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THE ROSE TECHNIC.

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A PERIOD never to be forgotten, with memories distinctly its own, the first vacation in a college course is an epoch in the life of the college man. For weeks it is looked forward to, its never ending delights pictured most vividly by the student in his first year away from home. Nervously he packs his trunk, for who makes this trip without his trunk? Proudly his colors flaunt from every available point of vantage as his chattels are tenderly placed aboard the train, and with infinite skill is his every word attuned so that no one can escape the knowledge that he is a college man, with special emphasis on the latter. Somewhat to his surprise on arriving at the place he honors by his residence, the inhabitants seem to have pursued the even tenor of their way, business and social, much as of yore. The first trip down town is a triumphal progress, every acquaintance is greeted with outstretched hand and all must be delighted to have seen the rising collegian. His calling list rivals that of the village pastor, for in the yet uncalloused heart, he cannot think of inflicting the sorrows of neglect upon any one he ever knew, and how could he call upon a favored few without doing this; so all are visited, and delighted with the history of his trials and triumphs. The cynosure of all eyes, the days of his sojourn glide by and soon 'tis over and once more he is merged with the crowd in the halls of learning. How different with the older college man, vacations are indeed welcomed and thoroughly enjoyed. For him no care of trunks, a dress suit, if he has one, occupies its box, and as few other articles as possible constitute his baggage. He treads his native paths unassumingly, with a ready nod for an acquaintance, a hearty handshake for a friend. His visits are not so widely extended, but the time integral foots up well, being directly proportional to the attraction with a tendency in the latter to centralize and increase in inverse ratio to the nearness of graduation. College no longer is the theme of his conversation, unless questioned on the subject; pleasant and unassuming, he is sought and appreciated in society, but the days of overpowering personality, the patronizing condescension, the glory of the first vacation are gone forever.

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VISITS and addresses by such men as President Coulter, of Indiana University, and Professor Waldo, of DePauw, are always appreciated by our students. The College Y. M. C. A. Board made no mistake in sending them to present its cause.

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THE Christmas examinations were followed by the usual number of fatalities, but the ranks have been closed up and all are preparing for the next attack.

IN a paper read before the American Society of Mechanical Engineers in New York City last November, on, "How can the present status of the engineering profession be improved?" the writer seemed not to put much faith in the degree of the technical institute. In fact he quotes those who hold that in many cases the title, for instance, C. E., given by a college, becomes as much a part of the name of the holder as the Christian name conferred on him at baptism and conveys but little more meaning aside from pointing out that the bearer had graduated in a technical course. He suggests that a board of regents appointed by a national association of engineers, composed of practical men of the world be empowered to confer titles for merit. "Nor would it be necessary to attend a technical school to obtain a title, the self-taught genius, on proving himself capable, would be awarded one as well." The London University gives degrees much in this way. During the first years a great effort was made to obtain its honors, but in later years they have been less and less sought, it being almost impossible to keep up a high standard without some educational qualifications aside from the purely mechanical. A degree-giving body labors under the disadvantage of not being in the personal touch with the candidate that the college authorities are, and an examination lasting a day or so may frequently be misleading. It cannot be claimed on the other hand that all college degrees are worth as much as they should be, nor as *prima facie* evidence of ability do they carry much weight. To quote again, "John Smith, C. E., they say, means that a man has at least some technical education; how much is not known; it depends upon the school from which he graduated." The last words contain the essence of the whole matter; this is the only estimate of value. High is the rank of the Engineer's degree at Rose, only obtainable in the least possible time, eight years after the commencement of the course, requiring at least one year's work under the direction of the faculty, leading to Master of Science, two years after graduation, and two years in actual practice of profession subsequent to receiving Master's degree. A board of regents as proposed may be desirable in many cases, but the college degree of the high standard of Rose will ever be of greatest value to its proud possessor.

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THE monthly receptions by President and Mrs. Eddy are proving a pleasing and important factor in the social life of the students. We do not believe that an entire withdrawal from society is conducive to the best interests of a student even in such a hard working institution as this. An acquaintance in cultured circles, and such are always open to the college man, can but help to elevate the mind and morals, while the lack of it and the consequent feeling of irresponsibility of action will ever be demoralizing in influence. THE TECHNIC believes that it echoes the sentiments of the entire Institute in thanking Dr. and Mrs. Eddy for their kindness and hospitality in giving us these delightful evenings and affording us the opportunity to become acquainted with the young people of the city.

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THIS term is the banquet season for Rose. Soon the after dinner orator will hie himself to some secluded spot there to practice the speech of his life. The evenings will witness brilliant combinations of appetite and eloquence, each class will unanimously decide itself the leader of all others, and next day the professor will kindly awaken the sleeping ones at the close of his lecture and dismiss them with his blessing, for has he not been there himself?

* * *

EARLY last term the Institute declared that a college pin was needed. Late last term action was taken as to what the pin should bear; the single letter R on a background of old rose and white, the shape of the button being left undecided. If final action is not taken soon, another vacation will find us still without a button. A little more energy in this matter would be much more characteristic of the R. P. I. of old, and gratifying to the students at large.

THE World's Columbian Exposition from the start has been a matter of surpassing interest to the engineering world; its grounds, buildings and exhibits in a great degree will be a triumph of engineering skill. Not here, though, where its labors usually cease, will the profession stop; its advances will not be subject to graphical representation alone. Great international congresses representing science in all its branches have been called to meet within the Exposition grounds during the Fair, and the ablest minds of the world are preparing a store of riches for these meetings. Every phase of engineering will come in for its due share of consideration, and the year of eighteen hundred and ninety-three will be a memorable one to the devotees of the arts constructive. One congress, of which Dr. Eddy is vice-president, is to be composed entirely of educators in technical branches of learning, and an effort is to be made towards obtaining more uniformity in the courses of the various institutions. A programme of subjects embracing the entire field of technical education has been prepared for discussion. Rose will be well represented, not only in this gathering, but in all the different bodies, where worth and ability are always recognized.

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THE TECHNIC has now arrived at a position when its articles are frequently quoted in the leading engineering journals, while several have been reprinted entirely. This statement is not intended in any degree to be self-laudatory, but is made that our contributors may know how we rank abroad, that they may be encouraged unto renewed effort, and that new writers may be added to the list. THE TECHNIC was founded in the interests of R. P. I. men, and its pages opened as a medium of communication from them to the world at large, and right well has the high character of the contributions prospered it in its aim.

STANDARDIZATION OF ELECTRICAL MEASUREMENTS.

THE WORK OF THE BRITISH ASSOCIATION COMMITTEE.

BY PROFESSOR THOMAS GRAY.

In view of the proposed congress of electrical engineers and physicists, to be held in Chicago during the coming summer, for the purpose of discussing, among other things, the standards of electrical measurement, it may be interesting for the readers of the THE TECHNIC to look over some of the work which has already been done in this subject. I propose, in this article, to give a brief summary of the work done by the committees of the British Association for the Advancement of Science. This association was the first scientific body to take up the systematic study of the subject of electrical units and most students are familiar with one result of their labors, namely, the "B. A. Ohm." The great importance of having a uniform standard of electrical resistance was brought before the British association in 1861, by Professor William Thomson (now Lord Kelvin) and a committee was appointed to consider the best means of obtaining such a standard. This committee consisted of Professors Williamson, Wheatstone, Thomson, Miller, and Messrs. Matthiessen and Jenkin, and was in the following year increased by the addition of C. F. Varley, Balfour Stewart, C. W. Siemens, Clerk Maxwell, Joule, Esselbach and Bright. This committee consulted a number of prominent scientific men in various countries with the object of obtaining their opinions and co-operation towards the establishment of a universal standard.

In the early days of electrical measurement, beginning about the year 1830, it was usual to express

the resistance of a heterogeneous circuit in terms of the equivalent length of some one conductor forming part of the circuit and this was usually called the "reduced length" of the circuit. This led to the expression of the resistance of a circuit in terms of the equivalent length of a wire of specified section and material. Thus Wheatstone proposed, in 1843, to use one foot of copper wire weighing 100 grains as a standard of resistance. In 1846 Hankel was using as a unit a certain iron wire. Buff and Horsford, in 1847, speak of resistances in terms of certain lengths of German silver wire, and so on. This method of working was very inconvenient, and in 1848 Jacobi attempted to obviate the difficulty by sending to a number of experimenters a certain copper wire and asking them to take copies of it, so that all their results might be expressed in the same units. This was subsequently known as Jacobi's standard. Its value was a little greater than one-and-a-half B. A. Ohms. Jacobi was probably the first to point out that the mere definition of the unit used as a certain length of a certain wire was not sufficient, as different wires of the same nominal material and of the same dimensions did not resist equally. Up to about 1850 measurements of resistance were almost entirely confined to laboratory experiments but with the development of the telegraph, particularly underground and submarine telegraphs, measurements of resistance became more and more necessary and important. What was sometimes called "distance" measurement, being used for the determination of the position of "faults" in the line. Resistances then began to be expressed in terms ot miles of telegraph wire, a very indefinite unit. For instance, in England a mile of No. 16 copper wire, in Germany a German mile of No. 8 iron wire, in France a kilometre of iron wire four millimetres in diameter, and so on. The first really good unit of this character was that constructed by Dr. Werner Siemens, which was the resistance of a column of pure mercury one metre long and one square millimetre in cross section when the temperature was 0° centigrade. Mercury had been proposed by several physicists but Siemens was the first to put the proposal in practical form and to construct standards of reliable constancy. In 1849 Kirchhoff had made an attempt to measure resistances in terms of what we now know as the "absolute unit" and in 1851, Weber proposed that electrical measurements might be made definite by the adoption of Gauss's absolute system. The subject was in this stage when the British Association took the matter up.

There were, therefore, three distinct methods in use at the time, namely, the expression of a resistance in terms of a certain length of a wire of solid pure metal, or in terms of the resistance of a certain column of mercury, or in terms of Weber's absolute system. It was very soon found that the first method could not be made satisfactory, because different wires of the same metal, made as pure as possible, seldom had the same specific resistance. Matthiessen's experiments showed that not only was the resistance changed by slight impurities but that it depended on the molecular structure of the wire, a hard drawn wire having a different resistance from an annealed wire. The resistance was found to change with time and with moderate fluctuations of temperature. Thus a wire kept at the temperature of boiling water for a few hours would be permanently changed as to electrical resistance. It was also found that for pure metals in the solid state the temporary change of resistance with change of temperature was so great as to render accurate comparisons difficult. Attention was then directed to alloys, and an important series of experiments was carried out by Matthiessen on the electrical resistance of gold-silver-copper, platinum-silver, platinum-iridium, gold-silver, silver palladium, german-silver and other alloys as to their electrical permanency and other electrical properties. Of these the most favorable results were obtained from an alloy containing two parts of silver to one of platinum. This alloy was found to vary little in re-istance, as in variation of resistance with temperature, for small variations of its composition. It was also little affected by annealing. and was, consequently, strongly recommended by Matthiessen as a material suitable for adoption in the manufacture of wire a certain length of a certain section of which could be taken as a standard of

resistance. On the other hand, Dr. Siemens strongly recommended mercury as the most suitable substance for such a standard, because of the great ease with which it could be prepared in a state of purity and of the constancy of its molecular condition. Mercury has also a comparatively low variation of resistance with temperature. The experiments of Siemens also showed that resistance could be reproduced with an error not excesding .05 per cent. by simple measurements of length and weight. Kirchhoff also proved the use of mercury as a means of reproducing the standard unit and pointed out that it could be advantageously used in conjunction with the absolute system proposed by Weber, by simply determining the specific resistance of mercury in terms of the absolute unit. This was not adopted by the committee at this time but is now practically the system used, the equivalent of the absolute unit in terms of a column of mercury being given as a means of obtaining the standard ohm. The committee finally decided to adopt Weber's system of units as being the most scientific, and the wisdom of their decision has been more and more emphasized as the applications of electricity have extended. The metre-gramme second system was first adopted but was afterwards changed to the centimetre-gramme-second system. Copies of the unit were expressed in wire coils of platinum, gold-silver alloy, platinum-silver alloy, platinum-iridium alloy and in mercury, two copies of each being made. In the copies of the standard destributed by the committee the platinum-silver alloy was used, because the committee believed it would make the most permanent standard.

The system of units having been decided, on the work of the committee became the experimental determination in terms of that unit of the resistance of a wire. A method of experiment was suggested by Thomson and adopted by the committee. In this method a system of two vertical coils of wire the dimensions and relative positions of which were quantitatively determined was caused to revolve uniformly round a vertical axis in the earth's magnetic field. The circuit of the coils being closed, an alternating current was set up in the coil of such a character as to produce a constant deflection on a needle placed at the centre of the system. As the current was proportional to the strength of the magnetic field and inversed proportional to the resistance and the deflection proportional to the magnetic field, the deflection was clearly independent of variations in the intensity of field in which the coil revolved and inversely proportional to the resistance of the circuit. This was of great importance and was the principal feature of the method proposed. Variations in the direction of the earth's force of course produced changes of deflection and these variations proved somewhat troublesome. An elaborated investigation of the correctness in the observations required for currents induced in the needle the self and mutual induction of the coils, &c., was made by Maxwell and after two years of work the ohm was given out in 1864 as probably correct, to one-fifth of one per cent. This unit was used for about twenty years but various independent determinations of the resistance of the standard coils in terms of the C. G. S. unit seemed to indicate some error. The subject was again taken up by Lord Rayleigh using the original method; and after a long and careful investigation involving a large number of repetitions with the gradual elimination of all possible sources of error he came to the conclusion that the B. A. unit was in error to the extent of about 1.3 per cent. A number of determinations in this country, in England and various continental countries confirmed this conclusion and a change was made at the congress of electricians, held in Paris, in 1884, the mean of the more important determinations being taken as probably most nearly correct.

This committee continued its work till 1869, and in the year 1870 three separate committees were appointed for the continuation of certain of the investigations. In the following year the apparatus and standards were deposited in Cavendish laboratory, at Cambridge, where they still are.

The work of the committee was not, by any means, confined to the determination in a practi-

cal form of the unit of resistance. A large amount of investigation was done by members of the committee in the subjects of the measurement of electromotive force, of electric currents, of electrostatic capacity and of the number of electrostatic units of electricity in the electromagnetic units. These investigations, among other things, resulted in production of a very valuable series of instruments by Thomson for the measurement of electromotive forces now known as Thomson's electrometers. The absolute electrometer being devised for the purpose of giving a measure of e. m. f. directly by the measurement of forces of attraction. The guard ring condenser, as a standard of capacity, was also devised by Thomson in connection with these experiments. Besides these, a large number of valuable experimental methods were devised in order to overcome difficulties in electrical measurements and the comparison of electrical quantities.

In the year 1880 another committee was appointed by the British association for the purpose of constructing and issuing practical standards. Of the work of this committee the researches of Lord Rayleigh and of Messrs. Glazebrook and Shaw on the redetermination of the ohm, of Lord Rayleigh and Mr. Sedgewick on the determination of the electrochemical equivalent of silver and on e. m. f. of the Clark cell deserve special attention, and full accounts of these researches will be found in the Philosophical Transactions of the Royal Society of London. Mr. Glazebrook has been Secretary of this committee and has, by himself and in conjunction with others, done a great amount of work both in original investigation and in the comparison of standards. The old B. A. standards have been regularly compared with each other each year and a record of their constancy or variations kept. About forty ohm and ten ohm standards were compared and certified to by this committee in 1892.

A long series of experiments have been made on the reliability of the Clark cell as a standard e. m. f. and results very favorable to this cell have been obtained. A full account of these experiments will be found in a paper, communicated to the Royal Society in February, 1892. This committee have also had the supervision of the construction of primary standards for the British Board of Trade Standardizing Laboratory and have constructed a standard ampere balance on the principle of that used by Lord Rayleigh and Mr. Sedgwick in their investigations on the electrochemical equivalent of silver, for that laboratory. They also compared the secondary standards, supplied by Lord Kelvin with the primary standard and report a perfect agreement between them. This latter report is interesting, from the fact that the Kelvin balances are standardized by copper electrotysis as it shows that absolutely accurate results can be obtained by this means. The standard of e. m. f. adopted by the British Board of Trade is the Clark cell, constructed in accordance with directions issued by a committee of that body, based on the results of experiment by members of the B. A. committee.

The British Board of Trade committee has recommended for adoption the values .9866 and 106.3 for the B. A. U. and the mercury standard respectively. The specific resistance of mercury in ohms is thus: $.9407 \times 10^{-4}$ and one ohm=1.01358 B. A. U.

The following determinations are also given in the committee's report for the mass of silver deposited from a solution of silver nitrate in one second by a current of one ampere:

Mascart "J. de Physique," III, 1884 0011156
Rayleigh "Phil Trans," II, 1884 0011179
Kohlrausch "Wied Ann" XXVII, 1886 0011183
T. Gray, "Phil. Mag." XXII, 1886 001118
Potier et Pellat, "J. de Physique," IX, 1890 . . .0011192

The value, .001118, has been adopted by the British Board of Trade.

The following values are also quoted for the e. m. f. of the Clark cell at 15°C. They are reduced from those given in the original papers, on the supposition that 1 B. A. U.=.9866 ohms, and that the mass of silver deposited per second per ampere is .001118 grammes.

Rayleigh "Phil. Trans." II, 1884 . . . . . 1.4345
Kahle Teitschrift für Instrumentenkunde, 1892 . 1.4341
Carhart 1.4340
Glazebrook & Skinner "Proc. R. S." Li. 1892 . . . 1.4342

The following tables of results, taken from the recent report of the B. A. committee, may be of interest:

THE VALUE OF THE OHM.

	Observer.	Date.	Method.	Value of B. A. U. in Ohms.	Value of 100 Centimeters of Mercury in B. A. Ohms.	Value of True Ohm in cms of Mercury.
1	Lord Rayleigh	1882	Rotating coil	.98651	.95412	106.31
2	Lord Rayleigh	1883	Lorenz method	.98677	. . .	106.27
3	Mascart	1884	Induced currents	.98611	.95374	106.33
4	Rowland	1887	Mean of several methods	.98644	.95349	106.32
5	Kohlrausch	1887	Damping of magnets	.98660	.95338	106.32
6	Glazebrook	1882 & 1888	Induced currents	.98665	.95352	106.29
7	Weillenmeier	1890		.98686	.95355	106.31
8	Duncan & Wilkes	1890	Lorenz	.98634	.85341	106.34
9	Jones	1891	Lorenz	. . .	. . .	106.31
			Mean	.98653		106.31
10	Stecker	1885	An absolute determination was not made. The value, .9657, has been used.		.95334	106.32
11	Hutchinson	1888			.95352	106.30
12	Salvioni	1890			.95332	106.33
12	Salvioni	1890			.95354	106.30
			Mean		.95354	106.31
13	H. F. Weber	1884	Induced currents	Absolute measurements, compared with German silver coils, issued by Siemens or Strecker.		105.37
14	H. F. Weber		Rotating coil			106.16
15	Roiti	1884	Induced currents			105.89
16	Himstedt	1885				105.98
17	Dorm	1889	Damping of a magnet			106.24
18	Wild	1883	Damping of a magnet			106.03
19	Lorenz	1895	Lorenz method			105.93

VENTILATION OF COAL MINES.

BY E. F. ROBINSON, '94.

Among the many annoyances which result from imperfect ventilation of coal mines, may be mentioned the impure air which has a disastrous effect on the animal working force of the mine, men, mules, etc., insufficient light, and above all, the dangerous and much dreaded fire damp.

Stringent state laws affecting ventilation are in most localities rigidly enforced, so that an efficient method for ventilation at a reasonable cost is one of the important items of the mining equipment; thus the important factor of good ventilation cannot receive too much attention from mine operators, as on it to a great extent the successful working of the mine depends.

The principles upon which effective ventilation rest are extremely simple, if the following facts be kept in mind: First, that air has weight; second, that other considerations being equal, a large mass will weigh more than a small one; third, that the particles of air are actual substances, therefore heat expands air, since it drives the particles further apart so that a given column of air

at a high temperature contains a less number of particles than the same column at a lower temperature; fourth, that since air is elastic, the particles naturally tend to separate in all directions, those at the bottom of a column being held closer together only by the weight of the particles above; this expansion may be produced in any given column simply by relieving the column of a portion of its pressure caused by the weight of air above; therefore, if connection be made between two confined, or partially confined, columns of air, and one column is raised to a higher temperature, then the warmer and lighter column will not balance the other and a current flowing toward the warmer column will be established. If, for example, an east and west drift be driven through a hill, and from any cause the temperature on the east side is higher than that on the west, a current will be established flowing toward the east. The sun is capable of producing reversals of current in a drift at different hours of the day. If the temperature happens to be the same at both ends of the drift, there will be no current. Such are the conditions in a mine ventilated by natural means; therefore, for ventilating large mines, recourse must be had to artificial means.

The first thing in providing for the ventilation of a mine artificially is to provide a way by which one column may constantly be kept lighter than another, and to see that the means adopted cause the flow of a sufficient amount of air to meet the needs of the mine. This result is accomplished by two methods: First, by expanding one column so that it be lighter than the other; second, by making it heavier than the other by forcing the new supply in at the top.

The first method is obtained by means of a furnace, the second by means of a centrifugal fan. The efficiency of a furnace depends much upon its position, as well as upon its construction and maintenance. Errors in the construction of furnaces are quite common. Small furnaces placed at the bottom of shallow shafts, either without stacks or with stacks so short or so loosely built as to be of little service, is one common error into which builders fall. Another general error is tardiness in starting the fire in the morning and insufficient attention to it during the day. During the night, while the fires are banked, accumulations of gases are constantly forming. The fires should be started early enough to have all such accumulation swept out and a steady current of fresh air flowing when the miners enter the mine. Fans are rapidly coming into use as ventilators and are proving efficient. The action of the fan is as follows: When the fan revolves all the air within receives motion, and if such motion was similar to that of the fan, the air would simply revolve and no useful effect would be obtained; but the particles of air rushing from the center of the fan form a current which is constantly maintained, the efficiency of the fan increasing with its velocity. Neither the furnace nor the fan would be of much avail if the air was not properly conducted throughout the mine requiring ventilation. There are several methods for conducting air through the mine. First, by double entries. In this case two parallel entries are driven from twenty to thirty feet apart and rooms turned on one side of each. "Break-throughs" are made at intervals in the pillars in order that the air may pass from one entry to the other. The air is then carried through the rooms on one entry, then out of the last room through a "break-through" to the parallel entry and through the rooms on it. The most common method for conducting the air is by single entry and by parallel air-course. Two parallel entries are driven with "break-throughs" between them at such intervals as are needed; rooms are turned on only one entry, the air is then carried through the rooms, across to the air course, through this air course to a position where communication is made by means of "break-throughs" with another entry, through the rooms on this and back by the next air-course and so on, the last air-course conducting the now foul air to the up-cast.

ALUMNI DEPARTMENT.

HIGHWAY BRIDGE BUILDING IN CALIFORNIA.

BY J. D. GALLOWAY, '89.

At the present time highway bridge building on the Pacific coast has reached the intermediate stage between the all iron and steel bridge and the wooden or Howe truss bridge. The combination bridge, in which the tension members are made of iron chord bars and the compression members of wooden struts, is the prevailing type of bridge. Large draw spans over important rivers and occasional fixed spans are built of iron and steel, but as yet these bridges are in the minority. There are several reasons for this, among which may be mentioned the distance from iron manufacturing centers, comparative cheapness of the first cost in erection and the abundance of good timber. Other reasons would be the lack of foresight among the county commissioners and the shortsighted efforts of the bridge companies to build a bridge which would wear out within twenty years and thus furnish another contract in the building of another bridge. The fact that good timber is available also plays an important part in keeping up the use of combination bridges. The Douglass fir, commonly called Oregon pine or Puget Sound fir, can be obtained in all sizes in San Francisco up to twenty inches square and forty feet long. Special orders will bring from Puget Sound almost any size required. The timber is also stronger for cross bending and longitudinal compression than any of the conifers of the United States. This assertion is based upon reports of tests made by the government and by the Union, Northern and Southern Pacific railroads. For this reason and on account of the cheapness of first cost the combination bridge will be built on the Pacific coast for some time to come.

For spans up to 220 feet in length, the single intersection Pratt truss is commonly used. Above 200 feet, modifications of the double intersection truss are used, the upper chord being inclined. The design of the long span bridges, however, usually depends upon the engineer, as various designs have been built. For short spans up to 100 feet, the live load is taken as being uniformly distributed and varying from 1,000 pounds per lineal foot to 1,800 pounds per lineal foot. For spans of from 100 feet to 200 feet, loads of 1,000 pounds per lineal foot to 1,200 pounds per lineal foot are used, and for spans above 200 feet, 1,000 per lineal foot is taken as the live load.

In dimensioning, the unit strain for chord bars and main diagonals of iron is taken as 12,500 pounds per square inch. Counters, lateral rods and hip verticals are proportioned for a unit strain of 10,000 pounds per square inch, and beam hangers for a strain of 9,000 pounds per square inch.

For compression members the crippling strain (for Douglass fir) is taken as equal to $\frac{6000}{1+.004\frac{l^2}{d^2}}$ Dividing by the safety factor, usually 5, gives the working strength. Joists and floor beams are proportioned by the formula $W = \frac{bd^3}{bl^2}$ where B is equal to 0.00575.

Floor beams are hung from the pins by yoke hangers provided with a wrought iron plate upon which the floor beam rests. Sometimes one hanger only is used, but this causes excessive bending moments in the pin and in every case possible two hangers should be used. Cast iron blocks are placed at the panel points of the upper chord and the batter brace. The pins pass through these blocks and the chord bars are packed outside. The lower lateral rods are attached to the floor beams and the upper lateral rods to the pins by bent eyes. A wrought iron jaw holds the strut, the jaw also being attached to the pin. The piers for the bridges are usually constructed of piles, but stone piers and those of the kind known as "Cushing" piers are gradually coming into use. The "Cushing" piers are built of two cylinders made of boiler iron $\frac{3}{16}$ inches thick. They vary in diameter from two and one-half feet upward,

depending upon the span of the bridge and the height of the pier. A cluster of piles is driven and then the cylinder is placed over them, the piles projecting up into the cylinder six or eight feet. The remaining space within the cylinder is then filled with concrete. Sometimes the cylinder is placed upon the bed rock or upon a wide base of concrete if the strata beneath is of a firm nature. The cylinders are braced with an "I" beam and tie rods fastened to plates riveted to the cylinders. The "I" beam forms the end floor beam for the bridge. Stone piers are made of rough rubble masonry or of concrete, founded sometimes upon piles with a grillage work floor, but usually upon a firm stratum of the earth. In such a case the base is made wider than the body of the pier.

Bridges are built by the various counties of the state. A law compels them to advertise for bids, plans, specifications, strain sheets and working details. This works a hardship on the local "practical bridge builder," but it insures the erection of bridges throughout the state which are designed by competent men. It is the county's fault if they do not secure good bridges, but the whole system of bridge letting is wrong. A better plan is suggested by Mr. Waddell in his "Highway Bridges." The above is an account mostly of combination bridges, as they form the larger number of the bridges built in the state. Iron and steel bridges are coming into favor and more will be built as the country grows older and richer. A large number of good iron bridges have been built in the state, and usually the county which has built one iron bridge prefers to build the next one of the same material. The various rolling mills of San Francisco are increasing their capacity and in a short time the Pacific coast will not be compelled to depend upon eastern mills for its bridge iron. In time, it is to be hoped, the wooden bridge will disappear and all streams be spanned by substantial iron bridges.

Mr. W. A. Layman, '92, recently superintended the installation of a Westinghouse Light Plant at Washington, Mo. Mr. Layman spent the holidays at his home in this city.

THE GENERATORS OF THE WORLD'S FAIR LIGHTING PLANT.

BY S. S. WALES, '91.

As is well known the contract to supply the 120,000 incandescent lights required for the World's Fair was awarded to the Westinghouse Electrical Company.

To supply this demand the company has in process of construction twelve large alternators of 1000 H. P., or 10,000 light capacity each. These dynamos are double machines; that is, they consist of two separate rings of field magnets about six inches apart, and two armatures carried on the same shaft. Each set of field magnets consists of thirty-six poles of laminated iron, projecting inward from a cast iron ring bolted to the frame of the machine. There are two distinct windings; one for the direct exciting current, from an external source, and the other for the compensating current. The compensating current is obtained by transforming a portion of the main current from the armature by two 20:1 converters fixed to the spider of the armature and then rectifying the same by means of a proper commutator carried on the shaft.

The armatures are of the pole type, built up of laminated iron. Stampings bolted together to the required thickness between wrought iron end plates of the same shape. These blocks, which carry one full and two half poles, are then placed in position on the circumference of a cast iron wheel having 18 T shaped poles, and fixed by leading. The armatures are wound after the pattern of the new Westinghouse alternator, by slipping machine wound coils over the poles, pressing them into position and securing them by wedges driven between two adjacent coils. (See Fleming page 210.) The completed armature is $7\frac{1}{2}$ feet in diameter and is to generate 2,000 volts at 200 revolutions per minute, giving 7,200 alternations. The armatures of each double machine are keyed on the shaft with the poles of one opposite the spaces of the other, thus generating a current one fourth phase ahead of the other. This makes the machines available for the transmission of power, by means of a motor manufactured by the Westinghouse company.

The total weight of the completed machine will be 55 tons, that of the armatures being 21.5 tons. These machines are to be tested by coupling two of them together, one being run as a generator, the other as a motor, by the current from the first, the loss in transmission, hysteresis and friction to be supplied by a 300 H. P. Westinghouse compound engine.

NOTES.

Mr. S. S. Wales, '91, has severed his connection with the Thomson-Houston Electrical Company Lynn, Mass., and is now with the Westinghouse Electrical Company, Pittsburg, Pa. Mr. Wales kindly sends us a description of "The Generators of the World's Fair Lighting Plant," which may be found in another part of this issue.

Mr. Benj. Putnam, '92, spent the holidays with his brother George, '90, at Washington, D. C.

Mr. Eugene F. McCabe, '91, will finish his work on the Library of Congress about the first of February, after which he will enter the engineering department of the Snead & Co. Iron Works, Louisville, Ky., temporarily. Then he will take charge of the iron construction of the new Boston Public Library, for the above firm.

Mr. J. D. Galloway, '89, engineer of construction work for Healy, Tibbits & Co., San Francisco, Cal., favors us with an article on highway bridge building on the Pacific coast.

Mr. E. G. Waters, '88, visited his home in this city during the holidays.

Mr. J. G. Mack, '87, of Cincinnati, O., spent the holidays in this city.

Mr. V. J. Gillett, '91, made a short visit in this city during the holidays.

Mr. S. D. Collett, '90, made a brief visit in the city recently.

ATHLETIC DEPARTMENT.

TENNIS.

BY PROF. A. S. HATHAWAY.

It will soon be fine tennis weather, I hope. In the meantime, it may not be amiss to offer a few suggestions that will enable all to enjoy it to the best advantage when it does come. A player generally enjoys a game of skill best when he is making it as hard as possible for his opponent, and this requires that the game should be studied and intelligently practiced. It is necessary, also, that a large number of our students should devote themselves to the game in this way, if we desire to hold our lead in tennis in the inter-collegiates.

Every game has what is called "good form." The object of good form in tennis is to play the ball to the greatest advantage with the least exertion. All violent movements are prohibited both as destructive of skill and as conducive of fatigue. Speed in serving or returning the ball is obtained not by great muscular exertion, but by a set of fulcrum movements each properly timed to superimpose its motion upon the preceding motions. The fulcrums are in order; the feet, the knees, the hips, the shoulder, the elbow, and the wrist. The movements about all these must be free and easy, so that the final motion of the ball shall be under perfect control of the wrist. It is the final wrist motion that imparts to the ball its direction, twist, sharpness and all those unexpected elements that make it difficult to return. The racket should follow the ball for an instant to render this control of the wrist perfect and to make the mass of the body movement effective. This makes it a case of inelastic collision with the body as the mass acting. Otherwise it is a case of elastic impact with the mass of the racket

and arm at most acting. Compute the momentum acquired by the ball in each case, and you will see the great advantage of the body movement following the ball. That foot must go forward to catch the body in its onward motion which is on the same side as the ball. The plane of the racket should be vertical or nearly so, and for this reason most balls are hit at the side so that body and ball form a line parallel to the net. The ball should be taken a little farther forward on the left than on the right. To take a low dropping volley at the net, incline the plane of the racket forward and impart a downward cut. This causes the ball to drop just over the net and bound short. This is very effectively used by expert volleyers on the swiftest balls. Ordinarily, however, any cut or twisted ball, except the over-twist, leaves one at a disadvantage with a good opponent, on account of the loss of speed. Cuts and twists should be used only to place the ball out of reach of your opponent, as in the case just cited, not to bother him.

One should stand, in waiting for the ball, with feet apart, knees slightly bent, and the weight upon the toes, ready to start quickly. This is an important point, as any violent exertion in getting to the ball is sure to weaken the return and disturb the accuracy of your stroke for several plays. The position to stand in court so as to properly guard it, must be learned by practice and observation of good players. A diagramatic study of the court will help greatly, and a knowledge of your opponent's habits of play, his strong and weak points, are of service. A little back of the middle of the back line and forward of the middle of the service line are standard positions for ground and volley play respectively. The latter position is by all odds the better if you can volley well enough to hold it safely. The only safe play against this position, when held by a good volleyer, is a very accurately placed ball out of reach, or a good lob. Both of these plays require steady nerves and a well trained wrist. A few successful volleys from this position are apt to unnerve the best of opponents and render him unable to make either play with his usual skill. Two good volleyers at the net, in the double game, have a still greater advantage. In fact, the only reply is for the other side to become volleyers too.

In returning a ball, remember that the object is to get the ball out of reach or where it can be reached only at a disadvantage. If you drop the ball in the middle of the court, in easy reach of your opponent, no matter how swiftly, he has the advantage; whereas, a slow ball placed along the side lines well forward or back, according to your opponent's position, will give you the advantage. Avoid, however, a cross-court play that allows your opponent to come up to the net.

There are three positions for taking the ball on the bound: first, when rising from the ground—the half volley, a difficult play and rarely used by the best players; second, when at its greatest height, the usual stroke of side arm players; third, when falling to the ground, the lawn tennis stroke *par excellence*. The ball can be played from the latter position more accurately and swiftly than any other, and moreover, on account of the resistance of the air, a swift ball has then lost about all its speed. The ball takes naturally the overtwist when returned from the third position, which may be added to if desired by the elbow and wrist movement. Beginners, however, should make the stroke from the shoulder, the arm moving nearly in a vertical plane without special effort at overtwist. Remember to hit with the plane of the racket vertical and hence at the side, otherwise the ball receives a sort of baby toss out of court. The direction of this return is determined by the twist of the wrist at the moment of impact. Do not forget to impart the body movement already referred to.

The racket should be held near the end of the handle, with the fingers slanting up the handle at the knuckles and the ends slanting down the handle, parallel to the thumb. Place the throat of the racket in the palm of the left hand with the plane of the racket vertical, and the handle in the right hand. This is the proper position when waiting for the ball. The balls of the thumb and forefinger may be placed, for the first hold, nearly upon the two upper edges of the handle with the farther vertical side of the handle in the palm of the hand. This hold is kept for strokes

on either side, balls being taken on either face of the racket according to the side. This is the hold used by Dwight and Sears. Turn the hand from this hold forward until the balls of the thumb and forefinger are nearly upon the two edges of the handle away from the body, and we have Lawford's hold. All balls are played on the nearer face of the racket, the back stroke being accomplished by a swing over the left shoulder and a backward twist of the arm. These holds have the disadvantage that strength of play on either side is sacrificed for the sake of unchanging grasp. A third hold is one between the first two forehand strokes, and with the hand turned a little farther back than in the first hold for backhand strokes. If a stroke at the backhand is expected, stand ready with the backhand hold; if it does come forehand, a quick forward turn of the wrist places the hand in position. So, *vice versa*.

These are the main points to be observed in practicing lawn tennis. There is one caution, and that is, avoid careless play. Try to make every stroke and play every game the best you can. Remember that it is your *habit* of good or poor play that you have to rely upon in a match, and not any particular skill you may exert on that day. The habit of good play is the only safeguard against those unaccountable nervous conditions that sometimes take a player completely off his base. There is no game of skill in which the ups and downs of good players seem to be so great as in tennis. There seems to be a sort of fatalism about everything you try one day, and another day you seem to be able to do almost anything you wish. If, however, the habit of uniform play is cultivated, the danger of inequality in one's play is greatly lessened, when the time of trial comes.

HOW WE STAND.

The Athletic Department has gone into winter quarters, and like too many other educational institutions, Rose Polytechnic is forced to acknowledge that proper physical training at this time of year is beyond our privilege.

All of us who give thought to this matter believe that such should not be the condition of affairs, and the error becomes more apparent when we consider it entirely within our power to give sufficient attention to the gymnasium, both to improve our physical development and to give that much neglected room a business-like appearance.

The spirit which moves the Senior Class in their undertaking, and which is followed by necessary action, should extend to the entire school; for not until the advantages at our disposal are made use of will the erection and equipment of a better gymnasium than we now have be warranted. The encouragement and advice of the faculty in this matter is indispensable, and if other means fail, the extreme measure adopted by some of the larger colleges and universities—that of compelling all students to engage in athletics—doubtless has its merits for our consideration. The subject is not beyond our comprehension and should be of sufficient interest to engage the attention of all.

NOTES.

Camp and McClurg, the celebrated coachers, are developing foot-ball players in California. The former is at Leland Stanford, Jr., the latter at the University of California. With unusual interest for all athletic sports, and having climatic advantages which permit of an uninterrupted season, it is but a matter of time when the college athlete of the Pacific slope will compare favorably with his brother in the east. The base ball players from that part of the country indicate the possibilities of athletics there.

Dr. J. William White, the surgeon of the University of Pennsylvania, is credited with the following significant remark, passed during a lecture before the medical students of that institution. Said the doctor: "I never neglect an opportunity to defend this great game of foot-ball, so conducive to health and so beneficial to the players in every way, which develops courage, endurance and every characteristic that goes to make a truly symmetrical man."

During a certain part of the year compulsory athletics in the form of foot-ball for one-half hour each week, is required of all male undergraduate students at Chicago University.

Several colleges of the state with aspirations for base ball honors are practicing their batteries for work of the coming season. Such preparation indicates which colleges will take part in the real struggle. Candidates for the Institute team should have practice of the same kind, or the failure of last season will be repeated.

The Butler-DePauw controversy about foot-ball is, we are pleased to observe, drawing to a close; the last blow was struck by DePauw, who repudiates the charge of having "stole that ball."

The strongest foot-ball team in the south last season was University of North Carolina. A cut from a photograph of the team was published in the *University Magazine* for December.

The financial report of Harvard Athletic Association for last year was as follows: Receipts, $12,100; expenses, $11,000.

Northwestern University claims the finest athletic field in this section of the country, one important feature of which is a three thousand dollar grand stand.

At this season of the year the need of a well equipped gymnasium is most keenly felt. If any alumnus cares to pose as a philanthropist, this is his opportunity.

The spiral curve track has been adopted for Yale's athletic field. This change will make it one of the fastest tracks in the country.

The Yale-Princeton foot-ball game was a success financially, the net receipts amounting to fifty-five thousand dollars.

The estimated cost of the proposed gymnasium for Chicago University is two hundred thousand dollars.

ROSE LEAVES.

"THAT TERRE HAUTE BRIDGE FAILURE."

To the Editors of the Technic:

You have requested me to make a reply to an article by Mr. Quintin McNabb, Supervisor B. & B., C. C. C. & St. L. Railway, which appeared in the *Railway Review* of January 7th, under the head of "The Terre Haute Bridge Failure." Before making any comments, it would be well to state, for the benefit of the readers of the TECHNIC, that Mr. McNabb's article was a reply to one which appeared in the *Engineering Record* of December 3d, under the same heading as the above, and also to one which appeared in the November issue of the TECHNIC. The article which appeared in the *Record* being a comment upon the one in the TECHNIC.

After a few preliminary remarks and a copy in full of the *Record's* article, Mr. McNabb says: "Such an erroneous and unjust statement from a student * * * * might be excused on account of youth or ignorance." Continuing he says: "I made the assertion that Yale or Harvard, with all their facilities for learning could not produce practical railroad men ready made. Nor can Rose Polytechnic do it." I do not purpose here to discuss this matter, only to say that the theory that a student from an engineering school knows as much practically as a man of long experience, is not held in this institution, nor as I believe, in any other institution.

The sooner the "self-made" man and practical men in general learn this the better it will be for the profession. I do not know of any institution, of reputable standing, that claims to produce practical engineers ready made. Certainly Rose Polytechnic does not,—we merely claim to lay a foundation upon which the young man, by experience, may build.

Referring to the passage above quoted from Mr. McNabb, I am inclined to think it may be misleading to the readers of the *Review*. Should any one take the trouble to compare the figures given by him and those in the TECHNIC, they will find that the statement was not as "erroneous and unjust" as Mr. McNabb would have his readers believe. It is true that my figures were not so very accurate, nor did I claim them to be so, for the measurements were obtained under great disadvantages, as the men in charge would permit no one to go on the bridge. It will be seen, however, that I gave the " brighter side " in every respect to the work.

If the batter legs of the second and third bents from the west pier had a shoe on each of them, I was not aware of it, my time was so occupied that I could not be at the river while every bent was being put in. Further, Mr. McNabb says * * * "and I am not sure but the batter legs in the other bents were similarly constructed." Is it possible that an engineer in charge does not know anything more definite about his work than that? Mr. Kittredge, the Chief Engineer, in his article to the *Record* of December 31st, does not claim any shoes for the batter legs. Granting however that there were shoes on the bents in question, it does not lessen the load on the three remaining bents, which had only the 12″ x 12″ base to rest on.

Assuming an engine excess and dead load of 4,000 pounds per lineal foot, the load carried by each leg would be 15,000 lbs., taking the spacing of the bents at about 15 feet. This pressure per square foot, coming as it does upon the surface of ordinary river bed, seems to me to be rather great. Then too the danger resulting from a slight scour or rise of the river is not to be overlooked.

I am still of the opinion that the repair in question was not the best of engineering practice.

S. B. Tinsley.

Those seniors who have not selected a thesis subject have been requested by Dr. Eddy to hand to him two subjects which they might desire to take in order that the apparatus and material may be provided before the first thesis week.

Y. M. C. A.

A Young Men's Christian Association is now almost an assured fact. Through the kindness of President Eddy and the faculty, the recitations on last Saturday morning were put forward a half hour so that all students could have the privilege of attending a general assembly at 11:30. A great many students took advantage of this privilege, and at the appointed hour the chemical lecture room was pretty well filled. The meeting was for the purpose of placing our Young Men's Christian Association on a more solid footing.

Dr. Coulter, President of the State University, State Secretary Stacy, Prof. Waldo, and Mr. Jameison, of the city association, addressed the meeting. Their talks, although brief, were to the point and very interesting. At 12 o'clock the meeting adjourned, it having been agreed, however, that those who were desirous of helping the association should meet again at the city association rooms at 3 o'clock. About twenty-two of the students were in attendance. Since the annual election of officers would follow this meeting so closely, it was agreed by common consent that the election should not be delayed. The officers elected were as follows: S. B. Tinsley, president; R. D. Valentine, vice president; O. E. McMeans, corresponding secretary; C. M. Ridgely, recording secretary; J. C. C. Holding, treasurer. In behalf of the directors of the city association, Mr. Jameison offered to us the use of their rooms for holding our meetings. This clears away one great obstacle that was a barrier to our work last year, and it is to be hoped that more students will take advantage of the offer that has been so kindly extended to us. It was decided to hold the regular meetings on Saturday evenings. Surely every student can spare forty-five minutes each week to carry on this work so nobly begun by a few. *B.*

Considerable excitement was caused in the Physical Laboratory the other day, by the short-circuiting of a 1,000 volt circuit from the Westinghouse machine. The result was a fine display of sparks, the burning of all the fuses, and the partial stoppage of the dynamo, but fortunately nothing more serious than this.

PREMIUMS FOR THESES.

The *Engineering News* offers three premiums, $75, $50 and $25 respectively, for the best graduating theses by '93 graduates in any engineering course of any of the colleges of the United States and Canada. The competing theses must be sent in by the college authorities and not by the authors, and in no case is the name of author or college to be known to the judges before announcement of awards. The articles will be judged by the editors of the *News*, and such engineering experts as they may select to aid them, the examination to be made on same basis as of papers for publication in engineering journals or society proceedings, selection to be made "according to their apparent permanent value for the advancement of engineering practice or theory either as records of original research or as intelligent and concise discussions or critical summaries of older researches."

The prizes for theses of '92 went respectively to Ohio State University, Purdue and Cornell men, honorable mention being awarded others. It is to be hoped that Rose will enter the lists this year, and that the Seniors put forth their best efforts in preparing theses which will prove prize winners.

THE ORCHESTRA.

The R. P. I. Orchestral Club is at present busy rehearsing for the annual concert, which it expects to give (this year) early in February. The club has been in existence four years, having been organized originally by members of '93, as a class affair. And '93, besides furnishing the leader, Mr. S. E. Johannessen, has taken an important part ever since. Ninety-six furnished six very valuable additions, and if next year's Freshman class will do as well, it will be possible for the club to continue in existence even after the loss of ninety-three.

Foot ball and matrimony have been the orchestra's worst enemies this year, but in spite of these difficulties it promises to be in good condition for the concert, which will be the fourth one it has given.

THE sudden death of Kirk R. Stone, '95, at his home in Cleveland, Ohio, on December 15th, 1892, was a great shock to his many friends in the Institute Mr. Stone entered the Sophomore class last September, but at the time when ill health compelled him to withdraw from the Institute he was one of '95's most popular members. The class has taken the following action:

The class of '95 having been bereaved of one of its members, Kirk Rollins Stone, wish to offer their sympathy in the following resolutions:

WHEREAS, We, as a class, feeling as we do the loss of so worthy a member, who, having been with us so short a time, could make so many friends, and knowing how much greater is the bereavement to those who had always loved him and shared his hopes and trials; therefore, be it

Resolved, That our deepest sympathy be extended to those who have so suddenly lost a beloved son and brother. Be it

Resolved, That a copy of these resolutions be sent to Mr. and Mrs. T. E. Stone, his father and mother, and that another copy be given to THE ROSE TECHNIC for publication.

STEWART S. COMFORT,
C. M. RIDGELEY,
HENRY S. BARTON,
Committee.

NO ONE who heard the very delightful concert of the Oberlin College Glee Club, given here during the holidays, could help wishing that a similar organization might be formed at Rose. We have, it is true, a comparatively small number of students, and no conservatory of music to draw from, and we could not hope to make a very pronounced artistic success of it. But we have members of the faculty who are excellent musicians, and who have already offered their assistance and advice, and it would seem as if it ought to be possible to organize a club which would be a source of enjoyment not only to its members but occasionally to others who like to hear college songs sung in a college way.

DIFFERENTIALS.

White, ex-'95, is still at Stanford.

The sleighing is very fine—to look at.

Craver '95, has gone into the chemical course.

"Professor do these induction coils generate ozone?"

The electrical club has adjourned its meetings indefinitely.

Odell and M. R. Thompson have left Stanford and gone into business.

The "bogen-lampe" is again the all absorbing topic among the Juniors.

"How far is she below zero this morning?" is the regular salution now.

Hunt, who left '95 last spring on account of sickness, is back with '96.

Most of the Seniors have purchased Silvanus Thompson's "Dynamo-Electric Machinery."

There is some talk of organizing a hair-lip club among the aspiring candidates for such distinction.

Hood and Huthsteiner will investigate the shearing strengths of various metals for their thesis.

Thaxter, formerly of '93, has had a surgical operation performed, which has kept him from Stanford.

Prof. Wickersham is arranging to take a number of students to visit some of the classes at Coates College.

In future, Least Squares will appear on the list of luxuries to be enjoyed only by students in Civil Engineering.

Professors Hathaway, Gray and Noyes read papers before the recent meeting of the Indiana Academy of Sciences.

A Junior electrified the class recently by maintaining that of several unmixable liquids the lowest was on the bottom.

Prof. Wickersham (at the first recitation after Christmas, of the Sophomore class:)—Wo ist Herr S——? Ist er durch-gefallen?

Ernest Hood, who left the Freshman class last spring on account of ill health, has entered the Freshman class again this term.

Moth '93, has just returned after an absence of two weeks at the beginning of the term, which was caused by his father's death.

Professor Noyes was elected one of the Vice-Presidents of the Indiana College Association at its recent meeting in Indianapolis.

Dale, Johonnott, Waite and McDermott will probably make a test of the Cable Power House at Cincinnati for their thesis work.

Mead '96, returned to the Institute January 8 after an absence of several weeks and will continue with his regular course of study.

How is this for enterprise; an evening paper announced last Saturday evening that revival meetings were being held at the Poly.

A younger brother of Huthsteiner '93 has entered the Terre Haute High School in order to prepare to enter Rose with the class of '97.

Prof. Hathaway has been busy recently writing excuses for the entire Junior class; he has ordered a rubber stamp to do the work for him.

W. H. Albert, C. E. Albert, W. G. Hesser and T. W. Ross expect to take as their thesis an efficiency test of the Cincinnati Electric Lighting Plant.

Thesis drawings must be handed in on or before May 1st. Waite and Hood have already finished their drawings, Hood having handed his in early in September.

Within a short time, when the usual yearly allowance has been expended, the Library will have been improved by the addition of several hundred volumes.

The four or five remaining members of the old R. P. W., met in solemn conclave on the road home from the Institute during the closing days of last term and disbanded the organization, the treasurer divided up the cash on hand and the object of the meeting was accomplished.

The last number of the *Scientific Quarterly* of the State School of Mines at Golden, Col., contains an interesting article by J. A. Parra, formerly of '94.

K. L. Hanson, at one time a student and champion broad-jumper of the Institute, is married and is at present in the City Engineer's office at Anderson, Ind.

Barry O'Brien ex-'94, is now doing chemical work at the University of Minnesota preparatory to entering the School of Mines at Golden, Colorado, next year.

Miss Hannah Smith, Assistant Librarian, has been quite seriously ill, but all will be glad to hear that she is recovering and will soon be able to re-assume her duties.

The Poly possesses some most enthusiastic wheel riders; think of riding out to the Institute, when cutters go gliding by and the thermometer stands at five below zero!

The new equipment of the R. P. I. coal road will soon be put into service. The efficient management has succeeded in keeping the road open during the late severe snow storms.

By the recent addition of several volumes to each set, the Journal of the London Chemical Society and the Transactions of the Royal Society of Edinburg complete, are now listed.

A few changes have been made in the Library regulations; the one concerning us most is, perhaps, the privilege which allows any student to take two books for an interval of two weeks.

In future, students will not be forced to hunt for Ah Moo Long's establishment, as an agency has been established at the college; at least there was a notice to that effect on the bulletin board recently.

The second reception of Dr. and Mrs. Eddy occurred on Saturday evening last, and was an unqualified success. The Society Editor has been trying his hand at description of some of the costumes worn by the ladies, and as soon as he feels sufficiently familiar with the subject he will give the readers a column of "fashion notes" which will rival Harper's Bazar.

„Da geſchah es, daß der König Pelias ein Gaſtmahl gab, und Jaſon dazu einladen ließ."

Freshman translating: "Now it happened that the king Pelias gave a party and Jason went to get loaded."

We desire to assure the students in general that the school button which was discussed last term, will *not* have to be sewed on. There may be a misunderstanding on this point, and it may be that a wholesome fear of this operation is keeping them from settling the matter immediately.

Two armature coils of the Westinghouse alternator were burned out just before the close of last term. Heating seems to be the great fault of this armature, it as has burned out several times without being overloaded. It is very much to be hoped that one of the latest slotted armatures will be obtained for it.

Mr. C. W. Pike, a Massachusetts Institute of Technology graduate, of '89, representing Queen & Co., instrument makers of Philadelphia, visited the Institute last week. Queen & Co. have recently commenced the manufacture of instruments of precision for electrical measurements, and Mr. Pike is visiting the colleges and technical schools of the country, with a view to the introduction of the American made instruments of Queen & Co., in place of the imported instruments now almost exclusively used.

Prof. Hathaway suggested to the Juniors the other day, a solution for a problem which has been bothering some of them, so they say, for some time. The problem is this: Suppose a man wishes to visit regularly a certain number of places—the first one m times per month, the second n times per month, etc., where must he locate in order to make his visits with the least amount of walking? The solution was a graphic one and necessitated the digging of a number of wells—but this last will be a small matter on account of the class's well-known experience in running pipe lines. It is said that the method has been tried in one or two instances and has resulted in each case in moving the room of the experimenter several squares toward Main street.

THE COLLEGE WORLD.

Wabash is to have a physical director.

Tuft's College has been opened to women.

The Yale foot ball team practice three hours daily.

The mechanical laboratory of Purdue is to be enlarged.

Princeton's new commencement hall is nearly completed.

A chair of physical training is to be established at DePauw.

The Moore's Hill Collegian refuses all advertising matter.

Purdue Athletic Association has a balance to its credit of $1,500.

Foot ball has been prohibited at the University of Heidelberg, Germany.

No tuition is charged for admission to any of the courses at Leland Stanford.

The University of Virginia is to have a twenty-eight thousand dollar gymnasium.

Washington University has night classes in elementary and mechanical drawing.

There is some talk of moving Kenyon Military Academy to Mansfield, Ohio.

The Junior class of Indiana University will probably issue an annual this year.

It is very probable the course at Worcester Polytechnic will be extended to four years.

De Pauw will have summer courses of instruction beginning June 20 and ending July 29.

THE MISTLETOE'S MISCHIEF.

She stood beneath the chandelier,
With eyes and cheeks aglow.
He promptly saw his chance for bliss
And pressed upon her lips a kiss,
And blessed that mistletoe.

It happened that her pa came in—
Oh, ruin, wreck and woe!
His boot was big and well applied,
And soon the young man stood outside
And cussed that missile toe.

—*Indianapolis Journal.*

A school of Pure Science has been established at Columbia College.

The Harvard Club of Philadelphia has a membership of over two hundred.

Williams, Dartmouth and Columbia have abandoned Commencement exercises.

It is said that students of Cornell bring over $500,000 yearly into the town of Ithaca.

Bowdoin College has been presented with a Science building which is to cost $60,000.

Nine million dollars and eight million dollars are the endowments of Columbia and Harvard.

There is a strong feeling among the trustees of Wabash in favor of co-education in that institution.

Every department of Purdue is to be fully represented by displays at the Columbian Exposition.

The Purdue foot ball players were banqueted by the citizens of Lafayette after their final victory.

The Italian government has ordered that English be taught in all of the colleges of the country.

There is some talk of erecting a new dining hall at Harvard large enough to seat one thousand men.

Charles K. Adams, recently president of Cornell, has been elected president of the University of Wisconsin.

To avoid confusion both the faculty and students of the University of Chicago are to be addressed as "Mr."

BACK NUMBERS BEST.

"What magazine is best. Come tell!"
I asked three maids one day.
"The *Cosmopolitan*," cried Nell,
"The *Century*," said May.

With a merry twinkle in her eye,
And saucy mien, sweet Bess
Declared—I know the reason why—
"I love the College press."—*Ex.*

The new athletic grounds of Harvard are to be situated close to the Charles river and are to contain ninety-four acres.

The foot ball team of the University of Pennsylvania played several games in the south during the Christmas holidays.

All minor students of the Worcester Polytechnic must obtain permission from their parents before entering any athletic contest.

The member of the Freshman class of Columbia who passes the best examination is given free tuition for the balance of the course.

A new four-story laboratory, for the biological, astronomical and physiological departments of the Sheffield Scientific School, has just been completed.

A professorship of Pacific Coast History has been established at Leland Stanford, Jr., University. The object of the professorship is to collect and preserve the records of the early settlement of the Pacific Coast.

Buchtel College has decided to change its system of government. All matters of discipline hereafter are to be referred to a committee composed of the faculty and a certain number of students, chosen from each class.

Yale and Harvard are to contest in a race at the annual winter meeting of the Boston Athletic Club. The race is over a mile course and each college is to send four contestants who are to relieve one another at each quarter.

Stanford has a crew and a boat house is to be built. The house will be at least sixty feet long so as to accommodate an eight oared racing barge and will be wide enough to accommodate pleasure boats owned by the members.

De Pauw is to have new athletic grounds on its own campus. A bicycle and pedestrian track, tennis courts, base ball and foot ball grounds are to be provided. It is hoped that the grounds will be in readiness before spring field-day.

Of all sad words of tongue or pen
The saddest are these,
"I didn't pass in the last exam."—*Ex.*

A HARROWING TALE.

There once was a freshman from Me.,
Who declared he would carry a Ce.;
But the Sophs caught this Mr.,
And raised such a Blr.,
His chagrin was outclassed by his Pe.
—*Wesleyan Argus.*

A Senate, composed of representatives of the different classes, together with the faculty, has been organized in Denver University. All cases of dispute, between the faculty and students, are referred to it, the action being subject to the veto of the President of the university.

"The record of the University of Illinois in the Illinois Inter-collegiate Athletic Association's field day contests, is like that of Rose Polytechnic in Indiana. At the games of the Illinois association, October 8th, the University won with ease, making four successive years that they have held the championship cup."—*The Bema.*

There will be four commencment days each year at the University of Chicago. President Harper said in his opening address that, "It will not be, I take it, the custom of the University to have addresses by those who are graduating, but rather an address by some person not in residence at the University on some theme of general interest."

The business men of LaFayette and West LaFayette have purchased a silver cup to be offered to the Indiana college winning the foot ball championship three successive years. The cup is of sterling silver, 14 inches high and 10 inches in diameter. The base and upper edge are ornamented with relief work and on the front is an etching of a foot ball team.

A dainty maid with mien sedate,
Did to her friend a tale narrate,
As her way she wended;
It was thus she ended—
"I thought I should evaporate!"—*The Wittenberger.*

The man who knows it all
And keeps it we adore;
But he who knows it all
And tells it is a bore.
Lockport Journal.