Spring 3-1901

Volume 10 - Issue 6 - March, 1901

Rose Technic Staff
Rose-Hulman Institute of Technology

THE ROSE TECHNIC.

VOL. X. TERRE HAUTE, IND., MARCH, 1901. No. 6

THE TECHNIC.

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One Year, $1.00. Single Copy, 15 cents.
Issued Monthly at the Rose Polytechnic Institute.
Entered at the Post Office, Terre Haute, Indiana, as second-class mail matter.

FOR some reason or other—perhaps because it is in the rather vociferous stage of development known as "goin' on ten" years of age—THE TECHNIC cannot help saying that it is immensely pleased with the state of athletic interest at Rose. A winter of such success at basket ball has never visited us before, and the team has never before had such loyal support. It is worth while for a team to win a game when a loyal crowd of friends is watching every step, is taking the responsibility for its success or failure. It is worth while to be on a team when three-quarters of the school are waiting at the end of the game to show the victors that it means something to the student when his team acquits itself nobly. And the students have done all this. Through their firm support they have made of five men playing basket-ball, a team representing the student body. And no one who has had an opportunity to see what determination and enthusiasm can do in athletic games will say that there is not a difference between the two.

Another encouraging feature of the winter's athletics was the successful inter-class indoor meet, a detailed description of which is given in this number. With this state of affairs it looks as if we ought to hope and plan for a successful spring, both as regards base-ball and Field Day. But we have to keep on working.

THE Rose Tech Y. M. C. A. has for some time been making preliminary arrangements for the establishment of an institution which promises to be of real value in the Institute's work. The object in view is the maintainance of a loan fund for the assistance of worthy and needy students in the completion of their course. A constitution has been drafted for the government of the "Loan Fund Committee," which is to have charge of the fund. Cases are constantly occurring where students have been compelled to give up their plans for graduation because they could not afford to continue in college. The object of the fund is to assist in such cases as this, giving precedence to students in the upper classes and to those of best standing and reputation. It is the intention that no preference be shown to members of the Y. M. C. A. The loan is to be made at 6 per cent interest, at whatever security the committee directs, the borrower giving his note for payment within two years of the time of his leaving the Institute. No more than $100 will be loaned to one student in one academic year. The Loan Fund Committee will be composed of the officers of the Y. M. C. A., the President of the Institute, and two Alumni who have been active members of the Association. The President of the Association will be chairman of the committee, and the treasurer one of the Alumni members, who are elected on alternate years for a term of two years. The interest on the money is to be applied in defraying the expenses of delegates to the Association conventions, but all interest not so used reverts to the Fund. As yet no attempts have been made to collect money for the Fund, but the prospects are good for the accumulation by subscription, within a few years, of a considerable sum. Such an

arrangement has been attempted by only two or three of the college associations of the country, and our Y. M. C. A. deserves hearty support in its development of this ambitious but wholly feasible plan.

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OURS is the sad duty of recording in this issue of THE TECHNIC the death of one who was a fellow-student and friend. Early on the morning of Tuesday, March 5th, Karl F. Peker, of the Junior Class, died at his home in Terre Haute. The news of his death, after so short an illness, was a surprise and a blow to those who had known him so well at school. It is a sorrowful thing, when a friend so strong and vigorous must leave us in the very opening promise of his life's usefulness. Karl Peker, as well as through his personal charateristics, had gained the regard of his fellow-students by his services as one of the Institute's most successful representatives in several departments of athletics. But it is his personal loss that will be most deeply felt, and THE TECHNIC joins with the Student Body in sorrow at his death, and in sympathy with his family.

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MR. Sanborn's article in this issue of THE TECHNIC, entitled "What Will It Cost?" offers a suggestion which if carried out would be of undoubted benefit to the Alumni and students of the Institute. The accumulation in accessible form of data regarding cost of construction would be a very valuable thing. We hope that such an arrangement may be made, and promise to it whatever support THE TECHNIC can give.

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THE TECHNIC wishes to thank two of its friends for favors done. For the drawing illustrating the article on "Storage Batteries," we are indebted to Mr. Dorn, '03, and for the photograph of the basket ball team to Mr. Schwartz, of the Senior Class.

Theory of the Lead-Sulphate Storage Cell.

By ARTHUR KENDRICK.

THE importance of the lead storage battery in the machinery of today is so well and generally recognized that comment on that point is unnecessary. The recent article, p. 53 of this volume of THE TECHNIC, by Prof. Gray, has very concisely stated the history, and attractively presented the forms of the modern cell, and given a very satisfactory sketch of the processes employed in the construction and formation of the plates and the behavior of the cell in charge and discharge. A theory, however, approaching completeness and consistent with facts, to explain the E. M. F. and the chemical action, has not been forthcoming until recently. Many partial theories have been put forward and contended over, some founded on indisputable facts, but others mostly the work of fancy. A German student and investigator of electro-chemical subjects, Dr. F. Dolezalek, has, after several years of investigation of the lead-sulphate cell, collected together the results of others' work and his own into a book of about 100 pages, entitled, "Die Theorie des Bleiaccumulators." That it leaves nothing to be desired is perhaps too much to say, but it certainly presents in an orderly way the facts, as determined by experiment, in regard to the resultant changes that occur in the cell in action, and upon these, by aid of thermo-dynamic principles, establishes in what seems to the writer a convincing way a theory of the cell, that seems to be in complete accord with the dissociation hypothesis and the osmotic theory.

It is the object of this article to give to THE TECHNIC'S readers, if possible, the salient features of the more important chapters of this book, and thus an intelligent idea of the theory, as Dr. Dolezalek presents it, of the lead-sulphate storage-cell without the mathematical developments or the many details essential to the establishment but not to the understanding of the theory.

CHEMICAL ACTION.

The discoverer of the lead-storage cell, Gaston Planté, believed that the water of the electrolyte was dissociated by the current into oxygen and hydrogen, resulting directly during the charging in a higher oxide formation at the positive plate and in the negative in a reduction to lead, while the reverse action took place during discharge. In many text-books the idea will still be found expressed that the oxidation processes are the reverse of each other at the two plates. Some prominent writers have also held to the idea that the formation of the gases oxygen and hydrogen have a part to play in the electrolytic action. It can easily be seen, however, that at the negative plate (when once it has become lead) there is no further oxide change. It is not so obvious that at the positive plate no reduction to a lower oxide takes place. But Gladstone and Tribe have shown that the acid changes in its density regularly and oppositely during the charge and discharge of the cell, *increasing* in density during *charge*, *decreasing* during *discharge*. This led them to the theory that the acid itself was the electrolytic medium, not the water, and that $H_2 S0_4$ is used when the cell discharges (forming $Pb S0_4$), and again $H_2 S0_4$ is formed when it charges.

That the primary current action is through the $S0_4$ ion, and that it results only in the formation of the simple sulphate, $Pb S0_4$, has been sharply assailed, and many other actions have been suggested as more likely. The verification of the sulphate formation, however, is a matter of direct experiment, and the reseaches that have established it are quite interesting in themselves, though of course cannot be described here. They practically establish the following electro-chemical statement :

When the cell is charging the reaction at the lead plate is,

$$Pb\,SO_4 + 2\overset{+}{H} = Pb + H_2\,SO_4 + \text{pos. electricity};$$

at the lead peroxide plate,

$$Pb\,SO_4 + \overline{SO_4} + 2H_2O = Pb\,O_2 + 2H_2\,SO_4 + \text{neg. elec.}$$

which means that the current is flowing from the $Pb\,O_2$ plate through the acid to the Pb plate.

When the cell discharges the current flows in the opposite direction and the reaction is:

at the Pb plate,

$$Pb + \overline{SO_4} = Pb\,SO_4 + \text{neg. electricity};$$

at the $Pb\,O_2$ plate,

$$Pb\,O_2 + 2\overset{+}{H} + H_2\,SO_4 = Pb\,SO_4 + 2H_2\,O + \text{pos. elec.}$$

Adding the two equations expressing charge and the two expressing discharge, we get for each sum:

$$Pb + PbO_2 + 2H_2\,SO_4 \rightleftarrows 2Pb\,SO_4 + 2H_2O$$

The parallel arrows mean that it is an equation of chemical equilibrium and that the reaction takes place in either direction, from left to right it represents discharge, from right to left, charge.

It is important to emphasize that the disappearance and reappearance of Pb and $Pb\,O_2$ from the electrodes in discharging and charging, and that the $Pb\,SO_4$ is formed on *both* plates, and also that the change in concentration of the acid in the proportion indicated by this formula have been *directly* determined by *experiment*.

Thus the ground-work of fact as to the resulting changes in the working of this cell seems to be indisputably laid, and any theory of its E. M. F. must rest upon that.

Whether the action indicated by the formula is direct and primary, or results indirectly and is therefore secondary, can not be determined from these experiments. For this a study of the E. M. F. must be made, and this author devotes several chapters to an exhaustive discussion of the E. M. F. calculated on the basis of thermodynamics and the osmotic theory, and compares it with the observed value.

ELECTRO-MOTIVE FORCE.

To one who has worked with metallic circuits for the most part, and is accustomed to measure potential differences directly with a volt-meter, it seems at first thought to be simple enough to determine directly the potential differences given between any two points, and thus an easy matter to find it for the substances involved in this formula. But a little consideration of the nature of electrolytic actions suggests the difficulties and points out the errors one would be led into if he took observations of a volt-meter to determine, for instance, what potential difference is met at the boundary of two different electrolytes. The total difference of potential that the volt-meter gives is due to the sums of three potential differences, viz.: one at each electrode and one at the boundary of the two liquids. No information would be given, therefore, as regards any one of these three parts. This serves to illustrate what is meant above by the difficulties in the way of determining the E. M. F. of the chemical action assumed by the formula. If the volt-meter takes current, so much the worse, for the polarization at the electrodes would often be so rapid that a 50% or greater change of E. M. F. would occur in the thing measured before an observation could be made.

But the energy relations through the well-determined mechanical and electrical equivalents of heat, furnish a basis of calculation of E. M. F. for any chemical reaction for which certain data are at hand.

$$E = \frac{Q}{23073} + T\frac{dE}{dT}$$

expresses the value in volts of the E. M. F. generated by a chemical action the total heat reaction of which is Q calories for each 96540 coulombs* of electricity yielded. T is the absolute temperature and $\frac{dE}{dT}$ is the temperature coefficient of E. M. F.

For the chemical action of our formula, Q has been determined by independent experimenters

*This is the quantity of electricity transported by 1 gram-molecular weight of an ion.

with a fair agreement. $\frac{dE}{dT}$ has also been determined, though not perhaps quite as exactly (for a large range of acid concentrations) as might be wished.

It is interesting to note that the determination of the value of $\frac{dE}{dT}$ for different concentrations of acids shows that this function is equal to zero when the acid is of density 1.044, negative below this density, and positive above it. At this density then the equation $E=\frac{Q}{23073}$ holds. Using the average value of Q found by experimenters, the E. M. F. of the cell for this density of acid is calculated to be 1.88 volts, which agrees exactly (*i. e.* within the limits of uncertainty of the data) with the actual value of the E. M. F. as observed.

A glance at the subjoined table will show the very marked change of the E. M. F. of the storage-cell with a change of concentration of the acid (compare columns 1 and 5):

1	2	3	4	5	6	7
Specific Gravity of Acid.	$\frac{dE}{dT}$ Milli-volts.	E. M. F. AT 0°C, IN VOLTS.				
		Calculated.		Observed.		
		From Heat.	From Vapor Press.	Dolezalek.	Streintz.	Heim.
1.553	+0.04	2.39	2.38	2.36	. .	. .
1.420	+0.06	2 25	2 26	2.25	2.27	. .
1.226	+0.11	2.10	2.10	2.10	2.10	2.10
1.154	+0.32	2.06	2.00	2.01	1.99	2.00
1.035	+0.07	1.75	1.80	1.89	1.89	. .

Now, this is used in a very ingenious way by the author to further establish the theory of the lead-sulphate cell. He takes two storage cells with acid of different densities, joins them in series, but positive against positive, and then discusses the E. M. F. of the resulting battery. When this battery works (if this chemical theory be true) there results a change of the concentration of the acid, due to the formation of sulphate in one and reduction of sulphate in the other, and the corresponding changes in the amount of the solids Pb, $Pb O_2$ and $Pb SO_4$. The change of free energy, however, is involved only in the changes of *concentration* produced in the *acid*, since the solid substances are in the same condition before and after any action of the cell. [This is like the deposit of copper on a copper electrode and solution of copper electrode in a $Cu SO_4$ solution]. The change of acid is easily calculated. The difference in E. M. F. of the two cells is, of course, the E. M. F. of the combination battery, and can be directly and exactly measured. The energy involved in the concentration change can be calculated in two ways: 1st, by the heat of dilution involved ; 2d, by the thermo-dynamic process of distillation of water from one acid to the other. This gives two independent methods for reckoning the same value, and this should agree with the diff. of E. M. F. of the two cells. From this can be found, of course, the E. M. F. of a cell for all concentrations.

Compare columns 3, 4, 5, 6, 7 on the table above, and see how remarkably they agree. Column 3 is calculated from the heat data, 4 from the distillation data.

Nernst's osmotic theory of E. M. F. gives another entirely independent method of calculating the E. M. F. that the chemical action of our formula should yield, and the following table will show the results of calculation by this theory compared with the observed values :

*Concentation of Acid.	E. M. F. AT 0°C, in volts.	
	Observed.	Calculated.
1.000	1.917	1.917
0.180	1.828	1.827
0.0505	1.764	1.760
0.0124	1.690	1.687
0.00046	1.488	1.516

*This can only be reckoned for dilute solutions, and the concentration is given in gr. Mol. $H_2 SO_4$ per litre.

To recapitulate, then, we find that that the author of this monograph takes the results of experimental reseach embodied in the equation,

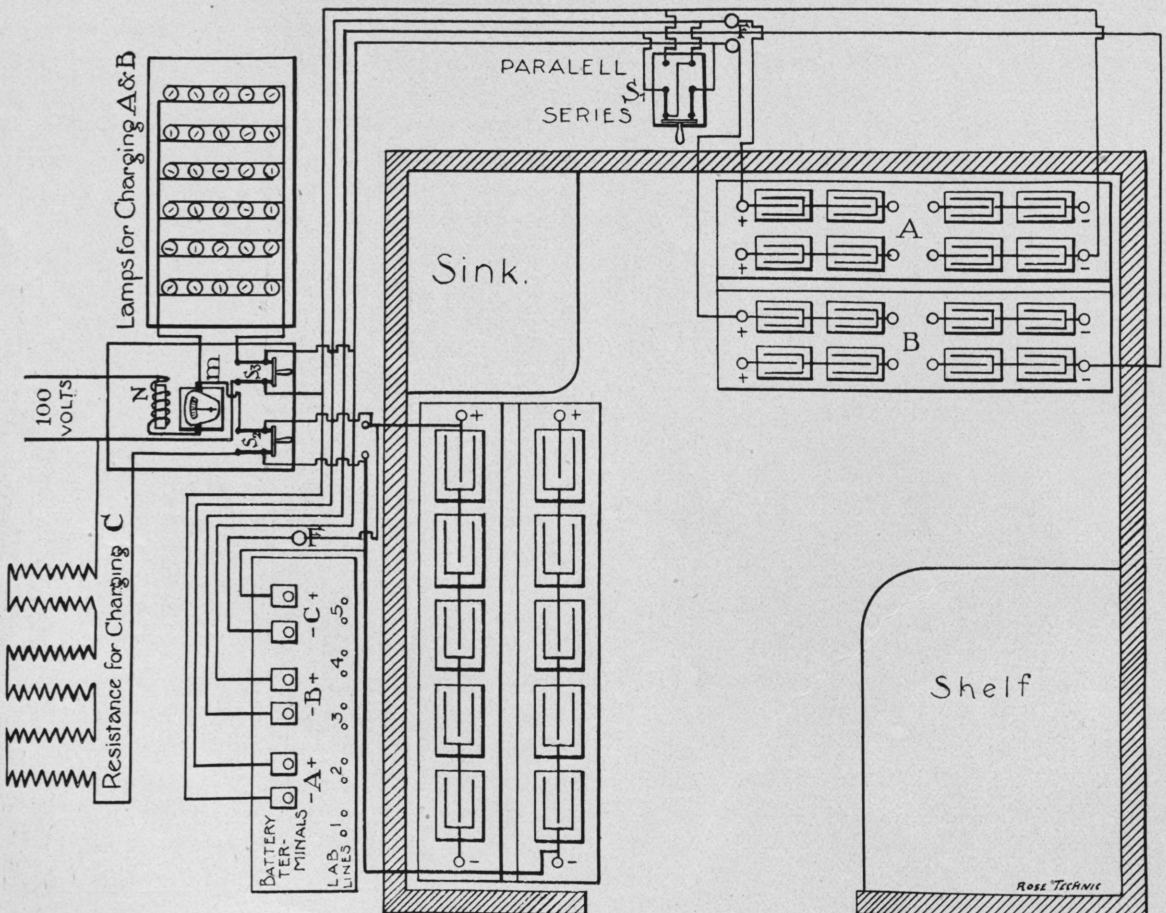
$$Pb + Pb\,O_2 + 2H_2\,SO_4 \rightleftarrows 2\,Pb\,SO_4 + 2H_2\,O$$

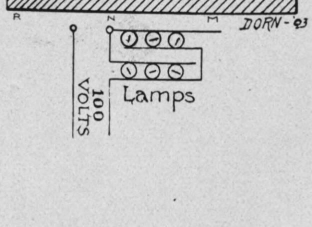
as the expression for the actual, essential and reversible, electro-chemical process that goes on in the lead storage-cell; that he then proceeds to apply three entirely independent methods to the calculation of the E. M. F. that such action would yield, and that the results of these calculations agree (well within the limits of uncertainty of data and observation) with the E. M. F. of the cell directly measured.

From the conclusion that the actual chemical action is simply what the formula states, there seems to be but one escape, viz.: of supposing that some other primary action takes place, resulting in this secondarily. But, if so, it must be such that the change of energy involved is zero, or so *small* as to be merely a slight correction.

We may, therefore, feel about as safe in accepting this theory for the lead-sulphate storage-cell as in accepting the dissociation theory itself.

The space required for this condensed review necessitates making mere mention of the facts



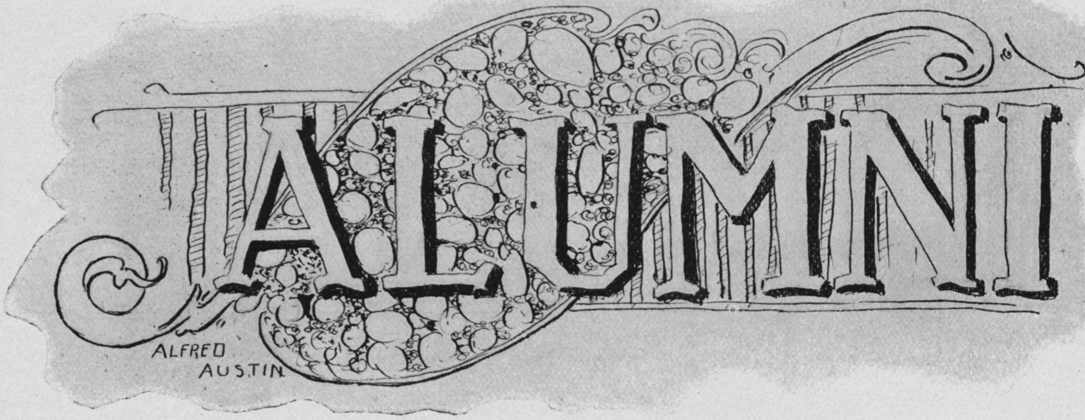


A, bank of 8 cells, 40 A. H each; B, bank of 8 cells, 40 A. H. each; C, 2 banks of 5 cells each, 160 A. H. each; F, fuses to protect batteries from short-circuit; S_1, switch for combining banks A and B in parallel; S_2, S_3, switches for charging batteries independently; N, circuit breaker in charging line; m, ampere-meter, in charging line.

that the actual reversibibity of the cell is also pretty satisfactorily established experimentally, and that the apparent considerable departures from the required E. M. F. under certain conditions of charge and discharge are accounted for on the basis of change of concentration of the acid within the plates themselves.

In the article by Gray, above referred to, Fig. 3, p. 56, illustrates very well the sudden rise in E. M. F. when the cell is nearly charged, and it is at this point that gas begins to come off. The gas does not cause the E. M. F. to rise, for the E. M. F. of the gas cell is not so high, and the formation of $H_2(SO_4)_2$ is not a satisfactory explanation. But the concentration change alone is sufficient to account for it.

It has been thought that in this connection it might interest some of the Alumni, especially those of very recent classes, to know that we have again in the battery-room a good working battery of fair capacity for the ordinary laboratory use. A cut is appended in order that those familiar with the room may get an idea of how we have remodeled. The cut will perhaps sufficiently explain itself. The ideas that have obtained in the plan have been: (a) to have two or three independent battery sources of moderate voltage, thus we have Battery C (10 cells of capacity 160 amp. h. each, with maximum safe current of 40 amp. each), and Batteries A and B (16 cells of cap. 40 amp. h. each, with max. safe current of 10 amp. each); (b) to keep all the cells of each battery in the same condition, hence terminals go to each battery as a whole, and not to individual cells; (c) to make the charging entirely independent of the distributing circuit. Battery C is arranged in two banks of 10 volts each, that may be connected in parallel or series. Batteries A and B can be used together or separately, controlled by the switch S; in each bank two cells in series form the unit, so 4, 8, 16 or 32 volts may be had. using all the cells alike. That is arranged by racks having copper links to make the desired connection for a whole bank at once, thus preventing short-circuiting that is so liable to occur if separate links are used.



*Factory Drive.

A Comparison Between Electrical and Mechanical Transmission.

By H. H. HOLDING, '89,
VICE-PRESIDENT PELTON ENGINEERING CO., CLEVELAND, O.

THE cost of a manufactured article is composed of many elements. Some of these are easily determined, and in making up shop costs can be estimated very closely. There are, however, some items which are difficult of determination, one of which seems to be an ever varying quantity, viz: factory expense. To this account is usually charged such expenditures as cost of fuel, oil, engineer's services, etc., and any saving, therefore, which can be made in the cost of fuel will reduce the expense of manufacture of the product.

In a belt-driven plant there is a friction load, which in almost every instance is a large percentage of the average load. The indicator diagram is an easy means of determining the energy required to operate a factory under various conditions, and by taking a series of cards covering a considerable length of time, the average output of the engine can be determined. By taking cards also when the machinery is out of use a close estimate can be made of the friction load of the factory. From a number of tests on several factories, three sets of results are given, viz:

Factory No. 1—Average load, 98.6 H. P.
Average friction, 65.7 H. P.
Useful energy, 22.9 H. P.
Efficiency at average load, 24 per ct.

Factory No. 2—Average load, 166 H. P.
Friction load, 78 H. P.
Average useful energy, 88 H. P.
Efficiency at average load, 53 per ct.

Factory No. 3—Average load, 220 H. P.
Average friction load, 49.8 H. P.
Efficiency at average load, 77 per ct.

A test on this factory a short time previous to taking up belts and lining shafting, showed an average efficiency of 70 per ct.

The friction load in a factory depends upon the condition of the shafting, its speed, the size and number of bolts, and in a large degree the alignment of the hangers. The effect of the condition of shafting upon the friction load is shown in factory No. 3, where a thorough periodical overhauling of the belting and shafting is considered essential. The friction load was in-

* Read before the Associated Technical Club of Cleveland, Ohio.

dicated in the above test just after one of these renovatings, and a saving of some 16 horse power was found to have been accomplished.

For comparison let us take factory No. 2, since it is undoubtedly a fairly average factory. It consists of a single building some three stories in height and about 200 feet long. The engine is located near the center, the heavier machinery being on the first floor. The shafting was well erected and the conditions are very good for belt driving. Taking the total capacity of the engine as 200 horse power, a diagram is made in the form of a curve showing the efficiency in per cent of the factory operating under various loads. (Fig. I, Curve A) Because of the large friction load, the efficiency, i. e., the ratio between work developed by the engine and the actually effective work, decreases very rapidly as the engine load decreases. While we have assumed the friction load to remain the same under various working conditions, the truth is that the friction increases with the load. There is, however, no convenient means of measuring this increase, and in order not to err by using hypothesis, we have neglected this quantity in drawing the curve shown.

Let us now consider the conditions should an electric transmission be adopted. In such a system there are three sources of loss; first, in the

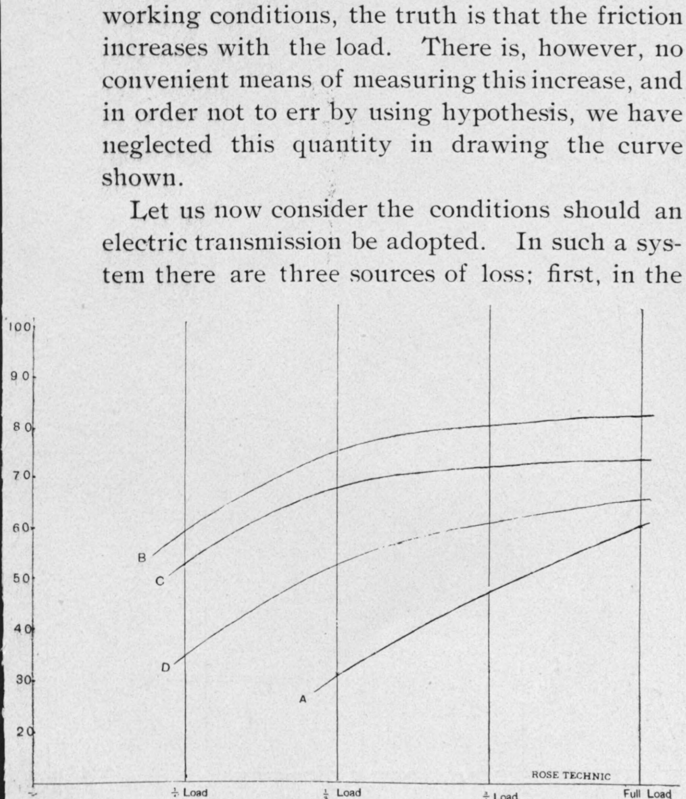


Fig. 1.

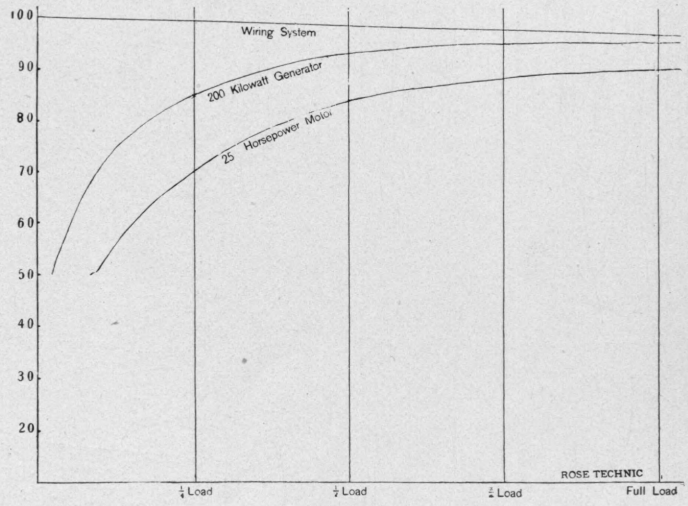
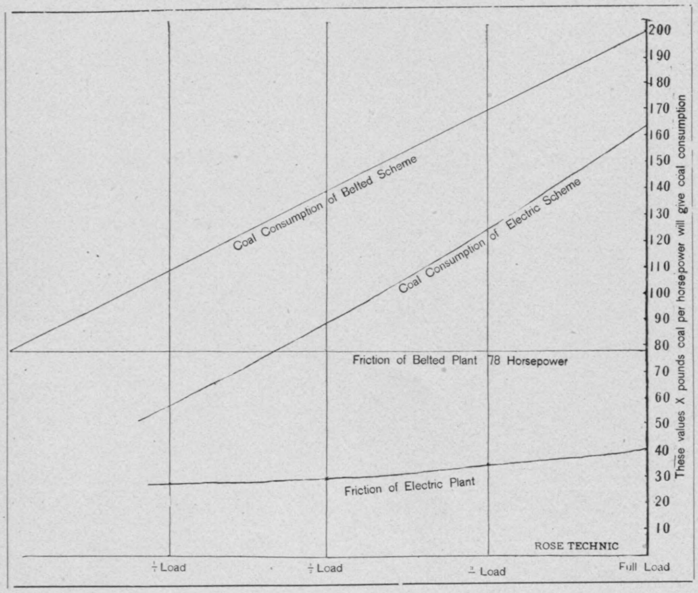


Fig. 2.

transformation from mechanical to electrical energy in the generator; second, the losses in the conductors or wires, and third, the losses in transformation from electrical energy in the motors. It is comparatively easy to determine the losses, and curves in Fig. 2 show the efficiency of the transmission system, the generator and motor. By combining these various values we can draw a line, as shown in Fig. 1, Curve B, which will represent the economy of the entire electric system under various conditions of load. This latter curve represents the efficiency of an electric transmission from the pulley of the generator to the pulley of the motor. In order to compare this with the belted factory curve in Fig. 1, Curve A, the losses in the engine must be taken into consideration.

Assuming the efficiency of the engine to be 90 per cent, and multiplying the values in Curve B by that quantity, the true efficiency curve of the electrically driven factory is drawn (C). Comparing this latter curve with the line representing the efficiency of the belted scheme (A), the relative advantage of electricity over belts is readily seen.

The point of interest to the factory manager, however, is not particularly the efficiency obtained from various schemes of transmission, but the fuel consumption of the respective methods of transmitting power.



Fig, 3.

Using the efficiencies in Fig. 1 (A and C), another set of curves has been made, showing the relative coal consumption in a 200 horse-power plant. (Factory No. 2, as shown above.)

The upper line (Fig. 3) shows the coal consumption under various loads of the belted plant, the maximum being 122 horse power of useful work. The next curve shows the coal consumption of the same factory electrically driven. In the latter case, however, 122 effective horse-power is obtained by an output of 164 horse-power instead of 200 horse-power. Should the factory be run at one-quarter its output it will be seen from the diagram that the electrically driven plant will require 48 per cent less coal than the belted factory. In drawing these curves it is assumed that the entire motor plant is in operation continuously. A still greater saving could be effected by shutting down the motors in departments where they are not needed.

Observations on electrically driven manufacturing plants have proven the correctness of Curve C, Fig. 1. For instance, a plant having a total capacity of 300 horse-power was indicated and a net efficiency of 70.7 per cent was shown. The curve ("C," Fig. 1) shows a full load of efficiency of 74 per cent, and as the plant in question had large quantities of shafting retained, we consider that the showing in actual practice is a very close agreement with the curve as drawn.

The electric drive has many advantages over the mechanical transmission, but as they are well known only a few will be mentioned, viz: the ability to shut down departments without interfering with other parts of the factory is important; the ability to arrange machinery irrespective of the lines of the building, thus obtaining sufficient grouping and effective lighting, is another valuable feature. Freedom from shut-downs due to the breaking of main belts; the lessening of fire risk by the abolishment of vertical openings through floors made necessary by vertical belts; the almost instantaneous response to sudden demands for power, and the ease with which additions can be made, are all worthy of consideration.

There has not been taken into account in our calculations the friction losses in such shafting as it may be necessary to retain, but as we have also neglected the increase in friction in the belted scheme as the load increases, we believe that the latter will more than offset the former. The diameter of shafting can be much smaller, because the machinery can be grouped and the

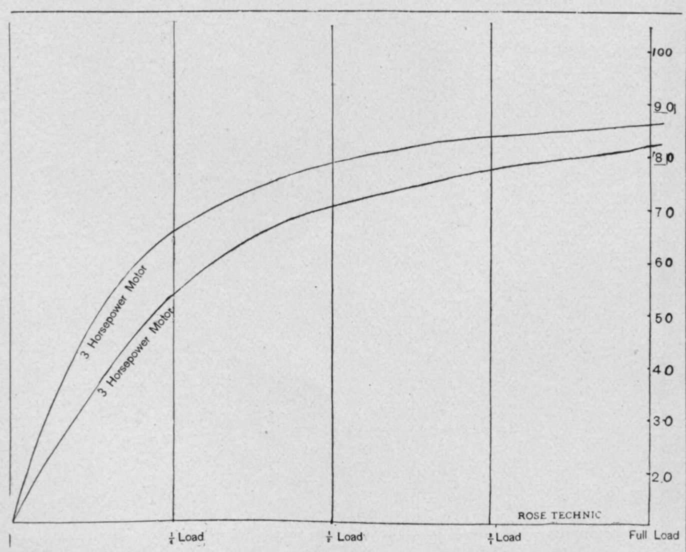


Fig. 4.

power applied to the shafts near the center of their length.

Much care should be taken in the selection of the electric apparatus. While high-grade electric machinery will show a decided saving in most cases over mechanical transmission, such saving could not be made should poorly designed machinery be installed. In Fig. 4, "A" is the efficiency curve of a three horse-power motor of inferior design, while "B" shows the curve of a well-designed motor. Should we substitute a poor grade of motors in place of the high grade used in our determinations, Fig. 1, C would become Curve D. Should we carry the subdivision too far and use motors of small size, the latter curve would also represent the factory efficiency under these conditions. Hence, if the most economical transmission is desired the motor should not only be well designed, but as large in size as possible. In making up the curve shown in C, Fig. 1, 25 horse-power motors have been used. The size of the motor, however, must be determined by a careful consideration of the conditions.

Generally very slow speed motors are less economical than those operating at moderate speeds, and this should also be considered in designing a factory drive.

Without entering upon a discussion of the advantages of various styles of motors, it will merely be said that because of its high efficiency the open motor should be used wherever possible.

With reference to the cost sheet it is readily seen that an electric system will reduce factory costs. There is a refinement, however, which is not as yet in general use, but which will become more and more adopted, we believe. This is the recording of energy delivered to separate departments in the factory. When each department has charged to it pro rata the cost of power the item of factory expense no longer remains a general charge, but is an item chargeable directly to the cost of the manufactured article. This will not only facilitate the determination of the factory cost of the article manufactured, but will enable the detection of sources of excessive expense, and consequently suggest the points where improvement can be made. The records will also indicate the presence of faults in shafting, pulleys, etc.

The manufacturer should not accept unequivocally a statement that electricity will make for him a veritable utopian condition, for there can be substituted for belt driving an electric transmission which would only slightly improve a belted plant and be a disappointment in the end. He should be guided not only by his own good sense, but should consult persons whose experience enables them to advise wisely. With a knowledge of what has been done in other places and a competent engineer to guide, there is no reason why almost any factory of considerable size cannot be driven electrically much more cheaply and more advantageously than would be possible by the use of mechanical means.

How Much Will It Cost?

By W. R. SANBORN, '93,
DIVISION ENGINEER INDIANA, ILLINOIS & IOWA R. R.

I BELIEVE there was an idea which I was going to spring on you. Its substance has been floating about in my head for some time past, but a recent letter from Prof. Howe crystallized it into definite form. He wished to know why I didn't pack up some blues and send him. Wondering what I could send brought to mind the standard designs of this road, its bridges and cost.

Through the Institute, as the collecting and distributing agent, I wish to propose the organization of a co-operative bureau for finding out the cost of material, labor and construction.

"Cost"—dollars and cents—is a very important part of an engineer's education which in my case has been supplied only by great effort on my part since leaving school, It may have been in our course at Rose, but if so, so little stress was put upon it that I've forgotten its existence.

The man or corporation that is back of some engineering enterprise, that is to say, the capitalist, wants work done, wants something built. He hires an engineer to do it. He takes it for granted that the engineer will accomplish the end aimed at; takes it for granted that when completed the engineer will turn over to him a first-class piece of work, and he never gives a thought to the amount of thinking and figuring it took on the part of said engineer to overcome the many obstacles, nor the amount of fighting, nor the perseverance it took on the part of the engineer to execute the work as planned. The whole thing with capital is: "How much will it cost in dollars to attain our ends, and how soon can you do it?"

Now, then: If you can train men at R. P. I. so that they can answer that question, so that they can *say for a certainty* how much MATERIAL, how much LABOR and how much TIME is required for the accomplishment of certain ends, you will turn out a class of men who can jump clear over any plodding draftsman or surveyor in the country.

To know those three things a man must of necessity have a clear insight into the mechanics and mathematics of each and every problem. It is easier to design a bridge, to carry a given load than it is to estimate its cost. If inexperienced in designing, there are numerous structures in place that can be examined and copied, but even if they keep a good set of books showing cost of work, no railroad company or other corporation is going to throw open its books for green engineers to hunt up cost of bridges in. The laws of mechanics are fairly stable; the strength of iron in 1901 is not materially different from what it was in 1897 or '96. The cost is,

That is the great handicap that the young engineer has to contend with. He can do more multiplying with his slide rule in an hour than his "practical" superior can by hand in a week, but he can count on always having a "superior" just as long as said superior supplies the cost price per unit.

The chief engineer can always find some sharp young fellow who can run in a curve, or if he have some mathematical training, who can put easements on his curves, or even figure out the strength of a bridge; who can read a 100-foot tape and plat notes and make a good looking tracing in a short time, and any fool can make a blue print, providing his paper don't give out before he succeeds in getting a good one. But after the assistant makes the plans and blue prints and bill of material it is the chief engineer who supplies the cost prices and says to the capitalist what it will cost and when he will have it

done; and it is the man who knows the art who will become chief engineer.

I figure that I have had a very good, broad and comprehensive experience at railroad construction since leaving school, but I feel very much handicapped as regards cost. I feel that with a chance offered me I could go ahead and build most any kind of railroad, and do as good and as cheap a job as any other engineer, but I should be less confident of my ability to say in advance what it would cost.

It is very hard to get data concerning cost. In the first place there are so very many items entering into the cost of any single piece of work that unless an expert accountant is constantly on duty he who does the work will not know when it is done, just how, when and where each one of the many thousand dollars went. He knows that the road cost $1,000,000, but he can't say what part was for bridges, what for grading, what for track laying, or what for ballasting.

Then, again, suppose he does have a fine system of book keeping and really finds where each dollar goes to. It is there in his books, but who ever takes the time to find out just how much more it costs to do work under one condition than it did under some other. By constant practice and lots of it the chief engineer has learned about what the cost of various items will be under various conditions, but I don't know, not having the broad experience. This railroad company has a well kept set of books showing cost of work, but nowhere on the books is there any notes saying why gravel ballasting should cost $400 per mile in one case and $700 in another; and I may add it is a well kept set of books that reduces total cost to cost per unit. Then again, if it cost $500 per mile in 1896 how am I to know what it will cost me to do an exactly similar job in 1901. I must know the relative market value of labor, gravel and train service; and if I never have done any such work, how completely am I at sea!

And how often does the young engineer get any idea of cost whatever? He sets stakes for a certain piece of work, and then as far as *he* is concerned his work is finished; some foreman does the work according to his stakes and the cost of it is buried somewhere in books to which the engineer has no access.

Such are the conditions, and the problem is, how shall the conditions be bettered. I have a scheme which I don't suppose is perfect, but the more I get it advertised the sooner other engineers can get busy helping me to perfect it. So I'll start the ball rolling by saying how I think we can educate ourselves as regards cost.

At R. P. I. establish a bureau to collect, classify, catalogue and distribute cost prices and specifications of every and any kind of material, or labor, or completed work that comes under the head of any of the branches of engineering taught at R. P. I. Now, I don't mean an indiscriminate clipping of "contract cost" items that appear each week in engineering magazines. That wouldn't fill the bill. We know too little of the attending conditions and specifications.

Rely chiefly on the alumni to supply the raw material. These cost prices must above all things be practical and detailed and up to date. To be of value they must be reliable. Guess work won't go. All of the alumni are working at something or other where from time to time they can get complete, accurate, detailed accounts of cost of work. There are enough of us so that we could keep a pretty steady stream of cost prices headed toward Terre Haute. The rudiments of Volkswirtschaftslehre teach that nobody is going to put himself out without some adequate return for his trouble. So to get the Alumni to take the trouble to find out these cost prices and send them in we must make them some substantial returns, of which I will speak later.

When once this information has arrived at Terre Haute let it be assorted and turned over to that particular department which it is most likely to benefit, and there let it be put in good shape. Should the cost of laying track come in at so much per *rod* let this department reduce it to its cost per foot or per mile or both. Have some comprehensive system to which all items can

be reduced, and at the same time show what were the conditions attending. Group all similar items under proper heads; classify and index them, always in every case preserving as far as possible the details as well as the final summation. This very act of catalogueing would be an education in itself for the students engaged in it. It would familiarize them with cost as nothing else but years of experience could, it would impress them as only a routine, oft-repeated occupation can, and at the end of a four years' course they would find themselves four years ahead of the average technical graduate.

With this information supplied and tabulated the next thing would be to multiply and distribute it, and I don't know of any better way than as a *supplement* to the Rose Technic. Have all the information that is gathered each term under its proper department heading, printed on *one* side of a sheet only, sent to all subscribers, to all undergraduates who in any way helped in its classification and to all alumni who contributed the fundamental information. I say printed on one side only, that those receiving same may preserve this information in some permanent book form and may likewise separate their own particular department from the other departments without destroying any.

Just to start things I have started on a detailed table of the cost of 10,000 lineal feet of pile bridging, which I shall send in soon, showing my ideas on this cost business.

The Effects of Some Common Poisons.

By L. L. HELMER, '01.

WHETHER a substance is or is not a poison is determined largely by the standpoint from which the word poison is defined. If we take the true scientific definition of a poison we must exclude a great number of substances which are harmful because of certain physical properties which they possess and through which they act more or less mechanically.

The knowledge and use of poisons are by no means modern, as there are records of books written on the subject as early as the third century B. C., and from that time down to the present, poisoning has been extremely popular for suicidal and criminal purposes. Especially was this true in ancient times, when poison was thought to be a very elegant way of getting rid of troublesome persons. For at that time the methods of detection were so crude that in many cases, although every circumstance pointed to death by poisoning, still no absolute proof could be obtained. And likewise in many cases death was ascribed to poisoning which in reality was due to natural causes.

A noticeable fact in the history of these times is the large number of royal personages who spent a great deal of their time in experimenting with substances of a poisonous nature, and to some of these persons, no doubt, modern science is more or less indebted. Charles IX. was especially enthusiastic in experimenting along this line, however some of the methods employed by him were a trifle unique, to say the least. It is said that in one case there was a question as to whether a certain substance was an antidote or not. To settle the matter, the King administered to a servant a lethal dose of corrosive sublimate and followed it up with the antidote. There was no longer any question, for the man died in a few hours.

The history of the detection of poisons has passed through a number of phases. In early times the only method of detection was that by antecedent and surrounding circumstances, aided sometimes by experiments on animals. If the death was sudden, if the post mortem decomposition was rapid, poison was indicated; sometimes a portion of the food last eaten or the suspected thing would be given to an animal. If the animal also died, such proof would be taken as conclusive. However, even this evidence would not, in the mind of the modern toxicologist, put the matter beyond doubt, for it is now well known that meat may become filled with bacilli and produce rapid death, and yet no poison, as such, has been added.

In the next phase the doctors were permitted to dissect the deceased person; and in this way the true cause of a large number of deaths,

which would otherwise have been ascribed to poisoning, was ascertained. It was not, however, until the end of the eighteenth and the beginning of the present century that chemistry was far enough advanced to test for the more common mineral poisons. The modern phase was then entered upon, and toxicology became properly the study of the chemist. And it is the development of chemistry that has made it possible at the present day to detect, even in very minute quantities, almost any poisonous substance known.

Poisons are classified in a large number of ways and in nearly all cases either the general symptoms, the local effects or the chemical structure is made the basts of classification. However, a truly scientific arrangement would be one based upon a comparison of all the properties of a poison, whether chemical, physical or physiological. Upon this basis there is no perfect, systematic arrangement at present attainable, and so it is necessary either to omit all classification or else to arrange poisons with a view to practical utility merely.

From the latter point of view an arrangement simply according to the most prominent symptoms seems to be a good one, and will undoubtedly be of more general interest. Hence the following outline has been suggested:

A. Poisons causing death immediately or in a few minutes. There are but few poisons which destroy life in a few minutes, the chief ones in this class being prussic or hydrocyanic acid, the cyanides, oxalic acid and occasionally strychnine.

B. Irritant poisons, the symptoms of which are mainly pain, vomiting and purging. Under this head may be included a large number of mineral and vegetable substances. Arsenic, antimony and phosphorus are types of the mineral poisons belonging to this class, while the Digitalis or Fox-glove plant may be taken as a type of the vegetable poisons.

C. Poisons more especially affecting the nervous system.

1. Narcotics. The chief symptom of these poisons is insensibility, and to this class belong opium, chloral and chloroform.

2. Deliriants. As the name implies, the most noticeable symptom of these poisons is delirium. Most of the substances comprising this class are of vegetable origin, and Belladona may be taken as an example.

3. Convulsives. Almost every poison has been known to produce convulsive effects, but the only true convulsive poisons are the alkaloids of the strychnos class, such as Strychnine, Brucine, Codeine and a large number of others.

Of the poisons which produce death almost immediately, prussic or hydrocyanic acid is probably the most deadly. This acid is extremely volatile and the fumes are equally as deadly in their action as the acid itself. For this reason the anhydrous acid is not an article of commerce and in most foreign countries the strength of the commercial article is fixed by law. A solution containing over fifty per cent prussic acid is very rarely met with, the more common strength being from five to twenty-five per cent.

Irrespective of suicidal or criminal poisoning, accidents from prussic acid may occur either through the use of cyanides in the arts or from the somewhat extensive distribution of prussic acid, or rather of substances producing prussic acid in the vegetable kingdom. The alkaline cyanides are much used in the gilding of metals, the colouring of black silks, the manufacture of Berlin blue, the dyeing of woolen cloth and in a few other manufacturing processes, and not infrequently fumes of prussic acids are developed.

In cases of accidental and criminal poisoning the poison is generally taken into the stomach. However, death has often been caused by breathing the fumes: as in the case of Scheele, the chemist who discovered the acid and who was killed by the accidental breaking of a flask containing some of the anhydride. There is also a case recorded of death being produced in a very short time by a man introducing some of the acid under his finger nails. It has also been shown by experiments in which every precaution was taken to prevent the fumes from being in-

haled, that hydrocyanic acid applied to the eye of warm blooded animals will destroy life in a very few minutes.

Notwithstanding the great number of persons who have died from the effects of cyanide poisoning it is yet somewhat uncertain as to what is the minimum dose likely to kill an adult healthy man. However, it is safe to say that in most cases the amount was much more than enough necessary to produce death, and it has been generally accepted by toxicologists that one grain or or about .0056 gram is sufficient to cause death in the average adult.

When a fatal but not an excessive dose of either prussic acid or potassium cyanide has been taken the first symptoms are generally noticeable in from six to ten seconds after the taking of the poison and in many cases loss of consciousness and death have been known to take place in as short a period of time. Generally the first symptom is a feeling of constriction in the throat accompanied by occasional vomiting ; the breathing is distinctly affected and confusion and giddiness of sight rapidly set in. These symptoms are followed by convulsions and a speedy death.

In England more especially than any other country, oxalic acid has been used in a large number of cases of suicidal poisoning. It has been invariably the case that oxalic acid or hydropotassic oxalate has been used, the neutral sodium and potassium oxalates having in no recorded instance been taken. The symptoms and even the locally destructive action of oxalic acid and the acid oxalate are so similar that neither from clinical nor post mortem signs is it possible to tell which substance has been taken.

A large dose of either causes a local and a remote effect ; the local is very similar to that produced by the mineral acids, that is more or less destructive of the mucous membranes with which the acid comes in contact. Regarding the true toxic effect of the poison there is some difference of opinion as to its action. It is claimed by some that oxalic acid is essentially a heart poison ; however, its chief action seems to be a profound influence exerted upon the nervous system, but as to the exact nature of this action authorities differ. The symptoms generally noticed in cases of oxalic acid poisoning have been first a burning in the throat, followed by burning in the stomach and vomiting. The pulse becomes very weak and the patient is exceedingly languid and generally dies in from ten to thirty minutes. Cases have been known, however, in which death did not take place until forty hours after the taking of the poison, and in other cases the patient has recovered entirely. The antidotes for oxalic acid are very few and the stomach pump is the most efficient one, but the acid should in all cases be neutralized at once by chalk or lime-water—in no case should sodium carbonate or any alkali be used, for the alkaline oxalates are more intensely poisonous than the acid.

Probably the most common poison and the one from which more deaths result than any other is strychnine. This is one of a class of substances known as alkaloids or vegetable alkalies, and is so powerfully bitter that one part dissolved in seventy thousand parts or water is readily perceptible. Strychnine is one of three of the principal constituents of the seed of the nux vomica or Koochla tree, and is met with in commerce either in the entire state or as a yellowish colored powder.

Strychnine is largely used in the manufacture of insect powders and vermin killers and these account for a large number of the cases of accidental poisoning from this substance, although strychnine is also very frequently used in cases of suicidal and criminal poisoning.

There has been a great deal of work done in the effort to determine the minimum lethal dose of strychnine for various animals, and it has been found that the degree of susceptibility of different animals to this poison differs very greatly. The more difficult question to solve, however, is the fatal dose for a man. It has been found that poisonous symptoms have resulted from the injection of an amount equal to one-eleventh of a grain and death has ensued from the injection of three-tenths of a grain; however, the best authorities place the minimum

dose likely to prove fatal from .5 to 2 grains.

Large doses of strychnine may be recovered from if proper medical treatment is sufficiently prompt. In fact there have been cases recorded in which a would-be suicide has saved his own life, by overdoing the matter of poisoning by taking simultaneously with the strychnine some narcotic, such as opium or chloral.

The commencement of the symptoms in cases of strychnine poisoning may be extremely rapid, the rapidity being mainly dependent upon the form of the poison and the manner of application. A soluble salt of strychnine injected under the skin will act in a very few seconds ; however, when nux vomica powder has been taken or when strychnine has been given in the form of a pill no such rapid action has been observed, the usual course being for the symptoms to begin in about a half an hour. It is possible for them to be delayed even from one to two hours and under certain circumstances for as long as eight hours. In a few cases there is first a feeling of uneasiness and a peculiar feeling in the muscles of the jaw, but generally the beginning of the symptoms is very sudden and the person has no warning whatever until he is seized with convulsions of almost the entire body. The convulsions are exceedingly violent and nearly every muscle in the entire body becomes rigid, the jaws being tightly set and the eyes prominent and staring. In nearly all cases there is a termination of some sort within thirty minutes after the first symptoms appear—the patient either dies or the convulsions cease and recovery follows.

In cases of poisoning by strychnine the patient should at once be placed under the influence of chloroform or ether and kept there for several hours if necessary. If neither of these substances can be obtained, the juice from a recently smoked pipe may be diffused in a little water and a few drops injected under the skin. In all cases the patient should be kept free from noise of any kind.

Of the mineral poisons, probably the one most commonly met with is arsenic. Arsenic is present in such a variety of commercial articles that that it is often not a little difficult in cases of poisoning by this agent to determine whether the poison was introduced into the system accidentally or intentionally. The length of time in which death generally occurs after arsenic has been administered depends upon the form in which the arsenic is used, the way in which it is administered and the size of the dose. If the poisoning is in the acute form, that is, if death takes place within two or three hours after the poison has been given, the symptoms are said to resemble very greatly the symptoms attending death from cholera. In cases of slow poisoning where the poison is being given in very small quantities and extending over a long period of time, there are no characteristic symptoms, and the person seems to be suffering from general ill health.

The antidotes to be used in cases of acute arsenic poisoning are almost any kind of oil, the white of egg or freshly precipitated ferric hydroxide. In the use of the last named substance care should be taken not to have excess of ammonia, if the iron is precipitated by ammonium hydroxde.

Taking chloroform as a type of poisons known as narcotics, it may produce death in either of two ways : by the action of the vapor, or the liquid. Accidents occur far more frequently in the use of the vapor for anæsthetic purposes than in the use of the liquid. Most of the cases of death through chloroform vapor are those caused accidentally in surgery and medical practice. A smaller number are suicidal, while for criminal purposes its use is extremely infrequent. There is a somewhat general idea that sudden insensibility may be produced by holding a cloth saturated with choloroform to the mouth of a sleeping person, or indeed of one entirely awake. This, however, is a very erroneous notion, as in a large number of experiments it was found impossible to bring a sleeping person under the influence of chloroform, and in no case could it be done without the exercise of the greatest care, for it was nearly always true that the person awakened almost immediately upon being exposed to the gas.

in any printed publication in this or any foreign country before his invention or discovery thereof, or more than two years prior to his application, and not in public use or on sale in this country for more than two years prior to his application, unless the same is proved to have been abandoned, may, upon the payment of fees required by law, and other due proceeding had, obtain a a patent therefor."

The accepted definitions of the four words which describe everything that is patentable, are as follows:

(1.) An Art.

"An art is an act or series of acts performed by some physical agent upon some physical object, and producing in such object some change either of character or of condition," or in other words, "Certain things done to certain substances in a certain way."

(2.) Machine.

"A machine is an instrument composed of one or more mechanical powers, and capable, *when set in motion*, of producing by its own operation certain predetermined physical effects."

(3.) Manufacture.

An instrument designed for the production of mechanical effects, but not capable of motion so as to by itself produce a predetermined result.

(4.) Composition of matter.

A mixture of two or more ingredients, which mixture possesses properties which belong to none of the ingredients in their separate state. It may be either mechanical or chemical.

A description was here given of the organization of the Patent Office, which is the representative of the public in the contract between the public and the inventor. It is under the general direction of a Commissioner of Patents, who has under him an assistant commissioner, a board of examiners-in-chief, about thirty-seven primary examiners and over two hundred assistant examiners.

The essential parts of an application for a patent were here detailed. They consist, in brief, of the illustrative drawings, the "specifications," including description of the invention and the inventor's claim for it, the petition and the oath alleging the novelty of the invention, and its conception by the claimant.

The course of the application through the Patent Office was next described, and the laws governing the so-called interference of applications explained at length. There followed further description of the construction put on patent claims and of what constitutes infringement. Attention was called to the fact, generally unknown, that it is unlawful to make a patented article even for one's personal use or for purposes of experiment. The reason that such infringements are rarely prosecuted is that they are not of sufficient importance to warrant attention.

The lecture closed with an interesting comparison of the patent law of the United States with that of other countries. Canadian laws require examination for novelty, as do those of the United States, but the ordeal is by no means so severe. The fees are $20 each six years, and special laws restrict foreign manufacture of the article patented. The term is 18 years. In Great Britain there is no examination for nov-

Gal 2 Rose Leaves—Lecture on Patent Laws

elty, the patent office holding that it is the duty of the courts to decide questions of novelty. The life of a patent is 14 years, and the fees are £4 at issue, £5 at end of fourth year, and an increase of £1 each year. There are no laws governing the time of working of the invention. Of the remaining European countries Germany and Austria are the principal ones requiring examination for novelty, and the life of the patent varies from 15 to 20 years, except in France, where the life may be 5, 10, or 15 years. In most foreign countries patent fees imposed by the government are very largely in excess of those charged by our government, and are imposed largely with a view to revenue. The fees for French patents are 100 francs each year. As a result of the low fees in this country (the Government fees amount to $35) the number of patents is very large, and a curious result is that the office is more profitable than in countries where higher fees are required. The great num-

The action of chloroform is usually divided into three more or less distinct stages. In the first stage there is a drunken condition, usually accompanied by changes in the senses of smell and taste. In the second, the patient falls into a deep sleep and consciousness is entirely lost. There is also a relaxation of all the muscles during this period. The third stage is that of paralysis, and death follows rapidly. There can be no limit placed on the amount necessary to produce death, as nearly every person would require a different amount.

On account of the large number of purposes for which carbolic acid is used, and the greater or less carelessness with which it is handled, this substance is responsible for frequent accidents and not a few suicides or attempts at suicide. Carbolic acid poisoning may result either from applying the acid to the skin or from taking it inwardly. The minimum fatal dose for an adult is placed by the best authorities at about fifteen grams, and the largest dose from which a person was ever known to recover was 160 grams of crude acid, representing about 75 grams of the pure article.

In nearly all cases of poisoning the stomach should be emptied either by the use of the stomach pump or tube, or by the use of emetics, such as sulphate of zinc, apomorphine, mustard or ipecac. If the poison was an acid, some such substances as magnesia, lime, chalk or soda should be given; if an alkali, it should be neutralized with a mild acid.

Lecture on Patent Law.

ON Monday, February 18th, and Tuesday, the 19th, Mr. Arthur M. Hood, '93, addressed the student body on "Patent Law as It Affects the Engineer." The lecture occupied an hour on each of the days mentioned. After opening remarks relative to the value of patent protection to the industries of the country, the speaker gave a short account of the development of English patent law. The first appearance of this right was as a monopoly granted under the royal prerogative, monopoly in this connection being defined as the exclusive right of making, using and selling any article which might otherwise have been used or sold by any other person.

From 925 to 1551 the Merchant Guilds assumed the control of the necessities of life, which were still private monopolies. After the latter date, however, the private monopolies underwent a steady decline in power until in 1623, when, by statute of James I. all domestic monopolies were abolished. This change had been made necessary by the enormous prices for necessaries of life, which were made possible by the right of private monopoly. In the year mentioned the foundations of the present system were laid, the royal prerogative being restricted to grants to inventors for a limited period.

As now accepted, a valid monopoly is a reward for service rendered without taking away any previously enjoyed rights of others. An invalid monopoly is one which takes away rights previously enjoyed by others. The means of granting a monopoly is through "Letters Patent." This is a term applied to what is in effect a contract between the public and an inventor, which grants to the latter certain exclusive rights and privileges.

The Revised Statutes of the United States provide that "Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, not known or used by others in this country before his invention or discovery thereof, and not patented or described

ber of inventions produced by citizens of this country is not entirely due to low government fees, as the American people are admittedly more original and inventive than others.

The lecture, at once novel and full of interest to most engineering students, was much enjoyed, and the only reason that the Technic presents no fuller account is that Mr. Hood has covered a part of the ground in an article contributed to the last volume of this journal.

SENIOR THESIS SUBJECTS.

New Method for the Determination of Manganese in Iron.—G. H. Clay.

Hydrolysis of Maltose.—G. Crawford.

Feasibility of Vandalia Line's changing present location of the Pocahontas (Ill.) curve to that surveyed by the Class of 1902, R. P. I.—W. R. Gibbons.

Test of Engine and Generator of Terre Haute Electric Co. Power Plant.—W. Hadley, J. R. Riggs, H. A. Schwartz, M. N. Troll.

Reconstruction and Test of 5 H. P. Induction Motor at R. P. I. shops.—M. J. Hammel.

Determination of Sulphur in Iron.—L. L. Helmer.

A study of the Stresses in the Web Members of the Panel above the Turn-table of a Drawbridge.—W. F. Huthsteiner, H. E. Perkins.

Expansion of Concrete and Steel in Arches.—E. E. King.

Investigation of the Action of Chlorine upon Ammonia.—A. C. Lyon.

Attempted preparation of Methyl Cyclo-pentane 1-2 Dicarboxylic Acid, and study of its anhydrides.—R. N. Miller.

Effect of Check Draught on a Locomotive Boiler.—H. D. Piper.

Study of Track Insulation and of Gravity Batteries of Automatic Railway Signals, to determine the best Track Ballast to use for Track Circuits.—F. W. Pfleging.

An Analysis of the Stresses in a Hopper-Bottom Steel Car of the type manufactured by the American Car and Foundry Company, with Impact and Spring Tests to determine the Coefficient of Impact.—R. K. Rochester.

The Hydrolysis of Dextrin.—R. R. Warfel.

RESOLUTIONS OF CONDOLENCE.

WHEREAS, We have been deprived, by the death of our fellow-student and friend, Karl F. Peker;

Resolved, That we, the Student Council and student Body of the Rose Polytechnic Institute, express our sorrow and sympathy to the bereaved family; and,

Resolved, That these resolutions be spread upon the records of the Council, and that copies be sent to the family, and to THE ROSE TECHNIC, for publication. COMMITTEE.

WHEREAS, We, the Class of 1902, of the Rose Polytechnic Institute, have been deprived of the companionship of our friend and classmate, Karl F. Peker;

Resolved, That we tender our most heartfelt sympathy to the bereaved family in this, their time of sorrow;

Resolved, That in respect to the memory of Mr. Peker, we, as a class, attend the funeral; and,

Resolved, That a copy of these resolutions be sent to the family and sent to THE TECHNIC for publication.

F. R. FISHBACK,
C. E. COX,
SAM D. BURGE,
Committee.

THE first inter-class indoor athletic contest was held in the gymnasium February 21. A very large per cent of the students was present. The attendance otherwise was very small, but enthusiasm made up for lack of numbers. It was very gratifying to see the large representation from the freshmen and sophomore classes. The meet was not finished until after 12 o'clock, owing to the large number of entries and the number of events. All the events were closely contested. Each class accorded its victor great homage. The senior class, with Huthsteiner, won the meet with 21 points; the sophomores were second with 18 points, the freshmen third, with 17 points and the juniors fourth with 8 points.

In the first event, the 60-yard potato race, Schroeder and Bowsher tied for first place, and as all the points went to the freshmen class the contest was not run off. The time was very good for this event, as anything below 15 seconds is considered first class.

In the second event, the shot put, Huthsteiner had no difficulty in winning. The second place was carried off by Bowie, with 33 feet, and third place was tied by Uhl and Randall, with 32 feet 8 inches. In the throw off for third place Randall put the shot 36 feet 6 inches, and Uhl 34 feet 7 inches, both of which puts would have won second place if they had been put in the contest.

In the fence vault, which was one of the most interesting events of the evening, Huthsteiner and Post cleared 6 feet 3 inches. Neither one could go any higher and a coin was tossed to decide the event, Huthsteiner winning.

In the standing broad jump Randall had no trouble in winning with a jump of 9 feet 7 inches.

In the running high jump Huthsteiner again came out winner with 5 feet 2 inches, and might have gone higher if he had been pressed.

In the pole vault Nicholson won after an interesting three-cornered contest with Huthsteiner and McCormick.

The quarter-mile potato race was won by McNabb against a field of seventeen men in the remarkably good time of 1 minute 44 seconds.

Prizes were given to the winners of each event in the shape of rose and white silk streamers. The next meet, the date of which is undecided, will be a handicap meet. It is the intention of the Athletic Association to have the meets once a month as nearly as possible. The summaries of the different events with the records of each man are given below:

SIXTY-YARD POTATO RACE.

	Seconds		Seconds
Bowsher, '04	14 3-5	Dorn, '03	15
Schroeder, '04	14 3-5	Miller, H. E., '04	15
Lindenberger, '03	14 4-5	McNabb, '04	15 2-5
Arnold, '03	15	Hampton, '04	15 3-5
Nicholson, '02	15	Oglesby, '03	15 4-5
Cox, I. J, '03	15	Jacob, '03	15 4-5

SHOT PUT.

	Feet	In		Feet	In
Huthsteiner, '01	38	1	Hills, '02	30	5
Bowie, '03	33		Hampton, '04	28	7
Randall, '03	32	8	Nicholson, '02	27	1
Uhl, '02	32	8	Ross, '04	26	6
Peck, '04	32	5	Oglesby, '03	25	4
Chamberlain, '03	31	5			

FENCE VAULT.

	Feet	In		Feet	In
Huthsteiner, '01	6	3	McCormick, '04	5	7
Post, '03	6	3	Clay, '01	5	7
Krieger, '03	6	2	Bowsher, '04	5	5
Crain, '04	6		Nicholson, '02	5	5
Katzenbach, '03	5	10	Randall, '03	5	5
Arnold, '03	5	10	Oglesby, '03	5	3
Pine, '03	5	9	Jacob, '03	5	3

STANDING BROAD JUMP.

	Feet	In		Feet	In
Randall, '03	9	7	Chamberlain, '03	9	1
Clay, '01	9	5	Troll, '01	9	
Crain, '04	9	3	Krieger, '03	8	8
Huthsteiner, '01	9	2½	Miller, '04	8	4

RUNNING HIGH JUMP.

	Feet	In		Feet	In
Huthsteiner, '01	5	2	Chamberlain, '03	4	6
Jumper, '02	5		Crain, '04	4	6
Huffaker, '04	4	10	Oglesby, '03	4	4
Hills, '02	4	8	Arnold, '03	4	4
Schroeder, '04	4	6	Katzenbach, '03	4	2
Randall, '03	4	6	Bowie, '03	4	

POLE VAULT.

	Feet	In		Feet	In
Nicholson, '02	8	8	Fishback, '02	7	4
Huthsteiner, 01	8	4	Brosius, '03	7	
McCormick, 04	8	4	McNabb, '04	7	

QUARTER-MILE POTATO RACE

	Min	Sec		Min	Sec
McNabb, '04	1	46	Bowsher, '04	1	52
Oglesby, '03	1	47 4-5	Bowie '03	1	52 2-5
Gilbert, '03	1	48	Nicholson, '02	1	53
Toner, '04	1	50	Schroeder, '04	1	54
Lindenberger, '03	1	50 2-5	Hills, '02	1	54 3-5
Krieger, '03	1	51	Dorn, '03	1	54 3-5
Post, '03	1	51	Fishback, '02	1	59
Arnold, '03	1	51 4-5	Hampton, '04	2	2

I. S. N., 12; ROSE, 21.

Not satisfied with defeating the Normals once, the basket ball team, crippled by the loss of Captain Hadley, defeated them again in the Rose gym on February 22. One of the largest crowds ever gathered in the gymnasium for an athletic contest attended this game and the Normalites came prepared to yell. The principal part of the evening's program was a contest between the factions of the different schools as to who could do the principal part of the yelling. The Rose men outplayed the Normalites at all points of the game and won with comparative ease. The score of the contest is as follows:

FIRST HALF.

ROSE.	Fouls	Field Goals	Foul Goals	NORMAL.	Fouls	Field Goals	Foul Goals
Cox, l. f.	1	0	0	Austin, l. f	2	0	0
Pfleging, r. f.	1	2	0	Light, r. f.	4	0	0
Arnold, c	1	1	0	Wellman, c	0	0	0
Barbazette, l. g	3	0	0	Wright, l. g.	0	0	0
Huthsteiner, r. g.	2	0	0	Boggs, r. g	3	0	5

SECOND HALF.

ROSE.				NORMAL.			
Cox, l. f.	0	0	1	Austin, l. f.	5	0	0
Pfleging, r. f	5	3	5	Light, r. f	2	0	0
Arnold, r. g.	2	0	0	Wellman, c	1	0	0
Barbazette, l. g	1	1	0	Wright, l g	0	0	0
Huthsteiner, r. g.	5	0	1	Boggs, r. g.	5	1	5

Score– Rose, 21; Normal, 12.

I. S. N., 13; ROSE 16.

The Normal and Rose met for the first time in two years in the Normal gym in a basket ball contest which was won by Rose. The best of feeling was shown by both sides and it now looks as if the former hard feeling had been forgotten, and future athletic relations with the Normal ought to be harmonious.

The Normal gymnasium was crowded on this occasion by partisans of both schools of both sexes. The Rose men attended about 100 strong and made the gym ring with a choice and new selection of songs and yells. The greatest enthusiasm was shown by both sides and each play of a good nature was wildly applauded and cheered. It would be difficult to pick out the stars on the Rose team, as each man played with a vengeance and a determination to beat the Normals at their own game, as basket ball is the game that the Normals specialize in.

When time was called at the end of the second half it was discovered that the score was a tie and it would be necessary to play the tie off. The teams lined up for the play-off, and after a few seconds play a Normal man fouled and Pfleging threw goal. As it still required another point to win, both teams were at it again in a few minutes and the play at this point was very rough. Hadley then threw a goal from the field, the ordeal was over and pandemonium broke loose. The Rose men broke out into the center of the floor and after giving all the yells and songs they went into the women's gymnasium, adjoining, and gave a war dance in the middle of the floor, and later repeated it on the Normal lawn. When the members of the team appeared they were carried on shoulders down Main street, and every Rose man went to bed that night feeling "first class."

The score of the game is as follows:

FIRST HALF.

ROSE.	Fouls	Field Goals	Foul Goals	NORMAL.	Fouls	Field Goals	Foul Goals
Cox, l. f.	0	0	0	Austin, l f.	0	1	0
Pfleging, r. f	1	1	0	Light, r. f.	0	0	0
Hadley c.	3	1	1	Wellman, c.	1	0	0
Barbazette, l. g	4	0	0	Wright, l. g	3	0	4
Arnold, r. g.	2	0	0	Boggs, r. g	2	0	0

SECOND HALF.

ROSE.	Fouls	Field Goals	Foul Goals	NORMAL.	Fouls	Field Goals	Foul Goals
Cox, l f.	0	1	0	Austin, l. f	3	1	0
Pfleging, r. f	2	1	5	Light, r. f	2	0	0
Hadley, c	1	1	0	Wellman c	1	1	0
Barbazette, l. g	2	0	0	Wright, l. g	3	0	3
Arnold, r. g.	1	0	0	Boggs, r. g.	0	0	0

Score—Rose, 16; Normal 13. Time of halves, 20 minutes. Referee, Connor, Y. M. C. A. Umpires, Attridge and Rippetoe.

Y. M. C. A., 17; Rose, 18.

The basket ball team showed the school the biggest surprise of the season when they defeated the strong Y. M. C. A. basket ball team by a score of 18 to 17. The victory came entirely unexpected to the students and supporters of the team after the overwhelming defeat by the same team a week or so before.

The boys showed the Y. M. C. A. boys some remarkably fast playing and ran them off their feet. Hadley and Pfleging lead for the honors for the Rose team. While none of the Y. M. C. A. boys showed up above the others as stars, they played a fierce and aggressive game and were hard losers. The victory seemed the more agreeable to the students as the Rose team had been defeated by a team of three regular men and two subs when they played before, while in this game the Y. M. C. A had their regular first team.

A GOOD BASKET-BALL TEAM.

The summary is as follows:

FIRST HALF.

ROSE	Field Goals	Foul Goals	Fouls	Y. M. C. A.	Field Goals	Foul Goals	Fouls
Cox, l. f.	0	0	0	Agnew, l f.	1	2	0
Pfleging, l. f.	3	2	3	Heinig, f.	2	0	0
Hadley, c	1	1	0	Trueblood, c.	0	1	0
Barbazette, l. g	1	0	0	Crook, l. g.	1	1	0
Arnold, r. g.	1	0	0	Connors, r. g.	0	2	1

SECOND HALF.

ROSE.	Field Goals	Foul Goals	Fouls	Y. M. C. A.	Field Goals	Foul Goals	Fouls
Cox, l. f.	0	0	1	Agnew, l f.	0	0	0
Pfleging, r. f	2	1	2	Heinig, r. f	4	0	0
Hadley, c	1	2	0	Trueblood, c.	0	1	0
Barbazette, l.g	0	0	0	Crook, l g.	2	0	0
Arnold, r. g.	0	0	0	Connors, r. g	1	0	2

Score—Rose, 18; Y. M. C. A, 17. Time of halves, 20 minutes.

BALL SCHEDULE.

There have been a number of changes in the base-ball schedule for this season. There is a probability of playing the two High Schools at Indianapolis on April 6. The team makes a trip, commencing May 30, for three days, playing Hanover, Wittenberg, and Bradley Polytechnic. Mgr. Crebs deserves great credit for this schedule, as it is one of the best for a number of years:

April 13. DePauw, at Terre Haute.
" 27. Wabash, at Crawfordsville.
May 6. DePauw, at Greencastle.
" 11. Wittenberg College, at Terre Haute.
" 18. Bradley Polytechnic, at Terre Haute.
" 30. Wittenberg College, at Springfield, Ohio.
" 31. Hanover, at Hanover.
June 1. Bradley, at Peoria.
" 8. Wabash, at Terre Haute.

Get Jones to tell you about his joke. It's a good one.

Levi:—"And the tube was thirty cubic centimeters long."

Dr. Noyes:—How do we soften waters of temporary hardness? Kellogg—By treating them with milk.

Kiefer expects to enjoy the "orthographic isochromatic" drawing next term.

All overcoats seem to look alike to Hampton when taking leave of a pretty girl.

Pfleging:—"Professor, I think we would get better along if we had a synopsis."

Heard at The Show—"How many Poly's are there who are not here, do you suppose?"

By merely handling a metallic element, Pine is strangely able to say with what substances it combines.

Levi has taken up basket ball. His only trouble, as he expresses it, is that "he can't be all over at once."

Prof. Howe:—"Now, Dr. Noyes drinks nothing but distilled water—that is, in the way of water."

Miss Beech is acting as registrar during the absence of Mrs. Burton, who is visiting relatives in Washington.

It is said that in some photographs of the lynching Polytechnic students were to be recognized in the crowd.

Levi approaches a chemist, after a rather violent explosion has startled the laboratory: "Did you know it was going to go off?"

The translation of "seiner Standesehre" as "his rank honor" can scarcely be said to give in good English the true meaning of the phrase.

The students at one boarding house have discovered one kind of "indoor meat" which is warranted by the discoverers to give splendid physical training for almost any form of sport.

At a meeting of the Y. M. C. A. held March first, S. D. Burge, President, and H. T. Kellogg, Vice-president, were re-elected to office, and E. B. Powell elected Secretary and Treasurer.

Lindenberger would appreciate the privilege of being allowed the use of the chemical lab. after 6 o'clock p. m. He was heard at this time one evening to say, "Well, I must go out and work in the Lab."

Prof. Wagner:—"In order to be certain of accuracy you ought to do this by logarithms and multiply it out by long division as well."

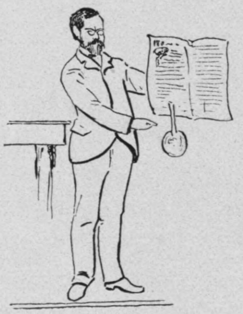
And the class had to explain to him why they were laughing.

The Rose Tech Y. M. C. A. was again the host of an informal good time on the evening of February 23. A good number of the students gathered in the Association room and spent several hours very pleasantly with games and refreshments.

One of the sophomores—we refuse to divulge the name—was the happy recipient of the following valentine which awaited him on the letter-board:

Utah is a funny State,
In fact it stands alone—
What we would call a clothes-pin
Out there they call a Cohn.

Prof. Hathaway lately so far forgot himself as to commence a recitation in Junior mechanics without first rounding up the members of his class, a proceeding so unusual that several of his students do not consider the absent marks given them on that date fairly deserved.



Mr. Hood's lecture on "Patent Law" was illustrated by a number of rare patents, some of which were interesting on account of their early date, and others as representing nearly all the foreign countries. The wax seals on some of the older English ones must have gone a long way to make the document weighty.

The first of the Institute lectures was an address by Mr. F. P. Cox, '87, who is with the General Electric Co. at Lynn, Mass. The subject of the address was, "Electric Meters." No abstract has been published of this lecture, as Mr. Cox has promised to put the very interesting matter there given in the form of an article for THE TECHNIC.

The discussion of an essay on "Athletics in Colleges," which was read in the senior language class, became very spirited, with Prof. Wickersham as the only champion of one side of the question. The fact that a majority of the class had yelled themselves hoarse at the basket ball game the night before, had a certain effect on the musical quality of their voices.

Larson, '00, erecting engineer with the E. P. Allis Engine Co. of Milwaukee, Wis., visited the Institute last month. His experiences with some of the ignorant negro firemen of the South are rather amusing. "I told one man to get up all the pressure he could early in the morning, and upbraided him when upon arriving I found the gauges near zero." "Well, boss, there's more there than you think for; that thing done gone around once and is trying to go around again."

Before one of his recitations with the sophomores the other day, Prof. Hathaway dropped a coin as he unlocked his door. The class was standing around, eager to get in (of course) and Levi made a sudden dive after it. Unfortunately for Sol, however, the Professor saw it and stopped its rolling by putting his foot on it. As Levi had at that instant gotten it in his fingers, the foot caught something else beside money. Of course the kind-hearted class turned its back and examined the landscape, so as not to embarrass anybody by laughing.

At the two recent games with the Normal the "rooting" was of a very high order. Enthusiasm was strong on both sides. All the yells of long standing were given, and at the latter game a number of new songs were introduced. These are as follows:

[TUNE: The Tale of a Kangaroo.]

Oh ball with leather covering,
Oh ball so round and true,
Pray do your best this evening
For we've work this night for you.
Seek out the Normal's basket
And in it swiftly drop,
And prove to all who're watching
That the Poly's are on top.

[Tune: There Are Only 100 Girls in This World For Me.]

Oh how I love my darlings,
The team that's led by Bill;
My I John Cox and my Hadley Cox,
My Pfleging and my Will;
My Arnold and my Barbazette,
Huthsteiner, too, you see—
In fact there's only a single team
In this town for me.

[Tune: Same Old Story.]

Same old Poly played the game,
Same old Normal put to shame,
Same old ending—Normal blue—
Same old ending—nothing new.

[Tune: Yankee Doodle]

Poly and I go to the game,
Along with Captain Hadley;
And here we meet the Normalites,
And we will beat them badly.

Poly, Poly keep it up,
Poly you're a dandy;
So mind you, watch the Normalites,
And with the ball be handy.

Prof. Wagner at the close of a senior lecture: — "That will be all for this evening and you will please put the chalk-box back on the table." And everyone suddenly discovered that the chalk-box had wandered to the back part of the room from the table in front, and that Marshall was walking out of the room with an eraser in his pocket. Marshall took the eraser back, later.

After a discussion of the matter in the Student Council, it was decided that a committee be appointed to secure and recommend a song that should be the official song of the Institute. The two songs which have been most sung by the students when in a body both lack the dignity and the sense which are necessary in a song which is to represent the Institute. The committee has invited the students to submit suggestions for the words and air of the new song. The official adoption of the song, "The Old Rose and the White," in the '92 *Modulus*, will be considered in connection with the contributions of the students.

"We, the quiet, attentive and devoted members of Section B, class of '03, do hereby most respectfully congratulate our beloved, learned and admirable German professor on his coming marriage, and do most devoutly wish him happiness and many children to grace his old age, and we also send sympathy to his beloved should she happen to contradict his most Excellent Highness, Prof. A. A. Faurot."

The Professor assured his class that they had been entirely misinformed, that there were not the slightest grounds for congratulations.

TECHNIGRAPHS,—VI.

"COMES IN LIKE A LION—."

The Cement Industry. 8 vo., cloth, 235 pp. The Engineering Record, New York.

THE continual and growing demand for cement and concrete work has made the manufacture of cement one of the most important engineering industries in the country. Some time ago the *Engineering Record* started a series of articles on the cement industry, most of which were contributed by Mr. Frederick H. Lewis, M. Am. Soc. C. E., and which were descriptive of the various processes of manufacture of Portland and natural cements, not only in this country but abroad. The demand for this series of articles soon exhausted the supply, and they are now published in convenient book form.

Descriptions are given in detail of many of the most important or otherwise interesting plants, and the details of manufacture very fully explained. The book will be of inestimable value to all those interested in the uses and manufacture of cement.

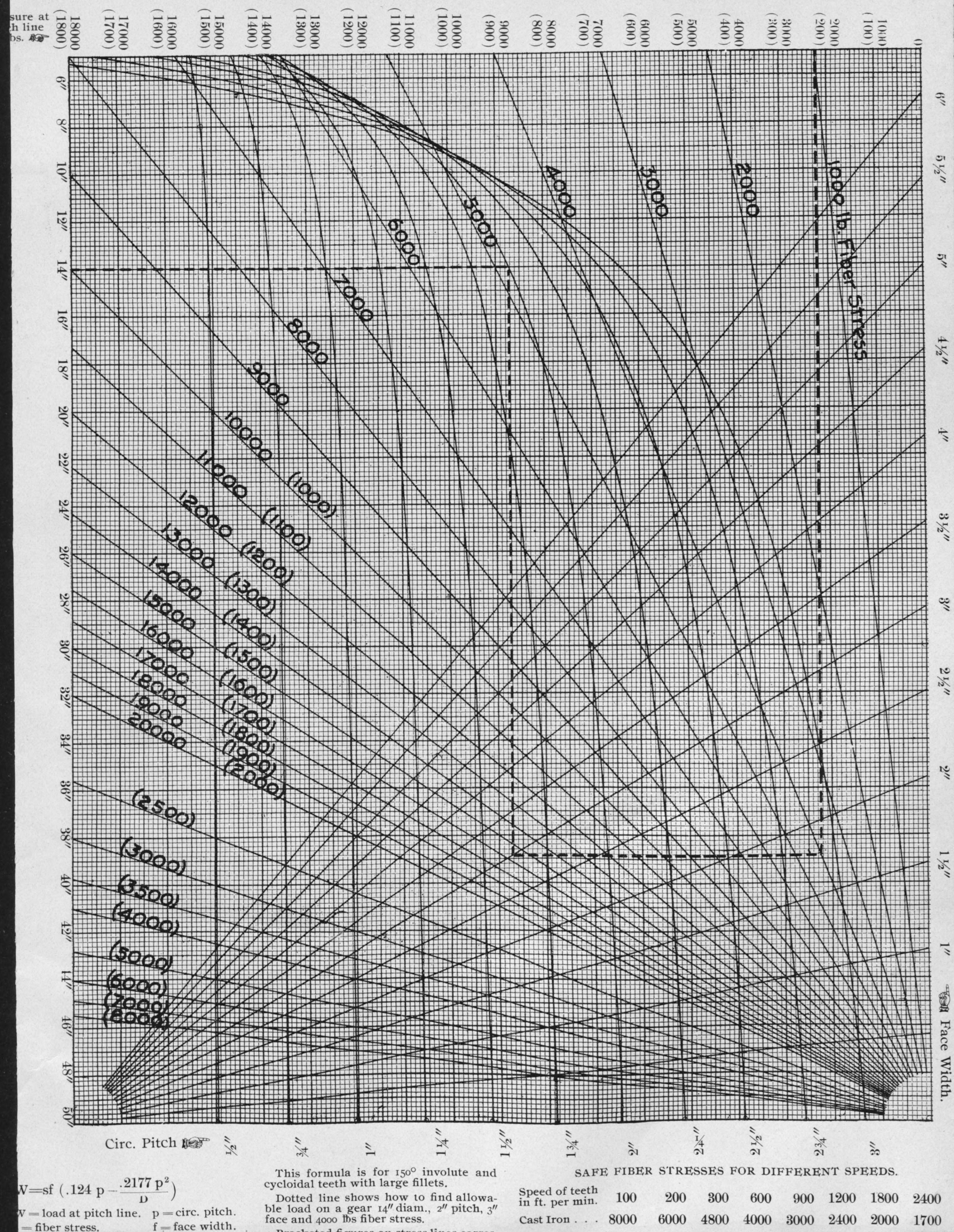
Several chapters are devoted to notes on materials and processes of manufacture, and the entire book is concise and furnishes a ready and convenient source of information for the cement man.

IT IS very interesting to note the ever-increasing attention which is now being bestowed upon the numerous details of engineering projects. Especially in the design of modern fast passenger locomotives is this increased vigilance naticeable. In no single case is the ingenuity of the designer so taxed as in the numerous complications which arise in the building of a large locomotive. In order to utilize the enormous power now demanded of locomotives hauling from ten to sixteen heavy coaches it is necessary to concentrate the weight of the engine upon the drivers in order to secure the necessary tractive effort, and here a serious difficulty is encountered in the fact that this concentration cannot proceed beyond certain limits without straining the bridges beyond their allowable limit. Another precaution has also to be taken, namely that of making the journals of the driving axles amply large, in order that the oil will not squeezed out and disastrous delays result from hot boxes.

In order to secure the additional tractive effort necessary in starting large trains with locomotives of the ''Atlantic'' type, a device known as a traction increaser has recently been applied to several locomotives built by the Schenectady Locomotive Works for the New York Central. The idea is not new, having been discarded some fifteen years ago. The present improvement consists in concentrating on the drivers part of the weight from the trailers and truck wheels, by moving the fulcrums of the rear equalizers. This is accomplished by the use of two cylinders operated by compressed air supplied from the train compressor, and is to be used only in starting heavy trains, as mentioned above.

Another detail which is now receiving its share of attention is the application of brakes to the engine truck wheels, as well as to the drivers and trailers, in the ''Atlantic'' type of locomotives. An additional braking effort of 10% is obtained in some instances, and since, in the case of a wreck, the last few feet are what count, it can be readily seen that this is a move in the proper direction.

Diagram for Strength of Gear Teeth. (Lewis' Formula).



$$W = sf\left(.124\,p - \frac{.2177\,p^2}{D}\right)$$

W = load at pitch line. p = circ. pitch.
= fiber stress. f = face width.

This formula is for 150° involute and cycloidal teeth with large fillets.

Dotted line shows how to find allowable load on a gear 14″ diam., 2″ pitch, 3″ face and 4000 lbs fiber stress.

Bracketed figures on stress lines corres-

SAFE FIBER STRESSES FOR DIFFERENT SPEEDS.

Speed of teeth in ft. per min.	100	200	300	600	900	1200	1800	2400
Cast Iron . . .	8000	6000	4800	4000	3000	2400	2000	1700
Steel . . .	20000	15000	12000	10000	7500	6000	5000	4300