers for the benefit of the priests. But they are interesting historically as forming one of the numerous instances in which the scientific toy has developed into a machine of great commercial importance.

After the time of Hero there are here and there in history isolated instances of men who kept up an interest in the study of steam, and who applied it in various ingenious ways. But in the latter part of the sixteenth century and in the beginning of the seventeenth, there arose a widespread interest in the study of steam and a determined effort toward its practical and commercial utilization.

To the Marquis of Worcester belongs the honor of first using steam to perform continuous and useful work on a commercial scale. His apparatus consisted of two forcing vessels working alternately. Steam is first introduced into the vessel, expelling the air; the valve is then closed and the steam allowed to condense, producing a partial vacuum and lifting the water up into the vessel through a suction pipe. When the chamber is filled with water the valve in the suction pipe is closed and one in the discharge pipe is opened. Fresh steam is then admitted above the water and by its pressure forces the water through the delivery pipe. At this time water was lifted in the Cornish mines by horse power. But such was the prejudice of mine owners that notwithstanding his wealth and position Worcester was unable to form a company for the exploitation of his invention.

Fifty years later the public had become educated sufficiently so that Thomas Savery was able to introduce an apparatus for raising water substantially the same as that of Worcester. The chief improvements which Savery introduced were surface condensation to hasten the action, the use of gauge cocks to show the height of water in the boiler, and the use of an auxiliary boiler to feed the main boiler.

Denys Papin, a contemporary of Savery, contributed largely to the development of the steam engine by two important inventions, the safety valve, and the piston working tightly in a cylinder.

The next step in advance was made by Thomas

Newcomen, a blacksmith, of Dartmouth, England. He combined the piston engine of Papin with the separate boiler and jet condenser of Savery. It was on one of Newcomen's engines that a boy, Humphrey Potter, in 1713, tied the valve levers to the walking beam and made the engine work its own valves.

The next step, or rather succession of steps, was taken by James Watt, who put the steam engine, so far as the action of the fluid is concerned, in its present universally adopted form. "Watt set to work scientifically from the first. He studied the laws of the pressure of elastic fluids and of the evaporating action of heat, so far as they were known in his time; he ascertained as accurately as he could with the means of experimenting at his disposal, the expenditure of fuel in evaporating a given quantity of water, and the relations between the temperature, pressure and volume of steam. Then, reasoning from the data he had thus obtained, he formed a body of principles expressing the conditions of the efficient and economic working of the steam engine, which are embodied in an invention described by himself in the following words, in the specification of his patent of 1769:—

'My method of lessening the consumption of steam, and consequently fuel, in fire engines, consists of the following principles:

'*First.* That vessel in which the powers of steam are to be employed to work the engine, which is called the cylinder in common fire engines, and which I call the steam vessel, must, during the whole time the engine is at work, be kept as hot as the steam that enters it; first, by inclosing it in a case of wood, or any other materials that transmit heat slowly; secondly, by surrounding it with steam or other heated bodies; and thirdly, by suffering neither water nor any other substance colder than the steam to enter or touch it during that time.

'*Secondly*, In engines that are to be worked wholly or partially by condensation of steam, the steam is to be condensed in vessels distinct from the steam vessels or cylinders, although occasionally communicating with them; these vessels I call condensers, and, whilst the engines are working, these condensers ought at least to be kept as cold as the air in the neighborhood of the engines, by application of water or other cold bodies.

'*Thirdly*, Whatever air or other elastic vapor is not condensed by the cold of the condenser, and may impede the working of the engine, is to be drawn out of the steam vessels or condensers by means of pumps, wrought by the engines themselves, or otherwise.

'*Fourthly*, I intend, in many cases, to employ the expansive powers of steam to press on the pistons, or whatever may be used instead of them, in the same manner in which the pressure of the atmosphere is now employed in common fire engines. In cases where cold water cannot be had in plenty, the engines may be wrought by this force of steam only, by discharging the steam into the air after it has done its office.

'*Lastly*, Instead of using water to render the pistons and other parts of the engines air and steam tight, I employ oils, wax, resinous bodies, fat of animals, quicksilver, and other metals in their fluid state.'"

Among Watt's numerous inventions were the separate condenser with an air pump, the steam jacket, the double acting engine, the crosshead and guides, the connecting rod and crank, the ball governor, the throttle valve, the fly-wheel, and the steam engine indicator.

Entitled to almost equal honor is Matthew Boulton, Watt's partner, without whose capital and business ability success would have been most improbable. Boulton himself was an inventor of no mean ability, and hence his ready appreciation of Watt's genius.

Among the contemporaries of James Watt were several men who contributed substantial improvements to the mechanism of the steam engine. William Murdoch, superintendent of construction for the firm of Boulton & Watt, invented the oscillating engine and the D slide valve driven by an eccentric.

Jonathan Hornblower invented the compound engine, in which the steam after being used in

the high pressure cylinder is expanded further in a second cylinder, called the low pressure cylinder.

William Bull and Richard Trevithick invented the direct acting pump. Metallic packing rings to make the piston steam tight were invented by Edward Cartwright, who also invented the power loom.

Thus at the beginning of the nineteenth century all the essential elements of the modern steam engine had been invented. Its further history is a history of its applications and of the modifications made in its mechanism to adapt it to particular kinds of service.

The most striking as well as the most important application of steam is the modern locomotive. The first attempts toward locomotion by the use of steam were in the direction of steam carriages to run on the streets. Watt and Murdoch made a model of such a carriage, but never brought it into practical use.

Among the first to take up the subject of steam locomotion was Oliver Evans, of Philadelphia, Pa., who in 1786 applied to the Pennsylvania legislature for a patent upon the application of steam to the driving of mills and to the steam carriage. In 1804 Evans built a steam dredging machine for the city of Philadelphia, which he mounted on wheels and drove by its own engine from his shop to the river. The dredge was also fitted with a paddle wheel operated by the same engine, which successfully propelled the craft in the water. Owing to the poor construction of the highways steam carriages never came into practical use in the United States. In England, however, where the roads were much better, the steam carriage made considerable progress and by 1830 it had become a formidable rival of the stage coach. A regular running speed of twelve miles an hour was made by some of these carriages. But the strennous opposition of stage coach proprietors, coupled with the increasing success of the steam railroad, caused their gradual abandonment.

Tramways had come into use in England before this time for the purpose of transporting coal and ore from the mines to the seaport, and were operated by horses. In 1804 Richard Trevithick built the first locomotive for service on one of these tramways. The steam cylinder was placed vertically on top of the boiler and the motion was transmitted by means of very long connecting rods to outside cranks on the driving wheel axle. Trevithick did not succeed in bringing his engine into general use, however.

William Hedley, in 1813, built two engines for use in the Wylam colliery, which also worked satisfactorily. During his experiments he determined the hauling power of smooth wheels upon a smooth track.

To George Stephenson is accorded the honor of putting the locomotive into such shape as to secure its extended use. He built his first locomotive in 1814. In 1829 he brought out an engine called the "Rocket," which is the prototype of our modern locomotives. A horizontal boiler with smoke stack in front and cylinders on the sides, a separate car for carrying coal and water, short connecting rods and the delivery of the exhaust into the chimney, are characteristic features of the engine. The Rocket obtained a speed of 25 to 30 miles per hour and its success led to the extended introduction of railroads.

A second most important application of the steam engine is to the propelling of ships. As early as 1785 John Fitch and James Rumsey were engaged independently in building steamboats in this country and with such measure of success that they obtained patents from several of the states for the application of steam to navigation.

Jouffroy, in France, constructed a steamboat which did satisfactory work at a public trial in 1783. The government refused to grant him a monopoly, however, and Jouffory abandoned his efforts.

In England inventors were at work upon the same problem, and in 1789 William Symmington constructed a good-sized steamboat, which on trial made seven miles an hour. Ten years later Symmington constructed another steamboat, which was also successful, but the death of his financial partner prevented further progress.

Steam navigation on a commercial scale, however, had its origin in the United States. In 1807 Robert Fulton equipped the "Clermont" with steam propulsion and made the run from New York to Albany, on the Hudson, a distance of 150 miles, in thirty-two hours without the use of sails. The Clermont was almost immediately put into regular service between New York and Albany, and the construction of other boats undertaken.

Fulton is commonly considered to be the inventor of the steamboat. He was not the first to propel a boat by steam, as neither was Watt the first to construct a steam engine, nor Stephenson the builder of the first locomotive, but all of them are entitled to honor as having so combined the work of their predecessors with their own as to produce commercially valuable machines.

The first steamship to cross the ocean was the Savannah, which in 1819 made a trip from Savannah, Georgia, to St. Petersburg, Russia, and return, stopping at various European ports. The great difficulty experienced was in carrying sufficient coal for the voyage. It was not until 1838 that a regular steamship service was established across the Atlantic.

The remaining applications of the steam engine may be grouped under the general head of stationary steam engines. The common form of mill engine up to the time when George H. Corliss introduced the Corliss valve gear, was the still often seen slide-valve engine with throttling governor. In 1849 Corliss introduced the "drop cut-off," controlled by the governor. The saving in fuel was so great that Corliss frequently contracted to replace the old type of engine with a Corliss engine and to take as payment the saving in fuel for the first one or two years.

The necessity for more constant speed, demanded first by the application to cotton mills, and more recently and emphatically by the introduction of electric lighting, has had a great influence in determining the modern types of stationary engines.

The most recent progress has been along the lines of triple and quadruple expansion engines for slow speeds and large powers, and of compound high speed engines.

In conclusion it is interesting to note the effect which the conditions of its use have had upon the development of the steam engine. Compare the locomotive, the marine engine, and the stationary engine. In the locomotive the controlling conditions are great simplicity, extreme compactness and reversibility. In the marine engine the prime condition is economy. In the stationary engine it is speed regulation. Notice how each type of engine takes its form and proportions from these controlling conditions.

Old Transformers vs. New.

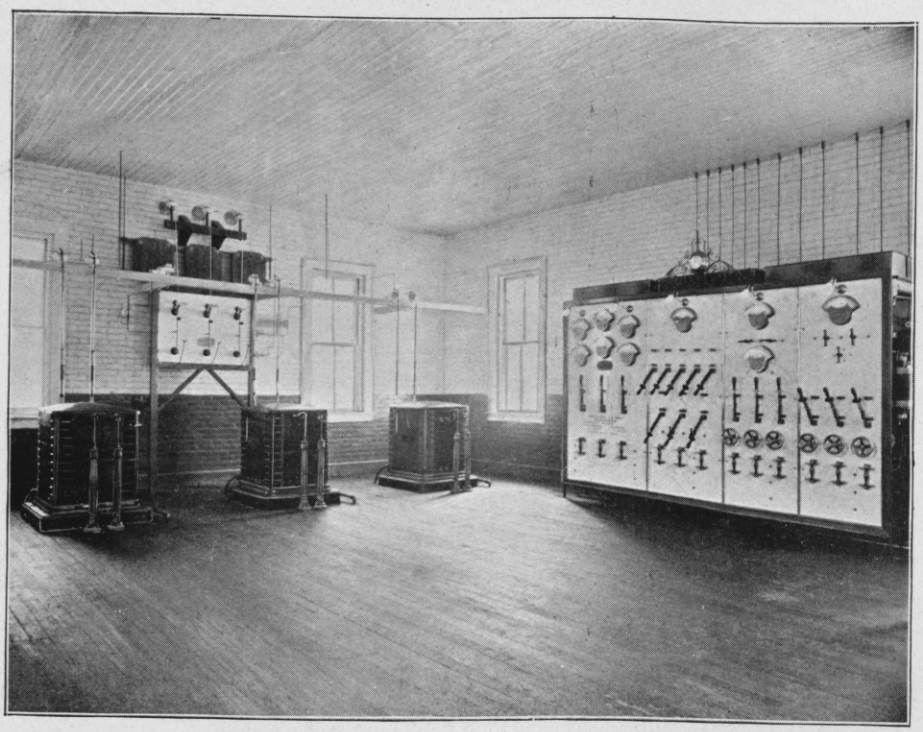
W. A. Layman, '92.

CENTRAL station men generally are just beginning to appreciate the very important element of transformer losses in the economic operation of alternating current systems of distribution. As a result many old transformer equipments are being consigned to the scrap pile, and entire installations of new apparatus of this character substituted. Justification for this action is clearly evidenced in data which follows.

Recently a change of transformer equipment was initiated by one of our very large central stations. As a preliminary step a total of 125 old transformers were taken down and very close measurements of both core loss and copper loss made. Summarizing the results, it was found that the total of the core losses was 10,839 volts, or energy sufficient for the illumination of 216 sixteen candle power lamps. The all day losses were 282,304 watt hours, calculated on a basis of two hours full load and twenty-two hours no load. The total losses within the transformers, including both core and copper losses, was 22,268 watts, or energy sufficient for the illumination of 445 sixteen candle power lamps. This loss, for a frequency of 133 cycles, is enormous.

It is proposed by the engineers in charge to install large transformers of recent design in place of these old and small units, in which the combined core and copper losses will be but 6083 watts or energy sufficient for the illumination of 121 lamps. In other words, the transformer losses by the exchange are to be reduced from 4 per cent. at full load to 1.1 per cent.

Our "statistician" has gone still further in his calculations as to the saving to be derived from the change and finds that the annual gain in dollars and cents, based on the company's cost for current per k. w. hour at the coal pile, to be $658. He also finds that this saving is 15 per cent. on the investment entailed in buying and erecting new transformers, paying freight on their delivery, restringing distributing circuits and substituting 100 for 50 volt lamps, assuming the old lamps to be worth 75 per cent. of the value of new lamps. The further assumption is made that the old transformers would have no scrap value and that the old wire taken out would be worth nothing. This latter assumption is manifestly unfair, as all this old material has a fair market value.

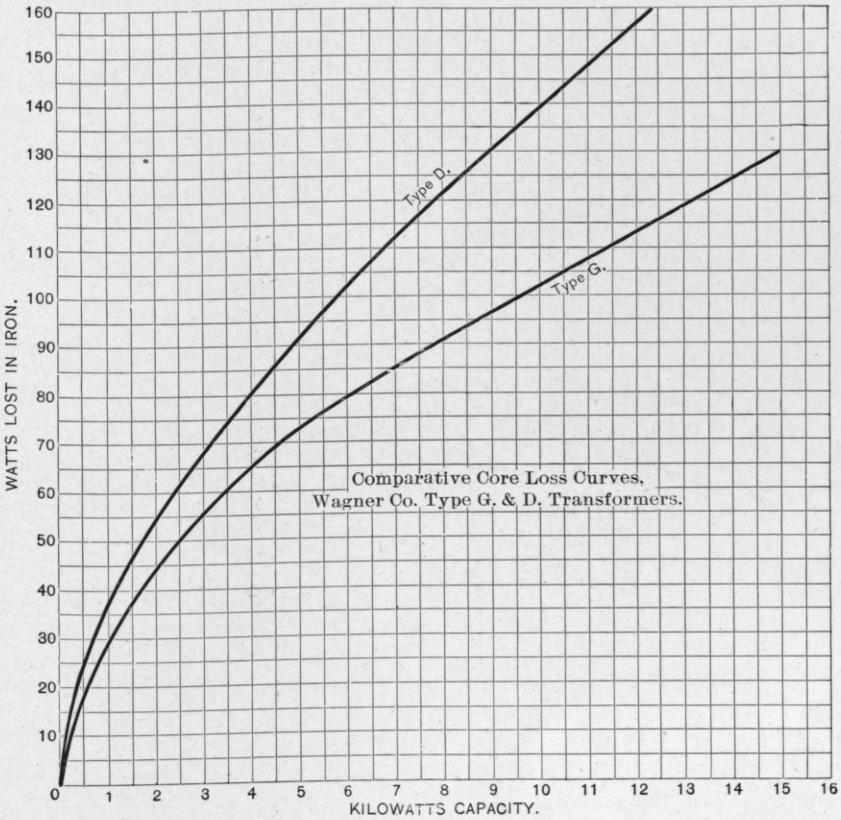


It is interesting to study the gains made, somewhat in detail, as shown in the table below:

	No. of Transformers.	Total Lights Capacity	Total Core Loss Watts.	Total Copper Loss Watts.	Total Losses Watts	All Day Losses W. Hrs
BLOCK NO. 1.						
Old Transformers . .	17	685	1,443	1,268	2,611	36,872
New Transformers .	2	600	216	480	696	3,555
Saving	15		1,227	788	1,915	33,317
BLOCK NO. 2.						
Old Transformers . .	12	865	997	1,350	2,347	26,016
New Transformers .	2	800	250	820	1,070	7,640
Saving	10		747	530	1,277	18,376
BLOCK NO. 3.						
Old Transformers . .	8	280	702	635	1,337	18,126
New Transformers .	1	300	108	240	348	3,075
Saving	7		594	395	989	15,051
BLOCK NO. 4.						
Old Transformers . .	9	400	627	722	1,349	16,502
New Transformers .	2	600	216	540	656	3,672
Saving	7		411	182	693	12,830
BLOCK NO. 5.						
Old Transformers . .	29	1,330	2,626	2,913	5,539	68,850
New Transformers .	2	1,000	330	730	1,060	9,380
Saving	27		2,296	2,183	4,479	59,470
BLOCK NO. 6						
Old Transformers . .	7	160	469	392	861	12,040
New Transformers .	1	200	82	165	247	2,298
Saving	6		387	227	614	9,742
BLOCK NO. 7.						
Old Transformers . .	9	435	884	865	1,749	22,946
New Transformers .	2	400	164	330	494	4,596
Saving	7		720	535	1,255	18,350
BLOCK NO. 8.						
Old Transformers . .	18	610	1,557	1,581	3,138	40,530
New Transformers .	2	600	216	540	756	6,260
Saving	16		1,341	1,041	2,382	34,270
BLOCK NO. 9.						
Old Transformers . .	16	695	1,534	1,803	3,337	40,422
New Transformers .	2	600	216	540	756	6,264
Saving	14		1,318	1,263	2,581	34,158
TOTAL FOR 9 BLOCKS.						
Old Transformers . .	125	5,460	10,839	11,529	22,268	282,304
New Transformers .	16	5,100	1,798	4,385	6,083	46,740
Saving	109		9,041	7,144	16,185	235,564

So much was to be gained in nine down town blocks. The same careful analysis for the entire system operated by this company would afford even greater satisfaction. As stated, the company's frequency at this time is 133 cycles. Subsequently this will probably be changed to 60 cycles. What the losses in the old transformers on 60 cycles would be one hardly dares guess. The writer has known instances where the leakage current on 133 cycle transformers has been the equivalent of full load current when they were tested on 60 cycles. It is not unreasonable to assume that such a thing might be expected with some of the old transformers in this case, as they have been in service many years.

Another interesting case of exactly the same character was developed in an Ohio city, where an entire equipment of old transformers was displaced. Without entering exhaustively into the results secured it is worth while to note how some of the old transformers compare with ones of recent design. Quite a number of 1000 watt transformers were found, the core losses of which were 75 watts on 133 cycles. A well-designed present day transformer of the same capacity has a core loss of but 24 watts. A few 2000 watt transformers ran over 110 as compared with 36 in the present day unit of same size, and so on through the list of all the sizes. Quite uniformly the losses ran from two to three times the present day losses.

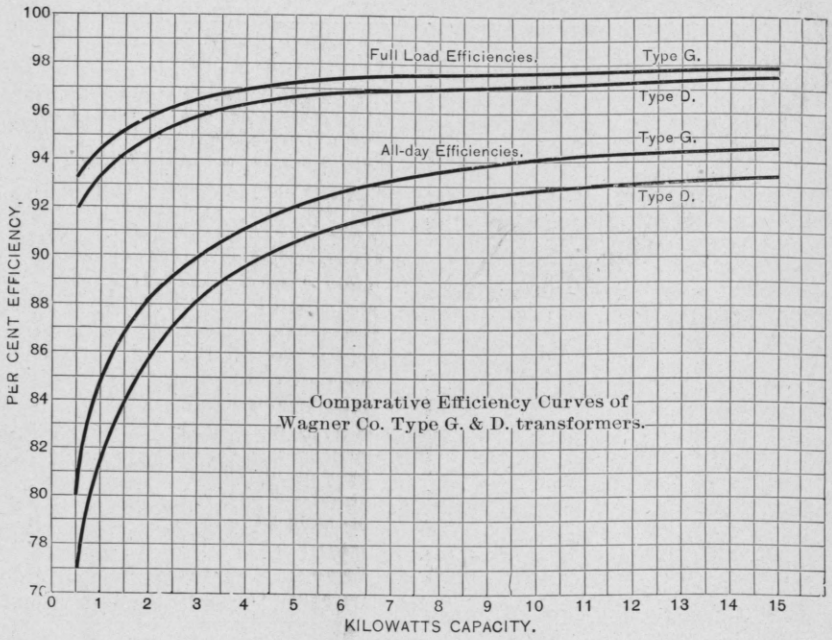


Comparative Core Loss Curves,
Wagner Co. Type G. & D. Transformers.

For a time transformer builders found few sympathetic listeners to their arguments for discarding old transformers for new, but now the tide has turned, and central station men are pressing exchange propositions on the manufacturers, endeavoring in the course of the negotiations which ensue to secure prices for the equipments to be scrapped, which are in some degree consolation for the extension of investment necessary.

To this point I have only referred to the actual difference existing between the new transformers and the old in the matter of total internal losses. There might also be mentioned in addition to the great differences in design a very vital difference in material. The old transformers were not so excessively bad when built as now. The "ageing" of their iron has also served to bring them into their present disadvantageous relation. There can be all the difference in the world between the quality of the iron used in the construction of transformers. This difference is not confined to the old as compared with the new. Quite to the contrary may it be said that some of the so-called transformers of today are worse in this respect than many of the old. For example, I may cite a report from a Wisconsin Central station, recently received, showing that the core loss in watts on a 5,000 watt transformer sent for test was seventy-three on April 20, '97. With no other load than its own leakage, this loss increased to 168 watts in less than one year, as shown in test made March 18, 1898. It goes without saying that this was in no sense a representative recent transformer.

As illustrating the development made by a single manufacturer of transformers within the last year, two curves are given herewith. One shows the core losses of a new high efficiency line as compared with the company's best line one year ago. The other illustrates the gain in



Comparative Efficiency Curves of Wagner Co. Type G. & D. transformers.

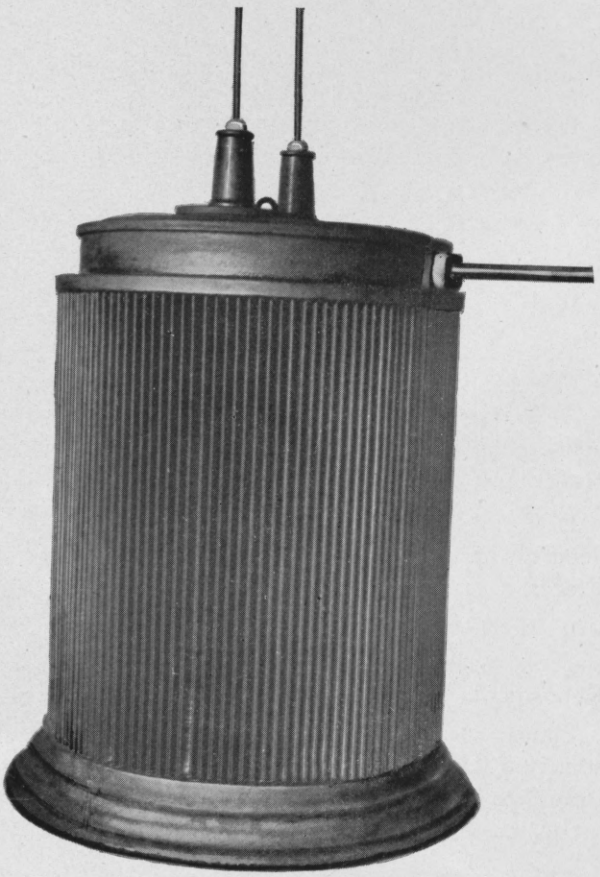
efficiencies resulting from this improvement in design. This great improvement has been secured without increase in the amount of material used, and represents, therefore, a real gain in design.

The writer desires to say in concluding this hurriedly prepared article, that he has endeavored only to present suggestive facts and not in any sense a discussion or argument concerning them.

Supplementary to the above it may be of interest to illustrate in THE TECHNIC the 500 to 40,000 volt 300 kilowatt transformers recently built by the Wagner Electric Mfg. Co. for the Telluride (Colo.) PowerTransmission Company. These transformers have been installed in Utah on the Provstransmission system and it is understood are giving excellent service. They are self-cooling units, having been so designed as to have a very large radiating surface. This large surface was secured by corrugating the cases as will be seen from the figure.

The transformers are oil filled, and were tested under full load for twenty hours. They were also tested for breakdown by the application of practically 70,000 volts to the high voltage winding. The 500 volt ends are brought out horizontally, the 40,000 volt ends vertically. They are grouped in delta on a three phase system.

Herewith is also presented an illustration of the transformer sub-station of the beautiful city of Riverside, California. This station is at the end of a 10,000 volt distributing system, the Riverside line of which is twenty-two miles long. The transformers in this installation are of one of the water jacketed types built by the Wagner Co. The cases are of cast iron, with vertical water channels on all the lateral faces. The water sup-



ply for cooling is derived from a tank upon the sub-station roof, and the flow is regulated by means of check valves in the ingoing and outgoing pipes. An interesting detail in the installation of these transformers is that they are insulated from earth by a three-foot rubber hose section in the ingoing and outgoing pipes, the cases proper resting on oak timbers boiled in gilsonite. This illustration is given for the double reason that it serves to show the marked contrast in this company's designs for high tension work for installation differing radically in character, and also to show a very neatly arranged transformer station.

ALUMNI NOTES.

J. M. Van Auken, '96, is assistant city engineer at Terre Haute.

A. G. Shaver, '97, is electrical repairman for the C. & E. I. R. R. at Danville, Ill.

H. J. Kilbourne, '94, is manager for the Shafer Acetylene Gas Generator Co., Terre Haute.

James Dale, '93, is secretary and general manager of the Peerless Amalgam Co., Denver, Col.

O. G. Hess, '90, holds the position of engineer with the Reymann Brewing Co., Wheeling, W. Va.

Wm. E. Burk, '96, is Vice President of the Shafer Acetylene Gas Generator Co., Terre Haute.

D. M. Roberts, '89, is president and general manager of the Indiana Construction Co., Terre Haute.

L. C. Anderson, '95, is in the manufacturing department of the Perfect Safety Paper Co., Franklin, O.

R. H. Moth, '93, holds the position of civil engineer with the Davy Burnt Clay Ballast Co., Kenosha, Wis.

Claude Ott, '92, is assistant engineer on construction of the Chihuhua & Pacific R. R., Chihuhua, Mex.

Charles H. Fry, '97, is assistant in the office of superintendent of motive power C. H. & D. R. R. at Lima, O.

E. F. Folsom, '92, is superintendent of pattern shop and foundry at the Brown-Ketcham Iron Works, Indianapolis.

Edward Walser, '96, holds the position of cyanide expert with the General Gold Extracting Co., Lim., Denver, Col.

T. L. Camp, '97, holds the position of mechanical and electrical engineer with the American Electric Vehicle Co., Chicago.

Geo. E. Wells, '96, is Superintendent of electrical contracting department of the Indianapolis District Telephone, Co., Indianapolis.

R. M. Newbold, '97, is the fuel inspector on the S. & N. A., and Birmingham divisions of the L. & N. R. R. at Birmingham, Ala.

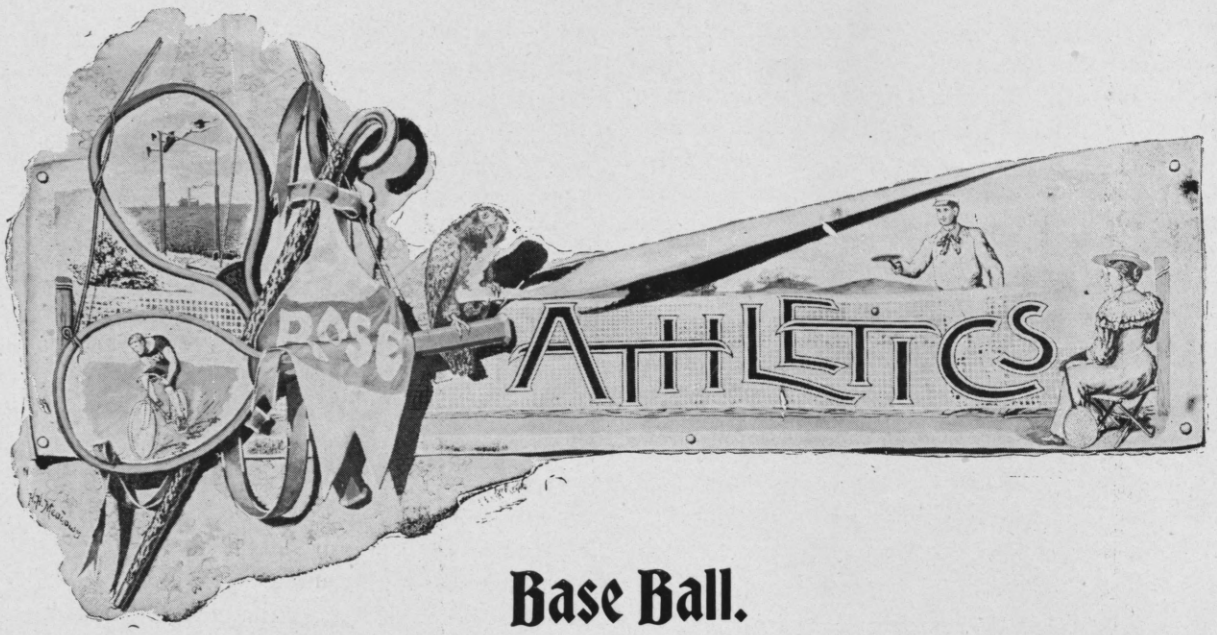
P. W. Klinger, '96, has in addition to the title of electrician, that of foreman of machine shop with Barney & Smith Car Co., Dayton, O.

The engagement of Miss Daggett of Terre Haute, to Mr. Harvey H. Meadows is announced. Mr. Meadows is a member of the class of '96 and is in charge of the southern office of the Babcock & Wilcox Co., Atlanta, Ga.

Hildreth, '94, is acting superintendent of the Vandalia shops, having taken the position left vacant by the resignation of McKeen, '89, who has assumed a position with the Prox & Brinkman foundry, of Terre Haute.

Mr. and Mrs. Crawford Fairbanks, of Terre Haute, have issued invitations for the wedding of their daughter, Miss Sadie, to Mr. Bruce F. Failey, for April 27th. Mr. Failey is a member of the class of '96 and secretary of the firm of the Blair & Failey Co., Terre Haute. James Farrington, '96, acted as best man.

Samuel S. Wales, a graduate of the Rose Polytechnic class of '91 and former resident of Terre Haute, was married at Youngstown, O., Thursday evening, April 7th, to Miss Olive Louise Leedy, of that city. Mr. Wales has a prominent position with the Ohio steel works at Youngstown, where he has been for the past four years.



Base Ball.

FOR three years there has not been so much interest in base ball as is being manifested by the men at Rose this season. Not only is there plenty of applicants for positions on the first team, but the second nine is also full to overflowing, and men must make an effort to hold their places even there. This state of affairs is truly out of the ordinary and has caused no small amount of delight to all those concerned in the welfare of the team. It serves not only as an encouragement to the first nine, but also renders them valuable help on the field of practice. It is only too true that some of the former teams have failed to awaken enough interest to get men to form a second team for practice. Not so this year, for everyone seems to be doing all in his power to make each evening's practice of the greatest possible benefit. Thus far several regular games have been played with the second team and in this way the men are receiving more team work and are making rapid progress at batting. This latter has been for several years a very weak point of Rose teams, and under the present methods of practice it is believed that much improvement will be noticed. From the present outlook there is every indication that the team will be a good one. Nearly all the men of last year's team are back and with several valuable additions from the Freshman class, the team is materially strengthened. A splendid schedule has been arranged, and if the men will give the team the support at the games that it deserves there is sure to be success for '98 base ball team. The schedule appeared in the February TECHNIC and every Saturday is engaged until June with several games in view after that. Although the men and their positions have not been definitely fixed, it is not likely that many changes will be made from that first decided upon.

Austin, '98, captain of the team, will hold his position of catcher. His reputation from last year's work at that position is quite flattering and there will be no lack of confidence in him this year. Trumbo, '99, is the only possible candidate for pitcher, and whenever "Jake" fails to saw them out or do his share of hard batting, it will be an off day for him. Freudenreich, '98, is showing up well at first and has made noticeable improvement at the bat over last year. Meriwether, '00, will play second and in all probabilities will fill the position well. He is especially strong at long and quick throws which, together

with his good judgment, will strengthen that part of the team. His batting qualities will stand, however, a considerable amount of improvement. Gibbons, '01, is a new man on the team and will put up a good game at third. He gives indications of being a hard batter and with more practice will be able to put the ball to first with speed. Wilbanks, '01, will play short stop, at which position he will be of good service. He is active on the diamond and a good batter and base-runner. Weatherhead, '01, will play left field and is also a good batter and a sure man in the field. Vorhees, '98, Kidder, '99, and Likert, '99, are known from last year's work to be reliable fielders and fair batters. A number of substitutes are also available whose services will be helpful in any emergency.

With these facts well known to nearly all the the men it is not surprising that there was discouragement felt on the part of those interested, that such a poor showing was made against the T. H. High School team on Saturday, April 9th, when a score of 14 to 8 was made in Rose's favor. The High School has a very good team for their class, but there was no excuse, outside of the fact that it was the first game, for the very poor playing by Rose.

Very little team work was done throughout the game and the number that struck out was beyond reasonable limits. The hits were mostly easy, the best being two base hits by both Austin and Weatherhead and a long hit by Gibbons. Against this the High Schools made one three-base hit, one two-base hit and several others of some importance. Rose made a large number of errors and in the sixth inning the men seemed to fly to pieces, got in each others way and kept one guessing whether they were playing base ball or not. The less said about this game the better and believing that it was not a fair test of their ability, it will be best to await future developments before refuting the first drawn conclusions.

FIELD DAY.

The coming field day, that is to be held at Indianapolis on Friday, May 20, is an occasion which should be looked forward to with much interest by every man at Rose. It is a day when a college man has a chance to give vent to his often suppressed feelings of school spirit and to support his school either by the skill and strength of his muscles, or by the proper use of his vocal organs in behalf of those who represent his interests.

Indianapolis is very conveniently located and there is no reason why the school should not turn out in a body, as was done in 1894, when Field Day was held at that place, and enjoy the pleasures of the day.

Rose will not be able to go to Field Day with the old time certainty of bringing home the pennant, but her chances are fair this year, and if the men will make a strong effort there is good reason to hope for success.

Rose stood second last year with 5 firsts, 3 seconds, and 6 thirds, making a total number of points of 40, and, although Shaver and Huthsteiner will be missed, still both the events—the mile walk and the pentathlon—in which they took first place, have been thrown out. The list of events are as good a selection as Rose could desire and if some of the Freshmen will show up in the short runs and in the hurdles, which are undoubtedly the weakest points for Rose, the chances would be far better.

Last year no place was obtained by a Rose man in the following events: 440 yd. run, 220 yd. run, 16 lb. shot and standing broad jump, while Huthsteiner was third in the 100 yd. dash and Brachmann third in 120 yd. hurdles.

The number of events has been considerably reduced this year and there is no reason why Rose should not be represented in each event by at least one man. As a large number of entries insures better success, each man should make it his duty to see what he is able to do and begin training immediately. The preliminary Field Day will be held very soon and in order that the best selections can be made, every man should find himself ready.

The running track will soon be put in good condition and all the apparatus will be set out

for use, and there is every reason to believe the campus will again assume its usual state of activity.

Below are given the various records for the different events of the coming Field Day:

Event.	Professional.	Amateur.	I.I.A.A.
120 Yd. Hurdles..	.....	:15⅖	:17
Half Mile Bicycle.	:58⅘	1:00⅕	1:07⅗
100 Yd. Dash	:09⅘	:09⅘	:10
1 Mile Run.....	4:12¾	4:15⅗	4:47⅘
440 Yd. Run.....	:48¼	:47¾	:53⅗
1 Mile Bicycle....	1:50⅖	2:00⅖	2:41
5 Mile Bicycle....	9:05⅗	10:48⅖	14:38⅘
220 Yd. Run.....	:21⅗	:21⅕	:23⅕
220 Yd. Hurdles..	.....	:24⅗	:27⅘
880 Yd. Run.....	1:53½	1:53⅖	.....
Run'g Bd. Jump.	23 ft. 3¾ in.	23 ft. 6½ in.	20 ft. 10 in.
16 Pound Shot...	.....	48 ft. ½ in.	39 ft. 5 in.
Run'ing High J'p	6 ft. 6½ in	6 ft. 5⅝ in.	5 ft. 6 in.
16 lb. Hammer ..	....	156 ft. 4 in.	109 ft. 5½ in.
Pole Vault	10 ft. 10½ in	11 ft. 9 in.	9 ft. 11 in.
Stand'g Bd. J'mp	14 ft. 11½ in.	10 ft. 11½ in.	10 ft. 8 in.

R. P. I. vs. VAVDALIA SHOPS.

On Saturday, April 16, Rose Tech played her second game of base ball of this season and quite redeemed herself from her poor showing of the Saturday previous. The fondest hopes of the enthusiasts were almost entirely gratified by the way the men handled the ball against the Vandalia Shop nine, and although the score stands against her, the game was decidedly in Rose's favor from start up to the ninth lnning, and it is generally admitted that if there had been a due degree of fairness on the part of the umpire, the score would not have been a tie at the end of that inning. The game was, however, far from being one sided and there was no time when the keenest interest was not felt, and at the end of the ninth when O'Dell made a three-base hit bringing in three men on bases, whose runs tied the score, the excitement knew no bounds. The tenth inning passed and no change was made in the score. The first half of the eleventh and still the same, but when the Vandalias came to bat the spell was broken and several good hits were made and the requisite score that broke the tie.

The Vandalia Shop men are splendid players and it is a credit to Rose to have made such a showing against them. They handled the bat well and it was encouraging to see the number that Trumbo struck out.

Rose started out with confidence and kept things lively until the seventh inning, allowing only one run from the Shops while bringing in five herself. In the seventh several errors were made which brought in three runs for the Shops. Then things ran evenly until the ninth when the turning point of the game took place. There was one out with Gibbons on second and Austin at the bat, when Austin knocked a ball into left field, bringing in Gibbons and reaching third himself. The ball was fair by only a small margin but the umpire rendered his decision before looking carefully into the matter and would not change it later. The men were much ruffled at the show of unfairness which reached the climax at this point. After that the Vandalias had the advantage, bringing in three runs in the same inning and winning the game later.

Although there was a number of errors made by Rose the playing was what could not be other than approved. Trumbo pitched a splendid game and kept an eagle eye on the bases. Austin held his position behind the bat perfectly secure and reduced the stealing of bases to a minimum. He also did some hard batting. Freudenreich has made wonderfnl improvements in all round playing, and unless the others watch out he will be heading the batting list. He made three hits out of four times at the bat and secured the batting record of the day. Gibbons made some hard hits and great confidence is being placed in his batting ability. Wilbanks played a good game, making a two-base hit in the fourth inning and keeping careful watch on short stop. Vorhees did some fine fielding in left field and made a fine throw from that position putting a man out at home. Meriwether made several good plays at second but lacks confidence at the bat. Likert, Weatherhead and A. Kidder each made several good plays, and taking the team as a whole Rose can make a splendid showing against any of the

teams that are scheduled for games with her this season. Now let every man lend his support at all the games and "root" for the Old Rose and White.

R. P. I.	VAN SHOPS.
Wilbanks, ss.	Jewett, rf.
Trumbo, p.	Shearns, c.
Gibbons, 3b.	Hauer, cf.
Austin, c	Werker, lf.
Vorhees, lf.	J. Shannon, 2b.
Kidder } rf.	O'Dell, ss.
Weatherhead }	Teightman, 1b.
Likert, cf.	O'Connell }
Freudenreich, 1b.	G. Shannon } p.
Meriwether, 2b.	S. O'Dell, 3b.

	1	2	3	4	5	6	7	8	9	10	11	Total.
R. P. I.	1	0	1	1	2	0	0	2	0	0	0	7.
Van Shops.	0	0	1	0	0	0	3	0	3	0	1	8.

Struck out—by Trumbo, 12; by Shannon, 6; by O'Connell, 6. Base on balls—by Trumbo, 7; by Shannon and O'Connell, 7.

Time of game, 2 hrs., 50 min.

Umpire, Robinson. Scorer, McLellan.

ATHLETIC DIRECTORS' MEETING.

A meeting of athletic directors was called on March 14th. The principal business of the meeting was to provide for the election of a base ball captain. It was decided to hold the election on the following Saturday morning between the hours of 9 and 11:15. The base ball manager was instructed to post a notice to that effect.

A committee of three, consisting of the president of the association, the base ball manager and base ball captain, was appointed to purchase base ball suits for the team.

The final business of the meeting was to elect Jumper, '99, to the position of track team manager, left vacant by the resignation of Lansden, '98.

NOTES.

The base ball team is to be supplied with new uniforms. This is a much needed action and judging from the rapidity with which the subscriptions were handed in it was in harmony with the entire student body. The color decided upon was steel blue for the suits and caps, with maroon and white stockings. The letters ROSE will be placed on the suits in red letters, and red stripes will encircle the caps, making in all a very appropriate combination.

The track has received its first rolling and after some subsequent treatment will soon be in good condition. The tennis courts are also soon to be rolled and marked off.

On March 12th the hand ball tournament was finished. The Senior team was defeated by that of the Junior class and the Freshmen failed to appear. The score was as follows:

Austin }			
Stilz }	21	15	18
Howell }			
Davis }	4	21	21

On March 19th ballots were cast by the men on last year's base ball team for the election of a captain for the coming season. Austin, '98, was elected.

Engraving by Process.

J. M. Lansden, Jr., '98.

CONCERNING the Arts of illustration, reproduction and engraving mechanically, the photographic process is the most modern and might well be called the usual method of illustration, although there are in general use numerous other processes, which are applied to certain branches other than those in common with our ordinary engraving. There are few people who at some time or another, have failed to notice the extraordinary growth and development, in so brief a time, of this art of illustration, simply in the comparison of the illustrated magazines and periodicals of to-day and those of five or ten years ago.

One reason for this may, perhaps, be due to the artist's or delineator's more general knowledge of the methods of reproduction and also the knowledge of the engraver's requirements for his more skillful and accurate work. On this latter subject much might be said, for oftentimes the beauty and worth of an original and an intended effect perhaps, is entirely lost, owing to the insufficient knowledge of the workings of the process, in the breaking down of contrasts, and the running together or even the losing of certain lines and parts. I will not dwell upon these points, for they are embraced in the art of drawing for reproduction, and in what is to follow, it may be supposed that the engraver or process man has to deal only with standard "copy." There are, of the engraving processes. two kinds, the *intaglio* and the *relievo*. The *intaglio* signifies a plate on which the image is *in*graved and is used in the same manner as etchings and steel engravings, for the photogravures and heliogravures. These last named were brought out soon after the invention of photography in 1834, and have always given excellent and beautiful results, but as they are exceedingly slow and also very expensive to produce, they are not commonly used for our every day, practical illustration. The *relievo* plates—on which the image stands in relief, the same as that of type—were used as early as 1860 and are now the basis of modern illustration and printing. I will first describe the general processes, by which these *relievo* blocks are prepared for the reproduction in "line" (where the image is represented by lines of different width and nearness, but of the same color) and the "tone" or "half tone" process, where the tints or gradations of color vary evenly from the lights to the darks.

The foundation of nearly all of these methods is the fact that gelatine or albumen, sensitized with bichromate of potassium or ammonium, will be made *insoluble*, after being acted upon by light. Another basis used quite commonly is a solution of bitumen in benzole.

There are three processes used for line reproduction; namely, the swelled gelatine, albumen

and bitumen. In the swelled gelatine process, a solution of hard gelatine, a small amount of sugar and chrome-alum is prepared. This is the stock solution for first coating the glass plates by covering them smoothly and evenly with the mixture.

The drawing or sketch to be reproduced is now photographed to the desired size, either reduced or enlarged, as the case may be. In ordinary practice the picture is reduced from one-half to a third size and thus, a drawing is mechanically smoothed in the appearance of its lines and points, rendering a much more finished picture. The plate now exposed is developed and fixed as usual. However, in the development the most prominent contrasts that can be obtained must be brought out, for throughout the remainder of the process there is always a lessening of the contrast values.

One of the glass plates prepared with the gelatine film is then sensitized in a solution of

Bichromate of potassium	1 ounce
Water	10 ounces
Alcohol	6 ounces

With this solution, the effect is to cause the parts of the film, struck by light, to be insoluble or rather non-absorbent. The negative obtained above is then placed in contact with the sensitized film, which is previously dried and the two exposed directly to the light, until the image is seen clearly through the back of the film. Then the film is placed in clean, cold water and the result is to swell up the parts which have not been acted upon by light, and the image, now an *intaglio*, is represented by the non-absorbent parts of the film. After swelling, a mould of plaster of Paris is taken, and then from this, a wax mould is made, which becomes also an *intaglio*. From the wax mould an electrotype is made and backed with type metal and the whole made type high. This now is the finished block, a relievo, and ready for printing. The swelled gelatine process, then, as just described, is the favorite with the artist, as it will give most accurately the delicacies and expressions of his original; but not so with the process man and publisher, for it requires the utmost skill and, indeed, a considerable expense in the operation.

The next two of the three principal line processes are the albumen and bitumen, commonly called "zinco" line processes, are being the means by which nearly all of the newspaper and cheaper blocks are made and are not so careful in the various points of execution, which in reality could be reached only by the process of the swelled gelatine.

The metal plates in the "zinco" processes are made of an alloy composed of zinc with a small quantity of tin, which makes them extremely hard, less brittle and therefore less liable to wear. These plates are cut to various sizes and rolled to a thickness of one sixteenth to one-eighth of an inch, and to a smooth surface, then cleared of all grease, irregularities, etc., and highly polished.

In the albumen process, a zinc sheet of the desired size is coated with this solution, carefully filtered:

Albumen of one egg.	
Saturated Solution of Bichromate of Potassium	1 ounce
Water	7 ounces

The sensitized zinc plate is now dried over a spirit lamp and is then ready for printing from the negative of the subject, as was performed in the swelled gelatine operation. The plates are exposed to direct sunlight for five minutes. After exposure, the plate is removed to the dark room and covered with a thin layer of transfer ink, spread on evenly by the use of an ordinary printer's composition roller. The ink is not affected by the acids that are used in the etching, and is commonly composed of beeswax, soap, lithographic ink and shellac. The plate thus exposed and inked is developed simply by immersing in water. The surface is gently rubbed, after the plate is thoroughly soaked, and the portions of the entire film, unaffected by light dissolve away, leaving the bare zinc in the background and an image, in relief, in ink. When the details are fully developed the plate is washed, allowed to dry and is then ready for the etching processes, which will further on be de-

scribed. The albumen method, as just given, is largely used for the rougher class of work, or where the reproduction is not, when finished, filled with an abundance of fine lines. It is also more suitable when the exposure and printing has to be done by electric light, the sunlight not being available always, and in addition, to the demands of business. This process is by far the quickest and most economical of the photographic methods, the finished blocks costing from five to seven cents per square inch.

I may mention now that in nearly all engraving establishments in this country, the exposing and printing is done entirely by electric light, thus making the times of exposure a known factor to give the desired results.

The remaining line method of the three is the bitumen process and is best adapted to fine lined and complex subjects and to the production of cuts, which are to be of the very best. The operation in this case is similar somewhat to the albumen process. The sensitizing solution is prepared by treating the powdered bitumen or asphaltum with ether, which dissolves out the constituents that are not sensitive to light. After these are thoroughly dissolved away, the residue is dissolved in benzole, in the proportion of one to thirty. The operation is carried on in the absence of white light, as soon as the ether has evaporated from the above residue. The zinc plates are now cut and polished as before and coated with the sensitive solution just made. The film should be as thin as possible for the reason that the bitumen mixture is much slower to print with than others, and in noticing an ordinary zinc plate, thus coated, it would be only by a very close examination that such a film could be detected. The subject negative as was made for both the swelled gelatine and albumen processes is now used to print from with the bitumen and an exposure of ten minutes in the sunlight and two or three hours in the shade, is given. The exposed plate is now put in the tray and sufficient turpentine is poured over it to cover the surface. The tray is rocked and the image gradually becomes outlined, and the parts which were not acted upon by the light gradually wash away. When the development is carried to the correct point, the plate is washed, leaving a perfect image in the film with a zinc background. It is then placed in a weak solution of nitric acid and this soon etches or "bites" the zinc deep enough to allow the transfer ink to be put on the film image with the roller, without covering the bare zinc which was exposed by the dissolving of the unaffected light portions. After inking the etching processes may be gone through with until safe enough for printing.

The difference between the albumen and the bitumen processes may be seen here. In the case of the albumen, the whole film is inked before any etching is done, but with the bitumen the etching is started and the image inked, thus giving every possible chance for each line to reproduce to the exact size and appearance of the relief image on the film; whereas, with the albumen, with similar subjects, the lines would most certainly be distorted and misplaced by the necessary careful working over of the transfer ink, which is to prevent the acid from destroying the film image.

The etching operations as are generally performed by the larger engraving concerns may be briefly deseribed as follows:

The metal plate, having the film or ink image on its surface, is first varnished or covered with on acid resisting mixture, on the edges and the back and then put in a dilute solution of the etching acid, which is usually nitric or hydrochloric. An oxide at once forms on the exposed surface and is brushed away with the "etching" brush, so as to hasten the action of the acid solution. The plate is only etched to a very slight depth because there is danger of "under etching," which is the attack of the acid on the metal directly beneath the film or image lines, thus causing an incorrect and ragged line. When etched to the proper depth, the plate is washed and prepared for the second bath. For this preparation the plate is carefully covered with the "etching" powder and tilted in several directions, allowing some of the powder to adhere to the

sides of the relief lines formed in the first etching and allowing the surplus powder to fall from the plate. The plate is lightly dusted to remove the powder sticking to open parts of the etching, and then given a gentle heat, which melts the etching powder on the sides of the lines, so as to form a layer, impervious to the acids, thus keeping the plate safe from "under etching." The plate remains in the bath until etched about twice the depth given in the first bath, and then washed. The preparations for the third bath are made in the same manner as for the second etching, and this time much stronger acid solution is used and the depth of etching carried much further. When etched deep enough along the sides of the relief lines to print clean, the plate is well washed and taken to the routing machine used for cutting away those parts in the open spaces, that are liable to print, owing to the heavy pressure given by the printing machine. The plate is then tacked on a wooden backing, trimmed, lined and made type high and is now a finished block, ready for the printer.

In many line reproductions, parts will be noticed filled with an even shade or tint, composed of lines, dots or figures regularly spaced, which give to the picture a very desirable and effective appearance. These "shading media" are used where a large space is to be evenly toned and, were it done otherwise, it would be an endless task for the one who undertakes to accomplish the effect; besides this economy, it produces, as was said before, an excellent and desirable result. There are numerous designs and patterns used to produce this shading which are engraved on sheets of transparent gelatine. When the zinc plate is ready for the first etching, then the gelatine sheet of the proper pattern is taken and inked with transfer ink. The sheet is now pressed on the part that is to be shaded, leaving the little ink dots or lines on the plate wherever desired. These ink figures resist the acids used in the etching, thus leaving in relief the design which was selected. The fact that these sheets are transparent enables the process worker to apply them easily and readily and also to many complex subjects with considerable skill.

The processes above described, all relate to line reproductions, or where the tones and gradations are given by lines of different thickness and nearness, or by hatching, stipple or spatter-work. But where smooth or even gradations of color are to be produced, such as those in a photograph or wash drawing, a radical change is brought about in the process.

This change was the evolution of the half-tone process, and consisted merely in the interposition of a screen plate between the object and the negative — when making the photographic copy — for the purpose of breaking up the half-tones in the photograph or subject into small dots or points, thus representing the deep shadows by dark points, closer together, or heavier and more numerous than those which indicate the grays and lighter shades. From this, then, it will be seen that there are no parts entirely black and none perfectly white. The screen plates most suitable for this work are prepared by coating a glass plate with a mixture of rubber, asphalt and turpentine and ruling them with a wood engraver's machine. After they are ruled the glass is etched with hydrofluoric acid and the resisting mixture then removed. The lines etched by the acid are filled with a good ink and we have now a transparent screen, crossed by a large number of fine lines. The lines are ruled parallel and at right angles to each other, usually from 120 to 240 lines to the inch. When the copying camera is in position, the screen is placed in contact with the sensitized dry plate, and the exposure is the same as for line work. The negative, when developed, is found to be covered with a great number of parallel or intersecting lines, which are perfectly transparent when held to the light. The next step is to print the picture taken, on the zinc or copper plate which is to be used for the block, and this is always done by the bitumen process. The albumen method is used for the coarse screen work only.

After the metal plate is prepared with the bit-

umen film a print is taken and developed in the the turpentine bath and it is then ready for etching. In this process the etching or cutting down is so slight that a very short time suffices to bring it to the right point, and the same precautions are observed as in the line etching. When the plate is carried far enough, it is washed well and after being trimmed and backed is then a completed block.

The metal used most commonly for the half-tone process is copper, and instead of nitric acid for the etching bath, a solution of perchloride of iron is used; it etches copper more quickly and there is no danger of dissolving the film, image or print. Where zinc is used, an electro-plate of nickel or copper is given, to insure it against the action of certain printing inks.

There is one kind of half-tone cuts, called a typogravure, where no screen is used for breaking the tones. The breaking up is accomplished by giving the metal surface an appropriate grain or ruling before it is printed upon, thus producing, when etched, a like appearance to the screen half-tone. With these kinds of blocks, some beautiful results and effects have been obtained, there being a peculiar style, softness of outline imparted that suggests nothing mechanical whatever.

With all these processes, every engraver has his own schemes and short cuts to suit his tastes, and to satisfy demands, but the above principles are adhered to in general, wherever modern engraving is practiced.

The printing from the block is the next thing to be considered, and it is found that there are as great a variety of methods in use as there are methods of engraving. A block is put into the hands of a pressman who obtains an excellent print, while the same block in another printer's hands, produces nothing more than a miserable failure. This is particularly the case as regards half-tone printing and oftentimes to the engraver is attributed the fault. Printing has advanced proportionately with the art of engraving and it necessarily follows that for proper results, the printer should keep abreast of his own art of printing, as well as those advanced ones concerned with engraving.

In the art of illustration, a most important step taken in recent years was the development of the process of engraving and printing in colors. Until very lately nearly all of the color reproductions were done by lithography, where almost as many impressions are taken as there are colors in the original, but now the "color" processes are being commonly used, in which only three or four colors are combined to reproduce almost exactly the original color subject. A "three-color" process, roughly described below, combines the three colors, red, blue and yellow, which, alone and combined, compose most of the colors in nature. Then to reproduce a natural view with a variety of colors, we will first separate the reds, the blues and the yellows. By photographing through a red screen, which allows only red light to pass through, we get a negative with different shades, which represent different patches of the red color in the subject, and the varying amounts of red color are represented by the proportionately varying intensities of the negative film. So, wherever there is any other color than red, or its shades, the negative film at that point is the least intense. The same operation is gone through with a blue and a yellow screen, and then on the respective negatives we have also the blues and yellows represented by the varying intensities of the film. Now, in order to produce these varying intensities for printing, we must adopt some half-tone method of engraving suitable for the purpose. Thus, to break up the different intensities, we must use a screen plate in making the exposure through the red, blue or yellow screen, and each time the rulings of the screen must be differently directed. Suppose the rulings are parallel and on the red screen are inclined 30° to the right of the vertical; on the blue, vertical; on the yellow 30° to the left of the vertical. Then from each of these negatives a positive is taken and from this is made an engraved plate from which to print. The yellow impression is given first, then the red, and last, the blue. The result gives a reproduction in

colors, truly remarkable, and very nearly an exact copy in the original colors. The print will be composed of intersecting lines of red, yellow and blue, and at each intersection a dark point is found, but which is so small that the "graying" effect is almost nothing. After the three plates are prepared much depends on the shades of the different colored inks used, but by practice the true primary colors are soon attained. Thus far, the color processes have most simply provided a means for natural color illustration—something that direct photography has not, as yet, been able to do; but photography has provided the basis for all modern engraving, without which the endeavor to bring thoughts into the mind by actually representing, better than by writing or printing,—the Art of Illustration—would result only in an insignificant advance.

THE LECTURE COURSE.

Professor Kendrick delivered the sixth lecture of the series March 23d. His subject was "Michael Faraday," the treatment of which was necessarily quite different from any of the previous lectures. Professor Kendrick did not attempt an eulogy, but rather to awaken the students' interest in the efforts, methods and accomplishments of great scientists, confining his paper, however, to the one man.

Michael Faraday was born a blacksmith's son, near London, September, 1791. When thirteen years old he was apprenticed to a bookbinder, and even then showed a disposition for study in scientific directions by his persistent efforts after working hours. In 1812 he obtained admission to the electrical and chemical lectures of Sir Humphrey Davy, and was soon after engaged by him as his assistant at the Royal Institution. In 1827 he succeeded Sir Humphrey in the chair of chemistry. Among his notable discoveries were new compounds of chlorine and carbon, alloys of steel, compounds of hydrogen and carbon, the manufacture of glass for optical purposes, and many new facts regarding electrical and magnetic phenomena.

Indeed, there is very little of all of our vast electrical work as practiced today, the principles of which were not known to Faraday. England and the Royal Society repeatedly recognized his greatness by very flattering offers and nominations, but he preferred to remain at his post of duty. He died in August, 1867,—a simple man, and yet one of the most distinguished chemists and natural philosophers of the nineteenth century.

MEETING SCIENTIFIC SOCIETY.

The monthly meeting of the Scientific Society was held March 18th. The president called the meeting to order at 7:40 P. M., and the minutes for the previous meeting were read and approved. No business was brought before the meeting and Lansden, '98, was asked for his paper on "Engraving by Process," which was highly appreciated by the audience.

Owing to sickness Schwed, '99, was unable to read his paper before the meeting. Dr. Mees then addressed the society on "Electrical Oscillations and their Practical Applications." He was closely followed throughout the address and the interesting subject was enjoyed by all, especially the electricals. A lengthy discussion followed and the meeting adjourned at 9:30 P. M.

THE CAMERA CLUB.

The April meeting of the Rose Tech Camera Club occurred Friday evening, the 8th, at the Y. M. C. A. rooms, about ten members being present. The minutes of the previous meeting were read and approved, and then the evening's programme was opened by the submission of pictures of "A Terre Haute Building." Several pictures were presented, among them one of the Minshall residence by Miller, '01, the Heminway residence by Schwartz, '01, and two of the Union Depot by Schwed, '99, and Kidder, '99. The honors were awarded to Kidder, Schwartz and Miller, respectively. These pictures are on exhibition in the club's case at the Institute. Instructor McMeans presented a paper, "Photographs versus Souvenir Spoons," an exceedingly interesting and appropriate paper. The paper

included the American's fondness for relics and souvenirs, the photograph being the most suggestive and artistic of all. Personal reminiscences and experiences, supplemented by suggestions to the uninitiated, were indulged in and proved very natural to the trials and tribulations of the amateur photographer. Pfleging, '00, gave a well prepared review of the current photographic journals. The programme closed with discussions and an inspection of the large album of Mr. McMeans. The next meeting will be held May 6th, with the following subjects for the pictures to be submitted:

"A Mechanical Detail."

"A Photographic Novelty."

"Student Life."

'98 THESIS SUBJECTS.

"Locomotive Boiler Test, with Determinations of Relative Heating Power of Different Alabama Coals and Effect of Different Arrangements of Draught Apparatus." A. C. Eastwood, Claiborne Pirtle, Brent Wiley and J. M. Lansden, Jr.

"A Coal Conveyor for the Wabash Flouring Mills," N. S. Kidder.

"Test of Pumping Plant of the Terre Haute Water Works Co.," W. F. Freudenreich and F. A. Whitten.

"Central Station Test at Galesburg, Ill.," J. E. Hubbell and M. B. Stewart.

"Electric Welding," H. B. Stilz and K. E. Voorhes.

"Design and Specifications for the Change of a Cable Railway to an Electric Conduit System," F. C. Brachmann.

"The Proximate Analysis of Coal," N. M. Austin.

"A Bridge Design," S. S. Roberts and W. E. Ford.

"Design of Elevated Crossing for the Big Four and C. & E. I. Railroads North of the City," Cale Walmsley and J. T. Montgomery.

"Determination of the Proper Temperature for Tempering Steel," Thomas Fletcher.

"Investigation of Alternate Current Motors in Use at Terre Haute," C. E. Theobald.

"Electric Resistance of Various Substances in Solution Under Different Conditions of Temperature and Density of Solution," Charles Kloer and Gustave F. Kloer.

"Efficiency and Breaking-down Point of Commercial Insulating Materials," W. B. Ryder, Jr. and F. W. Schneider.

DOTS AND DASHES.

The telegraph line is now in complete working order and the operators are in full readiness to receive and send all war news. Those desiring to be cut in should notify the superintendent at once. By applying to the president or superintendent prices can be given on instruments at a good discount.

At a meeting held April 13 the following officers were elected to serve for the coming year:

President—H. S. Richardson, '00.

Secy. and Treas.—R. K. Rochester, '01.

Supt.—W. C. Appleton, '00.

Asst. Supt.—B. Shepard, '01.

At the next meeting of the directors, plans will be formulated for the reconstruction of the entire line. The line will also be divided into districts, with one director in each district. All trouble and changes will be reported to the director in charge; who will report the same to the superintendent.

By the next issue of the TECHNIC definite plans can be given. Among the new members are Rochester, Kittredge, Shepard, Osborne and Jumper. Remember the old expression: "*Don't leave your key open.*"

NOTES.

Quite an addition has been made to the library in the form of a large double steel framed bookcase, reaching from the floor to the ceiling, and extending the full length of the south alcove, giving room for about three thousand volumes. This change has been much needed, as the crowded condition of the shelves indicated. The work of re-arranging and cataloguing the books

is almost completed, and the new space and distribution of the books in sections, will greatly add to the ease and convenience with which a desired volume can be found. The arrangement of the reading room has also been changed, giving more room and better light.

The annual catalogue is to be supplemented by department pamphlets representing the five courses now offered by the Institute.

These pamphlets will contain extracts from the catalogue pertaining to each course, and in addition many notes and explanations that will give a more general idea of the aim and work of each department. Another feature which will add much to their usefulness, will be a number of half-tone views of buildings, campus, interiors of the different departments, apparatus, and special machinery. The excellent photographs from which these views have been made are the work of Professor Peddle. The pamphlets are to be sent out with the catalogue to those desiring information concerning any one of the courses or departments. They will no doubt be of great service to prospective students as a clear idea of the future work will be given, as also of the building and grounds which he hopes to make his home for the next few years.

Dr. Mees spent part of the vacation at his home in Columbus.

Student in laboratory: "Mr. Shepard, I am broke as to test tubes."

The Freshmen are using the first chapters, in pamphlet form, of Professor Hathaway's new work on Calculus.

"Now if you take a line like this, which cuts the curve where it does not, you will get two imaginary points."

Professor Howe's new cement testing machine for the department of Civil Engineering has been completed in the shops.

Eastwood, '98, spent the vacation in Decatur and Birmingham, Ala., making the final preparations for his thesis work.

Mr. McCormick suggests that the equation of that curve known as the human profile might be called one's personal equation.

Mr. Charles Shields, of the R. P. I. shops, and Miss Eliza Willis were married April 14th. We extend "Charlie" our best wishes.

Thesis work will begin on May 4th and continue for six weeks. The general arrangement and disposition of work will be the same as last year.

The campus presents a shorn and airy appearance in consequence of the tree trimmer's visit. The library, too, has been overhauled and rearranged.

The Juniors are supplementing their work in calculus and analytical mechanics by a course in Perry's Calculus for Engineers. This work deals with the practical application of calculus to engineering problems.

Professor Gray delivered a lecture at the Terre Haute Science Club meeting held in State Normal hall on Friday evening. His subject was "The History and Development of the Electric Telegraph."

Freshman, just before an examination: "I'm afraid Mac's going to soak us today." Sophomore: "I hope he doesn't expect to get much on such collateral."

The instructors must think the Freshman intellect is going into a decline. The latter were informed the other day that "page six comes just before page seven."

Mr. Harris has made a new departure in shop work. Printed cards are distributed among the students and they are expected to keep a record of their work upon them.

The Thesis subjects have all been submitted and approved, and after the degree examination the first week in May, the Seniors will be occupied solely with their chosen subjects.

Mr. McCormick, in speaking of a problem, says, "It will all come out in the solution." We understand this as a polite and elegant paraphrase of an older and more plebeian expression.

Work has been commenced on the 20-foot model of a draw bridge. This is a working model of one-eighth size of a modern draw bridge to be used in the Civil Department.

At the last business meeting of the Y. M. C. A., the following officers were elected:

President—J. F. Schwed, '99.

Vice President and Corresponding Secretary—Hugh L. McKibben, '01.

Secretary and Treasurer—Arthur L. Kittredge, '01.

W. H. Insley, '00, rendered his report of the Cleveland convention.

Those desiring copies of the excellent pictures of the Institute, which Professor Peddle has prepared for the pamphlets, may obtain them from the Registrar, the large ones at 25c and the small at 20c.

A new wide angle photograph lense was purchased for the department of drawing, to be used in photographing the buildings and interior for the new department supplements, to be sent out with the catalogue.

Professor Faurot: "You will take for your next lesson in German from the bottom of page sixty-*one* to the top of page sixty-*two*." Not a smile betrayed to the professor the mistake he had made and the class departed rejoicing.

Some X Ray photographs were taken not long ago in our laboratory of a man who had been injured by a small piece of steel becoming imbeded in his arm. The photographs were not successful, and no trace of the steel could be found.

Professor Hathaway—"Perhaps there are some in this class who may be such brilliant men that I will be proud of their work and of having been their instructor." A voice: "Yes, Brewer, '00, will be cutting hyperbolas on the planing machine in the near future."

Dr. Mees and Professor Howe spent the first of the week in Louisville attending the meeting of the Engineers' Club. Prof. Howe delivered an address before the Alumni Association of the Manual Training School. Dr. Gray will address the Association on the 29th.

An unusually large nnmber of students remained in the city for their vacation. Many were doing extra and original work. The afternoon found the base ball men at practice. Members of the camera club were seen occasionally dodging around in search of "Subjects."

The shop force has been kept busy for the last month with outside orders. Mr. Wires has completed a pattern of a car wheel for the Pennsylvania Railroad, which has attracted considerable attention from the students, both on account of the novelty and the perfection of the work.

A number of the students spent the vacation at home. Among those who enjoyed a visit out of the city are: Crebs, '99, Stevens, '01, Kittredge, '99–'01, Dayton; Lansden, '98, Cairo; Schwable, '99, Greenville; Wiley, '98, Paris; Hammel, '01, Chicago; Edwards, '99, Meriwether, '01; Miller, '01, Schwartz, '01, Louisville; Willis, '01, Weatherhead, '01, Cincinnati.

The Freshmen who have just commenced work in the foundry talk of little else but 'Arry. We understand this enthusiasm is as good a sign of spring, as is the inevitable and familiar spring fever. If some philanthropic person would pub-

lish even a small part, say a dozen volumes, of his interesting and imaginative memoirs, a boon would be conferred on the eager world, unequalled since the days of Munchausen.

A very valuable number in the city Y. M. C. A. series of practical lectures was rendered April 12th by Professor Howe, who gave them his "History of the Stone Arch Bridge." Sixty lantern views selected from the Professor's large collection, were shown to an appreciative audience.

The Institute has frequently been asked for pictures of the buildings, grounds and interiors, and has just completed an excellent collection of views, which will be used to send to several schools that have asked for a collection of pictures. A very handsomely framed set has been sent to the Dayton High school.

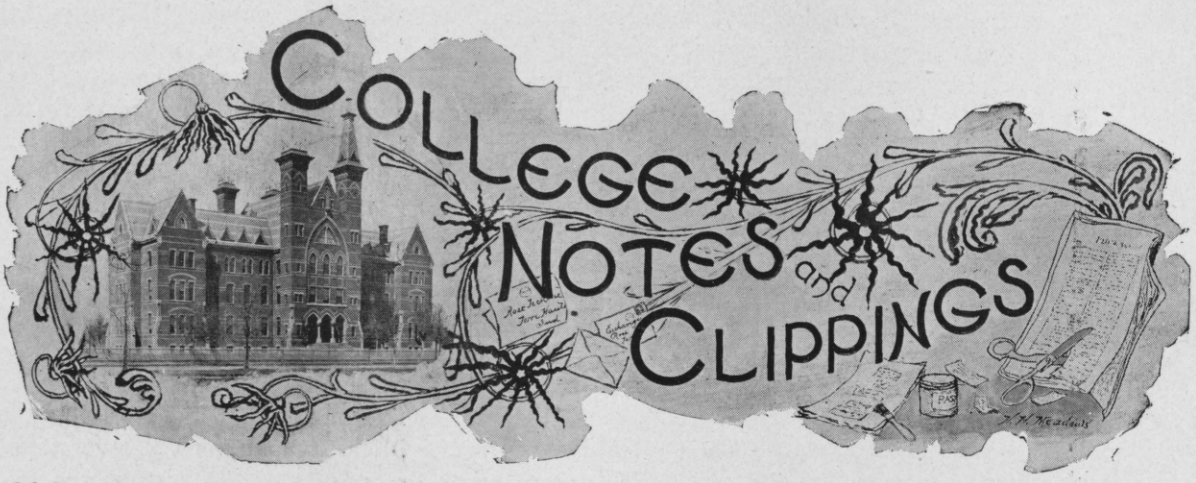
The library has received from Prof. Henry, the state librarian, the first of a series of bibliographies which are being prepared by the State Library. This number contains an index of all the material in the State Library on the subject of taxation, and will no doubt be found very useful by those interested in the subject.

The exhibit of photographs by the Camera Club, which is framed and hung in the hall by Professor Hathaway's door, deserves notice, as it is a very creditable beginning and shows the members are taking real interest in the club. An admirable plan has been suggested in placing the photographs on exhibition and then collecting them in an album, together with the papers read before the club, and presenting these to the library.

The *Journal* of the Association of Engineering Societies for February contains a very interesting article by Prof. Howe on the "History of the Stone Arch," being a paper read before the Engineer's Club, of St. Louis, last December. The article reviews the whole subject of stone arches from the earliest types of Egypt to the most modern of architectural structures. It is also profusely illustrated with half-tones from Prof. Howe's collection of bridges.

The Inland Printer, in its current issue, says: "The Globe Printing House, Terre Haute, Ind., forwards a copy of THE ROSE TECHNIC, the organ of the Rose Polytechnic Institute. It is mechanically a very fine production and is highly creditable to the Globe Company. The cover design, by one of the students of the Institute, is much above the average of such work. To adopt a popular form of criticism of such work, it might be appropriate to suggest that the young woman, who is shivering so far from the fire might have pulled her cloak higher about her shoulders and sat nearer to the heat."

Mr. Harris has made a most admirable change in the shop work of the Soph class. Heretofore it has been customary to give lectures once a week on shop methods, practice, special tools, etc. In place of these lectures Mr. Harris will keep posted a list of articles found in the current engineering magazines upon the usual subjects covered by the lectures. The class is required to read these and take notes, upon which they will be examined. This plan has met with general favor, as the hour for the lecture is deducted from the time and besides, it will give the class splendid exercises in the ability to understand machinery and mechanical appliances from a description, without a model to illustrate the varied workings.



Of the 44 candidates for the Yale nine, 16 are outfielders, 18 are infield and 10 are battery men. —*Ex.*

The University of Illinois has recently completed a new library building at a cost of $75,000.

Purdue University has recently received a full sized model of the front end, smoke box, stack, cylinders and valves of a Richmond locomotive.

We note with pleasure the change in the *Georgia Tech* to a technical journal, which is in keeping with the thought and work of the Institution.

The annual cost of maintaining a modern battle ship is over three times the total annual expense of an institute such as Johns Hopkins University.—*Ex.*

President Schurman, of Cornell, has offered a prize of $50 for the best contribution to the college daily. The work must equal two hundred inches of printed matter.—*Wabash.*

A good student can be known by three things: He can begin to study when he doesn't like it; he can study when he would rather quit; he can quit when he ought to.—*Normal Advance.*

The Senior class of West Point and the Junior and Senior classes of Annapolis have been given their diplomas and sent into active service on account of the threatening war situation.

In the April issue of the *American Engineer*, Francis J. Cole has the first of a series of papers on locomotive design, which is in very simple language and at the same time gives very accurate information on the subject.

The annual catalogue from Northwestern University shows an attendance of 2,063 students in all degree conferring departments. This does not include the preparatory school or the Cummack school of oratory, which a have combined registration of 800 students.—*Ex.*

A Harvard senior has presented a certain French literary and dramatic society, of which he is the president, with a fund of $30,000 for the establishment of an annual lectureship on subjects connected with French literature, art and history. The novelty of the scheme lies in the fact that the lectures are to be given in that language by some prominent French scholar, invited to this country each year.—*Wabash.*

Power for April has a description of a new motor put out by the Wright Wave Motor Co., Los Angeles, Cal., which is quite ingenious and altogether practicable, as is evidenced by the report of a test. In this machine the force of waves raises a large float, which on lowering, pumps water into a tank having an air cushion at the top. In this way a pressure of 350 pounds is maintained, which is sufficient to operate a turbine wheel. The operation is extremely simple and greatly reduces the price of power for seaboard cities.


Robert K. Rochester
J. M. Lansden Jr.
Jas. J. McLellan
T. D. Witherspoon Jr.
Harry Schwarz
Harry B. Stilz
Walter D. Cook
A. D. Kidder