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THE TECHNIC.

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YOU see before you the first number of the *thirteenth* volume of THE ROSE TECHNIC. If the new Board of Editors were possessed of one grain of superstition, the initiatory suspense which they now experience would be greatly increased. We are thankful to say, however, that we see no inauspicious foreboding in this slandered number. There is another fact which troubles us; namely, that we follow up the work of a Board directed by such a competent man as last year's Editor.

During the past twelve years THE TECHNIC has been a journal in which, we believe, Faculty, Alumni, and Students could take a just pride. It is our earnest endeavor to keep up this good reputation, and we assure you that, with your help, we will do our part in even raising the standard if possible. Your aid and criticism is therefore solicited. Give us your best thoughts. We ask the Freshmen, in particular, to take note of the names of the Local Editors, and to inform them of any happenings worthy of publication.

THE ALUMNI of Rose is composed of three hundred and thirty-five members. They are scattered around the country in all directions, and one has but to look at the list in the Institute catalogue to see that they are appreciated by the Engineering World. We are proud of them and of what they have accomplished, and those of us who have had dealings with them know that they are perfect gentlemen.

At the beginning of the thirteenth year of THE TECHNIC there is one question which we wish to ask of the Alumni. Briefly: "are they supporting THE TECHNIC as they should?" Last year out of the three hundred members only ninety-two subscribed for THE TECHNIC. This year we shall be greatly disappointed unless we receive subscriptions from two hundred. The position now occupied by THE TECHNIC in college journalism, the engineering articles contained in its columns, and the fact that their *Alma Mater* claims their support, seem to be sufficient grounds for a better showing on the part of our Alumni in this matter.

Alumni, send in your subscriptions. Thus you will not only be doing your duty, but you will receive a monthly journal which we hope will contain valuable articles for you. And lastly, remember the good old days when, sitting in your room, you were accustomed to hear, in the distance, the old Poly bell counting the happy hours of college life.

> "When years no more of active life remain,
> 'Tis youth renewed, to laugh them o'er again."

WE ask you to direct your attention each month to the advertisements found in THE TECHNIC. Remember that our advertisers are furnishing us with funds, and that as they are helping us, so they deserve your help. When you do business with them it is very easy to mention that you saw their "ad" in THE TECHNIC. Finally we can assure you that firms thus represented are the people who keep what you want, and that they are perfectly reliable. We older ones have had experience.

ONE of the first things we look for when we return to Rose each September is the Y. M. C. A. hand-book. This year we were especially gratified to find a book which shows the results of much work on the part of those who had the responsibility on their shoulders. The 1903-1904 hand-book contains all that the former book contained besides several valuable additions, such as a more modern map of Terre Haute, space for results of athletic contests, and a list of the officers of the several organizations. The following men made up the hand-book committee, and deserve much credit for their work: Schuchardt, '05; Falley, '05; Burr, '05; Randall, '04; Blair, '03; Post, '03.

THE success of athletics in any college does not depend alone on the few men who form the several teams. There is another great factor and that is the spirit of the student body. When the teams and the student body have the right kind of spirit, results are sure to follow.

Now let us see how we stand at Rose. Those who have watched the work of the foot-ball team will not question their spirit. It therefore remains for the student body to give them the proper support. There are those among us who take no interest in anything except studies. There are others who take a lively interest in college life and yet stand just as high in their studies. We believe that to derive all the benefits of our course here, a man should belong to the latter class There are many ways in which you can help without taking too much time from your studies. Don't be a dead one. Either be active, or take an interest in the active ones. Jolly our teams along. Make them feel that you are taking an interest in them. Praise them when they deserve it. Don't look on as though you didn't belong to the Institution. Get into it, and show them that you are with them. Cheer at the right time. Come out to the games, and as often as you can to the practice. It is nonsense for most students to say that they can't afford the time to attend the games.

This is what we mean by spirit. Let's all work for enthusiasm, and we shall be surprised at our success.

WE believe that it is the duty of THE TECHNIC to criticise all that seems wrong or unfair in any branch of our college affairs. With this end in view, we intend to voice our sentiments when we feel sure that we are working for the good of Rose.

Before the game with Washington University we noticed that there was a large number of men out for practice every evening. The following week it was noticeable that several members of the first team thought it was only necessary to come out when they felt like it. Coach Holste has given notice that he has changed his policy now, and that absence from practice, without a good excuse, means dismissal from the team. Several men have already been laid off on this account. When a man comes out for foot-ball practice merely to take advantage of the trips, we believe it is time something was said about it. It is safe to conclude, in such a case, that this man has no school spirit at all, and that his idea of loyalty is sadly at fault. The student body has no use for such a person. He is merely looking out for himself.

Now, if we are going to have athletics at Rose, let's make a business of it. We grumble and complain that the town will not support athletics. But when things are run in this way we cannot blame the town for getting sick of what we call "Poly luck." We are too much afraid of hurting each other's feelings.

Rose boasts of her "clean athletics," but are we clean amongst ourselves? We believe not. If a man doesn't do his duty we say: "Take him off the team, no matter if he happens to be the best player." Let's have a team that *is* a team. Let's have fellows on that team who are going to *stick*. The foot-ball season lasts for two months only, and those who start, and then drop off at the least excuse are "*quitters*." We, as fellow students of those on the team, should insist on their holding up our honor and reputation. Too many of us are more *dead* than *alive*.

ON behalf of all the students we wish to extend to the new members of the Faculty, a hearty welcome. Dr. John White succeeds Dr. Wm. A. Noyes who resigned to accept a Government position. Dr. White received his Ph. D. at Johns Hopkins. He taught at Cornell, then was Professor of Chemistry at the University of Nebraska, and comes direct from there to his present position at Rose.

Mr. Fred F. Wadleigh, who succeeds Mr. Hirshler as Librarian and Instructor in German, is a graduate of the University of Vermont. For the last two years he has been studying abroad. Dr. Patterson, formerly Instructor in Chemistry, is succeeded by Mr. John M. Nelson, B. S. Mr. Nelson graduated from the University of Nebraska in the class of 1901, and since then has held the position of State Chemist for Nebraska.

The successor of Dr. Earhart has not been decided upon yet, but his name will soon be announced. Dr. Earhart has accepted an assistant professorship at Ohio State University.

We hope that our relations with our new friends may be as pleasant as they were with their predecessors.

MUCH has been said and written on the Wabash-Rose controversy over the game which was scheduled for Saturday, Oct. 10th. We informed Wabash that we would not play if Gordon, their colored player, held his position. They replied that they must treat Rose the same as any other college, and that Gordon must play. Rose then cancelled the game. Then on the very day that they were to have played us, they took Gordon off the team and played Culver. It is a well-known fact that Culver absolutely refuses to play any team with a colored man on it. We regard this act of Wabash as a plain breach of good faith.

Some Determinations of the Hysteresis Constant in Transformer Iron and Steel.*

Communicated by DR. THOMAS GRAY.

THE extensive use of transformers makes all knowledge regarding their efficiency valuable. As the iron loss continues whether the secondary is open or closed, information concerning this is doubly useful. Mr. C. J. Kiefer and I used Lord Rayleigh's alternate current phasemeter to determine the constant of this hysteresis loss in iron of different qualities.

The watts lost, as found by the phasemeter method, include both hysteresis and eddy current loss and the constant found is for the total loss.

The phasemeter as its name indicates, measures the angle of lag of the current behind the electromotive force, but with calibrations it can be used to measure current, electromotive force, watts, hysteresis, etc.

DESCRIPTION AND THEORY OF THE PHASEMETER.

It consists of a current coil, M, and an E.M.F. coil, S, arranged as shown in figure I, and a soft iron needle, m, suspended at 45° to the common axis of these coils. Each coil is adjustable along this axis. The couple acting on the needle due to the current in either coil acting alone is proportional to the square of the current and to the $\sin 2\theta$, θ being the angle between the needle and the axis of the coils. Thus the couple is maximum for $\theta=45°$, and zero for $\theta=0°$, or $\theta=90°$.

The instantaneous values of the currents in M and S being $a' \cos(\omega t-\phi)$ and $b' \cos \omega t$ respectively, then

$$\left.\begin{aligned} \frac{1}{T}\int_0^T [Ha' \cos(\omega t-\phi)]^2\,dt &= \frac{H^2a'^2}{2} = A^2 \\ \frac{1}{T}\int_0^T [Kb' \cos \omega t]^2\,dt &= \frac{K^2b'^2}{2} = B^2 \end{aligned}\right\} \text{(I)}$$

where H and K are constants which multiplied into the instantaneous values of the currents give the instantaneous values of the intensities of the magnetic fields produced at the needle by the coils M and S respectively.

A^2, being proportional to the mean square value of the current, will vary as the readings on the scale, and may be represented by it. The same is true of B^2.

The following equations may be obtained when the current of both coils act simultaneously on the needle giving couples:—in the same direction

$$\left.\begin{aligned} &\frac{1}{T}\int_0^T [Ha' \cos(\omega t-\phi)+Kb' \cos \omega t]^2\,dt = C_1^2 \\ &\text{in the opposite directions:} \\ &\frac{1}{T}\int_0^T [Ha' \cos(\omega t-\phi)-Kb' \cos \omega t]^2\,dt = C_2^2 \end{aligned}\right\} \text{(II)}$$

Here C_1^2 and C_2^2 may be represented by the readings and

$$\left.\begin{aligned} C_1^2 &= A^2+B^2+2AB\cos\phi \\ C_2^2 &= A^2+B^2-2AB\cos\phi \end{aligned}\right\} \text{(III)}$$

Thus having these four readings:

$$\cos\phi = \frac{C_1^2-A^2-B^2}{2AB} = \frac{A^2+B^2-C_2^2}{2AB} = \frac{C_1^2-C_2^2}{4AB} \quad \text{(IV)}$$

Equation (III) gives $C_1^2+C_2^2 = 2(A^2+B^2)$ giving a method of placing the needle at 45° to the axis.

APPARATUS USED.

Our phasemeter was made as follows: The current coil had 19 turns of No. 16 B. & S. gauge wire wound simultaneously with the correcting coil of No. 26 B. & S. gauge wire. The E. M. F. coil had 300 turns of No. 26 B. & S. gauge wire. Both coils had the same average diameter and could be at various distances from the needle. By means of a scale and a pointer it was possible to place these coils at certain

*This article is the substance of a Thesis by Brent C. Jacob and C. J. Kiefer, which was submitted to the Institute for the degree of B. S.

places where constants were determined, as will be explained later.

The needle consisted of three pieces of iron wire placed horizontally and parallel to each other. The two outer pieces were 1 cm. long and the middle 2 m.m. longer. The mirror and needle were connected by a glass fibre having at each end a circular loop, the plane of one being 45° to the other. To the back of the needle was fastened a mica vane to dampen the motion of the system. This system was suspended by a flat phosphor-bronze torsion fibre about 8 inches long. The deflection of the needle was measured by a ray of light focused by a lens on a scale about 1 meter away.

A second phasemeter, F, with two E. M. F. coils of 555 turns each of No. 30 B. & S. gauge

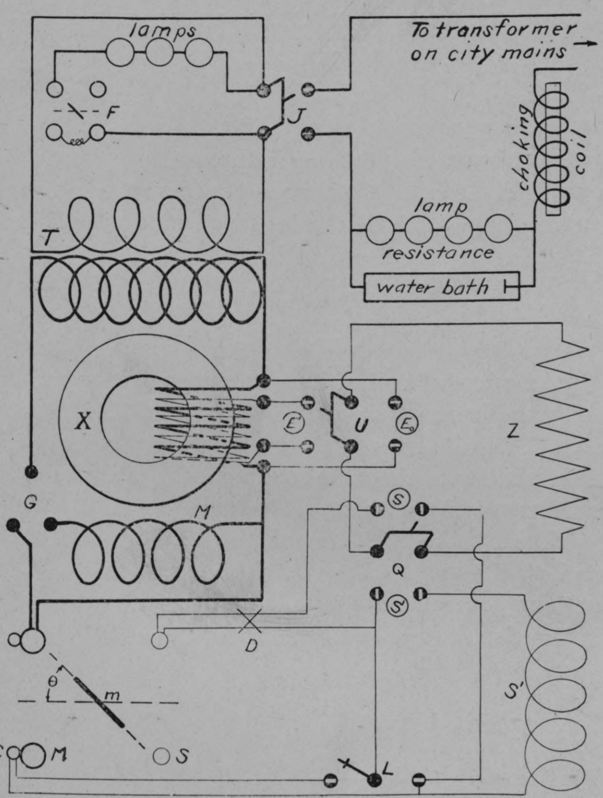


Fig. 1

wire and with no current coil was used as a detector to see that all four readings were taken under the same conditions. It was connected as shown in figure I.

DETERMINATION OF CONSTANTS.

Since the current in either coil acting alone is proportional to the square root of the deflection we may put

$$I = h\sqrt{A^2} = hA$$

also as E=IR

$$E = k\sqrt{B^2} = kB$$

where h and k are constants obtained as follows:

For the determination of h, a Kelvin balance was connected in series with a current coil, M, which in this particular case was placed at 2 on the scale. (Therefore we called this constant h_2, using the subscript to indicate the position of the coil) The deflection was noted for the balance readings and used as below:

A^2	Kelvin balance	Double sq. rt.	Balance constant	I	$\frac{I}{\sqrt{A^2}} = h$
44	54	14.697		294	$\frac{.294}{\sqrt{44}} = .0443$
64	80	17.889	×.02 =	.358	$\frac{.358}{\sqrt{64}} = .04475$
115	148	24.33		.487	$\frac{.487}{\sqrt{115}} = .0454$
50	61	15.62		.313	$\frac{.313}{\sqrt{50}} = .04425$

Taking the average value of h we find

$$h_2 = .044675$$

For the determination of k, the Kelvin balance was shunted across the part of the circuit in which the fall of potential was to be determined. The E. M. F. coil, S, was also shunted across the same place. The following results were obtained:

B^2	Kelvin balance	Double sq rt.	Balance constant	I	R	E	$\frac{E}{\sqrt{B^2}}=k$
103	31	11.136		.0557		35.9	$\frac{35.9}{\sqrt{103}}=3.54$
132	38	12.329	$\times .005=$	.0616	$\times 646=$	39.75	$\frac{39.75}{\sqrt{132}}=3.46$
233	73	17.088		.0854		55.2	$\frac{55.2}{\sqrt{233}}=3.61$

Taking the average value of k we find

$$k_2=3.536$$

The watt-meter constant, l, which will be explained later, equals $\frac{hk}{4}$. For example

$$l_2=\frac{h_2k_2}{4}=.0395$$

DESCRIPTION OF CONNECTIONS.

Figure 1 represents diagramatically the instruments and their connections for testing the samples. In one of the leads from the transformer on the city circuit was placed a choking coil and in series with this was a resistance of lamps and water bath in parallel. The other transformer lead was fastened to the double pole switch, J. To this switch was attached a 1:3 transformer, T. The detector phasemeter, F, was shunted across the primary terminals of T, and had a variable lamp resistance in series with it so as to keep its readings on the scale for various conditions. To the secondary terminals of T were connected in series the magnetizing coil of the specimen, X, to be tested and the current coil, M, of the phasemeter. By means of a two-way switch, G, a coil, M′, exactly similar to M could replace M, thus keeping the conditions of the circuit the same. The E. M. F. connections are represented by the fine lines. The E. M. F. coil, S, is either shunted across the magnetizing coil of X, or placed in series with the exploring coil of X by means of the double-throw switch, U, by putting the switch at E_o or E′ respectively. The double-throw switch, Q, makes it possible to replace S by S′, an exactly similar coil, when the reading for A^2 is taken. D is a reversing switch used to change the direction of the current in S with respect to that in M. The two-way switch, L, is used to cut-in or out the correcting coil, C, either with S or S′. The non-inductive resistance, Z, of 1325.5 ohms is in series with either S or S′.

METHODS OF DETERMINING WATTS USED.

METHOD I.

The E. M. F. coil, S, (Fig. 1) is shunted across the magnetizing coil of the specimen, X, and measures E, the volts impressed on the circuit. The coil, M, measures the current. The angle of lag, ϕ_o, is determined by equation (IV). Then the watts consumed in the circuit are

$$W_o=IE_o \cos \phi_o.$$

METHOD II.

The current coil, M, is connected in series with the magnetizing coil while the E. M. F. coil, S, is in series with an exploring coil, exactly similar to the magnetizing coil and wound simultaneously with it.

Thus E′, the E. M. F. of the exploring coil, and ϕ', the angle of lag between it and the magnetizing current, are found and the watts spent in the circuit, less the I^2R loss in the primary is

$$W'=IE' \cos \phi'.$$

Either method gives

$$W=IE \cos \phi=hAkB\frac{C_1^2-C_2^2}{4AB}=\frac{hk}{4}(C_1^2-C_2^2)=l\ (C_1^2-C_2^2)$$

where $l=\frac{hk}{4}$, a constant determined from the current and E. M. F. constants.

THE CORRECTING COIL.

In Method I, as the current carried by M was the sum of the currents in the magnetizing coil and the E. M. F. coil, S or S′, a wire was wound simultaneously with the current coil, M, and connected in series with either S or S′ so as to carry the current of S or S′ in the opposite direction to that in M.

A good idea of the meaning of the values obtained by Methods I and II is given by the following diagram used by Dr. E. S. Johonnott*

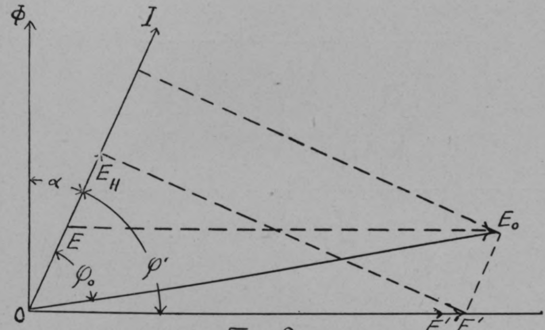


Fig. 2

$O\phi$—Induction.
OI—Primary current.
$OE_\circ$—Primary impressed E. M. F.
—OE′—Secondary induced E. M. F.
—$OE'_\circ$—Primary self-induced E. M. F.
OE_r—E. M. F. to overcome resistance.
OE_H—E. M. F. to overcome hysteresis.
α—Angle of hysteretic advance of phase.
$\phi_\circ$—Angle of lag.

From this it is seen that Method I gives hysteresis watts

$$H=W_\circ-I^2R=IE'_\circ\cos\phi'$$

while Method II gives at once

$$H=W'=IE'\cos\phi'$$

which equals the above value when there is no magnetic leakage.

Thus having the watts lost by hysteresis it is only necessary to use the two following equations to obtain the hysteresis constant, η.

$$b=\frac{E+IO^8}{4.44nSa} \quad \text{and}$$

$$\eta=\frac{H+IO^7}{n\,V\,b^{1.6}} \quad \text{(Steinmetz)}$$

SAMPLES.

The iron tested was cut and held in the forms shown by figures 3, 4, 5, and 6. Two coils were used. Coil No. 1 consisted of 216 double turns of No. 18 B. & S. gauge wire of .967 ohms resistance per circuit and was used on forms like figures 3 and 6. It had rectangular cross-section and was like two U's put end on. Coil No. 2, consisting of 115 double turns of No. 18 B. & S gauge wire of .615 ohms resistance per circuit was used on forms like figures 4 and 5. It had a circular cross-section and was like an anchor ring. In these coils one circuit was used for magnetizing, while the other was used for exploring.

The results of the experiments are given in the following tables :

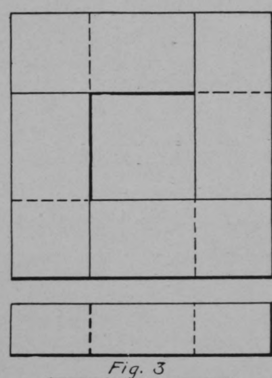


Fig. 3

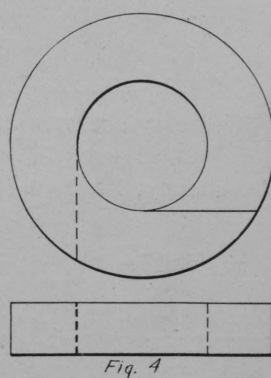


Fig. 4

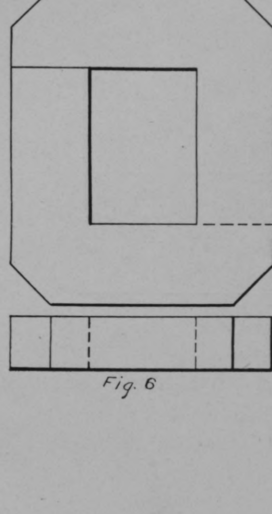


Fig. 6

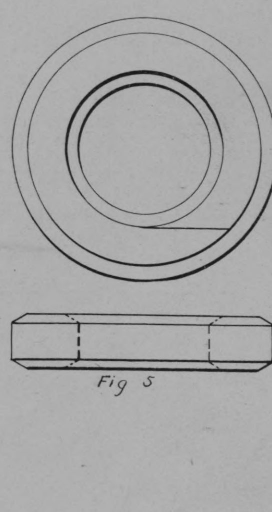


Fig 5

*Physical Review, Vol. XV, No. 5. November, 1902.

TABLE I. SAMPLE I.

Ordinary sheet iron, 10 mils thick. Core in form of figure 3; rectangular cross-section. Frequency, 120 cycles per second.

Method I.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	$E=kB$	$I=hA$	$\cos\phi_o$
249	45	99	47	204	35.2	.306	.74
248	46	100	48	202	35.36	.309	.729
251	48	101	48	203	35.6	.309	.725
250	47	101	48	203	35.6	.309	.725
Averages.........				203	35.44	.308	.729

W_o	R	I^2R	W	b	a	S	V
8.02	.967	.0917	7.9283	6025	5.12	216	116.8

From the above results the hysteretic constant

$\eta=.005075$

TABLE II. SAMPLE I.

Ordinary sheet iron, 10 mils thick. Core in form of figure 3; rectangular cross-section. Frequency, 120 cycles per second.

Method II.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	$E=kB$	$I=hA$	$\cos\phi'$
264	52	107	52	212	36.56	.322	.71
264	52	107	52	212	36.56	.322	.71
258	50	106	51	208	36.41	.319	.719
263	52	108	51	211	36.74	.319	.712
Averages.........				210.75	36.56	.3205	.715

W	b	a	S	V
8.35	6220	5.12	.216	116.8

From the above results the hysteretic constant

$\eta=.00507$

TABLE III. SAMPLE I′.

Same as Sample I; fewer sheets used. Frequency, 60 cycles per second.

Method I.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	$E=kB$	$I=hA$	$\cos\phi_o$
155	70	23	88	85	16.93	.418	.442
146	65	21	85	81	16.2	.411	.471
159	74	24	94	85	17.3	.4325	.42
Averages.........				83.6	16.81	.4205	.443

W_o	R	I^2R	W	b	a	S	V
3.31	.967	.1711	3.139	10360	2.82	216	64.5

From the above results the hysteretic constant

$\eta=.0038$

TABLE IV. SAMPLE I′.

Same as Sample I; fewer sheets used. Frequency, 60 cycles per second.

Method II.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	$E=kB$	$I=hA$	$\cos\phi'$
154	74	23	90	80	16.93	.424	.43
150	72	22.5	80.5	78	16.73	.42	.441
146	69	22	84	77	16.6	.41	.455
Averages.........				78.3	16.75	.418	.442

W	b	a	S	V
3.098	10320	2.82	216	64.5

From the above results the hysteretic constant

$\eta=.00379$

TABLE V. SAMPLE II.

Raw transformer iron, 12.5 mils thick, from the Wagner Electric Co. Core in form of figure 5, octagonal cross-section. Frequency, 120 cycles per second.

Method I.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ_o
183	56	58	59	127	26.96	.343	.526
173	50	57	53	123	26.64	.326	.553
164	43	53	52	121	25.72	.322	.58
169	46	53	52	123	25.72	.322	.58
Averages........				123 5	26.26	.328	.557

W_o	R	I^2R	W	b	a	S	V
4.875	.615	.0661	4.8099	12660	3.39	115	48.3

From the above results the hysteretic constant $\eta=.00226$

TABLE VI. SAMPLE II.

Raw transformer iron, 12.5 mils thick, from the Wagner Electric Co. Core in form of figure 5, octagonal cross-section. Frequency, 120 cycles per second.

Method II.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ'
164	46	54	51	118	25.98	.319	.564
157	42	50	48	115	25	.309	.605
173	50	56	55	123	26.41	.331	.535
163	45	54	51	118	25.98	.319	.564
Averages.........				118.5	25.84	.3195	.565

W	b	a	S	V
4.675	12450	3.39	115	48.3

From the above results the hysteretic constant $\eta=.00226$

TABLE VII. SAMPLE II′.

Raw transformer iron of Sample II, after being annealed. Frequency, 60 cycles per second.

Method I.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ_o
236	193	10	204	43	9.9	.6375	.223
230	188	10	198	42	9.9	.628	.227
240	198	10.5	209	42	10.15	.646	.215
241	200	10.5	209	41	10.15	.646	.215
Averages.........				42	10.025	.6393	.22

W_o	R	I^2R	W	b	a	S	V
1.66	.615	.2513	1.4087	13570	2.415	115	31.55

From the above results the hysteretic constant $\eta=.001731$

TABLE VIII. SAMPLE II′.

Raw transformer iron of Sample II, after being annealed. Frequency, 60 cycles per second.

Method II.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ'
243	206	10	214	37	9.9	.6525	.206
240	206	11	213	34	10.4	.652	.196
246	218	11	218	28	10.4	.659	.194
164	128	9	136	36	9.4	.52	.274
Averages.........				33.75	10.025	.62	.214

W	b	a	S	V
1.333	13570	2.415	115	31.55

From the above results the hysteretic constant $\eta=.001722$

TABLE IX. SAMPLE III.

Annealed transformer iron, 12.5 mils thick, core in form of figure 5, from the Wagner Electric Co. Frequency, 60 cycles per second.

Method I.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ_o
180	129	15.5	139	51	13.93	.526	.263
183	129	15.5	140	54	13.93	.527	.262
178	126	16	135	52	14.14	.518	.262
186	131	15.5	144	55	13.93	.535	.258
Averages.........				53	13.98	.526	.261

W_o	R	I^2R	W	b	a	S	V
2.092	.615	.1698	1.922	15390	2.97	115	45.5

From the above results the hysteretic constant $\eta=.001409$

TABLE X. SAMPE III.

Annealed transformer iron from the Wagner Electric Co. 12.5 mils thick. Core in form of figure 5. Frequency, 60 cycles per second.

Method II.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ'
212	163	16	171	49	14.15	.585	.234
209	161	17	168	48	14.59	.576	.23
223	174	17	181	49	14.59	.603	.22
227	177	18	184	50	14.99	.608	.212
Averages.........				49	14.58	.593	.224

W	b	a	S	V
1.936	16050	2.97	115	45.5

From the above results the hysteretic constant $\eta=.00133$

TABLE XI. SAMPLE IV.

An old Wagner Electric Co. transformer core, from a small unit, which had been in use quite a while; see figure 8. Frequency, 60 cycles per second.

Method I.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ_o
223	68	59	86	155	27.15	.413	.506
214	64	59	81	150	27.15	.402	.52
222	67	59	86	155	27.15	.413	.506
224	68	60	86	156	27.4	.413	.500
Averages.........				154	27.212	.41	.5075

W_o	R	I^2R	W	b	a	S	V
6.08	.967	.396	5 684	7620	6.22	216	307.5

From the above results the hysteretic constant $\eta=.001896$

TABLE XII. SAMPLE IV.

An old Wagner Electric Co. transformer core, from a small unit, which had been in use quite a while; see figure 6. Frequency, 60 cycles per second.

Methob II.

$k_2=3.536$ $h_2=.04467$ $l_2=.0395$

C_2^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ'
209	63	56	80	146	26.5	.3985	.542
203	61	55	78	142	26.2	.393	.557
214	65	56	83	149	26.4	.406	.534
204	61	54	79	143	26.	.396	.556
Averages.........				145	26.3	.393	.555

W	b	a	S	V
5.74	7360	6.22	216	307.5

From the above results the hysteretic constant $\eta=.00203$

TABLE XIII. SAMPLE V.

Same iron as in Sample I, cut in anchor ring with rectangular cross-section. (Fig. 4). Frequency, 60 cycles per second.

Method I.

k_2=3.536 h_2=.04467 l_2=.0395

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ_o
189	98	17	125	91	14.57	.498	.499
184	92	16	121	92	14.14	.491	.521
199	100	19	129	99	15.42	.507	.463
203	102	18	134	101	15	.516	.468
Averages.........				95.75	14.782	.503	.488

W_o	R	I^2R	W	b	a	S	V
3.78	.615	.156	3.624	8560	5.64	115	119.3

From the above results the hysteretic constant η=.00258

TABLE XIV. SAMPLE V.

Same iron as Sample I, cut in anchor ring with rectangular cross-section. (Fig. 4). Frequency, 60 cycles per second.

Method II.

k_2=3.536 h_2=.04467 l_2=.0395

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ'
208	108	20	138	100	15.82	.524	.483
212	110	20.5	140	102	16	.527	.482
208	107	20.	136	101	15.82	.521	.483
212	110	20.5	140	102	16	.527	.482
Averages........				101.25	15.91	.525	.4825

W	b	a	S	V
4.005	9240	5.64	115	119.3

From the above results the hysteretic constant η=.00253

TABLE XV. SAMPLE VI.

The iron of Sample V, after being well annealed. Frequency, 60 cycles per second.

Method I.

k_2=3.536 h_2=.04467 l_2=.0395

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ_o
120	46	20	62	74	15.82	.3519	.488
117	45	20	60	72	15.82	.3462	.494
108	41	18	56	67	15	.3341	.54
112	43	18	58	69	15	.341	.53
Averages.........				70.5	15.41	.3433	.512

W_o	R	I^2R	W	b	a	S	V
2.78	.615	.0725	2.708	8920	5.64	115	119.3

From the above results the hysteretic constant η=.001808

TABLE XVI. SAMPLE VI.

The iron of Sample V, after being well annealed. Frequency, 60 cycles per second.

Method II.

k_2=3.536 h_2=.04467 l_2=.0395

C_1^2	C_2^2	B^2	A^2	$C_1^2-C_2^2$	E=kB	I=hA	Cos ϕ'
120	47	20	62	73	15.82	.3519	.525
122	51	21	66	71	16.19	.3632	.497
130	55	22	72	75	16.58	.379	.465
131	55	22	72	76	16.58	.379	.465
Averages.........				73.8	16.29	.3683	.487

W	b	a	S	V
2.92	9450	5.64	115	119.3

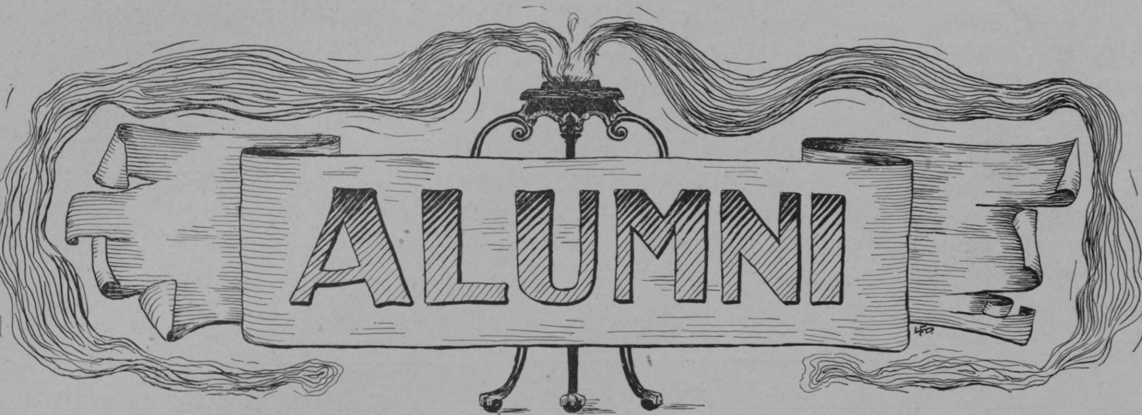
From the above results the hysteretic constant η=.00178

These results were calculated using 60 cycles per second, the rated frequency of the city circuit. However, on testing the speed of the generators at the power station and also by means of a chronographic arrangement, the frequency was found to vary from 58.5 to 60. The entire variation would make less than 2% change in the constants given.

The values of the constants in the first four tables are probably unreliable through inexperience of manipulating the phasemeter. Although the wide variation of results for the same iron might have been partly caused by the inequality of the material and the conditions under which it was tested.

The effect of annealing is apparent from the tables, giving in all cases a lower hysteretic constant.

For much valuable information regarding the phasemeter I wish to thank Dr. Johonnott, whose experience enabled us to obtain results in much less time and to avoid many difficulties that we otherwise would have met.



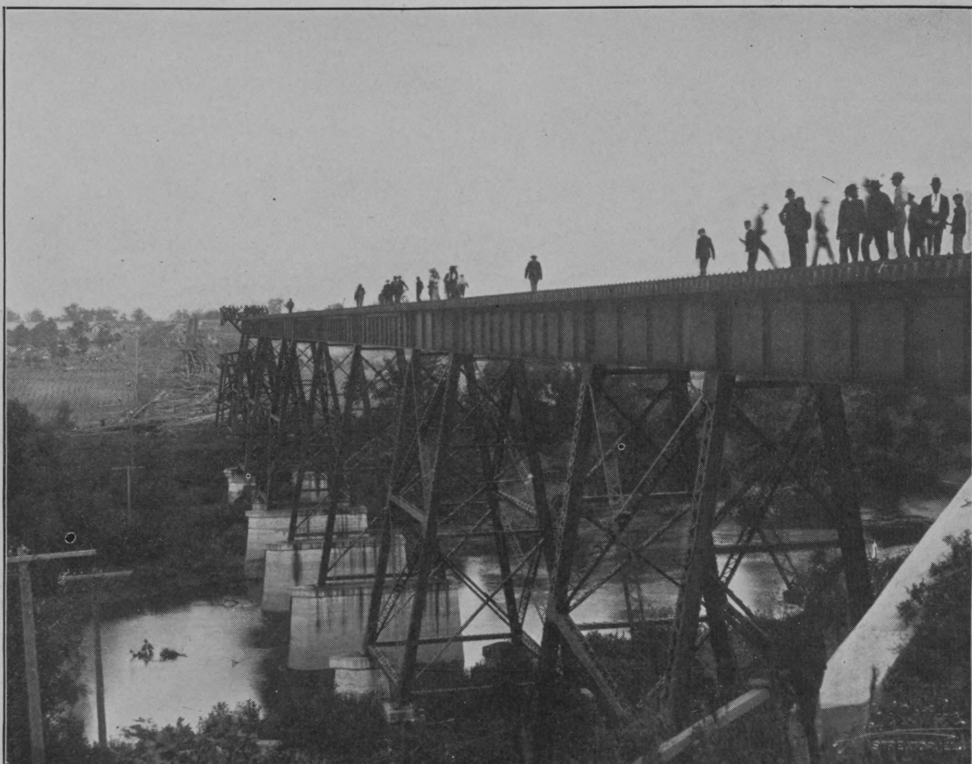
Rebuilding the Vermillion River Trestle.

By W. R. SANBORN, '96.

THE bridge department of a railroad does its work quietly and unobtrusively. Old bridges are replaced by new structures of timber, masonry or steel, without delaying a single train. The public accepts it all as a matter of course and quite forgets the existence of the bridge department, except on those rare occasions when the wreck of a bridge completely ties up the traffic of some railroad.

Friday, July 17, 1903, at about five-thirty P. M., a cyclone struck the northern outskirts of the city of Streator, Illinois. Seven or eight persons were killed, two brick factory buildings were destroyed, numerous frame buildings were razed, and the timber trestle at the west end of the Indiana, Illinois & Iowa Railroad Company's Vermillion River bridge was completely wrecked. Fortunately for the people of Streator there were but few buildings of any kind in the path of the cyclone, which cut a clean swath, and wrecked everything in its way, except the steel portion of the Vermillion River trestle. This steel work was not damaged in any way whatever.

It was eight P. M. before news of the disaster reached the office of the Engineer of Maintenance of Way, at Kankakee, and nine P. M. before that office was advised as to the extent and character of the wreck. A special train was ordered at once. The Engineer M. of W., his assistant and the general bridge foreman, were on the ground before daybreak on Saturday, sizing up the situation, and taking note of what material from the wreck could be utilized in the new trestle. The timber trestle, 846 feet long and averaging 42 feet high, was a wreck from end to end. Rails, timbers and broken piles were scattered the full width of the right of way. Entire 32 foot frame bents were tangled together and covered with stringers, ties, rails and splinters of all kinds. One bent, weighing three tons, had blown entirely off the right of way. The entire floor of the east half of the bridge lay more or less badly broken, 50 feet south of the center line; 80 feet of floor lay in one piece sticking almost straight in the air, balanced on two 32 foot bents, which were firmly braced together and had been blown bodily from one pile foundation and had broken another. The rest of the floor lay tangled in among the piling and broken timbers not far from the center line of the right of way. The trestle, which was not quite four years old, had consisted of 53 bents, spaced 16 feet center to center. Beginning at the steel trestle, there were 40 frame bents 32 feet high, set on pile bents of various heights, 10 frame bents 20′—6″ high set on piles, and 3 bents of piles, driven in the toe of the embankment. The last two of the pile bents were left standing, fit for use in the new trestle. On looking over the wreckage it was found that more than half the timber could be used again. An approximate list of the sizes and lengths of such timbers was made. With this list and profile of the bridge as guides, the details for the new trestle were designed, and a bill of all material needed to rebuild the trestle was made out. For rapid reconstruction piling was out of the question. Furthermore, piles were not wanted, nor could they have been quickly obtained had they been wanted. Everything about the wreck indicated that the piles were the weakest detail in the old bridge. The new trestle was designed with a view to using as much as possible of material on hand in the Kankakee storeyard, at the same time to make a good stiff trestle, conforming as nearly as could be to the standard of the road. The length of span was changed from 16 feet to 14 feet. The piles were replaced by frame bents resting on mud sills. The new trestle is made up of 60 bents. Beginning at the steel there are 43 double-deck bents, the upper bents 20′—6″ high, resting on a set of lower bents, whose height depends upon the profile of the ground. Next there are 15 single deck bents, of various heights, reaching from the ground to the stringers. Finally come the two pile bents left standing by the cyclone. The highest double-deck frame bent is 54½ feet from sill to tie. The 43 double bents all measure more than 40 feet from sill to tie.



It is no small task to obtain the material necessary to rebuild such a bridge. Before leaving Kankakee Friday night orders were left for all the bridgemen at Kankakee to get out at three A. M. and load every stick of timber in the Kankakee store yard that could be of use in rebuilding. After the bill of material for the new bridge had been made out, such material as the I. I. & I. R. R. could not supply was ordered from the general store of the L. S. & M. S. Ry. The material so ordered consisted mostly of 12″x12″ posts 20′ and 22′ long, and sway braces 24′ to 30′ long. The miscellaneous assortment of sizes and lengths received, indicated that the order was something of a tax on even such a well-equipped store as that of the L. S. & M. S. Ry. The order was sent from Streator to Cleveland, Ohio, by wire at six A. M. Saturday. The material ordered arrived at Streator by special train at six A. M. Sunday. Part of the material from Kankakee arrived at eleven A. M. Saturday. The other Kankakee material came on the special Sunday.

Things seemed to go slowly on Saturday. Practically the whole day was spent in getting men on the ground. Bridgemen and trackmen were picked up along the line for fifty miles each side of the bridge. Some 35 bridgemen and 100 or more trackmen worked most of the afternoon clearing up enough of the wreck to make room for more effective work next day, though the bridgemen did raise the first one of the lower series of bents. Sunday, fifteen more bridgemen arrived from the L. S. & M. S. Ry. and 40 more trackmen. By that time enough of the wreck had been cleared so that the bridgemen could give their whole attention to rebuilding. The 140 trackmen began to clear up the wreckage and make a place for the bridgemen to work. They removed the fastenings from the rails and tore the ties from the stringers, every second tie being double line-spiked and the spikes rusted into both ties and stringers. The wooden guard rails were double bolted to every fourth tie. The rail on the old trestle was badly bent and twisted. New rail was ordered to take its place. The ties were all good, were saved and used again. There was no time at first to save or pick up bolts, spikes, washers or similar iron. Bolts were cut off or pulled from the old timbers, according to which was done more easily. The stringers of the old trestle were 8″x16″x32′ Oregon fir, bolted three in a chord, with broken joints. Many of the stringers were broken squarely in two, and others split from end to end. The chords were hard to break up, as the bolts were rusted in. It was found easiest to cut the nuts off the bolts and force the stringer timbers apart with the jacks ordinarily used to raise track. The trackmen also cut the bolts in the old 32′ bents. The sway braces on these bents were generally too badly broken to be used again, and received but little consideration from the wreckers, being cut, sawed or split, anything to get them out of the way. More care had to be used in breaking up the old bents and stringers, as they furnished nearly one-half of the material in the new trestle.

Sunday, 50 more men worked on the 80 feet of floor hanging on the two bents. It took them the entire day to clear away the tangle that surrounded it, and to pull this mass of timber to the the ground. It was done without damage to the two 32′ bents on which the floor had hung. The trackmen afterwards moved them bodily up hill 75 feet to a position fitting their height, and they were used in place of new bents.

As the wreckage was broken up and cleared away, such timbers as were selected for use in the new trestle were left lying in the middle of the right of way ready for the carpenters to frame. Tuesday night the entire bridge site was cleared, ready for the carpenters. More properly, enough was cleared to enable the carpenters to work, a strip 35 feet wide down the middle of the right of way. All over this strip old sill and post timbers were laid up on blocks ready for the carpenters to frame. To the north, outside of this strip, broken piling and other useless material and some good sway braces and girts were piled. To the south were ties, rails, stringers, and caps.

As fast as the trackmen cleared away the wreckage the bridgemen took possession of the timber that was fit for use and began to mark and frame it for the lower series of double-deck bents. These and the high single bents afforded the framers a chance to show their ability. The old 30′ posts from the wreckage, and some of the new 40′ posts were badly twisted by seasoning. Care was required, too, in selecting old posts, to avoid the use of crippled timber. As sound posts were cleared of wreckage they were rolled up on blocks and the carpenters took them out of wind. It required work to get the old posts out of wind, ready for re-framing, but besides utilizing old timber there was a certain economy in this, because the wreckage strewn everywhere when the posts were framed would make it almost impossible to get new timber out where it was wanted. For each bent the engineer gave the foreman of the framing gang the length of plumb post. The foreman figured the length of batterlegs at ⅜″ per foot, and marked the four posts of a bent for his men to saw, numbering each post and cap so it could be found when wanted. It is simple to write about. Just take a post out of wind, mark it, saw off the ends with a two-man saw and number it. In fact, there was only little framing to do on this work, but it takes time, labor and a level-headed foreman to frame 53 bents of old stuff, scattered out for 800 feet, with no two bents of a height and in the end have them all check, right for length, with an even full bearing on each end of every post.

About 85% of the posts of the old trestle were fit to reframe, only 22 new posts being used in the lower series of double-deck bents. Nearly all the old caps were in good condition, but only 15 were used, at the west end of the trestle, asit was easier to frame new caps at the same time that posts for the upper series of bents were framed. The 28′ sills of the old 32′ bents were cut to 22 feet and used for intermediate sills, or caps for the lower bents. The frame bents of the old trestle had been mortised and tenoned, which rather spoiled the looks of the underside of these caps, but did not destroy their usefulness. The mortise and tenon is a back number on this kind of work. It shortens the life of a bridge, by making a convenient pocket in which water collects and rots the timber. The posts of the new trestle are sawed square off, dapped into the cap and driftbolted, and toenailed to the sill with eight ⅜″x10″ boatspikes in each post.

Monday night only fourteen lower bents had been erected. Tuesday morning 30 more bridgemen from the L. S. & M. S. Ry. reported for work, making a total of 80 carpenters at the bridge. Some of the trackmen were sent back to their regular work. Some of the new bridgemen established themselves at the east end of the the steel trestle, where they began framing the top series of the double-deck bents, which the other new men erected.

The principal tools used in framing were the two-man cross-cut saw and the adze. Ship augers were used to bore the stringers, the caps, and the tops of the posts for drift bolts. After the adze had done the heavy work, a jack-plane was of use in taking the timber out of wind and in smoothing the daps in the caps. The 14′ sills in the old trestle, which were used as caps in the lower bents of the new, had been dapped to 13½″. In the new trestle they were dapped to 13″ over the posts, and the ends of posts were framed to 11½″, thus insuring a perfect joint. Only new, straight timber was used in framing the 43 upper bents. There were, however, in the new timber a number of 10″x 12″ pieces, and some pieces scant 18 feet long, which had to be used, there not being enough 12″x 12″x 20′ posts for the whole job. The 10″x12″ stuff was used by framing to 9½″ at the top and providing a cap to fit. Most of the 18′ sticks overran in length. The few that did not were used with a two or three inch shimblock spiked on the top end ; ordinarily classed as bad practice, but made necessary in this case because of the relatively large amount of 20′ and 22′ sticks required in the entire work.

Very fortunately the ground upon which the trestle stands is naturally well drained, and of a material suited to sustain a heavy load. With such ground the foundation of mud sills set on blocking, makes the new structure far more stable than the old. The only surveying of any importance done on the work was in connection with these foundations. As soon as the wreckage was cleared away enough to make room for it, a stake was set and numbered for the center of each bent; the line being carried from the center of the track on the steel bridge and a trestle some 500 feet west of the west end of the new trestle. Approximate heights of the various bents were calculated from preliminary levels run on the center line. Small stakes were set at right angles to the center line to mark the location of plumb legs and batter posts The ground was then dug to a level, even surface around each of the four stakes of a bent, but no particular care was taken to bring each to the same level. Such differences in level were made up by using 8″ blocks at the high side and 12″ or 14″ at the low side of a bent. The ground sloped sufficiently in a few cases to require 14″ blocks cribbed up on another set of blocking. A straight edge and a carpenter's level or track level were used to level the top of a set of blocking. The blocking was leveled by digging down, never by building up the earth under the block, except when the block was only a quarter or a half inch low. This did away entirely with adzing and shimming which would have occured had the men been required to bring the tops of these blocks to any specified grade. The length of plumb post was figured from the levels taken on top of these blocks and given to the foreman in charge of the framing gang.

Blocks under each bent generally consisted of eight pieces four feet long or longer, two under each post, giving a ground bearing of about 45 square feet per bent. Thirty-two foot stringers from the wreckage were used for mud sills as long as they lasted, that is 44 bents. They were laid flat, two to a bent, one on top of the other. New 12″x14″ stuff, set on edge, was used for the remaining bents. The old stringers had the advantage of being long enough so as not to require splicing, except under some of the highest bents. Posts for a bent were generally cut and framed before sills had been dragged out from among the wreckage. In giving lengths for cutting posts, the sills were figured as being 16″ deep. Some stringers were 7¾″ thick, others 8¼″. However, when all the bents were erected ready for the floor, they presented a very level, even surface, no bent being more than an inch out of surface, a matter easily rectified by shims between the caps and stringers.

Erecting the bents was the showy part of the work, and perhaps the most satisfying part, as it afforded a visible evidence of progress. The lower series of double bents and all the single bents were assembled and erected by two I. I. & I. bridge gangs from Kankakee, assisted first by a crowd of Italian trackmen and later by teams. When a foundation of blocking and the lower sill were in place, the posts and cap for a bent were rolled over into position just ahead of the foundation. As long as two stringers were used for a sill, the under stringer was braced against the sill of the previous bent with two struts cut from old girts or sway braces, one at each end of the sill. The top stringer was rolled over on edge just ahead of, and touching the lower stringer. The plumb posts lying ahead of it were butted against it and toenailed, being centered from the stakes. The batterlegs were laid somewhere near their proper place and the cap drift bolted to all four posts, holes having been bored for that purpose, in framing. Various old bolts were used for this, mostly three-quarter inch bolts cut from the chords of the old bridge. The cap and sill were held tight to the plumb posts with chains and right and left screw-pulling jacks. Then the batter posts were crowded in at the bottom and toenailed.

In the general hurry of erecting the first five bents, the foreman overlooked the fact that unless the ends of two batter posts are equally distant from the center of the bent, the plumb posts will not be plumb. He used a carpenter's square, squared the sill and the warped seasoned posts, with startling results. However, the oversight was not of enough importance to warrant tearing apart the bents already erected, and having been corrected, the other bents all lined up perfectly.

The posts, cap, and sill being assembled, one sash brace and two sway braces were spiked across the upper face of the bent as it lay blocked up a few feet above the ground. These braces were secured by four ⅜"x8" boat spikes at each intersection. The bent was then ready to raise. A set of double tackle blocks was made fast at each end of the cap and anchored to the cap of the preceding bent, already erected and securely braced. The pulling ropes ran through snatch blocks at the sill of this preceding bent. A team was hitched to each of the two pulling ropes and the bent went up smoothly and easily, being prevented from going too far by a snubbing rope around one of the many broken piles ahead of the erecters. Previous to using teams for this work second sets of tackle had been fastened to the pulling rope to raise the bent about half way. Beyond that point the second sets of tackle were not required. Once erected, the bents were pinched over so that the top sill stringer matched the lower, and the bent centered on the alignment stake. Then the bent was plumbed and tied to the preceding bent with sway braces spiked to the batter posts, near the top. These show plainly in the picture of the completed bridge. The bents were plumbed by eye or by means of a plumb and string held at arm's length. Because of their height it was necessary to plumb most of them from both sides. The accuracy of the method used was proved by the uniform spacing of the caps when it came time to frame the stringers.

A small gang followed the erecters as fast as the bents were raised, putting on the remaining sash braces, sway braces, tower braces, and "A" braces. This gang kept at the heels of the erecters and completed their work before the trestle was ready for the ties and rails.

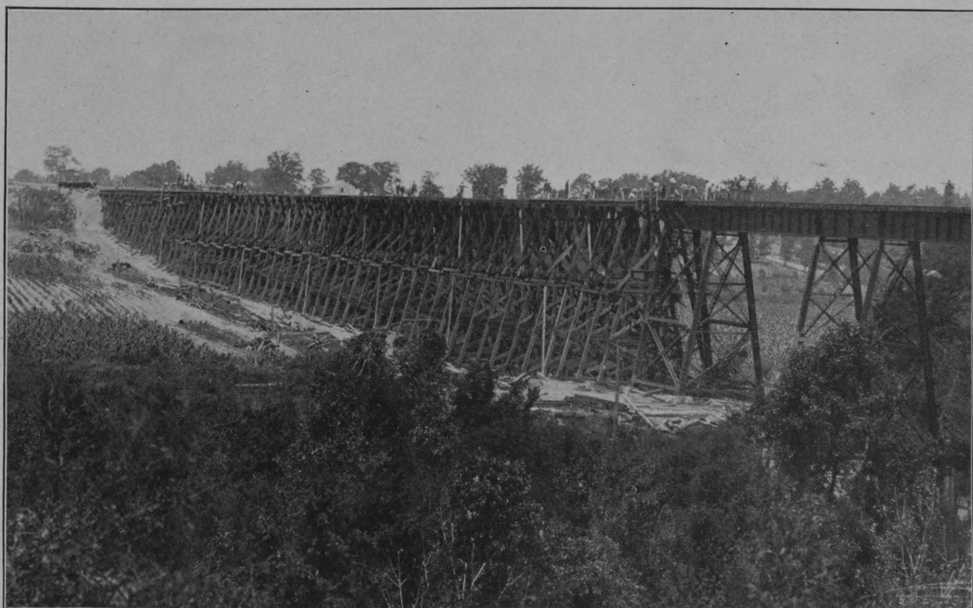
The top series of double bents 20'-6" high was erected in practically in the same way as the others, but the work was somewhat slower. All material for these bents was framed east of the steel trestle and was brought out across the trestle and let down to the tops of the lower bents. It was necessary to build a pretty fair floor of loose planks on top of the lower bents to get the timber out where it was wanted and to give the bridgemen a footing to work upon. The bridgemen had to do all the work of erecting the 43 upper bents without help from the trackmen. It was too far from the ground and there were not enough planks in the floor to suit the trackmen. Tuesday, Wednesday and Thursday, 64 bents were erected; Friday, 22; and the last was erected at 7:40 A. M. Saturday.

It required work to assemble, fasten together, erect, and tie 20 to 25 bents per day. Transportation of material played a very important part in the work. At first, while things were so badly mixed up, trackmen did the entire work of lifting and carrying timber and wreckage to and from the carpenters. Twenty or thirty men picked up a stick with lug hooks and carried it through thick and thin to its desired destination. Carpenters, with cant-hooks, turned and twisted it as required. The trackmen, in helping the carpenters, soon learned to make themselves useful in many other ways, so that it was not profitable to let 20 or 30 of them take time to carry a piece of timber several hundred feet.

Tuesday, after a long hunt, one team was found and Wednesday two more, at the unparalleled rate of $6.00 per day. A roadway was cleared south of the bridge and the teams set to dragging posts, sills, and caps from the various points at which they had been framed, to the erecting gang. There was plenty of such work for them, as the old material was generally several hundred feet from its position in the new trestle. A good gang of trackmen was required to follow the teams, rolling the timbers from the wreckage so that the teams could get to them. The Italian trackmen carried sway braces for some time after the teams came. It was more work to get the old sway braces out from the wreckage than it was to carry them to the erecters; and at first when new braces were used the distance was not so great, and there was plenty for the teams to do without carrying plank. The roadway was made wider as the work progressed, because of timber used. New sway braces were lowered from the steel trestle and teams dragged them three or four at a load as occasion demanded. The teams also erected bents after they were framed and spiked together, thus taking the place of some sixty men who had been used for that work. Later, for the west twenty top bents, the teams hoisted all necessary timber to the top of the lower series of bents at a gin-pole which had been erected a little west of the center of the trestle. The gin-pole was a home-made, hurry-up affair, consisting of two 3″x12″x 28′ pieces made with another spiked in between them with 60d. nails, so as to give it a total

stuff was required was unloaded from the first car loads of material that arrived, and was trucked across on push cars, from the material yard established at the east end of the steel trestle. At the west end of the steel trestle it was lowered to the ground with ropes by a gang of trackmen. This gang also supplied the erecters with framed timbers for the first twenty-three top bents, delivering the timber to the bridgemen at the west end of the steel trestle.

When the erecting gang at the front end of the work began to use new timber for its posts,



height of 40 feet. It was securely chained to a 20′ bent of the lower series, and was guyed at first to the other bents and telegraph poles. The guys were found to be unnecessary and were soon discarded. The first day, timber was hoisted with only a series of snatch-blocks, but the team owners objected to that arrangement as being more severe on the teams than erecting a completed bent. Double blocks were substituted, and there was no more complaint.

Most of the timber used the first two or three days came from the wreckage. What little new

sills, etc., a work train was required to keep them supplied with material. This work train consisted of an engine, a track pile-driver, and a home-made derrick, mounted on a flat car, operated by the engine and drum of the pile-driver. This combination picked up timbers or bundles of planks or bolts or kegs of spikes east of the bridge, ran to the west end of the steel trestle and let them down to a gang of framers working there. This train was kept busy until the bridge was ready for traffic. One might ask why it did not take out whole car-loads of material and unload it. Sometimes, when practicable, this was done, but to do so the services of a second engine were required, to switch the desired cars on a siding a quarter mile from the bridges, so the work train could get at them. Ordinarily no one car contained material in just the sizes and lengths needed below. Frequently a certain long stick wanted would be found at the bottom of a carload. The second engine, with a gang of trackmen for helpers, unloaded such cars, disposed of empty cars, and brought loads to the front as required. The material had not been unloaded when it first arrived. Most of it was stored on empty sidetracks, between Streator station and the bridge, until needed.

After the C., B. & Q. R. R. had rebuilt a small bridge and opened up their line, one carload of stringers was shipped around via the C., B. & Q. to the west end of the Vermillion River trestle. Another carload was picked up from a supply forty miles west of Streator. Friday morning one gang at each end of the bridge began to run the stringers out to position on the caps and frame them. They required but little framing. The ends were cut off so that the joint came over the middle of the cap, and the end of any stringer over 15½" deep was adzed off to that size, to give an even bearing for the ties. Half the stringers were run out on the trestle and framed Friday, just one week after the cyclone. Saturday the remaining stringers were placed and framed, nearly all of them were bored and three-fourths of them packed and turned up ready for ties. Boring was slow work. There were 480 holes to be bored through two feet of timber, a day's work for a dozen men. Previous to boring, the stringers were laid flat, three deep, with broken joints. They were bored in this position, then packed and bolted. As the bolts were put in, the stringers were pinched up at each joint and 2" cast iron packing washers slipped in. Sections 200 to 300 feet long were then turned up into position. The men were not able to start them with cant-hooks. A stout lever ten feet long was chained to one end of the chord. This lever and a set of double blocks started it easily and the chord turned rapidly over like a long row of dominoes.

The ties had to be hoisted from the ground below. The teams and some trackmen spent a good part of Saturday collecting the ties in two piles near the ends of the trestle. A smaller gin-pole was rigged at the west pile and ties enough to reach one-third of the way across the trestle were hoisted by the teams. Every effort was made to finish the trestle all over at once. It was found that about one-fourth of the rails from the old trestle were not injured very much, so Saturday afternoon ties were laid on the west one-fourth of the bridge. The usable rails were hoisted and laid. This proved a considerable help in hurrying the trestle to completion. Sunday, ties were hoisted at the east end by the work train and derrick, and the rails run out on a push car. Shortly after dinner the last rail was spiked down, and the new trestle declared ready for traffic, eight and one-half days after the old trestle was destroyed. The first train passed over late in the afternoon. Sunday night the men returned to their regular work, except a small gang of bridgemen, who remained to surface the floor, place the guard rails, and put one and three-quarter inch bolts in each end of the many sway braces.

A few figures of the material, labor and cost may be of interest. The old trestle, not including rail, was built by contract in 1899 at a cost of $10,-127.00. This represents a unit cost of $33.00 per 1000 Ft. B. M. for 244,000 ft. of timber; 33c per lineal foot for piling; and 2½c to 3½c per pound for iron, including both labor and material. Of the 244,000 Ft. B. M. of the timber in the old trestle, 162,000 Ft. B. M. were used in the new, for posts, caps, sills, blocking, ties and guard rails. The L. S. & M. S. Ry. furnished 95,000 Ft. B. M. new timber. The I. I. & I. R. R. furnished 94,000 Ft. B. M. new timber. Most of this was fir. All told, there is over 351,000 Ft. B. M. of timber in the new trestle. The new iron cost $341.37. The new timber $5,176.94, an average of $27.25 per 1000 ft. Besides $435.35 for work train service, the labor of bridgemen, trackmen, etc., amounted to $4,162.72. An average of $11.85 per 1000 ft. for all timber, old and new, in the trestle. The total cost of reconstruction was $10,116.39, an average of $12.00 per lineal foot. Barring accidents, the new structure is good for eight or ten years' hard service.

ALUMNI NOTES.

Robert B. Arnold, '03, was in Terre Haute for a short visit, soon after school opened.

Robert C. Warren, '02, formerly with the Armour Packing Co., has recently accepted a position as Assistant Chemist in Kansas City, Mo.

At the beginning of the term, W. R. Sanborn, '96, and C. L. Post, '03, were in the city, each being accompanied by a brother starting at Rose.

Albert C. Lyons, with the Chiapas Mining Co., in Mexico, recently made the Institute a visit, while on a short vacation.

Y. E. Troxler, '95, is with the St. Louis Transit Co.

Fred R. Fishback, '02, was in the city recently on his way from Cheyenne, Wyo., where he has been with the Union Pacific, to St. Elmo, Ill., to accept a position as round house foreman with the C. & E. I. R. R.

Edgar L. Flory, '02, with the Hammond Packing Co., at St. Joe, Mo., made his friends in Terre Haute a visit for a few days, shortly after school opened.

Ira Marshall, '02, is at Ft. Smith, Ark., with the Equitable Powder, Mfg. Co., of St. Louis.

H. E. Weideman, '03, has accepted a position with Nelson, Morris & Co., of East St. Louis.

Harry S. Richardson, '00, is now with the Electric Controller and Supply Co., Consulting Electrical Engineers, of Cleveland, Ohio.

James C. C. Holding, '94, announces the arrival of a daughter on Sept. 9th, Miss Laura Anna. THE TECHNIC offers its congratulations.

Announcement of the engagement of Miss Emma Crawford of Terre Haute, to B. H. Pine, '03, has been made. The marriage will take place the middle of October. Following so closely upon Pine's graduation, it took his many friends by surprise.

Frank Jumper, '99, and his brother, Charles Jumper, '02, spent the first two weeks of October in Terre Haute.

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about which is wound a 1½ inch cable, long enough to extend over thirty cars if necessary. This drum is operated by two twin engines using steam furnished by the locomotive. When the Lidgerwood couples on to a cut of loads the cable is stretched over the train and fastened to a plow which is on the last flat car, by means of a cable stretcher. The cable stretcher consisted of two piling driven one on each side of the track about seven feet from the center line. The tops of the piling were about eight feet above the rail, and each had a chain attached to it, which, when not in use, hung loosely by the sides of the piling. When in use these chains were connected, forming a support to which the end of the cable was anchored. After attaching the cable to this chain the train is backed up and the cable unwound from the reel and drawn over the loads until it reaches the plow. Then it is disconnected from the chain and attached to the plow. The train is then taken to the place for unloading, and the Lidgerwood winding up the cable plows the dirt off in three or four minutes. The Lidgerwood is of great advantage in unloading, for aside from saving time and labor, it permits the size of the dump to be regulated by moving the train during the unloading.

The track at Dunkirk was raised in place. Dirt was unloaded on each side of the track, which was then jacked up and the dirt thrown under by laborers. The track was then tamped up and put in shape for the unloading of more dirt. Some of the dirt unloaded would be spread by means of a spreader car in order to give a shoulder to the embankment on which more dirt could be unloaded. The banks also were widened to the proper width after the track was up to the proper grade by means of the spreader.

The spreader consisted of a heavily ballasted car, equipped with a steel wing on each side. These wings were operated by air received from the engine. The end of a wing when ready to spread being braced at an angle of about 30° to the car by an 8x8 timber. The spreader leveled the dirt with the bottom of the ties, and could spread a distance of 18 ft. from the center of the track.

When a road crossing was to be placed under grade, the fill was first completed then a pile bridge built, and afterward the excavation was made by teams for the road way.

In staking out this fill grade stakes were put in at the approaches where the fill was light. Where the fill was heavy, spikes set in the telegraph poles indicated the new grade, and these served the purpose much better than grade stakes, as they were never disturbed.

At Hartford City, on account of the height of the fill and a railroad crossing over the L. E. & W. R. R., a temporary trestle was built and filled in. The trestle was 5,000 ft. long and consisted of pile bents, 15 ft. centers, two piling to the bent. The land bought for the borrow pit contained a great many trees, and these were converted into piling, forming an adequate supply. The stringers were taken out after the fill was completed. It was not necessary for the trestle to carry the weight of an engine, as the train was always pushed out on the trestle and unloaded, the engine remaining on solid fill and advancing as the fill was made.

When the cuts and fills were completed the track was ballasted up and put in line and surface, and turned over to main track traffic, trains at first not being allowed to exceed a speed of ten miles an hour on fills and fifteen in the cuts. On account of the settlement a large force of men was kept employed on fills after they were completed, to keep the track in line and surface. The settlement of the embankment at Hartford City was considerably greater than that at Dunkirk, on account of the manner in which the fill was made at each place. When a track is raised in place work trains pass over it after every lift, making the fill more compact than when it is made from a trestle.

CIVIL CAMP.

By J. S. McBRIDE, '05.

IT was on June 10th when Prof. R. L. McCormick with his crowd of Civil Engineers, to be, left Union Depot for the annual civil camp of 1903, It is the custom at R. P. I. for the Sophomore and Freshman students of the Civil Engineering department, after the school year is ended, to enter upon a two weeks' railroad camp, where the practical problems and obstacles of railroad engineering are met with and worked out on the field.

The class this year, as well as for several years past, made a survey and located a line for the Vandalia R. R. The headquarters of the camp in 1903 were at Reelsville, Ind., 25 miles east of Terre Haute. The Vandalia road from Reelsville to Greencastle is a conglomeration of curves, and much more resembles a number of French curves thrown together than it does a railroad track. It was to rid, as much as possible, the company of these curves that we went to Reelsville. The line was started from Eagles, 2½ miles west of Reelsville, and crossed two miles north of Reelsville. The line ran to a point 2½ miles north of Hambricks, a distance of about eight miles.

The first day at camp was spent in walking over what we thought would be about the location of our line. The reason in going over the ground first was to obtain a knowledge of the lay of the ground, so that in running the line we might be better able to minimize the amount of curvature and the cuts and fills of the line. On the second day, transit parties were sent out to run the line, which consumed several days. After the line had been run by the transit parties, profile and traverse parties were sent over the line, the profile parties to make a profile and the traverse parties to locate the different roads, section corners, and townships. The topographical parties were soon following It was the duty of the topographers to take all the topography 600 feet. each side of the line.

If any of the other students think that the life of the Civil at camp is a "snap," I suggest that they try it themselves for two weeks. To leave after the other students have gone home, when you know it will be two weeks more before you can go home and see some fair one, who has been waiting (perhaps) since Christmas for your return. Then there is the work in the field from 7 A. M. till 6 P. M., with an eight mile or ten mile walk thrown in, and after that, office work until 8 or 9 o'clock at night. Last, but not least, is the boarding house fare—perhaps the least said about that, the better it would be for the reputations of the boarding houses where we stopped.

Our work, however, was not without its side lines of amusements. The Sopomores and Freshmen were staying at different houses, and a nightshirt visit from one class to the other, about 10 o'clock, came to be part of the regular routine of the day. Then, again, we would have our little swimming parties, down at the hole by the the old mill.

There was not an accident of a serious nature to mar the pleasure of the entire camp. One accident was only averted by one of the ever-ready Sophomores, who were always on the alert to prevent the Freshmen from doing harm to themselves. The occasion I speak of was when the Soph, in question, had a Freshman in his party as an axeman and it became necessary for a limb of a tree to be chopped off. The 1905 man told the Freshman to cut the limb for him. The Soph turned his back for a moment, only to turn back again and see the Freshman sitting out on the limb and chopping at it for dear life. He was cutting the limb between himself and the tree. What the result would have been, you may surmise. It was only after a somewhat lengthy argument on the part of the Sophomore that he could convince the '06 man of the peril of his position.

There is an incident that happened at the camp, which, if cited, might brighten up this somewhat dull narrative of the camp. It concerns Prof.

McCormick. We all know and respect the Professor for his mathematical genius and his ability to "stick it" to the Freshmen; but he appeared in an entirely new role at camp—that of a doctor. According to the barber at Reelsville, who shaved the Professor several times, it seems that the Professor prescribed some pills for the barber, but for some unknown reason the pills did not have the desired effect. This did not suit the barber, so he proceeded to drink Reelsville dry, and came near doing this. The barber told us this story while in this fix, much to the discomfiture of the Professor, who blushed perceptibly, so you may accept it for what it is worth. At any rate, the barber always called the Professor "Doctor" after that. I hope this won't cause any hard feelings on your part, Professor, but it was too good to keep.

The camp broke up on June 25, much to the delight of all. The boys were all glad it was over, so that they might go home, but there was not one of them that regretted that he had spent those two weeks in camp, for invaluable was the experience we gained, thanks to Prof. McCormick. How well the work was done may best be answered by the Juniors, who are now making the map of the survey.

Y. M. C. A. RECEPTION.

The annual reception was held in the R. P. I. gymnasium Friday evening, September 25. This is one of the most important social functions of the year. It is here that the Freshmen meet, on an equal footing, all the upper classmen. Here they become acquainted with the Faculty and their ladies.

It is always a pleasant occasion for all concerned, and this year the Y. M. C. A. boys outdid any previous effort. Long ribbons of red, white and blue were festooned from light to light and then to the corners of the gym. The American flag was also much in evidence. These decorations, together with the tasty arrangement of sofa pillows, went a great way toward eliminating the barn-like appearance common to all gymnasiums. The Glee Club rendered several selections which were heartily applauded. The Orchestra also played some numbers in a manner that spoke well for their training. Then the free for all singing was begun, and it is safe to say that everyone did his part.

Refreshments were served and punch was in order all the evening. The great number present, the pretty girls in dainty attire, and the extreme good nature of all, made it an event to be remembered not only by the Freshmen but by the upper classmen and those who have left the nest but are still for Rose Polytechnic.

FRESHMAN CLASS.

Albin, Earl G.	Osage City, Kansas
Andrick, Wallace P.	Terre Haute
Austin, Harold S.	Terre Haute
Bard, Bert H.	Brazil Ind.
Barker, Maxwell S., Jr.	Louisville, Ky.
Brannon, Frank S.	Owensboro, Ky.
Briggs, Charles E.	Portland, Ind.
Byrn, Dexter	Terre Haute
Cash, Frederick H.	Hume, Ill.
Claypool, Robert R.	Newton, Ind,
Crane, Claude R.	Milroy, Ind.
Cazin, Franz A.	Denver, Colo.
Crawley, Vernon V.	Sullivan, Ind.
Davies, Harry L.	Marshall, Ind.
Davis, Ben M.	Newport, Ind.
Finley, L. Monroe	Duncanville, Texas
Flickinger, Edward W.	Galion, Ohio
Gillette, Stephen A.	Terre Haute
Glover, Frank B.	Terre Haute
Goodman, Milton	Terre Haute
Hall, Schuler P.	Terre Haute
Hamilton, Paul B.	Terre Haute
Hannum, Frank J.	Concordia, Kan.
Hathaway, Robert M.	Owensboro, Ky.
Heniken, George E.	Grayville, Ill.
Hill, John F.	Lima, Ohio
Houston, William V.	Bedford, Ind.
Hughes. Edward E.	Terre Haute
Kaylor, Harry Dee	Arcadia, Ind.

Kelly, Warren W.	Topeka, Kan.
Kiely, Edward D.	California, Mo.
Krannichfeld, Delbert	Terre Haute
Lammers, Charles N.	Terre Haute
Laux, Henry	Flatonia, Texas
Lyons, Samuel	Hume, Ill.
McCormick, George F.	Terre Haute
McDaniel, Donald	Mt. Carmel, Ill.
McKenna, Raymond J.	Omaha, Neb.
Meyers, Morris	Louisville, Ky.
Miller, Howard L.	Valley Station, Ky.
Miner, Erwin J.	Louisville. Ky.
Nantz, Frank A.	Glenn, Ind.
O'Loughlin, Walter M.	Terre Haute
Orr, Harry H.	Louisville, Ky.
Parker, C. Channing	Bloomfield, Ind.
Phillips, J. Emerson	Judson, Ind.
Plew, William R.	Palestine, Ill.
Post, Clifford W.	Gordon, Ohio
Read, Edwin C.	Terre Haute
Riddell, Clarence D.	Brazil, Ind.
Rontledge, Thomas E.	Newman, Ill.
Sage, Russell S.	Terre Haute
Samuel, Robert L.	Maysville, Ky.
Sanborn, William G.	Rockford, Ill.
Scharpenberg, Charles	Gerard, Ill.
Schenker, Francis E.	Vincennes, Ind.
Schofield, Alonzo D. Jr.	Mason, Ga.
Schickel, Boyd,	Terre Haute
Schickel, Harry M.	Terre Haute
Sievers, Charles H.	Omaha, Neb.
Snider, Luther C.	Newcastle, Ind.
Smith, Chauncey F.	Decatur, Ill.
Stalker, James R.	Terre Haute
Strecker, Robert	Terre Haute
Theobald, Charles F.	Terre Haute
Toner, Floyd	Terre Haute
Trueblood, Cecil N.	Terre Haute
Unckrich, Clarence F.	Galion, O.
Veach, Ralph W.	Terre Haute
Watt, Harry H.	Barnesville, O.
Whayne, Harry T.	Louisville, Ky.
Whitecotton, Otto G.	Terre Haute
Wickersham, E. Paul	Terre Haute
Wickliffe, Paul R.	Greenville, Ky.
Wood, Ottiwell	Terre Haute
Williams, James P.	Wabash, Ind.
Yeager, Otto N.	Prairie Creek

NEW SOPHOMORES.

d'Amorin, Ambrosio	Manaos, Brazil, S. A.
Hatch, Frederick N.	Terre Haute
Kahlert, Ernest D.	Louisville, Ky.
Wischmeyer, Henry W.	Louisville, Ky.
Worthington, Arthur	Terre Haute

NEW SENIORS.

Cohn, Clarence A.	Salt Lake City, Utah
Katzenbach, Brown	Indianapolis, Ind.

GRADUATE STUDENT.

Ijams, J. Warren	Terre Haute

Graduate Students	1
Seniors	30
Juniors	49
Sophomores	53
Freshmen	77
Total	210

OFFICIAL DIRECTORY.

Senior Class—President, J. Newton Ross; Vice-President, Merwin B. Miller; Secretary and Treasurer, L. A. Touzalin.

Junior Class—President, Herbert L. Watson; Vice-President, Edward H. Spalding; Secretary and Treasurer, J. Edward Daily.

Sophomore Class—President, H. R. Canfield: Vice-President, Lilburn Beattie; Secretary and Treasurer, C. R. Demmitt.

Freshman Class—President, Erwin J. Miner.

Student Council—President, J. Newton Ross; Vice-President, Merwin B. Miller; Secretary, H. R. Canfield; Treasurer, Clifford B. Speaker; Clerk, R. W. Hill.

Athletic Association—President, John F. Regan, Jr., '04; Vice-President, Clifton Brannon, '04; Treasurer, George H. Pfeif, '05; Secretary, Addison Lee, '06.

Y. M. C. A.—President, Merwin B. Miller; Vice-President, Cleo B. Cook; Secretary-Treasurer, Walter H. Burr.

Telegraph Association—President, Clifford B. Speaker; Vice-President, H. John Wilms; Superintendent, Carl Wischmeyer.

Camera Club—President, Roy W. Hill; Vice-President, Robert F. Garrettson; Secretary-Treasurer, Leo F. Dorn.

Symphony Club—President, J. Edward Daily; Vice-Presidents, Robert D. Landrum and John F. Regan, Jr.; Secretary-Treasurer, William H. Hazard.

Orchestra—President, Robert D. Landrum; Vice-President, J. Edward Daily; Secretary-Treasurer, Leo F. Dorn.

Glee Club—President, John F. Regan, Jr.; Vice-President, George Benson; Secretary-Treasurer, Ralph C. Blanchard.

CAMERA CLUB.

All Freshmen who own cameras and are interested in amateur photography, should give their names to one of the officers of the Rose Tech

Camera Club. The Club maintains a dark-room in the basement for the benefit of its members, and specimens of their work are displayed from time to time in the case in the hall. As the officers are especially anxious that all interested should share in these benefits, it is hoped that all owning cameras will take an interest and join. Keys to the dark-room may be obtained from Mr. Dorn, '04. It is requested that all those using the dark-room leave everything clean and in good order, and turn off the light and water when through.

THE 1905 NUMBER OF THE MODULUS.

The Junior Class of the Rose Polytechnic Institute announces that on May 1, 1904, the sixth *Modulus* will appear. The excellence of the previous books, as well as the fitness of the class of 1905 to publish an annual, gives confidence to the announcement that the book will be original, well gotten up and worthy of its *Alma Mater*.

The Modulus board will do its utmost, not only to render the book an artistic success, but also to make it of more general and permanent interest than the average college annual.

The edition will be 600 or more volumes, bound in an appropriate and specially designed cover, 8 x 11 inches in size. Hardly a page will be without an illustration, and special care will be taken with the drawings and decorations. Many photographs of organizations and objects of interest will be included, and every feature of life at old Rose will be represented in the volume.

The price of the book has not been definitely fixed, but it will not exceed $1.50. The Board hopes to sell the book for less than the above sum, but has deemed it best not to fix the price absolutely until the resources are more accurately known.

Communications may be addressed to the Editor or Business Manager at the Institute.

THE PIPE RUSH.

PIPES! Pipes! Pipes! From the beginning of school until after the following Saturday the absorbing topic of the school was: "When will the Sophs put up the challenge prohibiting pipes to the Freshies, and will the Freshmen take it down?" At last the red rag went up, and according to custom was taken down by the Freshmen, who seemed to be looking for trouble. They got it, as anyone who witnessed the scrap at the building that night will vouch for.

Finally Saturday rolled around and the campus was filled with '06 and '07 men, dressed in their worst, and eagerly waiting to fly at each others' throats. The proceedings opened with the customary ball game, and '06, with Demmitt in the box, had scored two runs before the Freshmen awoke to their own defeat. However, as as soon as '07 saw they could not win, they lifted up one of their number who promptly showed a pipe. Then the fun began, and during the next ten minutes many an interesting scrap entertained the spectators. But force of numbers soon told, as '06 found to her sorrow, for when the whistle blew for the end of the first half there was no Sophomore who could claim a superior point of vantage over a Freshman, or, in other words, who was on top of an '07 man. After a short breathing spell, the two classes were lined up at opposite ends of the campus and the big pipe placed midway between them. Again the whistle was blown, and both classes were told to "whoop 'em up," which they did. But again numbers counted, and the unfortunate Sophs were unwillingly dragged from their positions on the pipe and each sat upon by some accommodating Freshie. At last the half was over, and the pipe rush of 1903 was a thing of the past. On counting the hands on the pipe it was found that the Freshmen had 17 to their credit, while there were no Sophs within touching distance of the coveted trophy.

The line-up of the two teams for the base ball game was as follows:

SOPHOMORES.		FRESHMEN.
Demmitt	p.	Strecker
Thurman	c.	Cazin
Wilms	1	E. Brannon
Downing	2	Goodman
Beattie	3	Crane
Pote	s.	Miner
A. W. Lee	l. f.	Kimball
Cannon	c. f.	Shickel
Ryan	r. f.	Lammers

FOOT BALL.

Prospects for a winning team this year are the the brightest the wearers of the Old Rose and White have had for several years. A good coach, abundance of material, and a hustling manager are surely sufficient foundation to give the R. P. I. a winning representation. During the early spring and summer Manager Watson was in communication with several men to serve as coach, but to clinch the matter, decided to see Mr. Stagg of Chicago U., who unhesitatingly recommended our present coach, Mr. Holste, as the best man who could be obtained for the position. At the first call for practice there were 25 men out in suits, and there have been enough fellows out ever since to make two teams to buck against each other. Although a good number of these men are inexperienced, still they are willing, and under the strict rule of Mr. Holste, who is every inch a worker, are improving rapidly. As yet the team has not been picked, and Mr. Holste says he will not do so until the season is almost over. According to this arrangement, every fellow ought to work hard to keep his place on the team, as it will give any new men who come out an equal chance for honor. Every one who comes out will be given a trial, and only the best men will fill the positions on the team.

R. P. I.—25; T. H. H. S.—0.

The Varsity team played a second practice game with the local High School team, and easily defeated them by the score of 25 to 0. Fifteen minute halves were played. The defense work of the Varsity team was fair, but it showed that there is much work ahead of every one if he wishes to have a winning team represent the R. P. I. during the coming season. However, great improvement was shown over preceding games, and much credit is due Mr. Holste for the same.

T. H. H. S.—ROSE.

The Poly team played its first practice game on Sept. 23, and won from its opponents by the scarcely creditable score of 11 to 6. But it must be taken into consideration that this was the first game of the season, and naturally both defense and offense work were weak. Whitlock of the High School made a 50-yard buck through center for a touch-down, and then kicked goal. This rather put the team on its mettle, and on the next kick-off they took the ball steadily down the field for a touch-down. Daily missed goal. At the end of the first half the game stood 6 to 5 in favor of the High School.

In the second half, R. P. I. kicked off to High School, who soon lost the ball on downs. On the next play, and aided by beautiful interference, Bland made a 45-yard run for a touch-down. Daily kicked goal. The half ended with the ball in the possession of the High School on their own 35-yard line.

The Poly team lined up as follows:

Walker,	c.	Demmitt,	l. g.
Wilms,	r. g.	Speaker,	l. t.
C. Brannon,	r. t.	McBride,	l. e.
E. Brannon,	r. e.	Kiely,	q.
Daily,	l. h. b.	Bland,	r. h. b.
Strecker,	f. b.		

THE WASHINGTON UNIVERSITY GAME.

The Varsity team met its first defeat of the season when they lined up against the heavy team of W. U. Although the defeat was not unexpected, still the difference in scores of 21 and 0 does not indicate by any means the relative merits of the two teams, for while the University men made one touch-down by hard work, the other scores were either made on flukes of the rankest kind, or after the Poly team had lost confidence and was not able to do justice to itself and to its coach. No definite account can be given of the game, as none was kept, but the first fifteen minutes of the game the W. U. players recognized that they were up against it, and only scored after the hardest kind of work. Even then they had to be helped by the officials, who did not seem to know the game from the rules standpoint. Had the officials been up to the mark it is safe to say the scoring would have been much less, for while it is hard work playing a heavier team, every one knows it is much worse with the officials thrown in. After a while it became so bad that a protest was made by the Poly team and a statement that if better officials could not be obtained the game would not proceed. Finally Mr. Holste, the Poly coach, was substituted, and he showed the University team how a game should be conducted.

Captain Bland won the toss and chose to defend the north goal. W. U. kicked off to Kiely, who returned the ball 10 yards. Line bucks netted 15 yards more, when the team was held for downs and the ball went over.

Washington then advanced the ball a short distance until an illegal play was made and the ball returned to Rose. Daily punted out of danger, and the W. U. carried the ball steadily down the field and would have scored a touch-down but for a fumble behind the line which McBride fell on. The ball was put into play by Daily at the 25-yard line. By steady line bucking W. U. then carried the ball over for a touch-down. Krause missed goal. The Poly team seemed to lose heart after this touch-down and played a listless sort of game, while Washington seemed to get more ginger into them at every play.

W. U. kicked out of bounds twice and then Daily kicked 45 yards to Stuttle, the University quarter, who returned the ball 10 yards. The St. Louis team then worked the ball to about the Rose 40-yard line and then punted to Kiely, who missed the punt and a Washington man fell on the ball in the Poly 5-yard line. Two mass plays on tackle and the ball went over. Goal was kicked and the half ended with the ball in Rose's possession on her own 40-yard line.

In the second half Daily kicked off to Washington right half, who fumbled, but fell on the ball. The Rose line seemed to be weak in this half, and Washington, by line bucking, mixed with a few end runs, soon carried the ball over the line. Krause missed goal. Daily kicked off to Stuttle, who by a brilliant run brought the ball back to the center of the field. Then by bucks of from 5 to 10 yards the ball was carried toward the Poly goal, when a mass play on tackle sent the oval over. The half ended with the ball in W. U.'s possession in her own 40-yard line.

The summary :

ROSE.		WASHINGTON.
Demmitt	r. e.	Bishoff
C. Brannon	r. t.	Hope
Heick	r. g.	Robinson
Speaker	c.	Cassell
Walker	l. g.	Sloan
E. Brannon	l. t.	W. Krause
McBride	l. e.	Snell
Kiely	l.	Stuttle
Daily	l. h. b.	Pitzman
Bland	r. h. b.	Smith
Strecker	f. b.	Garstang

Final score - W. U., 21 ; R. P. I., 0.

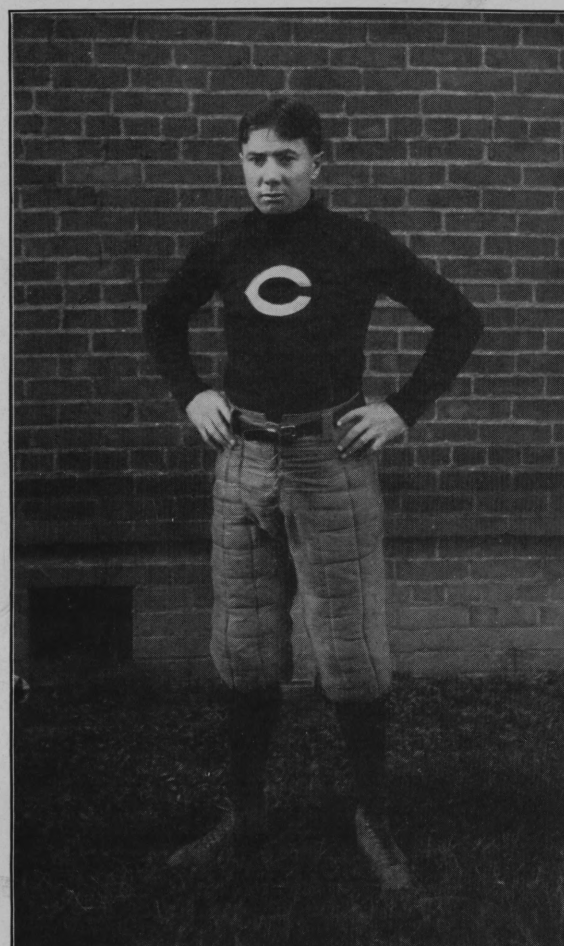
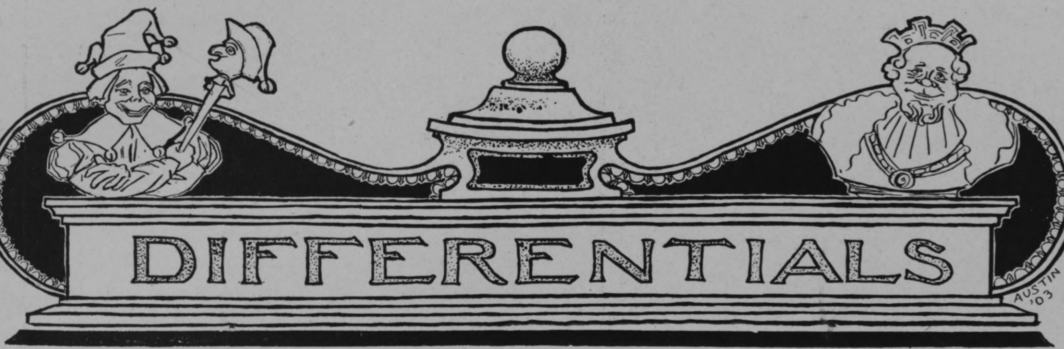


Photo by Hill, '04. COACH HOLSTE



"Go, little TECHNIC, go,
Bearing an honored name,
'Till everywhere that thou hast went
They're glad that thou hast came."

As a great blow to track athletics came the news that Paul Turk, our last year's champion, is not to return. California is a long way off, and we hardly blame Turk for entering school nearer home.

At a meeting of the tennis players of the school, a Tennis Club was organized, with the following officers: President, Cargill; Secretary, A. Lee; Treasurer, C. Wischmeyer.

The object of the association is to get the courts into good condition, and keep them so. It is the intention of the members to put on a sub-bed of cinders, thoroughly soaked with petroleum, covered over with a bed of sand and clay. This should practically eliminate all trouble with weeds and grass, and do away with the unpleasant job of "skinning" off the courts each year.

Naughty-Six now has only about fifty members, out of an aggregate of nearly one hundred. She started with eighty-four, received several recruits during the year, and starts in this year with four new men, Worthington, formerly of Naughty-Five, Kahlert, H. W. Wischmeyer, and Hatch.

"Aha!" cried Touzie, as one inspired, "I know why those flies are all falling into the milk. They can't see. They've left their specks on the ceiling."

Hath:—"This explanation is rather hard to follow, but you must bear it in mind mentally."

The orchestra has again begun work under the direction of Mr. Hugh McGibeney, and promises to be ever better than last year.

Have you heard Hath's latest joke? At the Freshman reception he wrote his class numerals as '04, '05, '06, '07, – – to n terms.

"My wife," said the fond husband, "can drive nails like lightning."

"That is to say," replied the bachelor, "she never strikes twice in the same place."

Little thinking how much amusement he was affording twonty sleepy Sophs, a "yaller dorg" strayed into the German room the other day, and in spite of the eloquent appeal of Mr. Wadleigh, quietly snoozed there the rest of the hour.

There has been some talk among the track men of organizing a Fall Track Team, for indoor work. This would be a very wise plan, for it would bring out some new material, and it is largely to new men that Rose must look for success on the track next Spring.

GLEANINGS FROM FRENCH.

Prof.:—This is invariably the case where there are no exceptions.

Wicky:—Now, if you know I have marked you zero and you don't want it, just let me know.

Prof.:—Which way does this line of force act, to the right or left?

Klenk:—Yes, sir.

STEAM VS. HOT AIR.

Waggie:—During combustion, what happens to the heat, Mr. B.?

Him:—Well, that depends on where you burn it.

Jo—Now, this spherical conductor is isolated by itself without being in contact with anything else.

Ducky:—"I've done a great many things I don't know anything about."

On a recent evening a prominent member of the Senior class was ambling down Ninth street, when he was approached by a person whom he took to be his room-mate, and who inquired if that was Ninth street. Promptly coming to attention, our hero saluted with profound dignity, and replied: "Aye, aye, Uncle Heiney."

The stranger started quickly down the street, looking behind him at every step.

Freshman colors are "Orange and Black."

ISN'T IT TRUE?

Vacation time we swear that when
Our days of rest are o'er,
We'll hustle back to school again,
And next year study more.

But when we've worked a week or two,
And studied like "darnation,"
We think of all the things we'll do
In our next long vacation.

Prof.:—Sommes Nous assis.

Leedy:—Well, I don't understand how you can properly say, "I see some Noses."

Mr. R. W. Hill, '04, begs his friends to take care not to confuse the *i* in his name with another vowel which comes before *i* in the alphabet.

Seniors in mechanical laboratory are having great times riding on the revolving grate of the new stoker.

Overheard at one of the receptions:

1st Normalite—"Say, I met a fine Terre Haute girl down home this summer."

2nd Normalite—"Does she go the Normal?"

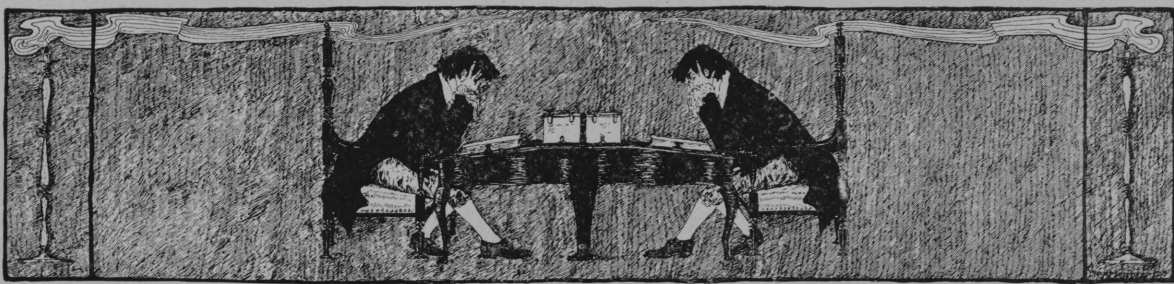
1st Normalite—"Oh, no! She goes to the Polytechnic."

A certain member of the Senior class recently had occasion to travel in a Pullman. In the morning when he reached for his trousers he found the legs, which had fallen on the edge of the berth, decorated with sundry articles of female wearing apparel. The lady in the lower berth had evidently mistaken the trousers for the curtain of the berth. The explanations which followed were rather embarrassing for both parties.

SHAKESPEARE IN COLLEGE.

Freshman—A Comedy of Errors.
Sophomore—Much Ado About Nothing.
Junior—As You Like It.
Senior—All 's Well that Ends Well.

—[*Ex.*



REVIEWS

THE department of Reviews is intended for the publication of reviews of scientific books, pamphlets and magazines which we receive from time to time and which may be found in the library. It is our aim to make this an aid to the readers in keeping in touch with some of the many technical books which are constantly being put on the market. We also re-publish articles taken from other magazines which we think will be interesting and instructive to others. It will be a great service to THE TECHNIC if any of our readers, after reading the reviews and then ordering any of the books reviewed, should mention THE TECHNIC.

Radio-Active Substances.

An Hypothesis as to the Source of the Energy Liberated by Radium and Similar Substances.

THE remarkable discoveries in the field of radio-activity which have been made by M. Becquerel, M. and Mme. Curie, and other investigators, have been followed in these columns, and very recently the phenomenon of the continuous emission of heat by salts of radium was commented upon. This phenomena, apparently contradictory to our ideas of physical laws, has given rise to a variety of hypotheses as to the nature of the processes by which radium and similar substances are able to give out energy for an indefinite period.

It has been suggested that radium may draw upon the kinetic energy due to the molecular motions of air. The radium atoms may be so constituted that they can abstract kinetic energy from the rapidly moving air molecules, and at the same time not give up any of their own energy to the slowly moving molecules. But it is hard to see how this hypothesis can explain the action of radium in melting a block of ice. The radium is placed in a closed cavity in a block of ice, and, according to the above hypothesis, the combined energy of the radium and the air in the cavity will not change, for any energy gained by the radium must be lost by the air. The ice, however, is melted, and the radium is clearly able to supply the energy needed for this action.

It has also been suggested that the air is traversed by a very penetrating kind of Becquerel radiation, and that it is the absorption of this radiation that furnishes the energy to the radium. Experiments have shown that the ionisation of a gas inside a closed vessel is diminished by immersing the vessel in water, suggesting that at least part of the ionisation of the gas is caused by a radiation which can penetrate the walls of the vessel, but which is stopped by the water. In order, however, that radium should possess the heating effects which have been observed, its absorption of this radiation must be far greater than that observed in the case of experiments with other metals.

It is possible that this may be the case, but a more reasonable hypothesis has been offered by Prof. J. J. Thomson, in a recent issue of *Nature*. He thinks "that the absence of change in radium has been assumed without sufficient justification ; all that the experiments warrant us in concluding is that the rate of change is not sufficiently rapid to be appreciable in a few months, There is, on the other hand, very strong evidence that the substances actually engaged in emitting these radiations can only keep up the process for a short time ; then they die out, and the subsequent radiation is due to a different set of radiators. Take, for example, Becquerel's experiment when he precipitated barium from a radium-active solution containing uranium, and found that the radio-activity was transferred to the precipitate, the solution not being radio-active ; after a time, however, the radio-active precipitate lost its radio-activity, while the solution of uranium regained its original vigor." [*Prof. J. J. Thomson—Nature.*

RADIO-ACTIVE SUBSTANCES

These considerations are highly interesting, not only as an explanation of the behavior of radium, but as showing that vast amounts of energy may be due to the inherent motions and configurations of the molecules and atoms of substances, energy which at present is beyond our reach, but which we may yet learn how to control and use. [—*Engineering Magazine.*

Locomotive Testing Plant at the St. Louis Exposition.

A LOCOMOTIVE testing laboratory is to be operated in the transportation department of the approaching exposition at St. Louis. Mr. Willard A. Smith, chief of that department, announces that the Pennsylvania Railroad will construct a plant for permanent installation at Altoona, and that this will be temporarily erected at the exposition as a part of the exhibit of the road. The entire exhibit will be under the charge of Mr. F. D. Casanave, formerly general superintendent of motive power of that road. Nothing of this kind has ever been attempted in connection with an exposition, and the valuable results already obtained upon locomotive testing plants in this country may be considered a promise of most important accomplishments at St. Louis. If a completely equipped testing plant is kept busy for seven months at the exposition and the work is carefully planned and executed, as it is sure to be, the undertaking will undoubtedly be a step toward a thorough scientific study of the modern locomotive, than which there can be no more fruitful investigation in connection with the subject of transportation. [—*American Engineer & R. R. Journal.*

Typesetting by Telegraph.

A CABLE dispatch from Paris of July 4 says: Prof. D'Arsonval this week submitted to the Academy of Science an invention for typesetting by telegraph, the electric current being made to perforate characters on a moving band connected with a typesetting machine. It is claimed that the contrivance, which is the work of M. Rodmal, will dispense with transcription altogether for press purposes [—*Electrical World.*